

SAP Calculation

Calculation Method:-

L1A 2013 (2016 Revisions)

Dwelling:-

Land South of Sundown

Client:-

Mr & Mrs R Brooks

By:-



Results Summary

Option GSHP/PV/MVHR Performance

Conditioned Energy	7699.8kWh/yr
Energy Reduction From PV	2563kWh
Energy Reduction From Renewables	33.3%
Final Conditioned Consumption	5136kWh

Revision (GSHP/MVHR/PV)	
Energy User	kWh/Year
Water Heating	1029.3765
Space Heating (Main System)	3840.8938
Space Heating (Secondary System)	1473.3275
Pumps & Fans	701.1464
Lighting	655.0997
	7699.8439
PV output	-2563.369
	5136.4747

Multiple iterations were explored to establish the lowest energy requirement with the addition of photovoltaic modules to the type offering the best performance.

Heating System	PV (kWp)	Technology	DER/TER	Energy KWh/Year	Energy Reduction
Gas	-	-	-13.47%	19,754	-
ASHP	-	-	20.99	9,980.92	49.47%
GSHP	-	-	36.78	8,342.36	57.77%
GSHP	-	MVHR	39.58	7,699.84	61.02%
GSHP	3	MVHR	64.25	5,136.47	74%

SAP 2013 (incorporating 2016 amendments for use in England) will allow the addition of photovoltaic modules but not the inclusion of battery storage; this is to be included in the new edition of Building Regulations which is believed to be due out sometime in 2021.

Design SAP Calculations

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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	SAP 0669			Issued on Date	07/06/2021
Assessment Reference	301 GSHP	Prop Type Ref			
Property					
SAP Rating	91 B	DER	7.81	TER	21.85
Environmental	92 A	% DER<TER	64.25		
CO ₂ Emissions (t/year)	1.29	DFEE	49.44	TFEE	59.24
General Requirements Compliance	Pass	% DFEE<TFEE	16.55		
Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com			Assessor ID	E477-0001
Client	HJ Concepts, HJC				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Detached House, total floor area 247 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:Electricity

Fuel factor:1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 21.85 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 7.81 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)59.2 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)49.4 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.21 (max. 0.30)	0.24 (max. 0.70)	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.14 (max. 2.00)	1.60 (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:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Heat pump with radiators or underfloor - Electric

Ground-to-water heat pump

Secondary heating system: Room heaters - Wood Logs

Closed room heater

Efficiency: 65%

Minimum: 65% OK

5 Cylinder insulation

Hot water storage: Nominal cylinder loss: 1.79 kWh/day

Permitted by DBSCG 2.30 OK

Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK

Independent timer for DHW OK

7 Low energy lights

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

Minimum 75%

8 Mechanical ventilation

Continuous supply and extract system

Specific fan power: 0.66

Maximum 1.5 OK

MVHR efficiency: 86%

Minimum: 70% OK

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

Overshading: Average
Windows facing North: 3.20 m², No overhang
Windows facing East: 25.59 m², No overhang
Windows facing South: 2.93 m², No overhang
Windows facing West: 13.08 m², Overhang twice as wide as window, ratio 0.99
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Roof U-value 0.11 W/m²K

Roof U-value 0.12 W/m²K

Floor U-value 0.12 W/m²K

Door U-value 1.10 W/m²K

Window U-value 1.10 W/m²K

Air permeability 3.0 m³/m²h

Secondary heating (wood logs)

Secondary heating fuel: wood logs

Photovoltaic array 3.00 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	140.4000 (1b)	x 2.4200 (2b)	= 339.7680 (1b) - (3b)
First floor	106.5000 (1c)	x 2.4000 (2c)	= 255.6000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	246.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	595.3680 (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					3.0000								
Infiltration rate					0.1500 (18)								
Number of sides sheltered					0 (19)								
Shelter factor					(20) = 1 - [0.075 x (19)] = 1.0000 (20)								
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.1500 (21)								
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)	
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)	
	0.1913	0.1875	0.1838	0.1650	0.1613	0.1425	0.1425	0.1388	0.1500	0.1613	0.1688	0.1763 (22b)	
Balanced mechanical ventilation with heat recovery													0.5000 (23a)
If mechanical ventilation:													60.2000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													
Effective ac	0.3903	0.3865	0.3828	0.3640	0.3603	0.3415	0.3415	0.3378	0.3490	0.3603	0.3678	0.3753 (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						
Front Door			2.1200	1.1000	2.3320			(26a)					
Windows (Uw = 1.10)			44.8000	1.0536	47.2031			(27)					
Utility Door			2.1200	1.6000	3.3920			(26a)					
Velux (Uw = 1.40)			4.3100	1.3258	5.7140			(27a)					
Ground Floor			140.4000	0.1200	16.8480			(28a)					
Brick and Block	29.6600		29.6600	0.2400	7.1184			(29a)					
Render Walls	84.4200	32.6700	51.7500	0.2300	11.9025			(29a)					
Timber Clad	112.5600	12.0500	100.5100	0.1886	18.9573			(29a)					
Dormers	9.6200	4.3200	5.3000	0.2300	1.2190			(29a)					
Stud to Loft Void	15.1600		15.1600	0.2400	3.6384			(29a)					
Pitched Roof	58.3500		58.3500	0.1100	6.4185			(30)					
Sloping Ceilings	85.6000	4.3100	81.2900	0.1800	14.6322			(30)					
Flat Roof	6.1400		6.1400	0.1800	1.1052			(30)					
Warm Room in Roof	14.6800		14.6800	0.1132	1.6619			(30)					
Total net area of external elements Aum(A, m2)			556.5900					(31)					
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		142.1425			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								29.8606 (36)					
Total fabric heat loss						(33) + (36) =		172.0031 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 76.6730	Feb 75.9362	Mar 75.1994	Apr 71.5156	May 70.7788	Jun 67.0950	Jul 67.0950	Aug 66.3582	Sep 68.5685	Oct 70.7788	Nov 72.2524	Dec 73.7259	(38)
Heat transfer coeff	248.6761	247.9393	247.2025	243.5187	242.7819	239.0981	239.0981	238.3613	240.5716	242.7819	244.2555	245.7290	(39)
Average = Sum(39)m / 12 =												243.3345	(39)
HLP	Jan 1.0072	Feb 1.0042	Mar 1.0012	Apr 0.9863	May 0.9833	Jun 0.9684	Jul 0.9684	Aug 0.9654	Sep 0.9744	Oct 0.9833	Nov 0.9893	Dec 0.9953	(40)
HLP (average)												0.9856	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.0629 (42)
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Average daily hot water use (litres/day)												106.9439 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	117.6383	113.3605	109.0828	104.8050	100.5272	96.2495	96.2495	100.5272	104.8050	109.0828	113.3605	117.6383 (44)
Energy content (annual)	174.4541	152.5787	157.4476	137.2666	131.7106	113.6562	105.3192	120.8553	122.2987	142.5273	155.5797	168.9495 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum (45)m = 1682.6436 (45)
Water storage loss:	26.1681	22.8868	23.6171	20.5900	19.7566	17.0484	15.7979	18.1283	18.3448	21.3791	23.3370	25.3424 (46)
Store volume												210.0000 (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												0.8298 (52)
Temperature factor from Table 2b												0.5400 (53)
Enter (49) or (54) in (55)												0.9682 (55)
Total storage loss	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (56)
If cylinder contains dedicated solar storage	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (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	227.7298	200.6986	210.7232	188.8236	184.9862	165.2133	158.5948	174.1309	173.8557	195.8030	207.1368	222.2251 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	227.7298	200.6986	210.7232	188.8236	184.9862	165.2133	158.5948	174.1309	173.8557	195.8030	207.1368	222.2251 (64)
Heat gains from water heating, kWh/month	100.6265	89.2283	94.9718	86.8868	86.4143	79.0363	77.6391	82.8049	81.9100	90.0108	92.9759	98.7962 (65)
5. Internal gains (see Table 5 and 5a)												
Metabolic gains (Table 5), Watts												
(66)m	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.0945	32.9470	26.7943	20.2850	15.1633	12.8015	13.8324	17.9799	24.1326	30.6419	35.7636	38.1254 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	413.6880	417.9808	407.1631	384.1335	355.0628	327.7405	309.4875	305.1947	316.0124	339.0419	368.1126	395.4350 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160 (71)
Water heating gains (Table 5)	135.2507	132.7803	127.6503	120.6761	116.1482	109.7727	104.3537	111.2969	113.7638	120.9823	129.1332	132.7906 (72)
Total internal gains	657.9766	655.6515	633.5512	597.0381	558.3178	522.2581	499.6171	506.4150	525.8523	562.6096	604.9530	638.2945 (73)
6. Solar gains												
[Jan]												
	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
North	3.2000	10.6334	0.6300	0.7000	0.7700	10.3990 (74)						
East	25.5900	19.6403	0.6300	0.7000	0.7700	153.5994 (76)						
South	2.9300	46.7521	0.6300	0.7000	0.7700	41.8640 (78)						
West	13.0800	19.6403	0.6300	0.7000	0.7700	78.5103 (80)						
North	2.3800	15.6897	0.6300	0.7000	1.0000	14.8208 (82)						
East	0.6500	26.2379	0.6300	0.7000	1.0000	6.7690 (82)						
South	1.2800	45.6416	0.6300	0.7000	1.0000	23.1874 (82)						
Solar gains	329.1499	625.7049	1004.1314	1451.8393	1786.4758	1836.2522	1744.8280	1490.7573	1161.1984	733.8361	406.6901	273.3067 (83)
Total gains	987.1266	1281.3564	1637.6826	2048.8774	2344.7936	2358.5104	2244.4450	1997.1723	1687.0507	1296.4457	1011.6431	911.6012 (84)
7. Mean internal temperature (heating season)												
Temperature during heating periods in the living area from Table 9, Th1 (C)												
Utilisation factor for gains for living area, nil,m (see Table 9a)												21.0000 (85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	68.9485	69.1533	69.3595	70.4087	70.6224	71.7105	71.7105	71.9321	71.2712	70.6224	70.1963	69.7754
alpha	5.5966	5.6102	5.6240	5.6939	5.7082	5.7807	5.7807	5.7955	5.7514	5.7082	5.6798	5.6517
util living area	0.9998	0.9988	0.9933	0.9578	0.8344	0.6291	0.4656	0.5412	0.8449	0.9890	0.9993	0.9998 (86)
MIT	20.0241	20.1568	20.3776	20.6629	20.8637	20.9392	20.9509	20.9485	20.8836	20.5868	20.2514	20.0076 (87)
Th 2	20.0773	20.0798	20.0823	20.0948	20.0973	20.1097	20.1097	20.1123	20.1047	20.0973	20.0923	20.0873 (88)
util rest of house	0.9997	0.9984	0.9909	0.9427	0.7856	0.5499	0.3731	0.4408	0.7786	0.9833	0.9990	0.9998 (89)
MIT 2	18.7464	18.9425	19.2665	19.6826	19.9427	20.0320	20.0401	20.0416	19.9790	19.5832	19.0912	18.7302 (90)
Living area fraction	19.0331	19.2150	19.5158	19.9026	20.1494	20.2356	20.2445	20.2452	20.1820	19.8084	19.3516	19.0169 (91)
MIT	19.0331	19.2150	19.5158	19.9026	20.1494	20.2356	20.2445	20.2452	20.1820	19.8084	19.3516	19.0169 (92)
Temperature adjustment												0.0000
adjusted MIT	19.0331	19.2150	19.5158	19.9026	20.1494	20.2356	20.2445	20.2452	20.1820	19.8084	19.3516	19.0169 (93)
8. Space heating requirement												

