

FULL SAP CALCULATION PRINTOUT

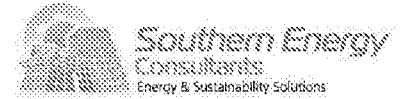
Calculation Type: New Build (As Designed)



Property Reference	SECANG012]			Issued on Date	04/02/2021
Assessment Reference	001	Prop Type Ref	Sem Bri Ga Ea		
Property	Hanbury +, Plot 13				
SAP Rating	84 B	DER	-0.23	TER	18.71
Environmental	102 A	% DER<TER	101.23		
CO ₂ Emissions (t/year)	-0.24	DFEE	46.60	TFEE	50.63
General Requirements Compliance	Pass	% DFEE<TFEE	7.95		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey			Assessor ID	T555-0001
Client	Persimon Homes Thames Valley				

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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) 18.71 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) -0.23 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)50.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.19 (max. 0.25)	0.19 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.34 (max. 2.00)	1.60 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

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

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

No cylinder

Boiler interlock

Yes OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

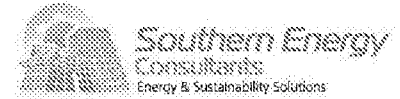
Overshading: Average
Windows facing North: 4.85 m², No overhang
Windows facing South: 7.74 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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
Photovoltaic array 2440.60 kWh/Year

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
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) =		46.5215		(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) =	55.4642 (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	89.3224	89.0900	88.8622	87.7921	87.5919	86.6599	86.6599	86.4873	87.0189	87.5919	87.9969	88.4203 (39)
Average = Sum(39)m / 12 =												87.7911 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2731	1.2698	1.2666	1.2513	1.2485	1.2352	1.2352	1.2327	1.2403	1.2485	1.2542	1.2603 (40)
HLP (average)												1.2513 (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

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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)
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 m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W	
North				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	47.1990	47.3221	47.4435	48.0217	48.1315	48.6491	48.6491	48.7462	48.4484	48.1315	47.9100	47.6805
alpha	4.1466	4.1548	4.1629	4.2014	4.2088	4.2433	4.2433	4.2497	4.2299	4.2088	4.1940	4.1787
util living area	0.9936	0.9863	0.9716	0.9360	0.8574	0.7112	0.5500	0.5909	0.8031	0.9490	0.9876	0.9951 (86)
MIT	19.5230	19.7336	20.0275	20.3888	20.7023	20.9075	20.9759	20.9673	20.8360	20.4284	19.9061	19.4859 (87)
Th 2	19.8619	19.8646	19.8671	19.8792	19.8814	19.8920	19.8920	19.8939	19.8879	19.8814	19.8769	19.8721 (88)
util rest of house	0.9917	0.9824	0.9629	0.9154	0.8097	0.6189	0.4230	0.4646	0.7254	0.9282	0.9832	0.9936 (89)
MIT 2	17.9143	18.2214	18.6466	19.1648	19.5829	19.8260	19.8821	19.8791	19.7543	19.2305	18.4825	17.8671 (90)
Living area fraction	18.2497	18.5368	18.9346	19.4200	19.8163	20.0515	20.1102	20.1060	19.9799	19.4803	18.7794	18.2046 (91)
MIT	18.0997	18.3868	18.7846	19.2700	19.6663	19.9015	19.9602	19.9560	19.8299	19.3303	18.6294	18.0546 (93)
Temperature adjustment												-0.1500
adjusted MIT	18.0997	18.3868	18.7846	19.2700	19.6663	19.9015	19.9602	19.9560	19.8299	19.3303	18.6294	18.0546 (93)

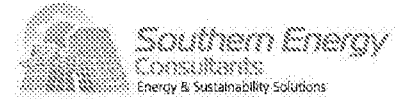
8. Space heating requirement

Utilisation	0.9873	0.9749	0.9516	0.9011	0.7988	0.6198	0.4313	0.4721	0.7207	0.9146	0.9761	0.9900	(94)
Useful gains	477.9730	561.7477	611.1389	621.7324	570.1016	428.6308	286.1654	300.1304	438.7706	502.8718	471.9292	449.7582	(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	1232.6266	1201.5354	1091.6353	910.4083	697.7874	459.4301	291.1925	307.5504	498.6071	764.7050	1014.5510	1225.0298	(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	561.4623	429.9373	357.4893	207.8467	94.9982	0.0000	0.0000	0.0000	0.0000	194.8039	390.6877	576.8021	(98)
Space heating												2814.0274	(98)
Space heating per m ²												(98) / (4) =	40.1087 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

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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												3109.4225 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	561.4623	429.9373	357.4893	207.8467	94.9982	0.0000	0.0000	0.0000	0.0000	194.8039	390.6877	576.8021 (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)	620.4003	475.0688	395.0158	229.6648	104.9704	0.0000	0.0000	0.0000	0.0000	215.2529	431.6991	637.3504 (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	89.7807	89.7022	89.5617	89.2649	88.6732	87.3000	87.3000	87.3000	87.3000	89.1867	89.6283	87.3000 (216)
Fuel for water heating, kWh/month	174.9237	153.5504	159.7304	141.1875	137.4746	122.1389	114.8065	129.4272	130.2861	146.6635	157.4172	169.8294 (219)
Water heating fuel used												1737.4355 (219)
Annual totals kWh/year												
Space heating fuel - main system												3109.4225 (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)
Energy saving/generation technologies (Appendices M,N and Q)												
Total delivered energy for all uses												5239.8790 (238)

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

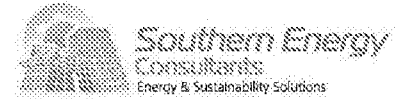
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3109.4225	0.2160	671.6353 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1737.4355	0.2160	375.2861 (264)
Space and water heating			1046.9213 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	318.0210	0.5190	165.0529 (268)
Energy saving/generation technologies			
PV Unit	-2440.8000	0.5190	-1266.7752 (269)
Total CO2, kg/year			-15.8760 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			-0.2300 (273)

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

DER		-0.2300 ZC1
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 ZC2
CO2 emissions from cooking, equation (L16)		2.4658 ZC3
Total CO2 emissions		18.9312 ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000 ZC7
Net CO2 emissions		18.9312 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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
TER Semi-glazed door			2.0600	1.2000	2.4720		(26a)
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, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.6804		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7822 (36)
Total fabric heat loss						(33) + (36) =	50.4626 (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	84.3208	84.0884	83.8605	82.7905	82.5903	81.6583	81.6583	81.4857	82.0173	82.5903	82.9953	83.4187 (39)
Average = Sum(39)m / 12 =												82.7895 (39)
HLP	1.2018	1.1985	1.1953	1.1800	1.1772	1.1639	1.1639	1.1614	1.1690	1.1772	1.1829	1.1890 (40)
HLP (average)												1.1800 (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	57.7820	57.9417	58.0991	58.8500	58.9927	59.6660	59.6660	59.7924	59.4048	58.9927	58.7048	58.4068
alpha	4.8521	4.8628	4.8733	4.9233	4.9328	4.9777	4.9777	4.9862	4.9603	4.9328	4.9137	4.8938
util living area	0.9964	0.9917	0.9810	0.9515	0.8770	0.7239	0.5528	0.5936	0.8174	0.9611	0.9922	0.9973 (86)
MIT	19.7698	19.9464	20.1959	20.5059	20.7731	20.9393	20.9872	20.9818	20.8840	20.5412	20.0965	19.7394 (87)
Th 2	19.9185	19.9212	19.9238	19.9360	19.9383	19.9490	19.9490	19.9510	19.9449	19.9383	19.9337	19.9288 (88)
util rest of house	0.9951	0.9889	0.9743	0.9336	0.8307	0.6311	0.4285	0.4692	0.7393	0.9430	0.9891	0.9964 (89)
MIT 2	18.2926	18.5513	18.9136	19.3609	19.7155	19.9084	19.9443	19.9436	19.8547	19.4185	18.7799	18.2557 (90)
Living area fraction	18.6006	18.8422	19.1810	19.5996	19.9360	20.1233	20.1618	20.1601	20.0693	19.6526	19.0544	18.5651 (92)
Temperature adjustment	18.6006	18.8422	19.1810	19.5996	19.9360	20.1233	20.1618	20.1601	20.0693	19.6526	19.0544	18.5651 (93)

8. Space heating requirement

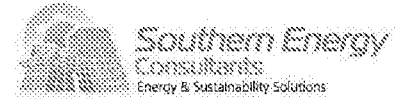
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	478.7722	555.9860	602.3806	614.0117	566.1287	426.9950	287.5311	301.3448	439.3585	501.3999	471.3545	451.8302 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1205.8415	1172.3761	1063.4326	885.8290	680.2173	451.0268	290.8471	306.3947	489.5889	747.6559	992.1615	1198.3172 (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	540.9396	414.2142	343.0226	195.7085	84.8819	0.0000	0.0000	0.0000	0.0000	183.2145	374.9810	555.3864 (98)
Space heating												2692.3486 (98)
Space heating per m ²										(98) / (4) =		38.3744 (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

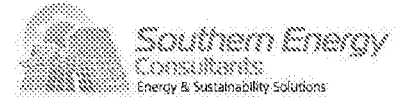
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2882.6002 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	540.9396	414.2142	343.0226	195.7085	84.8819	0.0000	0.0000	0.0000	0.0000	183.2145	374.9810	555.3864	(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)	579.1644	443.4841	367.2619	209.5380	90.8799	0.0000	0.0000	0.0000	0.0000	196.1612	401.4786	594.6321	(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	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 (217)m	87.5155	87.2366	86.7211	85.6420	83.6799	80.3000	80.3000	80.3000	80.3000	85.3561	86.9434	87.6177	(216)
Fuel for water heating, kWh/month	219.4873	192.3407	201.3078	180.7997	179.1504	164.4269	157.5335	175.6130	177.5524	190.2026	199.3307	214.0830	(219)
Water heating fuel used													2251.8280 (219)
Annual totals kWh/year													
Space heating fuel - main system													2882.6002 (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													5527.4492 (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	2882.6002	0.2160	622.6417 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2251.8280	0.2160	486.3948 (264)
Space and water heating			1109.0365 (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			1313.0144 (272)
Emissions per m2 for space and water heating			15.8072 (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) = (15.8072 * 1.00) + 2.3525 + 0.5548, rounded to 2 d.p.			18.7100 (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 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
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) =	46.5215		(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) =	55.4642 (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	89.3224	89.0900	88.8622	87.7921	87.5919	86.6599	86.6599	86.4873	87.0189	87.5919	87.9969	88.4203 (39)
Average = Sum(39)m / 12 =												87.7911 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2731	1.2698	1.2666	1.2513	1.2485	1.2352	1.2352	1.2327	1.2403	1.2485	1.2542	1.2603 (40)
HLP (average)												1.2513 (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

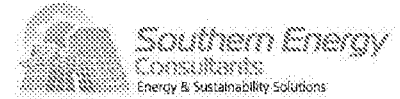
Elmhurst Energy Systems

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	46.2395	46.3602	46.4790	47.0456	47.1531	47.6602	47.6602	47.7553	47.4636	47.1531	46.9361	46.7113
alpha	4.0826	4.0907	4.0986	4.1364	4.1435	4.1773	4.1773	4.1837	4.1642	4.1435	4.1291	4.1141
util living area	0.9946	0.9880	0.9744	0.9412	0.8668	0.7252	0.5646	0.6080	0.8171	0.9546	0.9894	0.9959 (86)
MIT	19.4555	19.6714	19.9739	20.3475	20.6752	20.8955	20.9718	20.9615	20.8164	20.3864	19.8478	19.4185 (87)
Th 2	19.8619	19.8646	19.8671	19.8792	19.8814	19.8920	19.8920	19.8939	19.8879	19.8814	19.8769	19.8721 (88)
util rest of house	0.9930	0.9845	0.9666	0.9220	0.8213	0.6341	0.4359	0.4804	0.7422	0.9359	0.9857	0.9947 (89)
MIT 2	18.4672	18.6833	18.9835	19.3544	19.6561	19.8399	19.8838	19.8817	19.7835	19.3994	18.8694	18.4382 (90)
Living area fraction	18.6733	18.8893	19.1900	19.5615	19.8686	20.0600	20.1107	20.1068	19.9989	19.6052	19.0734	18.6426 (92)
Temperature adjustment	18.6733	18.8893	19.1900	19.5615	19.8686	20.0600	20.1107	20.1068	19.9989	19.6052	19.0734	18.6426 (93)
adjusted MIT	18.6733	18.8893	19.1900	19.5615	19.8686	20.0600	20.1107	20.1068	19.9989	19.6052	19.0734	18.6426 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9907	0.9805	0.9606	0.9154	0.8207	0.6493	0.4627	0.5066	0.7508	0.9301	0.9821	0.9928 (94)
Useful gains	449.1269	535.5187	589.4747	607.4108	565.1336	433.9609	297.0131	310.0157	438.7986	486.6971	446.3706	421.1984 (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	1283.8570	1246.3089	1127.6597	935.9938	715.5052	473.1662	304.2374	320.5934	513.3145	788.7837	1053.6227	1277.0201 (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	621.0392	477.6511	400.4097	236.5797	111.8765	0.0000	0.0000	0.0000	0.0000	224.7524	437.2215	636.7313 (98)
Space heating												3146.2614 (98)
Space heating per m2										(98) / (4) =		44.8441 (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	814.6030	641.2832	657.3035	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8303	0.8958	0.8768	0.0000	0.0000	0.0000	0.0000 (101)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

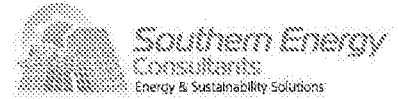


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	676.3271	574.4392	576.3278	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	135.8181	191.9156	165.5256	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			493.2593 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Intermittency factor	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	33.9545	47.9789	41.3814	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												123.3148 (107)
Energy for space heating												1.7576 (108)
Energy for space cooling												44.8441 (99)
Total												1.7576 (108)
Dwelling Fabric Energy Efficiency (DFEE)												46.6017 (109)
												46.6 (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 m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Semi-glazed door			2.0600	1.2000	2.4720		(26a)
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, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.6804		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7822 (36)
Total fabric heat loss						(33) + (36) =	50.4626 (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	84.3208	84.0884	83.8605	82.7905	82.5903	81.6583	81.6583	81.4857	82.0173	82.5903	82.9953	83.4187 (39)
Average = Sum(39)m / 12 =												82.7895 (39)
HLP	1.2018	1.1985	1.1953	1.1800	1.1772	1.1639	1.1639	1.1614	1.1690	1.1772	1.1829	1.1890 (40)
HLP (average)												1.1800 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

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	57.7820	57.9417	58.0991	58.8500	58.9927	59.6660	59.6660	59.7924	59.4048	58.9927	58.7048	58.4068	
alpha	4.8521	4.8628	4.8733	4.9233	4.9328	4.9777	4.9777	4.9862	4.9603	4.9328	4.9137	4.8938	
util living area	0.9976	0.9939	0.9853	0.9604	0.8941	0.7489	0.5774	0.6223	0.8427	0.9702	0.9947	0.9982	(86)
MIT	19.7142	19.8937	20.1483	20.4672	20.7475	20.9293	20.9845	20.9777	20.8651	20.4997	20.0449	19.6845	(87)
Th 2	19.9185	19.9212	19.9238	19.9360	19.9383	19.9490	19.9490	19.9510	19.9449	19.9383	19.9337	19.9288	(88)
util rest of house	0.9967	0.9919	0.9801	0.9451	0.8516	0.6570	0.4492	0.4945	0.7690	0.9557	0.9925	0.9976	(89)
MIT 2	18.7532	18.9338	19.1879	19.5077	19.7660	19.9159	19.9450	19.9446	19.8712	19.5452	19.0950	18.7318	(90)
Living area fraction									fLA = Living area / (4) =			0.2085	(91)
MIT	18.9536	19.1340	19.3881	19.7078	19.9707	20.1273	20.1618	20.1601	20.0785	19.7442	19.2931	18.9304	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9536	19.1340	19.3881	19.7078	19.9707	20.1273	20.1618	20.1601	20.0785	19.7442	19.2931	18.9304	(93)

8. Space heating requirement

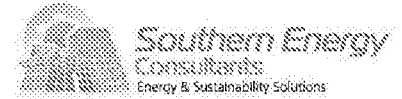
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	437.7250	517.9323	569.4245	589.3981	552.0351	422.7289	286.7803	300.0659	430.1058	474.3971	434.0695	411.1360	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(95)
Heat loss rate W	1235.6022	1196.9140	1080.8067	894.7800	683.0772	451.3458	290.8500	306.3914	490.3384	755.2241	1011.9689	1228.7940	(96)
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	593.6207	456.2757	380.4684	219.8750	97.4954	0.0000	0.0000	0.0000	0.0000	208.9353	416.0876	608.3376	(98)
Space heating												2981.0956	(98)
Space heating per m ²										(98) / (4) =		42.4900	(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	767.5878	604.2712	619.2912	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8574	0.9211	0.9041	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	658.1658	556.6195	559.9028	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	114.1628	170.5939	146.0224	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												430.7791	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

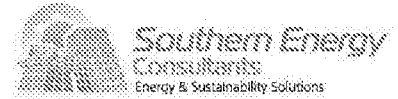


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	28.5407	42.6485	36.5056	0.0000	0.0000	0.0000 (107)
Space cooling											107.6948 (107)
Space cooling per m2											1.5350 (108)
Energy for space heating											42.4900 (99)
Energy for space cooling											1.5350 (108)
Total											44.0249 (109)
Target Fabric Energy Efficiency (TFEE)											50.6 (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 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
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) =		46.5215		(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) =	55.4642 (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	87.3963	87.0189	87.0189	86.4873	86.4873	85.8430	85.9971	85.6934	85.8430	86.1559	86.1559	86.6599 (39)
Average = Sum(39)m / 12 =												86.3964 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2457	1.2403	1.2403	1.2327	1.2327	1.2235	1.2257	1.2214	1.2235	1.2280	1.2280	1.2352 (40)
HLP (average)												1.2314 (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

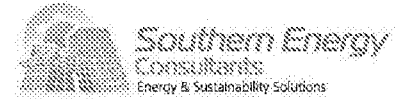
Elmhurst Energy Systems

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	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)
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	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	
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)

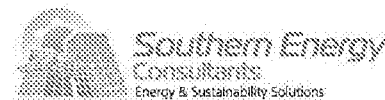
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	48.2392	48.4484	48.4484	48.7462	48.7462	49.1121	49.0240	49.1978	49.1121	48.9337	48.9337	48.6491
alpha	4.2159	4.2299	4.2299	4.2497	4.2497	4.2741	4.2683	4.2799	4.2741	4.2622	4.2622	4.2433
util living area	0.9767	0.9630	0.9319	0.8599	0.7215	0.4937	0.3283	0.3464	0.6137	0.8619	0.9550	0.9807 (86)
MIT	19.9064	20.0685	20.3404	20.6482	20.8783	20.9823	20.9977	20.9971	20.9534	20.7009	20.2714	19.8726 (87)
Th 2	19.8836	19.8879	19.8879	19.8939	19.8939	19.9012	19.8995	19.9029	19.9012	19.8977	19.8977	19.8920 (88)
util rest of house	0.9702	0.9529	0.9130	0.8215	0.6497	0.3917	0.2128	0.2290	0.5139	0.8160	0.9408	0.9752 (89)
MIT 2	18.4827	18.7162	19.0983	19.5156	19.7912	19.8928	19.8991	19.9024	19.8728	19.5948	19.0155	18.4405 (90)
Living area fraction	18.7795	18.9982	19.3573	19.7518	20.0179	20.1200	20.1282	20.1306	20.0982	19.8255	19.2774	18.7391 (91)
MIT	18.6295	18.8482	19.2073	19.6018	19.8679	19.9700	19.9782	19.9806	19.9482	19.6755	19.1274	18.5891 (92)
Temperature adjustment												-0.1500
adjusted MIT												18.5891 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	634.4649	690.4491	708.8393	679.1328	547.0891	336.5655	178.4922	186.5619	393.8893	566.9573	608.0361	603.2519	(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	1182.4320	1152.8458	1027.4568	839.0822	593.9865	340.7943	178.7155	186.8665	407.5957	695.7505	958.6903	1168.9640	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	407.6875	310.7306	237.0514	115.1636	34.8916	0.0000	0.0000	0.0000	0.0000	95.8221	252.4710	420.8898	(98)
Space heating												1874.7078	(98)
RHI space heating demand												1875	(98)

FULL SAP CALCULATION PRINTOUT

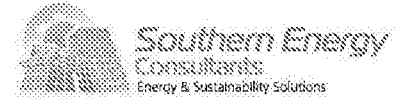
Calculation Type: New Build (As Designed)



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 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
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) =	46.5215		(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) =	55.4642 (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	89.3224	89.0900	88.8622	87.7921	87.5919	86.6599	86.6599	86.4873	87.0189	87.5919	87.9969	88.4203 (39)
Average = Sum(39)m / 12 =												87.7911 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2731	1.2698	1.2666	1.2513	1.2485	1.2352	1.2352	1.2327	1.2403	1.2485	1.2542	1.2603 (40)
HLP (average)												1.2513 (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)

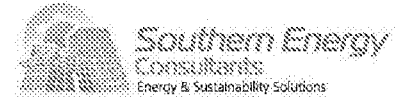
Regs Region: England

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 (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)
Total per year (kWh/year) = Sum(64)m =	1543.7815 (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	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	47.1990	47.3221	47.4435	48.0217	48.1315	48.6491	48.6491	48.7462	48.4484	48.1315	47.9100	47.6805
alpha	4.1466	4.1548	4.1629	4.2014	4.2088	4.2433	4.2433	4.2497	4.2299	4.2088	4.1940	4.1787
util living area	0.9820	0.9683	0.9437	0.8913	0.7918	0.6303	0.4736	0.5072	0.7164	0.9011	0.9682	0.9852 (86)
MIT	19.7492	19.9469	20.2145	20.5321	20.7889	20.9417	20.9862	20.9815	20.8964	20.5765	20.1078	19.7100 (87)
Th 2	19.8619	19.8646	19.8671	19.8792	19.8814	19.8920	19.8920	19.8939	19.8879	19.8814	19.8769	19.8721 (88)
util rest of house	0.9771	0.9599	0.9285	0.8613	0.7350	0.5390	0.3600	0.3930	0.6315	0.8675	0.9582	0.9811 (89)
MIT 2	18.2408	18.5255	18.9064	19.3515	19.6796	19.8526	19.8866	19.8860	19.8093	19.4220	18.7688	18.1914 (90)
Living area fraction									fLA = Living area /	(4) =	0.2085	91
MIT	18.5553	18.8219	19.1792	19.5977	19.9109	20.0797	20.1159	20.1145	20.0359	19.6628	19.0480	18.5081 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.4053	18.6719	19.0292	19.4477	19.7609	19.9297	19.9659	19.9645	19.8859	19.5128	18.8980	18.3581 (93)

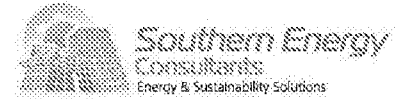
8. Space heating requirement

Utilisation	0.9682	0.9481	0.9142	0.8474	0.7282	0.5423	0.3679	0.4006	0.6313	0.8539	0.9464	0.9734 (94)
Useful gains	626.9122	699.3042	728.1660	706.9072	616.9743	443.0816	288.9329	304.2791	467.0305	590.0036	601.0993	597.7748 (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	1259.9197	1226.9382	1113.3674	926.0037	706.0725	461.8730	291.6889	308.2816	503.4867	780.6858	1038.1860	1251.8623 (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	470.9576	354.5701	286.5899	157.7494	66.2891	0.0000	0.0000	0.0000	0.0000	141.8676	314.7024	486.6411 (98)
Space heating												2279.3671 (98)
Space heating per m2												(98) / (4) = 32.4881 (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													2518.6377	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	470.9576	354.5701	286.5899	157.7494	66.2891	0.0000	0.0000	0.0000	0.0000	141.8676	314.7024	486.6411	(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)	520.3951	391.7901	316.6739	174.3088	73.2476	0.0000	0.0000	0.0000	0.0000	156.7597	347.7375	537.7250	(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	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	89.6780	89.5813	89.4088	89.0503	88.4010	87.3000	87.3000	87.3000	87.3000	88.9361	89.4847	87.3000	(216)	
(217)m	89.6780	89.5813	89.4088	89.0503	88.4010	87.3000	87.3000	87.3000	87.3000	88.9361	89.4847	89.7152	(217)	
Fuel for water heating, kWh/month	175.1241	153.7576	160.0037	141.5277	137.8979	122.1389	114.8065	129.4272	130.2861	147.0767	157.6699	170.0117	(219)	
Water heating fuel used												1739.7281	(219)	
Annual totals kWh/year														
Space heating fuel - main system												2518.6377	(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)	
Energy saving/generation technologies (Appendices M ,N and Q)														
Total delivered energy for all uses												4651.3868	(238)	

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2518.6377	3.4800	87.6486	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1739.7281	3.4800	60.5425	(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)
Energy saving/generation technologies				
PV Unit	0.0000	13.1900	0.0000	(252)
Total energy cost			320.0306	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):			0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$		1.1672 (257)
SAP value			83.7178
SAP rating (Section 12)			84 (258)
SAP band			B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2518.6377	0.2160	544.0257	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1739.7281	0.2160	375.7813	(264)
Space and water heating			919.8070	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	318.0210	0.5190	165.0529	(268)
Energy saving/generation technologies				
PV Unit	-2440.8000	0.5190	-1266.7752	(269)
Total kg/year			-142.9903	(272)
CO2 emissions per m2			-2.0400	(273)
EI value			101.6638	
EI rating			102	(274)
EI band			A	

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

Regs Region: England

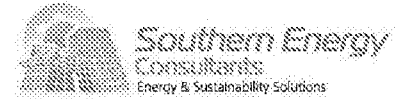
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating environmental impact
Water heating energy efficiency
Water heating environmental impact

$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4
 $3.48 / 0.8862 = 3.927$, stars = 4
 $0.216 / 0.8862 = 0.2437$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of EPC Costs, Emissions and Primary Energy 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
Calculation of EPC Costs, Emissions and Primary Energy 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
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) =		46.5215		(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) =				55.4642 (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	87.3963	87.0189	87.0189	86.4873	86.4873	85.8430	85.9971	85.6934	85.8430	86.1559	86.1559	86.6599 (39)
Average = Sum(39)m / 12 =												86.3964 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2457	1.2403	1.2403	1.2327	1.2327	1.2235	1.2257	1.2214	1.2235	1.2280	1.2280	1.2352 (40)
HLP (average)												1.2314 (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)

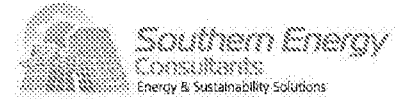
Regs Region: England

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)
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	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	48.2392	48.4484	48.4484	48.7462	48.7462	49.1121	49.0240	49.1978	49.1121	48.9337	48.9337	48.6491
alpha	4.2159	4.2299	4.2299	4.2497	4.2497	4.2741	4.2683	4.2799	4.2741	4.2622	4.2622	4.2433
util living area	0.9767	0.9630	0.9319	0.8599	0.7215	0.4937	0.3283	0.3464	0.6137	0.8619	0.9550	0.9807 (86)
MIT	19.9064	20.0685	20.3404	20.6482	20.8783	20.9823	20.9977	20.9971	20.9534	20.7009	20.2714	19.8726 (87)
Th 2	19.8836	19.8879	19.8879	19.8939	19.8939	19.9012	19.8995	19.9029	19.9012	19.8977	19.8977	19.8920 (88)
util rest of house	0.9702	0.9529	0.9130	0.8215	0.6497	0.3917	0.2128	0.2290	0.5139	0.8160	0.9408	0.9752 (89)
MIT 2	18.4827	18.7162	19.0983	19.5156	19.7912	19.8928	19.8991	19.9024	19.8728	19.5948	19.0155	18.4405 (90)
Living area fraction	18.7795	18.9982	19.3573	19.7518	20.0179	20.1200	20.1282	20.1306	20.0982	19.8255	19.2774	18.7391 (91)
MIT	18.7795	18.9982	19.3573	19.7518	20.0179	20.1200	20.1282	20.1306	20.0982	19.8255	19.2774	18.7391 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6295	18.8482	19.2073	19.6018	19.8679	19.9700	19.9782	19.9806	19.9482	19.6755	19.1274	18.5891 (93)

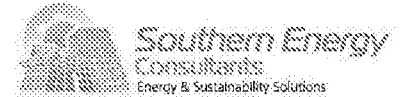
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9601	0.9406	0.8986	0.8097	0.6479	0.3983	0.2211	0.2374	0.5184	0.8050	0.9277	0.9662 (94)
Useful gains	634.4649	690.4491	708.8393	679.1328	547.0891	336.5655	178.4922	186.5619	393.8893	566.9573	608.0361	603.2519 (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	1182.4320	1152.8458	1027.4568	839.0822	593.9865	340.7943	178.7155	186.8665	407.5957	695.7505	958.6903	1168.9640 (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	407.6875	310.7306	237.0514	115.1636	34.8916	0.0000	0.0000	0.0000	0.0000	95.8221	252.4710	420.8898 (98)
Space heating												1874.7078 (98)
Space heating per m2												(98) / (4) = 26.7205 (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												2071.5003 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	407.6875	310.7306	237.0514	115.1636	34.8916	0.0000	0.0000	0.0000	0.0000	95.8221	252.4710	420.8898 (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)	450.4834	343.3488	261.9352	127.2526	38.5543	0.0000	0.0000	0.0000	0.0000	105.8808	278.9735	465.0716 (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	89.5868	89.4925	89.2685	88.7992	87.9924	87.3000	87.3000	87.3000	87.3000	88.6250	89.3262	87.3000 (216)
Fuel for water heating, kWh/month	175.3023	153.9102	160.2551	141.9279	138.5383	122.1389	114.8065	129.4272	130.2861	147.5931	157.9496	170.1807 (219)
Water heating fuel used												1742.3162 (219)
Annual totals kWh/year												
Space heating fuel - main system												2071.5003 (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)
Energy saving/generation technologies (Appendices M,N and Q)												
Total delivered energy for all uses												4206.8374 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2071.5003	3.8700	80.1671 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1742.3162	3.8700	67.4276 (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)
Energy saving/generation technologies			
PV Unit	0.0000	18.9000	0.0000 (252)
Total energy cost			314.8757 (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	2071.5003	0.2160	447.4441 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1742.3162	0.2160	376.3403 (264)
Space and water heating			823.7843 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	318.0210	0.5190	165.0529 (268)
Energy saving/generation technologies			
PV Unit	-2440.8000	0.5190	-1266.7752 (269)
Total kg/year			-239.0129 (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	2071.5003	1.2200	2527.2303 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1742.3162	1.2200	2125.6257 (264)
Space and water heating			4652.8560 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	318.0210	3.0700	976.3245 (268)
Energy saving/generation technologies			
PV Unit	-2440.8000	3.0700	-7493.2560 (269)
Primary energy kWh/year			-1633.8254 (272)
Primary energy kWh/m2/year			-23.2871 (273)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
Current environmental impact rating: A 102

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 27	-175 kg (73.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£27 2.50 kg/m²	B 85	A 104
Total Savings	£27 2.50 kg/m²		
Potential energy efficiency rating:		B 85	
Potential environmental impact rating:			A 104

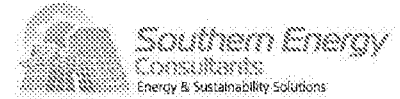
Fuel prices for cost data on this page from database revision number 470 TEST (21 Dec 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£74	£84	-£9
Mains gas	£241	£205	£36
Space heating	£187	£187	£0
Water heating	£67	£41	£27
Lighting	£60	£60	£0
Total cost of fuels	£315	£289	£27
Total cost of uses	£314	£288	£27
Delivered energy	60 kWh/m²	47 kWh/m²	13 kWh/m²
Carbon dioxide emissions	-0.2 tonnes	-0.4 tonnes	0.2 tonnes
CO2 emissions per m²	-3 kg/m²	-6 kg/m²	2 kg/m²
Primary energy	-23 kWh/m²	-37 kWh/m²	14 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 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
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) =	46.5215		(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) =	55.4642 (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	89.3224	89.0900	88.8622	87.7921	87.5919	86.6599	86.6599	86.4873	87.0189	87.5919	87.9969	88.4203 (39)
Average = Sum(39)m / 12 =												87.7911 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2731	1.2698	1.2666	1.2513	1.2485	1.2352	1.2352	1.2327	1.2403	1.2485	1.2542	1.2603 (40)
HLP (average)												1.2513 (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)

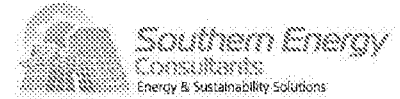
Regs Region: England

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	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												1079.5246 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1813.6014 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.3153 (H8)
Utilisation factor												0.5325 (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												-822.6836 (H17)
Solar input	-23.8562	-39.8091	-67.7995	-90.8647	-112.2556	-110.3652	-108.9067	-95.1523	-74.5233	-50.8907	-28.2969	-19.9636 (63)
	Solar input (sum of months) = Sum(63)m =											-822.6836 (63)
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	132.5628 (64)
	Total per year (kWh/year) = Sum(64)m =											733.5163 (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)

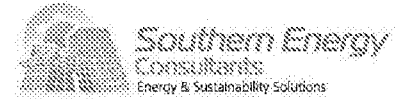
Solar gains	140.0711	234.1757	312.5036	380.2071	423.9992	421.3212	405.9480	372.4186	335.3951	256.3128	166.8757	120.5024	(83)
Total gains	647.4944	737.5951	796.5264	834.1784	847.3028	817.0379	785.4514	759.5947	739.7807	690.9502	635.1553	614.1399	(84)

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	47.1990	47.3221	47.4435	48.0217	48.1315	48.6491	48.6491	48.7462	48.4484	48.1315	47.9100	47.6805
alpha	4.1466	4.1548	4.1629	4.2014	4.2088	4.2433	4.2433	4.2497	4.2299	4.2088	4.1940	4.1787
util living area	0.9820	0.9683	0.9437	0.8913	0.7918	0.6303	0.4736	0.5072	0.7164	0.9011	0.9682	0.9852 (86)
MIT	19.7492	19.9469	20.2145	20.5321	20.7889	20.9417	20.9862	20.9815	20.8964	20.5765	20.1078	19.7100 (87)
Th 2	19.8619	19.8646	19.8671	19.8792	19.8814	19.8920	19.8920	19.8939	19.8879	19.8814	19.8769	19.8721 (88)
util rest of house	0.9771	0.9599	0.9285	0.8613	0.7350	0.5390	0.3600	0.3930	0.6315	0.8675	0.9582	0.9811 (89)
MIT 2	18.2408	18.5255	18.9064	19.3515	19.6796	19.8526	19.8866	19.8860	19.8093	19.4220	18.7688	18.1914 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.5553	18.8219	19.1792	19.5977	19.9109	20.0797	20.1159	20.1145	20.0359	19.6628	19.0480	18.5081 (91)
Temperature adjustment	-0.1500											
adjusted MIT	18.4053	18.6719	19.0292	19.4477	19.7609	19.9297	19.9659	19.9645	19.8859	19.5128	18.8980	18.3581 (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	0.9481	0.9142	0.8474	0.7282	0.5423	0.3679	0.4006	0.6313	0.8539	0.9464	0.9734	(94)
Useful gains	626.9122	699.3042	728.1660	706.9072	616.9743	443.0816	288.9329	304.2791	467.0305	590.0036	601.0993	597.7748	(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													
	1259.9197	1226.9382	1113.3674	926.0037	706.0725	461.8730	291.6889	308.2816	503.4867	780.6858	1038.1860	1251.8623	(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	470.9576	354.5701	286.5899	157.7494	66.2891	0.0000	0.0000	0.0000	0.0000	141.8676	314.7024	486.6411	(98)
Space heating												2279.3671	(98)
Space heating per m2											(98) / (4) =	32.4881	(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													2518.6377 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	470.9576	354.5701	286.5899	157.7494	66.2891	0.0000	0.0000	0.0000	0.0000	141.8676	314.7024	486.6411	(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)	520.3951	391.7901	316.6739	174.3088	73.2476	0.0000	0.0000	0.0000	0.0000	156.7597	347.7375	537.7250	(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	89.7745	89.7877	89.8153	89.8993	90.0805	87.3000	87.3000	87.3000	87.3000	89.3203	89.6331	89.7953	(216)
(217)m	89.7745	89.7877	89.8153	89.8993	90.0805	87.3000	87.3000	87.3000	87.3000	89.3203	89.6331	89.7953	(217)
Fuel for water heating, kWh/month	148.3623	109.0672	83.7918	39.1173	10.7099	0.0000	0.0000	20.4326	44.9215	89.4687	125.8391	147.6277	(219)
Water heating fuel used												819.3382	(219)
Annual totals kWh/year													
Space heating fuel - main system												2518.6377	(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)													
Total delivered energy for all uses												3780.9969	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2518.6377	3.4800	87.6486	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	819.3382	3.4800	28.5130	(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	0.0000	13.1900	0.0000	(252)
Total energy cost			294.5960	(255)

11a. SAP rating - Individual heating systems

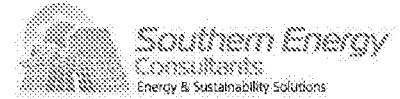
Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)		1.0744	(257)
SAP value	[(255) x (256)] / [(4) + 45.0] =	85.0116	
SAP rating (Section 12)		85	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	2518.6377	0.2160	544.0257 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	819.3382	0.2160	176.9771 (264)
Space and water heating			721.0028 (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	-2440.8000	0.5190	-1266.7752 (269)
Total kg/year			-315.8445 (272)
CO2 emissions per m2			-4.5000 (273)
EI value			103.6752
EI rating			104 (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 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
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) =	46.5215		(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) =	55.4642 (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	87.3963	87.0189	87.0189	86.4873	86.4873	85.8430	85.9971	85.6934	85.8430	86.1559	86.1559	86.6599 (39)
Average = Sum(39)m / 12 =												86.3964 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2457	1.2403	1.2403	1.2327	1.2327	1.2235	1.2257	1.2214	1.2235	1.2280	1.2280	1.2352 (40)
HLP (average)												1.2314 (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

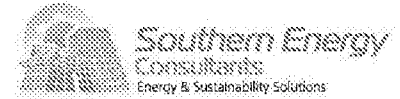
Elmhurst Energy Systems

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)		

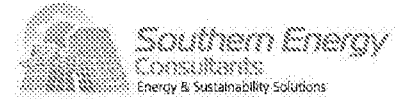
Solar gains	153.3858	230.6628	304.7845	384.8231	421.1364	449.3268	427.6410	398.7734	355.3901	269.6729	187.1655	130.7257 (83)
Total gains	660.8091	734.0822	788.8073	838.7943	844.4400	845.0436	807.1444	785.9495	759.7758	704.3102	655.4451	624.3633 (84)

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	48.2392	48.4484	48.4484	48.7462	48.7462	49.1121	49.0240	49.1978	49.1121	48.9337	48.9337	48.6491
alpha	4.2159	4.2299	4.2299	4.2497	4.2497	4.2741	4.2683	4.2799	4.2741	4.2622	4.2622	4.2433
util living area	0.9767	0.9630	0.9319	0.8599	0.7215	0.4937	0.3283	0.3464	0.6137	0.8619	0.9550	0.9807 (86)
MIT	19.9064	20.0685	20.3404	20.6482	20.8783	20.9823	20.9977	20.9971	20.9534	20.7009	20.2714	19.8726 (87)
Th 2	19.8836	19.8879	19.8879	19.8939	19.8939	19.9012	19.8995	19.9029	19.9012	19.8977	19.8977	19.8920 (88)
util rest of house	0.9702	0.9529	0.9130	0.8215	0.6497	0.3917	0.2128	0.2290	0.5139	0.8160	0.9408	0.9752 (89)
MIT 2	18.4827	18.7162	19.0983	19.5156	19.7912	19.8928	19.8991	19.9024	19.8728	19.5948	19.0155	18.4405 (90)
Living area fraction	fLA = Living area / (4) =											0.2085 (91)
MIT	18.7795	18.9982	19.3573	19.7518	20.0179	20.1200	20.1282	20.1306	20.0982	19.8255	19.2774	18.7391 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6295	18.8482	19.2073	19.6018	19.8679	19.9700	19.9782	19.9806	19.9482	19.6755	19.1274	18.5891 (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	0.9601	0.9406	0.8986	0.8097	0.6479	0.3983	0.2211	0.2374	0.5184	0.8050	0.9277	0.9662	(94)
Useful gains	634.4649	690.4491	708.8393	679.1328	547.0891	336.5655	178.4922	186.5619	393.8893	566.9573	608.0361	603.2519	(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													
	1182.4320	1152.8458	1027.4568	839.0822	593.9865	340.7943	178.7155	186.8665	407.5957	695.7505	958.6903	1168.9640	(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													
	407.6875	310.7306	237.0514	115.1636	34.8916	0.0000	0.0000	0.0000	0.0000	95.8221	252.4710	420.8898	(98)
Space heating												1874.7078	(98)
Space heating per m2											(98) / (4) =	26.7205	(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													2071.5003	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	407.6875	310.7306	237.0514	115.1636	34.8916	0.0000	0.0000	0.0000	0.0000	95.8221	252.4710	420.8898	(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)	450.4834	343.3488	261.9352	127.2526	38.5543	0.0000	0.0000	0.0000	0.0000	105.8808	278.9735	465.0716	(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	89.6992	89.7055	89.6875	89.7193	89.5941	87.3000	87.3000	87.3000	87.3000	89.0365	89.5059	89.7186	(216)	
(217)m	89.6992	89.7055	89.6875	89.7193	89.5941	87.3000	87.3000	87.3000	87.3000	89.0365	89.5059	89.7186	(217)	
Fuel for water heating, kWh/month	146.3481	110.3597	86.7627	39.9540	14.8345	0.0000	0.0000	15.3056	41.2138	87.4985	122.6294	146.2036	(219)	
Water heating fuel used												811.1100	(219)	
Annual totals kWh/year														
Space heating fuel - main system												2071.5003	(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)														
Total delivered energy for all uses													3325.6313	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost f/year	
Space heating - main system 1	2071.5003	3.8700	80.1671	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	811.1100	3.8700	31.3900	(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	0.0000	18.9000	0.0000	(252)
Total energy cost			288.2880	(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	2071.5003	0.2160	447.4441	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	811.1100	0.2160	175.1998	(264)
Space and water heating			622.6438	(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	-2440.8000	0.5190	-1266.7752	(269)
Total kg/year			-414.2035	(272)

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

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	2071.5003	1.2200	2527.2303 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	811.1100	1.2200	989.5542 (264)
Space and water heating			3516.7845 (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			
PV Unit	-2440.8000	3.0700	-7493.2560 (269)
Primary energy kWh/year			-2616.3970 (272)
Primary energy kWh/m2/year			-37.2919 (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	55.46 (37)
Summer heat loss coefficient	278.45 (P2)

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

Solar shading	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
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	g 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 525	Jul 500	Aug 466	(P4)
Internal gains	393	377	364	
Total summer gains	918	876	850	(P5)
Summer gain/loss ratio	3.30	3.15	3.05	(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	19.78	21.53	21.34	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			