

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECANG006		Issued on Date	04/02/2021	
Assessment Reference	001	Prop Type Ref	Det Br Ea Ga		
Property	Derwent, Plot 51				
SAP Rating	83 B	DER	18.66	TET	18.97
Environmental	85 B	% DER<TET	1.61		
CO ₂ Emissions (t/year)	1.36	DPEE	53.92	TPEE	57.72
General Requirements Compliance	Pass	% DPEE<TPEE	6.57		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey, [REDACTED]			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

Detached House, total floor area 88 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) 18.97 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.66 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)57.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.35 (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:

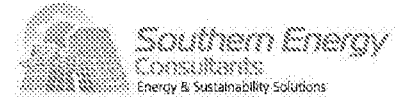
Overshading: Average
Windows facing North: 0.83 m², No overhang
Windows facing East: 7.72 m², No overhang
Windows facing South: 0.60 m², No overhang
Windows facing West: 5.22 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Thermal bridging y-value 0.038 W/m²K

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	44.2200 (1c)	x 2.5300 (2c)	= 111.8766 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3514 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4357 (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) =	0.3704 (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	0.4722	0.4630	0.4537	0.4074	0.3982	0.3519	0.3519	0.3426	0.3704	0.3982	0.4167	0.4352 (22b)
Effective ac	0.6115	0.6072	0.6029	0.5630	0.5793	0.5619	0.5619	0.5587	0.5686	0.5793	0.5868	0.5947 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			14.3700	1.2357	17.7576		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick Cavity	135.8700	18.6700	117.2000	0.2500	29.3000	60.0000	7032.0000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Total net area of external elements Aum (A, m ²)			224.3100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.2158		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17698.2000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 200.1153 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.5520 (36)
Total fabric heat loss (33) + (36) = 75.7678 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	43.4571	43.1494	42.8478	41.4311	41.1661	39.9322	39.9322	39.7037	40.4075	41.1661	41.7023	42.2628 (38)
Average = Sum(39)m / 12 =	119.2249	118.9172	118.6156	117.1989	116.9339	115.7000	115.7000	115.4715	116.1753	116.9339	117.4701	118.0306 (39)
												117.1976 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3481	1.3446	1.3412	1.3252	1.3222	1.3082	1.3082	1.3056	1.3136	1.3222	1.3282	1.3346 (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												2.6038 (42)
Average daily hot water use (litres/day)												96.0393 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	105.6432	101.8017	97.9601	94.1185	90.2769	86.4354	86.4354	90.2769	94.1185	97.9601	101.8017	105.6432 (44)
Energy content (annual)	156.6659	137.0210	141.3934	123.2702	118.2806	102.0672	94.5803	108.5322	109.8285	127.9945	139.7160	151.7225 (45)
										Total = Sum(45)m =		1511.0721 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.4999	20.5531	21.2090	18.4905	17.7421	15.3101	14.1870	16.2798	16.4743	19.1992	20.9574	22.7584 (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	14.1326	12.7541	14.0890	13.5912	14.0128	13.5245	13.9528	13.9917	13.5609	14.0575	13.6481	14.1207 (61)
Total heat required for water heating calculated for each month	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432 (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	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432 (64)
Heat gains from water heating, kWh/month	55.6245	48.7480	50.5355	44.3851	42.8315	37.3185	34.9361	39.5849	39.9082	46.0725	49.8676	53.9779 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1676.5080 (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	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.9007	19.4520	15.8194	11.9763	8.9525	7.5580	8.1667	10.6154	14.2480	18.0911	21.1150	22.5094 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.1783	238.6291	232.4532	219.3054	202.7086	187.1101	176.6892	174.2385	180.4144	193.5622	210.1589	225.7575 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188 (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)	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504 (71)
Water heating gains (Table 5)	74.7642	72.5417	67.9241	61.6460	57.5693	51.8312	46.9572	53.2055	55.4280	61.9254	69.2605	72.5510 (72)
Total internal gains	397.8996	395.6792	381.2531	357.9841	334.2867	311.5557	296.8695	303.1158	315.1468	338.6351	365.5908	385.8742 (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					0.8300	10.6334	0.4400	0.0000	0.7700		2.9902 (74)	
East					7.7200	19.6403	0.4400	0.0000	0.7700		51.3698 (76)	
South					0.6000	46.7521	0.4400	0.0000	0.7700		9.5038 (78)	
West					5.2200	19.6403	0.4400	0.0000	0.7700		34.7345 (80)	
Solar gains	98.5982	189.7174	306.9307	442.5678	540.1679	552.5106	526.1607	453.0490	355.0066	223.4564	122.3159	81.5129 (83)
Total gains	496.4978	585.3965	688.1838	800.5519	874.4547	864.0663	823.0303	756.1648	670.1534	562.0916	487.9067	467.3871 (84)

7. Mean internal temperature (heating season)

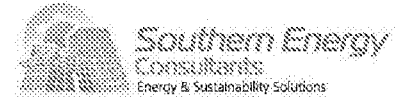
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	41.2344	41.3411	41.4462	41.9472	42.0423	42.4906	42.4906	42.5747	42.3168	42.0423	41.8504	41.6516
alpha	3.7490	3.7561	3.7631	3.7965	3.8028	3.8327	3.8327	3.8383	3.8211	3.8028	3.7900	3.7768
util living area	0.9959	0.9919	0.9807	0.9469	0.8683	0.7279	0.5770	0.6367	0.8570	0.9707	0.9928	0.9967 (86)
MIT	19.1906	19.3861	19.7347	20.1982	20.6010	20.8641	20.9584	20.9393	20.7232	20.1850	19.6058	19.1607 (87)
Th 2	19.8034	19.8061	19.8087	19.8212	19.8235	19.8344	19.8344	19.8364	19.8302	19.8235	19.8188	19.8138 (88)
util rest of house	0.9947	0.9895	0.9747	0.9295	0.8232	0.6355	0.4423	0.5028	0.7899	0.9580	0.9903	0.9958 (89)
MIT 2	17.4048	17.6914	18.1988	18.8678	19.4139	19.7334	19.8162	19.8067	19.5870	18.8620	18.0213	17.3678 (90)
Living area fraction	17.6814	17.9539	18.4367	19.0739	19.5978	19.9086	19.9931	19.9822	19.7630	19.0670	18.2667	17.6455 (92)
MIT	17.6814	17.9539	18.4367	19.0739	19.5978	19.9086	19.9931	19.9822	19.7630	19.0670	18.2667	17.6455 (91)
Temperature adjustment												-0.1500
adjusted MIT	17.5314	17.8039	18.2867	18.9239	19.4478	19.7586	19.8431	19.8322	19.6130	18.9170	18.1167	17.4955 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9910	0.9833	0.9635	0.9117	0.8056	0.6286	0.4434	0.5023	0.7743	0.9435	0.9844	0.9927 (94)
Useful gains	492.0167	575.5953	663.0603	729.8660	704.4387	543.1647	364.9415	379.7957	518.8739	530.3157	480.2986	463.9926 (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	1577.5165	1534.4990	1398.0920	1174.7894	905.9846	596.8473	375.2320	396.3201	640.4792	972.5333	1294.1352	1569.2780 (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	807.6118	644.3833	546.8636	320.3448	149.9502	0.0000	0.0000	0.0000	0.0000	329.0099	585.9623	822.3324 (98)
Space heating												4206.4584 (98)
Space heating per m2												(98) / (4) = 47.5628 (99)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4648.0203 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	807.6118	644.3833	546.8636	320.3448	149.9502	0.0000	0.0000	0.0000	0.0000	329.0099	585.9623	822.3324	(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)	892.3888	712.0257	604.2692	353.9722	165.6908	0.0000	0.0000	0.0000	0.0000	363.5469	647.4722	908.6546	(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	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432	(64)
Efficiency of water heater (217)m	89.9246	89.8787	89.7715	89.5178	88.9714	87.3000	87.3000	87.3000	87.3000	89.5106	89.8171	89.9467	(217)
Fuel for water heating, kWh/month	189.9352	166.6414	173.1978	152.8874	148.6922	132.4075	124.3219	140.3482	141.3395	158.6985	170.7516	184.3795	(219)
Water heating fuel used												1883.6006	(219)
Annual totals kWh/year													
Space heating fuel - main system												4648.0203	(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)												386.7735	(232)
Total delivered energy for all uses												6993.3944	(238)

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

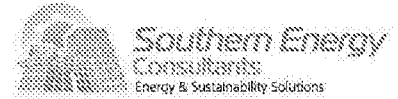
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4648.0203	0.2160	1003.9724 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1883.6006	0.2160	406.8577 (264)
Space and water heating			1410.8301 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	386.7735	0.5190	200.7355 (268)
Total CO2, kg/year			1650.4906 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.6600 (273)

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

DER		18.6600	ZC1
Total Floor Area	TFA	88.4400	
Assumed number of occupants	N	2.6038	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.8248	ZC2
CO2 emissions from cooking, equation (L16)		2.0521	ZC3
Total CO2 emissions		36.5369	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		36.5369	ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	44.2200 (1c)	x 2.5300 (2c)	= 111.8766 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3514 (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) = 0.1393 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3893 (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) =	0.3309 (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	0.4219	0.4136	0.4054	0.3640	0.3557	0.3144	0.3144	0.3061	0.3309	0.3557	0.3723	0.3888 (22b)
Effective ac	0.5890	0.5855	0.5822	0.5662	0.5633	0.5494	0.5494	0.5468	0.5548	0.5633	0.5693	0.5756 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
TER Opaque door			2.1500	1.0000	2.1500			(26)					
TER Semi-glazed door			2.1500	1.2000	2.5800			(26a)					
TER Opening Type (Uw = 1.40)			14.3700	1.3258	19.0511			(27)					
Heat Loss Floor 1			44.2200	0.1300	5.7486			(28a)					
Brick Cavity	135.8700	18.6700	117.2000	0.1800	21.0960			(29a)					
Main Plane	44.2200		44.2200	0.1300	5.7486			(30)					
Total net area of external elements Aum(A, m2)			224.3100					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.3743			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								10.7128 (36)					
Total fabric heat loss						(33) + (36) =		67.0871 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 41.8582	Feb 41.6126	Mar 41.3718	Apr 40.2410	May 40.0294	Jun 39.0446	Jul 39.0446	Aug 38.8622	Sep 39.4239	Oct 40.0294	Nov 40.4574	Dec 40.9049	(38)
Heat transfer coeff	108.9453	108.6997	108.4590	107.3282	107.1166	106.1317	106.1317	105.9493	106.5111	107.1166	107.5446	107.9920	(39)
Average = Sum(39)m / 12 =												107.3271	(39)
HLP	Jan 1.2319	Feb 1.2291	Mar 1.2264	Apr 1.2136	May 1.2112	Jun 1.2000	Jul 1.2000	Aug 1.1980	Sep 1.2043	Oct 1.2112	Nov 1.2160	Dec 1.2211	(40)
HLP (average)												1.2136	(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												2.6038 (42)
Average daily hot water use (litres/day)												96.0393 (43)
Daily hot water use	Jan 105.6432	Feb 101.8017	Mar 97.9601	Apr 94.1185	May 90.2769	Jun 86.4354	Jul 86.4354	Aug 90.2769	Sep 94.1185	Oct 97.9601	Nov 101.8017	Dec 105.6432 (44)
Energy conte	156.6659	137.0210	141.3934	123.2702	118.2806	102.0672	94.5803	108.5322	109.8285	127.9945	139.7160	151.7225 (45)
Energy content (annual)												Total = Sum(45)m = 1511.0721 (45)
Distribution loss (46)m = 0.15 x (45)m	23.4999	20.5531	21.2090	18.4905	17.7421	15.3101	14.1870	16.2798	16.4743	19.1992	20.9574	22.7584 (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)

Regs Region: England

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If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	49.9194	46.4146	46.0041	42.6257	44.0465	46.0041	46.4146	49.9194	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	207.6248	183.0484	191.3127	169.6848	164.2848	144.6929	138.6268	154.5364	156.2431	177.9139	189.0311	202.6814	(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	207.6248	183.0484	191.3127	169.6848	164.2848	144.6929	138.6268	154.5364	156.2431	177.9139	189.0311	202.6814	(64)
Heat gains from water heating, kWh/month	64.8311	57.0663	59.4931	52.5910	50.8293	44.5938	42.4596	47.5880	48.1216	55.0380	58.7843	63.1875	(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	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.9007	19.4520	15.8194	11.9763	8.9525	7.5580	8.1667	10.6154	14.2480	18.0911	21.1150	22.5094	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.1783	238.6291	232.4532	219.3054	202.7086	187.1101	176.6892	174.2385	180.4144	193.5622	210.1589	225.7575	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	(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)	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	(71)
Water heating gains (Table 5)	87.1386	84.9201	79.9639	73.0430	68.3190	61.9358	57.0693	63.9624	66.8356	73.9758	81.6449	84.9294	(72)
Total internal gains	410.2740	408.0576	393.2929	369.3811	345.0365	321.6603	306.9817	313.8726	326.5543	350.6855	377.9752	398.2527	(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				0.8300	10.6334	0.6300	0.7000			0.7700			2.6973 (74)
East				7.7200	19.6403	0.6300	0.7000			0.7700			46.3379 (76)
South				0.6000	46.7521	0.6300	0.7000			0.7700			8.5728 (78)
West				5.2200	19.6403	0.6300	0.7000			0.7700			31.3321 (80)

Solar gains	88.9401	171.1337	276.8654	399.2163	487.2560	498.3897	474.6209	408.6708	320.2321	201.5679	110.3345	73.5283	(83)
Total gains	499.2141	579.1913	670.1583	768.5974	832.2925	820.0500	781.6026	722.5434	646.7864	552.2534	488.3097	471.7810	(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	56.3738	56.5012	56.6266	57.2233	57.3363	57.8684	57.8684	57.9680	57.6622	57.3363	57.1081	56.8715		
alpha	4.7583	4.7667	4.7751	4.8149	4.8224	4.8579	4.8579	4.8645	4.8441	4.8224	4.8072	4.7914		
util living area	0.9985	0.9966	0.9902	0.9657	0.8934	0.7431	0.5768	0.6386	0.8772	0.9826	0.9969	0.9988	(86)	
MIT	19.6179	19.7722	20.0479	20.4159	20.7347	20.9265	20.9830	20.9727	20.8238	20.3999	19.9422	19.5920	(87)	
Th 2	19.8946	19.8968	19.8990	19.9092	19.9111	19.9200	19.9200	19.9216	19.9165	19.9111	19.9072	19.9032	(88)	
util rest of house	0.9979	0.9953	0.9865	0.9520	0.8503	0.6491	0.4456	0.5061	0.8106	0.9733	0.9956	0.9984	(89)	
MIT 2	18.0544	18.2813	18.6838	19.2174	19.6467	19.8701	19.9137	19.9102	19.7698	19.2038	18.5376	18.0226	(90)	
Living area fraction	18.2966	18.5122	18.8951	19.4031	19.8153	20.0338	20.0793	20.0748	19.9331	19.3891	18.7552	18.2657	(92)	
MIT	18.2966	18.5122	18.8951	19.4031	19.8153	20.0338	20.0793	20.0748	19.9331	19.3891	18.7552	18.2657	(93)	
Temperature adjustment														
adjusted MIT	18.2966	18.5122	18.8951	19.4031	19.8153	20.0338	20.0793	20.0748	19.9331	19.3891	18.7552	18.2657		

8. Space heating requirement

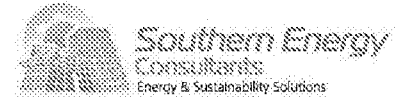
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	497.5573	575.1418	657.8382	725.2395	703.9070	541.2411	364.1020	380.2301	525.0622	534.0039	485.0884	470.5799	(94)	
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)	
Heat loss rate W	1524.8648	1479.6467	1344.3617	1127.2757	869.2792	576.6957	369.2669	389.3419	621.2888	941.4531	1253.4491	1518.9838	(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	764.3168	607.8273	510.7735	289.4660	123.0369	0.0000	0.0000	0.0000	0.0000	303.1422	553.2197	780.0125	(98)	
Space heating												3931.7951	(98)	
Space heating per m ²												(98) / (4) =	44.4572	(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												4209.6307 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	764.3168	607.8273	510.7735	289.4660	123.0369	0.0000	0.0000	0.0000	0.0000	303.1422	553.2197	780.0125 (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)	818.3263	650.7787	546.8667	309.9208	131.7312	0.0000	0.0000	0.0000	0.0000	324.5634	592.3123	835.1312 (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	207.6248	183.0484	191.3127	169.6848	164.2848	144.6929	138.6268	154.5364	156.2431	177.9139	189.0311	202.6814 (64)
Efficiency of water heater (217)m	88.0346	87.8428	87.4043	86.3846	84.3348	80.3000	80.3000	80.3000	80.3000	86.3817	87.5942	88.1142 (217)
Fuel for water heating, kWh/month	235.8444	208.3818	218.8824	196.4294	194.8006	180.1904	172.6361	192.4488	194.5742	205.9624	215.8033	230.0214 (219)
Water heating fuel used												2445.9752 (219)
Annual totals kWh/year												
Space heating fuel - main system												4209.6307 (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)												386.7735 (232)
Total delivered energy for all uses												7117.3794 (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	4209.6307	0.2160	909.2802 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2445.9752	0.2160	528.3306 (264)
Space and water heating			1437.6109 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	386.7735	0.5190	200.7355 (268)
Total CO2, kg/m2/year			1677.2713 (272)
Emissions per m2 for space and water heating			16.2552 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2697 (272b)
Emissions per m2 for pumps and fans			0.4401 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2552 * 1.00) + 2.2697 + 0.4401, rounded to 2 d.p.			18.9700 (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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	44.2200 (1c)	x 2.5300 (2c)	= 111.8766 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3514 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					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) = 0.1393 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3893 (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)	=	0.3309 (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	0.4219	0.4136	0.4054	0.3640	0.3557	0.3144	0.3144	0.3061	0.3309	0.3557	0.3723	0.3888 (22b)
Effective ac	0.5890	0.5855	0.5822	0.5662	0.5633	0.5494	0.5494	0.5468	0.5548	0.5633	0.5693	0.5756 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			14.3700	1.2357	17.7576		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick Cavity	135.8700	18.6700	117.2000	0.2500	29.3000	60.0000	7032.0000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Total net area of external elements Aum (A, m ²)			224.3100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.2158		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			9.0000	397.9800 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss
(28)...(30) + (32) + (32a)...(32e) = 17300.2200 (34)
195.6153 (35)
8.5520 (36)
(33) + (36) = 75.7678 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	41.8582	41.6126	41.3718	40.2410	40.0294	39.0446	39.0446	38.8622	39.4239	40.0294	40.4574	40.9049 (38)
Heat transfer coeff	117.6260	117.3804	117.1396	116.0088	115.7972	114.8123	114.8123	114.6299	115.1917	115.7972	116.2252	116.6727 (39)
Average = Sum(39)m / 12 =												116.0078 (39)
HLP	1.3300	1.3272	1.3245	1.3117	1.3093	1.2982	1.2982	1.2961	1.3025	1.3093	1.3142	1.3192 (40)
HLP (average)												1.3117 (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												2.6038 (42)
Average daily hot water use (litres/day)												96.0393 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.6432	101.8017	97.9601	94.1185	90.2769	86.4354	86.4354	90.2769	94.1185	97.9601	101.8017	105.6432 (44)
Energy conte	156.6659	137.0210	141.3934	123.2702	118.2806	102.0672	94.5803	108.5322	109.8285	127.9945	139.7160	151.7225 (45)
Energy content (annual)										Total = Sum(45)m =		1511.0721 (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

Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.2915	29.1170	30.0461	26.1949	25.1346	21.6893	20.0983	23.0631	23.3385	27.1988	29.6896	32.2410 (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	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.9007	19.4520	15.8194	11.9763	8.9525	7.5580	8.1667	10.6154	14.2480	18.0911	21.1150	22.5094	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.1783	236.6291	232.4532	219.3054	202.7066	187.1101	176.6892	174.2385	180.4144	193.5622	210.1589	225.7575	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	(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)	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	(71)
Water heating gains (Table 5)	44.7466	43.3288	40.3845	36.3818	33.7831	30.1240	27.0139	30.9988	32.4146	36.5576	41.2356	43.3347	(72)
Total internal gains	364.8820	363.4663	350.7135	329.7199	307.5006	286.8485	273.9262	277.9091	289.1334	310.2672	334.5659	353.6580	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.8300	10.6334	0.4400		0.0000	0.7700	2.9902 (74)
East	7.7200	19.6403	0.4400		0.0000	0.7700	51.3698 (76)
South	0.6000	46.7521	0.4400		0.0000	0.7700	9.5038 (78)
West	5.2200	19.6403	0.4400		0.0000	0.7700	34.7345 (80)

Solar gains	98.5982	189.7174	306.9307	442.5678	540.1679	552.5106	526.1607	453.0490	355.0066	223.4564	122.3159	81.5129	(83)
Total gains	463.4803	553.1837	657.6442	772.2877	847.6685	839.3591	800.0870	730.9581	644.1400	533.7237	456.8818	435.1709	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.8551	40.9406	41.0247	41.4246	41.5003	41.8563	41.8563	41.9229	41.7184	41.5003	41.3474	41.1889	
alpha	3.7237	3.7294	3.7350	3.7616	3.7667	3.7904	3.7904	3.7949	3.7812	3.7667	3.7565	3.7459	
util living area	0.9965	0.9927	0.9821	0.9495	0.8730	0.7357	0.5856	0.6478	0.8649	0.9735	0.9937	0.9972	(86)
MIT	19.1465	19.3452	19.6999	20.1698	20.5826	20.8543	20.9545	20.9332	20.7051	20.1516	19.5623	19.1130	(87)
Th 2	19.8174	19.8196	19.8217	19.8317	19.8335	19.8422	19.8422	19.8439	19.8389	19.8335	19.8297	19.8258	(88)
util rest of house	0.9955	0.9907	0.9767	0.9332	0.8297	0.6449	0.4512	0.5148	0.8010	0.9620	0.9916	0.9964	(89)
MIT 2	18.1349	18.3343	18.6877	19.1536	19.5380	19.7670	19.8283	19.8209	19.6588	19.1449	18.5592	18.1078	(90)
Living area fraction									fLA = Living area / (4) =			0.1549	(91)
MIT	18.2916	18.4909	18.8445	19.3111	19.6998	19.9354	20.0027	19.9932	19.8209	19.3009	18.7146	18.2635	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2916	18.4909	18.8445	19.3111	19.6998	19.9354	20.0027	19.9932	19.8209	19.3009	18.7146	18.2635	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	460.5004	546.1782	638.2783	713.5092	698.2811	548.1726	377.0301	390.1051	515.1635	509.6356	451.6885	432.9503	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1645.7756	1595.3074	1446.0251	1207.7735	926.3527	612.5735	390.6775	411.8872	658.9981	1007.5373	1349.9099	1640.8271	(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	881.8448	705.0148	600.9636	355.8703	169.6852	0.0000	0.0000	0.0000	0.0000	370.4389	646.7194	898.6603	(98)
Space heating												4629.1973	(98)
Space heating per m2										(98) / (4) =		52.3428	(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	1079.2360	849.6113	871.1876	0.0000	0.0000	0.0000	0.0000	(100)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

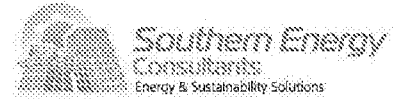


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7913	0.8603	0.8252	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	854.0028	730.9257	718.8866	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1079.3810	1031.4406	952.4340	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	162.2723	223.5831	173.7593	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												559.6147 (104)
Intermittency factor (Table 10b)									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	40.5681	55.8958	43.4398	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												139.9037 (107)
Energy for space heating												1.5819 (108)
Energy for space cooling												52.3428 (99)
Total												1.5819 (108)
Dwelling Fabric Energy Efficiency (DFEE)												53.9247 (109)
												53.9 (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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	44.2200 (1c)	x 2.5300 (2c)	= 111.8766 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3514 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					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) = 0.1393 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3893 (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) =	0.3309 (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	0.4219	0.4136	0.4054	0.3640	0.3557	0.3144	0.3144	0.3061	0.3309	0.3557	0.3723	0.3888 (22b)
Effective ac	0.5890	0.5855	0.5822	0.5662	0.5633	0.5494	0.5494	0.5468	0.5548	0.5633	0.5693	0.5756 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
TER Opaque door			2.1500	1.0000	2.1500			(26)					
TER Semi-glazed door			2.1500	1.2000	2.5800			(26a)					
TER Opening Type (Uw = 1.40)			14.3700	1.3258	19.0511			(27)					
Heat Loss Floor 1			44.2200	0.1300	5.7486			(28a)					
Brick Cavity	135.8700	18.6700	117.2000	0.1800	21.0960			(29a)					
Main Plane	44.2200		44.2200	0.1300	5.7486			(30)					
Total net area of external elements Aum(A, m2)			224.3100					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.3743			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								10.7128 (36)					
Total fabric heat loss						(33) + (36) =		67.0871 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 41.8582	Feb 41.6126	Mar 41.3718	Apr 40.2410	May 40.0294	Jun 39.0446	Jul 39.0446	Aug 38.8622	Sep 39.4239	Oct 40.0294	Nov 40.4574	Dec 40.9049	(38)
Heat transfer coeff	108.9453	108.6997	108.4590	107.3282	107.1166	106.1317	106.1317	105.9493	106.5111	107.1166	107.5446	107.9920	(39)
Average = Sum(39)m / 12 =												107.3271	(39)
HLP	Jan 1.2319	Feb 1.2291	Mar 1.2264	Apr 1.2136	May 1.2112	Jun 1.2000	Jul 1.2000	Aug 1.1980	Sep 1.2043	Oct 1.2112	Nov 1.2160	Dec 1.2211	(40)
HLP (average)												1.2136	(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												2.6038 (42)
Average daily hot water use (litres/day)												96.0393 (43)
Daily hot water use	Jan 105.6432	Feb 101.8017	Mar 97.9601	Apr 94.1185	May 90.2769	Jun 86.4354	Jul 86.4354	Aug 90.2769	Sep 94.1185	Oct 97.9601	Nov 101.8017	Dec 105.6432 (44)
Energy conte	156.6659	137.0210	141.3934	123.2702	118.2806	102.0672	94.5803	108.5322	109.8285	127.9945	139.7160	151.7225 (45)
Energy content (annual)												Total = Sum(45)m = 1511.0721 (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)

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 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	33.2915	29.1170	30.0461	26.1949	25.1346	21.6893	20.0983	23.0631	23.3385	27.1988	29.6896	32.2410 (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	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	130.1880	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.9007	19.4520	15.8194	11.9763	8.9525	7.5580	8.1667	10.6154	14.2480	18.0911	21.1150	22.5094	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.1783	238.6291	232.4532	219.3054	202.7086	187.1101	176.6892	174.2385	180.4144	193.5622	210.1589	225.7575	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	36.0188	(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)	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	(71)
Water heating gains (Table 5)	44.7466	43.3288	40.3845	36.3818	33.7831	30.1240	27.0139	30.9988	32.4146	36.5576	41.2356	43.3347	(72)
Total internal gains	364.8820	363.4663	350.7135	329.7199	307.5006	286.8485	273.9262	277.9091	289.1334	310.2672	334.5659	353.6580	(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	0.8300	10.6334	0.6300	0.7000	0.7700	2.6973 (74)
East	7.7200	19.6403	0.6300	0.7000	0.7700	46.3379 (76)
South	0.6000	46.7521	0.6300	0.7000	0.7700	8.5728 (78)
West	5.2200	19.6403	0.6300	0.7000	0.7700	31.3321 (80)

Solar gains	88.9401	171.1337	276.8654	399.2163	487.2560	498.3897	474.6209	408.6708	320.2321	201.5679	110.3345	73.5283	(83)
Total gains	453.8221	534.6000	627.5790	728.9362	794.7566	785.2382	748.5471	686.5798	609.3655	511.8351	444.9004	427.1863	(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	56.3738	56.5012	56.6266	57.2233	57.3363	57.8684	57.8684	57.9680	57.6622	57.3363	57.1081	56.8715	
alpha	4.7583	4.7667	4.7751	4.8149	4.8224	4.8579	4.8579	4.8645	4.8441	4.8224	4.8072	4.7914	
util living area	0.9990	0.9976	0.9925	0.9718	0.9070	0.7642	0.5985	0.6649	0.8964	0.9872	0.9979	0.9993	(86)
MIT	19.5707	19.7262	20.0052	20.3804	20.7108	20.9167	20.9801	20.9675	20.8016	20.3607	19.8973	19.5455	(87)
Th 2	19.8946	19.8968	19.8990	19.9092	19.9111	19.9200	19.9200	19.9216	19.9165	19.9111	19.9072	19.9032	(88)
util rest of house	0.9986	0.9967	0.9896	0.9602	0.8674	0.6715	0.4642	0.5303	0.8357	0.9801	0.9970	0.9990	(89)
MIT 2	18.5911	18.7481	19.0274	19.4035	19.7113	19.8806	19.9149	19.9121	19.8006	19.3904	18.9274	18.5728	(90)
Living area fraction									fLA = Living area / (4) =			0.1549	(91)
MIT	18.7429	18.8996	19.1789	19.5548	19.8662	20.0411	20.0799	20.0756	19.9556	19.5407	19.0777	18.7234	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7429	18.8996	19.1789	19.5548	19.8662	20.0411	20.0799	20.0756	19.9556	19.5407	19.0777	18.7234	(93)

8. Space heating requirement

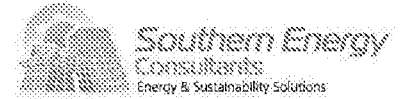
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9981	0.9956	0.9870	0.9553	0.8654	0.6830	0.4852	0.5511	0.8384	0.9767	0.9960	0.9986	(94)
Ext temp.	452.9510	532.2259	619.4338	696.3288	687.7849	536.3447	363.1778	378.3455	510.8751	499.9121	443.1397	426.5749	(95)
Ext temp.	4.3000	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	1573.4844	1521.7538	1375.1363	1143.5620	874.7307	577.4765	369.3240	389.4286	623.6887	957.7018	1288.1315	1568.4166	(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	833.6769	664.9628	562.2427	322.0079	139.0876	0.0000	0.0000	0.0000	0.0000	340.5955	608.3941	849.5303	(98)
Space heating												4320.4977	(98)
Space heating per m ²											(98) / (4) =	48.8523	(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	997.6379	785.3745	805.2147	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8368	0.9042	0.8724	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	834.8351	710.1303	702.4311	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1016.1228	971.1992	900.5634	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													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	130.5271	194.2352	147.4104	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												472.1728 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	32.6318	48.5588	36.8526	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												118.0432 (107)
Space cooling per m2												1.3347 (108)
Energy for space heating												48.8523 (99)
Energy for space cooling												1.3347 (108)
Total												50.1870 (109)
Target Fabric Energy Efficiency (TFEE)												57.7 (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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	44.2200 (1c)	x 2.5300 (2c)	= 111.8766 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3514 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4357 (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) =	0.3704 (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	0.3889	0.3704	0.3704	0.3426	0.3426	0.3056	0.3148	0.2963	0.3056	0.3241	0.3241	0.3519 (22b)
Effective ac	0.5756	0.5686	0.5686	0.5587	0.5587	0.5467	0.5496	0.5439	0.5467	0.5525	0.5525	0.5619 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			14.3700	1.2357	17.7576		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick Cavity	135.8700	18.6700	117.2000	0.2500	29.3000	60.0000	7032.0000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Total net area of external elements Aum (A, m ²)			224.3100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.2158		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17698.2000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 200.1153 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.5520 (36)
Total fabric heat loss (33) + (36) = 75.7678 (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	40.9071	40.4075	40.4075	39.7037	39.7037	38.8507	39.0548	38.6527	38.8507	39.2650	39.2650	39.9322 (38)
Heat transfer coeff	116.6749	116.1753	116.1753	115.4715	115.4715	114.6185	114.8226	114.4204	114.6185	115.0328	115.0328	115.7000 (39)
Average = Sum(39)m / 12 =												115.3512 (39)
HLP	1.3193	1.3136	1.3136	1.3056	1.3056	1.2960	1.2983	1.2938	1.2960	1.3007	1.3007	1.3082 (40)
HLP (average)												1.3043 (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												2.6038 (42)
Average daily hot water use (litres/day)												96.0393 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.6432	101.8017	97.9601	94.1185	90.2769	86.4354	86.4354	90.2769	94.1185	97.9601	101.8017	105.6432 (44)
Energy conte	156.6659	137.0210	141.3934	123.2702	118.2806	102.0672	94.5803	108.5322	109.8285	127.9945	139.7160	151.7225 (45)
Energy content (annual)										Total = Sum(45)m =		1511.0721 (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

Distribution loss (46)m = 0.15 x (45)m	23.4999	20.5531	21.2090	18.4905	17.7421	15.3101	14.1870	16.2798	16.4743	19.1992	20.9574	22.7584 (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	14.1326	12.7541	14.0890	13.5912	14.0128	13.5245	13.9528	13.9917	13.5609	14.0575	13.6481	14.1207 (61)
Total heat required for water heating calculated for each month	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432 (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	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	55.6245	48.7480	50.5355	44.3851	42.8315	37.3185	34.9361	39.5849	39.9082	46.0725	49.8676	53.9779 (65)
												1677 (64)
												1676.5080 (64)
												1677 (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	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	54.7518	48.6301	39.5486	29.9409	22.3811	18.8951	20.4168	26.5386	35.6200	45.2278	52.7875	56.2735 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.5049	356.1628	346.9450	327.3214	302.5502	279.2687	263.7153	260.0574	269.2752	288.8987	313.6700	336.9514 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263 (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)	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504 (71)
Water heating gains (Table 5)	74.7642	72.5417	67.9241	61.6460	57.5693	51.8312	46.9572	53.2055	55.4280	61.9254	69.2605	72.5510 (72)
Total internal gains	590.3224	585.6360	562.7193	527.2098	490.8021	458.2966	439.3908	448.1030	468.6247	504.3535	544.0195	574.0774 (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					0.8300	11.9814	0.4400	0.0000	0.7700		3.3692 (74)	
East					7.7200	22.3313	0.4400	0.0000	0.7700		58.4084 (76)	
South					0.6000	50.9848	0.4400	0.0000	0.7700		10.3642 (78)	
West					5.2200	22.3313	0.4400	0.0000	0.7700		39.4937 (80)	
Solar gains	111.6355	193.3513	308.7900	458.0973	544.0159	595.1973	560.7983	494.2849	386.9051	243.1298	141.9021	91.3804 (83)
Total gains	701.9579	778.9874	871.5092	985.3072	1034.8180	1053.4939	1000.1891	942.3878	855.5298	747.4833	685.9217	665.4578 (84)

7. Mean internal temperature (heating season)

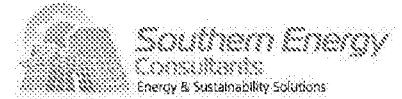
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	42.1356	42.3168	42.3168	42.5747	42.5747	42.8916	42.8153	42.9658	42.8916	42.7371	42.7371	42.4906
alpha	3.8090	3.8211	3.8211	3.8383	3.8383	3.8594	3.8544	3.8644	3.8594	3.8491	3.8491	3.8327
util living area	0.9845	0.9760	0.9510	0.8829	0.7461	0.5190	0.3516	0.3823	0.6844	0.9105	0.9724	0.9869 (86)
MIT	19.5842	19.7472	20.0853	20.4977	20.8149	20.9679	20.9947	20.9928	20.9031	20.5107	19.9885	19.5580 (87)
Th 2	19.8258	19.8302	19.8302	19.8364	19.8364	19.8440	19.8422	19.8457	19.8440	19.8403	19.8403	19.8344 (88)
util rest of house	0.9802	0.9694	0.9369	0.8490	0.6752	0.4097	0.2224	0.2475	0.5803	0.8761	0.9633	0.9833 (89)
MIT 2	17.9908	18.2284	18.7109	19.2811	19.6743	19.8279	19.8412	19.8443	19.7799	19.3163	18.5861	17.9588 (90)
Living area fraction									fLA = Living area / (4) =			0.1549 (91)
MIT	18.2376	18.4637	18.9238	19.4695	19.8510	20.0045	20.0199	20.0222	19.9539	19.5013	18.8034	18.2065 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.0876	18.3137	18.7738	19.3195	19.7010	19.8545	19.8699	19.8722	19.8039	19.3513	18.6534	18.0565 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9706	0.9570	0.9198	0.8306	0.6659	0.4107	0.2256	0.2507	0.5763	0.8573	0.9498	0.9748 (94)
Useful gains	681.3518	745.5187	801.6266	818.3794	689.0673	432.6946	225.6195	236.2428	493.0594	640.8399	651.5066	648.6650 (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	1515.3271	1477.0196	1321.3570	1087.6872	773.7776	441.7923	226.1884	237.1012	527.6934	891.6521	1225.4869	1499.0677 (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	620.4776	491.5686	386.6794	193.9017	63.0245	0.0000	0.0000	0.0000	0.0000	186.6043	413.2658	632.6996 (98)
Space heating												2988.2215 (98)
RHI space heating demand												2988 (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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	44.2200 (1c)	x 2.5300 (2c)	= 111.8766 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3514 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4357 (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) =	0.3704 (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	0.4722	0.4630	0.4537	0.4074	0.3982	0.3519	0.3519	0.3426	0.3704	0.3982	0.4167	0.4352 (22b)
Effective ac	0.6115	0.6072	0.6029	0.5630	0.5793	0.5619	0.5619	0.5587	0.5686	0.5793	0.5868	0.5947 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			14.3700	1.2357	17.7576		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick Cavity	135.8700	18.6700	117.2000	0.2500	29.3000	60.0000	7032.0000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Total net area of external elements Aum (A, m ²)			224.3100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.2158		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17698.2000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							200.1153 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5520 (36)
Total fabric heat loss						(33) + (36) =	75.7678 (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	43.4571	43.1494	42.8478	41.4311	41.1661	39.9322	39.9322	39.7037	40.4075	41.1661	41.7023	42.2628 (38)
Heat transfer coeff	119.2249	118.9172	118.6156	117.1989	116.9339	115.7000	115.7000	115.4715	116.1753	116.9339	117.4701	118.0306 (39)
Average = Sum(39)m / 12 =												117.1976 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3481	1.3446	1.3412	1.3252	1.3222	1.3082	1.3082	1.3056	1.3136	1.3222	1.3282	1.3346 (40)
HLP (average)												1.3252 (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												2.6038 (42)
Average daily hot water use (litres/day)												96.0393 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.6432	101.8017	97.9601	94.1185	90.2769	86.4354	86.4354	90.2769	94.1185	97.9601	101.8017	105.6432 (44)
Energy conte	156.6659	137.0210	141.3934	123.2702	118.2806	102.0672	94.5803	108.5322	109.8285	127.9945	139.7160	151.7225 (45)
Energy content (annual)										Total = Sum(45)m =		1511.0721 (45)

Regs Region: England

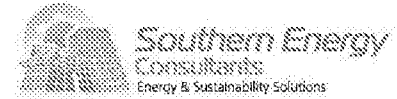
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.4999	20.5531	21.2090	18.4905	17.7421	15.3101	14.1870	16.2798	16.4743	19.1992	20.9574	22.7584 (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	14.1326	12.7541	14.0890	13.5912	14.0128	13.5245	13.9528	13.9917	13.5609	14.0575	13.6481	14.1207 (61)
Total heat required for water heating calculated for each month	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432 (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	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432 (64)
Heat gains from water heating, kWh/month	55.6245	48.7480	50.5355	44.3851	42.8315	37.3185	34.9361	39.5849	39.9082	46.0725	49.8676	53.9779 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1676.5080 (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	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	54.7518	48.6301	39.5486	29.9409	22.3811	18.8951	20.4168	26.5386	35.6200	45.2278	52.7875	56.2735 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.5049	356.1628	346.9450	327.3214	302.5502	279.2687	263.7153	260.0574	269.2752	288.8987	313.6700	336.9514 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263 (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)	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504 (71)
Water heating gains (Table 5)	74.7642	72.5417	67.9241	61.6460	57.5693	51.8312	46.9572	53.2055	55.4280	61.9254	69.2605	72.5510 (72)
Total internal gains	590.3224	585.6360	562.7193	527.2098	490.8021	458.2966	439.3908	448.1030	468.6247	504.3535	544.0195	574.0774 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.8300	10.6334	0.4400	0.0000	0.7700	2.9902 (74)
East	7.7200	19.6403	0.4400	0.0000	0.7700	51.3698 (76)
South	0.6000	46.7521	0.4400	0.0000	0.7700	9.5038 (78)
West	5.2200	19.6403	0.4400	0.0000	0.7700	34.7345 (80)

Solar gains	98.5982	189.7174	306.9307	442.5678	540.1679	552.5106	526.1607	453.0490	355.0066	223.4564	122.3159	81.5129 (83)
Total gains	688.9206	775.3534	869.6499	969.7776	1030.9700	1010.8072	965.5515	901.1520	823.6313	727.8099	666.3354	655.5903 (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	41.2344	41.3411	41.4462	41.9472	42.0423	42.4906	42.4906	42.5747	42.3168	42.0423	41.8504	41.6516
alpha	3.7490	3.7561	3.7631	3.7965	3.8028	3.8327	3.8327	3.8383	3.8211	3.8028	3.7900	3.7768
util living area	0.9877	0.9798	0.9605	0.9109	0.8124	0.6561	0.5048	0.5549	0.7817	0.9377	0.9799	0.9897 (86)
MIT	19.4154	19.6027	19.9289	20.3504	20.6962	20.9058	20.9736	20.9621	20.8079	20.3513	19.8104	19.3826 (87)
Th 2	19.8034	19.8061	19.8087	19.8212	19.8235	19.8344	19.8344	19.8364	19.8302	19.8235	19.8188	19.8138 (88)
util rest of house	0.9843	0.9743	0.9494	0.8852	0.7582	0.5623	0.3812	0.4296	0.7012	0.9141	0.9735	0.9869 (89)
MIT 2	17.7311	18.0036	18.4735	19.0711	19.5240	19.7679	19.8235	19.8191	19.6729	19.0878	18.3156	17.6902 (90)
Living area fraction	17.9920	18.2513	18.6989	19.2693	19.7056	19.9442	20.0016	19.9961	19.8487	19.2836	18.5471	17.9524 (92)
Temperature adjustment	17.8420	18.1013	18.5489	19.1193	19.5556	19.7942	19.8516	19.8461	19.6987	19.1336	18.3971	-0.1500
adjusted MIT												17.8024 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9760	0.9629	0.9334	0.8659	0.7438	0.5588	0.3831	0.4307	0.6906	0.8955	0.9620	0.9796 (94)
Ext temp.	672.4178	746.6158	811.7053	839.7176	766.8768	564.8282	369.9502	388.0974	568.7785	651.7900	641.0329	642.2339 (95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Month fracti	1614.5467	1569.8626	1429.1895	1197.6926	918.5829	600.9705	376.2123	397.9284	650.4323	997.8628	1327.0734	1605.4975 (97)
Space heating kWh	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	700.9439	553.2218	459.4082	257.7421	112.8694	0.0000	0.0000	0.0000	0.0000	257.4782	493.9492	716.6681 (98)
Space heating per m2												3552.2808 (98)
(98) / (4) = 40.1660 (99)												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of Energy Ratings 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.5000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3925.1722 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	700.9439	553.2218	459.4082	257.7421	112.8694	0.0000	0.0000	0.0000	0.0000	257.4782	493.9492	716.6681 (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)	774.5237	611.2948	507.6334	284.7979	124.7175	0.0000	0.0000	0.0000	0.0000	284.5062	545.8002	791.8985 (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	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432 (64)
Efficiency of water heater (217)m	89.8547	89.7987	89.6689	89.3639	88.7447	87.3000	87.3000	87.3000	87.3000	89.3357	89.7208	89.8809 (217)
Fuel for water heating, kWh/month	190.0829	166.7898	173.3961	153.1507	149.0720	132.4075	124.3219	140.3482	141.3395	159.0091	170.9348	184.5145 (219)
Water heating fuel used												1885.3669 (219)
Annual totals kWh/year												
Space heating fuel - main system												3925.1722 (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)												386.7735 (232)
Total delivered energy for all uses												6272.3126 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3925.1722	3.4800	136.5960 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1885.3669	3.4800	65.6108 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	386.7735	13.1900	51.0154 (250)
Additional standing charges			120.0000 (251)
Total energy cost			383.1147 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] = 1.2058 (257)
SAP value	83.1784
SAP rating (Section 12)	B (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	3925.1722	0.2160	847.8372 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1885.3669	0.2160	407.2393 (264)
Space and water heating			1255.0764 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	386.7735	0.5190	200.7355 (268)
Total kg/year			1494.7369 (272)
CO2 emissions per m2			16.9000 (273)
EI value			84.9899
EI rating			B (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4
Water heating energy efficiency	$3.48 / 0.8880 = 3.919$, stars = 4
Water heating environmental impact	$0.216 / 0.8880 = 0.2433$, stars = 4

