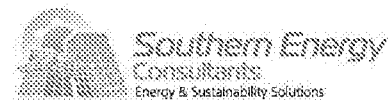


FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECANG005F		Issued on Date	04/02/2021	
Assessment Reference	001	Prop Type Ref	Det Br Re Ea Ga		
Property	Lockwood Corner, Plot 77				
SAP Rating	83 B	DER	18.72	TET	19.08
Environmental	85 B	% DER<TER	1.88		
CO ₂ Emissions (t/year)	1.42	DPEE	55.00	TPEE	59.33
General Requirements Compliance	Pass	% DPEE<TPEE	7.30		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey, [REDACTED]			Assessor ID	T555-0001
Client	Persimmon Homes Thames Valley				

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 92 m²

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

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.08 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.72 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)59.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)55.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.30 (max. 0.35)	OK
Openings	1.34 (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: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

No cylinder

Boiler interlock

Yes OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

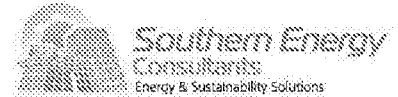
Overshading: Average
Windows facing North East: 5.16 m², No overhang
Windows facing South East: 0.48 m², No overhang
Windows facing South West: 3.93 m², No overhang
Windows facing North West: 6.97 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K

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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1804 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.4304 (18)	
Number of sides sheltered				2 (19)	
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3658 (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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298 (22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (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	44.5528	44.2437	43.9407	42.5176	42.2513	41.0119	41.0119	40.7823	41.4893	42.2513	42.7900	43.3531 (38)
Heat transfer coeff	123.9763	123.6672	123.3642	121.9411	121.6749	120.4354	120.4354	120.2059	120.9128	121.6749	122.2135	122.7766 (39)
Average = Sum(39)m / 12 =												121.9399 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3532	1.3498	1.3465	1.3309	1.3280	1.3145	1.3145	1.3120	1.3197	1.3280	1.3339	1.3401 (40)
HLP (average)												1.3309 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1527.3239 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (46)
Water storage loss:											
Total storage loss											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517 (61)
Total heat required for water heating calculated for each month											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (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 (63)
Solar input (sum of months) = Sum(63)m =	0.0000 (63)										
Output from w/h											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (64)
Heat gains from water heating, kWh/month											
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	54.5215 (65)
Total per year (kWh/year) = Sum(64)m =	1692.8195 (64)										

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	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.0274	19.5645	15.9109	12.0456	9.0042	7.6018	8.2140	10.6768	14.3304	18.1957	21.2371	22.6396	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.0267	244.5382	238.2094	224.7360	207.7283	191.7434	181.0646	178.5531	184.8819	198.3553	215.3630	231.3479	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815	(72)
Total internal gains	405.2814	403.0836	388.4352	364.7507	340.5809	317.3937	302.4005	308.6676	320.8965	344.8027	372.2646	392.9778	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W		
Northeast				5.1600	11.2829	0.4400	0.0000	0.7700		19.7249 (75)		
Southeast				0.4800	36.7938	0.4400	0.0000	0.7700		5.9836 (77)		
Southwest				3.9300	36.7938	0.4400	0.0000	0.7700		48.9904 (79)		
Northwest				6.9700	11.2829	0.4400	0.0000	0.7700		26.6439 (81)		
Solar gains	101.3428	188.0262	298.1758	438.0258	553.2144	576.7446	544.5863	454.4415	345.9420	218.8394	124.1902	84.9134 (83)
Total gains	506.6243	591.1098	686.6110	802.7766	893.7953	894.1383	846.9868	763.1091	666.8385	563.6421	496.4548	477.8912 (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	39.6597	39.7589	39.8565	40.3216	40.4099	40.8258	40.8258	40.9037	40.6646	40.4099	40.2318	40.0473
alpha	3.6440	3.6506	3.6571	3.6881	3.6940	3.7217	3.7217	3.7269	3.7110	3.6940	3.6821	3.6698
util living area	0.9955	0.9916	0.9812	0.9487	0.8687	0.7262	0.5797	0.6478	0.8659	0.9714	0.9923	0.9964 (86)
MIT	19.1277	19.3192	19.6650	20.1425	20.5731	20.8536	20.9531	20.9293	20.6907	20.1371	19.5521	19.0980 (87)
Th 2	19.7994	19.8020	19.8046	19.8167	19.8189	19.8295	19.8295	19.8314	19.8254	19.8189	19.8144	19.8096 (88)
util rest of house	0.9943	0.9892	0.9756	0.9322	0.8245	0.6345	0.4451	0.5140	0.8022	0.9592	0.9898	0.9954 (89)
MIT 2	17.3167	17.5974	18.1010	18.7912	19.3771	19.7192	19.8084	19.7957	19.5480	18.7960	17.9462	17.2796 (90)
Living area fraction	fLA = Living area / (4) =											0.1914 (91)
MIT	17.6634	17.9270	18.4004	19.0499	19.6061	19.9364	20.0276	20.0127	19.7667	19.0528	18.2536	17.6277 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.5134	17.7770	18.2504	18.8999	19.4561	19.7864	19.8776	19.8627	19.6167	18.9028	18.1036	17.4777 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9904	0.9830	0.9647	0.9149	0.8078	0.6307	0.4511	0.5180	0.7879	0.9453	0.9838	0.9921	(94)	
Useful gains	501.7417	581.0331	662.3607	734.4549	722.0147	563.9175	382.0965	395.2814	525.3690	532.7832	488.3942	474.1381	(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	1638.1457	1592.4605	1449.5843	1219.4010	943.7192	624.6218	394.7374	416.2372	667.0434	1010.2368	1344.7936	1630.1919	(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	845.4846	679.6792	585.6944	349.1612	164.9482	0.0000	0.0000	0.0000	0.0000	355.2255	616.6076	860.1040	(98)	
Space heating												4456.9046	(98)	
Space heating per m2												(98) / (4) =	48.6455	(99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4924.7565 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	845.4846	679.6792	585.6944	349.1612	164.9482	0.0000	0.0000	0.0000	0.0000	355.2255	616.6076	860.1040	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	934.2371	751.0268	647.1761	385.8135	182.2632	0.0000	0.0000	0.0000	0.0000	392.5144	681.3343	950.3912	(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	172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789	(64)
Efficiency of water heater (217)m	89.9414	89.9002	89.8041	89.5690	89.0396	87.3000	87.3000	87.3000	87.3000	89.5558	89.8389	87.3000	(216)
Fuel for water heating, kWh/month	191.7776	168.2447	174.8364	154.2868	150.0131	133.6702	125.4920	141.6911	142.6987	160.1629	172.3867	186.1652	(219)
Water heating fuel used												1901.4253	(219)
Annual totals kWh/year													
Space heating fuel - main system												4924.7565	(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)												389.0105	(232)
Total delivered energy for all uses												7290.1923	(238)

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

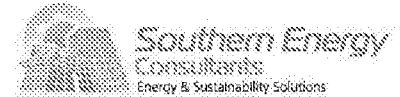
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4924.7565	0.2160	1063.7474	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1901.4253	0.2160	410.7079	(264)
Space and water heating			1474.4553	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	389.0105	0.5190	201.8964	(268)
Total CO2, kg/year			1715.2767	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.7200	(273)

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

DER		18.7200	ZC1
Total Floor Area	TFA	91.6200	
Assumed number of occupants	N	2.6473	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.6538	ZC2
CO2 emissions from cooking, equation (L16)		1.9923	ZC3
Total CO2 emissions		36.3661	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		36.3661	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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1353 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3853 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3275 (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	0.4175	0.4094	0.4012	0.3602	0.3520	0.3111	0.3111	0.3029	0.3275	0.3520	0.3684	0.3848 (22b)
Effective ac	0.5872	0.5838	0.5805	0.5649	0.5620	0.5484	0.5484	0.5459	0.5536	0.5620	0.5679	0.5740 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Semi-glazed door			2.1500	1.2000	2.5800		(26a)
TER Opening Type (Uw = 1.40)			16.5400	1.3258	21.9280		(27)
Heat Loss Floor 1			45.5700	0.1300	5.9241		(28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.1800	20.5920		(29a)
Main Plane	45.5700		45.5700	0.1300	5.9241		(30)
Bay Roof/GRP	0.5300		0.5300	0.1300	0.0689		(30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		59.1671		(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)							11.5960 (36)
Total fabric heat loss						(33) + (36) =	70.7631 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	42.9721	42.7244	42.4816	41.3411	41.1277	40.1343	40.1343	39.9504	40.5169	41.1277	41.5593	42.0106 (38)
Heat transfer coeff	113.7352	113.4875	113.2447	112.1042	111.8908	110.8974	110.8974	110.7135	111.2801	111.8908	112.3225	112.7738 (39)
Average = Sum(39)m / 12 =												112.1032 (39)
HLP	1.2414	1.2387	1.2360	1.2236	1.2212	1.2104	1.2104	1.2084	1.2146	1.2212	1.2260	1.2309 (40)
HLP (average)												1.2236 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)
Energy content (annual)										Total = Sum(45)m =		1527.3239 (45)
Distribution loss (46)m = 0.15 x (45)m												
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (46)	
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.4563	46.9138	46.4989	43.0841	44.5202	46.4989	46.9138	50.4563	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	209.3097	184.5220	193.3703	171.5097	166.0517	146.2491	140.1177	156.1984	157.9235	179.8274	190.5337	204.3132 (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	209.3097	184.5220	193.3703	171.5097	166.0517	146.2491	140.1177	156.1984	157.9235	179.8274	190.5337	204.3132 (64)
Heat gains from water heating, kWh/month	65.3914	57.5563	60.1330	53.1566	51.3760	45.0734	42.9162	48.0998	48.6392	55.6300	59.2840	63.7300 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 2099.9266 (64)												

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)
(66)m	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.0274	19.5645	15.9109	12.0456	9.0042	7.6018	8.2140	10.6768	14.3304	18.1957	21.2371	22.6396	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.0267	244.5382	238.2094	224.7360	207.7283	191.7434	181.0646	178.5531	184.8819	198.3553	215.3630	231.3479	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	87.8916	85.6493	80.8239	73.8286	69.0538	62.6019	57.6831	64.6503	67.5544	74.7714	82.3388	85.6586	(72)
Total internal gains	417.6545	415.4608	400.6530	376.3190	351.4951	327.6559	312.6704	319.5890	332.4755	357.0313	384.6477	405.3549	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	5.1600	11.2829	0.6300	0.7000		17.7928 (75)
Southeast	0.4800	36.7938	0.6300	0.7000		5.3974 (77)
Southwest	3.9300	36.7938	0.6300	0.7000		44.1916 (79)
Northwest	6.9700	11.2829	0.6300	0.7000		24.0340 (81)

Solar gains	91.4158	169.6082	268.9681	395.1192	499.0245	520.2499	491.2416	409.9269	312.0554	197.4031	112.0252	76.5958 (83)
Total gains	509.0703	585.0689	669.6211	771.4382	850.5196	847.9057	803.9120	729.5159	644.5309	554.4344	496.6729	481.9506 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.9413	56.0634	56.1836	56.7552	56.8635	57.3728	57.3728	57.4682	57.1756	56.8635	56.6449	56.4183	
alpha	4.7294	4.7376	4.7456	4.7837	4.7909	4.8249	4.8249	4.8312	4.8117	4.7909	4.7763	4.7612	
util living area	0.9986	0.9969	0.9916	0.9699	0.8991	0.7474	0.5843	0.6558	0.8917	0.9848	0.9971	0.9989	(86)
MIT	19.5974	19.7452	20.0129	20.3847	20.7209	20.9229	20.9815	20.9687	20.8043	20.3750	19.9222	19.5724	(87)
Th 2	19.8870	19.8892	19.8913	19.9012	19.9030	19.9117	19.9117	19.9133	19.9084	19.9030	19.8993	19.8954	(88)
util rest of house	0.9980	0.9958	0.9884	0.9575	0.8572	0.6532	0.4511	0.5209	0.8291	0.9765	0.9959	0.9985	(89)
MIT 2	18.0193	18.2367	18.6279	19.1684	19.6233	19.8594	19.9049	19.9000	19.7422	19.1627	18.5028	17.9885	(90)
Living area fraction	18.3215	18.5255	18.8931	19.4012	19.8334	20.0630	20.1110	20.1046	19.9455	19.3948	18.7745	18.2918	(91)
MIT	18.3215	18.5255	18.8931	19.4012	19.8334	20.0630	20.1110	20.1046	19.9455	19.3948	18.7745	18.2918	(92)
Temperature adjustment	18.3215	18.5255	18.8931	19.4012	19.8334	20.0630	20.1110	20.1046	19.9455	19.3948	18.7745	18.2918	(93)
adjusted MIT	18.3215	18.5255	18.8931	19.4012	19.8334	20.0630	20.1110	20.1046	19.9455	19.3948	18.7745	18.2918	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9938	0.9842	0.9500	0.8541	0.6676	0.4767	0.5464	0.8317	0.9710	0.9940	0.9976	(94)
Useful gains	507.5034	581.4155	659.0192	732.8848	726.3942	566.0548	383.1919	398.6332	536.0703	538.3605	493.6734	480.8041	(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	1594.7335	1546.3201	1403.4486	1177.2334	910.0550	605.8295	389.3576	410.1501	650.4914	984.0566	1311.3137	1589.1811	(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	808.8992	648.4159	553.8555	319.9310	136.6437	0.0000	0.0000	0.0000	0.0000	331.5979	588.7010	824.6325	(98)
Space heating												4212.6767	(98)
Space heating per m2												45.9799	(99)
										(98) / (4) =			