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9995	0.9979	0.9889	0.9388	0.7887	0.5615	0.3872	0.4562	0.7851	0.9808	0.9986	0.9997	(94)
Useful gains	986.6582	1278.6566	1619.4509	1923.3978	1849.2530	1324.2334	869.1428	911.0758	1324.5302	1271.5193	1010.2275	911.3285	(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	3663.7803	3549.2546	3217.5463	2679.3304	2051.3654	1347.4670	871.3931	916.5358	1463.1541	2235.6444	2992.5171	3640.9306	(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	1991.7788	1525.8419	1188.9830	544.2715	150.3716	0.0000	0.0000	0.0000	0.0000	717.3090	1427.2485	2030.8240	(98)
Space heating												9576.6284	(98)
Space heating per m2											(98) / (4) =	38.7875	(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 %)													224.4000	(206)
Efficiency of secondary/supplementary heating system, %													65.0000	(208)
Space heating requirement													3840.8938	(211)
Space heating requirement	1991.7788	1525.8419	1188.9830	544.2715	150.3716	0.0000	0.0000	0.0000	0.0000	717.3090	1427.2485	2030.8240	(98)	
Space heating efficiency (main heating system 1)	224.4000	224.4000	224.4000	224.4000	224.4000	0.0000	0.0000	0.0000	0.0000	224.4000	224.4000	224.4000	(210)	
Space heating fuel (main heating system)	798.8418	611.9687	476.8648	218.2907	60.3095	0.0000	0.0000	0.0000	0.0000	287.6908	572.4259	814.5016	(211)	
Water heating requirement	306.4275	234.7449	182.9205	83.7341	23.1341	0.0000	0.0000	0.0000	0.0000	110.3552	219.5767	312.4345	(215)	
Water heating requirement	227.7298	200.6986	210.7232	188.8236	184.9862	165.2133	158.5948	174.1309	173.8557	195.8030	207.1368	222.2251	(64)	
Efficiency of water heater	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	(216)	
Fuel for water heating, kWh/month	101.4838	89.4379	93.9052	84.1460	82.4359	73.6244	70.6750	77.5984	77.4758	87.2562	92.3069	99.0308	(219)	
Water heating fuel used												1029.3765	(219)	
Annual totals kWh/year														
Space heating fuel - main system													3840.8938	(211)
Space heating fuel - secondary													1473.3275	(215)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9240)														
mechanical ventilation fans (SFP = 0.9240)													671.1464	(230a)
central heating pump													30.0000	(230c)
Total electricity for the above, kWh/year													701.1464	(231)
Electricity for lighting (calculated in Appendix L)													655.0997	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 3.00 * 1068 * 1.00) =										-2563.3692			-2563.3692	(233)
Total delivered energy for all uses													5136.4747	(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	3840.8938	0.5190	1993.4239	(261)
Space heating - secondary	1473.3275	0.0190	27.9932	(263)
Water heating (other fuel)	1029.3765	0.5190	534.2464	(264)
Space and water heating			2555.6635	(265)
Pumps and fans	701.1464	0.5190	363.8950	(267)
Energy for lighting	655.0997	0.5190	339.9968	(268)
Energy saving/generation technologies				
PV Unit	-2563.3692	0.5190	-1330.3886	(269)
Total CO2, kg/year			1929.1667	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			7.8100	(273)

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

DER			7.8100	ZC1
Total Floor Area		TFA	246.9000	
Assumed number of occupants		N	3.0629	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			9.9288	ZC2
CO2 emissions from cooking, equation (L16)			0.7797	ZC3
Total CO2 emissions			18.5185	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			18.5185	ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	140.4000 (1b)	x 2.4200 (2b)	= 339.7680 (1b) - (3b)
First floor	106.5000 (1c)	x 2.4000 (2c)	= 255.6000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	246.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 595.3680 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour
										heating	heating			
Number of chimneys					0	+	0	+	0	=	0 * 40 =	0.0000 (6a)		
Number of open flues					0	+	0	+	0	=	0 * 20 =	0.0000 (6b)		
Number of intermittent fans											4 * 10 =	40.0000 (7a)		
Number of passive vents											0 * 10 =	0.0000 (7b)		
Number of flueless gas fires											0 * 40 =	0.0000 (7c)		
												Air changes per hour		
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =										40.0000	/ (5) =	0.0672 (8)	
Pressure test												Yes		
Measured/design AP50												5.0000		
Infiltration rate												0.3172 (18)		
Number of sides sheltered												0 (19)		
Shelter factor											(20) = 1 - [0.075 x (19)] =	1.0000 (20)		
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =	0.3172 (21)		
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)		
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)		
Adj infilt rate	0.4044	0.3965	0.3886	0.3489	0.3410	0.3013	0.3013	0.2934	0.3172	0.3410	0.3568	0.3727 (22b)		
Effective ac	0.5818	0.5786	0.5755	0.5609	0.5581	0.5454	0.5454	0.5430	0.5503	0.5581	0.5637	0.5694 (25)		

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Semi-glazed door			4.2400	1.2000	5.0880		(26a)
TER Opening Type (Uw = 1.40)			44.8000	1.3258	59.3939		(27)
TER Room Window (Uw = 1.70)			4.3100	1.5918	6.8605		(27a)
Ground Floor			140.4000	0.1300	18.2520		(28a)
Brick and Block	29.6600		29.6600	0.1800	5.3388		(29a)
Render Walls	84.4200	32.6700	51.7500	0.1800	9.3150		(29a)
Timber Clad	112.5600	12.0500	100.5100	0.1800	18.0918		(29a)
Dormers	9.6200	4.3200	5.3000	0.1800	0.9540		(29a)
Stud to Loft Void	15.1600		15.1600	0.1800	2.7288		(29a)
Pitched Roof	58.3500		58.3500	0.1300	7.5855		(30)
Sloping Ceilings	85.6000	4.3100	81.2900	0.1300	10.5677		(30)
Flat Roof	6.1400		6.1400	0.1300	0.7982		(30)
Warm Room in Roof	14.6800		14.6800	0.1300	1.9084		(30)
Total net area of external elements Aum(A, m ²)			556.5900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	146.8826		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							26.8904 (36)
Total fabric heat loss						(33) + (36) =	173.7730 (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	114.3020	113.6782	113.0666	110.1943	109.6569	107.1553	107.1553	106.6920	108.1189	109.6569	110.7441	111.8807 (38)
Heat transfer coeff	288.0751	287.4512	286.8397	283.9674	283.4300	280.9283	280.9283	280.4650	281.8919	283.4300	284.5171	285.6537 (39)
Average = Sum(39)m / 12 =												283.9648 (39)
HLP	Jan 1.1668	Feb 1.1642	Mar 1.1618	Apr 1.1501	May 1.1480	Jun 1.1378	Jul 1.1378	Aug 1.1359	Sep 1.1417	Oct 1.1480	Nov 1.1524	Dec 1.1570 (40)
HLP (average)												1.1501 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0629 (42)
Average daily hot water use (litres/day)												106.9439 (43)
Daily hot water use	Jan 117.6383	Feb 113.3605	Mar 109.0828	Apr 104.8050	May 100.5272	Jun 96.2495	Jul 96.2495	Aug 100.5272	Sep 104.8050	Oct 109.0828	Nov 113.3605	Dec 117.6383 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)	174.4541	152.5787	157.4476	137.2666	131.7106	113.6562	105.3192	120.8553	122.2987	142.5273	155.5797	168.9495 (45)
Distribution loss (46)m = 0.15 x (45)m	26.1681	22.8868	23.6171	20.5900	19.7566	17.0484	15.7979	18.1283	18.3448	21.3791	23.3370	25.3424 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9188 (55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (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	226.2007	199.3176	209.1942	187.3439	183.4572	163.7336	157.0658	172.6019	172.3760	194.2739	205.6571	220.6961 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	226.2007	199.3176	209.1942	187.3439	183.4572	163.7336	157.0658	172.6019	172.3760	194.2739	205.6571	220.6961 (64)
Heat gains from water heating, kWh/month	99.4033	88.1235	93.7486	85.7030	85.1910	77.8526	76.4159	81.5817	80.7262	88.7876	91.7921	97.5730 (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	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.0945	32.9470	26.7943	20.2850	15.1633	12.8015	13.8324	17.9799	24.1326	30.6419	35.7636	38.1254 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	413.6880	417.9808	407.1631	384.1335	355.0628	327.7405	309.4875	305.1947	316.0124	339.0419	368.1126	395.4350 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160 (71)
Water heating gains (Table 5)	133.6066	131.1362	126.0062	119.0320	114.5041	108.1286	102.7095	109.6528	112.1197	119.3382	127.4891	131.1465 (72)
Total internal gains	656.3325	654.0074	631.9070	595.3940	556.6737	520.6140	497.9730	504.7709	524.2082	560.9655	603.3088	636.6504 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W	
North				3.2000	10.6334	0.6300	0.7000		0.7700		10.3990 (74)	
East				25.5900	19.6403	0.6300	0.7000		0.7700		153.5994 (76)	
South				2.9300	46.7521	0.6300	0.7000		0.7700		41.8640 (78)	
West				13.0800	19.6403	0.6300	0.7000		0.7700		78.5103 (80)	
North				2.3800	15.6897	0.6300	0.7000		1.0000		14.8208 (82)	
East				0.6500	26.2379	0.6300	0.7000		1.0000		6.7690 (82)	
South				1.2800	45.6416	0.6300	0.7000		1.0000		23.1874 (82)	
Solar gains	329.1499	625.7049	1004.1314	1451.8393	1786.4758	1836.2522	1744.8280	1490.7573	1161.1984	733.8361	406.6901	273.3067 (83)
Total gains	985.4824	1279.7123	1636.0385	2047.2333	2343.1494	2356.8662	2242.8009	1995.5282	1685.4066	1294.8016	1009.9990	909.9571 (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	59.5186	59.6478	59.7750	60.3796	60.4941	61.0328	61.0328	61.1336	60.8241	60.4941	60.2629	60.0231
alpha	4.9679	4.9765	4.9850	5.0253	5.0329	5.0689	5.0689	5.0756	5.0549	5.0329	5.0175	5.0015
util living area	0.9997	0.9988	0.9942	0.9687	0.8792	0.7060	0.5387	0.6196	0.8885	0.9910	0.9992	0.9998 (86)
MIT	19.5492	19.7291	20.0387	20.4473	20.7809	20.9489	20.9894	20.9795	20.8295	20.3666	19.8800	19.5225 (87)
Th 2	19.9467	19.9487	19.9507	19.9601	19.9619	19.9701	19.9701	19.9716	19.9669	19.9619	19.9583	19.9546 (88)
util rest of house	0.9996	0.9984	0.9920	0.9561	0.8340	0.6144	0.4190	0.4943	0.8269	0.9860	0.9989	0.9997 (89)
MIT 2	17.9903	18.2549	18.7080	19.3009	19.7459	19.9362	19.9662	19.9630	19.8217	19.1945	18.4828	17.9567 (90)
Living area fraction									fLA = Living area / (4) =			0.2244 (91)
MIT	18.3401	18.5857	19.0067	19.5582	19.9782	20.1635	20.1958	20.1912	20.0479	19.4576	18.7964	18.3081 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3401	18.5857	19.0067	19.5582	19.9782	20.1635	20.1958	20.1912	20.0479	19.4576	18.7964	18.3081 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9993	0.9975	0.9890	0.9499	0.8348	0.6328	0.4460	0.5224	0.8327	0.9824	0.9982	0.9995 (94)
Ext temp.	984.8126	1276.4793	1618.1116	1944.6191	1956.0609	1491.3891	1000.3480	1042.4895	1403.3783	1271.9938	1008.2235	909.5445 (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)
Heat loss rate W	4044.6135	3933.9844	3587.4045	3026.5767	2346.2810	1562.9405	1010.1665	1063.2866	1676.6536	2510.5033	3327.8196	4030.0279 (97)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	2276.4919	1785.8435	1465.1539	779.0095	290.3238	0.0000	0.0000	0.0000	0.0000	921.4510	1670.1092	2321.6397 (98)
Space heating												11510.0224 (98)
Space heating per m2										(98) / (4) =		46.6182 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												93.5000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												12310.1844 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	2276.4919	1785.8435	1465.1539	779.0095	290.3238	0.0000	0.0000	0.0000	0.0000	921.4510	1670.1092	2321.6397 (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)	2434.7507	1909.9930	1567.0095	833.1653	310.5067	0.0000	0.0000	0.0000	0.0000	985.5091	1786.2130	2483.0371 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	226.2007	199.3176	209.1942	187.3439	183.4572	163.7336	157.0658	172.6019	172.3760	194.2739	205.6571	220.6961 (64)
Efficiency of water heater (217)m	89.4164	89.2978	89.0089	88.2071	86.0331	79.8000	79.8000	79.8000	79.8000	88.4353	89.1888	79.8000 (216)
Fuel for water heating, kWh/month	252.9747	223.2054	235.0262	212.3910	213.2401	205.1799	196.8243	216.2931	216.0101	219.6792	230.5861	246.7016 (219)
Water heating fuel used												2668.1118 (219)
Annual totals kWh/year												
Space heating fuel - main system												12310.1844 (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)												655.0997 (232)
Total delivered energy for all uses												15708.3959 (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	12310.1844	0.2160	2658.9998 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2668.1118	0.2160	576.3121 (264)
Space and water heating			3235.3120 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	655.0997	0.5190	339.9968 (268)
Total CO2, kg/m2/year			3614.2337 (272)
Emissions per m2 for space and water heating			13.1037 (272a)
Fuel factor (electricity)			1.5500
Emissions per m2 for lighting			1.3771 (272b)
Emissions per m2 for pumps and fans			0.1577 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.1037 * 1.55) + 1.3771 + 0.1577, rounded to 2 d.p.			21.8500 (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	140.4000 (1b)	x 2.4200 (2b)	= 339.7680 (1b) - (3b)
First floor	106.5000 (1c)	x 2.4000 (2c)	= 255.6000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	246.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 595.3680 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
Number of chimneys										0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues										0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans																4 * 10 =	40.0000 (7a)
Number of passive vents																0 * 10 =	0.0000 (7b)
Number of flueless gas fires																0 * 40 =	0.0000 (7c)
										Air changes per hour							
Infiltration due to chimneys, flues and fans										= (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000	/ (5) =	0.0672 (8)
Pressure test										Yes							
Measured/design AP50										3.0000							
Infiltration rate										0.2172 (18)							
Number of sides sheltered										0 (19)							
Shelter factor										(20) = 1 - [0.075 x (19)] =					1.0000	(20)	
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =					0.2172	(21)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)				
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)				
Adj infilt rate	0.2769	0.2715	0.2661	0.2389	0.2335	0.2063	0.2063	0.2009	0.2172	0.2335	0.2443	0.2552	(22b)				
Effective ac	0.5383	0.5369	0.5354	0.5285	0.5273	0.5213	0.5213	0.5202	0.5236	0.5273	0.5298	0.5326	(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						
Front Door			2.1200	1.1000	2.3320			(26a)					
Windows (Uw = 1.10)			44.8000	1.0536	47.2031			(27)					
Utility Door			2.1200	1.6000	3.3920			(26a)					
Velux (Uw = 1.40)			4.3100	1.3258	5.7140			(27a)					
Ground Floor			140.4000	0.1200	16.8480			(28a)					
Brick and Block	29.6600		29.6600	0.2400	7.1184			(29a)					
Render Walls	84.4200	32.6700	51.7500	0.2300	11.9025			(29a)					
Timber Clad	112.5600	12.0500	100.5100	0.1886	18.9573			(29a)					
Dormers	9.6200	4.3200	5.3000	0.2300	1.2190			(29a)					
Stud to Loft Void	15.1600		15.1600	0.2400	3.6384			(29a)					
Pitched Roof	58.3500		58.3500	0.1100	6.4185			(30)					
Sloping Ceilings	85.6000	4.3100	81.2900	0.1800	14.6322			(30)					
Flat Roof	6.1400		6.1400	0.1800	1.1052			(30)					
Warm Room in Roof	14.6800		14.6800	0.1132	1.6619			(30)					
Total net area of external elements Aum(A, m2)			556.5900					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	142.1425			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								29.8606 (36)					
Total fabric heat loss						(33) + (36) =		172.0031 (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	105.7684	105.4759	105.1892	103.8425	103.5906	102.4177	102.4177	102.2005	102.8694	103.5906	104.1003	104.6332	(38)
Heat transfer coeff	277.7715	277.4790	277.1923	275.8456	275.5937	274.4208	274.4208	274.2036	274.8726	275.5937	276.1034	276.6363	(39)
Average = Sum(39)m / 12 =												275.8444	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1250	1.1239	1.1227	1.1172	1.1162	1.1115	1.1115	1.1106	1.1133	1.1162	1.1183	1.1204	(40)
HLP (average)												1.1172	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0629 (42)
Average daily hot water use (litres/day)												106.9439 (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	117.6383	113.3605	109.0828	104.8050	100.5272	96.2495	96.2495	100.5272	104.8050	109.0828	113.3605	117.6383 (44)
Energy content (annual)	174.4541	152.5787	157.4476	137.2666	131.7106	113.6562	105.3192	120.8553	122.2987	142.5273	155.5797	168.9495 (45)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum (45)m =		1682.6436 (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	37.0715	32.4230	33.4576	29.1692	27.9885	24.1519	22.3803	25.6818	25.9885	30.2871	33.0607	35.9018 (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	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.0945	32.9470	26.7943	20.2850	15.1633	12.8015	13.8324	17.9799	24.1326	30.6419	35.7636	38.1254	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	413.6880	417.9808	407.1631	384.1335	355.0628	327.7405	309.4875	305.1947	316.0124	339.0419	368.1126	395.4350	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	(71)
Water heating gains (Table 5)	49.8273	48.2485	44.9699	40.5127	37.6189	33.5444	30.0811	34.5185	36.0951	40.7084	45.9176	48.2551	(72)
Total internal gains	569.5533	568.1197	547.8708	513.8747	476.7886	443.0298	422.3445	426.6366	445.1836	479.3358	518.7374	550.7590	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					3.2000	10.6334	0.6300	0.7000	0.7700		10.3990 (74)	
East					25.5900	19.6403	0.6300	0.7000	0.7700		153.5994 (76)	
South					2.9300	46.7521	0.6300	0.7000	0.7700		41.8640 (78)	
West					13.0800	19.6403	0.6300	0.7000	0.7700		78.5103 (80)	
North					2.3800	15.6897	0.6300	0.7000	1.0000		14.8208 (82)	
East					0.6500	26.2379	0.6300	0.7000	1.0000		6.7690 (82)	
South					1.2800	45.6416	0.6300	0.7000	1.0000		23.1874 (82)	
Solar gains	329.1499	625.7049	1004.1314	1451.8393	1786.4758	1836.2522	1744.8280	1490.7573	1161.1984	733.8361	406.6901	273.3067 (83)
Total gains	898.7032	1193.8246	1552.0022	1965.7140	2263.2643	2279.2821	2167.1725	1917.3939	1606.3820	1213.1718	925.4275	824.0656 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.7264	61.7915	61.8554	62.1573	62.2142	62.4801	62.4801	62.5296	62.3774	62.2142	62.0993	61.9797	
alpha	5.1151	5.1194	5.1237	5.1438	5.1476	5.1653	5.1653	5.1686	5.1585	5.1476	5.1400	5.1320	
util living area	0.9998	0.9991	0.9953	0.9719	0.8847	0.7130	0.5448	0.6299	0.8986	0.9931	0.9995	0.9999	(86)
MIT	19.5708	19.7484	20.0540	20.4539	20.7854	20.9498	20.9897	20.9795	20.8265	20.3641	19.8856	19.5377	(87)
Th 2	19.9804	19.9814	19.9823	19.9868	19.9876	19.9915	19.9915	19.9922	19.9900	19.9876	19.9859	19.9842	(88)
util rest of house	0.9998	0.9988	0.9935	0.9606	0.8411	0.6229	0.4263	0.5056	0.8409	0.9891	0.9993	0.9998	(89)
MIT 2	18.6594	18.8377	19.1431	19.5391	19.8421	19.9685	19.9889	19.9862	19.8873	19.4567	18.9785	18.6294	(90)
Living area fraction									fLA = Living area / (4) =			0.2244	(91)
MIT	18.8639	19.0421	19.3475	19.7444	20.0538	20.1888	20.2135	20.2091	20.0981	19.6603	19.1821	18.8332	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8639	19.0421	19.3475	19.7444	20.0538	20.1888	20.2135	20.2091	20.0981	19.6603	19.1821	18.8332	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	898.3850	1191.9454	1539.5038	1881.5923	1911.0974	1462.6858	982.0617	1023.3936	1362.7153	1197.8101	924.5090	823.8797	(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	4045.4506	3924.1396	3561.2409	2991.3753	2302.2412	1533.6698	991.6188	1044.4788	1648.6994	2496.9711	3335.9059	4048.0811	(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	2341.4168	1836.0345	1504.1724	799.0438	291.0110	0.0000	0.0000	0.0000	0.0000	966.5758	1736.2058	2398.8059	(98)
Space heating												11873.2659	(98)
Space heating per m2												(98) / (4) =	48.0894 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	2579.5552	2030.7137	2083.9470	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8660	0.9255	0.8849	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2234.0237	1879.5167	1844.1431	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2769.5742	2637.6827	2357.9810	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	385.5964	564.0755	382.2954	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													(104)
Cooled fraction									FC = cooled area / (4) =				1.0000 (105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	96.3991	141.0189	95.5738	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													(107)
Space cooling per m2													1.3487 (108)
Energy for space heating													48.0894 (99)
Energy for space cooling													1.3487 (108)
Total													49.4381 (109)
Dwelling Fabric Energy Efficiency (DFEE)													49.4 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	140.4000 (1b)	x 2.4200 (2b)	= 339.7680 (1b) - (3b)
First floor	106.5000 (1c)	x 2.4000 (2c)	= 255.6000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	246.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 595.3680 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.0672 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3172 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3172 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4044	0.3965	0.3886	0.3489	0.3410	0.3013	0.3013	0.2934	0.3172	0.3410	0.3568	0.3727 (22b)
Effective ac	0.5818	0.5786	0.5755	0.5609	0.5581	0.5454	0.5454	0.5430	0.5503	0.5581	0.5637	0.5694 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Semi-glazed door			4.2400	1.2000	5.0880		(26a)
TER Opening Type (Uw = 1.40)			44.8000	1.3258	59.3939		(27)
TER Room Window (Uw = 1.70)			4.3100	1.5918	6.8605		(27a)
Ground Floor			140.4000	0.1300	18.2520		(28a)
Brick and Block	29.6600		29.6600	0.1800	5.3388		(29a)
Render Walls	84.4200	32.6700	51.7500	0.1800	9.3150		(29a)
Timber Clad	112.5600	12.0500	100.5100	0.1800	18.0918		(29a)
Dormers	9.6200	4.3200	5.3000	0.1800	0.9540		(29a)
Stud to Loft Void	15.1600		15.1600	0.1800	2.7288		(29a)
Pitched Roof	58.3500		58.3500	0.1300	7.5855		(30)
Sloping Ceilings	85.6000	4.3100	81.2900	0.1300	10.5677		(30)
Flat Roof	6.1400		6.1400	0.1300	0.7982		(30)
Warm Room in Roof	14.6800		14.6800	0.1300	1.9084		(30)
Total net area of external elements Aum(A, m ²)			556.5900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	146.8826		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							26.8904 (36)
Total fabric heat loss						(33) + (36) =	173.7730 (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	114.3020	113.6782	113.0666	110.1943	109.6569	107.1553	107.1553	106.6920	108.1189	109.6569	110.7441	111.8807 (38)
Heat transfer coeff	288.0751	287.4512	286.8397	283.9674	283.4300	280.9283	280.9283	280.4650	281.8919	283.4300	284.5171	285.6537 (39)
Average = Sum(39)m / 12 =												283.9648 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1668	1.1642	1.1618	1.1501	1.1480	1.1378	1.1378	1.1359	1.1417	1.1480	1.1524	1.1570 (40)
HLP (average)												1.1501 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0629 (42)
Average daily hot water use (litres/day)												106.9439 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	117.6383	113.3605	109.0828	104.8050	100.5272	96.2495	96.2495	100.5272	104.8050	109.0828	113.3605	117.6383 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	174.4541	152.5787	157.4476	137.2666	131.7106	113.6562	105.3192	120.8553	122.2987	142.5273	155.5797	168.9495 (45)
Energy content (annual)										Total =	Sum (45)m =	1682.6436 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	37.0715	32.4230	33.4576	29.1692	27.9885	24.1519	22.3803	25.6818	25.9885	30.2871	33.0607	35.9018 (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	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450	153.1450 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.0945	32.9470	26.7943	20.2850	15.1633	12.8015	13.8324	17.9799	24.1326	30.6419	35.7636	38.1254 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	413.6880	417.9808	407.1631	384.1335	355.0628	327.7405	309.4875	305.1947	316.0124	339.0419	368.1126	395.4350 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145	38.3145 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160 (71)
Water heating gains (Table 5)	49.8273	48.2485	44.9699	40.5127	37.6189	33.5444	30.0811	34.5185	36.0951	40.7084	45.9176	48.2551 (72)
Total internal gains	569.5533	568.1197	547.8708	513.8747	476.7886	443.0298	422.3445	426.6366	445.1836	479.3358	518.7374	550.7590 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					3.2000	10.6334	0.6300	0.7000	0.7700		10.3990 (74)	
East					25.5900	19.6403	0.6300	0.7000	0.7700		153.5994 (76)	
South					2.9300	46.7521	0.6300	0.7000	0.7700		41.8640 (78)	
West					13.0800	19.6403	0.6300	0.7000	0.7700		78.5103 (80)	
North					2.3800	15.6897	0.6300	0.7000	1.0000		14.8208 (82)	
East					0.6500	26.2379	0.6300	0.7000	1.0000		6.7690 (82)	
South					1.2800	45.6416	0.6300	0.7000	1.0000		23.1874 (82)	
Solar gains	329.1499	625.7049	1004.1314	1451.8393	1786.4758	1836.2522	1744.8280	1490.7573	1161.1984	733.8361	406.6901	273.3067 (83)
Total gains	898.7032	1193.8246	1552.0022	1965.7140	2263.2643	2279.2821	2167.1725	1917.3939	1606.3820	1213.1718	925.4275	824.0656 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	59.5186	59.6478	59.7750	60.3796	60.4941	61.0328	61.0328	61.1336	60.8241	60.4941	60.2629	60.0231
alpha	4.9679	4.9765	4.9850	5.0253	5.0329	5.0689	5.0689	5.0756	5.0549	5.0329	5.0175	5.0015
util living area	0.9998	0.9991	0.9954	0.9732	0.8908	0.7232	0.5556	0.6405	0.9035	0.9932	0.9995	0.9999 (86)
MIT	19.5164	19.6967	20.0077	20.4207	20.7642	20.9430	20.9878	20.9763	20.8119	20.3369	19.8480	19.4899 (87)
Th 2	19.9467	19.9487	19.9507	19.9601	19.9619	19.9701	19.9701	19.9716	19.9669	19.9619	19.9583	19.9546 (88)
util rest of house	0.9997	0.9988	0.9936	0.9622	0.8481	0.6318	0.4331	0.5130	0.8468	0.9893	0.9992	0.9998 (89)
MIT 2	18.5781	18.7599	19.0716	19.4849	19.8012	19.9439	19.9670	19.9647	19.8550	19.4089	18.9189	18.5579 (90)
Living area fraction									fLA =	Living area / (4) =		0.2244 (91)
MIT	18.7887	18.9702	19.2817	19.6950	20.0173	20.1681	20.1961	20.1917	20.0698	19.6171	19.1274	18.7671 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7887	18.9702	19.2817	19.6950	20.0173	20.1681	20.1961	20.1917	20.0698	19.6171	19.1274	18.7671 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9996	0.9984	0.9920	0.9587	0.8508	0.6507	0.4609	0.5419	0.8536	0.9875	0.9990	0.9998 (94)
Ext temp.	898.3603	1191.8830	1539.6057	1884.5219	1925.4985	1483.1981	998.8695	1038.9910	1371.2523	1198.0155	924.4727	823.8648 (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	4173.8191	4044.4833	3666.2873	3065.4140	2357.3816	1564.2466	1010.2439	1063.4463	1682.8359	2555.7290	3422.0066	4161.1376 (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	2436.9414	1916.9474	1582.2511	850.2423	321.3211	0.0000	0.0000	0.0000	0.0000	1010.1389	1798.2245	2482.9309 (98)
Space heating per m2												12398.9975 (98)
										(98) / (4) =		50.2187 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	2640.7260	2078.8694	2131.5342	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8545	0.9171	0.8745	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2256.3910	1906.4612	1864.0950	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2769.5742	2637.6827	2357.9810	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	369.4919	544.0288	367.4512	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction									fC = cooled area / (4) =			1280.9719	(104)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	92.3730	136.0072	91.8628	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling													
Space cooling per m2												320.2430	(107)
Energy for space heating												1.2971	(108)
Energy for space cooling												50.2187	(99)
Total												1.2971	(108)
Target Fabric Energy Efficiency (TFEE)												51.5158	(109)
												59.2	(109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	140.4000 (1b)	x 2.4200 (2b)	= 339.7680 (1b) - (3b)
First floor	106.5000 (1c)	x 2.4000 (2c)	= 255.6000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	246.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	595.3680 (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					3.0000							
Infiltration rate					0.1500 (18)							
Number of sides sheltered					0 (19)							
Shelter factor					(20) = 1 - [0.075 x (19)] = 1.0000 (20)							
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.1500 (21)							
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.1575	0.1500	0.1500	0.1388	0.1388	0.1238	0.1275	0.1200	0.1238	0.1313	0.1313	0.1425 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation:												
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
												0.5000 (23a)
												60.2000 (23c)
Effective ac	0.3565	0.3490	0.3490	0.3378	0.3378	0.3228	0.3265	0.3190	0.3228	0.3303	0.3303	0.3415 (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						
Front Door			2.1200	1.1000	2.3320			(26a)					
Windows (Uw = 1.10)			44.8000	1.0536	47.2031			(27)					
Utility Door			2.1200	1.6000	3.3920			(26a)					
Velux (Uw = 1.40)			4.3100	1.3258	5.7140			(27a)					
Ground Floor			140.4000	0.1200	16.8480			(28a)					
Brick and Block	29.6600		29.6600	0.2400	7.1184			(29a)					
Render Walls	84.4200	32.6700	51.7500	0.2300	11.9025			(29a)					
Timber Clad	112.5600	12.0500	100.5100	0.1886	18.9573			(29a)					
Dormers	9.6200	4.3200	5.3000	0.2300	1.2190			(29a)					
Stud to Loft Void	15.1600		15.1600	0.2400	3.6384			(29a)					
Pitched Roof	58.3500		58.3500	0.1100	6.4185			(30)					
Sloping Ceilings	85.6000	4.3100	81.2900	0.1800	14.6322			(30)					
Flat Roof	6.1400		6.1400	0.1800	1.1052			(30)					
Warm Room in Roof	14.6800		14.6800	0.1132	1.6619			(30)					
Total net area of external elements Aum(A, m2)			556.5900					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	142.1425			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							29.8606	(36)					
Total fabric heat loss						(33) + (36) =	172.0031	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 70.0421	Feb 68.5685	Mar 68.5685	Apr 66.3582	May 66.3582	Jun 63.4112	Jul 64.1479	Aug 62.6744	Sep 63.4112	Oct 64.8847	Nov 64.8847	Dec 67.0950	(38)
Heat transfer coeff	242.0452	240.5716	240.5716	238.3613	238.3613	235.4143	236.1510	234.6775	235.4143	236.8878	236.8878	239.0981	(39)
Average = Sum(39)m / 12 =												237.8702	(39)
HLP	Jan 0.9803	Feb 0.9744	Mar 0.9744	Apr 0.9654	May 0.9654	Jun 0.9535	Jul 0.9565	Aug 0.9505	Sep 0.9535	Oct 0.9594	Nov 0.9594	Dec 0.9684	(40)
HLP (average)												0.9634	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.0629 (42)
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Average daily hot water use (litres/day)												106.9439 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	117.6383	113.3605	109.0828	104.8050	100.5272	96.2495	96.2495	100.5272	104.8050	109.0828	113.3605	117.6383 (44)
Energy content (annual)	174.4541	152.5787	157.4476	137.2666	131.7106	113.6562	105.3192	120.8553	122.2987	142.5273	155.5797	168.9495 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum (45)m = 1682.6436 (45)
Water storage loss:	26.1681	22.8868	23.6171	20.5900	19.7566	17.0484	15.7979	18.1283	18.3448	21.3791	23.3370	25.3424 (46)
Store volume												210.0000 (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												0.8298 (52)
Temperature factor from Table 2b												0.5400 (53)
Enter (49) or (54) in (55)												0.9682 (55)
Total storage loss	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (56)
If cylinder contains dedicated solar storage	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (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	227.7298	200.6986	210.7232	188.8236	184.9862	165.2133	158.5948	174.1309	173.8557	195.8030	207.1368	222.2251 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	227.7298	200.6986	210.7232	188.8236	184.9862	165.2133	158.5948	174.1309	173.8557	195.8030	207.1368	222.2251 (64)
RHI water heating demand												Total per year (kWh/year) = Sum (64)m = 2309.9210 (64)
Heat gains from water heating, kWh/month	100.6265	89.2283	94.9718	86.8868	86.4143	79.0363	77.6391	82.8049	81.9100	90.0108	92.9759	98.7962 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	92.7361	82.3674	66.9857	50.7125	37.9082	32.0037	34.5811	44.9498	60.3316	76.6048	89.4091	95.3136 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	617.4448	623.8519	607.7061	573.3336	529.9445	489.1649	461.9216	455.5145	471.6603	506.0327	549.4218	590.2015 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160 (71)
Water heating gains (Table 5)	135.2507	132.7803	127.6503	120.6761	116.1482	109.7727	104.3537	111.2969	113.7638	120.9823	129.1332	132.7906 (72)
Total internal gains	966.1299	959.6979	923.0404	865.4205	804.6992	751.6395	721.5547	732.4595	766.4539	824.3181	888.6624	939.0039 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	3.2000	11.9814	0.6300	0.7000	0.7700	11.7174 (74)
East	25.5900	22.3313	0.6300	0.7000	0.7700	174.6451 (76)
South	2.9300	50.9848	0.6300	0.7000	0.7700	45.6542 (78)
West	13.0800	22.3313	0.6300	0.7000	0.7700	89.2676 (80)
North	2.3800	17.5238	0.6300	0.7000	1.0000	16.5534 (82)
East	0.6500	30.0122	0.6300	0.7000	1.0000	7.7427 (82)
South	1.2800	50.8779	0.6300	0.7000	1.0000	25.8476 (82)

Solar gains	371.4280	636.3123	1009.9077	1504.8535	1803.0102	1982.5633	1863.7960	1629.3259	1266.1033	797.2653	470.3873	305.2791 (83)
Total gains	1337.5578	1596.0103	1932.9481	2370.2739	2607.7094	2734.2028	2585.3507	2361.7854	2032.5573	1621.5834	1359.0497	1244.2831 (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	70.8373	71.2712	71.2712	71.9321	71.9321	72.8326	72.6054	73.0613	72.8326	72.3796	72.3796	71.7105
alpha	5.7225	5.7514	5.7514	5.7955	5.7955	5.8555	5.8404	5.8708	5.8555	5.8253	5.8253	5.7807
util living area	0.9985	0.9955	0.9796	0.8954	0.6949	0.4287	0.2830	0.3177	0.6488	0.9516	0.9952	0.9989 (86)
MIT	20.2127	20.3291	20.5465	20.7986	20.9251	20.9521	20.9533	20.9535	20.9398	20.7513	20.4429	20.1980 (87)
Th 2	20.0998	20.1047	20.1047	20.1123	20.1123	20.1223	20.1198	20.1248	20.1223	20.1173	20.1173	20.1097 (88)
util rest of house	0.9979	0.9939	0.9724	0.8639	0.6303	0.3544	0.2027	0.2310	0.5608	0.9291	0.9932	0.9986 (89)
MIT 2	19.0403	19.2140	19.5275	19.8765	20.0212	20.0536	20.0516	20.0569	20.0461	19.8277	19.3907	19.0269 (90)
Living area fraction	19.3034	19.4643	19.7562	20.0834	20.2241	20.2553	20.2539	20.2581	20.2466	20.0350	19.6268	19.2898 (92)
Temperature adjustment	19.3034	19.4643	19.7562	20.0834	20.2241	20.2553	20.2539	20.2581	20.2466	20.0350	19.6268	19.2898 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9924	0.9689	0.8628	0.6388	0.3657	0.2150	0.2442	0.5738	0.9265	0.9917	0.9981	(94)
Useful gains	1333.8682	1583.9260	1872.7755	2045.0504	1665.8083	999.9771	555.8322	576.7575	1166.2235	1502.3728	1347.7163	1241.8913	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	3437.8648	3335.3559	2972.5582	2427.3298	1721.9355	1001.7538	555.8873	576.8686	1188.0467	1998.1388	2754.2531	3392.7462	(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													
	1565.3735	1176.9609	818.2383	275.2412	41.7586	0.0000	0.0000	0.0000	0.0000	368.8499	1012.7065	1600.2361	(98)
Space heating												6859.3651	(98)
RHI space heating demand												6859	(98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	140.4000 (1b)	x 2.4200 (2b)	= 339.7680 (1b) - (3b)
First floor	106.5000 (1c)	x 2.4000 (2c)	= 255.6000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	246.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 595.3680 (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					3.0000							
Infiltration rate					0.1500 (18)							
Number of sides sheltered					0 (19)							
Shelter factor					(20) = 1 - [0.075 x (19)] = 1.0000 (20)							
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.1500 (21)							
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
	0.1913	0.1875	0.1838	0.1650	0.1613	0.1425	0.1425	0.1388	0.1500	0.1613	0.1688	0.1763 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation:												
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.3903	0.3865	0.3828	0.3640	0.3603	0.3415	0.3415	0.3378	0.3490	0.3603	0.3678	0.3753 (25)
												0.5000 (23a)
												60.2000 (23c)

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						
Front Door			2.1200	1.1000	2.3320			(26a)					
Windows (Uw = 1.10)			44.8000	1.0536	47.2031			(27)					
Utility Door			2.1200	1.6000	3.3920			(26a)					
Velux (Uw = 1.40)			4.3100	1.3258	5.7140			(27a)					
Ground Floor			140.4000	0.1200	16.8480			(28a)					
Brick and Block	29.6600		29.6600	0.2400	7.1184			(29a)					
Render Walls	84.4200	32.6700	51.7500	0.2300	11.9025			(29a)					
Timber Clad	112.5600	12.0500	100.5100	0.1886	18.9573			(29a)					
Dormers	9.6200	4.3200	5.3000	0.2300	1.2190			(29a)					
Stud to Loft Void	15.1600		15.1600	0.2400	3.6384			(29a)					
Pitched Roof	58.3500		58.3500	0.1100	6.4185			(30)					
Sloping Ceilings	85.6000	4.3100	81.2900	0.1800	14.6322			(30)					
Flat Roof	6.1400		6.1400	0.1800	1.1052			(30)					
Warm Room in Roof	14.6800		14.6800	0.1132	1.6619			(30)					
Total net area of external elements Aum(A, m2)			556.5900					(31)					
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		142.1425			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								29.8606 (36)					
Total fabric heat loss						(33) + (36) =		172.0031 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 76.6730	Feb 75.9362	Mar 75.1994	Apr 71.5156	May 70.7788	Jun 67.0950	Jul 67.0950	Aug 66.3582	Sep 68.5685	Oct 70.7788	Nov 72.2524	Dec 73.7259	(38)
Heat transfer coeff	248.6761	247.9393	247.2025	243.5187	242.7819	239.0981	239.0981	238.3613	240.5716	242.7819	244.2555	245.7290	(39)
Average = Sum(39)m / 12 =												243.3345	(39)
HLP	Jan 1.0072	Feb 1.0042	Mar 1.0012	Apr 0.9863	May 0.9833	Jun 0.9684	Jul 0.9684	Aug 0.9654	Sep 0.9744	Oct 0.9833	Nov 0.9893	Dec 0.9953	(40)
HLP (average)												0.9856	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.0629 (42)
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Average daily hot water use (litres/day)												106.9439 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	117.6383	113.3605	109.0828	104.8050	100.5272	96.2495	96.2495	100.5272	104.8050	109.0828	113.3605	117.6383 (44)
Energy conte	174.4541	152.5787	157.4476	137.2666	131.7106	113.6562	105.3192	120.8553	122.2987	142.5273	155.5797	168.9495 (45)
Energy content (annual)												
Distribution loss	(46)m = 0.15 x (45)m									Total = Sum (45)m =		1682.6436 (45)
	26.1681	22.8868	23.6171	20.5900	19.7566	17.0484	15.7979	18.1283	18.3448	21.3791	23.3370	25.3424 (46)
Water storage loss:												
Store volume												210.0000 (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												0.8298 (52)
Temperature factor from Table 2b												0.5400 (53)
Enter (49) or (54) in (55)												0.9682 (55)
Total storage loss												
	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (56)
If cylinder contains dedicated solar storage												
	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (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	227.7298	200.6986	210.7232	188.8236	184.9862	165.2133	158.5948	174.1309	173.8557	195.8030	207.1368	222.2251 (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	227.7298	200.6986	210.7232	188.8236	184.9862	165.2133	158.5948	174.1309	173.8557	195.8030	207.1368	222.2251 (64)
								Total per year (kWh/year) = Sum (64)m =				2309.9210 (64)
Heat gains from water heating, kWh/month	100.6265	89.2283	94.9718	86.8868	86.4143	79.0363	77.6391	82.8049	81.9100	90.0108	92.9759	98.7962 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	92.7361	82.3674	66.9857	50.7125	37.9082	32.0037	34.5811	44.9498	60.3316	76.6048	89.4091	95.3136 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	617.4448	623.8519	607.7061	573.3336	529.9445	489.1649	461.9216	455.5145	471.6603	506.0327	549.4218	590.2015 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160 (71)
Water heating gains (Table 5)	135.2507	132.7803	127.6503	120.6761	116.1482	109.7727	104.3537	111.2969	113.7638	120.9823	129.1332	132.7906 (72)
Total internal gains	966.1299	959.6979	923.0404	865.4205	804.6992	751.6395	721.5547	732.4595	766.4539	824.3181	888.6624	939.0039 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	3.2000	10.6334	0.6300	0.7000	0.7700	10.3990 (74)
East	25.5900	19.6403	0.6300	0.7000	0.7700	153.5994 (76)
South	2.9300	46.7521	0.6300	0.7000	0.7700	41.8640 (78)
West	13.0800	19.6403	0.6300	0.7000	0.7700	78.5103 (80)
North	2.3800	15.6897	0.6300	0.7000	1.0000	14.8208 (82)
East	0.6500	26.2379	0.6300	0.7000	1.0000	6.7690 (82)
South	1.2800	45.6416	0.6300	0.7000	1.0000	23.1874 (82)

Solar gains	329.1499	625.7049	1004.1314	1451.8393	1786.4758	1836.2522	1744.8280	1490.7573	1161.1984	733.8361	406.6901	273.3067 (83)
Total gains	1295.2798	1585.4028	1927.1718	2317.2598	2591.1749	2587.8918	2466.3826	2223.2168	1927.6523	1558.1542	1295.3525	1212.3106 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)

Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	68.9485	69.1533	69.3595	70.4087	70.6224	71.7105	71.7105	71.9321	71.2712	70.6224	70.1963	69.7754
alpha	5.5966	5.6102	5.6240	5.6939	5.7082	5.7807	5.7807	5.7955	5.7514	5.7082	5.6798	5.6517
util living area	0.9990	0.9966	0.9857	0.9320	0.7867	0.5794	0.4248	0.4890	0.7815	0.9747	0.9974	0.9993 (86)
MIT	20.1141	20.2447	20.4576	20.7209	20.8878	20.9439	20.9517	20.9503	20.9075	20.6563	20.3340	20.0957 (87)
Th 2	20.0773	20.0798	20.0823	20.0948	20.0973	20.1097	20.1097	20.1123	20.1047	20.0973	20.0923	20.0873 (88)
util rest of house	0.9986	0.9955	0.9807	0.9103	0.7334	0.5040	0.3398	0.3969	0.7077	0.9627	0.9963	0.9991 (89)
MIT 2	18.8780	19.0708	19.3813	19.7592	19.9679	20.0352	20.0404	20.0424	20.0008	19.6803	19.2117	18.8591 (90)
Living area fraction									fLA = Living area / (4) =			0.2244 (91)
MIT	19.1554	19.3342	19.6228	19.9751	20.1744	20.2391	20.2449	20.2462	20.2043	19.8993	19.4636	19.1366 (92)
Temperature adjustment												0.0000
adjusted MIT	19.1554	19.3342	19.6228	19.9751	20.1744	20.2391	20.2449	20.2462	20.2043	19.8993	19.4636	19.1366 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9942	0.9776	0.9070	0.7383	0.5152	0.3528	0.4109	0.7167	0.9593	0.9953	0.9987	(94)
Useful gains	1292.8921	1576.1935	1883.9729	2101.6976	1913.1151	1333.2145	870.1115	913.6002	1381.4979	1494.7527	1289.2893	1210.7590	(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	3694.1783	3578.8163	3243.9942	2696.9845	2057.4234	1348.2983	871.4907	916.7831	1468.5247	2257.7109	3019.8784	3670.3514	(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	1786.5570	1345.7625	1011.8558	428.6065	107.3654	0.0000	0.0000	0.0000	0.0000	567.6408	1246.0242	1829.9367	(98)
Space heating												8323.7490	(98)
Space heating per m2												33.7130	(99)

(98) / (4) =

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	224.4000	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)
Space heating requirement	3338.4020	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1786.5570	1345.7625	1011.8558	428.6065	107.3654	0.0000	0.0000	0.0000	0.0000	567.6408	1246.0242	1829.9367	(98)
Space heating efficiency (main heating system 1)	224.4000	224.4000	224.4000	224.4000	224.4000	0.0000	0.0000	0.0000	0.0000	224.4000	224.4000	224.4000	(210)
Space heating fuel (main heating system)	716.5336	539.7443	405.8245	171.9010	43.0610	0.0000	0.0000	0.0000	0.0000	227.6634	499.7423	733.9318	(211)
Water heating requirement	274.8549	207.0404	155.6701	65.9395	16.5178	0.0000	0.0000	0.0000	0.0000	87.3294	191.6960	281.5287	(215)

Water heating													
Water heating requirement	227.7298	200.6986	210.7232	188.8236	184.9862	165.2133	158.5948	174.1309	173.8557	195.8030	207.1368	222.2251	(64)
Efficiency of water heater	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	(216)
(217)m	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	(217)
Fuel for water heating, kWh/month	101.4838	89.4379	93.9052	84.1460	82.4359	73.6244	70.6750	77.5984	77.4758	87.2562	92.3069	99.0308	(219)
Water heating fuel used												1029.3765	(219)
Annual totals kWh/year													
Space heating fuel - main system												3338.4020	(211)
Space heating fuel - secondary												1280.5768	(215)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9240)		
mechanical ventilation fans (SFP = 0.9240)		671.1464 (230a)
central heating pump		30.0000 (230c)
Total electricity for the above, kWh/year		701.1464 (231)
Electricity for lighting (calculated in Appendix L)		655.0997 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV Unit 0 (0.80 * 3.00 * 1068 * 1.00) =	-2563.3692	-2563.3692 (233)
Total delivered energy for all uses		4441.2323 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3338.4020	13.1900	440.3352	(240)
Space heating - secondary	1280.5768	4.2300	54.1684	(242)
Water heating (other fuel)	1029.3765	13.1900	135.7748	(247)
Mechanical ventilation fans	671.1464	13.1900	88.5242	(249)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	655.0997	13.1900	86.4077	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-2563.3692	13.1900	-338.1084	(252)
Total energy cost			471.0589	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)		0.6778	(257)
SAP value		90.5449	
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	3338.4020	0.5190	1732.6306	(261)

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Calculation Type: New Build (As Designed)

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Space heating - secondary	1280.5768	0.0190	24.3310 (263)
Water heating (other fuel)	1029.3765	0.5190	534.2464 (264)
Space and water heating			2291.2080 (265)
Pumps and fans	701.1464	0.5190	363.8950 (267)
Energy for lighting	655.0997	0.5190	339.9968 (268)
Energy saving/generation technologies			
PV Unit	-2563.3692	0.5190	-1330.3886 (269)
Total kg/year			1664.7112 (272)
CO2 emissions per m2			6.7400 (273)
EI value			92.3580
EI rating			92 (274)
EI band			A

----- Calculation of stars for heating and DHW

Main heating energy efficiency	$13.19 \times (1 + 0.29 \times 0.25) / 2.2440 = 6.304$, stars = 3
Main heating environmental impact	$0.519 \times (1 + 0.29 \times 0.25) / 2.2440 = 0.2481$, stars = 4
Water heating energy efficiency	$13.19 / 2.2440 = 5.878$, stars = 3
Water heating environmental impact	$0.519 / 2.2440 = 0.2313$, 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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	140.4000 (1b)	x 2.4200 (2b)	= 339.7680 (1b) - (3b)
First floor	106.5000 (1c)	x 2.4000 (2c)	= 255.6000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	246.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 595.3680 (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					3.0000								
Infiltration rate					0.1500 (18)								
Number of sides sheltered					0 (19)								
Shelter factor					(20) = 1 - [0.075 x (19)] = 1.0000 (20)								
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.1500 (21)								
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)	
Adj infilt rate	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)	
	0.1575	0.1500	0.1500	0.1388	0.1388	0.1238	0.1275	0.1200	0.1238	0.1313	0.1313	0.1425 (22b)	
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation:													0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													60.2000 (23c)
Effective ac	0.3565	0.3490	0.3490	0.3378	0.3378	0.3228	0.3265	0.3190	0.3228	0.3303	0.3303	0.3415 (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						
Front Door			2.1200	1.1000	2.3320			(26a)					
Windows (Uw = 1.10)			44.8000	1.0536	47.2031			(27)					
Utility Door			2.1200	1.6000	3.3920			(26a)					
Velux (Uw = 1.40)			4.3100	1.3258	5.7140			(27a)					
Ground Floor			140.4000	0.1200	16.8480			(28a)					
Brick and Block	29.6600		29.6600	0.2400	7.1184			(29a)					
Render Walls	84.4200	32.6700	51.7500	0.2300	11.9025			(29a)					
Timber Clad	112.5600	12.0500	100.5100	0.1886	18.9573			(29a)					
Dormers	9.6200	4.3200	5.3000	0.2300	1.2190			(29a)					
Stud to Loft Void	15.1600		15.1600	0.2400	3.6384			(29a)					
Pitched Roof	58.3500		58.3500	0.1100	6.4185			(30)					
Sloping Ceilings	85.6000	4.3100	81.2900	0.1800	14.6322			(30)					
Flat Roof	6.1400		6.1400	0.1800	1.1052			(30)					
Warm Room in Roof	14.6800		14.6800	0.1132	1.6619			(30)					
Total net area of external elements Aum(A, m2)			556.5900					(31)					
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		142.1425			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								29.8606 (36)					
Total fabric heat loss						(33) + (36) =		172.0031 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 70.0421	Feb 68.5685	Mar 68.5685	Apr 66.3582	May 66.3582	Jun 63.4112	Jul 64.1479	Aug 62.6744	Sep 63.4112	Oct 64.8847	Nov 64.8847	Dec 67.0950	(38)
Heat transfer coeff	242.0452	240.5716	240.5716	238.3613	238.3613	235.4143	236.1510	234.6775	235.4143	236.8878	236.8878	239.0981	(39)
Average = Sum(39)m / 12 =												237.8702	(39)
HLP	Jan 0.9803	Feb 0.9744	Mar 0.9744	Apr 0.9654	May 0.9654	Jun 0.9535	Jul 0.9565	Aug 0.9505	Sep 0.9535	Oct 0.9594	Nov 0.9594	Dec 0.9684	(40)
HLP (average)												0.9634	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.0629 (42)
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Average daily hot water use (litres/day)												106.9439 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	117.6383	113.3605	109.0828	104.8050	100.5272	96.2495	96.2495	100.5272	104.8050	109.0828	113.3605	117.6383 (44)
Energy content (annual)	174.4541	152.5787	157.4476	137.2666	131.7106	113.6562	105.3192	120.8553	122.2987	142.5273	155.5797	168.9495 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum (45)m = 1682.6436 (45)
	26.1681	22.8868	23.6171	20.5900	19.7566	17.0484	15.7979	18.1283	18.3448	21.3791	23.3370	25.3424 (46)
Water storage loss:												
Store volume												210.0000 (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												0.8298 (52)
Temperature factor from Table 2b												0.5400 (53)
Enter (49) or (54) in (55)												0.9682 (55)
Total storage loss	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (56)
If cylinder contains dedicated solar storage	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (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	227.7298	200.6986	210.7232	188.8236	184.9862	165.2133	158.5948	174.1309	173.8557	195.8030	207.1368	222.2251 (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	227.7298	200.6986	210.7232	188.8236	184.9862	165.2133	158.5948	174.1309	173.8557	195.8030	207.1368	222.2251 (64)
												Total per year (kWh/year) = Sum (64)m = 2309.9210 (64)
Heat gains from water heating, kWh/month	100.6265	89.2283	94.9718	86.8868	86.4143	79.0363	77.6391	82.8049	81.9100	90.0108	92.9759	98.7962 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	92.7361	82.3674	66.9857	50.7125	37.9082	32.0037	34.5811	44.9498	60.3316	76.6048	89.4091	95.3136 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	617.4448	623.8519	607.7061	573.3336	529.9445	489.1649	461.9216	455.5145	471.6603	506.0327	549.4218	590.2015 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160 (71)
Water heating gains (Table 5)	135.2507	132.7803	127.6503	120.6761	116.1482	109.7727	104.3537	111.2969	113.7638	120.9823	129.1332	132.7906 (72)
Total internal gains	966.1299	959.6979	923.0404	865.4205	804.6992	751.6395	721.5547	732.4595	766.4539	824.3181	888.6624	939.0039 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	3.2000	11.9814	0.6300	0.7000	0.7700	11.7174 (74)
East	25.5900	22.3313	0.6300	0.7000	0.7700	174.6451 (76)
South	2.9300	50.9848	0.6300	0.7000	0.7700	45.6542 (78)
West	13.0800	22.3313	0.6300	0.7000	0.7700	89.2676 (80)
North	2.3800	17.5238	0.6300	0.7000	1.0000	16.5534 (82)
East	0.6500	30.0122	0.6300	0.7000	1.0000	7.7427 (82)
South	1.2800	50.8779	0.6300	0.7000	1.0000	25.8476 (82)

Solar gains	371.4280	636.3123	1009.9077	1504.8535	1803.0102	1982.5633	1863.7960	1629.3259	1266.1033	797.2653	470.3873	305.2791 (83)
Total gains	1337.5578	1596.0103	1932.9481	2370.2739	2607.7094	2734.2028	2585.3507	2361.7854	2032.5573	1621.5834	1359.0497	1244.2831 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)

Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	70.8373	71.2712	71.2712	71.9321	71.9321	72.8326	72.6054	73.0613	72.8326	72.3796	72.3796	71.7105
alpha	5.7225	5.7514	5.7514	5.7955	5.7955	5.8555	5.8404	5.8708	5.8555	5.8253	5.8253	5.7807
util living area	0.9985	0.9955	0.9796	0.8954	0.6949	0.4287	0.2830	0.3177	0.6488	0.9516	0.9952	0.9989 (86)
MIT	20.2127	20.3291	20.5465	20.7986	20.9251	20.9521	20.9533	20.9535	20.9398	20.7513	20.4429	20.1980 (87)
Th 2	20.0998	20.1047	20.1047	20.1123	20.1123	20.1223	20.1198	20.1248	20.1223	20.1173	20.1173	20.1097 (88)
util rest of house	0.9979	0.9939	0.9724	0.8639	0.6303	0.3544	0.2027	0.2310	0.5608	0.9291	0.9932	0.9986 (89)
MIT 2	19.0403	19.2140	19.5275	19.8765	20.0212	20.0536	20.0516	20.0569	20.0461	19.8277	19.3907	19.0269 (90)
Living area fraction	19.3034	19.4643	19.7562	20.0834	20.2241	20.2553	20.2539	20.2581	20.2466	20.0350	19.6268	19.2898 (92)
MIT	19.3034	19.4643	19.7562	20.0834	20.2241	20.2553	20.2539	20.2581	20.2466	20.0350	19.6268	19.2898 (93)
Temperature adjustment												0.0000
adjusted MIT	19.3034	19.4643	19.7562	20.0834	20.2241	20.2553	20.2539	20.2581	20.2466	20.0350	19.6268	19.2898 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9924	0.9689	0.8628	0.6388	0.3657	0.2150	0.2442	0.5738	0.9265	0.9917	0.9981	(94)
Useful gains	1333.8682	1583.9260	1872.7755	2045.0504	1665.8083	999.9771	555.8322	576.7575	1166.2235	1502.3728	1347.7163	1241.8913	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	3437.8648	3335.3559	2972.5582	2427.3298	1721.9355	1001.7538	555.8873	576.8686	1188.0467	1998.1388	2754.2531	3392.7462	(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	1565.3735	1176.9609	818.2383	275.2412	41.7586	0.0000	0.0000	0.0000	0.0000	368.8499	1012.7065	1600.2361	(98)
Space heating												6859.3651	(98)
Space heating per m2											(98) / (4) =	27.7820	(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 %)													224.4000	(206)
Efficiency of secondary/supplementary heating system, %													65.0000	(208)
Space heating requirement													2751.0823	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1565.3735	1176.9609	818.2383	275.2412	41.7586	0.0000	0.0000	0.0000	0.0000	368.8499	1012.7065	1600.2361	(98)	
Space heating efficiency (main heating system 1)	224.4000	224.4000	224.4000	224.4000	224.4000	0.0000	0.0000	0.0000	0.0000	224.4000	224.4000	224.4000	(210)	
Space heating fuel (main heating system)	627.8236	472.0432	328.1705	110.3909	16.7481	0.0000	0.0000	0.0000	0.0000	147.9344	406.1657	641.8059	(211)	
Water heating requirement	240.8267	181.0709	125.8828	42.3448	6.4244	0.0000	0.0000	0.0000	0.0000	56.7461	155.8010	246.1902	(215)	
Water heating														
Water heating requirement	227.7298	200.6986	210.7232	188.8236	184.9862	165.2133	158.5948	174.1309	173.8557	195.8030	207.1368	222.2251	(64)	
Efficiency of water heater													224.4000	(216)
(217)m	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	(217)	
Fuel for water heating, kWh/month	101.4838	89.4379	93.9052	84.1460	82.4359	73.6244	70.6750	77.5984	77.4758	87.2562	92.3069	99.0308	(219)	
Water heating fuel used													1029.3765	(219)
Annual totals kWh/year														
Space heating fuel - main system													2751.0823	(211)
Space heating fuel - secondary													1055.2869	(215)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9240)														
mechanical ventilation fans (SFP = 0.9240)													671.1464	(230a)
central heating pump													30.0000	(230c)
Total electricity for the above, kWh/year													701.1464	(231)
Electricity for lighting (calculated in Appendix L)													655.0997	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 3.00 * 1121 * 1.00) =										-2690.3476			-2690.3476	(233)
Total delivered energy for all uses													3501.6443	(238)

10a. Fuel costs - using BEDF prices (477)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2751.0823	18.9000	519.9545	(240)
Space heating - secondary	1055.2869	4.9500	52.2367	(242)
Water heating (other fuel)	1029.3765	18.9000	194.5522	(247)
Mechanical ventilation fans	671.1464	18.9000	126.8467	(249)
Pumps and fans for heating	30.0000	18.9000	5.6700	(249)
Energy for lighting	655.0997	18.9000	123.8138	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-2690.3476	18.9000	-508.4757	(252)
Total energy cost			514.5982	(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	2751.0823	0.5190	1427.8117	(261)
Space heating - secondary	1055.2869	0.0190	20.0505	(263)
Water heating (other fuel)	1029.3765	0.5190	534.2464	(264)
Space and water heating			1982.1086	(265)
Pumps and fans	701.1464	0.5190	363.8950	(267)
Energy for lighting	655.0997	0.5190	339.9968	(268)
Energy saving/generation technologies				
PV Unit	-2690.3476	0.5190	-1396.2904	(269)
Total kg/year			1289.7099	(272)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	2751.0823	3.0700	8445.8225 (261)
Space heating - secondary	1055.2869	1.0400	1097.4984 (263)
Water heating (other fuel)	1029.3765	3.0700	3160.1860 (264)
Space and water heating			12703.5069 (265)
Pumps and fans	701.1464	3.0700	2152.5196 (267)
Energy for lighting	655.0997	3.0700	2011.1561 (268)
Energy saving/generation technologies			
PV Unit	-2690.3476	3.0700	-8259.3670 (269)
Primary energy kWh/year			8607.8156 (272)
Primary energy kWh/m ² /year			34.8636 (273)

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO ₂ change
N Solar water heating	+ 1.0	-£ 73	-200 kg (15.5%)
V2 Wind turbine	+ 9.5	-£ 676	-1856 kg (170.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£73	0.81 kg/m ²	A 92 A 93
Wind turbine	£676	7.52 kg/m ²	A 101 A 102
Total Savings	£748	8.33 kg/m ²	

Potential energy efficiency rating: A 101
Potential environmental impact rating: A 102

Fuel prices for cost data on this page from database revision number 477 TEST (30 Apr 2021)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£971	£898	£73
Wood	£52	£52	-£0
Space heating	£705	£705	-£0
Water heating	£195	£121	£73
Lighting	£124	£124	£0
Generated (PV)	-£508	-£508	£0
Generated (wind)	-£0	-£676	£676
Total cost of fuels	£515	-£234	£749
Total cost of uses	£516	-£234	£749
Delivered energy	14 kWh/m ²	-2 kWh/m ²	16 kWh/m ²
Carbon dioxide emissions	1.3 tonnes	-0.8 tonnes	2.1 tonnes

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

CO2 emissions per m ²	5 kg/m ²	-3 kg/m ²	8 kg/m ²
Primary energy	35 kWh/m ²	-14 kWh/m ²	49 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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	140.4000 (1b)	x 2.4200 (2b)	= 339.7680 (1b) - (3b)
First floor	106.5000 (1c)	x 2.4000 (2c)	= 255.6000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	246.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 595.3680 (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)				
Air changes per hour												
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						0.0000 / (5) =	0.0000 (8)				
Pressure test							Yes					
Measured/design AP50								3.0000				
Infiltration rate								0.1500 (18)				
Number of sides sheltered								0 (19)				
Shelter factor							(20) = 1 - [0.075 x (19)] =	1.0000 (20)				
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.1500 (21)				
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
	0.1913	0.1875	0.1838	0.1650	0.1613	0.1425	0.1425	0.1388	0.1500	0.1613	0.1688	0.1763 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation:												0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												60.2000 (23c)
Effective ac	0.3903	0.3865	0.3828	0.3640	0.3603	0.3415	0.3415	0.3378	0.3490	0.3603	0.3678	0.3753 (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					
Front Door			2.1200	1.1000	2.3320			(26a)				
Windows (Uw = 1.10)			44.8000	1.0536	47.2031			(27)				
Utility Door			2.1200	1.6000	3.3920			(26a)				
Velux (Uw = 1.40)			4.3100	1.3258	5.7140			(27a)				
Ground Floor			140.4000	0.1200	16.8480			(28a)				
Brick and Block	29.6600		29.6600	0.2400	7.1184			(29a)				
Render Walls	84.4200	32.6700	51.7500	0.2300	11.9025			(29a)				
Timber Clad	112.5600	12.0500	100.5100	0.1886	18.9573			(29a)				
Dormers	9.6200	4.3200	5.3000	0.2300	1.2190			(29a)				
Stud to Loft Void	15.1600		15.1600	0.2400	3.6384			(29a)				
Pitched Roof	58.3500		58.3500	0.1100	6.4185			(30)				
Sloping Ceilings	85.6000	4.3100	81.2900	0.1800	14.6322			(30)				
Flat Roof	6.1400		6.1400	0.1800	1.1052			(30)				
Warm Room in Roof	14.6800		14.6800	0.1132	1.6619			(30)				
Total net area of external elements Aum(A, m2)			556.5900					(31)				
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	142.1425			(33)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								29.8606 (36)				
Total fabric heat loss						(33) + (36) =		172.0031 (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	76.6730	75.9362	75.1994	71.5156	70.7788	67.0950	67.0950	66.3582	68.5685	70.7788	72.2524	73.7259 (38)
Heat transfer coeff	248.6761	247.9393	247.2025	243.5187	242.7819	239.0981	239.0981	238.3613	240.5716	242.7819	244.2555	245.7290 (39)
Average = Sum(39)m / 12 =												243.3345 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0072	1.0042	1.0012	0.9863	0.9833	0.9684	0.9684	0.9654	0.9744	0.9833	0.9893	0.9953 (40)
HLP (average)												0.9856 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.0629 (42)
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Average daily hot water use (litres/day)												106.9439 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	117.6383	113.3605	109.0828	104.8050	100.5272	96.2495	96.2495	100.5272	104.8050	109.0828	113.3605	117.6383 (44)
Energy content (annual)	174.4541	152.5787	157.4476	137.2666	131.7106	113.6562	105.3192	120.8553	122.2987	142.5273	155.5797	168.9495 (45)
Distribution loss (46)m = 0.15 x (45)m	26.1681	22.8868	23.6171	20.5900	19.7566	17.0484	15.7979	18.1283	18.3448	21.3791	23.3370	25.3424 (46)
Water storage loss:												
Store volume	210.0000 (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	0.8298 (52)											
Temperature factor from Table 2b	0.5400 (53)											
Enter (49) or (54) in (55)	0.9682 (55)											
Total storage loss	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (56)
If cylinder contains dedicated solar storage	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (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	227.7298	200.6986	209.3274	182.0700	172.1919	152.6065	145.5679	162.0345	168.4529	194.4072	207.1368	222.2251 (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	1.0778 (H8)											
Utilisation factor	0.6046 (H9)											
Collector performance factor	0.8793 (H10)											
Dedicated solar storage volume	75.0000 (H11)											
Effective solar volume	75.0000 (H13)											
Daily hot water demand	106.9439 (H14)											
Volume ratio Veff/V	0.7013 (H15)											
Solar storage volume factor	0.9290 (H16)											
Solar input	-895.6905 (H17)											
Solar input	-25.9732	-43.3419	-73.8162	-98.9282	-122.2175	-120.1592	-118.5713	-103.5963	-81.1367	-55.4068	-30.8080	-21.7352 (63)
Output from w/h	201.7565	157.3567	135.5113	83.1418	49.9744	32.4473	26.9966	58.4381	87.3162	139.0004	176.3288	200.4900 (64)
Heat gains from water heating, kWh/month	100.6265	89.2283	93.8552	81.4839	76.1788	68.9509	67.2176	73.1277	77.5876	88.8942	92.9759	98.7962 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	92.7361	82.3674	66.9857	50.7125	37.9082	32.0037	34.5811	44.9498	60.3316	76.6048	89.4091	95.3136 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	617.4448	623.8519	607.7061	573.3336	529.9445	489.1649	461.9216	455.5145	471.6603	506.0327	549.4218	590.2015 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160 (71)
Water heating gains (Table 5)	135.2507	132.7803	126.1495	113.1721	102.3909	95.7652	90.3462	98.2899	107.7606	119.4815	129.1332	132.7906 (72)
Total internal gains	966.1299	959.6979	921.5396	857.9165	790.9419	737.6321	707.5472	719.4525	760.4507	822.8173	888.6624	939.0039 (73)

6. Solar gains												

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	W/m2	Specific data	factor	W						
				or Table 6b	Table 6c							
North	3.2000	10.6334	0.6300	0.7000	0.7700	10.3990 (74)						
East	25.5900	19.6403	0.6300	0.7000	0.7700	153.5994 (76)						
South	2.9300	46.7521	0.6300	0.7000	0.7700	41.8640 (78)						
West	13.0800	19.6403	0.6300	0.7000	0.7700	78.5103 (80)						
North	2.3800	15.6897	0.6300	0.7000	1.0000	14.8208 (82)						
East	0.6500	26.2379	0.6300	0.7000	1.0000	6.7690 (82)						
South	1.2800	45.6416	0.6300	0.7000	1.0000	23.1874 (82)						

Solar gains	329.1499	625.7049	1004.1314	1451.8393	1786.4758	1836.2522	1744.8280	1490.7573	1161.1984	733.8361	406.6901	273.3067 (83)
Total gains	1295.2798	1585.4028	1925.6710	2309.7558	2577.4176	2573.8843	2452.3751	2210.2098	1921.6491	1556.6534	1295.3525	1212.3106 (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	68.9485	69.1533	69.3595	70.4087	70.6224	71.7105	71.7105	71.9321	71.2712	70.6224	70.1963	69.7754

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

alpha	5.5966	5.6102	5.6240	5.6939	5.7082	5.7807	5.7807	5.7955	5.7514	5.7082	5.6798	5.6517
util living area	0.9990	0.9966	0.9857	0.9328	0.7893	0.5822	0.4271	0.4918	0.7831	0.9748	0.9974	0.9993 (86)
MIT	20.1141	20.2447	20.4572	20.7194	20.8866	20.9436	20.9516	20.9503	20.9070	20.6559	20.3340	20.0957 (87)
Th 2	20.0773	20.0798	20.0823	20.0948	20.0973	20.1097	20.1097	20.1123	20.1047	20.0973	20.0923	20.0873 (88)
util rest of house	0.9986	0.9955	0.9808	0.9113	0.7363	0.5066	0.3417	0.3992	0.7094	0.9628	0.9963	0.9991 (89)
MIT 2	18.8780	19.0708	19.3807	19.7573	19.9667	20.0350	20.0404	20.0424	20.0004	19.6798	19.2117	18.8591 (90)
Living area fraction									fLA = Living area / (4) =			0.2244 (91)
MIT	19.1554	19.3342	19.6223	19.9732	20.1732	20.2389	20.2449	20.2461	20.2039	19.8988	19.4636	19.1366 (92)
Temperature adjustment												0.0000
adjusted MIT	19.1554	19.3342	19.6223	19.9732	20.1732	20.2389	20.2449	20.2461	20.2039	19.8988	19.4636	19.1366 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9942	0.9777	0.9079	0.7411	0.5178	0.3548	0.4133	0.7183	0.9595	0.9953	0.9987	(94)
Useful gains	1292.8921	1576.1935	1882.6450	2097.1251	1910.0864	1332.7814	870.0651	913.4931	1380.3780	1493.5485	1289.2893	1210.7590	(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	3694.1783	3578.8163	3243.8611	2696.5331	2057.1378	1348.2582	871.4860	916.7726	1468.4197	2257.5916	3019.8784	3670.3514	(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	1786.5570	1345.7625	1012.7447	431.5737	109.4063	0.0000	0.0000	0.0000	0.0000	568.4481	1246.0242	1829.9367	(98)
Space heating												8330.4533	(98)
Space heating per m2											(98) / (4) =	33.7402	(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 %)													224.4000 (206)
Efficiency of secondary/supplementary heating system, %													65.0000 (208)
Space heating requirement													3341.0909 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1786.5570	1345.7625	1012.7447	431.5737	109.4063	0.0000	0.0000	0.0000	0.0000	568.4481	1246.0242	1829.9367	(98)
Space heating efficiency (main heating system 1)	224.4000	224.4000	224.4000	224.4000	224.4000	0.0000	0.0000	0.0000	0.0000	224.4000	224.4000	224.4000	(210)
Space heating fuel (main heating system)	716.5336	539.7443	406.1810	173.0911	43.8795	0.0000	0.0000	0.0000	0.0000	227.9872	499.7423	733.9318	(211)
Water heating requirement	274.8549	207.0404	155.8069	66.3960	16.8317	0.0000	0.0000	0.0000	0.0000	87.4535	191.6960	281.5287	(215)
Water heating													
Water heating requirement	201.7565	157.3567	135.5113	83.1418	49.9744	32.4473	26.9966	58.4381	87.3162	139.0004	176.3288	200.4900	(64)
Efficiency of water heater	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	(216)
(217)m	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	(217)
Fuel for water heating, kWh/month	89.9093	70.1233	60.3883	37.0507	22.2702	14.4596	12.0306	26.0420	38.9109	61.9431	78.5779	89.3449	(219)
Water heating fuel used												601.0508	(219)
Annual totals kWh/year													
Space heating fuel - main system													3341.0909 (211)
Space heating fuel - secondary													1281.6082 (215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9240)													
mechanical ventilation fans (SFP = 0.9240)													671.1464 (230a)
central heating pump													30.0000 (230c)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													751.1464 (231)
Electricity for lighting (calculated in Appendix L)													655.0997 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 3.00 * 1068 * 1.00) =									-2563.3692				-2563.3692 (233)
Wind generation													-3575.5408 (234)
Total delivered energy for all uses													491.0862 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3341.0909	13.1900	440.6899	(240)
Space heating - secondary	1281.6082	4.2300	54.2120	(242)
Water heating (other fuel)	601.0508	13.1900	79.2786	(247)
Mechanical ventilation fans	671.1464	13.1900	88.5242	(249)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	655.0997	13.1900	86.4077	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-2563.3692	13.1900	-338.1084	(252)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Wind Turbine	-3575.5408	13.1900	-471.6138 (252)
Total energy cost			-50.0578 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	-0.0720 (257)
SAP value		101.0048
SAP rating (Section 12)		101 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	3341.0909	0.5190	1734.0262 (261)
Space heating - secondary	1281.6082	0.0190	24.3506 (263)
Water heating (other fuel)	601.0508	0.5190	311.9454 (264)
Space and water heating			2070.3221 (265)
Pumps and fans	751.1464	0.5190	389.8450 (267)
Energy for lighting	655.0997	0.5190	339.9968 (268)
Energy saving/generation technologies			
PV Unit	-2563.3692	0.5190	-1330.3886 (269)
Wind Turbine	-3575.5408	0.5190	-1855.7056 (269)
Total kg/year			-385.9304 (272)
CO ₂ emissions per m ²			-1.5600 (273)
EI value			101.7717
EI rating			102 (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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	140.4000 (1b)	x 2.4200 (2b)	= 339.7680 (1b) - (3b)
First floor	106.5000 (1c)	x 2.4000 (2c)	= 255.6000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	246.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	595.3680 (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					3.0000							
Infiltration rate					0.1500 (18)							
Number of sides sheltered					0 (19)							
Shelter factor					(20) = 1 - [0.075 x (19)] = 1.0000 (20)							
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.1500 (21)							
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.1575	0.1500	0.1500	0.1388	0.1388	0.1238	0.1275	0.1200	0.1238	0.1313	0.1313	0.1425 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation:												
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
												0.5000 (23a)
												60.2000 (23c)
Effective ac	0.3565	0.3490	0.3490	0.3378	0.3378	0.3228	0.3265	0.3190	0.3228	0.3303	0.3303	0.3415 (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						
Front Door			2.1200	1.1000	2.3320			(26a)					
Windows (Uw = 1.10)			44.8000	1.0536	47.2031			(27)					
Utility Door			2.1200	1.6000	3.3920			(26a)					
Velux (Uw = 1.40)			4.3100	1.3258	5.7140			(27a)					
Ground Floor			140.4000	0.1200	16.8480			(28a)					
Brick and Block	29.6600		29.6600	0.2400	7.1184			(29a)					
Render Walls	84.4200	32.6700	51.7500	0.2300	11.9025			(29a)					
Timber Clad	112.5600	12.0500	100.5100	0.1886	18.9573			(29a)					
Dormers	9.6200	4.3200	5.3000	0.2300	1.2190			(29a)					
Stud to Loft Void	15.1600		15.1600	0.2400	3.6384			(29a)					
Pitched Roof	58.3500		58.3500	0.1100	6.4185			(30)					
Sloping Ceilings	85.6000	4.3100	81.2900	0.1800	14.6322			(30)					
Flat Roof	6.1400		6.1400	0.1800	1.1052			(30)					
Warm Room in Roof	14.6800		14.6800	0.1132	1.6619			(30)					
Total net area of external elements Aum(A, m2)			556.5900					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	142.1425			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							29.8606	(36)					
Total fabric heat loss						(33) + (36) =	172.0031	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	70.0421	68.5685	68.5685	66.3582	66.3582	63.4112	64.1479	62.6744	63.4112	64.8847	64.8847	67.0950	(38)
Heat transfer coeff	242.0452	240.5716	240.5716	238.3613	238.3613	235.4143	236.1510	234.6775	235.4143	236.8878	236.8878	239.0981	(39)
Average = Sum(39)m / 12 =												237.8702	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9803	0.9744	0.9744	0.9654	0.9654	0.9535	0.9565	0.9505	0.9535	0.9594	0.9594	0.9684	(40)
HLP (average)												0.9634	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0629 (42)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Average daily hot water use (litres/day)												106.9439 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	117.6383	113.3605	109.0828	104.8050	100.5272	96.2495	96.2495	100.5272	104.8050	109.0828	113.3605	117.6383 (44)
Energy content (annual)	174.4541	152.5787	157.4476	137.2666	131.7106	113.6562	105.3192	120.8553	122.2987	142.5273	155.5797	168.9495 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum (45)m = 1682.6436 (45)
	26.1681	22.8868	23.6171	20.5900	19.7566	17.0484	15.7979	18.1283	18.3448	21.3791	23.3370	25.3424 (46)
Water storage loss:												
Store volume												210.0000 (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												0.8298 (52)
Temperature factor from Table 2b												0.5400 (53)
Enter (49) or (54) in (55)												0.9682 (55)
Total storage loss	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (56)
If cylinder contains dedicated solar storage	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132 (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	227.7298	200.6986	209.3274	182.0700	172.1919	152.6065	145.5679	162.0345	168.4529	194.4072	207.1368	222.2251 (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												1140.0998 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1915.3676 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1383 (H8)
Utilisation factor												0.5846 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												106.9439 (H14)
Volume ratio Veff/V												0.7013 (H15)
Solar storage volume factor												0.9290 (H16)
Solar input												-914.6869 (H17)
Solar input	-28.1536	-42.3148	-71.2635	-98.5080	-118.6367	-124.8600	-121.8619	-108.8234	-84.9370	-57.7811	-34.2214	-23.3254 (63)
Output from w/h	199.5762	158.3838	138.0639	83.5621	53.5551	27.7465	23.7060	53.2111	83.5158	136.6261	172.9153	198.8997 (64)
Heat gains from water heating, kWh/month	100.6265	89.2283	93.8552	81.4839	76.1788	68.9509	67.2176	73.1277	77.5876	88.8942	92.9759	98.7962 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740	183.7740 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	92.7361	82.3674	66.9857	50.7125	37.9082	32.0037	34.5811	44.9498	60.3316	76.6048	89.4091	95.3136 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	617.4448	623.8519	607.7061	573.3336	529.9445	489.1649	461.9216	455.5145	471.6603	506.0327	549.4218	590.2015 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403	56.4403 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160	-122.5160 (71)
Water heating gains (Table 5)	135.2507	132.7803	126.1495	113.1721	102.3909	95.7652	90.3462	98.2899	107.7606	119.4815	129.1332	132.7906 (72)
Total internal gains	966.1299	959.6979	921.5396	857.9165	790.9419	737.6321	707.5472	719.4525	760.4507	822.8173	888.6624	939.0039 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				3.2000	11.9814	0.6300	0.7000	0.7700	11.7174 (74)			
East				25.5900	22.3313	0.6300	0.7000	0.7700	174.6451 (76)			
South				2.9300	50.9848	0.6300	0.7000	0.7700	45.6542 (78)			
West				13.0800	22.3313	0.6300	0.7000	0.7700	89.2676 (80)			
North				2.3800	17.5238	0.6300	0.7000	1.0000	16.5534 (82)			
East				0.6500	30.0122	0.6300	0.7000	1.0000	7.7427 (82)			
South				1.2800	50.8779	0.6300	0.7000	1.0000	25.8476 (82)			
Solar gains	371.4280	636.3123	1009.9077	1504.8535	1803.0102	1982.5633	1863.7960	1629.3259	1266.1033	797.2653	470.3873	305.2791 (83)
Total gains	1337.5578	1596.0103	1931.4473	2362.7699	2593.9521	2720.1954	2571.3432	2348.7784	2026.5541	1620.0826	1359.0497	1244.2831 (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	70.8373	71.2712	71.2712	71.9321	71.9321	72.8326	72.6054	73.0613	72.8326	72.3796	72.3796	71.7105

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alpha	5.7225	5.7514	5.7514	5.7955	5.7955	5.8555	5.8404	5.8708	5.8555	5.8253	5.8253	5.7807
util living area	0.9985	0.9955	0.9797	0.8965	0.6978	0.4309	0.2846	0.3195	0.6504	0.9518	0.9952	0.9989 (86)
MIT	20.2127	20.3291	20.5461	20.7973	20.9245	20.9521	20.9533	20.9535	20.9396	20.7509	20.4429	20.1980 (87)
Th 2	20.0998	20.1047	20.1047	20.1123	20.1123	20.1223	20.1198	20.1248	20.1223	20.1173	20.1173	20.1097 (88)
util rest of house	0.9979	0.9939	0.9725	0.8652	0.6332	0.3562	0.2038	0.2322	0.5623	0.9293	0.9932	0.9986 (89)
MIT 2	19.0403	19.2140	19.5270	19.8750	20.0207	20.0536	20.0516	20.0569	20.0459	19.8272	19.3907	19.0269 (90)
Living area fraction									fLA = Living area / (4) =			0.2244 (91)
MIT	19.3034	19.4643	19.7557	20.0820	20.2235	20.2553	20.2539	20.2581	20.2465	20.0345	19.6268	19.2898 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3034	19.4643	19.7557	20.0820	20.2235	20.2553	20.2539	20.2581	20.2465	20.0345	19.6268	19.2898 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9972	0.9924	0.9690	0.8640	0.6417	0.3676	0.2162	0.2456	0.5753	0.9267	0.9917	0.9981 (94)
Useful gains	1333.8682	1583.9260	1871.5104	2041.5035	1664.4197	999.9231	555.8303	576.7536	1165.8961	1501.3664	1347.7163	1241.8913 (95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000 (96)
Heat loss rate W	3437.8648	3335.3559	2972.4340	2426.9899	1721.8082	1001.7486	555.8871	576.8681	1188.0165	1998.0415	2754.2531	3392.7462 (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	1565.3735	1176.9609	819.0871	277.5502	42.6971	0.0000	0.0000	0.0000	0.0000	369.5263	1012.7065	1600.2361 (98)
Space heating												6864.1377 (98)
Space heating per m2										(98) / (4) =		27.8013 (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 %)												224.4000 (206)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
Space heating requirement												2752.9964 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1565.3735	1176.9609	819.0871	277.5502	42.6971	0.0000	0.0000	0.0000	0.0000	369.5263	1012.7065	1600.2361 (98)
Space heating efficiency (main heating system 1)	224.4000	224.4000	224.4000	224.4000	224.4000	0.0000	0.0000	0.0000	0.0000	224.4000	224.4000	224.4000 (210)
Space heating fuel (main heating system)	627.8236	472.0432	328.5109	111.3169	17.1245	0.0000	0.0000	0.0000	0.0000	148.2057	406.1657	641.8059 (211)
Water heating requirement	240.8267	181.0709	126.0134	42.7000	6.5688	0.0000	0.0000	0.0000	0.0000	56.8502	155.8010	246.1902 (215)
Water heating												
Water heating requirement	199.5762	158.3838	138.0639	83.5621	53.5551	27.7465	23.7060	53.2111	83.5158	136.6261	172.9153	198.8997 (64)
Efficiency of water heater	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000 (216)
(217)m	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000 (217)
Fuel for water heating, kWh/month	88.9377	70.5810	61.5258	37.2380	23.8659	12.3648	10.5642	23.7126	37.2174	60.8851	77.0567	88.6362 (219)
Water heating fuel used												592.5854 (219)
Annual totals kWh/year												
Space heating fuel - main system												2752.9964 (211)
Space heating fuel - secondary												1056.0212 (215)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9240)												
mechanical ventilation fans (SFP = 0.9240)												671.1464 (230a)
central heating pump												30.0000 (230c)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												751.1464 (231)
Electricity for lighting (calculated in Appendix L)												655.0997 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 3.00 * 1121 * 1.00) =									-2690.3476			-2690.3476 (233)
Wind generation												-3575.5408 (234)
Total delivered energy for all uses												-458.0392 (238)

10a. Fuel costs - using BEDF prices (477)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2752.9964	18.9000	520.3163 (240)
Space heating - secondary	1056.0212	4.9500	52.2730 (242)
Water heating (other fuel)	592.5854	18.9000	111.9986 (247)
Mechanical ventilation fans	671.1464	18.9000	126.8467 (249)
Pumps and fans for heating	30.0000	18.9000	5.6700 (249)
Pump for solar water heating	50.0000	18.9000	9.4500 (249)
Energy for lighting	655.0997	18.9000	123.8138 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-2690.3476	18.9000	-508.4757 (252)

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Wind Turbine	-3575.5408	18.9000	-675.7772 (252)
Total energy cost			-233.8844 (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	2752.9964	0.5190	1428.8051 (261)
Space heating - secondary	1056.0212	0.0190	20.0644 (263)
Water heating (other fuel)	592.5854	0.5190	307.5518 (264)
Space and water heating			1756.4214 (265)
Pumps and fans	751.1464	0.5190	389.8450 (267)
Energy for lighting	655.0997	0.5190	339.9968 (268)
Energy saving/generation technologies			
PV Unit	-2690.3476	0.5190	-1396.2904 (269)
Wind Turbine	-3575.5408	0.5190	-1855.7056 (269)
Total kg/year			-765.7329 (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	2752.9964	3.0700	8451.6990 (261)
Space heating - secondary	1056.0212	1.0400	1098.2620 (263)
Water heating (other fuel)	592.5854	3.0700	1819.2372 (264)
Space and water heating			11369.1982 (265)
Pumps and fans	751.1464	3.0700	2306.0196 (267)
Energy for lighting	655.0997	3.0700	2011.1561 (268)
Energy saving/generation technologies			
PV Unit	-2690.3476	3.0700	-8259.3670 (269)
Wind Turbine	-3575.5408	3.0700	-10976.9101 (269)
Primary energy kWh/year			-3549.9032 (272)
Primary energy kWh/m2/year			-14.3779 (273)