

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	BD23 6RR Plot 4			Issued on Date	24/01/2022
Assessment Reference	001	Prop Type Ref	Type E		
Property	Plot 4, Shires Lane, Embsay, Skipton, BD23 6RR				
SAP Rating	84 B	DER	15.86	TER	16.13
Environmental	85 B	% DER<TER	1.70		
CO ₂ Emissions (t/year)	2.59	DFEE	54.46	TFEE	59.90
General Requirements Compliance	Pass	% DFEE<TFEE	9.07		
Assessor Details	Mr. Jake Eaton, Jake Eaton, Tel: 01400283471, jake@eratech.co.uk			Assessor ID	P711-0001
Client					

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

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DWELLING AS DESIGNED

Detached House, total floor area 163 m²

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

1a TER and DER

Fuel for main heating: Mains gas
Fuel factor: 1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.13 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.86 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 59.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 54.5 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Floor	0.14 (max. 0.25)	0.19 (max. 0.70)	OK
Roof	0.14 (max. 0.20)	0.17 (max. 0.35)	OK
Openings	1.61 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer rated a

Efficiency: 89%
Minimum: 88% OK

Secondary heating system: Room heaters - Wood Logs

Closed room heater

Efficiency: 65%
Minimum: 65% OK

5 Cylinder insulation

Hot water storage Permitted by DBSCG 2.56
Nominal cylinder loss: 2.01 kWh/day
Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

Cylinderstat OK
Independent timer for DHW OK

Boiler interlock

Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%
Minimum 75% OK

8 Mechanical ventilation

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

9 Summertime temperature

Overheating risk (North East England): Not significant OK

Based on:

Overshading: Average
Windows facing North East: 6.69 m², No overhang
Windows facing South East: 6.34 m², No overhang
Windows facing South West: 11.09 m², No overhang
Windows facing North West: 4.01 m², No overhang
Air change rate: 2.50 ach
Blinds/curtains: Light-coloured curtain or roller blind, closed 50% of daylight hours

10 Key features

Secondary heating (wood logs)
Secondary heating fuel: wood logs

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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	77.0400 (1b)	2.6800 (2b)	206.4672 (1b) - (3b)
First floor	86.2800 (1c)	2.7400 (2c)	236.4072 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.3200		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 442.8744 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)							
Number of intermittent fans				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)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2709	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		(26)					
Opening Type 2 (Uw = 1.60)			28.1300	1.5038	42.3008		(27)					
Opening Type 3 (Uw = 1.60)			1.5300	1.5038	2.3008		(27a)					
Heat Loss Floor 1			77.0400	0.1300	10.0152	75.0000	5778.0000 (28a)					
Heat Loss Floor 2			22.2000	0.1886	4.1872	20.0000	444.0000 (28b)					
External Wall 1	189.7100	30.2500	159.4600	0.1800	28.7028	110.0000	17540.6000 (29a)					
Wall to Garage	18.1800		18.1800	0.1557	2.8307	110.0000	1999.8000 (29a)					
External Roof 2	86.2800		86.2800	0.1300	11.2164	9.0000	776.5200 (30)					
External Roof 2	13.9800	1.5300	12.4500	0.1700	2.1165	0.0000	0.0000 (30)					
Total net area of external elements Aum(A, m2)			407.3900				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		107.4863		(33)					
Internal Wall 1			63.3600			75.0000	4752.0000 (32c)					
Internal Wall 2			121.8900			9.0000	1097.0100 (32c)					
Internal Floor 1			64.0800			18.0000	1153.4400 (32d)					
Internal Ceiling 1			64.0800			18.0000	1153.4400 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 34694.8100 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							212.4345 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							30.2487 (36)					
Total fabric heat loss							(33) + (36) = 137.7350 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 76.1343	Feb 75.3578	Mar 74.5814	Apr 73.0743	May 73.0743	Jun 73.0743	Jul 73.0743	Aug 73.0743	Sep 73.0743	Oct 73.0743	Nov 73.0743	Dec 73.0743 (38)
Heat transfer coeff	213.8693	213.0929	212.3164	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093 (39)
Average = Sum(39)m / 12 =												211.3802 (39)
HLP	Jan 1.3095	Feb 1.3048	Mar 1.3000	Apr 1.2908	May 1.2908	Jun 1.2908	Jul 1.2908	Aug 1.2908	Sep 1.2908	Oct 1.2908	Nov 1.2908	Dec 1.2908 (40)
HLP (average)												1.2943 (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	2.9535 (42)
Average daily hot water use (litres/day)	104.3461 (43)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.7807	110.6068	106.4330	102.2592	98.0853	93.9115	93.9115	98.0853	102.2592	106.4330	110.6068	114.7807	(44)
Energy conte	170.2164	148.8724	153.6230	133.9322	128.5112	110.8954	102.7609	117.9196	119.3279	139.0652	151.8005	164.8455	(45)
Energy content (annual)	Total = Sum (45)m =												1641.7701 (45)
Distribution loss (46)m = 0.15 x (45)m	25.5325	22.3309	23.0434	20.0898	19.2767	16.6343	15.4141	17.6879	17.8992	20.8598	22.7701	24.7268	(46)
Water storage loss:													
Store volume													250.0000 (47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)													0.0103 (51)
Volume factor from Table 2a													0.7830 (52)
Temperature factor from Table 2b													0.5400 (53)
Enter (49) or (54) in (55)													1.0875 (55)
Total storage loss	33.7127	30.4501	33.7127	32.6252	33.7127	32.6252	33.7127	33.7127	32.6252	33.7127	32.6252	33.7127	(56)
If cylinder contains dedicated solar storage	33.7127	30.4501	33.7127	32.6252	33.7127	32.6252	33.7127	33.7127	32.6252	33.7127	32.6252	33.7127	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	227.1915	200.3337	210.5980	189.0694	185.4862	166.0325	159.7359	174.8946	174.4651	196.0402	206.9377	221.8206	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum (63)m =													0.0000 (63)
Output from w/h	227.1915	200.3337	210.5980	189.0694	185.4862	166.0325	159.7359	174.8946	174.4651	196.0402	206.9377	221.8206	(64)
Total per year (kWh/year) = Sum (64)m =													2312.6054 (64)
Heat gains from water heating, kWh/month	102.1770	90.6691	96.6597	88.6422	88.3100	80.9824	79.7480	84.7883	83.7863	91.8192	94.5834	100.3912	(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	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.1168	26.7495	21.7541	16.4693	12.3110	10.3935	11.2305	14.5978	19.5932	24.8780	29.0363	30.9539	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	334.6728	338.1456	329.3942	310.7633	287.2451	265.1414	250.3748	246.9019	255.6534	274.2843	297.8024	319.9061	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	(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)	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	(71)
Water heating gains (Table 5)	137.3347	134.9243	129.9189	123.1141	118.6962	112.4756	107.1882	113.9628	116.3698	123.4129	131.3658	134.9344	(72)
Total internal gains	572.4271	570.1222	551.3700	520.6495	488.5552	458.3132	439.0962	445.7653	461.9191	492.8780	528.5073	556.0972	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
Northeast	6.6900	11.2829	0.7600	0.7500	0.7700	29.8165 (75)							
Southeast	6.3400	36.7938	0.7600	0.7500	0.7700	92.1451 (77)							
Southwest	11.0900	36.7938	0.7600	0.7500	0.7700	161.1813 (79)							
Northwest	4.0100	11.2829	0.7600	0.7500	0.7700	17.8721 (81)							
Southwest	1.5300	34.0172	0.7600	0.7000	1.0000	24.9198 (82)							
Solar gains	325.9348	577.0796	845.0109	1135.4609	1349.3242	1372.8021	1309.7600	1145.6962	945.1844	653.0032	394.4475	276.2740	(83)
Total gains	898.3618	1147.2018	1396.3809	1656.1104	1837.8794	1831.1154	1748.8563	1591.4615	1407.1036	1145.8812	922.9549	832.3712	(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)	45.0623	45.2265	45.3919	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	21.0000 (85)
tau	4.0042	4.0151	4.0261	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	
alpha	0.9970	0.9918	0.9769	0.9312	0.8269	0.6651	0.5104	0.5744	0.8150	0.9641	0.9936	0.9978	(86)
util living area	19.6646	19.8452	20.1190	20.4535	20.7235	20.8708	20.9166	20.9067	20.7868	20.4159	19.9757	19.6438	(87)
MIT	19.8334	19.8371	19.8408	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	(88)
Th 2	0.9961	0.9893	0.9697	0.9093	0.7739	0.5704	0.3861	0.4461	0.7379	0.9485	0.9913	0.9972	(89)
util rest of house	18.0501	18.3158	18.7146	19.1915	19.5444	19.7071	19.7436	19.7384	19.6294	19.1493	18.5155	18.0305	(90)
Living area fraction	18.2503	18.5055	18.8887	19.3480	19.6906	19.8514	19.8890	19.8833	19.7729	19.3063	18.6966	18.2306	(91)
MIT 2	18.1003	18.3555	18.7387	19.1980	19.5406	19.7014	19.7390	19.7333	19.6229	19.1563	18.5466	18.0806	(92)
Temperature adjustment													-0.1500
adjusted MIT													18.0806 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9940	0.9847	0.9603	0.8936	0.7572	0.5571	0.3737	0.4324	0.7197	0.9353	0.9873	0.9956	(94)

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Useful gains	893.0104	1129.6302	1340.9307	1479.8589	1391.7121	1020.1793	653.6276	688.1069	1012.6822	1071.7659	911.2123	828.6923	(95)	
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)	
Heat loss rate W														
Month fracti	2951.4503	2867.2621	2598.4758	2170.9107	1652.8766	1075.4200	661.7373	702.6858	1164.2751	1803.7488	2413.0435	2926.1544	(97)	
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)	
Space heating	1531.4793	1167.6886	935.6135	497.5573	194.3064	0.0000	0.0000	0.0000	0.0000	544.5953	1081.3185	1560.5118	(98)	
Space heating per m2												7513.0707	(98)	
												(98) / (4) =	46.0021	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.1000	(201)	
Fraction of space heat from main system(s)														0.9000	(202)
Efficiency of main space heating system 1 (in %)														89.0000	(206)
Efficiency of secondary/supplementary heating system, %														65.0000	(208)
Space heating requirement														7597.4872	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Space heating requirement	1531.4793	1167.6886	935.6135	497.5573	194.3064	0.0000	0.0000	0.0000	0.0000	544.5953	1081.3185	1560.5118		(98)	
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000		(210)	
Space heating fuel (main heating system)	1548.6869	1180.8087	946.1260	503.1478	196.4896	0.0000	0.0000	0.0000	0.0000	550.7144	1093.4681	1578.0457		(211)	
Water heating requirement	235.6122	179.6444	143.9405	76.5473	29.8933	0.0000	0.0000	0.0000	0.0000	83.7839	166.3567	240.0787		(215)	
Water heating requirement	227.1915	200.3337	210.5980	189.0694	185.4862	166.0325	159.7359	174.8946	174.4651	196.0402	206.9377	221.8206		(64)	
Efficiency of water heater (217)m	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000		(216)	
Fuel for water heating, kWh/month	255.2713	225.0941	236.6270	212.4375	208.4115	186.5534	179.4785	196.5108	196.0282	220.2699	232.5142	249.2366		(219)	
Water heating fuel used														2598.4331	(219)
Annual totals kWh/year															
Space heating fuel - main system														7597.4872	(211)
Space heating fuel - secondary														1155.8570	(215)

Electricity for pumps and fans:

(MEV)Decentralised, Database: total watage = 10.6720, total flow = 58.0000, SFP = 0.1840)																
mechanical ventilation fans (SFP = 0.1840)															99.4164	(230a)
central heating pump															30.0000	(230c)
main heating flue fan															45.0000	(230e)
Total electricity for the above, kWh/year															174.4164	(231)
Electricity for lighting (calculated in Appendix L)															531.8724	(232)
Total delivered energy for all uses															12058.0662	(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	7597.4872	0.2160	1641.0572	(261)
Space heating - secondary	1155.8570	0.0190	21.9613	(263)
Water heating (other fuel)	2598.4331	0.2160	561.2615	(264)
Space and water heating			2224.2801	(265)
Pumps and fans	174.4164	0.5190	90.5221	(267)
Energy for lighting	531.8724	0.5190	276.0418	(268)
Total CO2, kg/year			2590.8440	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.8600	(273)

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

DER			15.8600	ZC1
Total Floor Area		TFA	163.3200	
Assumed number of occupants		N	2.9535	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			12.1430	ZC2
CO2 emissions from cooking, equation (L16)			1.1627	ZC3
Total CO2 emissions			29.1657	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			29.1657	ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	77.0400 (1b)	2.6800 (2b)	206.4672 (1b) - (3b)
First floor	86.2800 (1c)	2.7400 (2c)	236.4072 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.3200		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 442.8744 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0903 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate					0.3403 (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) =		0.2893 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.3688	0.3616	0.3544	0.3182	0.3110	0.2748	0.2748	0.2676	0.2893	0.3110	0.3254	0.3399 (22b)
	0.5680	0.5654	0.5628	0.5506	0.5484	0.5378	0.5378	0.5358	0.5418	0.5484	0.5530	0.5578 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			28.1300	1.3258	37.2936		(27)
TER Room Window (Uw = 1.70)			1.5300	1.5918	2.4354		(27a)
Heat Loss Floor 1			77.0400	0.1300	10.0152		(28a)
Heat Loss Floor 2			22.2000	0.1300	2.8860		(28b)
External Wall 1	189.7100	30.2500	159.4600	0.1800	28.7028		(29a)
Wall to Garage	18.1800		18.1800	0.1800	3.2724		(29a)
External Roof 2	86.2800		86.2800	0.1300	11.2164		(30)
External Roof 2	13.9800	1.5300	12.4500	0.1300	1.6185		(30)
Total net area of external elements Aum(A, m2)			407.3900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.5603		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							20.0502 (36)
Total fabric heat loss						(33) + (36) =	119.6105 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	83.0145	82.6285	82.2501	80.4731	80.1406	78.5928	78.5928	78.3062	79.1890	80.1406	80.8132	81.5164 (38)
Heat transfer coeff	202.6249	202.2389	201.8606	200.0835	199.7510	198.2032	198.2032	197.9166	198.7994	199.7510	200.4236	201.1268 (39)
Average = Sum(39)m / 12 =												200.0819 (39)
HLP	1.2407	1.2383	1.2360	1.2251	1.2231	1.2136	1.2136	1.2118	1.2172	1.2231	1.2272	1.2315 (40)
HLP (average)												1.2251 (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												2.9535 (42)
Average daily hot water use (litres/day)												104.3461 (43)
Daily hot water use	114.7807	110.6068	106.4330	102.2592	98.0853	93.9115	93.9115	98.0853	102.2592	106.4330	110.6068	114.7807 (44)
Energy conte	170.2164	148.8724	153.6230	133.9322	128.5112	110.8954	102.7609	117.9196	119.3279	139.0652	151.8005	164.8455 (45)
Energy content (annual)												Total = Sum(45)m = 1641.7701 (45)
Distribution loss (46)m = 0.15 x (45)m	25.5325	22.3309	23.0434	20.0898	19.2767	16.6343	15.4141	17.6879	17.8992	20.8598	22.7701	24.7268 (46)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 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)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													8053.1064 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1476.2941	1155.7062	965.6738	547.8938	230.7477	0.0000	0.0000	0.0000	0.0000	575.2763	1067.5397	1510.5230	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	1578.9241	1236.0494	1032.8062	585.9826	246.7890	0.0000	0.0000	0.0000	0.0000	615.2687	1141.7536	1615.5326	(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	225.1232	198.4656	208.5298	187.0678	183.4179	164.0310	157.6676	172.8264	172.4635	193.9720	204.9361	219.7523	(64)
Efficiency of water heater (217)m	88.9224	88.7558	88.3951	87.5133	85.4272	79.8000	79.8000	79.8000	79.8000	87.5402	88.5870	79.8000	(216)
Fuel for water heating, kWh/month	253.1682	223.6085	235.9065	213.7593	214.7066	205.5526	197.5785	216.5744	216.1197	221.5804	231.3389	246.9553	(219)
Water heating fuel used												2676.8490	(219)
Annual totals kWh/year													
Space heating fuel - main system													8053.1064 (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)													536.5511 (232)
Total delivered energy for all uses													11341.5065 (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	8053.1064	0.2160	1739.4710	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2676.8490	0.2160	578.1994	(264)
Space and water heating			2317.6704	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	536.5511	0.5190	278.4700	(268)
Total CO2, kg/m2/year			2635.0654	(272)
Emissions per m2 for space and water heating			14.1910	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.7051	(272b)
Emissions per m2 for pumps and fans			0.2383	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.1910 * 1.00) + 1.7051 + 0.2383, rounded to 2 d.p.			16.1300	(273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	77.0400 (1b)	x 2.6800 (2b)	= 206.4672 (1b) - (3b)
First floor	86.2800 (1c)	x 2.7400 (2c)	= 236.4072 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.3200		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 442.8744 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0903 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate					0.3403 (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) =		0.2893 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infiltr rate												
Effective ac	0.3688	0.3616	0.3544	0.3182	0.3110	0.2748	0.2748	0.2676	0.2893	0.3110	0.3254	0.3399 (22b)
	0.5680	0.5654	0.5628	0.5506	0.5484	0.5378	0.5378	0.5358	0.5418	0.5484	0.5530	0.5578 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1200	1.8000	3.8160		(26)
Opening Type 2 (Uw = 1.60)			28.1300	1.5038	42.3008		(27)
Opening Type 3 (Uw = 1.60)			1.5300	1.5038	2.3008		(27a)
Heat Loss Floor 1			77.0400	0.1300	10.0152	75.0000	5778.0000 (28a)
Heat Loss Floor 2			22.2000	0.1886	4.1872	20.0000	444.0000 (28b)
External Wall 1	189.7100	30.2500	159.4600	0.1800	28.7028	110.0000	17540.6000 (29a)
Wall to Garage	18.1800		18.1800	0.1557	2.8307	110.0000	1999.8000 (29a)
External Roof 2	86.2800		86.2800	0.1300	11.2164	9.0000	776.5200 (30)
External Roof 2	13.9800	1.5300	12.4500	0.1700	2.1165	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m ²)			407.3900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 107.4863		(33)
Internal Wall 1			63.3600			75.0000	4752.0000 (32c)
Internal Wall 2			121.8900			9.0000	1097.0100 (32c)
Internal Floor 1			64.0800			18.0000	1153.4400 (32d)
Internal Ceiling 1			64.0800			9.0000	576.7200 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 34118.0900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							208.9033 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							30.2487 (36)
Total fabric heat loss							(33) + (36) = 137.7350 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	83.0145	82.6285	82.2501	80.4731	80.1406	78.5928	78.5928	78.3062	79.1890	80.1406	80.8132	81.5164 (38)
Heat transfer coeff	220.7495	220.3635	219.9852	218.2081	217.8756	216.3278	216.3278	216.0412	216.9240	217.8756	218.5482	219.2514 (39)
Average = Sum(39)m / 12 =												218.2065 (39)
HLP	1.3516	1.3493	1.3470	1.3361	1.3340	1.3246	1.3246	1.3228	1.3282	1.3340	1.3382	1.3425 (40)
HLP (average)												1.3361 (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	2.9535 (42)											
Average daily hot water use (litres/day)	104.3461 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	114.7807	110.6068	106.4330	102.2592	98.0853	93.9115	93.9115	98.0853	102.2592	106.4330	110.6068	114.7807 (44)
Energy content (annual)	170.2164	148.8724	153.6230	133.9322	128.5112	110.8954	102.7609	117.9196	119.3279	139.0652	151.8005	164.8455 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1641.7701 (45)
Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	36.1710	31.6354	32.6449	28.4606	27.3086	23.5653	21.8367	25.0579	25.3572	29.5514	32.2576	35.0297 (65)

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

Metabolic gains (Table 5), Watts (66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	30.1168	26.7495	21.7541	16.4693	12.3110	10.3935	11.2305	14.5978	19.5932	24.8780	29.0363	30.9539	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	334.6728	338.1456	329.3942	310.7633	287.2451	265.1414	250.3748	246.9019	255.6534	274.2843	297.8024	319.9061	(68)
Pumps, fans	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	(69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Water heating gains (Table 5)	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	(71)
Total internal gains	48.6169	47.0765	43.8775	39.5286	36.7051	32.7295	29.3504	33.6800	35.2183	39.7196	44.8022	47.0829	(72)
	480.7093	479.2744	462.3286	434.0640	403.5640	375.5672	358.2584	362.4825	377.7676	406.1846	438.9437	465.2457	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
Northeast	6.6900	11.2829	0.7600	0.7500	0.7700	29.8165 (75)							
Southeast	6.3400	36.7938	0.7600	0.7500	0.7700	92.1451 (77)							
Southwest	11.0900	36.7938	0.7600	0.7500	0.7700	161.1813 (79)							
Northwest	4.0100	11.2829	0.7600	0.7500	0.7700	17.8721 (81)							
Southwest	1.5300	34.0172	0.7600	0.7000	1.0000	24.9198 (82)							
Solar gains	325.9348	577.0796	845.0109	1135.4609	1349.3242	1372.8021	1309.7600	1145.6962	945.1844	653.0032	394.4475	276.2740	(83)
Total gains	806.6441	1056.3540	1307.3395	1569.5248	1752.8883	1748.3693	1668.0185	1508.1787	1322.9521	1059.1878	833.3913	741.5197	(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	42.9321	43.0073	43.0813	43.4322	43.4984	43.8097	43.8097	43.8678	43.6893	43.4984	43.3646	43.2255	
alpha	3.8621	3.8672	3.8721	3.8955	3.8999	3.9206	3.9206	3.9245	3.9126	3.8999	3.8910	3.8817	
util living area	0.9978	0.9935	0.9811	0.9420	0.8492	0.6952	0.5416	0.6088	0.8424	0.9719	0.9953	0.9984	(86)
MIT	19.1726	19.4149	19.7894	20.2609	20.6578	20.8922	20.9692	20.9518	20.7564	20.2131	19.5957	19.1302	(87)
Th 2	19.8006	19.8024	19.8042	19.8127	19.8143	19.8216	19.8216	19.8230	19.8188	19.8143	19.8111	19.8077	(88)
util rest of house	0.9971	0.9915	0.9751	0.9228	0.7993	0.5994	0.4098	0.4746	0.7701	0.9592	0.9935	0.9979	(89)
MIT 2	18.1407	18.3834	18.7556	19.2192	19.5808	19.7696	19.8131	19.8079	19.6775	19.1832	18.5711	18.1037	(90)
Living area fraction									fLA = Living area / (4) =			0.1240	(91)
MIT	18.2687	18.5113	18.8838	19.3483	19.7143	19.9088	19.9564	19.9497	19.8113	19.3109	18.6981	18.2310	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2687	18.5113	18.8838	19.3483	19.7143	19.9088	19.9564	19.9497	19.8113	19.3109	18.6981	18.2310	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9958	0.9885	0.9688	0.9133	0.7944	0.6072	0.4257	0.4902	0.7695	0.9518	0.9911	0.9970	(94)
Ext temp.	803.2835	1044.1848	1266.5876	1433.4397	1392.4489	1061.6098	710.0933	739.3831	1018.0274	1008.1205	825.9795	739.2695	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	3083.5745	2999.4358	2724.2541	2279.9141	1746.1307	1148.4381	726.0864	766.8855	1238.9105	1897.8914	2534.7513	3076.3157	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating	1696.5365	1313.9287	1084.5039	609.4616	263.1392	0.0000	0.0000	0.0000	0.0000	661.9895	1230.3157	1738.7624	(98)
Space heating per m2												8598.6376	(98)
										(98) / (4) =		52.6490	(99)

8c. Space cooling requirement

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

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Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	2033.4814	1600.8258	1641.9130	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8181	0.8824	0.8456	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1663.6789	1412.5347	1388.4805	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2148.8241	2053.0425	1872.2956	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	349.3046	476.5379	359.9584	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling Cooled fraction													1185.8009 (104)
Intermittency factor (Table 10b)													fC = cooled area / (4) = 1.0000 (105)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	87.3262	119.1345	89.9896	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling Energy for space heating													296.4502 (107)
Space cooling Energy for space cooling													1.8151 (108)
Total													52.6490 (99)
Dwelling Fabric Energy Efficiency (DFEE)													1.8151 (108)
													54.4642 (109)
													54.5 (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	77.0400 (1b)	2.6800 (2b)	206.4672 (1b) - (3b)
First floor	86.2800 (1c)	2.7400 (2c)	236.4072 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.3200		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 442.8744 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0903 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate					0.3403 (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) =		0.2893 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.3688	0.3616	0.3544	0.3182	0.3110	0.2748	0.2748	0.2676	0.2893	0.3110	0.3254	0.3399 (22b)
	0.5680	0.5654	0.5628	0.5506	0.5484	0.5378	0.5378	0.5358	0.5418	0.5484	0.5530	0.5578 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			28.1300	1.3258	37.2936		(27)
TER Room Window (Uw = 1.70)			1.5300	1.5918	2.4354		(27a)
Heat Loss Floor 1			77.0400	0.1300	10.0152		(28a)
Heat Loss Floor 2			22.2000	0.1300	2.8860		(28b)
External Wall 1	189.7100	30.2500	159.4600	0.1800	28.7028		(29a)
Wall to Garage	18.1800		18.1800	0.1800	3.2724		(29a)
External Roof 2	86.2800		86.2800	0.1300	11.2164		(30)
External Roof 2	13.9800	1.5300	12.4500	0.1300	1.6185		(30)
Total net area of external elements Aum(A, m2)			407.3900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.5603		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							20.0502 (36)
Total fabric heat loss						(33) + (36) =	119.6105 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	83.0145	82.6285	82.2501	80.4731	80.1406	78.5928	78.5928	78.3062	79.1890	80.1406	80.8132	81.5164 (38)
Heat transfer coeff	202.6249	202.2389	201.8606	200.0835	199.7510	198.2032	198.2032	197.9166	198.7994	199.7510	200.4236	201.1268 (39)
Average = Sum(39)m / 12 =												200.0819 (39)
HLP	1.2407	1.2383	1.2360	1.2251	1.2231	1.2136	1.2136	1.2118	1.2172	1.2231	1.2272	1.2315 (40)
HLP (average)												1.2251 (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												2.9535 (42)
Average daily hot water use (litres/day)												104.3461 (43)
Daily hot water use	114.7807	110.6068	106.4330	102.2592	98.0853	93.9115	93.9115	98.0853	102.2592	106.4330	110.6068	114.7807 (44)
Energy conte	170.2164	148.8724	153.6230	133.9322	128.5112	110.8954	102.7609	117.9196	119.3279	139.0652	151.8005	164.8455 (45)
Energy content (annual)												Total = Sum(45)m = 1641.7701 (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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	36.1710	31.6354	32.6449	28.4606	27.3086	23.5653	21.8367	25.0579	25.3572	29.5514	32.2576	35.0297	(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	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	147.6759	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.3817	26.9848	21.9455	16.6142	12.4193	10.4849	11.3293	14.7262	19.7655	25.0969	29.2917	31.2261	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	334.6728	338.1456	329.3942	310.7633	287.2451	265.1414	250.3748	246.9019	255.6534	274.2843	297.8024	319.9061	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	37.7676	(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)	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	(71)
Water heating gains (Table 5)	48.6169	47.0765	43.8775	39.5286	36.7051	32.7295	29.3504	33.6800	35.2183	39.7196	44.8022	47.0829	(72)
Total internal gains	480.9742	479.5097	462.5200	434.2088	403.6723	375.6586	358.3572	362.6109	377.9400	406.4035	439.1992	465.5180	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
Northeast	6.6900	11.2829	0.6300	0.7000	0.7700	23.0685 (75)							
Southeast	6.3400	36.7938	0.6300	0.7000	0.7700	71.2912 (77)							
Southwest	11.0900	36.7938	0.6300	0.7000	0.7700	124.7034 (79)							
Northwest	4.0100	11.2829	0.6300	0.7000	0.7700	13.8273 (81)							
Southwest	1.5300	34.0172	0.6300	0.7000	1.0000	20.6572 (82)							
Solar gains	253.5477	449.1576	658.1766	884.9370	1051.9004	1070.2793	1021.1020	893.0386	736.4020	508.3939	306.8919	214.8837	(83)
Total gains	734.5220	928.6673	1120.6966	1319.1458	1455.5728	1445.9380	1379.4592	1255.6495	1114.3420	914.7974	746.0910	680.4016	(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	55.9737	56.0805	56.1856	56.6847	56.7790	57.2224	57.2224	57.3053	57.0508	56.7790	56.5885	56.3906	
alpha	4.7316	4.7387	4.7457	4.7790	4.7853	4.8148	4.8148	4.8204	4.8034	4.7853	4.7726	4.7594	
util living area	0.9994	0.9981	0.9935	0.9742	0.9109	0.7697	0.6047	0.6750	0.9013	0.9889	0.9986	0.9996	(86)
MIT	19.5010	19.6819	19.9732	20.3556	20.6982	20.9116	20.9785	20.9643	20.7913	20.3344	19.8427	19.4708	(87)
Th 2	19.8876	19.8895	19.8913	19.9000	19.9016	19.9091	19.9091	19.9105	19.9062	19.9016	19.8983	19.8949	(88)
util rest of house	0.9992	0.9974	0.9910	0.9634	0.8722	0.6768	0.4684	0.5386	0.8419	0.9826	0.9980	0.9995	(89)
MIT 2	18.5161	18.6981	18.9896	19.3724	19.6923	19.8673	19.9036	19.9000	19.7835	19.3573	18.8660	18.4916	(90)
Living area fraction	18.6382	18.8201	19.1116	19.4943	19.8170	19.9968	20.0369	20.0320	19.9084	19.4785	18.9871	18.6130	(91)
MIT	18.6382	18.8201	19.1116	19.4943	19.8170	19.9968	20.0369	20.0320	19.9084	19.4785	18.9871	18.6130	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6382	18.8201	19.1116	19.4943	19.8170	19.9968	20.0369	20.0320	19.9084	19.4785	18.9871	18.6130	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9989	0.9965	0.9885	0.9582	0.8686	0.6852	0.4853	0.5552	0.8421	0.9792	0.9973	0.9992	(94)
Ext temp.	733.7017	925.4135	1107.8032	1263.9433	1264.2383	990.7761	669.4694	697.0967	938.3604	895.7387	744.0787	679.8758	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	2905.2769	2815.1790	2545.7815	2119.7421	1621.3874	1069.6581	681.2021	718.8302	1154.7145	1773.4813	2382.4543	2898.8349	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(98)
Space heating per m2	1615.6520	1269.9224	1069.8558	616.1752	265.7189	0.0000	0.0000	0.0000	0.0000	653.0405	1179.6304	1650.9056	(99)
												8320.9007	(98)
												50.9484	(99) / (4) =

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	1863.1105	1466.7040	1504.1663	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8134	0.8868	0.8481	0.0000	0.0000	0.0000	0.0000	(101)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1515.4284	1300.6226	1275.6660	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1799.7210	1719.9528	1580.7680	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	204.6906	311.9817	226.9959	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												743.6682 (104)
Intermittency factor (Table 10b)									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	51.1727	77.9954	56.7490	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												185.9171 (107)
Energy for space heating												1.1384 (108)
Energy for space cooling												50.9484 (99)
Total												1.1384 (108)
Target Fabric Energy Efficiency (TFEE)												52.0868 (109)
												59.9 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	77.0400 (1b)	2.6800 (2b)	206.4672 (1b) - (3b)
First floor	86.2800 (1c)	2.7400 (2c)	236.4072 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.3200		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 442.8744 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)							
Number of intermittent fans				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)							
Wind speed	Jan 5.0000	Feb 5.0000	Mar 4.9000	Apr 4.3000	May 4.2000	Jun 3.9000	Jul 3.7000	Aug 3.5000	Sep 3.9000	Oct 4.2000	Nov 4.5000	Dec 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:												
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		(26)					
Opening Type 2 (Uw = 1.60)			28.1300	1.5038	42.3008		(27)					
Opening Type 3 (Uw = 1.60)			1.5300	1.5038	2.3008		(27a)					
Heat Loss Floor 1			77.0400	0.1300	10.0152	75.0000	5778.0000 (28a)					
Heat Loss Floor 2			22.2000	0.1886	4.1872	20.0000	444.0000 (28b)					
External Wall 1	189.7100	30.2500	159.4600	0.1800	28.7028	110.0000	17540.6000 (29a)					
Wall to Garage	18.1800		18.1800	0.1557	2.8307	110.0000	1999.8000 (29a)					
External Roof 2	86.2800		86.2800	0.1300	11.2164	9.0000	776.5200 (30)					
External Roof 2	13.9800	1.5300	12.4500	0.1700	2.1165	0.0000	0.0000 (30)					
Total net area of external elements Aum(A, m2)			407.3900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	107.4863		(33)					
Internal Wall 1			63.3600			75.0000	4752.0000 (32c)					
Internal Wall 2			121.8900			9.0000	1097.0100 (32c)					
Internal Floor 1			64.0800			18.0000	1153.4400 (32d)					
Internal Ceiling 1			64.0800			18.0000	1153.4400 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 34694.8100 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							212.4345 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							30.2487 (36)					
Total fabric heat loss							(33) + (36) = 137.7350 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 75.3578	Feb 75.3578	Mar 74.5814	Apr 73.0743	May 73.0743	Jun 73.0743	Jul 73.0743	Aug 73.0743	Sep 73.0743	Oct 73.0743	Nov 73.0743	Dec 73.0743 (38)
Heat transfer coeff	213.0929	213.0929	212.3164	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093 (39)
Average = Sum(39)m / 12 =												211.3155 (39)
HLP	Jan 1.3048	Feb 1.3048	Mar 1.3000	Apr 1.2908	May 1.2908	Jun 1.2908	Jul 1.2908	Aug 1.2908	Sep 1.2908	Oct 1.2908	Nov 1.2908	Dec 1.2908 (40)
HLP (average)												1.2939 (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	2.9535 (42)
Average daily hot water use (litres/day)	104.3461 (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	114.7807	110.6068	106.4330	102.2592	98.0853	93.9115	93.9115	98.0853	102.2592	106.4330	110.6068	114.7807 (44)
Energy conte	170.2164	148.8724	153.6230	133.9322	128.5112	110.8954	102.7609	117.9196	119.3279	139.0652	151.8005	164.8455 (45)
Energy content (annual)	Total = Sum (45)m = 1641.7701 (45)											
Distribution loss (46)m = 0.15 x (45)m	25.5325	22.3309	23.0434	20.0898	19.2767	16.6343	15.4141	17.6879	17.8992	20.8598	22.7701	24.7268 (46)
Water storage loss:												
Store volume	250.0000 (47)											
b) If manufacturer declared loss factor is not known :												
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103 (51)											
Volume factor from Table 2a	0.7830 (52)											
Temperature factor from Table 2b	0.5400 (53)											
Enter (49) or (54) in (55)	1.0875 (55)											
Total storage loss	33.7127	30.4501	33.7127	32.6252	33.7127	32.6252	33.7127	33.7127	32.6252	33.7127	32.6252	33.7127 (56)
If cylinder contains dedicated solar storage	33.7127	30.4501	33.7127	32.6252	33.7127	32.6252	33.7127	33.7127	32.6252	33.7127	32.6252	33.7127 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	227.1915	200.3337	210.5980	189.0694	185.4862	166.0325	159.7359	174.8946	174.4651	196.0402	206.9377	221.8206 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum (63)m =	0.0000 (63)											
Output from w/h	227.1915	200.3337	210.5980	189.0694	185.4862	166.0325	159.7359	174.8946	174.4651	196.0402	206.9377	221.8206 (64)
Total per year (kWh/year) = Sum (64)m =	2312.6054 (64)											
RHI water heating demand	2313 (64)											
Heat gains from water heating, kWh/month	102.1770	90.6691	96.6597	88.6422	88.3100	80.9824	79.7480	84.7883	83.7863	91.8192	94.5834	100.3912 (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	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.2920	66.8737	54.3854	41.1732	30.7775	25.9836	28.0762	36.4946	48.9829	62.1951	72.5908	77.3846 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	499.5116	504.6950	491.6331	463.8258	428.7241	395.7334	373.6937	368.5103	381.5722	409.3795	444.4812	477.4718 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746 (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)	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408 (71)
Water heating gains (Table 5)	137.3347	134.9243	129.9189	123.1141	118.6962	112.4756	107.1882	113.9628	116.3698	123.4129	131.3658	134.9344 (72)
Total internal gains	829.8834	824.2380	793.6824	745.8582	695.9428	651.9377	626.7031	636.7126	664.6699	712.7325	766.1828	807.5359 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	6.6900	10.4427	0.7600	0.7500	0.7700	27.5960 (75)						
Southeast	6.3400	34.4805	0.7600	0.7500	0.7700	86.3518 (77)						
Southwest	11.0900	34.4805	0.7600	0.7500	0.7700	151.0475 (79)						
Northwest	4.0100	10.4427	0.7600	0.7500	0.7700	16.5411 (81)						
Southwest	1.5300	31.5636	0.7600	0.7000	1.0000	23.1223 (82)						
Solar gains	304.6588	540.6035	826.3659	1119.7455	1319.2669	1328.5737	1265.4124	1092.9646	911.5373	610.1876	350.9430	253.1505 (83)
Total gains	1134.5421	1364.8415	1620.0483	1865.6037	2015.2098	1980.5114	1892.1156	1729.6772	1576.2072	1322.9201	1117.1259	1060.6864 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)	0.9940	0.9875	0.9699	0.9247	0.8306	0.7031	0.6023	0.6615	0.8371	0.9589	0.9897	0.9954 (86)
MIT	19.7090	19.8538	20.1165	20.4302	20.6966	20.8434	20.8937	20.8758	20.7385	20.3835	19.9852	19.6808 (87)
Th 2	19.8371	19.8371	19.8408	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481 (88)
util rest of house	0.9923	0.9841	0.9615	0.9035	0.7839	0.6237	0.4998	0.5600	0.7775	0.9435	0.9863	0.9941 (89)
MIT 2	18.1171	18.3273	18.7085	19.1552	19.5072	19.6784	19.7264	19.7129	19.5689	19.1001	18.5282	18.0841 (90)
Living area fraction	fLA = Living area / (4) = 0.1240 (91)											
MIT	18.3145	18.5165	18.8830	19.3132	19.6547	19.8229	19.8711	19.8571	19.7139	19.2592	18.7089	18.2821 (92)
Temperature adjustment	-0.1500											
adjusted MIT	18.1645	18.3665	18.7330	19.1632	19.5047	19.6729	19.7211	19.7071	19.5639	19.1092	18.5589	18.1321 (93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Utilisation	0.9888	0.9780	0.9508	0.8878	0.7676	0.6103	0.4876	0.5462	0.7598	0.9300	0.9807	0.9912 (94)
Useful gains	1121.8000	1334.8014	1540.2969	1656.3520	1546.9169	1208.6512	922.6668	944.8072	1197.6207	1230.3413	1095.5367	1051.3969 (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	3103.5872	3061.4062	2809.5934	2395.4776	1856.1060	1301.2958	953.0923	992.3048	1425.8962	2025.7119	2584.2809	3084.5747 (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	1474.4497	1160.2784	944.3566	532.1705	230.0367	0.0000	0.0000	0.0000	0.0000	591.7557	1071.8958	1512.6843 (98)
Space heating												7517.6277 (98)
RHI space heating demand												7518 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	77.0400 (1b)	x 2.6800 (2b)	= 206.4672 (1b) - (3b)
First floor	86.2800 (1c)	x 2.7400 (2c)	= 236.4072 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.3200		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 442.8744 (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	5.1000	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 inflt 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												
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		(26)
Opening Type 2 (Uw = 1.60)			28.1300	1.5038	42.3008		(27)
Opening Type 3 (Uw = 1.60)			1.5300	1.5038	2.3008		(27a)
Heat Loss Floor 1			77.0400	0.1300	10.0152	75.0000	5778.0000 (28a)
Heat Loss Floor 2			22.2000	0.1886	4.1872	20.0000	444.0000 (28b)
External Wall 1	189.7100	30.2500	159.4600	0.1800	28.7028	110.0000	17540.6000 (29a)
Wall to Garage	18.1800		18.1800	0.1557	2.8307	110.0000	1999.8000 (29a)
External Roof 2	86.2800		86.2800	0.1300	11.2164	9.0000	776.5200 (30)
External Roof 2	13.9800	1.5300	12.4500	0.1700	2.1165	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m2)			407.3900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	107.4863		(33)
Internal Wall 1			63.3600			75.0000	4752.0000 (32c)
Internal Wall 2			121.8900			9.0000	1097.0100 (32c)
Internal Floor 1			64.0800			18.0000	1153.4400 (32d)
Internal Ceiling 1			64.0800			18.0000	1153.4400 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 34694.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							212.4345 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							30.2487 (36)
Total fabric heat loss							(33) + (36) = 137.7350 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	76.1343	75.3578	74.5814	73.0743	73.0743	73.0743	73.0743	73.0743	73.0743	73.0743	73.0743	73.0743 (38)
Heat transfer coeff	213.8693	213.0929	212.3164	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093 (39)
Average = Sum(39)m / 12 =												211.3802 (39)
HLP	1.3095	1.3048	1.3000	1.2908	1.2908	1.2908	1.2908	1.2908	1.2908	1.2908	1.2908	1.2908 (40)
HLP (average)												1.2943 (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	2.9535 (42)
Average daily hot water use (litres/day)	104.3461 (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	114.7807	110.6068	106.4330	102.2592	98.0853	93.9115	93.9115	98.0853	102.2592	106.4330	110.6068	114.7807	(44)	
Energy conte	170.2164	148.8724	153.6230	133.9322	128.5112	110.8954	102.7609	117.9196	119.3279	139.0652	151.8005	164.8455	(45)	
Energy content (annual)	Total = Sum(45)m =												1641.7701	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5325	22.3309	23.0434	20.0898	19.2767	16.6343	15.4141	17.6879	17.8992	20.8598	22.7701	24.7268	(46)	
Water storage loss:														
Store volume													250.0000	(47)
b) If manufacturer declared loss factor is not known :														
Hot water storage loss factor from Table 2 (kWh/litre/day)													0.0103	(51)
Volume factor from Table 2a													0.7830	(52)
Temperature factor from Table 2b													0.5400	(53)
Enter (49) or (54) in (55)													1.0875	(55)
Total storage loss	33.7127	30.4501	33.7127	32.6252	33.7127	32.6252	33.7127	33.7127	32.6252	33.7127	32.6252	33.7127	(56)	
If cylinder contains dedicated solar storage	33.7127	30.4501	33.7127	32.6252	33.7127	32.6252	33.7127	33.7127	32.6252	33.7127	32.6252	33.7127	(57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)	
Total heat required for water heating calculated for each month	227.1915	200.3337	210.5980	189.0694	185.4862	166.0325	159.7359	174.8946	174.4651	196.0402	206.9377	221.8206	(62)	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)	
Solar input (sum of months) = Sum(63)m =													0.0000	(63)
Output from w/h	227.1915	200.3337	210.5980	189.0694	185.4862	166.0325	159.7359	174.8946	174.4651	196.0402	206.9377	221.8206	(64)	
Total per year (kWh/year) = Sum(64)m =													2312.6054	(64)
Heat gains from water heating, kWh/month	102.1770	90.6691	96.6597	88.6422	88.3100	80.9824	79.7480	84.7883	83.7863	91.8192	94.5834	100.3912	(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	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.2920	66.8737	54.3854	41.1732	30.7775	25.9836	28.0762	36.4946	48.9829	62.1951	72.5908	77.3846	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	499.5116	504.6950	491.6331	463.8258	428.7241	395.7334	373.6937	368.5103	381.5722	409.3795	444.4812	477.4718	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	(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)	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	(71)
Water heating gains (Table 5)	137.3347	134.9243	129.9189	123.1141	118.6962	112.4756	107.1882	113.9628	116.3698	123.4129	131.3658	134.9344	(72)
Total internal gains	829.8834	824.2380	793.6824	745.8582	695.9428	651.9377	626.7031	636.7126	664.6699	712.7325	766.1828	807.5359	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
Northeast	6.6900	11.2829	0.7600	0.7500	0.7700	29.8165 (75)							
Southeast	6.3400	36.7938	0.7600	0.7500	0.7700	92.1451 (77)							
Southwest	11.0900	36.7938	0.7600	0.7500	0.7700	161.1813 (79)							
Northwest	4.0100	11.2829	0.7600	0.7500	0.7700	17.8721 (81)							
Southwest	1.5300	34.0172	0.7600	0.7000	1.0000	24.9198 (82)							
Solar gains	325.9348	577.0796	845.0109	1135.4609	1349.3242	1372.8021	1309.7600	1145.6962	945.1844	653.0032	394.4475	276.2740	(83)
Total gains	1155.8181	1401.3176	1638.6933	1881.3190	2045.2671	2024.7398	1936.4632	1782.4088	1609.8544	1365.7357	1160.6304	1083.8099	(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)	45.0623	45.2265	45.3919	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	21.0000 (85)	
tau	4.0042	4.0151	4.0261	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478		
alpha	0.9926	0.9836	0.9614	0.9025	0.7846	0.6170	0.4660	0.5219	0.7593	0.9389	0.9856	0.9942	(86)	
util living area	19.7838	19.9592	20.2193	20.5275	20.7639	20.8856	20.9212	20.9144	20.8227	20.5003	20.0836	19.7613	(87)	
MIT	19.8334	19.8371	19.8408	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	(88)	
Th 2	0.9904	0.9789	0.9503	0.8744	0.7265	0.5239	0.3502	0.4013	0.6753	0.9150	0.9807	0.9926	(89)	
util rest of house	18.2235	18.4803	18.8558	19.2884	19.5887	19.7184	19.7456	19.7421	19.6634	19.2626	18.6711	18.2017	(90)	
Living area fraction	18.4169	18.6637	19.0248	19.4421	19.7345	19.8631	19.8913	19.8875	19.8071	19.4161	18.8462	18.3951	(91)	
MIT	18.2669	18.5137	18.8748	19.2921	19.5845	19.7131	19.7413	19.7375	19.6571	19.2661	18.6962	18.2451	(92)	
Temperature adjustment													-0.1500	
adjusted MIT													18.2451	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9862	0.9714	0.9380	0.8578	0.7114	0.5121	0.3390	0.3891	0.6592	0.8990	0.9736	0.9891	(94)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Useful gains	1139.8590	1361.2653	1537.0509	1613.8293	1454.9352	1036.9074	656.5340	693.5924	1061.2259	1227.7788	1130.0272	1071.9782 (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	2987.1006	2900.9794	2627.3802	2190.7444	1662.1166	1077.8938	662.2212	703.5737	1171.4952	1826.8918	2444.5964	2960.8346 (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	1374.3477	1034.6879	811.2050	415.3789	154.1429	0.0000	0.0000	0.0000	0.0000	445.7401	946.4898	1405.3092 (98)
Space heating per m2												6587.3015 (98)
												(98) / (4) = 40.3337 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.1000 (201)
Fraction of space heat from main system(s)												0.9000 (202)
Efficiency of main space heating system 1 (in %)												89.0000 (206)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
Space heating requirement												6661.3161 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1374.3477	1034.6879	811.2050	415.3789	154.1429	0.0000	0.0000	0.0000	0.0000	445.7401	946.4898	1405.3092 (98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000 (210)
Space heating fuel (main heating system)	1389.7899	1046.3136	820.3197	420.0461	155.8749	0.0000	0.0000	0.0000	0.0000	450.7484	957.1245	1421.0992 (211)
Water heating requirement	211.4381	159.1827	124.8008	63.9044	23.7143	0.0000	0.0000	0.0000	0.0000	68.5754	145.6138	216.2014 (215)
Water heating requirement	227.1915	200.3337	210.5980	189.0694	185.4862	166.0325	159.7359	174.8946	174.4651	196.0402	206.9377	221.8206 (64)
Efficiency of water heater	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000 (216)
Fuel for water heating, kWh/month	255.2713	225.0941	236.6270	212.4375	208.4115	186.5534	179.4785	196.5108	196.0282	220.2699	232.5142	249.2366 (219)
Water heating fuel used												2598.4331 (219)
Annual totals kWh/year												
Space heating fuel - main system												6661.3161 (211)
Space heating fuel - secondary												1013.4310 (215)
Electricity for pumps and fans:												
(MEV)Decentralised, Database: total watage = 10.6720, total flow = 58.0000, SFP = 0.1840)												
mechanical ventilation fans (SFP = 0.1840)												99.4164 (230a)
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												174.4164 (231)
Electricity for lighting (calculated in Appendix L)												531.8724 (232)
Total delivered energy for all uses												10979.4691 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	6661.3161	3.4800	231.8138 (240)
Space heating - secondary	1013.4310	4.2300	42.8681 (242)
Water heating (other fuel)	2598.4331	3.4800	90.4255 (247)
Mechanical ventilation fans	99.4164	13.1900	13.1130 (249)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	531.8724	13.1900	70.1540 (250)
Additional standing charges			120.0000 (251)
Total energy cost			578.2669 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1659 (257)
SAP value		83.7362
SAP rating (Section 12)		84 (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	6661.3161	0.2160	1438.8443 (261)
Space heating - secondary	1013.4310	0.0190	19.2552 (263)
Water heating (other fuel)	2598.4331	0.2160	561.2615 (264)
Space and water heating			2019.3610 (265)
Pumps and fans	174.4164	0.5190	90.5221 (267)
Energy for lighting	531.8724	0.5190	276.0418 (268)
Total kg/year			2385.9249 (272)
CO2 emissions per m2			14.6100 (273)
EI value			84.6527