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4510.3605 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	808.8992	648.4159	553.8555	319.9310	136.6437	0.0000	0.0000	0.0000	0.0000	331.5979	588.7010	824.6325	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	866.0591	694.2354	592.9930	342.5385	146.2994	0.0000	0.0000	0.0000	0.0000	355.0299	630.3009	882.9042	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	209.3097	184.5220	193.3703	171.5097	166.0517	146.2491	140.1177	156.1984	157.9235	179.8274	190.5337	204.3132	(64)
Efficiency of water heater (217)m	88.1215	87.9494	87.5503	86.5987	84.5651	80.3000	80.3000	80.3000	80.3000	86.5713	87.7027	88.1973	(217)
Fuel for water heating, kWh/month	237.5239	209.8048	220.8677	198.0512	196.3596	182.1283	174.4928	194.5186	196.6669	207.7217	217.2494	231.6549	(219)
Water heating fuel used												2467.0399	(219)
Annual totals kWh/year													
Space heating fuel - main system												4510.3605	(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)												389.0105	(232)
Total delivered energy for all uses												7441.4110	(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	4510.3605	0.2160	974.2379 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2467.0399	0.2160	532.8806 (264)
Space and water heating			1507.1185 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	389.0105	0.5190	201.8964 (268)
Total CO2, kg/m2/year			1747.9399 (272)
Emissions per m2 for space and water heating			16.4497 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2036 (272b)
Emissions per m2 for pumps and fans			0.4249 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.4497 * 1.00) + 2.2036 + 0.4249, rounded to 2 d.p.			19.0800 (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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1353 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3853 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3275 (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	0.4175	0.4094	0.4012	0.3602	0.3520	0.3111	0.3111	0.3029	0.3275	0.3520	0.3684	0.3848 (22b)
Effective ac	0.5872	0.5838	0.5805	0.5649	0.5620	0.5484	0.5484	0.5459	0.5536	0.5620	0.5679	0.5740 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			9.0000	410.1300 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17290.5900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							188.7207 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (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	42.9721	42.7244	42.4816	41.3411	41.1277	40.1343	40.1343	39.9504	40.5169	41.1277	41.5593	42.0106 (38)
Heat transfer coeff	122.3957	122.1479	121.9051	120.7646	120.5512	119.5579	119.5579	119.3739	119.9405	120.5512	120.9829	121.4342 (39)
Average = Sum(39)m / 12 =												120.7636 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3359	1.3332	1.3306	1.3181	1.3158	1.3049	1.3049	1.3029	1.3091	1.3158	1.3205	1.3254 (40)
HLP (average)												1.3181 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6473 (42)
Average daily hot water use (litres/day)	97.0722 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1527.3239 (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	33.6495	29.4301	30.3692	26.4766	25.4050	21.9226	20.3145	23.3111	23.5896	27.4914	30.0090	32.5878 (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)
(66)m	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.0274	19.5645	15.9109	12.0456	9.0042	7.6018	8.2140	10.6768	14.3304	18.1957	21.2371	22.6396	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.0267	244.5382	238.2094	224.7360	207.7283	191.7434	181.0646	178.5531	184.8819	198.3553	215.3630	231.3479	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	45.2279	43.7948	40.8189	36.7731	34.1465	30.4480	27.3044	31.3322	32.7633	36.9507	41.6791	43.8008	(72)
Total internal gains	371.9908	370.6063	357.6479	336.2635	313.5877	292.5019	279.2917	283.2709	294.6844	316.2106	340.9880	360.4970	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W
Northeast				5.1600	11.2829	0.4400	0.0000	0.7700		19.7249 (75)
Southeast				0.4800	36.7938	0.4400	0.0000	0.7700		5.9836 (77)
Southwest				3.9300	36.7938	0.4400	0.0000	0.7700		48.9904 (79)
Northwest				6.9700	11.2829	0.4400	0.0000	0.7700		26.6439 (81)
Solar gains	101.3428	188.0262	298.1758	438.0258	553.2144	576.7446	544.5863	454.4415	345.9420	218.8394 124.1902 84.9134 (83)
Total gains	473.3336	558.6325	655.8237	774.2893	866.8021	869.2466	823.8780	737.7124	640.6264	535.0500 465.1782 445.4104 (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	39.2411	39.3207	39.3990	39.7711	39.8415	40.1725	40.1725	40.2344	40.0444	39.8415	39.6993	39.5518	
alpha	3.6161	3.6214	3.6266	3.6514	3.6561	3.6782	3.6782	3.6823	3.6696	3.6561	3.6466	3.6368	
util living area	0.9961	0.9925	0.9826	0.9512	0.8732	0.7335	0.5880	0.6587	0.8734	0.9740	0.9933	0.9969	(86)
MIT	19.0812	19.2759	19.6279	20.1123	20.5536	20.8433	20.9489	20.9223	20.6710	20.1022	19.5069	19.0481	(87)
Th 2	19.8128	19.8149	19.8170	19.8267	19.8285	19.8370	19.8370	19.8385	19.8337	19.8285	19.8248	19.8210	(88)
util rest of house	0.9950	0.9904	0.9774	0.9356	0.8306	0.6435	0.4538	0.5260	0.8128	0.9631	0.9911	0.9961	(89)
MIT 2	18.0707	18.2661	18.6169	19.0977	19.5099	19.7549	19.8208	19.8109	19.6287	19.0966	18.5045	18.0437	(90)
Living area fraction	18.2642	18.4594	18.8104	19.2919	19.7097	19.9633	20.0368	20.0237	19.8283	19.2891	18.6964	18.2360	(92)
Temperature adjustment	18.2642	18.4594	18.8104	19.2919	19.7097	19.9633	20.0368	20.0237	19.8283	19.2891	18.6964	18.2360	(93)
adjusted MIT	18.2642	18.4594	18.8104	19.2919	19.7097	19.9633	20.0368	20.0237	19.8283	19.2891	18.6964	18.2360	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	470.0289	551.3542	637.0724	717.4208	715.4908	568.8564	394.3156	405.2704	520.4744	511.5718	459.5940	442.9073	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1709.1572	1656.2565	1500.7018	1254.9783	965.5799	641.2240	410.8966	432.5754	687.0522	1047.4814	1402.9652	1704.4463	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	921.9114	742.4943	642.5403	387.0414	186.0663	0.0000	0.0000	0.0000	0.0000	398.7168	679.2273	938.5850	(98)
Space heating												4896.5827	(98)
Space heating per m2												53.4445	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1123.8438	884.7281	907.2417	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.7836	0.8513	0.8089	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	880.5997	753.1624	733.8769	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1116.2295	1061.0902	962.1626	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	169.6535	229.0982	169.8445	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									FC = cooled area / (4) =			568.5963 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	42.4134	57.2746	42.4611	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												142.1491 (107)
Energy for space heating												1.5515 (108)
Energy for space cooling												53.4445 (99)
Total												1.5515 (108)
Dwelling Fabric Energy Efficiency (DFEE)												54.9960 (109)
												55.0 (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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1353 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3853 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3275 (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	0.4175	0.4094	0.4012	0.3602	0.3520	0.3111	0.3111	0.3029	0.3275	0.3520	0.3684	0.3848 (22b)
Effective ac	0.5872	0.5838	0.5805	0.5649	0.5620	0.5484	0.5484	0.5459	0.5536	0.5620	0.5679	0.5740 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Semi-glazed door			2.1500	1.2000	2.5800		(26a)
TER Opening Type (Uw = 1.40)			16.5400	1.3258	21.9280		(27)
Heat Loss Floor 1			45.5700	0.1300	5.9241		(28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.1800	20.5920		(29a)
Main Plane	45.5700		45.5700	0.1300	5.9241		(30)
Bay Roof/GRP	0.5300		0.5300	0.1300	0.0689		(30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.1671		(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)							11.5960 (36)
Total fabric heat loss						(33) + (36) =	70.7631 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	42.9721	42.7244	42.4816	41.3411	41.1277	40.1343	40.1343	39.9504	40.5169	41.1277	41.5593	42.0106 (38)
Heat transfer coeff	113.7352	113.4875	113.2447	112.1042	111.8908	110.8974	110.8974	110.7135	111.2801	111.8908	112.3225	112.7738 (39)
Average = Sum(39)m / 12 =												112.1032 (39)
HLP	1.2414	1.2387	1.2360	1.2236	1.2212	1.2104	1.2104	1.2084	1.2146	1.2212	1.2260	1.2309 (40)
HLP (average)												1.2236 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)
Energy content (annual)										Total = Sum(45)m =		1527.3239 (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												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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	33.6495	29.4301	30.3692	26.4766	25.4050	21.9226	20.3145	23.3111	23.5896	27.4914	30.0090	32.5878 (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	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.0274	19.5645	15.9109	12.0456	9.0042	7.6018	8.2140	10.6768	14.3304	18.1957	21.2371	22.6396	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.0267	244.5382	238.2094	224.7360	207.7283	191.7434	181.0646	178.5531	184.8819	198.3553	215.3630	231.3479	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	45.2279	43.7948	40.8189	36.7731	34.1465	30.4480	27.3044	31.3322	32.7633	36.9507	41.6791	43.8008	(72)
Total internal gains	371.9908	370.6063	357.6479	336.2635	313.5877	292.5019	279.2917	283.2709	294.6844	316.2106	340.9880	360.4970	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	5.1600	11.2829	0.6300	0.7000	0.7700	17.7928 (75)
Southeast	0.4800	36.7938	0.6300	0.7000	0.7700	5.3974 (77)
Southwest	3.9300	36.7938	0.6300	0.7000	0.7700	44.1916 (79)
Northwest	6.9700	11.2829	0.6300	0.7000	0.7700	24.0340 (81)

