

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECANG008d			Issued on Date	04/02/2021
Assessment Reference	001	Prop Type Ref	End Bri Re Ga Ea		
Property	WP3520A+, Plot 29				
SAP Rating	84 B	DER	17.24	TER	17.86
Environmental	36 B	% DER<TER	3.50		
CO ₂ Emissions (t/year)	1.32	DFEE	48.11	TFEE	51.47
General Requirements Compliance	Pass	% DFEE<TFEE	6.53		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey			Assessor ID	T555-0001
Client	Persimon Homes Thames Valley				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

DWELLING AS DESIGNED

End-Terrace House, total floor area 93 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) 17.86 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.24 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)48.1 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.19 (max. 0.25)	0.19 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.36 (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:

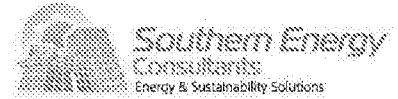
Overshading: Average
Windows facing East: 4.52 m², No overhang
Windows facing South: 2.13 m², No overhang
Windows facing West: 3.49 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key Features

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (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					2 * 10 = 20.0000 (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) =					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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) = 0.2854 (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	0.3638	0.3567	0.3496	0.3139	0.3068	0.2711	0.2711	0.2640	0.2854	0.3068	0.3210	0.3353 (22b)
Effective ac	0.5662	0.5636	0.5611	0.5493	0.5471	0.5367	0.5367	0.5348	0.5407	0.5471	0.5515	0.5562 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	14.4400	87.5100	0.2500	21.8775	60.0000	5250.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	54.8559			(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum (A x k)							(28)...(30) + (32) + (32a)...(32e) = 18532.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							198.5859 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4805 (36)
Total fabric heat loss							(33) + (36) = 64.3364 (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	43.5905	43.3926	43.1986	42.2876	42.1171	41.3236	41.3236	41.1767	41.6293	42.1171	42.4620	42.8225 (38)
Heat transfer coeff	107.9269	107.7290	107.5351	106.6240	106.4536	105.6601	105.6601	105.5131	105.9657	106.4536	106.7984	107.1589 (39)
Average = Sum(39)m / 12 =												106.6232 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1565	1.1544	1.1523	1.1426	1.1407	1.1322	1.1322	1.1307	1.1355	1.1407	1.1444	1.1483 (40)
HLP (average)												1.1426 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1535.2611 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.8761 20.8822 21.5485 18.7865 18.0261 15.5552 14.4141 16.5404 16.7380 19.5065 21.2929 23.1227 (46)											
Water storage loss:											
Total storage loss											
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)											
If cylinder contains dedicated solar storage											
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)											
Combi loss 14.1386 12.7594 14.0997 13.6002 14.0211 13.5314 13.9591 13.9993 13.5689 14.0672 13.6535 14.1265 (61)											
Total heat required for water heating calculated for each month											
173.3123 151.9738 157.7565 138.8437 134.1952 117.2324 110.0534 124.2689 125.1555 144.1106 155.6060 168.2778 (62)											
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)											
Solar input (sum of months) = Sum(63)m = 0.0000 (63)											
Output from w/h											
173.3123 151.9738 157.7565 138.8437 134.1952 117.2324 110.0534 124.2689 125.1555 144.1106 155.6060 168.2778 (64)											
Heat gains from water heating, kWh/month											
56.4599 49.4786 51.2908 45.0435 43.4632 37.8634 35.4411 40.1645 40.4948 46.7562 50.6126 54.7869 (65)											
Total per year (kWh/year) = Sum(64)m = 1700.7860 (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	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.7833	22.0123	17.9016	13.5527	10.1308	8.5528	9.2416	12.0126	16.1233	20.4723	23.8942	25.4721	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.0548	247.5977	241.1897	227.5478	210.3273	194.1424	183.3300	180.7871	187.1951	200.8370	218.0575	234.2424	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383	(72)
Total internal gains	411.7525	409.2663	394.0579	369.6882	344.9036	321.3108	306.2349	312.8116	325.5885	350.1811	378.2743	399.3802	(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
East			4.5200		19.6403		0.4400		0.0000		0.7700		30.0766 (76)
South			2.1300		46.7521		0.4400		0.0000		0.7700		33.7383 (78)
West			3.4900		19.6403		0.4400		0.0000		0.7700		23.2229 (80)
Solar gains	87.0379	159.5199	242.0946	329.9786	389.8057	393.9528	377.0551	332.6267	273.2308	183.3168	106.4497	72.9840	(83)
Total gains	498.7904	568.7862	636.1525	699.6668	734.7093	715.2635	683.2900	645.4382	598.8193	533.4978	484.7240	472.3642	(84)

7. Mean internal temperature (heating season)

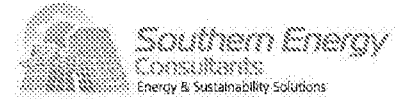
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	47.6970	47.7846	47.8708	48.2798	48.3571	48.7203	48.7203	48.7881	48.5798	48.3571	48.2010	48.0388
alpha	4.1798	4.1856	4.1914	4.2187	4.2238	4.2480	4.2480	4.2525	4.2387	4.2238	4.2134	4.2026
util living area	0.9966	0.9937	0.9861	0.9639	0.9073	0.7861	0.6316	0.6805	0.8803	0.9757	0.9940	0.9973 (86)
MIT	19.4336	19.5962	19.8805	20.2588	20.6106	20.8625	20.9597	20.9443	20.7540	20.2937	19.7935	19.4021 (87)
Th 2	19.9549	19.9566	19.9583	19.9662	19.9677	19.9746	19.9746	19.9759	19.9719	19.9677	19.9647	19.9616 (88)
util rest of house	0.9957	0.9919	0.9819	0.9520	0.8738	0.7065	0.5055	0.5582	0.8243	0.9656	0.9919	0.9966 (89)
MIT 2	17.8581	18.0964	18.5111	19.0603	19.5477	19.8641	19.9549	19.9458	19.7448	19.1174	18.3908	17.8165 (90)
Living area fraction	18.1927	18.4149	18.8020	19.3148	19.7735	20.0761	20.1683	20.1579	19.9592	19.3672	18.6887	18.1532 (91)
MIT	18.0427	18.2649	18.6520	19.1648	19.6235	19.9261	20.0183	20.0079	19.8092	19.2172	18.5387	18.0032 (93)
Temperature adjustment												-0.1500
adjusted MIT												18.0032 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9930	0.9875	0.9743	0.9395	0.8599	0.7022	0.5114	0.5625	0.8132	0.9549	0.9876	0.9944 (94)
Useful gains	495.2974	561.6754	619.7869	657.3468	631.7957	502.2429	349.4198	363.0410	486.9758	509.4618	478.7256	469.7035 (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	1483.2109	1439.7914	1306.7613	1094.4771	843.4802	562.7599	361.1827	380.6804	604.9764	917.3361	1221.6346	1479.1398 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	735.0077	590.0940	511.1089	314.7338	157.4933	0.0000	0.0000	0.0000	0.0000	303.4585	534.8945	751.0206 (98)
Space heating												3897.8113 (98)
Space heating per m2												41.7682 (99)
										(98) / (4) =		

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													90.5000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													4306.9738	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	735.0077	590.0940	511.1089	314.7338	157.4933	0.0000	0.0000	0.0000	0.0000	303.4585	534.8945	751.0206	(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)	812.1632	652.0376	564.7613	347.7721	174.0257	0.0000	0.0000	0.0000	0.0000	335.3133	591.0436	829.8570	(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	173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778	(64)	
Efficiency of water heater (217)m	89.8714	89.8257	89.7243	89.4958	88.9991	87.3000	87.3000	87.3000	87.3000	89.4443	89.7586	89.8968	(216)	
Fuel for water heating, kWh/month	192.8447	169.1874	175.8236	155.1398	150.7825	134.2869	126.0634	142.3470	143.3625	161.1176	173.3606	187.1899	(219)	
Water heating fuel used												1911.5060	(219)	
Annual totals kWh/year														
Space heating fuel - main system													4306.9738	(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)													437.6809	(232)
Total delivered energy for all uses													6731.1607	(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	4306.9738	0.2160	930.3063 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1911.5060	0.2160	412.8853 (264)
Space and water heating			1343.1916 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	437.6809	0.5190	227.1564 (268)
Total CO2, kg/year			1609.2730 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.2400 (273)

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

DER		17.2400	ZC1
Total Floor Area	TFA	93.3200	
Assumed number of occupants	N	2.6685	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.5609	ZC2
CO2 emissions from cooking, equation (L16)		1.9615	ZC3
Total CO2 emissions		34.7624	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		34.7624	ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (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) = 0.1286 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3786 (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) =	0.3218 (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	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
Effective ac	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Semi-glazed door			2.1500	1.2000	2.5800		(26a)
TER Opening Type (Uw = 1.40)			10.1400	1.3258	13.4432		(27)
Heat Loss Floor 1			46.6600	0.1300	6.0658		(28a)
Brick/Pender Cavity	101.9500	14.4400	87.5100	0.1800	15.7518		(29a)
External Roof 1	46.6600		46.6600	0.1300	6.0658		(30)
Total net area of external elements Aum(A, m ²)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.0566		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.4741 (36)
Total fabric heat loss						(33) + (36) =	56.5307 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	44.9748	44.7232	44.4765	43.3180	43.1012	42.0922	42.0922
Heat transfer coeff	101.5055	101.2538	101.0072	99.8487	99.6319	98.6229	98.6229
Average = Sum(39)m / 12 =							
HLP	1.0877	1.0850	1.0824	1.0700	1.0676	1.0568	1.0568
HLP (average)							
Days in month	31	28	31	30	31	30	31
							31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)
Energy content (annual)												Total = Sum(45)m = 1535.2611 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8761	20.8822	21.5485	18.7865	18.0261	15.5552	14.4141	16.5404	16.7380	19.5065	21.2929	23.1227 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.7185	47.1576	46.7406	43.3080	44.7516	46.7406	47.1576	50.7185	49.3151	50.9589	50.9589	50.9589	(61)
Total heat required for water heating calculated for each month	210.1326	185.2418	194.3752	172.4010	166.9146	147.0091	140.8459	157.0102	158.7442	180.7619	191.2676	205.1102	205.1102	205.1102	(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	0.0000	0.0000	(63)
Output from w/h	210.1326	185.2418	194.3752	172.4010	166.9146	147.0091	140.8459	157.0102	158.7442	180.7619	191.2676	205.1102	205.1102	205.1102	(64)
Heat gains from water heating, kWh/month	65.6650	57.7956	60.4455	53.4328	51.6430	45.3076	43.1393	48.3498	48.8919	55.9191	59.5280	63.9950	63.9950	63.9950	(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	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.7833	22.0123	17.9016	13.5527	10.1308	8.5528	9.2416	12.0126	16.1233	20.4723	23.8942	25.4721	25.4721	25.4721	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.0548	247.5977	241.1897	227.5478	210.3273	194.1424	183.3300	180.7871	187.1951	200.8370	218.0575	234.2424	234.2424	234.2424	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	(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	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	88.2594	86.0054	81.2439	74.2123	69.4127	62.9272	57.9829	64.9863	67.9055	75.1600	82.6778	86.0148	86.0148	86.0148	(72)
Total internal gains	424.1249	421.6428	406.3626	381.3401	355.8981	331.6499	316.5818	323.8133	337.2513	362.4967	390.6568	411.7567	411.7567	411.7567	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
East	4.5200	19.6403	0.6300		0.7000	0.7700	27.1305 (76)
South	2.1300	46.7521	0.6300		0.7000	0.7700	30.4335 (78)
West	3.4900	19.6403	0.6300		0.7000	0.7700	20.9481 (80)

Solar gains	78.5121	143.8942	218.3803	297.6557	351.6224	355.3633	340.1208	300.0444	246.4666	165.3601	96.0224	65.8349	65.8349	65.8349	(83)
Total gains	502.6370	565.5370	624.7429	678.9958	707.5205	687.0132	656.7027	623.8577	583.7179	527.8568	486.6793	477.5915	477.5915	477.5915	(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	63.8444	64.0031	64.1594	64.9038	65.0450	65.7105	65.7105	65.8352	65.4525	65.0450	64.7600	64.4647	64.4647	64.4647	
alpha	5.2563	5.2669	5.2773	5.3269	5.3363	5.3807	5.3807	5.3890	5.3635	5.3363	5.3173	5.2976	5.2976	5.2976	
util living area	0.9988	0.9975	0.9936	0.9791	0.9316	0.8055	0.6348	0.6852	0.9010	0.9864	0.9976	0.9991	0.9991	0.9991	(86)
MIT	19.7855	19.9143	20.1401	20.4451	20.7267	20.9203	20.9825	20.9740	20.8392	20.4733	20.0757	19.7642	19.7642	19.7642	(87)
Th 2	20.0109	20.0131	20.0153	20.0254	20.0274	20.0362	20.0362	20.0379	20.0328	20.0274	20.0235	20.0195	20.0195	20.0195	(88)
util rest of house	0.9984	0.9967	0.9912	0.9705	0.9010	0.7236	0.5088	0.5614	0.8455	0.9792	0.9965	0.9988	0.9988	0.9988	(89)
MIT 2	18.3815	18.5712	18.9021	19.3494	19.7397	19.9777	20.0291	20.0261	19.8922	19.3953	18.8150	18.3564	18.3564	18.3564	(90)
Living area fraction	18.6797	18.8565	19.1650	19.5821	19.9493	20.1779	20.2316	20.2274	20.0933	19.6243	19.0828	18.6554	18.6554	18.6554	(91)
Temperature adjustment	18.6797	18.8565	19.1650	19.5821	19.9493	20.1779	20.2316	20.2274	20.0933	19.6243	19.0828	18.6554	18.6554	18.6554	(92)
adjusted MIT	18.6797	18.8565	19.1650	19.5821	19.9493	20.1779	20.2316	20.2274	20.0933	19.6243	19.0828	18.6554	18.6554	18.6554	(93)

8. Space heating requirement

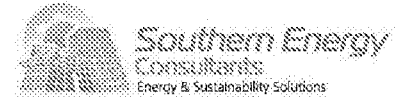
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Useful gains	501.4211	562.8011	617.3821	655.3830	635.3308	506.3562	351.7915	366.4937	495.9886	514.6973	484.2792	476.7080	476.7080	476.7080	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	4.2000	4.2000	(95)
Heat loss rate W	1459.6142	1413.1478	1279.2579	1066.5977	821.8965	550.1104	358.1624	376.7544	593.4045	899.1033	1199.1193	1453.1858	1453.1858	1453.1858	(96)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97)
Space heating kWh	712.8956	571.4330	492.4356	296.0746	138.8049	0.0000	0.0000	0.0000	0.0000	285.9981	514.6849	726.4995	726.4995	726.4995	(98)
Space heating per m ²															(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	4003.0259 (211)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	712.8956	571.4330	492.4356	296.0746	138.8049	0.0000	0.0000	0.0000	0.0000	285.9981	514.6849	726.4995 (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)	763.2716	611.8126	527.2330	316.9963	148.6134	0.0000	0.0000	0.0000	0.0000	306.2078	551.0545	777.8367 (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	210.1326	185.2418	194.3752	172.4010	166.9146	147.0091	140.8459	157.0102	158.7442	180.7619	191.2676	205.1102 (64)
Efficiency of water heater (217)m	87.8835	87.6996	87.2927	86.4008	84.5910	80.3000	80.3000	80.3000	80.3000	86.2011	87.4209	80.3000 (216)
Fuel for water heating, kWh/month	239.1035	211.2231	222.6707	199.5365	197.3196	183.0748	175.3996	195.5295	197.6889	209.6978	218.7894	233.1749 (219)
Water heating fuel used												2483.2084 (219)
Annual totals kWh/year												
Space heating fuel - main system												4003.0259 (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)												437.6809 (232)
Total delivered energy for all uses												6998.9151 (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	4003.0259	0.2160	864.6536 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2483.2084	0.2160	536.3730 (264)
Space and water heating			1401.0266 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	437.6809	0.5190	227.1564 (268)
Total CO2, kg/m2/year			1667.1080 (272)
Emissions per m2 for space and water heating			15.0131 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.4342 (272b)
Emissions per m2 for pumps and fans			0.4171 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.0131 * 1.00) + 2.4342 + 0.4171, rounded to 2 d.p.			17.8600 (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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (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) = 0.1286 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3786 (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)	=	0.3218 (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	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
Effective ac	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	14.4400	87.5100	0.2500	21.8775	60.0000	5250.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.8559		(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			9.0000	419.9400 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				18112.1000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							194.0859 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4805 (36)
Total fabric heat loss			(33) + (36) =				64.3364 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	44.9748	44.7232	44.4765	43.3180	43.1012	42.0922	42.0922	41.9053	42.4808	43.1012	43.5397	43.9981 (38)
Heat transfer coeff	109.3112	109.0596	108.8129	107.6544	107.4376	106.4286	106.4286	106.2417	106.8173	107.4376	107.8761	108.3346 (39)
Average = Sum(39)m / 12 =												107.6534 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1714	1.1687	1.1660	1.1536	1.1513	1.1405	1.1405	1.1385	1.1446	1.1513	1.1560	1.1609 (40)
HLP (average)												1.1536 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

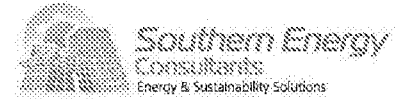
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1535.2611 (45)											
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.8244	29.5831	30.5271	26.6142	25.5370	22.0365	20.4200	23.4323	23.7121	27.6342	30.1649	32.7571 (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	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.7833	22.0123	17.9016	13.5527	10.1308	8.5528	9.2416	12.0126	16.1233	20.4723	23.8942	25.4721	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.0548	247.5977	241.1897	227.5478	210.3273	194.1424	183.3300	180.7871	187.1951	200.8370	218.0575	234.2424	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	45.4629	44.0224	41.0310	36.9642	34.3239	30.6062	27.4463	31.4950	32.9335	37.1428	41.8957	44.0284	(72)
Total internal gains	378.3284	376.6598	363.1497	341.0920	317.8093	296.3289	283.0453	287.3221	299.2793	321.4794	346.8748	366.7703	(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
East			4.5200		19.6403		0.4400		0.0000		0.7700		30.0766 (76)
South			2.1300		46.7521		0.4400		0.0000		0.7700		33.7383 (78)
West			3.4900		19.6403		0.4400		0.0000		0.7700		23.2229 (80)
Solar gains	87.0379	159.5199	242.0946	329.9786	389.8057	393.9528	377.0551	332.6267	273.2308	183.3168	106.4497	72.9840	(83)
Total gains	465.3663	536.1797	605.2443	671.0706	707.6150	690.2816	660.1004	619.9488	572.5101	504.7962	453.3244	439.7542	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	46.0258	46.1320	46.2366	46.7342	46.8285	47.2724	47.2724	47.3556	47.1004	46.8285	46.6381	46.4408	
alpha	4.0684	4.0755	4.0824	4.1156	4.1219	4.1515	4.1515	4.1570	4.1400	4.1219	4.1092	4.0961	
util living area	0.9971	0.9945	0.9876	0.9673	0.9151	0.8005	0.6497	0.7005	0.8921	0.9789	0.9949	0.9977	(86)
MIT	19.3434	19.5114	19.8061	20.2017	20.5703	20.8425	20.9517	20.9333	20.7230	20.2383	19.7199	19.3154	(87)
Th 2	19.9430	19.9452	19.9473	19.9573	19.9592	19.9679	19.9679	19.9695	19.9645	19.9592	19.9554	19.9514	(88)
util rest of house	0.9963	0.9929	0.9839	0.9564	0.8839	0.7232	0.5225	0.5783	0.8399	0.9700	0.9932	0.9971	(89)
MIT 2	18.4265	18.5956	18.8901	19.2872	19.6391	19.8796	19.9513	19.9441	19.7864	19.3287	18.8119	18.4050	(90)
Living area fraction	18.6212	18.7901	19.0847	19.4815	19.8369	20.0841	20.1638	20.1542	19.9853	19.5219	19.0048	18.5984	(91)
MIT	18.6212	18.7901	19.0847	19.4815	19.8369	20.0841	20.1638	20.1542	19.9853	19.5219	19.0048	18.5984	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6212	18.7901	19.0847	19.4815	19.8369	20.0841	20.1638	20.1542	19.9853	19.5219	19.0048	18.5984	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9949	0.9906	0.9798	0.9501	0.8795	0.7331	0.5486	0.6025	0.8412	0.9650	0.9910	0.9960	(94)
Useful gains	463.0108	531.1269	593.0015	637.5976	622.3184	506.0284	362.1268	373.5068	481.5808	487.1373	449.2402	437.9851	(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	1565.4718	1514.8504	1369.3755	1139.1396	874.2048	583.6633	379.2865	398.8537	628.6503	958.5467	1284.2384	1559.8431	(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	820.2310	661.0622	577.6222	361.1103	187.4035	0.0000	0.0000	0.0000	0.0000	350.7286	601.1987	834.6624	(98)
Space heating													4394.0190 (98)
Space heating per m2													(98) / (4) = 47.0855 (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	1000.4287	787.5716	807.4372	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	0.7656	0.8446	0.8157	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	765.9109	665.1548	658.6318	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	909.2667	871.9402	827.1917	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	103.2161	153.8483	125.4086	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												382.4731 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
Intermittency factor	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	25.8040	38.4621	31.3521	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												95.6183 (107)
Space cooling per m2												1.0246 (108)
Energy for space heating												47.0855 (99)
Energy for space cooling												1.0246 (108)
Total												48.1101 (109)
Dwelling Fabric Energy Efficiency (DFEE)												48.1 (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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (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) = 0.1286 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3786 (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) =	0.3218 (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	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
Effective ac	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (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)			10.1400	1.3258	13.4432			(27)					
Heat Loss Floor 1			46.6600	0.1300	6.0658			(28a)					
Brick/Render Cavity	101.9500	14.4400	87.5100	0.1800	15.7518			(29a)					
External Roof 1	46.6600		46.6600	0.1300	6.0658			(30)					
Total net area of external elements Aum(A, m2)			195.2700					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.0566			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								10.4741 (36)					
Total fabric heat loss						(33) + (36) =		56.5307 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 44.9748	Feb 44.7232	Mar 44.4765	Apr 43.3180	May 43.1012	Jun 42.0922	Jul 42.0922	Aug 41.9053	Sep 42.4808	Oct 43.1012	Nov 43.5397	Dec 43.9981	(38)
Heat transfer coeff	101.5055	101.2538	101.0072	99.8487	99.6319	98.6229	98.6229	98.4360	99.0115	99.6319	100.0704	100.5288	(39)
Average = Sum(39)m / 12 =												99.8476	(39)
HLP	Jan 1.0877	Feb 1.0850	Mar 1.0824	Apr 1.0700	May 1.0676	Jun 1.0568	Jul 1.0568	Aug 1.0548	Sep 1.0610	Oct 1.0676	Nov 1.0723	Dec 1.0772	(40)
HLP (average)												1.0699	(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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)
Energy content (annual)												Total = Sum(45)m = 1535.2611 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.8244	29.5831	30.5271	26.6142	25.5370	22.0365	20.4200	23.4323	23.7121	27.6342	30.1649	32.7571 (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	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.7833	22.0123	17.9016	13.5527	10.1308	8.5528	9.2416	12.0126	16.1233	20.4723	23.8942	25.4721	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.0548	247.5977	241.1897	227.5478	210.3273	194.1424	183.3300	180.7871	187.1951	200.8370	218.0575	234.2424	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	45.4629	44.0224	41.0310	36.9642	34.3239	30.6062	27.4463	31.4950	32.9335	37.1428	41.6957	44.0284	(72)
Total internal gains	378.3284	376.6598	363.1497	341.0920	317.8093	296.3289	283.0453	287.3221	299.2793	321.4794	346.8748	366.7703	(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
East	4.5200	19.6403	0.6300	0.7000	0.7700	27.1305 (76)
South	2.1300	46.7521	0.6300	0.7000	0.7700	30.4335 (78)
West	3.4900	19.6403	0.6300	0.7000	0.7700	20.9481 (80)

Solar gains	78.5121	143.8942	218.3803	297.6557	351.6224	355.3633	340.1208	300.0444	246.4666	165.3601	96.0224	65.8349	(83)
Total gains	456.8405	520.5540	581.5300	638.7477	669.4318	651.6922	623.1661	587.3665	545.7459	486.8395	442.8972	432.6051	(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	63.8444	64.0031	64.1594	64.9038	65.0450	65.7105	65.7105	65.8352	65.4525	65.0450	64.7600	64.4647	
alpha	5.2563	5.2669	5.2773	5.3269	5.3363	5.3807	5.3807	5.3890	5.3635	5.3363	5.3173	5.2976	
util living area	0.9993	0.9983	0.9954	0.9839	0.9439	0.8295	0.6629	0.7173	0.9207	0.9905	0.9984	0.9995	(86)
MIT	19.7391	19.8690	20.0975	20.4080	20.6989	20.9072	20.9786	20.9677	20.8151	20.4340	20.0315	19.7185	(87)
Th 2	20.0109	20.0131	20.0153	20.0254	20.0274	20.0362	20.0362	20.0379	20.0328	20.0274	20.0235	20.0195	(88)
util rest of house	0.9990	0.9977	0.9936	0.9770	0.9173	0.7510	0.5343	0.5924	0.8721	0.9853	0.9978	0.9993	(89)
MIT 2	18.8521	18.9836	19.2130	19.5283	19.8071	19.9884	20.0302	20.0275	19.9188	19.5578	19.1544	18.8384	(90)
Living area fraction									fLA = Living area / (4) =			0.2124	(91)
MIT	19.0405	19.1716	19.4009	19.7151	19.9965	20.1836	20.2316	20.2272	20.1092	19.7439	19.3407	19.0253	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0405	19.1716	19.4009	19.7151	19.9965	20.1836	20.2316	20.2272	20.1092	19.7439	19.3407	19.0253	(93)

8. Space heating requirement

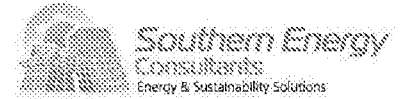
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	456.2189	519.0131	576.9437	622.2394	613.3965	498.3053	350.1900	363.6288	478.5437	478.6844	441.6299	432.1671	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(95)
Heat loss rate W	1496.2417	1445.0570	1303.0803	1079.8754	826.5953	550.6683	358.1586	376.7347	594.9777	911.0240	1224.9311	1490.3706	(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	773.7770	622.3015	540.2456	329.4979	158.6199	0.0000	0.0000	0.0000	0.0000	321.6607	563.9768	787.3034	(98)
Space heating												4097.3828	(98)
Space heating per m2										(98) / (4) =		43.9068	(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	927.0548	729.8091	748.1136	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8122	0.8916	0.8651	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	752.9625	650.7028	647.1754	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	864.1621	828.7703	789.1085	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	80.0637	132.4822	105.5982	0.0000	0.0000	0.0000	0.0000	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												318.1442 (104)
Cooled fraction												1.0000 (105)
Intermittency factor (Table 10b)												
	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	20.0159	33.1206	26.3996	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												79.5360 (107)
Space cooling per m2												0.8523 (108)
Energy for space heating												43.9068 (99)
Energy for space cooling												0.8523 (108)
Total												44.7591 (109)
Target Fabric Energy Efficiency (TFEE)												51.5 (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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (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					2 * 10 = 20.0000 (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)					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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)	=	0.2854 (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	0.2996	0.2854	0.2854	0.2640	0.2640	0.2354	0.2426	0.2283	0.2354	0.2497	0.2497	0.2711 (22b)
Effective ac	0.5449	0.5407	0.5407	0.5348	0.5348	0.5277	0.5294	0.5261	0.5277	0.5312	0.5312	0.5367 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	14.4400	87.5100	0.2500	21.8775	60.0000	5250.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.8559		(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18532.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							198.5859 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4805 (36)
Total fabric heat loss						(33) + (36) =	64.3364 (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	41.9506	41.6293	41.6293	41.1767	41.1767	40.6281	40.7594	40.5008	40.6281	40.8946	40.8946	41.3236 (38)
Heat transfer coeff	106.2870	105.9657	105.9657	105.5131	105.5131	104.9645	105.0958	104.8372	104.9645	105.2310	105.2310	105.6601 (39)
Average = Sum(39)m / 12 =												105.4357 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1390	1.1355	1.1355	1.1307	1.1307	1.1248	1.1262	1.1234	1.1248	1.1276	1.1276	1.1322 (40)
HLP (average)												1.1298 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1535.2611 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.8761	20.8822	21.5485	18.7865	18.0261	15.5552	14.4141	16.5404	16.7380	19.5065	21.2929	23.1227 (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	14.1386	12.7594	14.0997	13.6002	14.0211	13.5314	13.9591	13.9993	13.5689	14.0672	13.6535 (61)
Total heat required for water heating calculated for each month											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =	0.0000 (63)										
Output from w/h											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (64)
RHI water heating demand											
Heat gains from water heating, kWh/month											
56.4599	49.4786	51.2908	45.0435	43.4632	37.8634	35.4411	40.1645	40.4948	46.7562	50.6126	54.7869 (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	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.9583	55.0308	44.7540	33.8817	25.3270	21.3821	23.1041	30.0316	40.3083	51.1807	59.7354	63.6803 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	365.7535	369.5489	359.9846	339.6235	313.9213	289.7648	273.6268	269.8314	279.3956	299.7568	325.4590	349.6155 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794 (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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397 (71)
Water heating gains (Table 5)	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383 (72)
Total internal gains	613.6480	608.2578	583.7272	546.1149	507.7157	473.7843	454.4161	463.8968	485.9960	523.8311	565.5389	596.9834 (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	
East				4.5200	22.3313	0.4400	0.0000			0.7700	34.1976 (76)	
South				2.1300	50.9848	0.4400	0.0000			0.7700	36.7929 (78)	
West				3.4900	22.3313	0.4400	0.0000			0.7700	26.4048 (80)	

Solar gains	97.3953	160.7161	241.0972	338.9216	390.3950	422.4440	399.8621	360.4376	295.0305	197.2469	122.0541	80.8659 (83)
Total gains	711.0433	768.9739	824.8244	885.0365	898.1107	896.2283	854.2781	824.3344	781.0265	721.0780	687.5931	677.8493 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	48.4329	48.5798	48.5798	48.7881	48.7881	49.0431	48.9819	49.1027	49.0431	48.9189	48.9189	48.7203
alpha	4.2289	4.2387	4.2387	4.2525	4.2525	4.2695	4.2655	4.2735	4.2695	4.2613	4.2613	4.2480
util living area	0.9849	0.9778	0.9575	0.9037	0.7837	0.5593	0.3775	0.4017	0.6983	0.9131	0.9727	0.9873 (86)
MIT	19.8078	19.9391	20.2148	20.5517	20.8307	20.9716	20.9960	20.9948	20.9234	20.6005	20.1557	19.7806 (87)
Th 2	19.9691	19.9719	19.9719	19.9759	19.9759	19.9806	19.9795	19.9818	19.9806	19.9783	19.9783	19.9746 (88)
util rest of house	0.9809	0.9719	0.9457	0.8758	0.7217	0.4565	0.2553	0.2766	0.6040	0.8816	0.9642	0.9838 (89)
MIT 2	18.4113	18.6025	18.9969	19.4667	19.8205	19.9652	19.9786	19.9805	19.9275	19.5432	18.9214	18.3759 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.7079	18.8864	19.2556	19.6971	20.0351	20.1789	20.1947	20.1959	20.1390	19.7678	19.1836	18.6742 (92)
Temperature adjustment												
adjusted MIT	18.5579	18.7364	19.1056	19.5471	19.8851	20.0289	20.0447	20.0459	19.9890	19.6178	19.0336	18.5242 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9731	0.9621	0.9326	0.8616	0.7155	0.4616	0.2632	0.2847	0.6049	0.8676	0.9533	0.9768 (94)
Useful gains	691.9430	739.8535	769.2497	762.5569	642.6043	413.6754	224.8355	234.6632	472.4084	625.6430	655.4773	662.1529 (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	1430.4036	1392.0030	1240.3916	1017.9005	726.4672	422.8945	225.4006	235.4591	502.6731	843.7189	1161.0732	1418.4042 (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	549.4147	438.2445	350.5295	183.8474	62.3940	0.0000	0.0000	0.0000	0.0000	162.2485	364.0290	562.6510 (98)
Space heating												2673.3585 (98)
RHI space heating demand												2673 (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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (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					2 * 10 = 20.0000 (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)					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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) =	0.2854 (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	0.3638	0.3567	0.3496	0.3139	0.3068	0.2711	0.2711	0.2640	0.2854	0.3068	0.3210	0.3353 (22b)
Effective ac	0.5662	0.5636	0.5611	0.5493	0.5471	0.5367	0.5367	0.5348	0.5407	0.5471	0.5515	0.5562 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	14.4400	87.5100	0.2500	21.8775	60.0000	5250.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.8559		(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18532.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							198.5859 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4805 (36)
Total fabric heat loss						(33) + (36) =	64.3364 (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	43.5905	43.3926	43.1986	42.2876	42.1171	41.3236	41.3236	41.1767	41.6293	42.1171	42.4620	42.8225 (38)
Heat transfer coeff	107.9269	107.7290	107.5351	106.6240	106.4536	105.6601	105.6601	105.5131	105.9657	106.4536	106.7984	107.1589 (39)
Average = Sum(39)m / 12 =												106.6232 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1565	1.1544	1.1523	1.1426	1.1407	1.1322	1.1322	1.1307	1.1355	1.1407	1.1444	1.1483 (40)
HLP (average)												1.1426 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1535.2611 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.8761 20.8822 21.5485 18.7865 18.0261 15.5552 14.4141 16.5404 16.7380 19.5065 21.2929 23.1227 (46)											
Water storage loss:											
Total storage loss											
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)											
If cylinder contains dedicated solar storage											
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)											
Combi loss 14.1386 12.7594 14.0997 13.6002 14.0211 13.5314 13.9591 13.9993 13.5689 14.0672 13.6535 14.1265 (61)											
Total heat required for water heating calculated for each month											
173.3123 151.9738 157.7565 138.8437 134.1952 117.2324 110.0534 124.2689 125.1555 144.1106 155.6060 168.2778 (62)											
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)											
Solar input (sum of months) = Sum(63)m = 0.0000 (63)											
Output from w/h											
173.3123 151.9738 157.7565 138.8437 134.1952 117.2324 110.0534 124.2689 125.1555 144.1106 155.6060 168.2778 (64)											
Heat gains from water heating, kWh/month											
56.4599 49.4786 51.2908 45.0435 43.4632 37.8634 35.4411 40.1645 40.4948 46.7562 50.6126 54.7869 (65)											
Total per year (kWh/year) = Sum(64)m = 1700.7860 (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	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.9583	55.0308	44.7540	33.8817	25.3270	21.3821	23.1041	30.0316	40.3083	51.1807	59.7354	63.6803	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	365.7535	369.5489	359.9846	339.6235	313.9213	289.7648	273.6268	269.8314	279.3956	299.7568	325.4590	349.6155	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383	(72)
Total internal gains	613.6480	608.2578	583.7272	546.1149	507.7157	473.7843	454.4161	463.8968	485.9960	523.8311	565.5389	596.9834	(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
East			4.5200		19.6403		0.4400		0.0000		0.7700		30.0766 (76)
South			2.1300		46.7521		0.4400		0.0000		0.7700		33.7383 (78)
West			3.4900		19.6403		0.4400		0.0000		0.7700		23.2229 (80)
Solar gains	87.0379	159.5199	242.0946	329.9786	389.8057	393.9528	377.0551	332.6267	273.2308	183.3168	106.4497	72.9840	(83)
Total gains	700.6859	767.7777	825.8218	876.0935	897.5214	867.7371	831.4712	796.5235	759.2268	707.1479	671.9886	669.9673	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	47.6970	47.7846	47.8708	48.2798	48.3571	48.7203	48.7203	48.7881	48.5798	48.3571	48.2010	48.0388
alpha	4.1798	4.1856	4.1914	4.2187	4.2238	4.2480	4.2480	4.2525	4.2387	4.2238	4.2134	4.2026
util living area	0.9881	0.9813	0.9660	0.9277	0.8460	0.6976	0.5372	0.5781	0.7936	0.9398	0.9803	0.9901 (86)
MIT	19.6679	19.8222	20.0853	20.4253	20.7222	20.9145	20.9780	20.9699	20.8449	20.4671	20.0064	19.6331 (87)
Th 2	19.9549	19.9566	19.9583	19.9662	19.9677	19.9746	19.9746	19.9759	19.9719	19.9677	19.9647	19.9616 (88)
util rest of house	0.9851	0.9765	0.9568	0.9070	0.8006	0.6126	0.4220	0.4631	0.7213	0.9183	0.9743	0.9875 (89)
MIT 2	18.1984	18.4227	18.8023	19.2869	19.6827	19.9104	19.9646	19.9609	19.8402	19.3542	18.6972	18.1525 (90)
Living area fraction	18.5105	18.7200	19.0748	19.5287	19.9035	20.1237	20.1799	20.1752	20.0536	19.5906	18.9753	18.4670 (92)
MIT	18.3605	18.5700	18.9248	19.3787	19.7535	19.9737	20.0299	20.0252	19.9036	19.4406	18.8253	18.3170 (93)
Temperature adjustment												-0.1500
adjusted MIT												18.3170 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9783	0.9676	0.9446	0.8924	0.7896	0.6125	0.4285	0.4690	0.7158	0.9041	0.9650	0.9816 (94)
Useful gains	685.4889	742.8684	780.0770	781.7901	708.6835	531.4769	356.3160	373.5341	543.4197	639.3479	648.4619	657.6136 (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	1517.5049	1472.6509	1336.0969	1117.2824	857.3207	567.7805	362.3984	382.5106	614.9808	941.1131	1252.2411	1512.7616 (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	619.0199	490.4138	413.6788	241.5544	110.5861	0.0000	0.0000	0.0000	0.0000	224.5133	434.7210	636.2301 (98)
Space heating												3170.7175 (98)
Space heating per m2												33.9768 (99)
										(98) / (4) =		

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													3503.5552	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	619.0199	490.4138	413.6788	241.5544	110.5861	0.0000	0.0000	0.0000	0.0000	224.5133	434.7210	636.2301	(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)	683.9999	541.8937	457.1037	266.9110	122.1946	0.0000	0.0000	0.0000	0.0000	248.0810	480.3547	703.0167	(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	173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778	(64)	
Efficiency of water heater (217)m	89.7802	89.7220	89.5934	89.3052	88.7172	87.3000	87.3000	87.3000	87.3000	89.2215	89.6340	89.8114	(217)	
Fuel for water heating, kWh/month	193.0408	169.3830	176.0805	155.4710	151.2617	134.2869	126.0634	142.3470	143.3625	161.5201	173.6017	187.3679	(219)	
Water heating fuel used												1913.7865	(219)	
Annual totals kWh/year														
Space heating fuel - main system													3503.5552	(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)													437.6809	(232)
Total delivered energy for all uses													5930.0226	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3503.5552	3.4800	121.9237 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1913.7865	3.4800	66.5998 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	437.6809	13.1900	57.7301 (250)
Additional standing charges			120.0000 (251)
Total energy cost			376.1461 (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] = 1.1421 (257)
SAP value	84.0671
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	3503.5552	0.2160	756.7679 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1913.7865	0.2160	413.3779 (264)
Space and water heating			1170.1458 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	437.6809	0.5190	227.1564 (268)
Total kg/year			1436.2272 (272)
CO2 emissions per m2			15.3900 (273)
EI value			86.0863
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	$3.48 / 0.8875 = 3.921$, stars = 4
Water heating environmental impact	$0.216 / 0.8875 = 0.2434$, 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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (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					2 * 10 = 20.0000 (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)					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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) =	0.2854 (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	0.2996	0.2854	0.2854	0.2640	0.2640	0.2354	0.2426	0.2283	0.2354	0.2497	0.2497	0.2711 (22b)
Effective ac	0.5449	0.5407	0.5407	0.5348	0.5348	0.5277	0.5294	0.5261	0.5277	0.5312	0.5312	0.5367 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	14.4400	87.5100	0.2500	21.8775	60.0000	5250.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	54.8559			(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18532.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							198.5859 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4805 (36)
Total fabric heat loss						(33) + (36) =	64.3364 (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	41.9506	41.6293	41.6293	41.1767	41.1767	40.6281	40.7594	40.5008	40.6281	40.8946	40.8946	41.3236 (38)
Heat transfer coeff	106.2870	105.9657	105.9657	105.5131	105.5131	104.9645	105.0958	104.8372	104.9645	105.2310	105.2310	105.6601 (39)
Average = Sum(39)m / 12 =												105.4357 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1390	1.1355	1.1355	1.1307	1.1307	1.1248	1.1262	1.1234	1.1248	1.1276	1.1276	1.1322 (40)
HLP (average)												1.1298 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Energy content (annual)	Total = Sum(45)m = 1535.2611 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.8761	20.8822	21.5485	18.7865	18.0261	15.5552	14.4141	16.5404	16.7380	19.5065	21.2929	23.1227 (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	14.1386	12.7594	14.0997	13.6002	14.0211	13.5314	13.9591	13.9993	13.5689	14.0672	13.6535 (61)
Total heat required for water heating calculated for each month											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (64)
Heat gains from water heating, kWh/month											
56.4599	49.4786	51.2908	45.0435	43.4632	37.8634	35.4411	40.1645	40.4948	46.7562	50.6126	54.7869 (65)
Total per year (kWh/year) = Sum(64)m = 1700.7860 (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	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.9583	55.0308	44.7540	33.8817	25.3270	21.3821	23.1041	30.0316	40.3083	51.1807	59.7354	63.6803	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	365.7535	369.5489	359.9846	339.6235	313.9213	289.7648	273.6268	269.8314	279.3956	299.7568	325.4590	349.6155	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383	(72)
Total internal gains	613.6480	608.2578	583.7272	546.1149	507.7157	473.7843	454.4161	463.8968	485.9960	523.8311	565.5389	596.9834	(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	
East				4.5200	22.3313	0.4400	0.0000		0.7700		34.1976 (76)	
South				2.1300	50.9848	0.4400	0.0000		0.7700		36.7929 (78)	
West				3.4900	22.3313	0.4400	0.0000		0.7700		26.4048 (80)	
Solar gains	97.3953	160.7161	241.0972	338.9216	390.3950	422.4440	399.8621	360.4376	295.0305	197.2469	122.0541	80.8659 (83)
Total gains	711.0433	768.9739	824.8244	885.0365	898.1107	896.2283	854.2781	824.3344	781.0265	721.0780	687.5931	677.8493 (84)

7. Mean internal temperature (heating season)

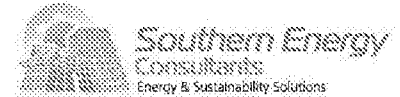
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	48.4329	48.5798	48.5798	48.7881	48.7881	49.0431	48.9819	49.1027	49.0431	48.9189	48.9189	48.7203
alpha	4.2289	4.2387	4.2387	4.2525	4.2525	4.2695	4.2655	4.2735	4.2695	4.2613	4.2613	4.2480
util living area	0.9849	0.9778	0.9575	0.9037	0.7837	0.5593	0.3775	0.4017	0.6983	0.9131	0.9727	0.9873 (86)
MIT	19.8078	19.9391	20.2148	20.5517	20.8307	20.9716	20.9960	20.9948	20.9234	20.6005	20.1557	19.7806 (87)
Th 2	19.9691	19.9719	19.9719	19.9759	19.9759	19.9806	19.9795	19.9818	19.9806	19.9783	19.9783	19.9746 (88)
util rest of house	0.9809	0.9719	0.9457	0.8758	0.7217	0.4565	0.2553	0.2766	0.6040	0.8816	0.9642	0.9838 (89)
MIT 2	18.4113	18.6025	18.9969	19.4667	19.8205	19.9652	19.9786	19.9805	19.9275	19.5432	18.9214	18.3759 (90)
Living area fraction	18.7079	18.8864	19.2556	19.6971	20.0351	20.1789	20.1947	20.1959	20.1390	19.7678	19.1836	18.6742 (91)
MIT	18.5579	18.7364	19.1056	19.5471	19.8851	20.0289	20.0447	20.0459	19.9890	19.6178	19.0336	18.5242 (93)
Temperature adjustment												-0.1500
adjusted MIT												18.5242 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	691.9430	739.8535	769.2497	762.5569	642.6043	413.6754	224.8355	234.6632	472.4084	625.6430	655.4773	662.1529	(94)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1430.4036	1392.0030	1240.3916	1017.9005	726.4672	422.8945	225.4006	235.4591	502.6731	843.7189	1161.0732	1418.4042	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	549.4147	438.2445	350.5295	183.8474	62.3940	0.0000	0.0000	0.0000	0.0000	162.2485	364.0290	562.6510	(98)
Space heating												2673.3585	(98)
Space heating per m2												(98) / (4) = 28.6472	(99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													90.5000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													2953.9873	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	549.4147	438.2445	350.5295	183.8474	62.3940	0.0000	0.0000	0.0000	0.0000	162.2485	364.0290	562.6510	(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)	607.0880	484.2480	387.3254	203.1463	68.9436	0.0000	0.0000	0.0000	0.0000	179.2801	402.2420	621.7138	(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	173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778	(64)	
Efficiency of water heater (217)m	89.7114	89.6538	89.4820	89.0948	88.2908	87.3000	87.3000	87.3000	87.3000	88.9660	89.5174	89.7427	(216)	
Fuel for water heating, kWh/month	193.1887	169.5117	176.2997	155.8381	151.9922	134.2869	126.0634	142.3470	143.3625	161.9839	173.8277	187.5115	(219)	
Water heating fuel used												1916.2131	(219)	
Annual totals kWh/year														
Space heating fuel - main system													2953.9873	(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)													437.6809	(232)
Total delivered energy for all uses													5382.8813	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2953.9873	3.8700	114.3193 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1916.2131	3.8700	74.1574 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	437.6809	18.9000	82.7217 (250)
Additional standing charges			93.0000 (251)
Total energy cost			378.3734 (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	2953.9873	0.2160	638.0613 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1916.2131	0.2160	413.9020 (264)
Space and water heating			1051.9633 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	437.6809	0.5190	227.1564 (268)
Total kg/year			1318.0447 (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	2953.9873	1.2200	3603.8645 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1916.2131	1.2200	2337.7800 (264)
Space and water heating			5941.6445 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	437.6809	3.0700	1343.6803 (268)
Primary energy kWh/year			7515.5748 (272)
Primary energy kWh/m2/year			80.5355 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
Current environmental impact rating: B 86

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-187 kg (14.2%)
U Solar photovoltaic panels	+ 9.7	-£ 345	-947 kg (83.7%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£29	2.01 kg/m²	B 85 B 88
Solar photovoltaic panels	£345	10.15 kg/m²	A 95 A 97
Total Savings	£374	12.15 kg/m²	

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 97

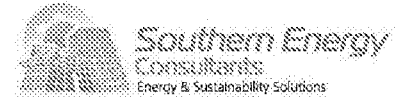
Fuel prices for cost data on this page from database revision number 470 TEST (21 Dec 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£97	£106	-£9
Mains gas	£281	£243	£38
Space heating	£221	£221	£0
Water heating	£74	£45	£29
Lighting	£83	£83	£0
Generated (PV)	-£0	-£345	£345
Total cost of fuels	£378	£4	£374
Total cost of uses	£378	£4	£374
Delivered energy	58 kWh/m²	28 kWh/m²	30 kWh/m²
Carbon dioxide emissions	1.3 tonnes	0.2 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	2 kg/m²	12 kg/m²
Primary energy	81 kWh/m²	9 kWh/m²	71 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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (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					2 * 10 = 20.0000 (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)					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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) =	0.2854 (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	0.3638	0.3567	0.3496	0.3139	0.3068	0.2711	0.2711	0.2640	0.2854	0.3068	0.3210	0.3353 (22b)
Effective ac	0.5662	0.5636	0.5611	0.5493	0.5471	0.5367	0.5367	0.5348	0.5407	0.5471	0.5515	0.5562 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	14.4400	87.5100	0.2500	21.8775	60.0000	5250.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.8559		(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18532.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							198.5859 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4805 (36)
Total fabric heat loss						(33) + (36) =	64.3364 (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	43.5905	43.3926	43.1986	42.2876	42.1171	41.3236	41.3236	41.1767	41.6293	42.1171	42.4620	42.8225 (38)
Heat transfer coeff	107.9269	107.7290	107.5351	106.6240	106.4536	105.6601	105.6601	105.5131	105.9657	106.4536	106.7984	107.1589 (39)
Average = Sum(39)m / 12 =												106.6232 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1565	1.1544	1.1523	1.1426	1.1407	1.1322	1.1322	1.1307	1.1355	1.1407	1.1444	1.1483 (40)
HLP (average)												1.1426 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1535.2611 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.8761	20.8822	21.5485	18.7865	18.0261	15.5552	14.4141	16.5404	16.7380	19.5065	21.2929	23.1227 (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	14.1386	12.7594	14.0997	13.6002	14.0211	13.5314	13.9591	13.9993	13.5689	14.0672	13.6535 (61)
Total heat required for water heating calculated for each month											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (62)
Aperture area of solar collector											
Zero-loss collector efficiency											
Collector heat loss coefficient											
Collector 2nd order heat loss coefficient											
Collector effective heat loss coefficient											
Collector performance ratio											
Annual solar radiation per m2											
Overshading factor											
Solar energy available											
Adjustment factor for showers											
Solar-to-load ratio											
Utilisation factor											
Collector performance factor											
Dedicated solar storage volume											
Effective solar volume											
Daily hot water demand											
Volume ratio Veff/V											
Solar storage volume factor											
Solar input											
Solar input	-25.0192	-41.7499	-71.1048	-95.2945	-117.7283	-115.7457	-114.2161	-99.7912	-78.1565	-53.3717	-29.6764
Output from w/h	148.2931	110.2239	86.6516	43.5492	16.4668	1.4867	0.0000	24.4777	46.9990	90.7389	125.9296
Heat gains from water heating, kWh/month	56.4599	49.4786	51.2908	45.0435	43.4632	37.8634	35.4411	40.1645	40.4948	46.7562	50.6126
Solar input (sum of months) = Sum(63)m =											
-862.7912											
Total per year (kWh/year) = Sum(64)m =											
842.1575											
54.7869											

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	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.9583	55.0308	44.7540	33.8817	25.3270	21.3821	23.1041	30.0316	40.3083	51.1807	59.7354	63.6803 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	365.7535	369.5489	359.9846	339.6235	313.9213	289.7648	273.6268	269.8314	279.3956	299.7568	325.4590	349.6155 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794 (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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397 (71)
Water heating gains (Table 5)	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383 (72)
Total internal gains	613.6480	608.2578	583.7272	546.1149	507.7157	473.7843	454.4161	463.8968	485.9960	523.8311	565.5389	596.9834 (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

East	4.5200	19.6403	0.4400	0.0000	0.7700	30.0766 (76)
South	2.1300	46.7521	0.4400	0.0000	0.7700	33.7383 (78)
West	3.4900	19.6403	0.4400	0.0000	0.7700	23.2229 (80)

Solar gains	87.0379	159.5199	242.0946	329.9786	389.8057	393.9528	377.0551	332.6267	273.2308	183.3168	106.4497	72.9840 (83)
Total gains	700.6859	767.7777	825.8218	876.0935	897.5214	867.7371	831.4712	796.5235	759.2268	707.1479	671.9886	669.9673 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	47.6970	47.7846	47.8708	48.2798	48.3571	48.7203	48.7203	48.7881	48.5798	48.3571	48.2010	48.0388
alpha	4.1798	4.1856	4.1914	4.2187	4.2238	4.2480	4.2480	4.2525	4.2387	4.2238	4.2134	4.2026
util living area	0.9881	0.9813	0.9660	0.9277	0.8460	0.6976	0.5372	0.5781	0.7936	0.9398	0.9803	0.9901 (86)
MIT	19.6679	19.8222	20.0853	20.4253	20.7222	20.9145	20.9780	20.9699	20.8449	20.4671	20.0064	19.6331 (87)
Th 2	19.9549	19.9566	19.9583	19.9662	19.9677	19.9746	19.9746	19.9759	19.9719	19.9677	19.9647	19.9616 (88)
util rest of house	0.9851	0.9765	0.9568	0.9070	0.8006	0.6126	0.4220	0.4631	0.7213	0.9183	0.9743	0.9875 (89)
MIT 2	18.1984	18.4227	18.8023	19.2869	19.6827	19.9104	19.9646	19.9609	19.8402	19.3542	18.6972	18.1525 (90)
Living area fraction	fLA = Living area / (4) = 0.2124 (91)											
MIT	18.5105	18.7200	19.0748	19.5287	19.9035	20.1237	20.1799	20.1752	20.0536	19.5906	18.9753	18.4670 (92)
Temperature adjustment	-1.0500											
adjusted MIT	18.3605	18.5700	18.9248	19.3787	19.7535	19.9737	20.0299	20.0252	19.9036	19.4406	18.8253	18.3170 (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	0.9783	0.9676	0.9446	0.8924	0.7896	0.6125	0.4285	0.4690	0.7158	0.9041	0.9650	0.9816	(94)
Useful gains	685.4889	742.8684	780.0770	781.7901	708.6835	531.4769	356.3160	373.5341	543.4197	639.3479	648.4619	657.6136	(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	1517.5049	1472.6509	1336.0969	1117.2824	857.3207	567.7805	362.3984	382.5106	614.9808	941.1131	1252.2411	1512.7616	(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	619.0199	490.4138	413.6788	241.5544	110.5861	0.0000	0.0000	0.0000	0.0000	224.5133	434.7210	636.2301	(98)
Space heating												3170.7175	(98)
Space heating per m2												(98) / (4) =	33.9768 (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													3503.5552 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	619.0199	490.4138	413.6788	241.5544	110.5861	0.0000	0.0000	0.0000	0.0000	224.5133	434.7210	636.2301	(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)	683.9999	541.8937	457.1037	266.9110	122.1946	0.0000	0.0000	0.0000	0.0000	248.0810	480.3547	703.0167	(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	148.2931	110.2239	86.6516	43.5492	16.4668	1.4867	0.0000	24.4777	46.9990	90.7389	125.9296	147.3410	(64)
Efficiency of water heater (217)m	89.8634	89.8953	89.9291	89.9961	90.0721	87.3000	87.3000	87.3000	87.3000	89.5552	89.7610	89.8805	(217)
Fuel for water heating, kWh/month	165.0206	122.6136	96.3555	48.3901	18.2818	1.7030	0.0000	28.0386	53.8362	101.3218	140.2944	163.9299	(219)
Water heating fuel used												939.7854	(219)
Annual totals kWh/year													
Space heating fuel - main system												3503.5552	(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)													437.6809 (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												3278.7821	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3503.5552	3.4800	121.9237	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	939.7854	3.4800	32.7045	(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	437.6809	13.1900	57.7301	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			121.0230	(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] =	0.3675 (257)
SAP value		94.8737
SAP rating (Section 12)		95 (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	3503.5552	0.2160	756.7679 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	939.7854	0.2160	202.9936 (264)
Space and water heating			959.7616 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	437.6809	0.5190	227.1564 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			355.3557 (272)
CO2 emissions per m2			3.8100 (273)
EI value			96.5574
EI rating			97 (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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (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					2 * 10 = 20.0000 (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)					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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)	=	0.2854 (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	0.2996	0.2854	0.2854	0.2640	0.2640	0.2354	0.2426	0.2283	0.2354	0.2497	0.2497	0.2711 (22b)
Effective ac	0.5449	0.5407	0.5407	0.5348	0.5348	0.5277	0.5294	0.5261	0.5277	0.5312	0.5312	0.5367 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	14.4400	87.5100	0.2500	21.8775	60.0000	5250.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.8559		(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18532.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							198.5859 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4805 (36)
Total fabric heat loss						(33) + (36) =	64.3364 (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	41.9506	41.6293	41.6293	41.1767	41.1767	40.6281	40.7594	40.5008	40.6281	40.8946	40.8946	41.3236 (38)
Heat transfer coeff	106.2870	105.9657	105.9657	105.5131	105.5131	104.9645	105.0958	104.8372	104.9645	105.2310	105.2310	105.6601 (39)
Average = Sum(39)m / 12 =												105.4357 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1390	1.1355	1.1355	1.1307	1.1307	1.1248	1.1262	1.1234	1.1248	1.1276	1.1276	1.1322 (40)
HLP (average)												1.1298 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Energy content (annual)												Total = Sum(45)m =	1535.2611 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.8761	20.8822	21.5485	18.7865	18.0261	15.5552	14.4141	16.5404	16.7380	19.5065	21.2929	23.1227 (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	14.1386	12.7594	14.0997	13.6002	14.0211	13.5314	13.9591	13.9993	13.5689	14.0672	13.6535	14.1265 (61)	
Total heat required for water heating calculated for each month													
	173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (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												1.2476 (H8)	
Utilisation factor												0.5514 (H9)	
Collector performance factor												0.8793 (H10)	
Dedicated solar storage volume												75.0000 (H11)	
Effective solar volume												75.0000 (H13)	
Daily hot water demand												97.5767 (H14)	
Volume ratio Veff/V												0.7686 (H15)	
Solar storage volume factor												0.9474 (H16)	
Solar input												-879.7230 (H17)	
Solar input	-27.0774	-40.6973	-68.5395	-94.7425	-114.1018	-120.0872	-117.2037	-104.6636	-81.6903	-55.5724	-32.9133	-22.4338 (63)	
	Solar input (sum of months) = Sum(63)m =											-879.7230 (63)	
Output from w/h	146.2349	111.2764	89.2170	44.1012	20.0933	0.0000	0.0000	19.6053	43.4651	88.5382	122.6927	145.8440 (64)	
	Total per year (kWh/year) = Sum(64)m =											831.0680 (64)	
Heat gains from water heating, kWh/month	56.4599	49.4786	51.2908	45.0435	43.4632	37.8634	35.4411	40.1645	40.4948	46.7562	50.6126	54.7869 (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	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.9583	55.0308	44.7540	33.8817	25.3270	21.3821	23.1041	30.0316	40.3083	51.1807	59.7354	63.6803	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	365.7535	369.5489	359.9846	339.6235	313.9213	289.7648	273.6268	269.8314	279.3956	299.7568	325.4590	349.6155	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383	(72)
Total internal gains	613.6480	608.2578	583.7272	546.1149	507.7157	473.7843	454.4161	463.8968	485.9960	523.8311	565.5389	596.9834	(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
East	4.5200	22.3313	0.4400	0.0000	0.7700	34.1976 (76)
South	2.1300	50.9848	0.4400	0.0000	0.7700	36.7929 (78)
West	3.4900	22.3313	0.4400	0.0000	0.7700	26.4048 (80)

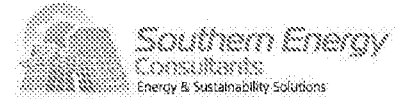
Solar gains	97.3953	160.7161	241.0972	338.9216	390.3950	422.4440	399.8621	360.4376	295.0305	197.2469	122.0541	80.8659 (83)
Total gains	711.0433	768.9739	824.8244	885.0365	898.1107	896.2283	854.2781	824.3344	781.0265	721.0780	687.5931	677.8493 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	48.4329	48.5798	48.5798	48.7881	48.7881	49.0431	48.9819	49.1027	49.0431	48.9189	48.9189	48.7203
alpha	4.2289	4.2387	4.2387	4.2525	4.2525	4.2695	4.2655	4.2735	4.2695	4.2613	4.2613	4.2480
util living area	0.9849	0.9778	0.9575	0.9037	0.7837	0.5593	0.3775	0.4017	0.6983	0.9131	0.9727	0.9873 (86)
MIT	19.8078	19.9391	20.2148	20.5517	20.8307	20.9716	20.9960	20.9948	20.9234	20.6005	20.1557	19.7806 (87)
Th 2	19.9691	19.9719	19.9719	19.9759	19.9759	19.9806	19.9795	19.9818	19.9806	19.9783	19.9783	19.9746 (88)
util rest of house	0.9809	0.9719	0.9457	0.8758	0.7217	0.4565	0.2553	0.2766	0.6040	0.8816	0.9642	0.9838 (89)
MIT 2	18.4113	18.6025	18.9969	19.4667	19.8205	19.9652	19.9786	19.9805	19.9275	19.5432	18.9214	18.3759 (90)
Living area fraction	fLA = Living area / (4) = 0.2124 (91)											
MIT	18.7079	18.8864	19.2556	19.6971	20.0351	20.1789	20.1947	20.1959	20.1390	19.7678	19.1836	18.6742 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.5579	18.7364	19.1056	19.5471	19.8851	20.0289	20.0447	20.0459	19.9890	19.6178	19.0336	18.5242 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9731	0.9621	0.9326	0.8616	0.7155	0.4616	0.2632	0.2847	0.6049	0.8676	0.9533	0.9768	(94)
Useful gains	691.9430	739.8535	769.2497	762.5569	642.6043	413.6754	224.8355	234.6632	472.4084	625.6430	655.4773	662.1529	(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													
	1430.4036	1392.0030	1240.3916	1017.9005	726.4672	422.8945	225.4006	235.4591	502.6731	843.7189	1161.0732	1418.4042	(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													
	549.4147	438.2445	350.5295	183.8474	62.3940	0.0000	0.0000	0.0000	0.0000	162.2485	364.0290	562.6510	(98)
Space heating												2673.3585	(98)
Space heating per m2											(98) / (4) =	28.6472	(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													2953.9873	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	549.4147	438.2445	350.5295	183.8474	62.3940	0.0000	0.0000	0.0000	0.0000	162.2485	364.0290	562.6510	(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)	607.0880	484.2480	387.3254	203.1463	68.9436	0.0000	0.0000	0.0000	0.0000	179.2801	402.2420	621.7138	(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	146.2349	111.2764	89.2170	44.1012	20.0933	0.0000	0.0000	19.6053	43.4651	88.5382	122.6927	145.8440	(64)	
Efficiency of water heater	89.8080	89.8332	89.8319	89.8627	89.6991	87.3000	87.3000	87.3000	87.3000	89.3438	89.6714	89.8222	(217)	
Fuel for water heating, kWh/month	162.8306	123.8700	99.3154	49.0761	22.4008	0.0000	0.0000	22.4574	49.7883	99.0983	136.8247	162.3695	(219)	
Water heating fuel used												928.0312	(219)	
Annual totals kWh/year														
Space heating fuel - main system												2953.9873	(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)													437.6809	(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												2620.5397	(238)	

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2953.9873	3.8700	114.3193	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	928.0312	3.8700	35.9148	(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	437.6809	18.9000	82.7217	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	18.9000	-344.7662	(252)
Total energy cost			4.8146	(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	2953.9873	0.2160	638.0613	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	928.0312	0.2160	200.4547	(264)
Space and water heating			838.5160	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	437.6809	0.5190	227.1564	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)

Regs Region: England

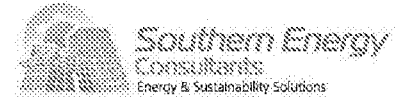
Elmhurst Energy Systems

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 183.8065 (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	2953.9873	1.2200	3603.8645 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	928.0312	1.2200	1132.1980 (264)
Space and water heating			4736.0626 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	437.6809	3.0700	1343.6803 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			863.3228 (272)
Primary energy kWh/m2/year			9.2512 (273)

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

Overheating Calculation Input Data

Dwelling type	EndTerrace House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	198.6 (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	307.96 (P1)
Transmission heat loss coefficient	64.34 (37)
Summer heat loss coefficient	372.29 (P2)

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

Solar shading Orientation	Z blinds	Solar access	Z overhangs	Z summer
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	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.5200	117.5071	0.4400	0.0000	0.9000	210.3283
South	2.1300	112.2060	0.4400	0.0000	0.9000	94.6435
West	3.4900	117.5071	0.4400	0.0000	0.9000	162.3995

total: 467.3712

	Jun	Jul	Aug	
Solar gains	494	467	421	(P4)
Internal gains	471	451	461	
Total summer gains	965	919	882	(P5)

Summer gain/loss ratio	2.59	2.47	2.37	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 198.6)	0.61	0.61	0.61	
Threshold temperature	19.20	20.98	20.78	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight