

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



<b>Property Reference</b>	BD23 6RR Plot 29			<b>Issued on Date</b>	20/07/2022
<b>Assessment Reference</b>	001	<b>Prop Type Ref</b>	Type A		
<b>Property</b>	Plot 29, Phase 3, Shires Lane, Embsay, Skipton, BD23 6RR				
<b>SAP Rating</b>	89 B	<b>DER</b>	11.66	<b>TER</b>	19.89
<b>Environmental</b>	91 B	<b>% DER&lt;TER</b>	41.39		
<b>CO<sub>2</sub> Emissions (t/year)</b>	0.95	<b>DFEE</b>	58.81	<b>TFEE</b>	60.15
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	2.23		
<b>Assessor Details</b>	Mr. Jake Eaton, Jake Eaton, Tel: 01400283471, jake@eratech.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

Semi-Detached House, total floor area 83 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) 19.89 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 11.66 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 60.1 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 58.8 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.17 (max. 0.25)	0.18 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.63 (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

Combi boiler  
Efficiency: 90%  
Minimum: 88% OK

Secondary heating system: Room heaters - Wood Logs

Closed room heater

Efficiency: 65%  
Minimum: 65% OK

#### 5 Cylinder insulation

Hot water storage No cylinder

#### 6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

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: 0.68 m<sup>2</sup>, No overhang  
Windows facing East: 8.27 m<sup>2</sup>, No overhang  
Windows facing West: 3.87 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

Party wall U-value 0.00 W/m<sup>2</sup>K  
Secondary heating (wood logs)  
Secondary heating fuel: wood logs  
Photovoltaic array 1.50 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	8.2500 (1b)	x 2.6000 (2b)	= 21.4500 (1b) - (3b)
First floor	39.4000 (1c)	x 2.4000 (2c)	= 94.5600 (1c) - (3c)
Second floor	35.2700 (1d)	x 2.6000 (2d)	= 91.7020 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.9200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 207.7120 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
					Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					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:												0.5000 (23a)
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 m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26a)
Opening Type 2 (Uw = 1.60)			12.8200	1.5038	19.2782		(27)
Heat Loss Floor 1			8.2500	0.1400	1.1550	75.0000	618.7500 (28a)
Heat Loss Floor 2			31.1500	0.1838	5.7241	20.0000	623.0000 (28b)
External Wall 1	104.0500	14.9400	89.1100	0.1800	16.0398	110.0000	9802.1000 (29a)
Wall To Garage	13.7800		13.7800	0.1524	2.0999	110.0000	1515.8000 (29a)
External Roof 2	39.4000		39.4000	0.1300	5.1220	9.0000	354.6000 (30)
Total net area of external elements Aum(A, m2)			196.6300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.2350		(33)
Party Wall 1			65.8300	0.0000	0.0000	70.0000	4608.1000 (32)
Internal Wall 2			76.5100			9.0000	688.5900 (32c)
Internal Floor 1			39.3800			18.0000	708.8400 (32d)
Internal Ceiling 1			39.3800			18.0000	708.8400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	19628.6200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							236.7176 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.8919 (36)
Total fabric heat loss						(33) + (36) =	76.1269 (37)

(38)m	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)	35.7076	35.3435	34.9793	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725 (38)
Heat transfer coeff	111.8345	111.4703	111.1062	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993 (39)
Average = Sum(39)m / 12 =												110.6671 (39)
HLP	1.3487	1.3443	1.3399	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314 (40)
HLP (average)												1.3346 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

Assumed occupancy	2.5159 (42)
Average daily hot water use (litres/day)	93.9534 (43)

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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
Daily hot water use	103.3488	99.5906	95.8325	92.0744	88.3162	84.5581	84.5581	88.3162	92.0744	95.8325	99.5906	103.3488 (44)
Energy conte	153.2633	134.0450	138.3225	120.5929	115.7117	99.8504	92.5261	106.1751	107.4431	125.2146	136.6815	148.4273 (45)
Energy content (annual)	Total = Sum(45)m = 1478.2535 (45)											
Distribution loss (46)m = 0.15 x (45)m	22.9895	20.1068	20.7484	18.0889	17.3568	14.9776	13.8789	15.9263	16.1165	18.7822	20.5022	22.2641 (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)
Combi loss	50.9589	45.8390	48.8352	45.4065	45.0050	41.6999	43.0899	45.0050	45.4065	48.8352	49.1132	50.9589 (61)
Total heat required for water heating calculated for each month	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862 (64)
Heat gains from water heating, kWh/month	63.6998	56.0297	58.2010	51.4488	49.7254	43.6252	41.5374	46.5545	47.0765	53.8427	57.7249	62.0918 (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	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.8275	18.4988	15.0443	11.3895	8.5138	7.1877	7.7665	10.0952	13.5498	17.2046	20.0803	21.4064 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	225.4349	227.7742	221.8792	209.3295	193.4877	178.5987	168.6519	166.3126	172.2076	184.7573	200.5991	215.4881 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797 (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)	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374 (71)
Water heating gains (Table 5)	85.6180	83.3776	78.2272	71.4566	66.8352	60.5906	55.8298	62.5732	65.3840	72.3692	80.1735	83.4567 (72)
Total internal gains	395.6194	393.3896	378.8897	355.9146	332.5757	310.1160	295.9873	302.7200	314.8804	338.0701	364.5919	384.0902 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	0.6800	10.6334	0.7600	0.7500	0.7700	2.8562 (74)						
East	8.2700	19.6403	0.7600	0.7500	0.7700	64.1595 (76)						
West	3.8700	19.6403	0.7600	0.7500	0.7700	30.0238 (80)						
Solar gains	97.0395	189.7009	312.6964	457.4200	562.3963	576.6530	548.6016	469.9245	364.0432	225.1168	120.9590	79.8329 (83)
Total gains	492.6589	583.0905	691.5860	813.3346	894.9721	886.7690	844.5889	772.6446	678.9236	563.1869	485.5509	463.9231 (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)	0.9974	0.9944	0.9844	0.9499	0.8622	0.7095	0.5511	0.6156	0.8546	0.9755	0.9951	0.9980 (86)
tau	19.7604	19.8976	20.1405	20.4541	20.7183	20.8706	20.9195	20.9093	20.7813	20.4237	20.0357	19.7440 (87)
alpha	19.8029	19.8063	19.8097	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163 (88)
util living area	0.9966	0.9925	0.9789	0.9313	0.8115	0.6097	0.4144	0.4764	0.7803	0.9631	0.9931	0.9974 (89)
MIT	18.1543	18.3570	18.7118	19.1619	19.5108	19.6797	19.7176	19.7125	19.5967	19.1275	18.5669	18.1405 (90)
Living area fraction	18.6792	18.8605	19.1788	19.5842	19.9055	20.0689	20.1104	20.1036	19.9839	19.5512	19.0469	18.6645 (92)
MIT 2	18.5292	18.7105	19.0288	19.4342	19.7555	19.9189	19.9604	19.9536	19.8339	19.4012	18.8969	18.5145 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	490.3239	577.2682	673.6027	751.3020	723.5629	549.0942	364.8199	381.4920	530.6632	539.0592	481.1186	462.2198 (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	1591.3192	1539.4580	1392.0237	1162.9712	889.3180	587.2020	370.9870	392.3200	633.0155	971.6412	1302.3720	1580.3158 (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 (98a)
Space heating kWh	819.1405	646.5916	534.5053	296.4019	123.3218	0.0000	0.0000	0.0000	0.0000	321.8410	591.3024	831.8634 (98)
Space heating												4164.9678 (98)
Space heating per m2												(98) / (4) = 50.2287 (99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.1000 (201)	
Fraction of space heat from main system(s)												0.9000 (202)	
Efficiency of main space heating system 1 (in %)												91.9000 (206)	
Efficiency of secondary/supplementary heating system, %												65.0000 (208)	
Space heating requirement												4078.8585 (211)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	819.1405	646.5916	534.5053	296.4019	123.3218	0.0000	0.0000	0.0000	0.0000	321.8410	591.3024	831.8634	(98)
Space heating efficiency (main heating system 1)	91.9000	91.9000	91.9000	91.9000	91.9000	0.0000	0.0000	0.0000	0.0000	91.9000	91.9000	91.9000	(210)
Space heating fuel (main heating system)	802.2051	633.2235	523.4546	290.2739	120.7722	0.0000	0.0000	0.0000	0.0000	315.1870	579.0775	814.6649	(211)
Water heating requirement	126.0216	99.4756	82.2316	45.6003	18.9726	0.0000	0.0000	0.0000	0.0000	49.5140	90.9696	127.9790	(215)
Water heating requirement	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862	(64)
Efficiency of water heater (217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(216)
Fuel for water heating, kWh/month	228.1812	200.9877	209.1147	185.4742	179.5718	158.1568	151.5262	168.9162	170.7817	194.4690	207.5919	222.7779	(219)
Water heating fuel used													(219)
Annual totals kWh/year													
Space heating fuel - main system													4078.8585 (211)
Space heating fuel - secondary													640.7643 (215)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)													46.6272 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													121.6272 (231)
Electricity for lighting (calculated in Appendix L)													367.8206 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.50 * 1080 * 1.00) =										-1295.4295			-1295.4295 (233)
Total delivered energy for all uses													6191.1905 (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	4078.8585	0.2160	881.0334 (261)
Space heating - secondary	640.7643	0.0190	12.1745 (263)
Water heating (other fuel)	2277.5494	0.2160	491.9507 (264)
Space and water heating			1385.1586 (265)
Pumps and fans	121.6272	0.5190	63.1245 (267)
Energy for lighting	367.8206	0.5190	190.8989 (268)
Energy saving/generation technologies			
PV Unit	-1295.4295	0.5190	-672.3279 (269)
Total CO2, kg/year			966.8541 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.6600 (273)

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

DER			11.6600 ZC1
Total Floor Area		TFA	82.9200
Assumed number of occupants		N	2.5159
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			16.1105 ZC2
CO2 emissions from cooking, equation (L16)			2.1633 ZC3
Total CO2 emissions			29.9338 ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000 ZC7
Net CO2 emissions			29.9338 ZC8

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### 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	8.2500 (1b)	x 2.6000 (2b)	= 21.4500 (1b) - (3b)
First floor	39.4000 (1c)	x 2.4000 (2c)	= 94.5600 (1c) - (3c)
Second floor	35.2700 (1d)	x 2.6000 (2d)	= 91.7020 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.9200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 207.7120 (5)

#### 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					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
					Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1444 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3944 (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) = 0.3353 (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	0.4275	0.4191	0.4107	0.3688	0.3604	0.3185	0.3185	0.3101	0.3353	0.3604	0.3772	0.3939 (22b)
Effective ac	0.5914	0.5878	0.5843	0.5680	0.5649	0.5507	0.5507	0.5481	0.5562	0.5649	0.5711	0.5776 (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 Semi-glazed door			2.1200	1.2000	2.5440		(26a)
TER Opening Type (Uw = 1.40)			12.8200	1.3258	16.9962		(27)
Heat Loss Floor 1			8.2500	0.1300	1.0725		(28a)
Heat Loss Floor 2			31.1500	0.1300	4.0495		(28b)
External Wall 1	104.0500	14.9400	89.1100	0.1800	16.0398		(29a)
Wall To Garage	13.7800		13.7800	0.1800	2.4804		(29a)
External Roof 2	39.4000		39.4000	0.1300	5.1220		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )					196.6300		(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 48.3044		(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) 14.4717 (36)  
 Total fabric heat loss (33) + (36) = 62.7761 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	40.5349	40.2918	40.0534	38.9338	38.7243	37.7492	37.7492	37.5686	38.1248	38.7243	39.1481	39.5911 (38)
Average = Sum(39)m / 12 =	103.3111	103.0679	102.8295	101.7099	101.5005	100.5253	100.5253	100.3448	100.9009	101.5005	101.9242	102.3672 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2459	1.2430	1.2401	1.2266	1.2241	1.2123	1.2123	1.2101	1.2168	1.2241	1.2292	1.2345 (40)
HLP (average)	1.2266 (40)											
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

Assumed occupancy 2.5159 (42)  
 Average daily hot water use (litres/day) 93.9534 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	103.3488	99.5906	95.8325	92.0744	88.3162	84.5581	84.5581	88.3162	92.0744	95.8325	99.5906	103.3488 (44)
Energy conte	153.2633	134.0450	138.3225	120.5929	115.7117	99.8504	92.5261	106.1751	107.4431	125.2146	136.6815	148.4273 (45)
Energy content (annual)	Total = Sum(45)m = 1478.2535 (45)											
Distribution loss (46)m = 0.15 x (45)m	22.9895	20.1068	20.7484	18.0889	17.3568	14.9776	13.8789	15.9263	16.1165	18.7822	20.5022	22.2641 (46)
Water storage loss:												

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.8390	48.8352	45.4065	45.0050	41.6999	43.0899	45.0050	45.4065	48.8352	49.1132	50.9589		(61)
Total heat required for water heating calculated for each month	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862		(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	0.0000	(63)
Output from w/h	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862		(64)
Heat gains from water heating, kWh/month	63.6998	56.0297	58.2010	51.4488	49.7254	43.6252	41.5374	46.5545	47.0765	53.8427	57.7249	62.0918		(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	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.1125	18.7519	15.2501	11.5453	8.6303	7.2860	7.8728	10.2334	13.7352	17.4400	20.3551	21.6993	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	225.4349	227.7742	221.8792	209.3295	193.4877	178.5987	168.6519	166.3126	172.2076	184.7573	200.5991	215.4881	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	(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)	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	(71)
Water heating gains (Table 5)	85.6180	83.3776	78.2272	71.4566	66.8352	60.5906	55.8298	62.5732	65.3840	72.3692	80.1735	83.4567	(72)
Total internal gains	395.9044	393.6427	379.0955	356.0704	332.6922	310.2144	296.0936	302.8582	315.0658	338.3055	364.8666	384.3831	(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							
North	0.6800	10.6334	0.6300	0.7000	0.7700	2.2098 (74)							
East	8.2700	19.6403	0.6300	0.7000	0.7700	49.6392 (76)							
West	3.8700	19.6403	0.6300	0.7000	0.7700	23.2290 (80)							
Solar gains	75.0780	146.7686	241.9283	353.8987	435.1172	446.1473	424.4444	363.5732	281.6545	174.1693	93.5841	61.7654	(83)
Total gains	470.9823	540.4113	621.0238	709.9691	767.8094	756.3617	720.5380	666.4314	596.7203	512.4748	458.4507	446.1486	(84)

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

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.7378	55.8693	55.9988	56.6153	56.7321	57.2824	57.2824	57.3855	57.0692	56.7321	56.4962	56.2517	
alpha	4.7159	4.7246	4.7333	4.7744	4.7821	4.8188	4.8188	4.8257	4.8046	4.7821	4.7664	4.7501	
util living area	0.9984	0.9966	0.9907	0.9681	0.9003	0.7551	0.5899	0.6516	0.8848	0.9835	0.9969	0.9988	(86)
MIT	19.6029	19.7517	20.0241	20.3930	20.7176	20.9191	20.9807	20.9694	20.8118	20.3836	19.9285	19.5788	(87)
Th 2	19.8834	19.8858	19.8880	19.8988	19.9008	19.9102	19.9102	19.9119	19.9065	19.9008	19.8967	19.8925	(88)
util rest of house	0.9978	0.9954	0.9872	0.9551	0.8587	0.6612	0.4557	0.5170	0.8201	0.9746	0.9955	0.9984	(89)
MIT 2	18.0248	18.2437	18.6418	19.1779	19.6175	19.8548	19.9030	19.8990	19.7483	19.1731	18.5102	17.9958	(90)
Living area fraction	18.5406	18.7366	19.0935	19.5750	19.9770	20.2026	20.2552	20.2488	20.0959	19.5687	18.9737	18.5131	(92)
Temperature adjustment	18.5406	18.7366	19.0935	19.5750	19.9770	20.2026	20.2552	20.2488	20.0959	19.5687	18.9737	18.5131	(93)
adjusted MIT	18.5406	18.7366	19.0935	19.5750	19.9770	20.2026	20.2552	20.2488	20.0959	19.5687	18.9737	18.5131	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	469.4920	536.9722	610.9010	674.5950	661.8943	520.8603	360.2813	374.0279	497.2880	497.5852	455.6534	445.0541	(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	1471.2103	1426.1069	1294.9871	1085.7564	840.1214	563.2081	367.4390	386.2089	604.9893	910.3314	1210.2180	1465.1938	(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	745.2784	597.4986	508.9601	296.0362	132.6010	0.0000	0.0000	0.0000	0.0000	307.0831	543.2865	758.9840	(98)
Space heating													3889.7278 (98)
Space heating per m2													46.9094 (99)

#### 8c. Space cooling requirement

Not applicable

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 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 %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4164.5908 (211)
Space heating requirement	745.2784	597.4986	508.9601	296.0362	132.6010	0.0000	0.0000	0.0000	0.0000	307.0831	543.2865	758.9840	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	797.9426	639.7201	544.9251	316.9552	141.9711	0.0000	0.0000	0.0000	0.0000	328.7828	581.6772	812.6167	(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	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862	(64)
Efficiency of water heater (217)m	88.0188	87.8433	87.4430	86.4915	84.5716	80.3000	80.3000	80.3000	80.3000	86.4658	87.5924	88.0948	(216)
Fuel for water heating, kWh/month	232.0210	204.7782	214.0340	191.9257	190.0364	176.2769	168.8867	188.2690	190.3483	201.2933	212.1128	226.3315	(219)
Water heating fuel used													2396.3136 (219)
Annual totals kWh/year													
Space heating fuel - main system													4164.5908 (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)													372.8536 (232)
Total delivered energy for all uses													7008.7580 (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	4164.5908	0.2160	899.5516	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2396.3136	0.2160	517.6037	(264)
Space and water heating			1417.1553	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	372.8536	0.5190	193.5110	(268)
Total CO2, kg/m2/year			1649.5914	(272)
Emissions per m2 for space and water heating			17.0906	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3337	(272b)
Emissions per m2 for pumps and fans			0.4694	(272c)
Target Carbon Dioxide Emission Rate (TER) = (17.0906 * 1.00) + 2.3337 + 0.4694, rounded to 2 d.p.			19.8900	(273)



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### 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	8.2500 (1b)	x 2.6000 (2b)	= 21.4500 (1b) - (3b)
First floor	39.4000 (1c)	x 2.4000 (2c)	= 94.5600 (1c) - (3c)
Second floor	35.2700 (1d)	x 2.6000 (2d)	= 91.7020 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.9200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 207.7120 (5)

#### 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					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
					Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1444 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3944 (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) =	0.3353 (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	0.4275	0.4191	0.4107	0.3688	0.3604	0.3185	0.3185	0.3101	0.3353	0.3604	0.3772	0.3939 (22b)
Effective ac	0.5914	0.5878	0.5843	0.5680	0.5649	0.5507	0.5507	0.5481	0.5562	0.5649	0.5711	0.5776 (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		(26a)
Opening Type 2 (Uw = 1.60)			12.8200	1.5038	19.2782		(27)
Heat Loss Floor 1			8.2500	0.1400	1.1550	75.0000	618.7500 (28a)
Heat Loss Floor 2			31.1500	0.1838	5.7241	20.0000	623.0000 (28b)
External Wall 1	104.0500	14.9400	89.1100	0.1800	16.0398	110.0000	9802.1000 (29a)
Wall To Garage	13.7800		13.7800	0.1524	2.0999	110.0000	1515.8000 (29a)
External Roof 2	39.4000		39.4000	0.1300	5.1220	9.0000	354.6000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			196.6300				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		53.2350		(33)
Party Wall 1			65.8300	0.0000	0.0000	70.0000	4608.1000 (32)
Internal Wall 2			76.5100			9.0000	688.5900 (32c)
Internal Floor 1			39.3800			18.0000	708.8400 (32d)
Internal Ceiling 1			39.3800			9.0000	354.4200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	19274.2000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							232.4433 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.8919 (36)
Total fabric heat loss						(33) + (36) =	76.1269 (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	40.5349	40.2918	40.0534	38.9338	38.7243	37.7492	37.7492	37.5686	38.1248	38.7243	39.1481	39.5911 (38)
Heat transfer coeff	116.6618	116.4186	116.1803	115.0607	114.8512	113.8761	113.8761	113.6955	114.2517	114.8512	115.2750	115.7180 (39)
Average = Sum(39)m / 12 =												115.0597 (39)
HLP	1.4069	1.4040	1.4011	1.3876	1.3851	1.3733	1.3733	1.3711	1.3779	1.3851	1.3902	1.3955 (40)
HLP (average)												1.3876 (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												2.5159 (42)
Average daily hot water use (litres/day)												93.9534 (43)
Daily hot water use	103.3488	99.5906	95.8325	92.0744	88.3162	84.5581	84.5581	88.3162	92.0744	95.8325	99.5906	103.3488 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	153.2633	134.0450	138.3225	120.5929	115.7117	99.8504	92.5261	106.1751	107.4431	125.2146	136.6815	148.4273 (45)
Energy content (annual)	Total = Sum(45)m = 1478.2535 (45)											
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
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	32.5684	28.4846	29.3935	25.6260	24.5887	21.2182	19.6618	22.5622	22.8317	26.6081	29.0448	31.5408 (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	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.8275	18.4988	15.0443	11.3895	8.5138	7.1877	7.7665	10.0952	13.5498	17.2046	20.0803	21.4064 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	225.4349	227.7742	221.8792	209.3295	193.4877	178.5987	168.6519	166.3126	172.2076	184.7573	200.5991	215.4881 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797 (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)	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374 (71)
Water heating gains (Table 5)	43.7748	42.3878	39.5074	35.5916	33.0494	29.4697	26.4271	30.3255	31.7106	35.7636	40.3400	42.3935 (72)
Total internal gains	350.7762	349.3998	337.1699	317.0496	295.7899	275.9951	263.5846	267.4724	278.2071	298.4645	321.7584	340.0271 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	0.6800	10.6334	0.7600	0.7500	0.7700	2.8562 (74)						
East	8.2700	19.6403	0.7600	0.7500	0.7700	64.1595 (76)						
West	3.8700	19.6403	0.7600	0.7500	0.7700	30.0238 (80)						
Solar gains	97.0395	189.7009	312.6964	457.4200	562.3963	576.6530	548.6016	469.9245	364.0432	225.1168	120.9590	79.8329 (83)
Total gains	447.8158	539.1007	649.8663	774.4697	858.1862	852.6481	812.1862	737.3969	642.2502	523.5813	442.7175	419.8599 (84)

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

Temperature during heating periods in the living area from Table 9, Thl (C)	21.0000 (85)											
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	45.8929	45.9887	46.0831	46.5315	46.6164	47.0155	47.0155	47.0902	46.8610	46.6164	46.4450	46.2672
alpha	4.0595	4.0659	4.0722	4.1021	4.1078	4.1344	4.1344	4.1393	4.1241	4.1078	4.0963	4.0845
util living area	0.9980	0.9955	0.9872	0.9579	0.8811	0.7375	0.5819	0.6492	0.8776	0.9807	0.9963	0.9985 (86)
MIT	19.2846	19.4708	19.8069	20.2542	20.6421	20.8850	20.9673	20.9491	20.7419	20.2188	19.6691	19.2541 (87)
Th 2	19.7580	19.7603	19.7625	19.7728	19.7748	19.7838	19.7838	19.7855	19.7804	19.7748	19.7709	19.7668 (88)
util rest of house	0.9974	0.9940	0.9826	0.9417	0.8341	0.6374	0.4375	0.5045	0.8090	0.9707	0.9947	0.9980 (89)
MIT 2	18.2079	18.3951	18.7305	19.1746	19.5321	19.7300	19.7755	19.7706	19.6317	19.1490	18.6016	18.1840 (90)
Living area fraction	fLA = Living area / (4) = 0.3268 (91)											
MIT	18.5598	18.7467	19.0823	19.5274	19.8949	20.1075	20.1650	20.1558	19.9945	19.4987	18.9505	18.5338 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.5598	18.7467	19.0823	19.5274	19.8949	20.1075	20.1650	20.1558	19.9945	19.4987	18.9505	18.5338 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	446.2244	534.9088	636.3474	726.1599	720.4215	568.4545	394.0832	407.0831	528.8624	506.6601	439.7465	418.7125 (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	1663.5715	1612.0108	1461.8115	1222.8007	941.1892	627.1741	405.9682	427.0166	673.4609	1022.0219	1366.0603	1658.6728 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	905.7062	723.8125	614.1453	357.5814	164.2512	0.0000	0.0000	0.0000	0.0000	383.4291	666.9460	922.5305 (98)
Space heating	4738.4021 (98)											
Space heating per m2	(98) / (4) = 57.1443 (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 FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1070.4351	842.6829	864.0857	0.0000	0.0000	0.0000	0.0000	(100)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8128	0.8801	0.8438	0.0000	0.0000	0.0000	0.0000	(101)	
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	870.0480	741.6658	729.1533	0.0000	0.0000	0.0000	0.0000	(102)	
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1090.9444	1041.7156	955.9841	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	159.0454	223.2371	168.7621	0.0000	0.0000	0.0000	0.0000	(104)	
Cooled fraction												551.0446	(104)	
Intermittency factor (Table 10b)												FC = cooled area / (4) =	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	39.7613	55.8093	42.1905	0.0000	0.0000	0.0000	0.0000	(107)	
Space cooling per m2												137.7611	(107)	
Energy for space heating												1.6614	(108)	
Energy for space cooling												57.1443	(99)	
Total												1.6614	(108)	
Dwelling Fabric Energy Efficiency (DFEE)												58.8056	(109)	
												58.8	(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 (m2)	Storey height (m)	Volume (m3)
Ground floor	8.2500 (1b)	x 2.6000 (2b)	= 21.4500 (1b) - (3b)
First floor	39.4000 (1c)	x 2.4000 (2c)	= 94.5600 (1c) - (3c)
Second floor	35.2700 (1d)	x 2.6000 (2d)	= 91.7020 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.9200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 207.7120 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					3 * 10 = 30.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
					Air changes per hour							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1444 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.3944 (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) = 0.3353 (21)							
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Effective ac	0.4275	0.4191	0.4107	0.3688	0.3604	0.3185	0.3185	0.3101	0.3353	0.3604	0.3772	0.3939 (22b)
	0.5914	0.5878	0.5843	0.5680	0.5649	0.5507	0.5507	0.5481	0.5562	0.5649	0.5711	0.5776 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Semi-glazed door			2.1200	1.2000	2.5440		(26a)					
TER Opening Type (Uw = 1.40)			12.8200	1.3258	16.9962		(27)					
Heat Loss Floor 1			8.2500	0.1300	1.0725		(28a)					
Heat Loss Floor 2			31.1500	0.1300	4.0495		(28b)					
External Wall 1	104.0500	14.9400	89.1100	0.1800	16.0398		(29a)					
Wall To Garage	13.7800		13.7800	0.1800	2.4804		(29a)					
External Roof 2	39.4000		39.4000	0.1300	5.1220		(30)					
Total net area of external elements Aum(A, m2)					196.6300		(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 48.3044		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								14.4717 (36)				
Total fabric heat loss								(33) + (36) = 62.7761 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	40.5349	40.2918	40.0534	38.9338	38.7243	37.7492	37.7492	37.5686	38.1248	38.7243	39.1481	39.5911 (38)
Average = Sum(39)m / 12 =	103.3111	103.0679	102.8295	101.7099	101.5005	100.5253	100.5253	100.3448	100.9009	101.5005	101.9242	102.3672 (39)
	101.7089 (39)											
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2459	1.2430	1.2401	1.2266	1.2241	1.2123	1.2123	1.2101	1.2168	1.2241	1.2292	1.2345 (40)
Days in month												1.2266 (40)
	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												
Average daily hot water use (litres/day)	2.5159 (42)											
Daily hot water use	93.9534 (43)											
Energy conte	103.3488	99.5906	95.8325	92.0744	88.3162	84.5581	84.5581	88.3162	92.0744	95.8325	99.5906	103.3488 (44)
Energy content (annual)	153.2633	134.0450	138.3225	120.5929	115.7117	99.8504	92.5261	106.1751	107.4431	125.2146	136.6815	148.4273 (45)
Distribution loss (46)m = 0.15 x (45)m	Total = Sum(45)m = 1478.2535 (45)											
Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	32.5684	28.4846	29.3935	25.6260	24.5887	21.2182	19.6618	22.5622	22.8317	26.6081	29.0448	31.5408	(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	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	125.7967	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.1125	18.7519	15.2501	11.5453	8.6303	7.2860	7.8728	10.2334	13.7352	17.4400	20.3551	21.6993	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	225.4349	227.7742	221.8792	209.3295	193.4877	178.5987	168.6519	166.3126	172.2076	184.7573	200.5991	215.4881	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	35.5797	(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)	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	(71)
Water heating gains (Table 5)	43.7748	42.3878	39.5074	35.5916	33.0494	29.4697	26.4271	30.3255	31.7106	35.7636	40.3400	42.3935	(72)
Total internal gains	351.0612	349.6529	337.3758	317.2055	295.9064	276.0935	263.6909	267.6105	278.3925	298.6999	322.0332	340.3200	(73)

#### 6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North		0.6800	10.6334	0.6300	0.7000	0.7700	2.2098 (74)						
East		8.2700	19.6403	0.6300	0.7000	0.7700	49.6392 (76)						
West		3.8700	19.6403	0.6300	0.7000	0.7700	23.2290 (80)						
Solar gains	75.0780	146.7686	241.9283	353.8987	435.1172	446.1473	424.4444	363.5732	281.6545	174.1693	93.5841	61.7654	(83)
Total gains	426.1392	496.4215	579.3040	671.1041	731.0236	722.2408	688.1353	631.1837	560.0469	472.8692	415.6173	402.0854	(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	55.7378	55.8693	55.9988	56.6153	56.7321	57.2824	57.2824	57.3855	57.0692	56.7321	56.4962	56.2517	
alpha	4.7159	4.7246	4.7333	4.7744	4.7821	4.8188	4.8188	4.8257	4.8046	4.7821	4.7664	4.7501	
util living area	0.9990	0.9977	0.9930	0.9741	0.9139	0.7770	0.6132	0.6795	0.9042	0.9880	0.9980	0.9992	(86)
MIT	19.5533	19.7034	19.9795	20.3555	20.6917	20.9080	20.9772	20.9634	20.7876	20.3424	19.8813	19.5299	(87)
Th 2	19.8834	19.8858	19.8880	19.8988	19.9008	19.9102	19.9102	19.9119	19.9065	19.9008	19.8967	19.8925	(88)
util rest of house	0.9986	0.9968	0.9903	0.9632	0.8761	0.6848	0.4759	0.5430	0.8458	0.9814	0.9971	0.9990	(89)
MIT 2	18.5650	18.7167	18.9933	19.3712	19.6863	19.8663	19.9043	19.9011	19.7810	19.3644	18.9031	18.5487	(90)
Living area fraction										fLA = Living area / (4) =			0.3268 (91)
MIT	18.8880	19.0392	19.3156	19.6929	20.0149	20.2067	20.2549	20.2483	20.1100	19.6840	19.2228	18.8693	(92)
Temperature adjustment													0.0000
adjusted MIT	18.8880	19.0392	19.3156	19.6929	20.0149	20.2067	20.2549	20.2483	20.1100	19.6840	19.2228	18.8693	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	425.3477	494.3976	572.6083	644.6726	643.8034	514.5574	358.8665	371.3072	481.0283	463.2135	414.0826	401.5219	(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	1507.1040	1457.2932	1317.8206	1097.7455	843.9631	563.6175	367.4135	386.1521	606.4131	922.0345	1235.6092	1501.6607	(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	804.8267	647.0658	554.4380	326.2125	148.9188	0.0000	0.0000	0.0000	0.0000	341.3629	591.4991	818.5033	(98)
Space heating												4232.8271	(98)
Space heating per m2										(98) / (4) =		51.0471	(99)

#### 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	944.9381	743.8875	762.6201	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8254	0.8956	0.8623	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	779.9219	666.1922	657.6229	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	938.6512	896.8625	832.0227	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	114.2851	171.6187	129.7534	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												415.6572 (104)
Cooled fraction												1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	28.5713	42.9047	32.4383	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												103.9143 (107)
Space cooling per m2												1.2532 (108)
Energy for space heating												51.0471 (99)
Energy for space cooling												1.2532 (108)
Total												52.3003 (109)
Target Fabric Energy Efficiency (TFEE)												60.1 (109)

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF HEAT DEMAND 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	8.2500 (1b)	x 2.6000 (2b)	= 21.4500 (1b) - (3b)
First floor	39.4000 (1c)	x 2.4000 (2c)	= 94.5600 (1c) - (3c)
Second floor	35.2700 (1d)	x 2.6000 (2d)	= 91.7020 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.9200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 207.7120 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					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 infilt 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:												0.5000 (23a)
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 m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26a)
Opening Type 2 (Uw = 1.60)			12.8200	1.5038	19.2782		(27)
Heat Loss Floor 1			8.2500	0.1400	1.1550	75.0000	618.7500 (28a)
Heat Loss Floor 2			31.1500	0.1838	5.7241	20.0000	623.0000 (28b)
External Wall 1	104.0500	14.9400	89.1100	0.1800	16.0398	110.0000	9802.1000 (29a)
Wall To Garage	13.7800		13.7800	0.1524	2.0999	110.0000	1515.8000 (29a)
External Roof 2	39.4000		39.4000	0.1300	5.1220	9.0000	354.6000 (30)
Total net area of external elements Aum(A, m2)			196.6300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.2350		(33)
Party Wall 1			65.8300	0.0000	0.0000	70.0000	4608.1000 (32)
Internal Wall 2			76.5100			9.0000	688.5900 (32c)
Internal Floor 1			39.3800			18.0000	708.8400 (32d)
Internal Ceiling 1			39.3800			18.0000	708.8400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	19628.6200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							236.7176 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.8919 (36)
Total fabric heat loss						(33) + (36) =	76.1269 (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)	35.3435	35.3435	34.9793	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725 (38)
Heat transfer coeff	111.4703	111.4703	111.1062	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993 (39)
Average = Sum(39)m / 12 =												110.6367 (39)
HLP	1.3443	1.3443	1.3399	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314 (40)
HLP (average)												1.3343 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

Assumed occupancy	2.5159 (42)
Average daily hot water use (litres/day)	93.9534 (43)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	103.3488	99.5906	95.8325	92.0744	88.3162	84.5581	84.5581	88.3162	92.0744	95.8325	99.5906	103.3488 (44)
Energy content	153.2633	134.0450	138.3225	120.5929	115.7117	99.8504	92.5261	106.1751	107.4431	125.2146	136.6815	148.4273 (45)
Energy content (annual)	Total = Sum(45)m = 1478.2535 (45)											
Distribution loss (46)m = 0.15 x (45)m	22.9895	20.1068	20.7484	18.0889	17.3568	14.9776	13.8789	15.9263	16.1165	18.7822	20.5022	22.2641 (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)
Combi loss	50.9589	45.8390	48.8352	45.4065	45.0050	41.6999	43.0899	45.0050	45.4065	48.8352	49.1132	50.9589 (61)
Total heat required for water heating calculated for each month	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862 (64)
RHI water heating demand	Total per year (kWh/year) = Sum(64)m = 2038.4067 (64)											
Heat gains from water heating, kWh/month	63.6998	56.0297	58.2010	51.4488	49.7254	43.6252	41.5374	46.5545	47.0765	53.8427	57.7249	62.0918 (65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Metabolic gains (Table 5), Watts	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.0688	46.2471	37.6106	28.4737	21.2844	17.9692	19.4163	25.2381	33.8745	43.0115	50.2008	53.5160 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	336.4700	339.9615	331.1630	312.4321	288.7876	266.5652	251.7193	248.2278	257.0262	275.7572	299.4016	321.6240 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115 (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)	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374 (71)
Water heating gains (Table 5)	85.6180	83.3776	78.2272	71.4566	66.8352	60.5906	55.8298	62.5732	65.3840	72.3692	80.1735	83.4567 (72)
Total internal gains	580.0870	575.5163	552.9310	518.2926	482.8375	451.0552	432.8957	441.9693	462.2150	497.0680	535.7061	564.5269 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	0.6900	9.8938	0.7600	0.7500	0.7700	2.6575 (74)						
East	8.2700	18.2144	0.7600	0.7500	0.7700	59.5015 (76)						
West	3.8700	18.2144	0.7600	0.7500	0.7700	27.8441 (80)						
Solar gains	90.0032	176.4301	304.0827	449.6314	549.0558	557.6231	529.4499	447.2071	349.4390	208.9433	106.7964	72.5805 (83)
Total gains	670.0901	751.9464	857.0137	967.9240	1031.8933	1008.6783	962.3456	889.1764	811.6540	706.0113	642.5024	637.1074 (84)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)											
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	48.9134	48.9134	49.0737	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879
alpha	4.2609	4.2609	4.2716	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925
util living area	0.9929	0.9882	0.9738	0.9345	0.8482	0.7237	0.6216	0.6770	0.8525	0.9626	0.9886	0.9943 (86)
MIT	19.8468	19.9514	20.1771	20.4631	20.7125	20.8529	20.9008	20.8851	20.7541	20.4312	20.0903	19.8239 (87)
Th 2	19.8063	19.8063	19.8097	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163 (88)
util rest of house	0.9908	0.9846	0.9658	0.9139	0.8008	0.6403	0.5127	0.5697	0.7916	0.9470	0.9845	0.9925 (89)
MIT 2	18.2822	18.4338	18.7615	19.1690	19.4978	19.6594	19.7036	19.6923	19.5581	19.1335	18.6447	18.2564 (90)
Living area fraction	FLA = Living area / (4) =											
MIT	18.7935	18.9298	19.2241	19.5920	19.8948	20.0494	20.0948	20.0821	19.9490	19.5576	19.1172	18.7687 (92)
Temperature adjustment	-0.1500											
adjusted MIT	18.6435	18.7798	19.0741	19.4420	19.7448	19.8994	19.9448	19.9321	19.7990	19.4076	18.9672	18.6187 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9879	0.9805	0.9593	0.9059	0.7975	0.6468	0.5253	0.5811	0.7906	0.9399	0.9805	0.9900 (94)
Useful gains	661.9499	737.2541	822.1509	876.8702	822.9297	652.3724	505.5575	516.7182	641.6772	663.6055	629.9721	630.7593 (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	1676.9068	1647.5055	1508.1677	1285.2644	998.5390	706.4927	523.8271	544.5054	772.6832	1093.7911	1398.4488	1669.0917 (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	755.1279	611.6890	510.3965	294.0438	130.6533	0.0000	0.0000	0.0000	0.0000	320.0581	553.3032	772.5193 (98)
Space heating	3947.7912 (98)											



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

RHI space heating demand

3948 (98)

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	8.2500 (1b)	x 2.6000 (2b)	= 21.4500 (1b) - (3b)
First floor	39.4000 (1c)	x 2.4000 (2c)	= 94.5600 (1c) - (3c)
Second floor	35.2700 (1d)	x 2.6000 (2d)	= 91.7020 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.9200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 207.7120 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
					Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					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:												0.5000 (23a)
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 m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26a)
Opening Type 2 (Uw = 1.60)			12.8200	1.5038	19.2782		(27)
Heat Loss Floor 1			8.2500	0.1400	1.1550	75.0000	618.7500 (28a)
Heat Loss Floor 2			31.1500	0.1838	5.7241	20.0000	623.0000 (28b)
External Wall 1	104.0500	14.9400	89.1100	0.1800	16.0398	110.0000	9802.1000 (29a)
Wall To Garage	13.7800		13.7800	0.1524	2.0999	110.0000	1515.8000 (29a)
External Roof 2	39.4000		39.4000	0.1300	5.1220	9.0000	354.6000 (30)
Total net area of external elements Aum(A, m2)			196.6300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.2350		(33)
Party Wall 1			65.8300	0.0000	0.0000	70.0000	4608.1000 (32)
Internal Wall 2			76.5100			9.0000	688.5900 (32c)
Internal Floor 1			39.3800			18.0000	708.8400 (32d)
Internal Ceiling 1			39.3800			18.0000	708.8400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	19628.6200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							236.7176 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.8919 (36)
Total fabric heat loss						(33) + (36) =	76.1269 (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)	35.7076	35.3435	34.9793	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725 (38)
Heat transfer coeff	111.8345	111.4703	111.1062	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993 (39)
Average = Sum(39)m / 12 =												110.6671 (39)
HLP	1.3487	1.3443	1.3399	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314 (40)
HLP (average)												1.3346 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

Assumed occupancy	2.5159 (42)
Average daily hot water use (litres/day)	93.9534 (43)

# 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
Daily hot water use	103.3488	99.5906	95.8325	92.0744	88.3162	84.5581	84.5581	88.3162	92.0744	95.8325	99.5906	103.3488 (44)
Energy content (annual)	153.2633	134.0450	138.3225	120.5929	115.7117	99.8504	92.5261	106.1751	107.4431	125.2146	136.6815	148.4273 (45)
Distribution loss (46)m = 0.15 x (45)m	22.9895	20.1068	20.7484	18.0889	17.3568	14.9776	13.8789	15.9263	16.1165	18.7822	20.5022	22.2641 (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)
Combi loss	50.9589	45.8390	48.8352	45.4065	45.0050	41.6999	43.0899	45.0050	45.4065	48.8352	49.1132	50.9589 (61)
Total heat required for water heating calculated for each month	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862 (64)
Heat gains from water heating, kWh/month	63.6998	56.0297	58.2010	51.4488	49.7254	43.6252	41.5374	46.5545	47.0765	53.8427	57.7249	62.0918 (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	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.0688	46.2471	37.6106	28.4737	21.2844	17.9692	19.4163	25.2381	33.8745	43.0115	50.2008	53.5160 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	336.4700	339.9615	331.1630	312.4321	288.7876	266.5652	251.7193	248.2278	257.0262	275.7572	299.4016	321.6240 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115 (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)	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374 (71)
Water heating gains (Table 5)	85.6180	83.3776	78.2272	71.4566	66.8352	60.5906	55.8298	62.5732	65.3840	72.3692	80.1735	83.4567 (72)
Total internal gains	580.0870	575.5163	552.9310	518.2926	482.8375	451.0552	432.8957	441.9693	462.2150	497.0680	535.7061	564.5269 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	0.6800	10.6334	0.7600	0.7500	0.7700	2.8562 (74)						
East	8.2700	19.6403	0.7600	0.7500	0.7700	64.1595 (76)						
West	3.8700	19.6403	0.7600	0.7500	0.7700	30.0238 (80)						
Solar gains	97.0395	189.7009	312.6964	457.4200	562.3963	576.6530	548.6016	469.9245	364.0432	225.1168	120.9590	79.8329 (83)
Total gains	677.1265	765.2173	865.6274	975.7126	1045.2338	1027.7083	981.4973	911.8938	826.2582	722.1849	656.6651	644.3598 (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)	4.2503	4.2609	4.2716	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925
tau	48.7541	48.9134	49.0737	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879
alpha	4.2503	4.2609	4.2716	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925
util living area	0.9914	0.9846	0.9661	0.9136	0.8037	0.6376	0.4824	0.5360	0.7767	0.9445	0.9849	0.9930 (86)
MIT	19.9141	20.0461	20.2736	20.5560	20.7770	20.8930	20.9264	20.9205	20.8341	20.5375	20.1759	19.8956 (87)
Th 2	19.8029	19.8063	19.8097	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163 (88)
util rest of house	0.9887	0.9798	0.9552	0.8857	0.7439	0.5388	0.3588	0.4081	0.6891	0.9204	0.9792	0.9908 (89)
MIT 2	18.3777	18.5712	18.8997	19.2959	19.5752	19.6962	19.7203	19.7176	19.6465	19.2810	18.7688	18.3610 (90)
Living area fraction	18.8799	19.0532	19.3487	19.7077	19.9680	20.0873	20.1145	20.1107	20.0346	19.6917	19.2286	18.8626 (92)
Temperature adjustment	18.7299	18.9032	19.1987	19.5577	19.8180	19.9373	19.9645	19.9607	19.8846	19.5417	19.0786	-0.1500
adjusted MIT	18.7299	18.9032	19.1987	19.5577	19.8180	19.9373	19.9645	19.9607	19.8846	19.5417	19.0786	18.7126 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	667.2205	746.0612	820.6963	857.0929	777.6731	564.8658	367.8504	386.9941	574.1195	659.5244	639.8751	636.5765 (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	1613.7552	1560.9466	1410.9091	1176.6075	896.2178	589.2361	371.4350	393.1034	638.6149	987.1542	1322.4344	1602.1784 (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 (98a)
Space heating kWh	704.2219	547.6030	439.1183	230.0505	88.1972	0.0000	0.0000	0.0000	0.0000	243.7565	491.4427	718.4079 (98)
Space heating												3462.7980 (98)
Space heating per m2												(98) / (4) = 41.7607 (99)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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 %)													91.9000 (206)
Efficiency of secondary/supplementary heating system, %													65.0000 (208)
Space heating requirement													3391.2059 (211)
Space heating requirement	704.2219	547.6030	439.1183	230.0505	88.1972	0.0000	0.0000	0.0000	0.0000	243.7565	491.4427	718.4079	(98)
Space heating efficiency (main heating system 1)	91.9000	91.9000	91.9000	91.9000	91.9000	0.0000	0.0000	0.0000	0.0000	91.9000	91.9000	91.9000	(210)
Space heating fuel (main heating system)	689.6623	536.2815	430.0397	225.2943	86.3738	0.0000	0.0000	0.0000	0.0000	238.7170	481.2823	703.5550	(211)
Water heating requirement	108.3418	84.2466	67.5567	35.3924	13.5688	0.0000	0.0000	0.0000	0.0000	37.5010	75.6066	110.5243	(215)
Water heating requirement	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862	(64)
Efficiency of water heater (217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(216)
Fuel for water heating, kWh/month	228.1812	200.9877	209.1147	185.4742	179.5718	158.1568	151.5262	168.9162	170.7817	194.4690	207.5919	222.7779	(219)
Water heating fuel used													2277.5494 (219)
Annual totals kWh/year													
Space heating fuel - main system													3391.2059 (211)
Space heating fuel - secondary													532.7382 (215)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)													46.6272 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													121.6272 (231)
Electricity for lighting (calculated in Appendix L)													367.8206 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.50 * 1080 * 1.00) =										-1295.4295			-1295.4295 (233)
Total delivered energy for all uses													5395.5117 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3391.2059	3.4800	118.0140	(240)
Space heating - secondary	532.7382	4.2300	22.5348	(242)
Water heating (other fuel)	2277.5494	3.4800	79.2587	(247)
Mechanical ventilation fans	46.6272	13.1900	6.1501	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	367.8206	13.1900	48.5155	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1295.4295	13.1900	-170.8672	(252)
Total energy cost			233.4985	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.7666 (257)
SAP value		89.3053
SAP rating (Section 12)		89 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3391.2059	0.2160	732.5005	(261)
Space heating - secondary	532.7382	0.0190	10.1220	(263)
Water heating (other fuel)	2277.5494	0.2160	491.9507	(264)
Space and water heating			1234.5732	(265)
Pumps and fans	121.6272	0.5190	63.1245	(267)
Energy for lighting	367.8206	0.5190	190.8989	(268)
Energy saving/generation technologies				
PV Unit	-1295.4295	0.5190	-672.3279	(269)
Total kg/year			816.2686	(272)
CO2 emissions per m2			9.8400	(273)
EI value			91.4493	

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI rating  
EI band

91 (274)  
B

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Calculation of stars for heating and DHW  
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Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.25) / 0.8950 = 4.170$ , stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.25) / 0.8950 = 0.2588$ , stars = 4
Water heating energy efficiency	$3.48 / 0.8950 = 3.888$ , stars = 4
Water heating environmental impact	$0.216 / 0.8950 = 0.2413$ , 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	8.2500 (1b)	x 2.6000 (2b)	= 21.4500 (1b) - (3b)
First floor	39.4000 (1c)	x 2.4000 (2c)	= 94.5600 (1c) - (3c)
Second floor	35.2700 (1d)	x 2.6000 (2d)	= 91.7020 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.9200		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 207.7120 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
					Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					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 infilt 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:												0.5000 (23a)
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 m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26a)
Opening Type 2 (Uw = 1.60)			12.8200	1.5038	19.2782		(27)
Heat Loss Floor 1			8.2500	0.1400	1.1550	75.0000	618.7500 (28a)
Heat Loss Floor 2			31.1500	0.1838	5.7241	20.0000	623.0000 (28b)
External Wall 1	104.0500	14.9400	89.1100	0.1800	16.0398	110.0000	9802.1000 (29a)
Wall To Garage	13.7800		13.7800	0.1524	2.0999	110.0000	1515.8000 (29a)
External Roof 2	39.4000		39.4000	0.1300	5.1220	9.0000	354.6000 (30)
Total net area of external elements Aum(A, m2)			196.6300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.2350		(33)
Party Wall 1			65.8300	0.0000	0.0000	70.0000	4608.1000 (32)
Internal Wall 2			76.5100			9.0000	688.5900 (32c)
Internal Floor 1			39.3800			18.0000	708.8400 (32d)
Internal Ceiling 1			39.3800			18.0000	708.8400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	19628.6200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							236.7176 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.8919 (36)
Total fabric heat loss						(33) + (36) =	76.1269 (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)	35.3435	35.3435	34.9793	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725 (38)
Heat transfer coeff	111.4703	111.4703	111.1062	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993 (39)
Average = Sum(39)m / 12 =												110.6367 (39)
HLP	1.3443	1.3443	1.3399	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314 (40)
HLP (average)												1.3343 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

Assumed occupancy	2.5159 (42)
Average daily hot water use (litres/day)	93.9534 (43)

# 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
Daily hot water use	103.3488	99.5906	95.8325	92.0744	88.3162	84.5581	84.5581	88.3162	92.0744	95.8325	99.5906	103.3488 (44)
Energy conte	153.2633	134.0450	138.3225	120.5929	115.7117	99.8504	92.5261	106.1751	107.4431	125.2146	136.6815	148.4273 (45)
Energy content (annual)												Total = Sum(45)m = 1478.2535 (45)
Distribution loss (46)m = 0.15 x (45)m	22.9895	20.1068	20.7484	18.0889	17.3568	14.9776	13.8789	15.9263	16.1165	18.7822	20.5022	22.2641 (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)
Combi loss	50.9589	45.8390	48.8352	45.4065	45.0050	41.6999	43.0899	45.0050	45.4065	48.8352	49.1132	50.9589 (61)
Total heat required for water heating calculated for each month	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862 (64)
Heat gains from water heating, kWh/month	63.6998	56.0297	58.2010	51.4488	49.7254	43.6252	41.5374	46.5545	47.0765	53.8427	57.7249	62.0918 (65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Metabolic gains (Table 5), Watts												
(66)m	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.0688	46.2471	37.6106	28.4737	21.2844	17.9692	19.4163	25.2381	33.8745	43.0115	50.2008	53.5160 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	336.4700	339.9615	331.1630	312.4321	288.7876	266.5652	251.7193	248.2278	257.0262	275.7572	299.4016	321.6240 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115 (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)	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374 (71)
Water heating gains (Table 5)	85.6180	83.3776	78.2272	71.4566	66.8352	60.5906	55.8298	62.5732	65.3840	72.3692	80.1735	83.4567 (72)
Total internal gains	580.0870	575.5163	552.9310	518.2926	482.8375	451.0552	432.8957	441.9693	462.2150	497.0680	535.7061	564.5269 (73)

#### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	0.6800	9.8938	0.7600	0.7500	0.7700	2.6575 (74)						
East	8.2700	18.2144	0.7600	0.7500	0.7700	59.5015 (76)						
West	3.8700	18.2144	0.7600	0.7500	0.7700	27.8441 (80)						
Solar gains	90.0032	176.4301	304.0827	449.6314	549.0558	557.6231	529.4499	447.2071	349.4390	208.9433	106.7964	72.5805 (83)
Total gains	670.0901	751.9464	857.0137	967.9240	1031.8933	1008.6783	962.3456	889.1764	811.6540	706.0113	642.5024	637.1074 (84)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	48.9134	48.9134	49.0737	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879
alpha	4.2609	4.2609	4.2716	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925
util living area	0.9929	0.9882	0.9738	0.9345	0.8482	0.7237	0.6216	0.6770	0.8525	0.9626	0.9886	0.9943 (86)
MIT	19.8468	19.9514	20.1771	20.4631	20.7125	20.8529	20.9008	20.8851	20.7541	20.4312	20.0903	19.8239 (87)
Th 2	19.8063	19.8063	19.8097	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163 (88)
util rest of house	0.9908	0.9846	0.9658	0.9139	0.8008	0.6403	0.5127	0.5697	0.7916	0.9470	0.9845	0.9925 (89)
MIT 2	18.2822	18.4338	18.7615	19.1690	19.4978	19.6594	19.7036	19.6923	19.5581	19.1335	18.6447	18.2564 (90)
Living area fraction										fLA = Living area / (4)		0.3268 (91)
MIT	18.7935	18.9298	19.2241	19.5920	19.8948	20.0494	20.0948	20.0821	19.9490	19.5576	19.1172	18.7687 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6435	18.7798	19.0741	19.4420	19.7448	19.8994	19.9448	19.9321	19.7990	19.4076	18.9672	18.6187 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9879	0.9805	0.9593	0.9059	0.7975	0.6468	0.5253	0.5811	0.7906	0.9399	0.9805	0.9900 (94)
Useful gains	661.9499	737.2541	822.1509	876.8702	822.9297	652.3724	505.5575	516.7182	641.6772	663.6055	629.9721	630.7593 (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	1676.9068	1647.5055	1508.1677	1285.2644	998.5390	706.4927	523.8271	544.5054	772.6832	1093.7911	1398.4488	1669.0917 (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	755.1279	611.6890	510.3965	294.0438	130.6533	0.0000	0.0000	0.0000	0.0000	320.0581	553.3032	772.5193 (98)
Space heating												3947.7912 (98)
Space heating per m <sup>2</sup>										(98) / (4) =		47.6096 (99)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

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 %)													91.9000 (206)
Efficiency of secondary/supplementary heating system, %													65.0000 (208)
Space heating requirement													3866.1721 (211)
Space heating requirement	755.1279	611.6890	510.3965	294.0438	130.6533	0.0000	0.0000	0.0000	0.0000	320.0581	553.3032	772.5193	(98)
Space heating efficiency (main heating system 1)	91.9000	91.9000	91.9000	91.9000	91.9000	0.0000	0.0000	0.0000	0.0000	91.9000	91.9000	91.9000	(210)
Space heating fuel (main heating system)	739.5159	599.0425	499.8442	287.9646	127.9521	0.0000	0.0000	0.0000	0.0000	313.4410	541.8639	756.5477	(211)
Water heating requirement	116.1735	94.1060	78.5225	45.2375	20.1005	0.0000	0.0000	0.0000	0.0000	49.2397	85.1236	118.8491	(215)
Water heating requirement	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862	(64)
Efficiency of water heater (217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(216)
Fuel for water heating, kWh/month	228.1812	200.9877	209.1147	185.4742	179.5718	158.1568	151.5262	168.9162	170.7817	194.4690	207.5919	222.7779	(219)
Water heating fuel used													2277.5494 (219)
Annual totals kWh/year													
Space heating fuel - main system													3866.1721 (211)
Space heating fuel - secondary													607.3525 (215)
Electricity for pumps and fans: (MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													46.6272 (230a)
mechanical ventilation fans (SFP = 0.1840)													30.0000 (230c)
central heating pump													45.0000 (230e)
main heating flue fan													121.6272 (231)
Total electricity for the above, kWh/year													367.8206 (232)
Electricity for lighting (calculated in Appendix L)													
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.50 * 1037 * 1.00) =										-1244.1879			-1244.1879 (233)
Total delivered energy for all uses													5996.3338 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3866.1721	3.6300	140.3420	(240)
Space heating - secondary	607.3525	5.1600	31.3394	(242)
Water heating (other fuel)	2277.5494	3.6300	82.6750	(247)
Mechanical ventilation fans	46.6272	19.4400	9.0643	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	367.8206	19.4400	71.5043	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1244.1879	19.4400	-241.8701	(252)
Total energy cost			202.6350	(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	3866.1721	0.2160	835.0932	(261)
Space heating - secondary	607.3525	0.0190	11.5397	(263)
Water heating (other fuel)	2277.5494	0.2160	491.9507	(264)
Space and water heating			1338.5835	(265)
Pumps and fans	121.6272	0.5190	63.1245	(267)
Energy for lighting	367.8206	0.5190	190.8989	(268)
Energy saving/generation technologies				
PV Unit	-1244.1879	0.5190	-645.7335	(269)
Total kg/year			946.8734	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3866.1721	1.2200	4716.7299	(261)
Space heating - secondary	607.3525	1.0400	631.6466	(263)
Water heating (other fuel)	2277.5494	1.2200	2778.6103	(264)
Space and water heating			8126.9868	(265)
Pumps and fans	121.6272	3.0700	373.3955	(267)



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Energy for lighting	367.8206	3.0700	1129.2092 (268)
Energy saving/generation technologies			
PV Unit	-1244.1879	3.0700	-3819.6569 (269)
Primary energy kWh/year			5809.9346 (272)
Primary energy kWh/m <sup>2</sup> /year			70.0667 (273)

#### SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 24	-176 kg (18.6%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£24	2.12 kg/m <sup>2</sup>	B 91 A 93
<b>Total Savings</b>	<b>£24</b>	<b>2.12 kg/m<sup>2</sup></b>	

Potential energy efficiency rating: B 91  
 Potential environmental impact rating: A 93

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	£95	£105	-£10
Mains gas	£318	£284	£34
Wood	£31	£31	£0
Space heating	£290	£290	£0
Water heating	£83	£58	£24
Lighting	£72	£72	£0
Generated (PV)	-£242	-£242	£0
<b>Total cost of fuels</b>	<b>£202</b>	<b>£178</b>	<b>£24</b>
<b>Total cost of uses</b>	<b>£203</b>	<b>£178</b>	<b>£24</b>
Delivered energy	72 kWh/m <sup>2</sup>	62 kWh/m <sup>2</sup>	11 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.9 tonnes	0.8 tonnes	0.2 tonnes
CO2 emissions per m <sup>2</sup>	11 kg/m <sup>2</sup>	9 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>
Primary energy	70 kWh/m <sup>2</sup>	58 kWh/m <sup>2</sup>	12 kWh/m <sup>2</sup>

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	8.2500 (1b)	x 2.6000 (2b)	= 21.4500 (1b) - (3b)
First floor	39.4000 (1c)	x 2.4000 (2c)	= 94.5600 (1c) - (3c)
Second floor	35.2700 (1d)	x 2.6000 (2d)	= 91.7020 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.9200		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 207.7120 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
					Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					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:												0.5000 (23a)
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 m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26a)
Opening Type 2 (Uw = 1.60)			12.8200	1.5038	19.2782		(27)
Heat Loss Floor 1			8.2500	0.1400	1.1550	75.0000	618.7500 (28a)
Heat Loss Floor 2			31.1500	0.1838	5.7241	20.0000	623.0000 (28b)
External Wall 1	104.0500	14.9400	89.1100	0.1800	16.0398	110.0000	9802.1000 (29a)
Wall To Garage	13.7800		13.7800	0.1524	2.0999	110.0000	1515.8000 (29a)
External Roof 2	39.4000		39.4000	0.1300	5.1220	9.0000	354.6000 (30)
Total net area of external elements Aum(A, m2)			196.6300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.2350		(33)
Party Wall 1			65.8300	0.0000	0.0000	70.0000	4608.1000 (32)
Internal Wall 2			76.5100			9.0000	688.5900 (32c)
Internal Floor 1			39.3800			18.0000	708.8400 (32d)
Internal Ceiling 1			39.3800			18.0000	708.8400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	19628.6200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							236.7176 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.8919 (36)
Total fabric heat loss						(33) + (36) =	76.1269 (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)	35.7076	35.3435	34.9793	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725 (38)
Heat transfer coeff	111.8345	111.4703	111.1062	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993 (39)
Average = Sum(39)m / 12 =												110.6671 (39)
HLP	1.3487	1.3443	1.3399	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314 (40)
HLP (average)												1.3346 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

Assumed occupancy	2.5159 (42)
Average daily hot water use (litres/day)	93.9534 (43)

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### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.3488	99.5906	95.8325	92.0744	88.3162	84.5581	84.5581	88.3162	92.0744	95.8325	99.5906	103.3488	(44)
Energy cont	153.2633	134.0450	138.3225	120.5929	115.7117	99.8504	92.5261	106.1751	107.4431	125.2146	136.6815	148.4273	(45)
Energy content (annual)	Total = Sum(45)m =											1478.2535 (45)	
Distribution loss (46)m = 0.15 x (45)m	22.9895	20.1068	20.7484	18.0889	17.3568	14.9776	13.8789	15.9263	16.1165	18.7822	20.5022	22.2641	(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)
Combi loss	50.9589	45.8390	48.8352	45.4065	45.0050	41.6999	43.0899	45.0050	45.4065	48.8352	49.1132	50.9589	(61)
Total heat required for water heating calculated for each month	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862	(62)
Aperture area of solar collector													
Zero-loss collector efficiency													
Collector heat loss coefficient													
Collector 2nd order heat loss coefficient													
Collector effective heat loss coefficient													
Collector performance ratio													
Annual solar radiation per m2													
Overshading factor													
Solar energy available													
Adjustment factor for showers													
Solar-to-load ratio													
Utilisation factor													
Collector performance factor													
Dedicated solar storage volume													
Effective solar volume													
Daily hot water demand													
Volume ratio Veff/V													
Solar storage volume factor													
Solar input	-24.6143	-41.0742	-69.9540	-93.7522	-115.8229	-113.8723	-112.3675	-98.1760	-76.8915	-52.5079	-29.1961	-20.5980	(63)
Solar input (sum of months) =	Sum(63)m =											-848.8268 (63)	
Output from w/h	179.6079	138.8099	117.2037	72.2473	44.8938	27.6780	23.2485	53.0040	75.9581	121.5419	156.5986	178.7882	(64)
Total per year (kWh/year) =	Sum(64)m =											1189.5799 (64)	
Heat gains from water heating, kWh/month	63.6998	56.0297	58.2010	51.4488	49.7254	43.6252	41.5374	46.5545	47.0765	53.8427	57.7249	62.0918	(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	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.0688	46.2471	37.6106	28.4737	21.2844	17.9692	19.4163	25.2381	33.8745	43.0115	50.2008	53.5160	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	336.4700	339.9615	331.1630	312.4321	288.7876	266.5652	251.7193	248.2278	257.0262	275.7572	299.4016	321.6240	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	(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)	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	(71)
Water heating gains (Table 5)	85.6180	83.3776	78.2272	71.4566	66.8352	60.5906	55.8298	62.5732	65.3840	72.3692	80.1735	83.4567	(72)
Total internal gains	580.0870	575.5163	552.9310	518.2926	482.8375	451.0552	432.8957	441.9693	462.2150	497.0680	535.7061	564.5269	(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					
North	0.6800	10.6334	0.7600	0.7500	0.7700	2.8562 (74)							
East	8.2700	19.6403	0.7600	0.7500	0.7700	64.1595 (76)							
West	3.8700	19.6403	0.7600	0.7500	0.7700	30.0238 (80)							
Solar gains	97.0395	189.7009	312.6964	457.4200	562.3963	576.6530	548.6016	469.9245	364.0432	225.1168	120.9590	79.8329	(83)
Total gains	677.1265	765.2173	865.6274	975.7126	1045.2338	1027.7083	981.4973	911.8938	826.2582	722.1849	656.6651	644.3598	(84)

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

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	48.7541	48.9134	49.0737	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	(86)
alpha	4.2503	4.2609	4.2716	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	(86)
util living area	0.9914	0.9846	0.9661	0.9136	0.8037	0.6376	0.4824	0.5360	0.7767	0.9445	0.9849	0.9930	(86)
MIT	19.9141	20.0461	20.2736	20.5560	20.7770	20.8930	20.9264	20.9205	20.8341	20.5375	20.1759	19.8956	(87)
Th 2	19.8029	19.8063	19.8097	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	(88)
util rest of house	0.9887	0.9798	0.9552	0.8857	0.7439	0.5388	0.3588	0.4081	0.6891	0.9204	0.9792	0.9908	(89)
MIT 2	18.3777	18.5712	18.8997	19.2959	19.5752	19.6962	19.7203	19.7176	19.6465	19.2810	18.7688	18.3610	(90)
Living area fraction													FLA = Living area / (4) =
MIT	18.8799	19.0532	19.3487	19.7077	19.9680	20.0873	20.1145	20.1107	20.0346	19.6917	19.2286	18.8626	(92)
Temperature adjustment													-0.1500

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adjusted MIT 18.7299 18.9032 19.1987 19.5577 19.8180 19.9373 19.9645 19.9607 19.8846 19.5417 19.0786 18.7126 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9854	0.9750	0.9481	0.8784	0.7440	0.5496	0.3748	0.4244	0.6948	0.9132	0.9744	0.9879	(94)
Useful gains	667.2205	746.0612	820.6963	857.0929	777.6731	564.8658	367.8504	386.9941	574.1195	659.5244	639.8751	636.5765	(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	1613.7552	1560.9466	1410.9091	1176.6075	896.2178	589.2361	371.4350	393.1034	638.6149	987.1542	1322.4344	1602.1784	(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	704.2219	547.6030	439.1183	230.0505	88.1972	0.0000	0.0000	0.0000	0.0000	243.7565	491.4427	718.4079	(98)
Space heating per m2													(98) / (4) = 41.7607 (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 %)													91.9000 (206)
Efficiency of secondary/supplementary heating system, %													65.0000 (208)
Space heating requirement													3391.2059 (211)
Space heating requirement	704.2219	547.6030	439.1183	230.0505	88.1972	0.0000	0.0000	0.0000	0.0000	243.7565	491.4427	718.4079	(98)
Space heating efficiency (main heating system 1)	91.9000	91.9000	91.9000	91.9000	91.9000	0.0000	0.0000	0.0000	0.0000	91.9000	91.9000	91.9000	(210)
Space heating fuel (main heating system)	689.6623	536.2815	430.0397	225.2943	86.3738	0.0000	0.0000	0.0000	0.0000	238.7170	481.2823	703.5550	(211)
Water heating requirement	108.3418	84.2466	67.5567	35.3924	13.5688	0.0000	0.0000	0.0000	0.0000	37.5010	75.6066	110.5243	(215)
Water heating requirement	179.6079	138.8099	117.2037	72.2473	44.8938	27.6780	23.2485	53.0040	75.9581	121.5419	156.5986	178.7882	(64)
Efficiency of water heater (217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(216)
Fuel for water heating, kWh/month	200.6792	155.0948	130.9538	80.7232	50.1607	30.9251	25.9760	59.2224	84.8694	135.8010	174.9705	199.7634	(219)
Water heating fuel used													1329.1396 (219)
Annual totals kWh/year													
Space heating fuel - main system													3391.2059 (211)
Space heating fuel - secondary													532.7382 (215)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840													
mechanical ventilation fans (SFP = 0.1840)													46.6272 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													171.6272 (231)
Electricity for lighting (calculated in Appendix L)													367.8206 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.50 * 1080 * 1.00) =										-1295.4295			-1295.4295 (233)
Total delivered energy for all uses													4497.1019 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3391.2059	3.4800	118.0140	(240)
Space heating - secondary	532.7382	4.2300	22.5348	(242)
Water heating (other fuel)	1329.1396	3.4800	46.2541	(247)
Mechanical ventilation fans	46.6272	13.1900	6.1501	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	367.8206	13.1900	48.5155	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1295.4295	13.1900	-170.8672	(252)
Total energy cost			207.0889	(255)

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

Energy cost deflator (Table 12):			0.4200 (256)
Energy cost factor (ECF)			0.6799 (257)
SAP value		[(255) x (256)] / [(4) + 45.0] =	90.5149
SAP rating (Section 12)			91 (258)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP band

B

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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3391.2059	0.2160	732.5005 (261)
Space heating - secondary	532.7382	0.0190	10.1220 (263)
Water heating (other fuel)	1329.1396	0.2160	287.0942 (264)
Space and water heating			1029.7167 (265)
Pumps and fans	171.6272	0.5190	89.0745 (267)
Energy for lighting	367.8206	0.5190	190.8989 (268)
Energy saving/generation technologies			
PV Unit	-1295.4295	0.5190	-672.3279 (269)
Total kg/year			637.3621 (272)
CO2 emissions per m2			7.6900 (273)
EI value			93.3234
EI rating			93 (274)
EI band			A

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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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	8.2500 (1b)	x 2.6000 (2b)	= 21.4500 (1b) - (3b)
First floor	39.4000 (1c)	x 2.4000 (2c)	= 94.5600 (1c) - (3c)
Second floor	35.2700 (1d)	x 2.6000 (2d)	= 91.7020 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.9200		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 207.7120 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
					Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					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 infilt 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:												0.5000 (23a)
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 m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26a)
Opening Type 2 (Uw = 1.60)			12.8200	1.5038	19.2782		(27)
Heat Loss Floor 1			8.2500	0.1400	1.1550	75.0000	618.7500 (28a)
Heat Loss Floor 2			31.1500	0.1838	5.7241	20.0000	623.0000 (28b)
External Wall 1	104.0500	14.9400	89.1100	0.1800	16.0398	110.0000	9802.1000 (29a)
Wall To Garage	13.7800		13.7800	0.1524	2.0999	110.0000	1515.8000 (29a)
External Roof 2	39.4000		39.4000	0.1300	5.1220	9.0000	354.6000 (30)
Total net area of external elements Aum(A, m2)			196.6300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.2350		(33)
Party Wall 1			65.8300	0.0000	0.0000	70.0000	4608.1000 (32)
Internal Wall 2			76.5100			9.0000	688.5900 (32c)
Internal Floor 1			39.3800			18.0000	708.8400 (32d)
Internal Ceiling 1			39.3800			18.0000	708.8400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	19628.6200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							236.7176 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.8919 (36)
Total fabric heat loss						(33) + (36) =	76.1269 (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)	35.3435	35.3435	34.9793	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725	34.2725 (38)
Heat transfer coeff	111.4703	111.4703	111.1062	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993	110.3993 (39)
Average = Sum(39)m / 12 =												110.6367 (39)
HLP	1.3443	1.3443	1.3399	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314	1.3314 (40)
HLP (average)												1.3343 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

Assumed occupancy	2.5159 (42)
Average daily hot water use (litres/day)	93.9534 (43)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.3488	99.5906	95.8325	92.0744	88.3162	84.5581	84.5581	88.3162	92.0744	95.8325	99.5906	103.3488	(44)
Energy conte	153.2633	134.0450	138.3225	120.5929	115.7117	99.8504	92.5261	106.1751	107.4431	125.2146	136.6815	148.4273	(45)
Energy content (annual)	Total = Sum(45)m =											1478.2535 (45)	
Distribution loss (46)m = 0.15 x (45)m	22.9895	20.1068	20.7484	18.0889	17.3568	14.9776	13.8789	15.9263	16.1165	18.7822	20.5022	22.2641	(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)
Combi loss	50.9589	45.8390	48.8352	45.4065	45.0050	41.6999	43.0899	45.0050	45.4065	48.8352	49.1132	50.9589	(61)
Total heat required for water heating calculated for each month	204.2222	179.8840	187.1577	165.9994	160.7167	141.5503	135.6160	151.1800	152.8497	174.0498	185.7947	199.3862	(62)
Aperture area of solar collector	3.0000 (H1)												
Zero-loss collector efficiency	0.7000 (H2)												
Collector heat loss coefficient	1.8000 (H3)												
Collector 2nd order heat loss coefficient	0.0050 (H3a)												
Collector effective heat loss coefficient	1.8063 (H3b)												
Collector performance ratio	2.5804 (H4)												
Annual solar radiation per m2	1036.8233 (H5)												
Overshading factor	0.8000 (H6)												
Solar energy available	1741.8631 (H7)												
Adjustment factor for showers	1.0000 (H7a)												
Solar-to-load ratio	1.1783 (H8)												
Utilisation factor	0.5720 (H9)												
Collector performance factor	0.8793 (H10)												
Dedicated solar storage volume	75.0000 (H11)												
Effective solar volume	75.0000 (H13)												
Daily hot water demand	93.9534 (H14)												
Volume ratio Veff/V	0.7983 (H15)												
Solar storage volume factor	0.9549 (H16)												
Solar input	-23.5319	-39.3646	-70.0468	-94.7906	-116.2123	-113.1301	-111.4310	-96.0657	-75.9667	-50.2083	-26.5691	-19.3038	(63)
Solar input (sum of months) = Sum(63)m =	-836.6210 (63)												
Output from w/h	180.6902	140.5194	117.1109	71.2088	44.5044	28.4203	24.1849	55.1144	76.8829	123.8415	159.2256	180.0824	(64)
Total per year (kWh/year) = Sum(64)m =	1201.7857 (64)												
Heat gains from water heating, kWh/month	63.6998	56.0297	58.2010	51.4488	49.7254	43.6252	41.5374	46.5545	47.0765	53.8427	57.7249	62.0918	(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	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	150.9561	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.0688	46.2471	37.6106	28.4737	21.2844	17.9692	19.4163	25.2381	33.8745	43.0115	50.2008	53.5160	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	336.4700	339.9615	331.1630	312.4321	288.7876	266.5652	251.7193	248.2278	257.0262	275.7572	299.4016	321.6240	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	52.6115	(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)	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	-100.6374	(71)
Water heating gains (Table 5)	85.6180	83.3776	78.2272	71.4566	66.8352	60.5906	55.8298	62.5732	65.3840	72.3692	80.1735	83.4567	(72)
Total internal gains	580.0870	575.5163	552.9310	518.2926	482.8375	451.0552	432.8957	441.9693	462.2150	497.0680	535.7061	564.5269	(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							
North	0.6800	9.8938	0.7600	0.7500	0.7700	2.6575 (74)							
East	8.2700	18.2144	0.7600	0.7500	0.7700	59.5015 (76)							
West	3.8700	18.2144	0.7600	0.7500	0.7700	27.8441 (80)							
Solar gains	90.0032	176.4301	304.0827	449.6314	549.0558	557.6231	529.4499	447.2071	349.4390	208.9433	106.7964	72.5805	(83)
Total gains	670.0901	751.9464	857.0137	967.9240	1031.8933	1008.6783	962.3456	889.1764	811.6540	706.0113	642.5024	637.1074	(84)

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

Temperature during heating periods in the living area from Table 9, T <sub>hl</sub> (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)	21.0000 (85)												
tau	48.9134	48.9134	49.0737	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	49.3879	
alpha	4.2609	4.2609	4.2716	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	4.2925	
util living area	0.9929	0.9882	0.9738	0.9345	0.8482	0.7237	0.6216	0.6770	0.8525	0.9626	0.9886	0.9943	(86)
MIT	19.8468	19.9514	20.1771	20.4631	20.7125	20.8529	20.9008	20.8851	20.7541	20.4312	20.0903	19.8239	(87)
Th 2	19.8063	19.8063	19.8097	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	19.8163	(88)
util rest of house	0.9908	0.9846	0.9658	0.9139	0.8008	0.6403	0.5127	0.5697	0.7916	0.9470	0.9845	0.9925	(89)
MIT 2	18.2822	18.4338	18.7615	19.1690	19.4978	19.6594	19.7036	19.6923	19.5581	19.1335	18.6447	18.2564	(90)
Living area fraction	fLA = Living area / (4) =												
MIT	18.7935	18.9298	19.2241	19.5920	19.8948	20.0494	20.0948	20.0821	19.9490	19.5576	19.1172	18.7687	(92)
Temperature adjustment	-0.1500												

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

adjusted MIT 18.6435 18.7798 19.0741 19.4420 19.7448 19.8994 19.9448 19.9321 19.7990 19.4076 18.9672 18.6187 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9879	0.9805	0.9593	0.9059	0.7975	0.6468	0.5253	0.5811	0.7906	0.9399	0.9805	0.9900	(94)
Useful gains	661.9499	737.2541	822.1509	876.8702	822.9297	652.3724	505.5575	516.7182	641.6772	663.6055	629.9721	630.7593	(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	1676.9068	1647.5055	1508.1677	1285.2644	998.5390	706.4927	523.8271	544.5054	772.6832	1093.7911	1398.4488	1669.0917	(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	755.1279	611.6890	510.3965	294.0438	130.6533	0.0000	0.0000	0.0000	0.0000	320.0581	553.3032	772.5193	(98)
Space heating per m2													(98) / (4) = 47.6096 (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 %)													91.9000 (206)
Efficiency of secondary/supplementary heating system, %													65.0000 (208)
Space heating requirement													3866.1721 (211)
Space heating requirement	755.1279	611.6890	510.3965	294.0438	130.6533	0.0000	0.0000	0.0000	0.0000	320.0581	553.3032	772.5193	(98)
Space heating efficiency (main heating system 1)	91.9000	91.9000	91.9000	91.9000	91.9000	0.0000	0.0000	0.0000	0.0000	91.9000	91.9000	91.9000	(210)
Space heating fuel (main heating system)	739.5159	599.0425	499.8442	287.9646	127.9521	0.0000	0.0000	0.0000	0.0000	313.4410	541.8639	756.5477	(211)
Water heating requirement	116.1735	94.1060	78.5225	45.2375	20.1005	0.0000	0.0000	0.0000	0.0000	49.2397	85.1236	118.8491	(215)
Water heating requirement	180.6902	140.5194	117.1109	71.2088	44.5044	28.4203	24.1849	55.1144	76.8829	123.8415	159.2256	180.0824	(64)
Efficiency of water heater (217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(216)
Fuel for water heating, kWh/month	201.8885	157.0049	130.8502	79.5629	49.7256	31.7545	27.0223	61.5803	85.9027	138.3704	177.9057	201.2094	(219)
Water heating fuel used													1342.7774 (219)
Annual totals kWh/year													
Space heating fuel - main system													3866.1721 (211)
Space heating fuel - secondary													607.3525 (215)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840													
mechanical ventilation fans (SFP = 0.1840)													46.6272 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													171.6272 (231)
Electricity for lighting (calculated in Appendix L)													367.8206 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.50 * 1037 * 1.00) =										-1244.1879			-1244.1879 (233)
Total delivered energy for all uses													5111.5618 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3866.1721	3.6300	140.3420	(240)
Space heating - secondary	607.3525	5.1600	31.3394	(242)
Water heating (other fuel)	1342.7774	3.6300	48.7428	(247)
Mechanical ventilation fans	46.6272	19.4400	9.0643	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	367.8206	19.4400	71.5043	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1244.1879	19.4400	-241.8701	(252)
Total energy cost			178.4228	(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	3866.1721	0.2160	835.0932	(261)
Space heating - secondary	607.3525	0.0190	11.5397	(263)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Water heating (other fuel)	1342.7774	0.2160	290.0399 (264)
Space and water heating			1136.6728 (265)
Pumps and fans	171.6272	0.5190	89.0745 (267)
Energy for lighting	367.8206	0.5190	190.8989 (268)
Energy saving/generation technologies			
PV Unit	-1244.1879	0.5190	-645.7335 (269)
Total kg/year			770.9126 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3866.1721	1.2200	4716.7299 (261)
Space heating - secondary	607.3525	1.0400	631.6466 (263)
Water heating (other fuel)	1342.7774	1.2200	1638.1884 (264)
Space and water heating			6986.5649 (265)
Pumps and fans	171.6272	3.0700	526.8955 (267)
Energy for lighting	367.8206	3.0700	1129.2092 (268)
Energy saving/generation technologies			
PV Unit	-1244.1879	3.0700	-3819.6569 (269)
Primary energy kWh/year			4823.0127 (272)
Primary energy kWh/m2/year			58.1646 (273)

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

#### Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	No
SAP Region	North East England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	236.7 (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	171.36 (P1)
Transmission heat loss coefficient	76.13 (37)
Summer heat loss coefficient	247.49 (P2)

#### Overhangs

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

#### Solar shading

Orientation	Z_blinds	Solar access	Z_overhangs	Z_summer
North	0.800	0.90	1.000	0.720 (P8)
East	0.800	0.90	1.000	0.720 (P8)
West	0.800	0.90	1.000	0.720 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.6800	74.6426	0.7600	0.7500	0.7200	18.7476
East	8.2700	111.2086	0.7600	0.7500	0.7200	339.6986
West	3.8700	111.2086	0.7600	0.7500	0.7200	158.9641

total: 517.4103

	Jun	Jul	Aug
Solar gains	535	517	438 (P3)
Internal gains	448	430	439
Total summer gains	984	947	877 (P5)

	3.97	3.83	3.55
Summer gain/loss ratio			(P6)
Summer external temperature	13.80	15.80	15.60
Thermal mass temperature increment (TMP = 236.7)	0.34	0.34	0.34
Threshold temperature	18.12	19.97	19.49 (P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant

Assessment of likelihood of high internal temperature: Not significant