Solar gains	91.4158	169.6082	268.9681	395.1192	499.0245	520.2499	491.2416	409.9269	312.0554	197.4031	112.0252	76.5958	(83)
Total gains	463.4066	540.2145	626.6160	731.3827	812.6123	812.7518	770.5333	693.1978	606.7398	513.6137	453.0132	437.0928	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.9413	56.0634	56.1836	56.7552	56.8635	57.3728	57.3728	57.4682	57.1756	56.8635	56.6449	56.4183	
alpha	4.7294	4.7376	4.7456	4.7837	4.7909	4.8249	4.8249	4.8312	4.8117	4.7909	4.7763	4.7612	
util living area	0.9990	0.9978	0.9936	0.9753	0.9120	0.7678	0.6057	0.6820	0.9094	0.9888	0.9981	0.9993	(86)
MIT	19.5517	19.7006	19.9711	20.3495	20.6969	20.9131	20.9785	20.9630	20.7811	20.3364	19.8786	19.5273	(87)
Th 2	19.8870	19.8892	19.8913	19.9012	19.9030	19.9117	19.9117	19.9133	19.9084	19.9030	19.8993	19.8954	(88)
util rest of house	0.9987	0.9970	0.9911	0.9649	0.8736	0.6749	0.4695	0.5455	0.8530	0.9825	0.9972	0.9990	(89)
MIT 2	18.5662	18.7165	18.9876	19.3675	19.6926	19.8706	19.9062	19.9023	19.7779	19.3604	18.9025	18.5484	(90)
Living area fraction									fLA = Living area / (4) =			0.1914	(91)
MIT	18.7549	18.9049	19.1758	19.5555	19.8849	20.0702	20.1114	20.1053	19.9699	19.5472	19.0894	18.7358	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7549	18.9049	19.1758	19.5555	19.8849	20.0702	20.1114	20.1053	19.9699	19.5472	19.0894	18.7358	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	462.5719	538.0629	619.6461	702.5614	709.2457	560.7724	382.1170	396.2973	519.9691	503.1735	451.3578	436.5001	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1644.0281	1589.3819	1435.4726	1194.5269	915.8100	606.6297	389.4099	410.2321	653.2058	1001.1106	1346.6739	1639.2625	(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	879.0034	706.4864	606.9749	354.2152	153.6839	0.0000	0.0000	0.0000	0.0000	370.4652	644.6276	894.8552	(98)
Space heating												4610.3117	(98)
Space heating per m ²										(98) / (4) =		50.3199	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1042.4360	820.6411	841.4225	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8314	0.8986	0.8593	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	866.6596	737.3962	723.0549	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1050.1967	998.7392	910.1325	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

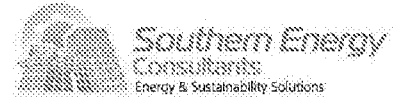


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	132.1467	194.4392	139.1858	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												465.7716 (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	33.0367	48.6098	34.7964	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												116.4429 (107)
Space cooling per m2												1.2709 (108)
Energy for space heating												50.3199 (99)
Energy for space cooling												1.2709 (108)
Total												51.5909 (109)
Target Fabric Energy Efficiency (TFEE)												59.3 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1804 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4304 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)]	=	0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20)	=	0.3658 (21)

	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	0.3841	0.3658	0.3658	0.3384	0.3384	0.3018	0.3109	0.2926	0.3018	0.3201	0.3201	0.3475 (22b)
Effective ac	0.5738	0.5669	0.5669	0.5572	0.5572	0.5455	0.5483	0.5428	0.5455	0.5512	0.5512	0.5604 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (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	41.9912	41.4893	41.4893	40.7823	40.7823	39.9254	40.1304	39.7265	39.9254	40.3416	40.3416	41.0119 (38)
Heat transfer coeff	121.4147	120.9128	120.9128	120.2059	120.2059	119.3489	119.5540	119.1500	119.3489	119.7652	119.7652	120.4354 (39)
Average = Sum(39)m / 12 =												120.0850 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3252	1.3197	1.3197	1.3120	1.3120	1.3027	1.3049	1.3005	1.3027	1.3072	1.3072	1.3145 (40)
HLP (average)												1.3107 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1527.3239 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (46)
Water storage loss:											
Total storage loss											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517 (61)
Total heat required for water heating calculated for each month											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (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 (63)
Solar input (sum of months) = Sum(63)m =	0.0000 (63)										
Output from w/h											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (64)
RHI water heating demand											
Heat gains from water heating, kWh/month											
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	54.5215 (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	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.0685	48.9113	39.7774	30.1140	22.5106	19.0044	20.5349	26.6920	35.8260	45.4893	53.0928	56.5990 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	361.2339	364.9824	355.5364	335.4268	310.0422	286.1842	270.2456	266.4971	275.9432	296.0527	321.4373	345.2953 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308 (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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900 (71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815 (72)
Total internal gains	601.2967	596.6416	573.3956	537.2770	500.1682	467.0041	447.6695	456.3939	477.2204	513.5607	553.9616	584.6516 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
Northeast				5.1600	12.9236	0.4400	0.0000	0.7700	22.5931 (75)			
Southeast				0.4800	40.4699	0.4400	0.0000	0.7700	6.5814 (77)			
Southwest				3.9300	40.4699	0.4400	0.0000	0.7700	53.8850 (79)			
Northwest				6.9700	12.9236	0.4400	0.0000	0.7700	30.5182 (81)			
Solar gains	113.5776	190.4495	300.1130	456.2070	561.8169	626.6262	585.3958	499.4871	378.1855	237.2169	142.7650	94.1359 (83)
Total gains	714.8744	787.0912	873.5087	993.4840	1061.9851	1093.6304	1033.0653	955.8809	855.4059	750.7776	696.7266	678.7875 (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)												
tau	40.4965	40.6646	40.6646	40.9037	40.9037	41.1974	41.1267	41.2662	41.1974	41.0542	41.0542	Dec
alpha	3.6998	3.7110	3.7110	3.7269	3.7269	3.7465	3.7418	3.7511	3.7465	3.7369	3.7369	3.7217
util living area	0.9839	0.9759	0.9528	0.8868	0.7477	0.5185	0.3538	0.3912	0.6990	0.9141	0.9720	0.9863 (86)
MIT	19.5241	19.6828	20.0221	20.4534	20.7978	20.9641	20.9938	20.9911	20.8861	20.4694	19.9379	19.4987 (87)
Th 2	19.8211	19.8254	19.8254	19.8314	19.8314	19.8388	19.8370	19.8405	19.8388	19.8352	19.8352	19.8295 (88)
util rest of house	0.9795	0.9694	0.9393	0.8542	0.6777	0.4094	0.2235	0.2532	0.5960	0.8813	0.9629	0.9825 (89)
MIT 2	17.9061	18.1376	18.6229	19.2216	19.6521	19.8204	19.8358	19.8386	19.7612	19.2611	18.5151	17.8749 (90)
Living area fraction												
MIT	18.2159	18.4334	18.8907	19.4574	19.8715	20.0393	20.0575	20.0592	19.9765	19.4924	18.7874	18.1858 (92)
Temperature adjustment												
adjusted MIT	18.0659	18.2834	18.7407	19.3074	19.7215	19.8893	19.9075	19.9092	19.8265	19.3424	18.6374	-0.1500 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9698	0.9572	0.9227	0.8363	0.6702	0.4144	0.2316	0.2616	0.5948	0.8632	0.9496	0.9739 (94)
Useful gains	693.3137	753.4008	805.9562	830.8039	711.7734	453.2243	239.2215	250.0753	508.7627	648.0852	661.6158	661.0424 (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	1574.2459	1533.5897	1371.2395	1130.8293	807.9581	464.1870	240.0048	251.3117	552.1722	927.2691	1273.9951	1557.9271 (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	655.4136	524.2869	420.5707	216.0183	71.5614	0.0000	0.0000	0.0000	0.0000	207.7128	440.9131	667.2822 (98)
Space heating												3203.7590 (98)
RHI space heating demand												3204 (98)

FULL SAP CALCULATION PRINTOUT

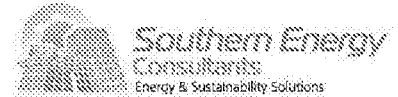
Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1804 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4304 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3658 (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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298 (22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (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	44.5528	44.2437	43.9407	42.5176	42.2513	41.0119	41.0119	40.7823	41.4893	42.2513	42.7900	43.3531 (38)
Heat transfer coeff	123.9763	123.6672	123.3642	121.9411	121.6749	120.4354	120.4354	120.2059	120.9128	121.6749	122.2135	122.7766 (39)
Average = Sum(39)m / 12 =												121.9399 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3532	1.3498	1.3465	1.3309	1.3280	1.3145	1.3145	1.3120	1.3197	1.3280	1.3339	1.3401 (40)
HLP (average)												1.3309 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1527.3239 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (46)
Water storage loss:											
Total storage loss											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517 (61)
Total heat required for water heating calculated for each month											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (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 (63)
Solar input (sum of months) = Sum(63)m =	0.0000 (63)										
Output from w/h											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (64)
Heat gains from water heating, kWh/month											
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	54.5215 (65)
Total per year (kWh/year) = Sum(64)m =	1692.8195 (64)										

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	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.0685	48.9113	39.7774	30.1140	22.5106	19.0044	20.5349	26.6920	35.8260	45.4893	53.0928	56.5990	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	361.2339	364.9824	355.5364	335.4268	310.0422	286.1842	270.2456	266.4971	275.9432	296.0527	321.4373	345.2953	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815	(72)
Total internal gains	601.2967	596.6416	573.3956	537.2770	500.1682	467.0041	447.6695	456.3939	477.2204	513.5607	553.9616	584.6516	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
Northeast				5.1600	11.2829	0.4400	0.0000	0.7700	19.7249 (75)			
Southeast				0.4800	36.7938	0.4400	0.0000	0.7700	5.9836 (77)			
Southwest				3.9300	36.7938	0.4400	0.0000	0.7700	48.9904 (79)			
Northwest				6.9700	11.2829	0.4400	0.0000	0.7700	26.6439 (81)			
Solar gains	101.3428	188.0262	298.1758	438.0258	553.2144	576.7446	544.5863	454.4415	345.9420	218.8394	124.1902	84.9134 (83)
Total gains	702.6395	784.6678	871.5714	975.3028	1053.3826	1043.7488	992.2558	910.8354	823.1623	732.4001	678.1518	669.5650 (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	39.6597	39.7589	39.8565	40.3216	40.4099	40.8258	40.8258	40.9037	40.6646	40.4099	40.2318	40.0473
alpha	3.6440	3.6506	3.6571	3.6881	3.6940	3.7217	3.7217	3.7269	3.7110	3.6940	3.6821	3.6698
util living area	0.9870	0.9795	0.9617	0.9140	0.8142	0.6564	0.5086	0.5661	0.7930	0.9395	0.9793	0.9891 (86)
MIT	19.3539	19.5374	19.8619	20.2984	20.6707	20.8967	20.9696	20.9550	20.7814	20.3060	19.7579	19.3211 (87)
Th 2	19.7994	19.8020	19.8046	19.8167	19.8189	19.8295	19.8295	19.8314	19.8254	19.8189	19.8144	19.8096 (88)
util rest of house	0.9836	0.9741	0.9511	0.8894	0.7610	0.5632	0.3846	0.4396	0.7149	0.9169	0.9728	0.9862 (89)
MIT 2	17.6448	17.9120	18.3801	19.0007	19.4911	19.7554	19.8165	19.8101	19.6424	19.0264	18.2422	17.6038 (90)
Living area fraction	fLA = Living area / (4) =											0.1914 (91)
MIT	17.9720	18.2232	18.6638	19.2492	19.7169	19.9739	20.0373	20.0293	19.8604	19.2714	18.5324	17.9325 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8220	18.0732	18.5138	19.0992	19.5669	19.8239	19.8873	19.8793	19.7104	19.1214	18.3824	17.7825 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9751	0.9627	0.9354	0.8705	0.7478	0.5627	0.3910	0.4452	0.7059	0.8989	0.9613	0.9787 (94)
Useful gains	685.1656	755.4333	815.3110	849.0416	787.7007	587.3267	388.0149	405.4728	581.0493	658.3692	651.9405	655.2874 (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	1676.4103	1629.0926	1482.0679	1243.6977	957.2040	629.1384	395.9052	418.2311	678.3717	1036.8382	1378.8602	1667.6177 (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	737.4861	587.0991	496.0671	284.1524	126.1104	0.0000	0.0000	0.0000	0.0000	281.5810	523.3822	753.1737 (98)
Space heating												3789.0520 (98)
Space heating per m2												(98) / (4) = 41.3562 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

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 %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4186.7978	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	737.4861	587.0991	496.0671	284.1524	126.1104	0.0000	0.0000	0.0000	0.0000	281.5810	523.3822	753.1737	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	814.9018	648.7282	548.1405	313.9805	139.3485	0.0000	0.0000	0.0000	0.0000	311.1392	578.3229	832.2362	(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	172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789	(64)
Efficiency of water heater	89.8755	89.8255	89.7094	89.4274	88.8253	87.3000	87.3000	87.3000	87.3000	89.3942	89.7488	87.3000	(216)
(217)m	89.8755	89.8255	89.7094	89.4274	88.8253	87.3000	87.3000	87.3000	87.3000	89.3942	89.7488	89.9005	(217)
Fuel for water heating, kWh/month	191.9181	168.3846	175.0209	154.5311	150.3752	133.6702	125.4920	141.6911	142.6987	160.4524	172.5598	186.2936	(219)
Water heating fuel used												1903.0875	(219)
Annual totals kWh/year													
Space heating fuel - main system												4186.7978	(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)												389.0105	(232)
Total delivered energy for all uses												6553.8957	(238)

10a. Fuel costs - using Table 12 prices

	Fuel	Fuel price	Fuel cost	
	kWh/year	p/kWh	£/year	
Space heating - main system 1	4186.7978	3.4800	145.7006	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1903.0875	3.4800	66.2274	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	389.0105	13.1900	51.3105	(250)
Additional standing charges			120.0000	(251)
Total energy cost			393.1310	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF)	1.2086	(257)
SAP value	83.1404	
SAP rating (Section 12)	83	(258)
SAP band	B	

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

	Energy	Emission factor	Emissions	
	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	4186.7978	0.2160	904.3483	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1903.0875	0.2160	411.0669	(264)
Space and water heating			1315.4152	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	389.0105	0.5190	201.8964	(268)
Total kg/year			1556.2367	(272)
CO2 emissions per m2			16.9900	(273)
EI value			84.7361	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4
Water heating energy efficiency	$3.48 / 0.8883 = 3.918$, stars = 4
Water heating environmental impact	$0.216 / 0.8883 = 0.2432$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1804 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4304 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3658 (21)

	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	0.3841	0.3658	0.3658	0.3384	0.3384	0.3018	0.3109	0.2926	0.3018	0.3201	0.3201	0.3475 (22b)
Effective ac	0.5738	0.5669	0.5669	0.5572	0.5572	0.5455	0.5483	0.5428	0.5455	0.5512	0.5512	0.5604 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (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	41.9912	41.4893	41.4893	40.7823	40.7823	39.9254	40.1304	39.7265	39.9254	40.3416	40.3416	41.0119 (38)
Heat transfer coeff	121.4147	120.9128	120.9128	120.2059	120.2059	119.3489	119.5540	119.1500	119.3489	119.7652	119.7652	120.4354 (39)
Average = Sum(39)m / 12 =												120.0850 (39)
HLP	1.3252	1.3197	1.3197	1.3120	1.3120	1.3027	1.3049	1.3005	1.3027	1.3072	1.3072	1.3145 (40)
HLP (average)												1.3107 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

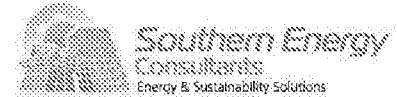
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Energy content (annual)	Total = Sum(45)m = 1527.3239 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (46)
Water storage loss:											
Total storage loss											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517 (61)
Total heat required for water heating calculated for each month											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (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 (63)
Solar input (sum of months) = Sum(63)m =	0.0000 (63)										
Output from w/h											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (64)
Heat gains from water heating, kWh/month											
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	54.5215 (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	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.0685	48.9113	39.7774	30.1140	22.5106	19.0044	20.5349	26.6920	35.8260	45.4893	53.0928	56.5990	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	361.2339	364.9824	355.5364	335.4268	310.0422	286.1842	270.2456	266.4971	275.9432	296.0527	321.4373	345.2953	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815	(72)
Total internal gains	601.2967	596.6416	573.3956	537.2770	500.1682	467.0041	447.6695	456.3939	477.2204	513.5607	553.9616	584.6516	(73)

6. Solar gains

[Jan]			Area m2		Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast			5.1600		12.9236		0.4400		0.0000		0.7700		22.5931 (75)
Southeast			0.4800		40.4699		0.4400		0.0000		0.7700		6.5814 (77)
Southwest			3.9300		40.4699		0.4400		0.0000		0.7700		53.8850 (79)
Northwest			6.9700		12.9236		0.4400		0.0000		0.7700		30.5182 (81)
Solar gains	113.5776	190.4495	300.1130	456.2070	561.8169	626.6262	585.3958	499.4871	378.1855	237.2169	142.7650		94.1359 (83)
Total gains	714.8744	787.0912	873.5087	993.4840	1061.9851	1093.6304	1033.0653	955.8809	855.4059	750.7776	696.7266		678.7875 (84)

7. Mean internal temperature (heating season)

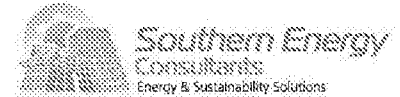
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	40.4965	40.6646	40.6646	40.9037	40.9037	41.1974	41.1267	41.2662	41.1974	41.0542	41.0542	40.8258
alpha	3.6998	3.7110	3.7110	3.7269	3.7269	3.7465	3.7418	3.7511	3.7465	3.7369	3.7369	3.7217
util living area	0.9839	0.9759	0.9528	0.8868	0.7477	0.5185	0.3538	0.3912	0.6990	0.9141	0.9720	0.9863 (86)
MIT	19.5241	19.6828	20.0221	20.4534	20.7978	20.9641	20.9938	20.9911	20.8861	20.4694	19.9379	19.4987 (87)
Th 2	19.8211	19.8254	19.8254	19.8314	19.8314	19.8388	19.8370	19.8405	19.8388	19.8352	19.8352	19.8295 (88)
util rest of house	0.9795	0.9694	0.9393	0.8542	0.6777	0.4094	0.2235	0.2532	0.5960	0.8813	0.9629	0.9825 (89)
MIT 2	17.9061	18.1376	18.6229	19.2216	19.6521	19.8204	19.8358	19.8386	19.7612	19.2611	18.5151	17.8749 (90)
Living area fraction	fLA = Living area / (4) =											0.1914 (91)
MIT	18.2159	18.4334	18.8907	19.4574	19.8715	20.0393	20.0575	20.0592	19.9765	19.4924	18.7874	18.1858 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.0659	18.2834	18.7407	19.3074	19.7215	19.8893	19.9075	19.9092	19.8265	19.3424	18.6374	18.0358 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9698	0.9572	0.9227	0.8363	0.6702	0.4144	0.2316	0.2616	0.5948	0.8632	0.9496	0.9739	(94)	
Useful gains	693.3137	753.4008	805.9562	830.8039	711.7734	453.2243	239.2215	250.0753	508.7627	648.0852	661.6158	661.0424	(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	1574.2459	1533.5897	1371.2395	1130.8293	807.9581	464.1870	240.0048	251.3117	552.1722	927.2691	1273.9951	1557.9271	(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	655.4136	524.2869	420.5707	216.0183	71.5614	0.0000	0.0000	0.0000	0.0000	207.7128	440.9131	667.2822	(98)	
Space heating												3203.7590	(98)	
Space heating per m2												(98) / (4) =	34.9679	(99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

8c. Space cooling requirement

Not applicable

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

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 %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3540.0652 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	655.4136	524.2869	420.5707	216.0183	71.5614	0.0000	0.0000	0.0000	0.0000	207.7128	440.9131	667.2822	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	724.2139	579.3226	464.7190	238.6942	79.0734	0.0000	0.0000	0.0000	0.0000	229.5169	487.1968	737.3284	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789	(64)
Efficiency of water heater (217)m	89.8141	89.7633	89.6071	89.2240	88.3903	87.3000	87.3000	87.3000	87.3000	89.1650	89.6458	87.3000	(216)
Fuel for water heating, kWh/month	192.0494	168.5013	175.2207	154.8834	151.1151	133.6702	125.4920	141.6911	142.6987	160.8648	172.7580	186.4205	(219)
Water heating fuel used													1905.3652 (219)
Annual totals kWh/year													
Space heating fuel - main system													3540.0652 (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)													389.0105 (232)
Total delivered energy for all uses													5909.4410 (238)

10a. Fuel costs - using BEDF prices (470)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3540.0652	3.8700	137.0005 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1905.3652	3.8700	73.7376 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	389.0105	18.9000	73.5230 (250)
Additional standing charges			93.0000 (251)
Total energy cost			391.4361 (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	3540.0652	0.2160	764.6541 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1905.3652	0.2160	411.5589 (264)
Space and water heating			1176.2130 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	389.0105	0.5190	201.8964 (268)
Total kg/year			1417.0344 (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	3540.0652	1.2200	4318.8796 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1905.3652	1.2200	2324.5456 (264)
Space and water heating			6643.4252 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	389.0105	3.0700	1194.2622 (268)
Primary energy kWh/year			8067.9374 (272)
Primary energy kWh/m2/year			88.0587 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 83
Current environmental impact rating: B 85

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-187 kg (13.2%)
U Solar photovoltaic panels	+ 9.8	-£ 345	-947 kg (76.9%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£29	2.04 kg/m²	B 84 B 87
Solar photovoltaic panels	£345	10.33 kg/m²	A 94 A 95
Total Savings	£373	12.37 kg/m²	

Potential energy efficiency rating: A 94
 Potential environmental impact rating: A 95

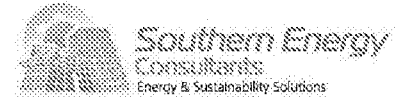
Fuel prices for cost data on this page from database revision number 470 TEST (21 Dec 2020)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£88	£97	-£9
Mains gas	£304	£266	£38
Space heating	£244	£244	£0
Water heating	£74	£45	£29
Lighting	£74	£74	£0
Generated (PV)	-£0	-£345	£345
Total cost of fuels	£392	£18	£374
Total cost of uses	£392	£18	£374
Delivered energy	64 kWh/m²	34 kWh/m²	30 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	12 kg/m²
Primary energy	88 kWh/m²	16 kWh/m²	73 kWh/m²

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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1804 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4304 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3658 (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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298 (22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (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	44.5528	44.2437	43.9407	42.5176	42.2513	41.0119	41.0119	40.7823	41.4893	42.2513	42.7900	43.3531 (38)
Heat transfer coeff	123.9763	123.6672	123.3642	121.9411	121.6749	120.4354	120.4354	120.2059	120.9128	121.6749	122.2135	122.7766 (39)
Average = Sum(39)m / 12 =												121.9399 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3532	1.3498	1.3465	1.3309	1.3280	1.3145	1.3145	1.3120	1.3197	1.3280	1.3339	1.3401 (40)
HLP (average)												1.3309 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

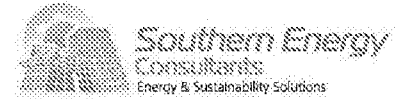
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1527.3239 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (46)
Water storage loss:											
Total storage loss											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517 (61)
Total heat required for water heating calculated for each month											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (62)
Aperture area of solar collector											
Zero-loss collector efficiency											
Collector heat loss coefficient											
Collector 2nd order heat loss coefficient											
Collector effective heat loss coefficient											
Collector performance ratio											
Annual solar radiation per m2											
Overshading factor											
Solar energy available											
Adjustment factor for showers											
Solar-to-load ratio											
Utilisation factor											
Collector performance factor											
Dedicated solar storage volume											
Effective solar volume											
Daily hot water demand											
Volume ratio Veff/V											
Solar storage volume factor											
Solar input											
Solar input	-24.9641	-41.6579	-70.9482	-95.0845	-117.4689	-115.4907	-113.9644	-99.5713	-77.9843	-53.2541	-29.6110 (63)
Output from w/h											
147.5233	109.5944	86.0621	43.1087	16.1022	1.2034	0.0000	24.1250	46.5916	90.1810	125.2594	146.5882 (64)
Heat gains from water heating, kWh/month											
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	54.5215 (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	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.0685	48.9113	39.7774	30.1140	22.5106	19.0044	20.5349	26.6920	35.8260	45.4893	53.0928	56.5990	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	361.2339	364.9824	355.5364	335.4268	310.0422	286.1842	270.2456	266.4971	275.9432	296.0527	321.4373	345.2953	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815	(72)
Total internal gains	601.2967	596.6416	573.3956	537.2770	500.1682	467.0041	447.6695	456.3939	477.2204	513.5607	553.9616	584.6516	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	5.1600	11.2829	0.4400	0.0000	0.7700	19.7249 (75)
Southeast	0.4800	36.7938	0.4400	0.0000	0.7700	5.9836 (77)
Southwest	3.9300	36.7938	0.4400	0.0000	0.7700	48.9904 (79)
Northwest	6.9700	11.2829	0.4400	0.0000	0.7700	26.6439 (81)

Solar gains	101.3428	188.0262	298.1758	438.0258	553.2144	576.7446	544.5863	454.4415	345.9420	218.8394	124.1902	84.9134 (83)
Total gains	702.6395	784.6678	871.5714	975.3028	1053.3826	1043.7488	992.2558	910.8354	823.1623	732.4001	678.1518	669.5650 (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	39.6597	39.7589	39.8565	40.3216	40.4099	40.8258	40.8258	40.9037	40.6646	40.4099	40.2318	40.0473
alpha	3.6440	3.6506	3.6571	3.6881	3.6940	3.7217	3.7217	3.7269	3.7110	3.6940	3.6821	3.6698
util living area	0.9870	0.9795	0.9617	0.9140	0.8142	0.6564	0.5086	0.5661	0.7930	0.9395	0.9793	0.9891 (86)
MIT	19.3539	19.5374	19.8619	20.2984	20.6707	20.8967	20.9696	20.9550	20.7814	20.3060	19.7579	19.3211 (87)
Th 2	19.7994	19.8020	19.8046	19.8167	19.8189	19.8295	19.8295	19.8314	19.8254	19.8189	19.8144	19.8096 (88)
util rest of house	0.9836	0.9741	0.9511	0.8894	0.7610	0.5632	0.3846	0.4396	0.7149	0.9169	0.9728	0.9862 (89)
MIT 2	17.6448	17.9120	18.3801	19.0007	19.4911	19.7554	19.8165	19.8101	19.6424	19.0264	18.2422	17.6038 (90)
Living area fraction	fLA = Living area / (4) =											0.1914 (91)
MIT	17.9720	18.2232	18.6638	19.2492	19.7169	19.9739	20.0373	20.0293	19.8604	19.2714	18.5324	17.9325 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8220	18.0732	18.5138	19.0992	19.5669	19.8239	19.8873	19.8793	19.7104	19.1214	18.3824	17.7825 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Calculation of Energy Ratings for Improved Dwelling 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9751	0.9627	0.9354	0.8705	0.7478	0.5627	0.3910	0.4452	0.7059	0.8989	0.9613	0.9787	(94)
Useful gains	685.1656	755.4333	815.3110	849.0416	787.7007	587.3267	388.0149	405.4728	581.0493	658.3692	651.9405	655.2874	(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	1676.4103	1629.0926	1482.0679	1243.6977	957.2040	629.1384	395.9052	418.2311	678.3717	1036.8382	1378.8602	1667.6177	(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	737.4861	587.0991	496.0671	284.1524	126.1104	0.0000	0.0000	0.0000	0.0000	281.5810	523.3822	753.1737	(98)
Space heating												3789.0520	(98)
Space heating per m2											(98) / (4) =	41.3562	(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 %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4186.7978 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	737.4861	587.0991	496.0671	284.1524	126.1104	0.0000	0.0000	0.0000	0.0000	281.5810	523.3822	753.1737	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	814.9018	648.7282	548.1405	313.9805	139.3485	0.0000	0.0000	0.0000	0.0000	311.1392	578.3229	832.2362	(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	147.5233	109.5944	86.0621	43.1087	16.1022	1.2034	0.0000	24.1250	46.5916	90.1810	125.2594	146.5882	(64)
Efficiency of water heater	89.9504	89.9812	90.0122	90.0651	90.1259	87.3000	87.3000	87.3000	87.3000	89.7024	89.8639	89.9628	(216)
Fuel for water heating, kWh/month	164.0052	121.7971	95.6115	47.8639	17.8663	1.3784	0.0000	27.6346	53.3696	100.5335	139.3879	162.9432	(219)
Water heating fuel used												932.3913	(219)
Annual totals kWh/year													
Space heating fuel - main system												4186.7978	(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)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												389.0105	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3905.9601	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost f/year	
Space heating - main system 1	4186.7978	3.4800	145.7006	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	932.3913	3.4800	32.4472	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	389.0105	13.1900	51.3105	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			138.1229	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4246	(257)
SAP value		94.0765	
SAP rating (Section 12)		94	(258)
SAP band		A	

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4186.7978	0.2160	904.3483 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	932.3913	0.2160	201.3965 (264)
Space and water heating			1105.7448 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	389.0105	0.5190	201.8964 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			476.0790 (272)
CO2 emissions per m2			5.2000 (273)
EI value			95.3305
EI rating			95 (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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1804 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4304 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)]	=	0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20)	=	0.3658 (21)

	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	0.3841	0.3658	0.3658	0.3384	0.3384	0.3018	0.3109	0.2926	0.3018	0.3201	0.3201	0.3475 (22b)
Effective ac	0.5738	0.5669	0.5669	0.5572	0.5572	0.5455	0.5483	0.5428	0.5455	0.5512	0.5512	0.5604 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (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	41.9912	41.4893	41.4893	40.7823	40.7823	39.9254	40.1304	39.7265	39.9254	40.3416	40.3416	41.0119 (38)
Heat transfer coeff	121.4147	120.9128	120.9128	120.2059	120.2059	119.3489	119.5540	119.1500	119.3489	119.7652	119.7652	120.4354 (39)
Average = Sum(39)m / 12 =												120.0850 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3252	1.3197	1.3197	1.3120	1.3120	1.3027	1.3049	1.3005	1.3027	1.3072	1.3072	1.3145 (40)
HLP (average)												1.3107 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Energy content (annual)	Total = Sum(45)m = 1527.3239 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (46)
Water storage loss:											
Total storage loss											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517 (61)
Total heat required for water heating calculated for each month											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (62)
Aperture area of solar collector											
Zero-loss collector efficiency											3.0000 (H1)
Collector heat loss coefficient											0.7000 (H2)
Collector 2nd order heat loss coefficient											1.8000 (H3)
Collector effective heat loss coefficient											0.0050 (H3a)
Collector performance ratio											1.8063 (H3b)
Annual solar radiation per m2											2.5804 (H4)
Overshading factor											1140.0998 (H5)
Solar energy available											0.8000 (H6)
Adjustment factor for showers											1915.3676 (H7)
Solar-to-load ratio											1.0000 (H7a)
Utilisation factor											1.2541 (H8)
Collector performance factor											0.5495 (H9)
Dedicated solar storage volume											0.8793 (H10)
Effective solar volume											75.0000 (H11)
Daily hot water demand											75.0000 (H13)
Volume ratio Veff/V											97.0722 (H14)
Solar storage volume factor											0.7726 (H15)
Solar input											0.9484 (H16)
Solar input	-27.0155	-40.6042	-68.3826	-94.5257	-113.8407	-119.8124	-116.9355	-104.4241	-81.5034	-55.4452	-32.8380 (H17)
Output from w/h											
145.4719	110.6481	88.6276	43.6675	19.7304	0.0000	0.0000	19.2722	43.0725	87.9898	122.0324	145.0964 (64)
Heat gains from water heating, kWh/month											
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	54.5215 (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	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.0685	48.9113	39.7774	30.1140	22.5106	19.0044	20.5349	26.6920	35.8260	45.4893	53.0928	56.5990	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	361.2339	364.9824	355.5364	335.4268	310.0422	286.1842	270.2456	266.4971	275.9432	296.0527	321.4373	345.2953	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815	(72)
Total internal gains	601.2967	596.6416	573.3956	537.2770	500.1682	467.0041	447.6695	456.3939	477.2204	513.5607	553.9616	584.6516	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	5.1600	12.9236	0.4400	0.0000	0.7700	22.5931 (75)
Southeast	0.4800	40.4699	0.4400	0.0000	0.7700	6.5814 (77)
Southwest	3.9300	40.4699	0.4400	0.0000	0.7700	53.8850 (79)
Northwest	6.9700	12.9236	0.4400	0.0000	0.7700	30.5182 (81)

Solar gains	113.5776	190.4495	300.1130	456.2070	561.8169	626.6262	585.3958	499.4871	378.1855	237.2169	142.7650	94.1359 (83)
Total gains	714.8744	787.0912	873.5087	993.4840	1061.9851	1093.6304	1033.0653	955.8809	855.4059	750.7776	696.7266	678.7875 (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	40.4965	40.6646	40.6646	40.9037	40.9037	41.1974	41.1267	41.2662	41.1974	41.0542	41.0542	40.8258
alpha	3.6998	3.7110	3.7110	3.7269	3.7269	3.7465	3.7418	3.7511	3.7465	3.7369	3.7369	3.7217
util living area	0.9839	0.9759	0.9528	0.8868	0.7477	0.5185	0.3538	0.3912	0.6990	0.9141	0.9720	0.9863 (86)
MIT	19.5241	19.6828	20.0221	20.4534	20.7978	20.9641	20.9938	20.9911	20.8861	20.4694	19.9379	19.4987 (87)
Th 2	19.8211	19.8254	19.8254	19.8314	19.8314	19.8388	19.8370	19.8405	19.8388	19.8352	19.8352	19.8295 (88)
util rest of house	0.9795	0.9694	0.9393	0.8542	0.6777	0.4094	0.2235	0.2532	0.5960	0.8813	0.9629	0.9825 (89)
MIT 2	17.9061	18.1376	18.6229	19.2216	19.6521	19.8204	19.8358	19.8386	19.7612	19.2611	18.5151	17.8749 (90)
Living area fraction	fLA = Living area / (4) =											0.1914 (91)
MIT	18.2159	18.4334	18.8907	19.4574	19.8715	20.0393	20.0575	20.0592	19.9765	19.4924	18.7874	18.1858 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.0659	18.2834	18.7407	19.3074	19.7215	19.8893	19.9075	19.9092	19.8265	19.3424	18.6374	18.0358 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9698	0.9572	0.9227	0.8363	0.6702	0.4144	0.2316	0.2616	0.5948	0.8632	0.9496	0.9739	(94)
Useful gains	693.3137	753.4008	805.9562	830.8039	711.7734	453.2243	239.2215	250.0753	508.7627	648.0852	661.6158	661.0424	(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	1574.2459	1533.5897	1371.2395	1130.8293	807.9581	464.1870	240.0048	251.3117	552.1722	927.2691	1273.9951	1557.9271	(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	655.4136	524.2869	420.5707	216.0183	71.5614	0.0000	0.0000	0.0000	0.0000	207.7128	440.9131	667.2822	(98)
Space heating												3203.7590	(98)
Space heating per m2											(98) / (4) =	34.9679	(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 %)													90.5000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													3540.0652	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	655.4136	524.2869	420.5707	216.0183	71.5614	0.0000	0.0000	0.0000	0.0000	207.7128	440.9131	667.2822	(98)	
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)	
Space heating fuel (main heating system)	724.2139	579.3226	464.7190	238.6942	79.0734	0.0000	0.0000	0.0000	0.0000	229.5169	487.1968	737.3284	(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	145.4719	110.6481	88.6276	43.6675	19.7304	0.0000	0.0000	19.2722	43.0725	87.9898	122.0324	145.0964	(64)	
Efficiency of water heater	89.9014	89.9256	89.9263	89.9456	89.7887	87.3000	87.3000	87.3000	87.3000	89.5235	89.7866	87.3000	(216)	
(217)m	89.9014	89.9256	89.9263	89.9456	89.7887	87.3000	87.3000	87.3000	87.3000	89.5235	89.7866	89.9114	(217)	
Fuel for water heating, kWh/month	161.8127	123.0441	98.5559	48.5488	21.9743	0.0000	0.0000	22.0758	49.3385	98.2868	135.9138	161.3772	(219)	
Water heating fuel used												920.9279	(219)	
Annual totals kWh/year														
Space heating fuel - main system												3540.0652	(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)	
pump for solar water heating												50.0000	(230g)	
Total electricity for the above, kWh/year												125.0000	(231)	
Electricity for lighting (calculated in Appendix L)												389.0105	(232)	
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)	
Total delivered energy for all uses												3150.8439	(238)	

10a. Fuel costs - using BEDF prices (470)

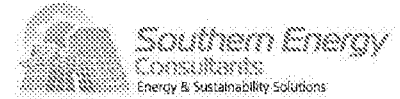
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3540.0652	3.8700	137.0005	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	920.9279	3.8700	35.6399	(247)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Pump for solar water heating	50.0000	18.9000	9.4500	(249)
Energy for lighting	389.0105	18.9000	73.5230	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	18.9000	-344.7662	(252)
Total energy cost			18.0222	(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	3540.0652	0.2160	764.6541	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	920.9279	0.2160	198.9204	(264)
Space and water heating			963.5745	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	389.0105	0.5190	201.8964	(268)
Energy saving/generation technologies				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			283.6071 (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	3540.0652	1.2200	4318.8796 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	920.9279	1.2200	1123.5320 (264)
Space and water heating			5442.4116 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	389.0105	3.0700	1194.2622 (268)

Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			1420.2537 (272)
Primary energy kWh/m2/year			15.5016 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	193.2 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	292.74 (P1)
Transmission heat loss coefficient	79.42 (37)
Summer heat loss coefficient	372.16 (P2)

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

Solar shading Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	5.1600	98.8453	0.4400	0.0000	0.9000	201.9765
South East	0.4800	119.9223	0.4400	0.0000	0.9000	22.7948
South West	3.9300	119.9223	0.4400	0.0000	0.9000	186.6328
North West	6.9700	98.8453	0.4400	0.0000	0.9000	272.8248

total:						684.2289
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	Jun	Jul	Aug	
Solar gains	732	684	584	(P4)
Internal gains	464	445	453	
Total summer gains	1196	1129	1037	(P5)
Summer gain/loss ratio	3.21	3.03	2.79	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 193.2)	0.65	0.65	0.65	
Threshold temperature	19.86	21.58	21.23	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			