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI rating
EI band

85 (274)
B

Calculation of stars for heating and DHW

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

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	77.0400 (1b)	x 2.6800 (2b)	= 206.4672 (1b) - (3b)
First floor	86.2800 (1c)	x 2.7400 (2c)	= 236.4072 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.3200		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 442.8744 (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)							
Wind speed	Jan 5.0000	Feb 5.0000	Mar 4.9000	Apr 4.3000	May 4.2000	Jun 3.9000	Jul 3.7000	Aug 3.5000	Sep 3.9000	Oct 4.2000	Nov 4.5000	Dec 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		(26)					
Opening Type 2 (Uw = 1.60)			28.1300	1.5038	42.3008		(27)					
Opening Type 3 (Uw = 1.60)			1.5300	1.5038	2.3008		(27a)					
Heat Loss Floor 1			77.0400	0.1300	10.0152	75.0000	5778.0000 (28a)					
Heat Loss Floor 2			22.2000	0.1886	4.1872	20.0000	444.0000 (28b)					
External Wall 1	189.7100	30.2500	159.4600	0.1800	28.7028	110.0000	17540.6000 (29a)					
Wall to Garage	18.1800		18.1800	0.1557	2.8307	110.0000	1999.8000 (29a)					
External Roof 2	86.2800		86.2800	0.1300	11.2164	9.0000	776.5200 (30)					
External Roof 2	13.9800	1.5300	12.4500	0.1700	2.1165	0.0000	0.0000 (30)					
Total net area of external elements Aum(A, m2)			407.3900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	107.4863		(33)					
Internal Wall 1			63.3600			75.0000	4752.0000 (32c)					
Internal Wall 2			121.8900			9.0000	1097.0100 (32c)					
Internal Floor 1			64.0800			18.0000	1153.4400 (32d)					
Internal Ceiling 1			64.0800			18.0000	1153.4400 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 34694.8100 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							212.4345 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							30.2487 (36)					
Total fabric heat loss							(33) + (36) = 137.7350 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 75.3578	Feb 75.3578	Mar 74.5814	Apr 73.0743	May 73.0743	Jun 73.0743	Jul 73.0743	Aug 73.0743	Sep 73.0743	Oct 73.0743	Nov 73.0743	Dec 73.0743 (38)
Heat transfer coeff	213.0929	213.0929	212.3164	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093 (39)
Average = Sum(39)m / 12 =												211.3155 (39)
HLP	Jan 1.3048	Feb 1.3048	Mar 1.3000	Apr 1.2908	May 1.2908	Jun 1.2908	Jul 1.2908	Aug 1.2908	Sep 1.2908	Oct 1.2908	Nov 1.2908	Dec 1.2908 (40)
HLP (average)												1.2939 (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	2.9535 (42)
Average daily hot water use (litres/day)	104.3461 (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	114.7807	110.6068	106.4330	102.2592	98.0853	93.9115	93.9115	98.0853	102.2592	106.4330	110.6068	114.7807	(44)	
Energy conte	170.2164	148.8724	153.6230	133.9322	128.5112	110.8954	102.7609	117.9196	119.3279	139.0652	151.8005	164.8455	(45)	
Energy content (annual)	Total = Sum(45)m =												1641.7701	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5325	22.3309	23.0434	20.0898	19.2767	16.6343	15.4141	17.6879	17.8992	20.8598	22.7701	24.7268	(46)	
Water storage loss:														
Store volume													250.0000	(47)
b) If manufacturer declared loss factor is not known :														
Hot water storage loss factor from Table 2 (kWh/litre/day)													0.0103	(51)
Volume factor from Table 2a													0.7830	(52)
Temperature factor from Table 2b													0.5400	(53)
Enter (49) or (54) in (55)													1.0875	(55)
Total storage loss	33.7127	30.4501	33.7127	32.6252	33.7127	32.6252	33.7127	33.7127	32.6252	33.7127	32.6252	33.7127	(56)	
If cylinder contains dedicated solar storage	33.7127	30.4501	33.7127	32.6252	33.7127	32.6252	33.7127	33.7127	32.6252	33.7127	32.6252	33.7127	(57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)	
Total heat required for water heating calculated for each month	227.1915	200.3337	210.5980	189.0694	185.4862	166.0325	159.7359	174.8946	174.4651	196.0402	206.9377	221.8206	(62)	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)	
Solar input (sum of months) = Sum(63)m =													0.0000	(63)
Output from w/h	227.1915	200.3337	210.5980	189.0694	185.4862	166.0325	159.7359	174.8946	174.4651	196.0402	206.9377	221.8206	(64)	
Total per year (kWh/year) = Sum(64)m =													2312.6054	(64)
Heat gains from water heating, kWh/month	102.1770	90.6691	96.6597	88.6422	88.3100	80.9824	79.7480	84.7883	83.7863	91.8192	94.5834	100.3912	(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	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.2920	66.8737	54.3854	41.1732	30.7775	25.9836	28.0762	36.4946	48.9829	62.1951	72.5908	77.3846	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	499.5116	504.6950	491.6331	463.8258	428.7241	395.7334	373.6937	368.5103	381.5722	409.3795	444.4812	477.4718	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	(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)	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	(71)
Water heating gains (Table 5)	137.3347	134.9243	129.9189	123.1141	118.6962	112.4756	107.1882	113.9628	116.3698	123.4129	131.3658	134.9344	(72)
Total internal gains	829.8834	824.2380	793.6824	745.8582	695.9428	651.9377	626.7031	636.7126	664.6699	712.7325	766.1828	807.5359	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W							
Northeast	6.6900	10.4427	0.7600	0.7500	0.7700	27.5960 (75)							
Southeast	6.3400	34.4805	0.7600	0.7500	0.7700	86.3518 (77)							
Southwest	11.0900	34.4805	0.7600	0.7500	0.7700	151.0475 (79)							
Northwest	4.0100	10.4427	0.7600	0.7500	0.7700	16.5411 (81)							
Southwest	1.5300	31.5636	0.7600	0.7000	1.0000	23.1223 (82)							
Solar gains	304.6588	540.6035	826.3659	1119.7455	1319.2669	1328.5737	1265.4124	1092.9646	911.5373	610.1876	350.9430	253.1505	(83)
Total gains	1134.5421	1364.8415	1620.0483	1865.6037	2015.2098	1980.5114	1892.1156	1729.6772	1576.2072	1322.9201	1117.1259	1060.6864	(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)	45.2265	45.2265	45.3919	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	21.0000 (85)
tau	4.0151	4.0151	4.0261	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	
alpha	0.9940	0.9875	0.9699	0.9247	0.8306	0.7031	0.6023	0.6615	0.8371	0.9589	0.9897	0.9954	(86)
util living area	19.7090	19.8538	20.1165	20.4302	20.6966	20.8434	20.8937	20.8758	20.7385	20.3835	19.9852	19.6808	(87)
MIT	19.8371	19.8371	19.8408	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	(88)
Th 2	0.9923	0.9841	0.9615	0.9035	0.7839	0.6237	0.4998	0.5600	0.7775	0.9435	0.9863	0.9941	(89)
util rest of house	18.1171	18.3273	18.7085	19.1552	19.5072	19.6784	19.7264	19.7129	19.5689	19.1001	18.5282	18.0841	(90)
Living area fraction	18.3145	18.5165	18.8830	19.3132	19.6547	19.8229	19.8711	19.8571	19.7139	19.2592	18.7089	18.2821	(91)
MIT	18.1645	18.3665	18.7330	19.1632	19.5047	19.6729	19.7211	19.7071	19.5639	19.1092	18.5589	18.1321	(92)
Temperature adjustment													-0.1500
adjusted MIT													18.1321 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9888	0.9780	0.9508	0.8878	0.7676	0.6103	0.4876	0.5462	0.7598	0.9300	0.9807	0.9912	(94)

FULL SAP CALCULATION PRINTOUT

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

Useful gains	1121.8000	1334.8014	1540.2969	1656.3520	1546.9169	1208.6512	922.6668	944.8072	1197.6207	1230.3413	1095.5367	1051.3969	(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	3103.5872	3061.4062	2809.5934	2395.4776	1856.1060	1301.2958	953.0923	992.3048	1425.8962	2025.7119	2584.2809	3084.5747	(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	1474.4497	1160.2784	944.3566	532.1705	230.0367	0.0000	0.0000	0.0000	0.0000	591.7557	1071.8958	1512.6843	(98)	
Space heating												7517.6277	(98)	
Space heating per m2												(98) / (4) =	46.0300	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.1000	(201)	
Fraction of space heat from main system(s)														0.9000	(202)
Efficiency of main space heating system 1 (in %)														89.0000	(206)
Efficiency of secondary/supplementary heating system, %														65.0000	(208)
Space heating requirement														7602.0954	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Space heating requirement	1474.4497	1160.2784	944.3566	532.1705	230.0367	0.0000	0.0000	0.0000	0.0000	591.7557	1071.8958	1512.6843	(98)		
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)		
Space heating fuel (main heating system)	1491.0165	1173.3152	954.9673	538.1499	232.6214	0.0000	0.0000	0.0000	0.0000	598.4046	1083.9396	1529.6807	(211)		
Water heating requirement	226.8384	178.5044	145.2856	81.8724	35.3903	0.0000	0.0000	0.0000	0.0000	91.0393	164.9070	232.7207	(215)		
Water heating requirement	227.1915	200.3337	210.5980	189.0694	185.4862	166.0325	159.7359	174.8946	174.4651	196.0402	206.9377	221.8206	(64)		
Efficiency of water heater	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	(216)		
(217)m	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	(217)		
Fuel for water heating, kWh/month	255.2713	225.0941	236.6270	212.4375	208.4115	186.5534	179.4785	196.5108	196.0282	220.2699	232.5142	249.2366	(219)		
Water heating fuel used													2598.4331	(219)	
Annual totals kWh/year															
Space heating fuel - main system														7602.0954	(211)
Space heating fuel - secondary														1156.5581	(215)

Electricity for pumps and fans:

(MEV)Decentralised, Database: total watage = 10.6720, total flow = 58.0000, SFP = 0.1840)																
mechanical ventilation fans (SFP = 0.1840)															99.4164	(230a)
central heating pump															30.0000	(230c)
main heating flue fan															45.0000	(230e)
Total electricity for the above, kWh/year															174.4164	(231)
Electricity for lighting (calculated in Appendix L)															531.8724	(232)
Total delivered energy for all uses															12063.3754	(238)

10a. Fuel costs - using BEDF prices (488)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7602.0954	3.6300	275.9561	(240)
Space heating - secondary	1156.5581	5.1600	59.6784	(242)
Water heating (other fuel)	2598.4331	3.6300	94.3231	(247)
Mechanical ventilation fans	99.4164	19.4400	19.3266	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	531.8724	19.4400	103.3960	(250)
Additional standing charges			95.0000	(251)
Total energy cost			662.2601	(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	7602.0954	0.2160	1642.0526	(261)
Space heating - secondary	1156.5581	0.0190	21.9746	(263)
Water heating (other fuel)	2598.4331	0.2160	561.2615	(264)
Space and water heating			2225.2888	(265)
Pumps and fans	174.4164	0.5190	90.5221	(267)
Energy for lighting	531.8724	0.5190	276.0418	(268)
Total kg/year			2591.8527	(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	7602.0954	1.2200	9274.5564	(261)
Space heating - secondary	1156.5581	1.0400	1202.8204	(263)
Water heating (other fuel)	2598.4331	1.2200	3170.0883	(264)
Space and water heating			13647.4652	(265)
Pumps and fans	174.4164	3.0700	535.4585	(267)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Energy for lighting 531.8724 3.0700 1632.8483 (268)
 Primary energy kWh/year 15815.7719 (272)
 Primary energy kWh/m²/year 96.8392 (273)

 SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
 Current environmental impact rating: B 85

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 34	-235 kg (9.1%)
U Solar photovoltaic panels	+ 6.4	-£ 322	-861 kg (36.5%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£34	1.44 kg/m ²	B 85 B 86
Solar photovoltaic panels	£322	5.27 kg/m ²	B 91 A 92
Total Savings	£356	6.71 kg/m²	

Potential energy efficiency rating: B 91
 Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 488 TEST (12 Jan 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	£137	£147	-£10
Mains gas	£465	£421	£44
Wood	£60	£60	-£0
Space heating	£465	£467	-£2
Water heating	£94	£58	£36
Lighting	£103	£103	£0
Generated (PV)	-£0	-£322	£322
Total cost of fuels	£662	£306	£356
Total cost of uses	£662	£306	£356
Delivered energy	74 kWh/m ²	57 kWh/m ²	17 kWh/m ²
Carbon dioxide emissions	2.6 tonnes	1.5 tonnes	1.1 tonnes
CO2 emissions per m ²	16 kg/m ²	9 kg/m ²	7 kg/m ²
Primary energy	97 kWh/m ²	58 kWh/m ²	39 kWh/m ²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	77.0400 (1b)	2.6800 (2b)	206.4672 (1b) - (3b)
First floor	86.2800 (1c)	2.7400 (2c)	236.4072 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.3200		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 442.8744 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)							
Number of intermittent fans				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)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross 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		(26)					
Opening Type 2 (Uw = 1.60)			28.1300	1.5038	42.3008		(27)					
Opening Type 3 (Uw = 1.60)			1.5300	1.5038	2.3008		(27a)					
Heat Loss Floor 1			77.0400	0.1300	10.0152	75.0000	5778.0000 (28a)					
Heat Loss Floor 2			22.2000	0.1886	4.1872	20.0000	444.0000 (28b)					
External Wall 1	189.7100	30.2500	159.4600	0.1800	28.7028	110.0000	17540.6000 (29a)					
Wall to Garage	18.1800		18.1800	0.1557	2.8307	110.0000	1999.8000 (29a)					
External Roof 2	86.2800		86.2800	0.1300	11.2164	9.0000	776.5200 (30)					
External Roof 2	13.9800	1.5300	12.4500	0.1700	2.1165	0.0000	0.0000 (30)					
Total net area of external elements Aum(A, m2)			407.3900				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	107.4863			(33)					
Internal Wall 1			63.3600			75.0000	4752.0000 (32c)					
Internal Wall 2			121.8900			9.0000	1097.0100 (32c)					
Internal Floor 1			64.0800			18.0000	1153.4400 (32d)					
Internal Ceiling 1			64.0800			18.0000	1153.4400 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 34694.8100 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							212.4345 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							30.2487 (36)					
Total fabric heat loss							(33) + (36) = 137.7350 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 76.1343	Feb 75.3578	Mar 74.5814	Apr 73.0743	May 73.0743	Jun 73.0743	Jul 73.0743	Aug 73.0743	Sep 73.0743	Oct 73.0743	Nov 73.0743	Dec 73.0743 (38)
Heat transfer coeff	213.8693	213.0929	212.3164	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093 (39)
Average = Sum(39)m / 12 =												211.3802 (39)
HLP	Jan 1.3095	Feb 1.3048	Mar 1.3000	Apr 1.2908	May 1.2908	Jun 1.2908	Jul 1.2908	Aug 1.2908	Sep 1.2908	Oct 1.2908	Nov 1.2908	Dec 1.2908 (40)
HLP (average)												1.2943 (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	2.9535 (42)
Average daily hot water use (litres/day)	104.3461 (43)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.7807	110.6068	106.4330	102.2592	98.0853	93.9115	93.9115	98.0853	102.2592	106.4330	110.6068	114.7807	(44)
Energy content (annual)	170.2164	148.8724	153.6230	133.9322	128.5112	110.8954	102.7609	117.9196	119.3279	139.0652	151.8005	164.8455	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5325	22.3309	23.0434	20.0898	19.2767	16.6343	15.4141	17.6879	17.8992	20.8598	22.7701	24.7268	(46)
Water storage loss:													
Store volume													250.0000 (47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)													0.0103 (51)
Volume factor from Table 2a													0.7830 (52)
Temperature factor from Table 2b													0.5400 (53)
Enter (49) or (54) in (55)													1.0875 (55)
Total storage loss	33.7127	30.4501	33.7127	32.6252	33.7127	32.6252	33.7127	33.7127	32.6252	33.7127	32.6252	33.7127	(56)
If cylinder contains dedicated solar storage	23.5989	21.3151	23.5989	22.8376	23.5989	22.8376	23.5989	23.5989	22.8376	23.5989	22.8376	23.5989	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	217.0777	191.1987	199.0885	172.5282	162.5781	143.6382	136.5952	152.6844	159.2746	184.5307	197.1501	211.7068	(62)
Aperture area of solar collector													3.0000 (H1)
Zero-loss collector efficiency													0.7000 (H2)
Collector heat loss coefficient													1.8000 (H3)
Collector 2nd order heat loss coefficient													0.0050 (H3a)
Collector effective heat loss coefficient													1.8063 (H3b)
Collector performance ratio													2.5804 (H4)
Annual solar radiation per m2													1079.5246 (H5)
Overshading factor													0.8000 (H6)
Solar energy available													1813.6014 (H7)
Adjustment factor for showers													1.0000 (H7a)
Solar-to-load ratio													1.1047 (H8)
Utilisation factor													0.5956 (H9)
Collector performance factor													0.8793 (H10)
Dedicated solar storage volume													75.0000 (H11)
Effective solar volume													127.5000 (H13)
Daily hot water demand													104.3461 (H14)
Volume ratio Veff/V													1.2219 (H15)
Solar storage volume factor													1.0000 (H16)
Solar input													-949.7337 (H17)
Solar input	-27.5404	-45.9570	-78.2700	-104.8972	-129.5917	-127.4093	-125.7255	-109.8470	-86.0322	-58.7499	-32.6669	-23.0466	(63)
Solar input (sum of months) = Sum(63)m =													-949.7337 (63)
Output from w/h	189.5373	145.2417	120.8185	67.6310	32.9864	16.2290	10.8697	42.8374	73.2424	125.7808	164.4833	188.6602	(64)
Total per year (kWh/year) = Sum(64)m =													1178.3175 (64)
Heat gains from water heating, kWh/month	94.0860	83.3611	87.4520	75.4093	69.9835	63.0670	61.2354	67.0201	71.6339	82.6116	86.7534	92.3001	(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	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.2920	66.8737	54.3854	41.1732	30.7775	25.9836	28.0762	36.4946	48.9829	62.1951	72.5908	77.3846	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	499.5116	504.6950	491.6331	463.8258	428.7241	395.7334	373.6937	368.5103	381.5722	409.3795	444.4812	477.4718	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	(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)	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	(71)
Water heating gains (Table 5)	126.4596	124.0493	117.5431	104.7351	94.0639	87.5931	82.3057	90.0808	99.4915	111.0371	120.4908	124.0593	(72)
Total internal gains	819.0083	813.3630	781.3065	727.4791	671.3104	627.0552	601.8206	612.8307	647.7917	700.3566	755.3078	796.6608	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W							
Northeast	6.6900	11.2829	0.7600	0.7500	0.7700	29.8165 (75)							
Southeast	6.3400	36.7938	0.7600	0.7500	0.7700	92.1451 (77)							
Southwest	11.0900	36.7938	0.7600	0.7500	0.7700	161.1813 (79)							
Northwest	4.0100	11.2829	0.7600	0.7500	0.7700	17.8721 (81)							
Southwest	1.5300	34.0172	0.7600	0.7000	1.0000	24.9198 (82)							
Solar gains	325.9348	577.0796	845.0109	1135.4609	1349.3242	1372.8021	1309.7600	1145.6962	945.1844	653.0032	394.4475	276.2740	(83)
Total gains	1144.9431	1390.4426	1626.3174	1862.9400	2020.6347	1999.8573	1911.5807	1758.5269	1592.9761	1353.3598	1149.7553	1072.9349	(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)	45.0623	45.2265	45.3919	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	21.0000 (85)
tau	4.0042	4.0151	4.0261	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	
alpha	0.9928	0.9840	0.9623	0.9050	0.7896	0.6229	0.4715	0.5280	0.7639	0.9405	0.9861	0.9944	(86)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT	19.7788	19.9544	20.2143	20.5218	20.7596	20.8840	20.9207	20.9136	20.8201	20.4958	20.0788	19.7563 (87)
Th 2	19.8334	19.8371	19.8408	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481 (88)
util rest of house												
	0.9908	0.9794	0.9514	0.8774	0.7321	0.5295	0.3546	0.4065	0.6803	0.9171	0.9813	0.9928 (89)
MIT 2	18.2163	18.4734	18.8489	19.2811	19.5841	19.7172	19.7453	19.7418	19.6610	19.2567	18.6642	18.1944 (90)
Living area fraction									fLA = Living area / (4) =			0.1240 (91)
MIT	18.4100	18.6571	19.0182	19.4349	19.7298	19.8618	19.8911	19.8871	19.8047	19.4103	18.8396	18.3880 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.2600	18.5071	18.8682	19.2849	19.5798	19.7118	19.7411	19.7371	19.6547	19.2603	18.6896	18.2380 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9866	0.9721	0.9392	0.8608	0.7167	0.5176	0.3433	0.3941	0.6640	0.9012	0.9744	0.9894	(94)
Useful gains	1129.6110	1351.6246	1527.4754	1603.6638	1448.2003	1035.0677	656.2162	693.0341	1057.7894	1219.6245	1120.3022	1061.6089	(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	2985.6145	2899.5696	2625.9643	2189.2416	1661.1367	1077.6221	662.1681	703.4830	1170.9862	1825.6795	2443.1866	2959.3509	(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	1380.8665	1040.2190	817.2757	421.6160	158.4247	0.0000	0.0000	0.0000	0.0000	450.9050	952.4768	1411.9201	(98)
Space heating													6633.7038 (98)
Space heating per m2										(98) / (4) =			40.6178 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.1000 (201)
Fraction of space heat from main system(s)													0.9000 (202)
Efficiency of main space heating system 1 (in %)													89.0000 (206)
Efficiency of secondary/supplementary heating system, %													65.0000 (208)
Space heating requirement													6708.2398 (211)
Space heating requirement	1380.8665	1040.2190	817.2757	421.6160	158.4247	0.0000	0.0000	0.0000	0.0000	450.9050	952.4768	1411.9201	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	1396.3819	1051.9069	826.4586	426.3533	160.2047	0.0000	0.0000	0.0000	0.0000	455.9713	963.1788	1427.7844	(211)
Water heating requirement	212.4410	160.0337	125.7347	64.8640	24.3730	0.0000	0.0000	0.0000	0.0000	69.3700	146.5349	217.2185	(215)
Water heating requirement	189.5373	145.2417	120.8185	67.6310	32.9864	16.2290	10.8697	42.8374	73.2424	125.7808	164.4833	188.6602	(64)
Efficiency of water heater (217)m	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	(216)
Fuel for water heating, kWh/month	212.9633	163.1929	135.7511	75.9899	37.0634	18.2348	12.2131	48.1319	82.2948	141.3267	184.8127	211.9777	(219)
Water heating fuel used													1323.9523 (219)
Annual totals kWh/year													6708.2398 (211)
Space heating fuel - main system													1020.5698 (215)
Space heating fuel - secondary													
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 10.6720, total flow = 58.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)													99.4164 (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													224.4164 (231)
Electricity for lighting (calculated in Appendix L)													531.8724 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394			-1727.2394 (233)
Total delivered energy for all uses													8081.8114 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6708.2398	3.4800	233.4467	(240)
Space heating - secondary	1020.5698	4.2300	43.1701	(242)
Water heating (other fuel)	1323.9523	3.4800	46.0735	(247)
Mechanical ventilation fans	99.4164	13.1900	13.1130	(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	531.8724	13.1900	70.1540	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			314.6220	(255)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.6343 (257)
SAP value		91.1513
SAP rating (Section 12)		91 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	6708.2398	0.2160	1448.9798 (261)
Space heating - secondary	1020.5698	0.0190	19.3908 (263)
Water heating (other fuel)	1323.9523	0.2160	285.9737 (264)
Space and water heating			1754.3443 (265)
Pumps and fans	224.4164	0.5190	116.4721 (267)
Energy for lighting	531.8724	0.5190	276.0418 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			1250.4210 (272)
CO2 emissions per m2			7.6600 (273)
EI value			91.9568
EI rating			92 (274)
EI band			A

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	77.0400 (1b)	x 2.6800 (2b)	= 206.4672 (1b) - (3b)
First floor	86.2800 (1c)	x 2.7400 (2c)	= 236.4072 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 442.8744 (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)							
Wind speed	Jan 5.0000	Feb 5.0000	Mar 4.9000	Apr 4.3000	May 4.2000	Jun 3.9000	Jul 3.7000	Aug 3.5000	Sep 3.9000	Oct 4.2000	Nov 4.5000	Dec 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		(26)					
Opening Type 2 (Uw = 1.60)			28.1300	1.5038	42.3008		(27)					
Opening Type 3 (Uw = 1.60)			1.5300	1.5038	2.3008		(27a)					
Heat Loss Floor 1			77.0400	0.1300	10.0152	75.0000	5778.0000 (28a)					
Heat Loss Floor 2			22.2000	0.1886	4.1872	20.0000	444.0000 (28b)					
External Wall 1	189.7100	30.2500	159.4600	0.1800	28.7028	110.0000	17540.6000 (29a)					
Wall to Garage	18.1800		18.1800	0.1557	2.8307	110.0000	1999.8000 (29a)					
External Roof 2	86.2800		86.2800	0.1300	11.2164	9.0000	776.5200 (30)					
External Roof 2	13.9800	1.5300	12.4500	0.1700	2.1165	0.0000	0.0000 (30)					
Total net area of external elements Aum(A, m2)			407.3900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	107.4863		(33)					
Internal Wall 1			63.3600			75.0000	4752.0000 (32c)					
Internal Wall 2			121.8900			9.0000	1097.0100 (32c)					
Internal Floor 1			64.0800			18.0000	1153.4400 (32d)					
Internal Ceiling 1			64.0800			18.0000	1153.4400 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 34694.8100 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							212.4345 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							30.2487 (36)					
Total fabric heat loss							(33) + (36) = 137.7350 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 75.3578	Feb 75.3578	Mar 74.5814	Apr 73.0743	May 73.0743	Jun 73.0743	Jul 73.0743	Aug 73.0743	Sep 73.0743	Oct 73.0743	Nov 73.0743	Dec 73.0743 (38)
Heat transfer coeff	213.0929	213.0929	212.3164	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093	210.8093 (39)
Average = Sum(39)m / 12 =												211.3155 (39)
HLP	Jan 1.3048	Feb 1.3048	Mar 1.3000	Apr 1.2908	May 1.2908	Jun 1.2908	Jul 1.2908	Aug 1.2908	Sep 1.2908	Oct 1.2908	Nov 1.2908	Dec 1.2908 (40)
HLP (average)												1.2939 (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	2.9535 (42)
Average daily hot water use (litres/day)	104.3461 (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	114.7807	110.6068	106.4330	102.2592	98.0853	93.9115	93.9115	98.0853	102.2592	106.4330	110.6068	114.7807	(44)
Energy content (annual)	170.2164	148.8724	153.6230	133.9322	128.5112	110.8954	102.7609	117.9196	119.3279	139.0652	151.8005	164.8455	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5325	22.3309	23.0434	20.0898	19.2767	16.6343	15.4141	17.6879	17.8992	20.8598	22.7701	24.7268	(46)
Water storage loss:													
Store volume													250.0000 (47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)													0.0103 (51)
Volume factor from Table 2a													0.7830 (52)
Temperature factor from Table 2b													0.5400 (53)
Enter (49) or (54) in (55)													1.0875 (55)
Total storage loss	33.7127	30.4501	33.7127	32.6252	33.7127	32.6252	33.7127	33.7127	32.6252	33.7127	32.6252	33.7127	(56)
If cylinder contains dedicated solar storage	23.5989	21.3151	23.5989	22.8376	23.5989	22.8376	23.5989	23.5989	22.8376	23.5989	22.8376	23.5989	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	217.0777	191.1987	199.0885	172.5282	162.5781	143.6382	136.5952	152.6844	159.2746	184.5307	197.1501	211.7068	(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													1.0610 (H8)
Utilisation factor													0.6104 (H9)
Collector performance factor													0.8793 (H10)
Dedicated solar storage volume													75.0000 (H11)
Effective solar volume													127.5000 (H13)
Daily hot water demand													104.3461 (H14)
Volume ratio Veff/V													1.2219 (H15)
Solar storage volume factor													1.0000 (H16)
Solar input													-934.8356 (H17)
Solar input	-26.2944	-43.9858	-78.2699	-105.9185	-129.8550	-126.4109	-124.5124	-107.3432	-84.8848	-56.1025	-29.6882	-21.5699	(63)
Solar input (sum of months) = Sum(63)m =													-934.8356 (63)
Output from w/h	190.7832	147.2129	120.8186	66.6097	32.7231	17.2274	12.0827	45.3412	74.3898	128.4282	167.4619	190.1368	(64)
Total per year (kWh/year) = Sum(64)m =													1193.2156 (64)
Heat gains from water heating, kWh/month	94.0860	83.3611	87.4520	75.4093	69.9835	63.0670	61.2354	67.0201	71.6339	82.6116	86.7534	92.3001	(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	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	177.2111	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.2920	66.8737	54.3854	41.1732	30.7775	25.9836	28.0762	36.4946	48.9829	62.1951	72.5908	77.3846	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	499.5116	504.6950	491.6331	463.8258	428.7241	395.7334	373.6937	368.5103	381.5722	409.3795	444.4812	477.4718	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	55.6746	(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)	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	-118.1408	(71)
Water heating gains (Table 5)	126.4596	124.0493	117.5431	104.7351	94.0639	87.5931	82.3057	90.0808	99.4915	111.0371	120.4908	124.0593	(72)
Total internal gains	819.0083	813.3630	781.3065	727.4791	671.3104	627.0552	601.8206	612.8307	647.7917	700.3566	755.3078	796.6608	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
Northeast	6.6900	10.4427	0.7600	0.7600	0.7500	0.7700	27.5960 (75)						
Southeast	6.3400	34.4805	0.7600	0.7600	0.7500	0.7700	86.3518 (77)						
Southwest	11.0900	34.4805	0.7600	0.7600	0.7500	0.7700	151.0475 (79)						
Northwest	4.0100	10.4427	0.7600	0.7600	0.7500	0.7700	16.5411 (81)						
Southwest	1.5300	31.5636	0.7600	0.7600	0.7000	1.0000	23.1223 (82)						
Solar gains	304.6588	540.6035	826.3659	1119.7455	1319.2669	1328.5737	1265.4124	1092.9646	911.5373	610.1876	350.9430	253.1505	(83)
Total gains	1123.6671	1353.9665	1607.6724	1847.2246	1990.5774	1955.6289	1867.2331	1705.7952	1559.3290	1310.5442	1106.2508	1049.8113	(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)	0.9942	0.9879	0.9706	0.9267	0.8351	0.7090	0.6086	0.6682	0.8409	0.9601	0.9900	0.9956	(86)
tau	45.2265	45.2265	45.3919	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	45.7164	
alpha	4.0151	4.0151	4.0261	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	4.0478	

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

MIT	19.7040	19.8490	20.1113	20.4239	20.6911	20.8406	20.8922	20.8737	20.7347	20.3786	19.9802	19.6757 (87)
Th 2	19.8371	19.8371	19.8408	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481	19.8481 (88)
util rest of house												
	0.9926	0.9845	0.9624	0.9060	0.7890	0.6297	0.5057	0.5665	0.7821	0.9450	0.9867	0.9943 (89)
MIT 2	18.1098	18.3202	18.7012	19.1468	19.5008	19.6759	19.7254	19.7114	19.5647	19.0934	18.5211	18.0767 (90)
Living area fraction									fLA = Living area / (4) =			0.1240 (91)
MIT	18.3075	18.5098	18.8761	19.3051	19.6484	19.8203	19.8700	19.8555	19.7097	19.2527	18.7020	18.2750 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1575	18.3598	18.7261	19.1551	19.4984	19.6703	19.7200	19.7055	19.5597	19.1027	18.5520	18.1250 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9891	0.9785	0.9518	0.8904	0.7726	0.6161	0.4933	0.5525	0.7642	0.9317	0.9813	0.9915 (94)
Useful gains	1111.4420	1324.8977	1530.2109	1644.7924	1537.9160	1204.9080	921.1599	942.4954	1191.6907	1221.0736	1085.5252	1040.9322 (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	3102.0929	3059.9644	2808.1083	2393.7683	1854.7884	1300.7505	952.8654	991.9588	1425.0175	2024.3424	2582.8372	3083.0808 (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	1481.0442	1165.9648	950.7557	539.2627	235.7531	0.0000	0.0000	0.0000	0.0000	597.6320	1078.0647	1519.3586 (98)
Space heating												7567.8357 (98)
Space heating per m2												(98) / (4) = 46.3375 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.1000 (201)
Fraction of space heat from main system(s)												0.9000 (202)
Efficiency of main space heating system 1 (in %)												89.0000 (206)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
Space heating requirement												7652.8675 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1481.0442	1165.9648	950.7557	539.2627	235.7531	0.0000	0.0000	0.0000	0.0000	597.6320	1078.0647	1519.3586 (98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000 (210)
Space heating fuel (main heating system)	1497.6852	1179.0655	961.4383	545.3218	238.4020	0.0000	0.0000	0.0000	0.0000	604.3469	1090.1777	1536.4300 (211)
Water heating requirement	227.8530	179.3792	146.2701	82.9635	36.2697	0.0000	0.0000	0.0000	0.0000	91.9434	165.8561	233.7475 (215)
Water heating requirement	190.7832	147.2129	120.8186	66.6097	32.7231	17.2274	12.0827	45.3412	74.3898	128.4282	167.4619	190.1368 (64)
Efficiency of water heater (217)m	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000	89.0000 (216)
Fuel for water heating, kWh/month	214.3632	165.4077	135.7513	74.8424	36.7675	19.3566	13.5761	50.9451	83.5841	144.3013	188.1595	213.6369 (219)
Water heating fuel used												1340.6917 (219)
Annual totals kWh/year												7652.8675 (211)
Space heating fuel - main system												1164.2824 (215)
Space heating fuel - secondary												
Electricity for pumps and fans:												
(MEV)Decentralised, Database: total watage = 10.6720, total flow = 58.0000, SFP = 0.1840)												
mechanical ventilation fans (SFP = 0.1840)												99.4164 (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												224.4164 (231)
Electricity for lighting (calculated in Appendix L)												531.8724 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.50 * 1037 * 0.80) =										-1658.9172		-1658.9172 (233)
Total delivered energy for all uses												9255.2133 (238)

10a. Fuel costs - using BEDF prices (488)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	7652.8675	3.6300	277.7991 (240)
Space heating - secondary	1164.2824	5.1600	60.0770 (242)
Water heating (other fuel)	1340.6917	3.6300	48.6671 (247)
Mechanical ventilation fans	99.4164	19.4400	19.3266 (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	531.8724	19.4400	103.3960 (250)
Additional standing charges			95.0000 (251)
Energy saving/generation technologies			
PV Unit		-1658.9172	-322.4935 (252)
Total energy cost			306.0722 (255)

FULL SAP CALCULATION PRINTOUT

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

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	7652.8675	0.2160	1653.0194 (261)
Space heating - secondary	1164.2824	0.0190	22.1214 (263)
Water heating (other fuel)	1340.6917	0.2160	289.5894 (264)
Space and water heating			1964.7302 (265)
Pumps and fans	224.4164	0.5190	116.4721 (267)
Energy for lighting	531.8724	0.5190	276.0418 (268)
Energy saving/generation technologies			
PV Unit	-1658.9172	0.5190	-860.9780 (269)
Total kg/year			1496.2660 (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	7652.8675	1.2200	9336.4984 (261)
Space heating - secondary	1164.2824	1.0400	1210.8537 (263)
Water heating (other fuel)	1340.6917	1.2200	1635.6439 (264)
Space and water heating			12182.9960 (265)
Pumps and fans	224.4164	3.0700	688.9585 (267)
Energy for lighting	531.8724	3.0700	1632.8483 (268)
Energy saving/generation technologies			
PV Unit	-1658.9172	3.0700	-5092.8758 (269)
Primary energy kWh/year			9411.9269 (272)
Primary energy kWh/m2/year			57.6287 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	No
SAP Region	North East England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	212.4 (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	365.37 (P1)
Transmission heat loss coefficient	137.74 (37)
Summer heat loss coefficient	503.11 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	6.6900	91.1383	0.7600	0.7500	0.7200	225.2043
South East	6.3400	115.6809	0.7600	0.7500	0.7200	270.8949
South West	11.0900	115.6809	0.7600	0.7500	0.7200	473.8524
North West	4.0100	91.1383	0.7600	0.7500	0.7200	134.9879
South West	1.5300	193.3062	0.7600	0.7000	1.0000	141.6092

total: 1246.5487

Solar gains	1286	1247	1081	(P3)
Internal gains	649	624	634	
Total summer gains	1935	1870	1714	(P5)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Summer gain/loss ratio	3.85	3.72	3.41	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 212.4)	0.51	0.51	0.51	
Threshold temperature	18.16	20.03	19.52	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature:	Not significant			