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	44.2200 (1c)	x 2.5300 (2c)	= 111.8766 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3514 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4357 (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) =		0.3704 (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	0.3889	0.3704	0.3704	0.3426	0.3426	0.3056	0.3148	0.2963	0.3056	0.3241	0.3241	0.3519 (22b)
Effective ac	0.5756	0.5686	0.5686	0.5587	0.5587	0.5467	0.5496	0.5439	0.5467	0.5525	0.5525	0.5619 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			14.3700	1.2357	17.7576		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick Cavity	135.8700	18.6700	117.2000	0.2500	29.3000	60.0000	7032.0000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Total net area of external elements Aum (A, m ²)			224.3100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.2158		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17698.2000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 200.1153 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.5520 (36)
Total fabric heat loss (33) + (36) = 75.7678 (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	40.9071	40.4075	40.4075	39.7037	39.7037	38.8507	39.0548	38.6527	38.8507	39.2650	39.2650	39.9322 (38)
Heat transfer coeff	116.6749	116.1753	116.1753	115.4715	115.4715	114.6185	114.8226	114.4204	114.6185	115.0328	115.0328	115.7000 (39)
Average = Sum(39)m / 12 =												115.3512 (39)
HLP	1.3193	1.3136	1.3136	1.3056	1.3056	1.2960	1.2983	1.2938	1.2960	1.3007	1.3007	1.3082 (40)
HLP (average)												1.3043 (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												2.6038 (42)
Average daily hot water use (litres/day)												96.0393 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.6432	101.8017	97.9601	94.1185	90.2769	86.4354	86.4354	90.2769	94.1185	97.9601	101.8017	105.6432 (44)
Energy conte	156.6659	137.0210	141.3934	123.2702	118.2806	102.0672	94.5803	108.5322	109.8285	127.9945	139.7160	151.7225 (45)
Energy content (annual)										Total = Sum(45)m =		1511.0721 (45)

Regs Region: England

Elmhurst Energy Systems

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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Distribution loss (46)m = 0.15 x (45)m	23.4999	20.5531	21.2090	18.4905	17.7421	15.3101	14.1870	16.2798	16.4743	19.1992	20.9574	22.7584 (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	14.1326	12.7541	14.0890	13.5912	14.0128	13.5245	13.9528	13.9917	13.5609	14.0575	13.6481	14.1207 (61)
Total heat required for water heating calculated for each month	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432 (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	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432 (64)
Heat gains from water heating, kWh/month	55.6245	48.7480	50.5355	44.3851	42.8315	37.3185	34.9361	39.5849	39.9082	46.0725	49.8676	53.9779 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1676.5080 (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	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	54.7518	48.6301	39.5486	29.9409	22.3811	18.8951	20.4168	26.5386	35.6200	45.2278	52.7875	56.2735	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.5049	356.1628	346.9450	327.3214	302.5502	279.2687	263.7153	260.0574	269.2752	288.8987	313.6700	336.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	(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)	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	(71)
Water heating gains (Table 5)	74.7642	72.5417	67.9241	61.6460	57.5693	51.8312	46.9572	53.2055	55.4280	61.9254	69.2605	72.5510	(72)
Total internal gains	590.3224	585.6360	562.7193	527.2098	490.8021	458.2966	439.3908	448.1030	468.6247	504.3535	544.0195	574.0774	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.8300	11.9814	0.4400	0.0000	0.7700	3.3692 (74)
East	7.7200	22.3313	0.4400	0.0000	0.7700	58.4084 (76)
South	0.6000	50.9848	0.4400	0.0000	0.7700	10.3642 (78)
West	5.2200	22.3313	0.4400	0.0000	0.7700	39.4937 (80)

Solar gains	111.6355	193.3513	308.7900	458.0973	544.0159	595.1973	560.7983	494.2849	386.9051	243.1298	141.9021	91.3804 (83)
Total gains	701.9579	778.9874	871.5092	985.3072	1034.8180	1053.4939	1000.1891	942.3878	855.5298	747.4833	685.9217	665.4578 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.1356	42.3168	42.3168	42.5747	42.5747	42.8916	42.8153	42.9658	42.8916	42.7371	42.7371	42.4906	
alpha	3.8090	3.8211	3.8211	3.8383	3.8383	3.8594	3.8544	3.8644	3.8594	3.8491	3.8491	3.8327	
util living area	0.9845	0.9760	0.9510	0.8829	0.7461	0.5190	0.3516	0.3823	0.6844	0.9105	0.9724	0.9869	(86)
MIT	19.5842	19.7472	20.0853	20.4977	20.8149	20.9679	20.9947	20.9928	20.9031	20.5107	19.9885	19.5580	(87)
Th 2	19.8258	19.8302	19.8302	19.8364	19.8364	19.8440	19.8422	19.8457	19.8440	19.8403	19.8403	19.8344	(88)
util rest of house	0.9802	0.9694	0.9369	0.8490	0.6752	0.4097	0.2224	0.2475	0.5803	0.8761	0.9633	0.9833	(89)
MIT 2	17.9908	18.2284	18.7109	19.2811	19.6743	19.8279	19.8412	19.8443	19.7799	19.3163	18.5861	17.9588	(90)
Living area fraction	18.2376	18.4637	18.9238	19.4695	19.8510	20.0045	20.0199	20.0222	19.9539	19.5013	18.8034	18.2065	(91)
MIT	18.0876	18.3137	18.7738	19.3195	19.7010	19.8545	19.8699	19.8722	19.8039	19.3513	18.6534	18.0565	(92)
Temperature adjustment												-0.1500	
adjusted MIT												18.0565	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9706	0.9570	0.9198	0.8306	0.6659	0.4107	0.2256	0.2507	0.5763	0.8573	0.9498	0.9748	(94)
Useful gains	681.3518	745.5187	801.6266	818.3794	689.0673	432.6946	225.6195	236.2428	493.0594	640.8399	651.5066	648.6650	(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	1515.3271	1477.0196	1321.3570	1087.6872	773.7776	441.7923	226.1884	237.1012	527.6934	891.6521	1225.4869	1499.0677	(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	620.4776	491.5686	386.6794	193.9017	63.0245	0.0000	0.0000	0.0000	0.0000	186.6043	413.2658	632.6996	(98)
Space heating												2988.2215	(98)
Space heating per m2												33.7881	(99)
										(98) / (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 EPC Costs, Emissions and Primary Energy 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													90.5000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													3301.9022	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	620.4776	491.5686	386.6794	193.9017	63.0245	0.0000	0.0000	0.0000	0.0000	186.6043	413.2658	632.6996	(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)	685.6106	543.1697	427.2701	214.2560	69.6403	0.0000	0.0000	0.0000	0.0000	206.1926	456.6473	699.1156	(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	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432	(64)	
Efficiency of water heater (217)m	89.7896	89.7319	89.5586	89.1479	88.3075	87.3000	87.3000	87.3000	87.3000	89.0886	89.6110	89.8163	(217)	
Fuel for water heating, kWh/month	190.2208	166.9140	173.6097	153.5217	149.8099	132.4075	124.3219	140.3482	141.3395	159.4503	171.1444	184.6472	(219)	
Water heating fuel used												1887.7350	(219)	
Annual totals kWh/year														
Space heating fuel - main system													3301.9022	(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)													386.7735	(232)
Total delivered energy for all uses													5651.4107	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3301.9022	3.8700	127.7836 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1887.7350	3.8700	73.0553 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	386.7735	18.9000	73.1002 (250)
Additional standing charges			93.0000 (251)
Total energy cost			381.1142 (255)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	3301.9022	0.2160	713.2109 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1887.7350	0.2160	407.7508 (264)
Space and water heating			1120.9616 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	386.7735	0.5190	200.7355 (268)
Total kg/year			1360.6221 (272)

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

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	3301.9022	1.2200	4028.3207 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1887.7350	1.2200	2303.0367 (264)
Space and water heating			6331.3574 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	386.7735	3.0700	1187.3948 (268)
Primary energy kWh/year			7749.0021 (272)
Primary energy kWh/m ² /year			87.6187 (273)

SAP 2012 EPC IMPROVEMENTS

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 28	-186 kg (13.6%)
U Solar photovoltaic panels	+ 10.0	-£ 345	-947 kg (80.6%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£28	2.10 kg/m²	B 84 B 87
Solar photovoltaic panels	£345	10.70 kg/m²	A 94 A 96
Total Savings	£373	12.80 kg/m²	

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 96

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	£87	£97	-£9
Mains gas	£294	£256	£38
Space heating	£235	£235	£0
Water heating	£73	£45	£28
Lighting	£73	£73	£0
Generated (PV)	-£0	-£345	£345

Total cost of fuels	£381	£8	£374
Total cost of uses	£381	£8	£373
Delivered energy	64 kWh/m²	33 kWh/m²	31 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.2 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	13 kg/m²
Primary energy	88 kWh/m²	13 kWh/m²	75 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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	44.2200 (1c)	x 2.5300 (2c)	= 111.8766 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3514 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4357 (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) =	0.3704 (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	0.4722	0.4630	0.4537	0.4074	0.3982	0.3519	0.3519	0.3426	0.3704	0.3982	0.4167	0.4352 (22b)
Effective ac	0.6115	0.6072	0.6029	0.5630	0.5793	0.5619	0.5619	0.5587	0.5686	0.5793	0.5868	0.5947 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			14.3700	1.2357	17.7576		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick Cavity	135.8700	18.6700	117.2000	0.2500	29.3000	60.0000	7032.0000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Total net area of external elements Aum (A, m ²)			224.3100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.2158		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17698.2000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 200.1153 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.5520 (36)
Total fabric heat loss (33) + (36) = 75.7678 (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	43.4571	43.1494	42.8478	41.4311	41.1661	39.9322	39.9322	39.7037	40.4075	41.1661	41.7023	42.2628 (38)
Heat transfer coeff	119.2249	118.9172	118.6156	117.1989	116.9339	115.7000	115.7000	115.4715	116.1753	116.9339	117.4701	118.0306 (39)
Average = Sum(39)m / 12 =												117.1976 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3481	1.3446	1.3412	1.3252	1.3222	1.3082	1.3082	1.3056	1.3136	1.3222	1.3282	1.3346 (40)
HLP (average)												1.3252 (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												2.6038 (42)
Average daily hot water use (litres/day)												96.0393 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.6432	101.8017	97.9601	94.1185	90.2769	86.4354	86.4354	90.2769	94.1185	97.9601	101.8017	105.6432 (44)
Energy conte	156.6659	137.0210	141.3934	123.2702	118.2806	102.0672	94.5803	108.5322	109.8285	127.9945	139.7160	151.7225 (45)
Energy content (annual)										Total = Sum(45)m =		1511.0721 (45)

Regs Region: England

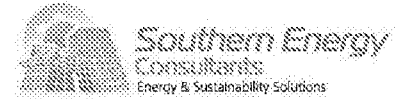
Elmhurst Energy Systems

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

Distribution loss (46)m = 0.15 x (45)m	23.4999	20.5531	21.2090	18.4905	17.7421	15.3101	14.1870	16.2798	16.4743	19.1992	20.9574	22.7584 (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	14.1326	12.7541	14.0890	13.5912	14.0128	13.5245	13.9528	13.9917	13.5609	14.0575	13.6481	14.1207 (61)
Total heat required for water heating calculated for each month	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432 (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												1.2002 (H8)
Utilisation factor												0.5653 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												96.0393 (H14)
Volume ratio Veff/V												0.7809 (H15)
Solar storage volume factor												0.9505 (H16)
Solar input	-24.8500	-41.4675	-70.6238	-94.6498	-116.9319	-114.9627	-113.4434	-99.1161	-77.6278	-53.0106	-29.4756	-856.9545 (H17)
Solar input (sum of months) = Sum(63)m =												-856.9545 (63)
Output from w/h	145.9484	108.3076	84.8585	42.2115	15.3616	0.6290	0.0000	23.4079	45.7616	89.0413	123.8885	145.0480 (64)
Total per year (kWh/year) = Sum(64)m =												824.4640 (64)
Heat gains from water heating, kWh/month	55.6245	48.7480	50.5355	44.3851	42.8315	37.3185	34.9361	39.5849	39.9082	46.0725	49.8676	53.9779 (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	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	54.7518	48.6301	39.5486	29.9409	22.3811	18.8951	20.4168	26.5386	35.6200	45.2278	52.7875	56.2735	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.5049	356.1628	346.9450	327.3214	302.5502	279.2687	263.7153	260.0574	269.2752	288.8987	313.6700	336.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	(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)	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	(71)
Water heating gains (Table 5)	74.7642	72.5417	67.9241	61.6460	57.5693	51.8312	46.9572	53.2055	55.4280	61.9254	69.2605	72.5510	(72)
Total internal gains	590.3224	585.6360	562.7193	527.2098	490.8021	458.2966	439.3908	448.1030	468.6247	504.3535	544.0195	574.0774	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	FF	Access factor Table 6d	Gains W	
North	0.8300	10.6334	0.4400	0.0000	0.0000	0.7700	2.9902 (74)	
East	7.7200	19.6403	0.4400	0.0000	0.0000	0.7700	51.3698 (76)	
South	0.6000	46.7521	0.4400	0.0000	0.0000	0.7700	9.5038 (78)	
West	5.2200	19.6403	0.4400	0.0000	0.0000	0.7700	34.7345 (80)	

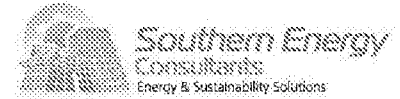
Solar gains	98.5982	189.7174	306.9307	442.5678	540.1679	552.5106	526.1607	453.0490	355.0066	223.4564	122.3159	81.5129 (83)
Total gains	688.9206	775.3534	869.6499	969.7776	1030.9700	1010.8072	965.5515	901.1520	823.6313	727.8099	666.3354	655.5903 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	41.2344	41.3411	41.4462	41.9472	42.0423	42.4906	42.4906	42.5747	42.3168	42.0423	41.8504	41.6516	
alpha	3.7490	3.7561	3.7631	3.7965	3.8028	3.8327	3.8327	3.8383	3.8211	3.8028	3.7900	3.7768	
util living area	0.9877	0.9798	0.9605	0.9109	0.8124	0.6561	0.5048	0.5549	0.7817	0.9377	0.9799	0.9897 (86)	
MIT	19.4154	19.6027	19.9289	20.3504	20.6962	20.9058	20.9736	20.9621	20.8079	20.3513	19.8104	19.3826 (87)	
Th 2	19.8034	19.8061	19.8087	19.8212	19.8235	19.8344	19.8344	19.8364	19.8302	19.8235	19.8188	19.8138 (88)	
util rest of house	0.9843	0.9743	0.9494	0.8852	0.7582	0.5623	0.3812	0.4296	0.7012	0.9141	0.9735	0.9869 (89)	
MIT 2	17.7311	18.0036	18.4735	19.0711	19.5240	19.7679	19.8235	19.8191	19.6729	19.0878	18.3156	17.6902 (90)	
Living area fraction									fLA = Living area / (4) =			0.1549 (91)	
MIT	17.9920	18.2513	18.6989	19.2693	19.7056	19.9442	20.0016	19.9961	19.8487	19.2836	18.5471	17.9524 (92)	
Temperature adjustment												-0.1500	
adjusted MIT	17.8420	18.1013	18.5489	19.1193	19.5556	19.7942	19.8516	19.8461	19.6987	19.1336	18.3971	17.8024 (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	0.9760	0.9629	0.9334	0.8659	0.7438	0.5588	0.3831	0.4307	0.6906	0.8955	0.9620	0.9796	(94)
Useful gains	672.4178	746.6158	811.7053	839.7176	766.8768	564.8282	369.9502	388.0974	568.7785	651.7900	641.0329	642.2339	(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	1614.5467	1569.8626	1429.1895	1197.6926	918.5829	600.9705	376.2123	397.9284	650.4323	997.8628	1327.0734	1605.4975	(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	700.9439	553.2218	459.4082	257.7421	112.8694	0.0000	0.0000	0.0000	0.0000	257.4782	493.9492	716.6681	(98)
Space heating												3552.2808	(98)
Space heating per m2												(98) / (4) =	40.1660 (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													3925.1722 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	700.9439	553.2218	459.4082	257.7421	112.8694	0.0000	0.0000	0.0000	0.0000	257.4782	493.9492	716.6681	(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)	774.5237	611.2948	507.6334	284.7979	124.7175	0.0000	0.0000	0.0000	0.0000	284.5062	545.8002	791.8985	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	145.9484	108.3076	84.8585	42.2115	15.3616	0.6290	0.0000	23.4079	45.7616	89.0413	123.8885	145.0480	(64)
Efficiency of water heater	89.9319	89.9601	89.9857	90.0356	90.1043	87.3000	87.3000	87.3000	87.3000	89.6555	89.8397	89.9450	(217)
Fuel for water heating, kWh/month	162.2877	120.3952	94.3022	46.8832	17.0486	0.7205	0.0000	26.8131	52.4188	99.3149	137.8995	161.2629	(219)
Water heating fuel used												919.3467	(219)
Annual totals kWh/year													
Space heating fuel - main system												3925.1722	(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)													386.7735 (232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3629.0530	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3925.1722	3.4800	136.5960	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	919.3467	3.4800	31.9933	(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	386.7735	13.1900	51.0154	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			128.2693	(255)

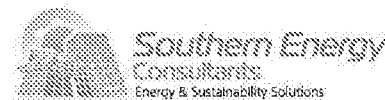
11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4037 (257)
SAP value		94.3680
SAP rating (Section 12)		94 (258)
SAP band		A

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3925.1722	0.2160	847.8372 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	919.3467	0.2160	198.5789 (264)
Space and water heating			1046.4161 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	386.7735	0.5190	200.7355 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			415.5893 (272)
CO2 emissions per m2			4.7000 (273)
EI value			95.8267
EI rating			96 (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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	44.2200 (1c)	x 2.5300 (2c)	= 111.8766 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 215.3514 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4357 (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) =		0.3704 (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	0.3889	0.3704	0.3704	0.3426	0.3426	0.3056	0.3148	0.2963	0.3056	0.3241	0.3241	0.3519 (22b)
Effective ac	0.5756	0.5686	0.5686	0.5587	0.5587	0.5467	0.5496	0.5439	0.5467	0.5525	0.5525	0.5619 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			14.3700	1.2357	17.7576		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick Cavity	135.8700	18.6700	117.2000	0.2500	29.3000	60.0000	7032.0000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Total net area of external elements Aum (A, m ²)			224.3100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.2158		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17698.2000 (34)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 200.1153 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.5520 (36)
 Total fabric heat loss (33) + (36) = 75.7678 (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	40.9071	40.4075	40.4075	39.7037	39.7037	38.8507	39.0548	38.6527	38.8507	39.2650	39.2650	39.9322 (38)
Heat transfer coeff	116.6749	116.1753	116.1753	115.4715	115.4715	114.6185	114.8226	114.4204	114.6185	115.0328	115.0328	115.7000 (39)
Average = Sum(39)m / 12 =												115.3512 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3193	1.3136	1.3136	1.3056	1.3056	1.2960	1.2983	1.2938	1.2960	1.3007	1.3007	1.3082 (40)
HLP (average)												1.3043 (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												2.6038 (42)
Average daily hot water use (litres/day)												96.0393 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.6432	101.8017	97.9601	94.1185	90.2769	86.4354	86.4354	90.2769	94.1185	97.9601	101.8017	105.6432 (44)
Energy conte	156.6659	137.0210	141.3934	123.2702	118.2806	102.0672	94.5803	108.5322	109.8285	127.9945	139.7160	151.7225 (45)
Energy content (annual)										Total = Sum(45)m =		1511.0721 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Distribution loss (46)m = 0.15 x (45)m	23.4999	20.5531	21.2090	18.4905	17.7421	15.3101	14.1870	16.2798	16.4743	19.1992	20.9574	22.7584 (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	14.1326	12.7541	14.0890	13.5912	14.0128	13.5245	13.9528	13.9917	13.5609	14.0575	13.6481	14.1207 (61)
Total heat required for water heating calculated for each month	170.7984	149.7751	155.4823	136.8614	132.2935	115.5917	108.5330	122.5240	123.3893	142.0520	153.3641	165.8432 (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												1.2676 (H8)
Utilisation factor												0.5457 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												96.0393 (H14)
Volume ratio Veff/V												0.7809 (H15)
Solar storage volume factor												0.9505 (H16)
Solar input	-26.8873	-40.4115	-68.0581	-94.0771	-113.3005	-119.2439	-116.3806	-103.9286	-81.1166	-55.1821	-32.6822	-873.5447 (H17)
Solar input (sum of months) = Sum(63)m =												-873.5447 (63)
Output from w/h	143.9111	109.3636	87.4242	42.7843	18.9930	0.0000	0.0000	18.5954	42.2727	86.8698	120.6819	143.5669 (64)
Total per year (kWh/year) = Sum(64)m =												814.4630 (64)
Heat gains from water heating, kWh/month	55.6245	48.7480	50.5355	44.3851	42.8315	37.3185	34.9361	39.5849	39.9082	46.0725	49.8676	53.9779 (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	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	156.2256	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	54.7518	48.6301	39.5486	29.9409	22.3811	18.8951	20.4168	26.5386	35.6200	45.2278	52.7875	56.2735	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.5049	356.1628	346.9450	327.3214	302.5502	279.2687	263.7153	260.0574	269.2752	288.8987	313.6700	336.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	53.2263	(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)	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	-104.1504	(71)
Water heating gains (Table 5)	74.7642	72.5417	67.9241	61.6460	57.5693	51.8312	46.9572	53.2055	55.4280	61.9254	69.2605	72.5510	(72)
Total internal gains	590.3224	585.6360	562.7193	527.2098	490.8021	458.2966	439.3908	448.1030	468.6247	504.3535	544.0195	574.0774	(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				0.8300	11.9814	0.4400		0.0000		0.7700	3.3692 (74)	
East				7.7200	22.3313	0.4400		0.0000		0.7700	58.4084 (76)	
South				0.6000	50.9848	0.4400		0.0000		0.7700	10.3642 (78)	
West				5.2200	22.3313	0.4400		0.0000		0.7700	39.4937 (80)	
Solar gains	111.6355	193.3513	308.7900	458.0973	544.0159	595.1973	560.7983	494.2849	386.9051	243.1298	141.9021	91.3804 (83)
Total gains	701.9579	778.9874	871.5092	985.3072	1034.8180	1053.4939	1000.1891	942.3878	855.5298	747.4833	685.9217	665.4578 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	42.1356	42.3168	42.3168	42.5747	42.5747	42.8916	42.8153	42.9658	42.8916	42.7371	42.7371	42.4906
alpha	3.8090	3.8211	3.8211	3.8383	3.8383	3.8594	3.8544	3.8644	3.8594	3.8491	3.8491	3.8327
util living area	0.9845	0.9760	0.9510	0.8829	0.7461	0.5190	0.3516	0.3823	0.6844	0.9105	0.9724	0.9869 (86)
MIT	19.5842	19.7472	20.0853	20.4977	20.8149	20.9679	20.9947	20.9928	20.9031	20.5107	19.9885	19.5580 (87)
Th 2	19.8258	19.8302	19.8302	19.8364	19.8364	19.8440	19.8422	19.8457	19.8440	19.8403	19.8403	19.8344 (88)
util rest of house	0.9802	0.9694	0.9369	0.8490	0.6752	0.4097	0.2224	0.2475	0.5803	0.8761	0.9633	0.9833 (89)
MIT 2	17.9908	18.2284	18.7109	19.2811	19.6743	19.8279	19.8412	19.8443	19.7799	19.3163	18.5861	17.9588 (90)
Living area fraction												
MIT	18.2376	18.4637	18.9238	19.4695	19.8510	20.0045	20.0199	20.0222	19.9539	19.5013	18.8034	18.2065 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.0876	18.3137	18.7738	19.3195	19.7010	19.8545	19.8699	19.8722	19.8039	19.3513	18.6534	18.0565 (93)

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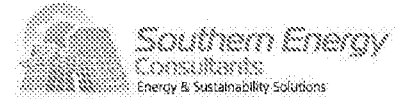
Elmhurst Energy Systems

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9706	0.9570	0.9198	0.8306	0.6659	0.4107	0.2256	0.2507	0.5763	0.8573	0.9498	0.9748	(94)
Useful gains	681.3518	745.5187	801.6266	818.3794	689.0673	432.6946	225.6195	236.2428	493.0594	640.8399	651.5066	648.6650	(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	1515.3271	1477.0196	1321.3570	1087.6872	773.7776	441.7923	226.1884	237.1012	527.6934	891.6521	1225.4869	1499.0677	(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	620.4776	491.5686	386.6794	193.9017	63.0245	0.0000	0.0000	0.0000	0.0000	186.6043	413.2658	632.6996	(98)
Space heating												2988.2215	(98)
Space heating per m2											(98) / (4) =	33.7881	(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													3301.9022	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	620.4776	491.5686	386.6794	193.9017	63.0245	0.0000	0.0000	0.0000	0.0000	186.6043	413.2658	632.6996	(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)	685.6106	543.1697	427.2701	214.2560	69.6403	0.0000	0.0000	0.0000	0.0000	206.1926	456.6473	699.1156	(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	143.9111	109.3636	87.4242	42.7843	18.9930	0.0000	0.0000	18.5954	42.2727	86.8698	120.6819	143.5669	(64)	
Efficiency of water heater	89.8797	89.9003	89.8924	89.9043	89.7383	87.3000	87.3000	87.3000	87.3000	89.4584	89.7564	89.8906	(217)	
Fuel for water heating, kWh/month	160.1152	121.6499	97.2543	47.5887	21.1649	0.0000	0.0000	21.3006	48.4224	97.1064	134.4550	159.7129	(219)	
Water heating fuel used												908.7701	(219)	
Annual totals kWh/year														
Space heating fuel - main system													3301.9022	(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)													386.7735	(232)
Energy saving/generation technologies (Appendices M, N and Q)														
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =									-1824.1596			-1824.1596	(233)	
Total delivered energy for all uses													2898.2862	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3301.9022	3.8700	127.7836	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	908.7701	3.8700	35.1694	(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	386.7735	18.9000	73.1002	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	18.9000	-344.7662	(252)
Total energy cost			7.9120	(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	3301.9022	0.2160	713.2109	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	908.7701	0.2160	196.2944	(264)
Space and water heating			909.5052	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	386.7735	0.5190	200.7355	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)

Regs Region: England

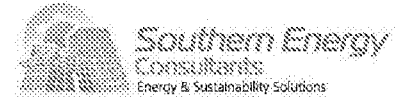
Elmhurst Energy Systems

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

Total kg/year 228.3768 (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	3301.9022	1.2200	4028.3207 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	908.7701	1.2200	1108.6996 (264)
Space and water heating			5137.0203 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	386.7735	3.0700	1187.3948 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			1107.9949 (272)
Primary energy kWh/m2/year			12.5282 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	200.1 (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	284.26 (P1)
Transmission heat loss coefficient	75.77 (37)
Summer heat loss coefficient	360.03 (P2)

Overhangs	Ratio	Z_overhangs	Overhang type
Orientation			
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
West	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)
East	1.000	0.90	1.000	0.900 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.8300	81.1852	0.4400	0.0000	0.9000	26.6839
East	7.7200	117.5071	0.4400	0.0000	0.9000	359.2332
South	0.6000	112.2060	0.4400	0.0000	0.9000	26.6601
West	5.2200	117.5071	0.4400	0.0000	0.9000	242.9012

total: 655.4785

	Jun	Jul	Aug	
Solar gains	696	655	578	(P4)
Internal gains	455	436	445	
Total summer gains	1151	1092	1023	(P5)

Summer gain/loss ratio	3.20	3.03	2.84	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 200.1)	0.60	0.60	0.60	
Threshold temperature	19.80	21.53	21.24	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight