

FULL SAP CALCULATION PRINTOUT

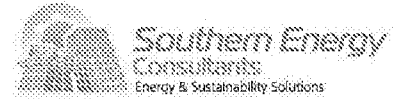
Calculation Type: New Build (As Designed)



Property Reference	SECANG012		Issued on Date	04/02/2021	
Assessment Reference	001	Prop Type Ref	Sem Bri Ga Ea		
Property	Hanbury +, Plot 23,24				
SAP Rating	84 B	DEI	17.76	TET	18.64
Environmental	87 B	% DER<TER	4.74		
CO ₂ Emissions (t/year)	1.02	DPEE	46.29	TPEE	50.25
General Requirements Compliance	Pass	% DPEE<TPEE	7.89		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey, [REDACTED]			Assessor ID	T555-0001
Client	Persimon Homes Thames Valley				

FULL SAP CALCULATION PRINTOUT

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 70 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) 18.64 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.76 kgCO₂/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 50.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 46.3 kWh/m²/yr OK

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	0.19 (max. 0.25)	0.19 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (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:

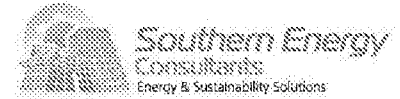
Overshading: Average
Windows facing North: 4.85 m², No overhang
Windows facing South: 7.74 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

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

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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	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (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) =	0.3635 (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	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (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			2.0600	1.4000	2.8840		(26)
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.1095		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss						(33) + (36) =	55.0522 (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	33.8582	33.6258	33.3980	32.3279	32.1277	31.1957	31.1957	31.0231	31.5547	32.1277	32.5327	32.9561 (38)
Heat transfer coeff	88.9104	88.6780	88.4502	87.3801	87.1799	86.2479	86.2479	86.0753	86.6069	87.1799	87.5849	88.0083 (39)
Average = Sum(39)m / 12 =												87.3791 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2673	1.2639	1.2607	1.2454	1.2426	1.2293	1.2293	1.2268	1.2344	1.2426	1.2484	1.2544 (40)
HLP (average)												1.2454 (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												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

Regs Region: England

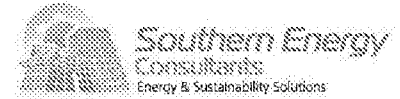
Elmhurst Energy Systems

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 = 1378.8803 (45)										
Distribution loss (46)m = 0.15 x (45)m											
21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674 (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	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970 (61)
Total heat required for water heating calculated for each month											
157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (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											
157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (64)
Total per year (kWh/year) = Sum(64)m =	1543.7815 (64)										
Heat gains from water heating, kWh/month											
51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908	49.5537 (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	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0077	15.9942	13.0074	9.8474	7.3611	6.2145	6.7150	8.7284	11.7153	14.8752	17.3616	18.5082	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.6702	199.7214	194.5525	183.5484	169.6577	156.6024	147.8807	145.8295	150.9984	162.0025	175.8932	188.9485	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	(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)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044	(72)
Total internal gains	344.0518	342.0577	329.6873	309.7956	289.6993	270.2624	257.5941	263.2570	273.4403	293.5322	316.6032	333.8111	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
North					4.8500	10.6334	0.4400	0.0000			0.7700	17.4726 (74)
South					7.7400	46.7521	0.4400	0.0000			0.7700	122.5985 (78)

Solar gains	140.0711	234.1757	312.5036	380.2071	423.9992	421.3212	405.9480	372.4186	335.3951	256.3128	166.8757	120.5024 (83)
Total gains	484.1229	576.2335	642.1909	690.0027	713.6985	691.5836	663.5421	635.6756	608.8354	549.8450	483.4789	454.3135 (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	47.4177	47.5420	47.6644	48.2481	48.3589	48.8815	48.8815	48.9795	48.6789	48.3589	48.1353	47.9037
alpha	4.1612	4.1695	4.1776	4.2165	4.2239	4.2588	4.2588	4.2653	4.2453	4.2239	4.2090	4.1936
util living area	0.9936	0.9863	0.9714	0.9356	0.8563	0.7093	0.5480	0.5889	0.8017	0.9486	0.9875	0.9951 (86)
MIT	19.5313	19.7418	20.0350	20.3949	20.7065	20.9094	20.9766	20.9681	20.8388	20.4338	19.9132	19.4943 (87)
Th 2	19.8666	19.8692	19.8718	19.8838	19.8861	19.8966	19.8966	19.8986	19.8926	19.8861	19.8815	19.8767 (88)
util rest of house	0.9917	0.9823	0.9628	0.9149	0.8086	0.6173	0.4218	0.4632	0.7240	0.9278	0.9832	0.9936 (89)
MIT 2	17.9295	18.2364	18.6606	19.1768	19.5919	19.8321	19.8870	19.8842	19.7613	19.2413	18.4960	17.8823 (90)
Living area fraction									fLA = Living area / (4) =			0.2085 (91)
MIT	18.2635	18.5503	18.9472	19.4308	19.8243	20.0567	20.1142	20.1102	19.9860	19.4900	18.7915	18.2185 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1135	18.4003	18.7972	19.2808	19.6743	19.9067	19.9642	19.9602	19.8360	19.3400	18.6415	18.0685 (93)

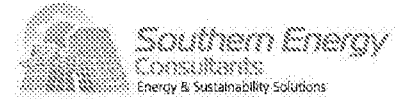
8. Space heating requirement

Utilisation	0.9873	0.9748	0.9515	0.9006	0.7978	0.6183	0.4299	0.4707	0.7194	0.9142	0.9761	0.9900	(94)
Useful gains	477.9782	561.7305	611.0493	621.4319	569.3955	427.5722	285.2740	299.2263	437.9953	502.6835	471.9172	449.7651	(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	1228.1658	1197.1828	1087.6865	907.0737	695.2008	457.6946	290.1567	306.4446	496.7733	761.9499	1010.8607	1220.5405	(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	558.1395	427.0240	354.6181	205.6621	93.5992	0.0000	0.0000	0.0000	0.0000	192.8942	388.0393	573.4569	(98)
Space heating												2793.4333	(98)
Space heating per m2												(98) / (4) =	39.8152 (99)

8c. Space cooling requirement

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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												3086.6666 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	558.1395	427.0240	354.6181	205.6621	93.5992	0.0000	0.0000	0.0000	0.0000	192.8942	388.0393	573.4569 (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)	616.7288	471.8497	391.8432	227.2509	103.4245	0.0000	0.0000	0.0000	0.0000	213.1428	428.7728	633.6540 (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	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (64)
Efficiency of water heater (217)m	89.7774	89.6981	89.5564	89.2569	88.6616	87.3000	87.3000	87.3000	87.3000	89.1791	89.6240	87.3000 (216)
Fuel for water heating, kWh/month	174.9302	153.5574	159.7400	141.2002	137.4926	122.1389	114.8065	129.4272	130.2861	146.6761	157.4247	169.8354 (219)
Water heating fuel used												1737.5153 (219)
Annual totals kWh/year												
Space heating fuel - main system												3086.6666 (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)												318.0210 (232)
Total delivered energy for all uses												5217.2030 (238)

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

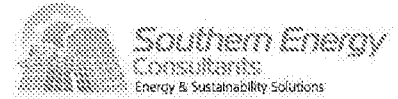
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3086.6666	0.2160	666.7200 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1737.5153	0.2160	375.3033 (264)
Space and water heating			1042.0233 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	318.0210	0.5190	165.0529 (268)
Total CO2, kg/year			1246.0012 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.7600 (273)

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

DER		17.7600 2C1
Total Floor Area	TFA	70.1600
Assumed number of occupants	N	2.2500
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		16.6954 2C2
CO2 emissions from cooking, equation (L16)		2.4658 2C3
Total CO2 emissions		36.9212 2C4
Residual CO2 emissions offset from biofuel CHP		0.0000 2C5
Additional allowable electricity generation, kWh/m²/year		0.0000 2C6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000 2C7
Net CO2 emissions		36.9212 2C8

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	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (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) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (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) =	0.3635 (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	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.0600	1.0000	2.0600		(26)					
TER Opening Type (Uw = 1.40)			12.5900	1.3258	16.6913		(27)					
Heat Loss Floor 1			35.8800	0.1300	4.6644		(28a)					
Brick Cavity	82.1100	14.6500	67.4600	0.1800	12.1428		(29a)					
External Roof 1	34.2800		34.2800	0.1300	4.4564		(30)					
Porch Roof	1.9500		1.9500	0.1300	0.2535		(30)					
Total net area of external elements Aum(A, m2)			154.2200				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.2684		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7822 (36)					
Total fabric heat loss						(33) + (36) =	50.0506 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 33.8582	Feb 33.6258	Mar 33.3980	Apr 32.3279	May 32.1277	Jun 31.1957	Jul 31.1957	Aug 31.0231	Sep 31.5547	Oct 32.1277	Nov 32.5327	Dec 32.9561 (38)
Heat transfer coeff	83.9088	83.6764	83.4485	82.3785	82.1783	81.2463	81.2463	81.0737	81.6053	82.1783	82.5833	83.0067 (39)
Average = Sum(39)m / 12 =												82.3775 (39)
HLP	Jan 1.1960	Feb 1.1927	Mar 1.1894	Apr 1.1742	May 1.1713	Jun 1.1580	Jul 1.1580	Aug 1.1556	Sep 1.1631	Oct 1.1713	Nov 1.1771	Dec 1.1831 (40)
HLP (average)												1.1741 (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												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)
Energy content (annual)										Total = Sum(45)m =		1378.8803 (45)
Distribution loss (46)m = 0.15 x (45)m	21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674 (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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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	49.1251	42.7575	45.5523	42.3542	41.9796	38.8967	40.1932	41.9796	42.3542	45.5523	45.8116	49.1251 (61)
Total heat required for water heating calculated for each month	192.0854	167.7916	174.5763	154.8404	149.9128	132.0348	126.4994	141.0172	142.5746	162.3496	173.3050	187.5746 (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	192.0854	167.7916	174.5763	154.8404	149.9128	132.0348	126.4994	141.0172	142.5746	162.3496	173.3050	187.5746 (64)
Heat gains from water heating, kWh/month	59.8156	52.2632	54.2885	47.9902	46.3827	40.6926	38.7451	43.4249	43.9118	50.2232	53.8444	58.3157 (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	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0077	15.9942	13.0074	9.8474	7.3611	6.2145	6.7150	8.7284	11.7153	14.8752	17.3616	18.5082 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.6702	199.7214	194.5525	183.5484	169.6577	156.6024	147.8807	145.8295	150.9984	162.0025	175.6932	188.9485 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500 (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)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001 (71)
Water heating gains (Table 5)	80.3973	77.7726	72.9685	66.6531	62.3423	56.5175	52.0768	58.3668	60.9887	67.5043	74.7839	78.3814 (72)
Total internal gains	355.8252	353.2383	340.2784	319.7989	299.1111	279.0845	266.4225	272.6747	283.4524	304.1321	327.7888	345.5880 (73)

6. Solar gains

[Jan]												Gains				
			Area			Solar flux			g			FF			Access	W
			m2			Table 6a			Specific data			Specific data			factor	
						W/m2			or Table 6b			or Table 6c			Table 6d	
North			4.8500			10.6334			0.6300			0.7000			0.7700	15.7611 (74)
South			7.7400			46.7521			0.6300			0.7000			0.7700	110.5894 (78)
Solar gains	126.3505	211.2372	281.8925	342.9641	382.4665	380.0509	366.1836	335.9385	302.5416	231.2058	150.5295	108.6986 (83)				
Total gains	482.1757	564.4755	622.1708	662.7630	681.5777	659.1353	632.6060	608.6132	585.9940	535.3379	478.3183	454.2867 (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	58.0657	58.2270	58.3859	59.1444	59.2884	59.9686	59.9686	60.0962	59.7048	59.2884	58.9977	58.6967
alpha	4.8710	4.8818	4.8924	4.9430	4.9526	4.9979	4.9979	5.0064	4.9803	4.9526	4.9332	4.9131
util living area	0.9964	0.9916	0.9809	0.9511	0.8758	0.7218	0.5504	0.5912	0.8157	0.9607	0.9922	0.9973 (86)
MIT	19.7776	19.9541	20.2029	20.5117	20.7769	20.9409	20.9876	20.9824	20.8864	20.5462	20.1031	19.7473 (87)
Th 2	19.9232	19.9259	19.9285	19.9407	19.9430	19.9537	19.9537	19.9557	19.9496	19.9430	19.9384	19.9335 (88)
util rest of house	0.9951	0.9889	0.9742	0.9330	0.8294	0.6293	0.4271	0.4677	0.7376	0.9425	0.9891	0.9964 (89)
MIT 2	18.3073	18.5658	18.9270	19.3724	19.7242	19.9142	19.9492	19.9486	19.8614	19.4290	18.7929	18.2705 (90)
Living area fraction	18.6139	18.8553	19.1931	19.6100	19.9437	20.1283	20.1657	20.1642	20.0751	19.6619	19.0661	0.2085 (91)
MIT	18.6139	18.8553	19.1931	19.6100	19.9437	20.1283	20.1657	20.1642	20.0751	19.6619	19.0661	18.5784 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6139	18.8553	19.1931	19.6100	19.9437	20.1283	20.1657	20.1642	20.0751	19.6619	19.0661	18.5784 (93)

8. Space heating requirement

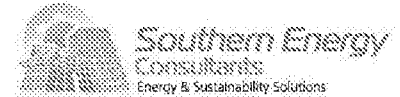
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	478.7743	555.9696	602.2984	613.7100	565.3473	425.7693	286.5046	300.2964	438.4522	501.2043	471.3414	451.8337 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1201.0638	1167.7247	1059.2180	882.2725	677.4509	449.1524	289.7022	305.1753	487.6016	744.6937	988.2011	1193.5073 (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	537.3834	411.0994	339.9481	193.3650	83.4051	0.0000	0.0000	0.0000	0.0000	181.1561	372.1390	551.8052 (98)
Space heating												2670.3014 (98)
Space heating per m ²										(98) / (4) =		38.0602 (99)

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

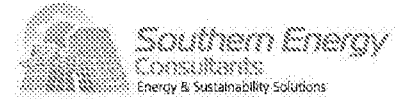
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2858.9951 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	537.3834	411.0994	339.9481	193.3650	83.4051	0.0000	0.0000	0.0000	0.0000	181.1561	372.1390	551.8052	(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)	575.3570	440.1493	363.9702	207.0289	89.2988	0.0000	0.0000	0.0000	0.0000	193.9573	398.4357	590.7979	(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	192.0854	167.7916	174.5763	154.8404	149.9128	132.0348	126.4994	141.0172	142.5746	162.3496	173.3050	187.5746	(64)
Efficiency of water heater	87.5019	87.2202	86.7000	85.6116	83.6405	80.3000	80.3000	80.3000	80.3000	85.3276	86.9261	87.6046	(216)
Fuel for water heating, kWh/month	219.5214	192.3769	201.3568	180.8637	179.2347	164.4269	157.5335	175.6130	177.5524	190.2662	199.3705	214.1149	(219)
Water heating fuel used													(219)
Annual totals kWh/year													
Space heating fuel - main system													2858.9951 (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)													318.0210 (232)
Total delivered energy for all uses													5504.2469 (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	2858.9951	0.2160	617.5429 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2252.2308	0.2160	486.4819 (264)
Space and water heating			1104.0248 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	318.0210	0.5190	165.0529 (268)
Total CO2, kg/m2/year			1308.0027 (272)
Emissions per m2 for space and water heating			15.7358 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3525 (272b)
Emissions per m2 for pumps and fans			0.5548 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.7358 * 1.00) + 2.3525 + 0.5548, rounded to 2 d.p.			18.6400 (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	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (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)	=	0.3635 (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	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (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			2.0600	1.4000	2.8840		(26)
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.1095		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			9.0000	308.5200 (32e)
Heat capacity Cm = Sum (A x k)			(28)...(30) + (32) + (32a)...(32e) =				14868.8200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							211.9273 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss						(33) + (36) =	55.0522 (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	33.8582	33.6258	33.3980	32.3279	32.1277	31.1957	31.1957	31.0231	31.5547	32.1277	32.5327	32.9561 (38)
Heat transfer coeff	88.9104	88.6780	88.4502	87.3801	87.1799	86.2479	86.2479	86.0753	86.6069	87.1799	87.5849	88.0083 (39)
Average = Sum(39)m / 12 =												87.3791 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2673	1.2639	1.2607	1.2454	1.2426	1.2293	1.2293	1.2268	1.2344	1.2426	1.2484	1.2544 (40)
HLP (average)												1.2454 (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												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

Regs Region: England

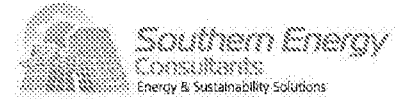
Elmhurst Energy Systems

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 = 1378.8803 (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 (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 (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 (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 (59)
Heat gains from water heating, kWh/month	30.3791	26.5697	27.4176	23.9033	22.9358	19.7919	18.3401	21.0455	21.2968	24.8194	27.0923 (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	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0077	15.9942	13.0074	9.8474	7.3611	6.2145	6.7150	8.7284	11.7153	14.8752	17.3616	18.5082	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.6702	199.7214	194.5525	183.5484	169.6577	156.6024	147.8807	145.8295	150.9984	162.0025	175.8932	188.9485	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	(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)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	40.8321	39.5383	36.8516	33.1991	30.8277	27.4887	24.6506	28.2870	29.5789	33.3594	37.6282	39.5437	(72)
Total internal gains	313.2600	312.0040	301.1615	283.3449	264.5965	247.0557	235.9963	239.5949	249.0427	266.9872	287.6331	303.7504	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
North					4.8500	10.6334	0.4400	0.0000			0.7700	17.4726 (74)
South					7.7400	46.7521	0.4400	0.0000			0.7700	122.5985 (78)
Solar gains	140.0711	234.1757	312.5036	380.2071	423.9992	421.3212	405.9480	372.4186	335.3951	256.3128	166.8757	120.5024 (83)
Total gains	453.3311	546.1797	613.6651	663.5520	688.5957	668.3768	641.9443	612.0135	584.4378	523.3000	454.5088	424.2528 (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	46.4538	46.5756	46.6955	47.2674	47.3759	47.8879	47.8879	47.9839	47.6894	47.3759	47.1568	46.9300
alpha	4.0969	4.1050	4.1130	4.1512	4.1584	4.1925	4.1925	4.1989	4.1793	4.1584	4.1438	4.1287
util living area	0.9946	0.9880	0.9743	0.9408	0.8658	0.7235	0.5626	0.6060	0.8158	0.9543	0.9894	0.9959 (86)
MIT	19.4639	19.6796	19.9814	20.3538	20.6796	20.8975	20.9726	20.9625	20.8193	20.3919	19.8549	19.4269 (87)
Th 2	19.8666	19.8692	19.8718	19.8838	19.8861	19.8966	19.8966	19.8986	19.8926	19.8861	19.8815	19.8767 (88)
util rest of house	0.9930	0.9845	0.9665	0.9216	0.8203	0.6325	0.4347	0.4790	0.7409	0.9356	0.9857	0.9947 (89)
MIT 2	18.4791	18.6951	18.9945	19.3641	19.6639	19.8457	19.8887	19.8866	19.7899	19.4083	18.8801	18.4501 (90)
Living area fraction	18.6845	18.9004	19.2003	19.5705	19.8757	20.0650	20.1147	20.1110	20.0045	19.6134	19.0833	18.6538 (92)
MIT	18.6845	18.9004	19.2003	19.5705	19.8757	20.0650	20.1147	20.1110	20.0045	19.6134	19.0833	18.6538 (91)
Temperature adjustment												0.0000
adjusted MIT	18.6845	18.9004	19.2003	19.5705	19.8757	20.0650	20.1147	20.1110	20.0045	19.6134	19.0833	18.6538 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9907	0.9805	0.9605	0.9150	0.8198	0.6478	0.4613	0.5051	0.7496	0.9298	0.9821	0.9928	(94)
Ext temp.	449.1319	535.5074	589.4044	607.1551	564.4983	432.9532	296.1091	309.1147	438.0961	486.5481	446.3642	421.2043	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	1278.9274	1241.5234	1123.3443	932.3891	712.7536	471.3445	303.1373	319.4219	511.3726	785.7886	1049.5602	1272.0568	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating per m2	617.3678	474.4427	397.2513	234.1685	110.3019	0.0000	0.0000	0.0000	0.0000	222.6350	434.3012	633.0343	(98)
												3123.5027	(98)
												44.5197	(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	810.7302	638.2344	654.1723	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8326	0.8976	0.8788	0.0000	0.0000	0.0000	0.0000	(101)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

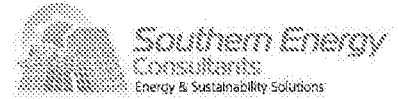


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	675.0301	572.8923	574.9171	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	864.9633	832.3903	798.8085	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	136.7519	193.0665	166.5752	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			496.3936 (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	34.1880	48.2666	41.6438	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												124.0984 (107)
Energy for space heating												1.7688 (108)
Energy for space cooling												44.5197 (99)
Total												1.7688 (108)
Dwelling Fabric Energy Efficiency (DFEE)												46.2885 (109)
												46.3 (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	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (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) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (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) = 0.3635 (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	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.0600	1.0000	2.0600		(26)					
TER Opening Type (Uw = 1.40)			12.5900	1.3258	16.6913		(27)					
Heat Loss Floor 1			35.8800	0.1300	4.6644		(28a)					
Brick Cavity	82.1100	14.6500	67.4600	0.1800	12.1428		(29a)					
External Roof 1	34.2800		34.2800	0.1300	4.4564		(30)					
Porch Roof	1.9500		1.9500	0.1300	0.2535		(30)					
Total net area of external elements Aum(A, m2)			154.2200				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.2684		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7822 (36)					
Total fabric heat loss							(33) + (36) = 50.0506 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	33.8582	33.6258	33.3980	32.3279	32.1277	31.1957	31.1957	31.0231	31.5547	32.1277	32.5327	32.9561 (38)
Average = Sum(39)m / 12 =	83.9088	83.6764	83.4485	82.3785	82.1783	81.2463	81.2463	81.0737	81.6053	82.1783	82.5833	83.0067 (39)
												82.3775 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1960	1.1927	1.1894	1.1742	1.1713	1.1580	1.1580	1.1556	1.1631	1.1713	1.1771	1.1831 (40)
Days in month												1.1741 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy content (annual)	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		1378.8803 (45)
Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	30.3791	26.5697	27.4176	23.9033	22.9358	19.7919	18.3401	21.0455	21.2968	24.8194	27.0923	29.4205 (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	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0077	15.9942	13.0074	9.8474	7.3611	6.2145	6.7150	8.7284	11.7153	14.8752	17.3616	18.5082	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.6702	199.7214	194.5525	183.5484	169.6577	156.6024	147.8807	145.8295	150.9984	162.0025	175.8932	188.9485	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	(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)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	40.8321	39.5383	36.8516	33.1991	30.8277	27.4887	24.6506	28.2870	29.5789	33.3594	37.6282	39.5437	(72)
Total internal gains	313.2600	312.0040	301.1615	283.3449	264.5965	247.0557	235.9963	239.5949	249.0427	266.9872	287.6331	303.7504	(73)

6. Solar gains

[Jan]												Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North												4.8500	10.6334	0.6300	0.7000	0.7700	15.7611 (74)
South												7.7400	46.7521	0.6300	0.7000	0.7700	110.5894 (78)
Solar gains	126.3505	211.2372	281.8925	342.9641	382.4665	380.0509	366.1836	335.9385	302.5416	231.2058	150.5295	108.6986 (83)					
Total gains	439.6105	523.2412	583.0540	626.3090	647.0630	627.1065	602.1799	575.5334	551.5843	498.1930	438.1626	412.4490 (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	58.0657	58.2270	58.3859	59.1444	59.2884	59.9686	59.9686	60.0962	59.7048	59.2884	58.9977	58.6967	
alpha	4.8710	4.8818	4.8924	4.9430	4.9526	4.9979	4.9979	5.0064	4.9803	4.9526	4.9332	4.9131	
util living area	0.9976	0.9939	0.9852	0.9601	0.8931	0.7469	0.5750	0.6199	0.8413	0.9700	0.9946	0.9982	(86)
MIT	19.7220	19.9013	20.1553	20.4730	20.7515	20.9310	20.9850	20.9784	20.8677	20.5048	20.0515	19.6923	(87)
Th 2	19.9232	19.9259	19.9285	19.9407	19.9430	19.9537	19.9537	19.9557	19.9496	19.9430	19.9384	19.9335	(88)
util rest of house	0.9967	0.9919	0.9799	0.9447	0.8505	0.6552	0.4477	0.4929	0.7674	0.9554	0.9925	0.9976	(89)
MIT 2	18.7647	18.9452	19.1985	19.5172	19.7736	19.9215	19.9499	19.9496	19.8774	19.5539	19.1054	18.7433	(90)
Living area fraction									fLA = Living area / (4) =			0.2085	(91)
MIT	18.9643	19.1446	19.3980	19.7165	19.9775	20.1320	20.1658	20.1641	20.0839	19.7522	19.3026	18.9412	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9643	19.1446	19.3980	19.7165	19.9775	20.1320	20.1658	20.1641	20.0839	19.7522	19.3026	18.9412	(93)

8. Space heating requirement

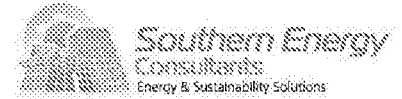
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9957	0.9898	0.9765	0.9407	0.8521	0.6723	0.4746	0.5196	0.7783	0.9520	0.9906	0.9968	(94)
Ext temp.	437.7279	517.9246	569.3700	589.1635	551.3590	421.5794	285.7754	299.0512	429.3085	474.2602	434.0646	411.1393	(95)
Ext temp.	4.3000	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	1230.4635	1191.9335	1076.3230	891.0437	680.2291	449.4568	289.7044	305.1710	488.3205	752.1095	1007.7349	1223.6187	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	589.7953	452.9340	377.1730	217.3537	95.8793	0.0000	0.0000	0.0000	0.0000	206.7199	413.0426	604.4847	(98)
Space heating												2957.3825	(98)
Space heating per m ²										(98) / (4) =		42.1520	(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	763.7150	601.2224	616.1600	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8599	0.9229	0.9061	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	656.7469	554.8928	558.3233	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	816.7253	785.9124	756.1694	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	115.1845	171.8786	147.1975	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												434.2605	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

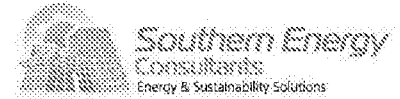


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	28.7961	42.9696	36.7994	0.0000	0.0000	0.0000 (107)
Space cooling											108.5651 (107)
Space cooling per m2											1.5474 (108)
Energy for space heating											42.1520 (99)
Energy for space cooling											1.5474 (108)
Total											43.6994 (109)
Target Fabric Energy Efficiency (TFEE)											50.3 (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	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (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)	=	0.3635 (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	0.3816	0.3635	0.3635	0.3362	0.3362	0.2998	0.3089	0.2908	0.2998	0.3180	0.3180	0.3453 (22b)
Effective ac	0.5728	0.5660	0.5660	0.5565	0.5565	0.5450	0.5477	0.5423	0.5450	0.5506	0.5506	0.5596 (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			2.0600	1.4000	2.8840		(26)
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	46.1095			(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss			(33) + (36) =				55.0522 (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	31.9321	31.5547	31.5547	31.0231	31.0231	30.3788	30.5329	30.2292	30.3788	30.6917	30.6917	31.1957 (38)
Heat transfer coeff	86.9843	86.6069	86.6069	86.0753	86.0753	85.4310	85.5851	85.2814	85.4310	85.7439	85.7439	86.2479 (39)
Average = Sum(39)m / 12 =												85.9844 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2398	1.2344	1.2344	1.2268	1.2268	1.2177	1.2199	1.2155	1.2177	1.2221	1.2221	1.2293 (40)
HLP (average)												1.2255 (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												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

Regs Region: England

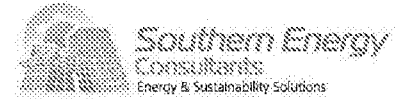
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)	Total = Sum(45)m =											1378.8803 (45)
Distribution loss (46)m = 0.15 x (45)m												
21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674	(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	(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	(57)
Combi loss	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970	(61)
Total heat required for water heating calculated for each month	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	(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	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	(64)
RHI water heating demand												
Heat gains from water heating, kWh/month	51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908	(65)
												1544 (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	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.0192	39.9856	32.5185	24.6186	18.4027	15.5363	16.7875	21.8211	29.2882	37.1881	43.4040	46.2704	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	295.0302	298.0916	290.3768	273.9528	253.2204	233.7349	220.7174	217.6559	225.3708	241.7948	262.5271	282.0126	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	(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)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044	(72)
Total internal gains	507.4233	503.4194	484.0228	453.9712	423.3037	395.7167	379.5034	387.1761	404.3856	434.6374	468.2796	493.6375	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					4.8500	11.9814	0.4400	0.0000	0.7700		19.6877	
South					7.7400	50.9848	0.4400	0.0000	0.7700		133.6981 (74)	

Solar gains	153.3858	230.6628	304.7845	384.8231	421.1364	449.3268	427.6410	398.7734	355.3901	269.6729	187.1655	130.7257 (83)
Total gains	660.8091	734.0822	788.8073	838.7943	844.4400	845.0436	807.1444	785.9495	759.7758	704.3102	655.4451	624.3633 (84)

7. Mean internal temperature (heating season)

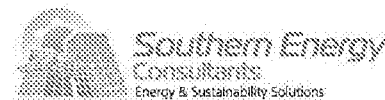
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	48.4677	48.6789	48.6789	48.9795	48.9795	49.3489	49.2600	49.4355	49.3489	49.1688	49.1688	48.8815
alpha	4.2312	4.2453	4.2453	4.2653	4.2653	4.2899	4.2840	4.2957	4.2899	4.2779	4.2779	4.2588
util living area	0.9766	0.9627	0.9314	0.8588	0.7197	0.4917	0.3268	0.3448	0.6117	0.8609	0.9548	0.9806 (86)
MIT	19.9147	20.0765	20.3473	20.6533	20.8807	20.9828	20.9978	20.9972	20.9546	20.7052	20.2782	19.8809 (87)
Th 2	19.8883	19.8926	19.8926	19.8986	19.8986	19.9059	19.9041	19.9076	19.9059	19.9023	19.9023	19.8966 (88)
util rest of house	0.9700	0.9527	0.9125	0.8203	0.6481	0.3904	0.2123	0.2284	0.5123	0.8148	0.9404	0.9751 (89)
MIT 2	18.4977	18.7310	19.1113	19.5258	19.7980	19.8977	19.9038	19.9071	19.8782	19.6040	19.0284	18.4556 (90)
Living area fraction	18.7932	19.0115	19.3691	19.7609	20.0238	20.1240	20.1319	20.1344	20.1027	19.8336	19.2890	18.7528 (91)
MIT	18.6432	18.8615	19.2191	19.6109	19.8738	19.9740	19.9819	19.9844	19.9527	19.6836	19.1390	18.6028 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6432	18.8615	19.2191	19.6109	19.8738	19.9740	19.9819	19.9844	19.9527	19.6836	19.1390	18.6028 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	634.3945	690.2879	708.4669	678.3002	545.7738	335.4067	177.9638	185.9940	392.6838	566.2546	607.8408	603.2026	(94)
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	1178.0457	1148.5409	1023.6115	835.8717	591.6659	339.5017	178.1785	186.2872	406.0257	693.1199	955.1014	1164.5869	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	404.4765	307.9460	234.4675	113.4515	34.1437	0.0000	0.0000	0.0000	0.0000	94.3878	250.0276	417.6700	(98)
Space heating												1856.5705	(98)
RHI space heating demand												1857	(98)

FULL SAP CALCULATION PRINTOUT

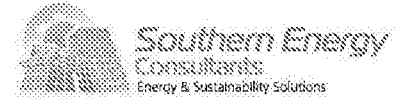
Calculation Type: New Build (As Designed)



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	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (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) =	0.3635 (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	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (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			2.0600	1.4000	2.8840		(26)
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.1095		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss						(33) + (36) =	55.0522 (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	33.8582	33.6258	33.3980	32.3279	32.1277	31.1957	31.1957	31.0231	31.5547	32.1277	32.5327	32.9561 (38)
Heat transfer coeff	88.9104	88.6780	88.4502	87.3801	87.1799	86.2479	86.2479	86.0753	86.6069	87.1799	87.5849	88.0083 (39)
Average = Sum(39)m / 12 =												87.3791 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2673	1.2639	1.2607	1.2454	1.2426	1.2293	1.2293	1.2268	1.2344	1.2426	1.2484	1.2544 (40)
HLP (average)												1.2454 (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	2.2500 (42)
Average daily hot water use (litres/day)	87.6376 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

Regs Region: England

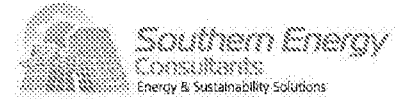
Elmhurst Energy Systems

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 =	1378.8803 (45)
Distribution loss (46)m = 0.15 x (45)m													
	21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674	(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	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970	14.0769	(61)
Total heat required for water heating calculated for each month	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264	(64)
Heat gains from water heating, kWh/month	51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908	49.5537	(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	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.0192	39.9856	32.5185	24.6186	18.4027	15.5363	16.7875	21.8211	29.2882	37.1881	43.4040	46.2704	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	295.0302	298.0916	290.3768	273.9528	253.2204	233.7349	220.7174	217.6559	225.3708	241.7948	262.5271	282.0126	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	(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)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044	(72)
Total internal gains	507.4233	503.4194	484.0228	453.9712	423.3037	395.7167	379.5034	387.1761	404.3856	434.6374	468.2796	493.6375	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
North					4.8500	10.6334	0.4400	0.0000			0.7700	17.4726 (74)
South					7.7400	46.7521	0.4400	0.0000			0.7700	122.5985 (78)

Solar gains	140.0711	234.1757	312.5036	380.2071	423.9992	421.3212	405.9480	372.4186	335.3951	256.3128	166.8757	120.5024 (83)
Total gains	647.4944	737.5951	796.5264	834.1784	847.3028	817.0379	785.4514	759.5947	739.7807	690.9502	635.1553	614.1399 (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	47.4177	47.5420	47.6644	48.2481	48.3589	48.8815	48.8815	48.9795	48.6789	48.3589	48.1353	47.9037	
alpha	4.1612	4.1695	4.1776	4.2165	4.2239	4.2588	4.2588	4.2653	4.2453	4.2239	4.2090	4.1936	
util living area	0.9819	0.9682	0.9434	0.8905	0.7903	0.6283	0.4716	0.5052	0.7147	0.9004	0.9680	0.9852	(86)
MIT	19.7577	19.9552	20.2219	20.5379	20.7925	20.9431	20.9867	20.9821	20.8985	20.5816	20.1150	19.7186	(87)
Th 2	19.8666	19.8692	19.8718	19.8838	19.8861	19.8966	19.8966	19.8986	19.8926	19.8861	19.8815	19.8767	(88)
util rest of house	0.9770	0.9597	0.9281	0.8604	0.7336	0.5374	0.3589	0.3918	0.6299	0.8667	0.9580	0.9811	(89)
MIT 2	18.2562	18.5406	18.9201	19.3628	19.6878	19.8583	19.8914	19.8909	19.8156	19.4323	18.7823	18.2070	(90)
Living area fraction	18.5693	18.8356	19.1916	19.6079	19.9182	20.0845	20.1198	20.1185	20.0414	19.6720	19.0602	18.5222	(91)
MIT	18.5693	18.8356	19.1916	19.6079	19.9182	20.0845	20.1198	20.1185	20.0414	19.6720	19.0602	18.5222	(92)
Temperature adjustment	18.4193	18.6856	19.0416	19.4579	19.7682	19.9345	19.9698	19.9685	19.8914	19.5220	18.9102	18.3722	(93)

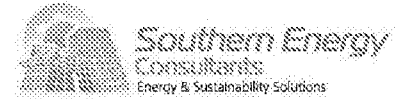
8. Space heating requirement

Utilisation	0.9682	0.9479	0.9138	0.8467	0.7269	0.5407	0.3666	0.3993	0.6298	0.8532	0.9462	0.9733	(94)
Useful gains	626.8741	699.1851	727.8829	706.2745	615.8641	441.7724	287.9710	303.2764	465.9015	589.5165	600.9896	597.7507	(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	1255.3564	1222.4783	1109.3050	922.5480	703.3807	460.0866	290.6393	307.1564	501.5732	777.8152	1034.3943	1247.2732	(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	467.5908	351.6530	283.7781	155.7169	65.1124	0.0000	0.0000	0.0000	0.0000	140.0943	312.0514	483.2448	(98)
Space heating												2259.2417	(98)
Space heating per m2												(98) / (4) =	32.2013 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of Energy Ratings 09 Jan 2014

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												2496.3996 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	467.5908	351.6530	283.7781	155.7169	65.1124	0.0000	0.0000	0.0000	0.0000	140.0943	312.0514	483.2448 (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)	516.6750	388.5669	313.5670	172.0629	71.9474	0.0000	0.0000	0.0000	0.0000	154.8003	344.8082	533.9721 (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	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (64)
Efficiency of water heater (217)m	89.6736	89.5759	89.4017	89.0401	88.3881	87.3000	87.3000	87.3000	87.3000	88.9261	89.4788	87.3000 (216)
Fuel for water heating, kWh/month	175.1326	153.7670	160.0164	141.5440	137.9180	122.1389	114.8065	129.4272	130.2861	147.0934	157.6803	170.0195 (219)
Water heating fuel used												1739.8300 (219)
Annual totals kWh/year												
Space heating fuel - main system												2496.3996 (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)												318.0210 (232)
Total delivered energy for all uses												4629.2507 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2496.3996	3.4800	86.8747 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1739.8300	3.4800	60.5461 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	318.0210	13.1900	41.9470 (250)
Additional standing charges			120.0000 (251)
Total energy cost			319.2603 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1644 (257)
SAP value		83.7570
SAP rating (Section 12)		B4 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2496.3996	0.2160	539.2223 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1739.8300	0.2160	375.8033 (264)
Space and water heating			915.0256 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	318.0210	0.5190	165.0529 (268)
Total kg/year			1119.0035 (272)
CO2 emissions per m2			15.9500 (273)
EI value			86.9793
EI rating			B7 (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	$3.48 / 0.8862 = 3.927$, stars = 4
Water heating environmental impact	$0.216 / 0.8862 = 0.2437$, stars = 4

Regs Region: England

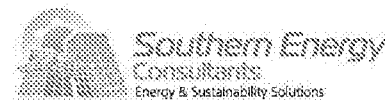
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (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) =		0.3635 (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	0.3816	0.3635	0.3635	0.3362	0.3362	0.2998	0.3089	0.2908	0.2998	0.3180	0.3180	0.3453 (22b)
Effective ac	0.5728	0.5660	0.5660	0.5565	0.5565	0.5450	0.5477	0.5423	0.5450	0.5506	0.5506	0.5596 (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			2.0600	1.4000	2.8840		(26)
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	46.1095			(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss			(33) + (36) =				55.0522 (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	31.9321	31.5547	31.5547	31.0231	31.0231	30.3788	30.5329	30.2292	30.3788	30.6917	30.6917	31.1957 (38)
Heat transfer coeff	86.9843	86.6069	86.6069	86.0753	86.0753	85.4310	85.5851	85.2814	85.4310	85.7439	85.7439	86.2479 (39)
Average = Sum(39)m / 12 =												85.9844 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2398	1.2344	1.2344	1.2268	1.2268	1.2177	1.2199	1.2155	1.2177	1.2221	1.2221	1.2293 (40)
HLP (average)												1.2255 (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												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

Regs Region: England

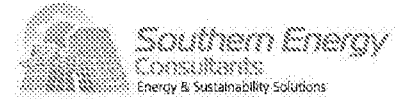
Elmhurst Energy Systems

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 = 1378.8803 (45)										
Distribution loss (46)m = 0.15 x (45)m											
21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674 (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	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970 (61)
Total heat required for water heating calculated for each month											
157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (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											
157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (64)
Heat gains from water heating, kWh/month											
51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908	49.5537 (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	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.0192	39.9856	32.5185	24.6186	18.4027	15.5363	16.7875	21.8211	29.2882	37.1881	43.4040	46.2704	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	295.0302	298.0916	290.3768	273.9528	253.2204	233.7349	220.7174	217.6559	225.3708	241.7948	262.5271	282.0126	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	(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)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044	(72)
Total internal gains	507.4233	503.4194	484.0228	453.9712	423.3037	395.7167	379.5034	387.1761	404.3856	434.6374	468.2796	493.6375	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
North					4.8500	11.9814	0.4400	0.0000			0.7700	19.6877 (74)
South					7.7400	50.9848	0.4400	0.0000			0.7700	133.6981 (78)

Solar gains	153.3858	230.6628	304.7845	384.8231	421.1364	449.3268	427.6410	398.7734	355.3901	269.6729	187.1655	130.7257 (83)
Total gains	660.8091	734.0822	788.8073	838.7943	844.4400	845.0436	807.1444	785.9495	759.7758	704.3102	655.4451	624.3633 (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	48.4677	48.6789	48.6789	48.9795	48.9795	49.3489	49.2600	49.4355	49.3489	49.1688	49.1688	48.8815
alpha	4.2312	4.2453	4.2453	4.2653	4.2653	4.2899	4.2840	4.2957	4.2899	4.2779	4.2779	4.2588
util living area	0.9766	0.9627	0.9314	0.8588	0.7197	0.4917	0.3268	0.3448	0.6117	0.8609	0.9548	0.9806 (86)
MIT	19.9147	20.0765	20.3473	20.6533	20.8807	20.9828	20.9978	20.9972	20.9546	20.7052	20.2782	19.8809 (87)
Th 2	19.8883	19.8926	19.8926	19.8986	19.8986	19.9059	19.9041	19.9076	19.9059	19.9023	19.9023	19.8966 (88)
util rest of house	0.9700	0.9527	0.9125	0.8203	0.6481	0.3904	0.2123	0.2284	0.5123	0.8148	0.9404	0.9751 (89)
MIT 2	18.4977	18.7310	19.1113	19.5258	19.7980	19.8977	19.9038	19.9071	19.8782	19.6040	19.0284	18.4556 (90)
Living area fraction	18.7932	19.0115	19.3691	19.7609	20.0238	20.1240	20.1319	20.1344	20.1027	19.8336	19.2890	18.7528 (91)
MIT	18.6432	18.8615	19.2191	19.6109	19.8738	19.9740	19.9819	19.9844	19.9527	19.6836	19.1390	18.6028 (93)
Temperature adjustment												-0.1500
adjusted MIT	18.6432	18.8615	19.2191	19.6109	19.8738	19.9740	19.9819	19.9844	19.9527	19.6836	19.1390	18.6028 (93)

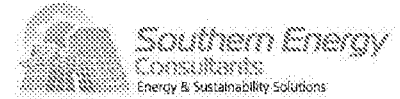
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9600	0.9403	0.8981	0.8087	0.6463	0.3969	0.2205	0.2366	0.5168	0.8040	0.9274	0.9661	(94)	
Useful gains	634.3945	690.2879	708.4669	678.3002	545.7738	335.4067	177.9638	185.9940	392.6838	566.2546	607.8408	603.2026	(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	1178.0457	1148.5409	1023.6115	835.8717	591.6659	339.5017	178.1785	186.2872	406.0257	693.1199	955.1014	1164.5869	(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	404.4765	307.9460	234.4675	113.4515	34.1437	0.0000	0.0000	0.0000	0.0000	94.3878	250.0276	417.6700	(98)	
Space heating												1856.5705	(98)	
Space heating per m2												(98) / (4) =	26.4620	(99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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												2051.4592 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	404.4765	307.9460	234.4675	113.4515	34.1437	0.0000	0.0000	0.0000	0.0000	94.3878	250.0276	417.6700 (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)	446.9354	340.2718	259.0802	125.3607	37.7278	0.0000	0.0000	0.0000	0.0000	104.2959	276.2736	461.5138 (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	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (64)
Efficiency of water heater (217)m	89.5816	89.4863	89.2602	88.7873	87.9807	87.3000	87.3000	87.3000	87.3000	88.6133	89.3189	87.3000 (216)
Fuel for water heating, kWh/month	175.3124	153.9209	160.2700	141.9470	138.5567	122.1389	114.8065	129.4272	130.2861	147.6126	157.9624	170.1900 (219)
Water heating fuel used												1742.4309 (219)
Annual totals kWh/year												
Space heating fuel - main system												2051.4592 (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)												318.0210 (232)
Total delivered energy for all uses												4186.9111 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2051.4592	3.8700	79.3915 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1742.4309	3.8700	67.4321 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	318.0210	18.9000	60.1060 (250)
Additional standing charges			93.0000 (251)
Total energy cost			314.1045 (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	2051.4592	0.2160	443.1152 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1742.4309	0.2160	376.3651 (264)
Space and water heating			819.4803 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	318.0210	0.5190	165.0529 (268)
Total kg/year			1023.4582 (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	2051.4592	1.2200	2502.7802 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1742.4309	1.2200	2125.7657 (264)
Space and water heating			4628.5459 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	318.0210	3.0700	976.3245 (268)
Primary energy kWh/year			5835.1204 (272)
Primary energy kWh/m2/year			83.1688 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
Current environmental impact rating: B 87

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	+ 1.3	-£ 27	-175 kg (17.1%)
U Solar photovoltaic panels	+ 11.6	-£ 345	-947 kg (111.6%)

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£27	2.50 kg/m²	B 85	B 89
Solar photovoltaic panels	£345	13.49 kg/m²	A 97	A 99
Total Savings	£371	15.99 kg/m²		

Potential energy efficiency rating: A 97
 Potential environmental impact rating: A 99

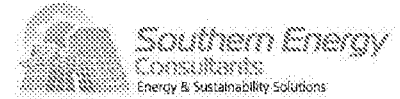
Fuel prices for cost data on this page from database revision number 470 TEST (21 Dec 2020)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£74	£84	-£9
Mains gas	£240	£204	£36
Space heating	£187	£187	£0
Water heating	£67	£41	£27
Lighting	£60	£60	£0
Generated (PV)	-£0	-£345	£345
Total cost of fuels	£314	-£57	£372
Total cost of uses	£314	-£57	£372
Delivered energy	60 kWh/m²	21 kWh/m²	39 kWh/m²
Carbon dioxide emissions	1.0 tonnes	-0.1 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	-1 kg/m²	16 kg/m²
Primary energy	83 kWh/m²	-11 kWh/m²	94 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	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (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) =	0.3635 (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	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (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			2.0600	1.4000	2.8840		(26)
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.1095		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss						(33) + (36) =	55.0522 (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	33.8582	33.6258	33.3980	32.3279	32.1277	31.1957	31.1957	31.0231	31.5547	32.1277	32.5327	32.9561 (38)
Heat transfer coeff	88.9104	88.6780	88.4502	87.3801	87.1799	86.2479	86.2479	86.0753	86.6069	87.1799	87.5849	88.0083 (39)
Average = Sum(39)m / 12 =												87.3791 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2673	1.2639	1.2607	1.2454	1.2426	1.2293	1.2293	1.2268	1.2344	1.2426	1.2484	1.2544 (40)
HLP (average)												1.2454 (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												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

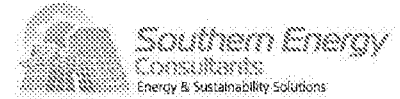
Regs Region: England

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 = 1378.8803 (45)										
Distribution loss (46)m = 0.15 x (45)m											
21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674 (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	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970 (61)
Total heat required for water heating calculated for each month											
157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (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	-23.8562	-39.8091	-67.7995	-90.8647	-112.2556	-110.3652	-108.9067	-95.1523	-74.5233	-50.8907	-28.2969
Solar input (sum of months) = Sum(63)m =											
Output from w/h	133.1915	97.9290	75.2578	35.1662	9.6475	0.0000	0.0000	17.8377	39.2165	79.9137	112.7935
Heat gains from water heating, kWh/month	51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908
51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908	49.5537 (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	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.0192	39.9856	32.5185	24.6186	18.4027	15.5363	16.7875	21.8211	29.2882	37.1881	43.4040	46.2704	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	295.0302	298.0916	290.3768	273.9528	253.2204	233.7349	220.7174	217.6559	225.3708	241.7948	262.5271	282.0126	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	(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)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044	(72)
Total internal gains	507.4233	503.4194	484.0228	453.9712	423.3037	395.7167	379.5034	387.1761	404.3856	434.6374	468.2796	493.6375	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d	Gains W	
North				4.8500	10.6334	0.4400		0.0000		0.7700	17.4726 (74)	
South				7.7400	46.7521	0.4400		0.0000		0.7700	122.5985 (78)	

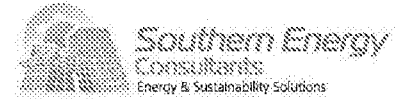
Solar gains	140.0711	234.1757	312.5036	380.2071	423.9992	421.3212	405.9480	372.4186	335.3951	256.3128	166.8757	120.5024 (83)
Total gains	647.4944	737.5951	796.5264	834.1784	847.3028	817.0379	785.4514	759.5947	739.7807	690.9502	635.1553	614.1399 (84)

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	47.4177	47.5420	47.6644	48.2481	48.3589	48.8815	48.8815	48.9795	48.6789	48.3589	48.1353	47.9037
alpha	4.1612	4.1695	4.1776	4.2165	4.2239	4.2588	4.2588	4.2653	4.2453	4.2239	4.2090	4.1936
util living area	0.9819	0.9682	0.9434	0.8905	0.7903	0.6283	0.4716	0.5052	0.7147	0.9004	0.9680	0.9852 (86)
MIT	19.7577	19.9552	20.2219	20.5379	20.7925	20.9431	20.9867	20.9821	20.8985	20.5816	20.1150	19.7186 (87)
Th 2	19.8666	19.8692	19.8718	19.8838	19.8861	19.8966	19.8966	19.8986	19.8926	19.8861	19.8815	19.8767 (88)
util rest of house	0.9770	0.9597	0.9281	0.8604	0.7336	0.5374	0.3589	0.3918	0.6299	0.8667	0.9580	0.9811 (89)
MIT 2	18.2562	18.5406	18.9201	19.3628	19.6878	19.8583	19.8914	19.8909	19.8156	19.4323	18.7823	18.2070 (90)
Living area fraction	fLa = Living area / (4) = 0.2085 (91)											
MIT	18.5693	18.8356	19.1916	19.6079	19.9182	20.0845	20.1198	20.1185	20.0414	19.6720	19.0602	18.5222 (92)
Temperature adjustment	-0.1500											
adjusted MIT	18.4193	18.6856	19.0416	19.4579	19.7682	19.9345	19.9698	19.9685	19.8914	19.5220	18.9102	18.3722 (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	0.9682	0.9479	0.9138	0.8467	0.7269	0.5407	0.3666	0.3993	0.6298	0.8532	0.9462	0.9733	(94)
Useful gains	626.8741	699.1851	727.8829	706.2745	615.8641	441.7724	287.9710	303.2764	465.9015	589.5165	600.9896	597.7507	(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													
	1255.3564	1222.4783	1109.3050	922.5480	703.3807	460.0866	290.6393	307.1564	501.5732	777.8152	1034.3943	1247.2732	(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													
	467.5908	351.6530	283.7781	155.7169	65.1124	0.0000	0.0000	0.0000	0.0000	140.0943	312.0514	483.2448	(98)
Space heating													
Space heating per m2												2259.2417	(98)
											(98) / (4) =	32.2013	(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													2496.3996 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	467.5908	351.6530	283.7781	155.7169	65.1124	0.0000	0.0000	0.0000	0.0000	140.0943	312.0514	483.2448	(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)	516.6750	388.5669	313.5670	172.0629	71.9474	0.0000	0.0000	0.0000	0.0000	154.8003	344.8082	533.9721	(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	133.1915	97.9290	75.2578	35.1662	9.6475	0.0000	0.0000	17.8377	39.2165	79.9137	112.7935	132.5628	(64)
Efficiency of water heater	89.7705	89.7831	89.8100	89.8930	90.0739	87.3000	87.3000	87.3000	87.3000	89.3109	89.6278	89.7915	(217)
Fuel for water heating, kWh/month	148.3689	109.0728	83.7968	39.1201	10.7107	0.0000	0.0000	20.4326	44.9215	89.4781	125.8466	147.6341	(219)
Water heating fuel used													
Annual totals kWh/year													819.3822 (219)
Space heating fuel - main system													2496.3996 (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)													318.0210 (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													2031.5635 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2496.3996	3.4800	86.8747 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	819.3822	3.4800	28.5145 (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	318.0210	13.1900	41.9470 (250)	
Additional standing charges			120.0000 (251)	
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229 (252)	
Total energy cost			66.0008 (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] =	0.2407 (257)
SAP value			96.6421
SAP rating (Section 12)			97 (258)
SAP band			A

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

Energy Emission factor Emissions

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	2496.3996	0.2160	539.2223 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	819.3822	0.2160	176.9866 (264)
Space and water heating			716.2089 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	318.0210	0.5190	165.0529 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			49.6995 (272)
CO2 emissions per m2			0.7100 (273)
EI value			99.4217
EI rating			99 (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	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (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) =		0.3635 (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	0.3816	0.3635	0.3635	0.3362	0.3362	0.2998	0.3089	0.2908	0.2998	0.3180	0.3180	0.3453 (22b)
Effective ac	0.5728	0.5660	0.5660	0.5565	0.5565	0.5450	0.5477	0.5423	0.5450	0.5506	0.5506	0.5596 (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			2.0600	1.4000	2.8840		(26)
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.1095		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss						(33) + (36) =	55.0522 (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	31.9321	31.5547	31.5547	31.0231	31.0231	30.3788	30.5329	30.2292	30.3788	30.6917	30.6917	31.1957 (38)
Heat transfer coeff	86.9843	86.6069	86.6069	86.0753	86.0753	85.4310	85.5851	85.2814	85.4310	85.7439	85.7439	86.2479 (39)
Average = Sum(39)m / 12 =												85.9844 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2398	1.2344	1.2344	1.2268	1.2268	1.2177	1.2199	1.2155	1.2177	1.2221	1.2221	1.2293 (40)
HLP (average)												1.2255 (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												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

Regs Region: England

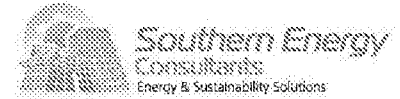
Elmhurst Energy Systems

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 =											1378.8803 (45)
Distribution loss (46)m = 0.15 x (45)m												
	21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674 (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	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970	14.0769 (61)
Total heat required for water heating calculated for each month	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1140.0998 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1915.3676 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.3891 (H8)
Utilisation factor												0.5132 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												87.6376 (H14)
Volume ratio Veff/V												0.8558 (H15)
Solar storage volume factor												0.9689 (H16)
Solar input												-837.3990 (H17)
Solar input	-25.7747	-38.7394	-65.2420	-90.1844	-108.6123	-114.3098	-111.5650	-99.6282	-77.7601	-52.8988	-31.3299	-21.3545 (63)
	Solar input (sum of months) = Sum(63)m =											-837.3990 (63)
Output from w/h	131.2730	98.9988	77.8153	35.8465	13.2908	0.0000	0.0000	13.3618	35.9797	77.9056	109.7605	131.1719 (64)
	Total per year (kWh/year) = Sum(64)m =											725.4038 (64)
Heat gains from water heating, kWh/month	51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908	49.5537 (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	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.0192	39.9856	32.5185	24.6186	18.4027	15.5363	16.7875	21.8211	29.2882	37.1881	43.4040	46.2704	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	295.0302	298.0916	290.3768	273.9528	253.2204	233.7349	220.7174	217.6559	225.3708	241.7948	262.5271	282.0126	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	(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)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044	(72)
Total internal gains	507.4233	503.4194	484.0228	453.9712	423.3037	395.7167	379.5034	387.1761	404.3856	434.6374	468.2796	493.6375	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
North					4.8500	11.9814	0.4400	0.0000	0.7700	19.6877 (74)		
South					7.7400	50.9848	0.4400	0.0000	0.7700	133.6981 (78)		

Solar gains	153.3858	230.6628	304.7845	384.8231	421.1364	449.3268	427.6410	398.7734	355.3901	269.6729	187.1655	130.7257 (83)
Total gains	660.8091	734.0822	788.8073	838.7943	844.4400	845.0436	807.1444	785.9495	759.7758	704.3102	655.4451	624.3633 (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	48.4677	48.6789	48.6789	48.9795	48.9795	49.3489	49.2600	49.4355	49.3489	49.1688	49.1688	48.8815
alpha	4.2312	4.2453	4.2453	4.2653	4.2653	4.2899	4.2840	4.2957	4.2899	4.2779	4.2779	4.2588
util living area	0.9766	0.9627	0.9314	0.8588	0.7197	0.4917	0.3268	0.3448	0.6117	0.8609	0.9548	0.9806 (86)
MIT	19.9147	20.0765	20.3473	20.6533	20.8807	20.9828	20.9978	20.9972	20.9546	20.7052	20.2782	19.8809 (87)
Th 2	19.8883	19.8926	19.8926	19.8986	19.8986	19.9059	19.9041	19.9076	19.9059	19.9023	19.9023	19.8966 (88)
util rest of house	0.9700	0.9527	0.9125	0.8203	0.6481	0.3904	0.2123	0.2284	0.5123	0.8148	0.9404	0.9751 (89)
MIT 2	18.4977	18.7310	19.1113	19.5258	19.7980	19.8977	19.9038	19.9071	19.8782	19.6040	19.0284	18.4556 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.7932	19.0115	19.3691	19.7609	20.0238	20.1240	20.1319	20.1344	20.1027	19.8336	19.2890	18.7528 (91)
Temperature adjustment	-0.1500											
adjusted MIT	18.6432	18.8615	19.2191	19.6109	19.8738	19.9740	19.9819	19.9844	19.9527	19.6836	19.1390	18.6028 (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	0.9600	0.9403	0.8981	0.8087	0.6463	0.3969	0.2205	0.2366	0.5168	0.8040	0.9274	0.9661	(94)
Useful gains	634.3945	690.2879	708.4669	678.3002	545.7738	335.4067	177.9638	185.9940	392.6838	566.2546	607.8408	603.2026	(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													
	1178.0457	1148.5409	1023.6115	835.8717	591.6659	339.5017	178.1785	186.2872	406.0257	693.1199	955.1014	1164.5869	(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													
	404.4765	307.9460	234.4675	113.4515	34.1437	0.0000	0.0000	0.0000	0.0000	94.3878	250.0276	417.6700	(98)
Space heating												1856.5705	(98)
Space heating per m2											(98) / (4) =	26.4620	(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													2051.4592 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	404.4765	307.9460	234.4675	113.4515	34.1437	0.0000	0.0000	0.0000	0.0000	94.3878	250.0276	417.6700	(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)	446.9354	340.2718	259.0802	125.3607	37.7278	0.0000	0.0000	0.0000	0.0000	104.2959	276.2736	461.5138	(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	131.2730	98.9988	77.8153	35.8465	13.2908	0.0000	0.0000	13.3618	35.9797	77.9056	109.7605	131.1719	(64)
Efficiency of water heater	89.6944	89.7001	89.6809	89.7105	89.5800	87.3000	87.3000	87.3000	87.3000	89.0245	89.4992	89.7141	(217)
Fuel for water heating, kWh/month	146.3558	110.3664	86.7692	39.9580	14.8368	0.0000	0.0000	15.3056	41.2138	87.5103	122.6386	146.2110	(219)
Water heating fuel used												811.1655	(219)
Annual totals kWh/year													
Space heating fuel - main system												2051.4592	(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)												318.0210	(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												1481.4860	(238)

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

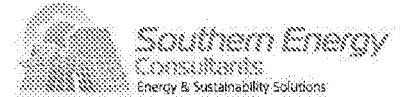
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2051.4592	3.8700	79.3915	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	811.1655	3.8700	31.3921	(247)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Pump for solar water heating	50.0000	18.9000	9.4500	(249)
Energy for lighting	318.0210	18.9000	60.1060	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	18.9000	-344.7662	(252)
Total energy cost			-57.2516	(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	2051.4592	0.2160	443.1152	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	811.1655	0.2160	175.2117	(264)
Space and water heating			618.3269	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	318.0210	0.5190	165.0529	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			-98.4840	(272)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2051.4592	1.2200	2502.7802 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	811.1655	1.2200	989.6219 (264)
Space and water heating			3492.4020 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	318.0210	3.0700	976.3245 (268)
Energy saving/generation technologies			
FV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			-747.6935 (272)
Primary energy kWh/m2/year			-10.6570 (273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	216.3 (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	222.98 (P1)
Transmission heat loss coefficient	55.05 (37)
Summer heat loss coefficient	278.03 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	4.8500	81.1852	0.4400	0.0000	0.9000	155.9242
South	7.7400	112.2060	0.4400	0.0000	0.9000	343.9159

total: 499.8401

Solar gains	Jun	Jul	Aug	(P4)
Internal gains	525	500	466	
Total summer gains	393	377	384	
	918	876	850	(P5)

Summer gain/loss ratio	3.30	3.15	3.06	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 216.3)	0.49	0.49	0.49	
Threshold temperature	19.79	21.54	21.34	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight