

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-211			Issued on Date	28/05/2019
Assessment Reference	As Built	Prop Type Ref	SHL2.5 - Semi (Op)		
Property	44, St Andrews Road, Botley, SOUTHAMPTON, SO32 2ST				
SAP Rating	88 B	DER	13.00	TER	16.38
Environmental	89 B	% DER<TER	20.61		
CO ₂ Emissions (t/year)	1.09	DFEE	44.22	TFEE	49.63
General Requirements Compliance	Pass	% DFEE<TFEE	10.90		
Assessor Details	Mr. Fraser Browning, Fraser Browning, Tel: 01884 242050, Fraser.browning@aessc.co.uk			Assessor ID	T511-0001
Client					

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

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DWELLING AS BUILT

Semi-Detached House, total floor area 110 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) 16.38 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.00 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)49.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)44.2 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.30 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.16 (max. 0.25)	0.16 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.30 (max. 0.35)	OK
Openings	1.36 (max. 2.00)	1.80 (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: 4.71 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Potterton Promax Ultra Combi 28 ErP
Combi boiler
Efficiency: 89.1% 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 (Southern England): Slight OK
Based on:
Overshading:
Average
Windows facing North: 2.91 m², No overhang
Windows facing East: 4.68 m², No overhang
Windows facing West: 7.56 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

External wall U-value	0.12 W/m ² K
Party wall U-value	0.00 W/m ² K
Roof U-value	0.12 W/m ² K
Door U-value	0.90 W/m ² K
Thermal bridging y-value	0.039 W/m ² K
Photovoltaic array	0.81 kW

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.7100
Infiltration rate					0.3871 (18)
Number of sides sheltered					1 (19)
Shelter factor					(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.3580 (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	0.4565	0.4475	0.4386	0.3938	0.3849	0.3401	0.3401	0.3312	0.3580	0.3849	0.4028	0.4207 (22b)
Effective ac	0.6042	0.6001	0.5962	0.5776	0.5741	0.5578	0.5578	0.5548	0.5641	0.5741	0.5811	0.5885 (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
Solid FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.7788		(33)
E-WM-28			54.5200	0.0000	0.0000	110.0000	5997.2000 (32)
GF Timber			65.3300			9.0000	587.9700 (32c)
1F Timber			64.3100			9.0000	578.7900 (32c)
2F Timber			63.1600			9.0000	568.4400 (32c)
Internal Floor 1F			39.0300			18.0000	702.5400 (32d)
Internal Floor 2F			32.1400			18.0000	578.5200 (32d)
Internal Ceiling GF			39.0300			18.0000	702.5400 (32e)
Internal Ceiling 1F			32.1400			18.0000	578.5200 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 18913.4600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 171.6285 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.9551 (36)
Total fabric heat loss (33) + (36) = 67.7339 (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	52.6228	52.2704	51.9250	50.3027	49.9992	48.5862	48.5862	48.3246	49.1305	49.9992	50.6132	51.2552 (38)
Heat transfer coeff	120.3567	120.0043	119.6589	118.0366	117.7331	116.3201	116.3201	116.0584	116.8644	117.7331	118.3471	118.9891 (39)
Average = Sum(39)m / 12 =												118.0352 (39)
HLP	1.0922	1.0890	1.0858	1.0711	1.0684	1.0555	1.0555	1.0532	1.0605	1.0684	1.0739	1.0798 (40)
HLP (average)												1.0711 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8160 (42)
Average daily hot water use (litres/day)												101.0805 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Energy content (annual)	Total = Sum(45)m =											1590.3899 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524 (61)
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
	Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
	Total per year (kWh/year) = Sum(64)m =											1846.2641 (64)
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589 (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	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.7327	22.8555	18.5874	14.0718	10.5189	8.8805	9.5957	12.4728	16.7410	21.2565	24.8095	26.4478	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.8431	274.6639	267.5554	252.4222	233.3192	215.3651	203.3707	200.5498	207.6584	222.7916	241.8945	259.8486	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	(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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	(71)
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082	(72)
Total internal gains	446.8571	444.4582	428.2167	401.9524	374.9954	349.3514	332.9348	339.5802	353.3030	379.7987	410.1842	433.2450	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
North					2.9100	10.6334	0.6200	0.7000			0.7700			9.3065 (74)
East					4.6800	19.6403	0.6200	0.7000			0.7700			27.6450 (76)
West					1.7600	19.6403	0.6200	0.7000			0.7700			10.3964 (80)
West					5.8000	19.6403	0.6200	0.7000			0.7700			34.2609 (80)
West					0.8600	26.0000	0.6300	0.7000			1.0000			8.8747 (82)
Solar gains	90.4834	177.6558	295.9186	439.4567	547.2599	564.4605	535.6198	453.9756	346.4956	211.5278	112.8972			74.3842 (83)
Total gains	537.3405	622.1140	724.1353	841.4092	922.2553	913.8119	868.5546	793.5558	699.7986	591.3265	523.0814			507.6292 (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	43.6514	43.7796	43.9060	44.5094	44.6242	45.1662	45.1662	45.2681	44.9559	44.6242	44.3926	44.1531
alpha	3.9101	3.9186	3.9271	3.9673	3.9749	4.0111	4.0111	4.0179	3.9971	3.9749	3.9595	3.9435
util living area	0.9958	0.9920	0.9809	0.9457	0.8612	0.7113	0.5580	0.6209	0.8522	0.9706	0.9927	0.9966 (86)
MIT	19.3052	19.4878	19.8206	20.2694	20.6524	20.8905	20.9686	20.9522	20.7568	20.2481	19.7005	19.2790 (87)
Th 2	20.0072	20.0099	20.0124	20.0245	20.0268	20.0373	20.0373	20.0393	20.0332	20.0268	20.0222	20.0174 (88)
util rest of house	0.9948	0.9900	0.9760	0.9310	0.8226	0.6343	0.4490	0.5116	0.7962	0.9600	0.9905	0.9958 (89)
MIT 2	17.7251	17.9931	18.4782	19.1283	19.6515	19.9475	20.0207	20.0115	19.8022	19.1089	18.3127	17.6935 (90)
Living area fraction	17.9519	18.2077	18.6709	19.2921	19.7952	20.0829	20.1567	20.1465	19.9392	19.2724	18.5119	17.9211 (91)
MIT	17.9519	18.2077	18.6709	19.2921	19.7952	20.0829	20.1567	20.1465	19.9392	19.2724	18.5119	17.9211 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8019	18.0577	18.5209	19.1421	19.6452	19.9329	20.0067	19.9965	19.7892	19.1224	18.3619	17.7711 (93)

8. Space heating requirement

Utilisation	0.9911	0.9841	0.9653	0.9135	0.8046	0.6250	0.4454	0.5063	0.7789	0.9459	0.9849	0.9928	(94)
Useful gains	532.5703	612.2124	698.9986	768.6476	742.0566	571.1396	386.8308	401.8126	545.0722	559.3379	515.1745	503.9888	(95)

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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	1625.0496	1578.9761	1438.4131	1208.9396	935.4106	620.3232	396.2715	417.4051	664.8682	1003.3736	1332.8160	1614.8103 (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	812.8046	649.6652	550.1244	317.0102	143.8554	0.0000	0.0000	0.0000	0.0000	330.3626	588.7019	826.4512 (98)
Space heating												4218.9754 (98)
Space heating per m2											(98) / (4) =	38.2847 (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 %)												90.0000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												4687.7505 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	812.8046	649.6652	550.1244	317.0102	143.8554	0.0000	0.0000	0.0000	0.0000	330.3626	588.7019	826.4512 (98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)	903.1162	721.8502	611.2493	352.2336	159.8393	0.0000	0.0000	0.0000	0.0000	367.0695	654.1133	918.2791 (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	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
Efficiency of water heater	89.3645	89.3150	89.1963	88.9093	88.3061	86.7000	86.7000	86.7000	86.7000	88.9124	89.2453	86.7000 (216)
(217)m	89.3645	89.3150	89.1963	88.9093	88.3061	86.7000	86.7000	86.7000	86.7000	88.9124	89.2453	89.3872 (217)
Fuel for water heating, kWh/month	208.9921	183.5648	191.2857	169.5816	165.5147	148.0073	139.6691	156.6973	157.5142	175.9660	188.4294	203.0927 (219)
Water heating fuel used												2088.3148 (219)
Annual totals kWh/year												
Space heating fuel - main system												4687.7505 (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)												454.4468 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.81 * 908 * 1.00) =									-588.2895			-588.2895 (233)
Total delivered energy for all uses												6717.2225 (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	4687.7505	0.2160	1012.5541 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2088.3148	0.2160	451.0760 (264)
Space and water heating			1463.6301 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)
Energy saving/generation technologies			
PV Unit	-588.2895	0.5190	-305.3223 (269)
Total CO2, kg/year			1433.0907 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.0000 (273)

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

DER		13.0000 ZC1
Total Floor Area		110.2000
Assumed number of occupants	TFA	2.8160
CO2 emission factor in Table 12 for electricity displaced from grid	N	0.5190
CO2 emissions from appliances, equation (L14)	EF	14.6178 ZC2
CO2 emissions from cooking, equation (L16)		1.6931 ZC3
Total CO2 emissions		29.3110 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		29.3110 ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4016 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3714 (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	0.4736	0.4643	0.4550	0.4086	0.3993	0.3529	0.3529	0.3436	0.3714	0.3993	0.4179	0.4364 (22b)
Effective ac	0.6121	0.6078	0.6035	0.5835	0.5797	0.5623	0.5623	0.5590	0.5690	0.5797	0.5873	0.5952 (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			1.9600	1.0000	1.9600		(26)
TER Opening Type (Uw = 1.40)			15.1500	1.3258	20.0852		(27)
TER Room Window (Uw = 1.70)			0.8600	1.5918	1.3689		(27a)
Jet Floor Lo			39.0300	0.1300	5.0739		(28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.1800	15.4818		(29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.1800	0.5076		(29a)
Wall to void	14.0000		14.0000	0.1800	2.5200		(29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178		(30)
Ceiling to Void	6.8900		6.8900	0.1300	0.8957		(30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1300	2.1398		(30)
Dormer Flat Roof	1.7800		1.7800	0.1300	0.2314		(30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.4821		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.0261 (36)
Total fabric heat loss						(33) + (36) =	63.5082 (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	53.3154	52.9362	52.5644	50.8183	50.4916	48.9707	48.9707	48.6891	49.5565	50.4916	51.1525	51.8434 (38)
Heat transfer coeff	116.8237	116.4444	116.0727	114.3265	113.9998	112.4790	112.4790	112.1974	113.0648	113.9998	114.6607	115.3517 (39)
Average = Sum(39)m / 12 =												114.3250 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0601	1.0567	1.0533	1.0374	1.0345	1.0207	1.0207	1.0181	1.0260	1.0345	1.0405	1.0467 (40)
HLP (average)												1.0374 (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												2.8160 (42)
Average daily hot water use (litres/day)												101.0805 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy conte	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m = 1590.3899 (45)
Distribution loss (46)m = 0.15 x (45)m												
	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	50.9589	46.0274	50.9589	48.8510	48.4189	44.8631	46.3586	48.4189	48.8510	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	215.8483	190.2407	199.7741	178.5917	172.9083	152.2879	145.9035	162.6482	164.4444	185.6720	196.3649	210.6455 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
	Solar input (sum of months) = Sum(63)m = 0.0000 (63)											
Output from w/h	215.8483	190.2407	199.7741	178.5917	172.9083	152.2879	145.9035	162.6482	164.4444	185.6720	196.3649	210.6455 (64)
	Total per year (kWh/year) = Sum(64)m = 2175.3295 (64)											
Heat gains from water heating, kWh/month	67.5655	59.4578	62.2208	55.3515	53.4974	46.9345	44.6883	50.0859	50.6476	57.5318	61.2228	65.8355 (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	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.7327	22.8555	18.5874	14.0718	10.5189	8.8805	9.5957	12.4728	16.7410	21.2565	24.8095	26.4478	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.8431	274.6639	267.5554	252.4222	233.3192	215.3651	203.3707	200.5498	207.6584	222.7916	241.8945	259.8486	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	(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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	(71)
Water heating gains (Table 5)	90.8138	88.4788	83.6301	76.8771	71.9052	65.1869	60.0649	67.3198	70.3438	77.3277	85.0317	88.4886	(72)
Total internal gains	456.6298	454.2386	438.0132	411.6115	383.9836	357.6728	341.2716	348.5828	362.9835	389.6161	419.9760	443.0254	(73)

6. Solar gains

[Jan]			Area m2		Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North			2.9100		10.6334	0.6300		0.7000		0.7700		9.4566 (74)
East			4.6800		19.6403	0.6300		0.7000		0.7700		28.0909 (76)
West			7.5600		19.6403	0.6300		0.7000		0.7700		45.3775 (80)
West			0.8600		26.0000	0.6300		0.7000		1.0000		8.8747 (82)

Solar gains	91.7997	180.2239	300.1630	445.7189	555.0296	572.4636	543.2183	460.4334	351.4511	214.5761	114.5365	75.4684 (83)
Total gains	548.4295	634.4625	738.1762	857.3304	939.0131	930.1364	884.4899	809.0162	714.4346	604.1922	534.5125	518.4937 (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	65.5071	65.7204	65.9309	66.9379	67.1297	68.0374	68.0374	68.2082	67.6849	67.1297	66.7428	66.3430
alpha	5.3671	5.3814	5.3954	5.4625	5.4753	5.5358	5.5358	5.5472	5.5123	5.4753	5.4495	5.4229
util living area	0.9992	0.9981	0.9934	0.9708	0.8920	0.7218	0.5494	0.6178	0.8811	0.9876	0.9983	0.9994 (86)
MIT	19.7844	19.9236	20.1761	20.5206	20.8062	20.9577	20.9922	20.9858	20.8686	20.4873	20.0781	19.7669 (87)
Th 2	20.0335	20.0364	20.0392	20.0522	20.0547	20.0661	20.0661	20.0683	20.0617	20.0547	20.0497	20.0446 (88)
util rest of house	0.9989	0.9974	0.9909	0.9594	0.8515	0.6367	0.4381	0.5028	0.8208	0.9811	0.9976	0.9992 (89)
MIT 2	18.3963	18.6018	18.9718	19.4756	19.8598	20.0373	20.0631	20.0621	19.9498	19.4362	18.8377	18.3786 (90)
Living area fraction	fLA = Living area / (4) = 0.1436 (91)											
MIT	18.5956	18.7916	19.1447	19.6256	19.9957	20.1694	20.1965	20.1947	20.0817	19.5871	19.0158	18.5779 (92)
Temperature adjustment												0.0000
adjusted MIT	18.5956	18.7916	19.1447	19.6256	19.9957	20.1694	20.1965	20.1947	20.0817	19.5871	19.0158	18.5779 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9983	0.9960	0.9877	0.9527	0.8486	0.6468	0.4541	0.5191	0.8223	0.9765	0.9963	0.9987	(94)
Useful gains	547.4941	631.9511	729.0656	816.8026	796.8023	601.6354	401.6247	419.9379	587.4929	589.9709	532.5521	517.8425	(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	1670.0602	1617.5963	1467.7021	1226.2250	945.7031	626.4414	404.5310	425.7548	676.3183	1024.5285	1366.2730	1658.5102	(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	835.1892	662.3536	549.5456	294.7841	110.7822	0.0000	0.0000	0.0000	0.0000	323.3108	600.2790	848.6568	(98)
Space heating												4224.9013	(98)
Space heating per m2												(98) / (4) = 38.3385	(99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 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 %)												93.4000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												4523.4489 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	835.1892	662.3536	549.5456	294.7841	110.7822	0.0000	0.0000	0.0000	0.0000	323.3108	600.2790	848.6568 (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)	894.2068	709.1580	588.3786	315.6147	118.6105	0.0000	0.0000	0.0000	0.0000	346.1572	642.6970	908.6261 (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	215.8483	190.2407	199.7741	178.5917	172.9083	152.2879	145.9035	162.6482	164.4444	185.6720	196.3649	210.6455 (64)
Efficiency of water heater (217)m	88.1237	87.9322	87.4669	86.3046	83.9633	80.3000	80.3000	80.3000	80.3000	86.4342	87.6816	80.3000 (216)
Fuel for water heating, kWh/month	244.9379	216.3494	228.3996	206.9318	205.9332	189.6487	181.6979	202.5506	204.7876	214.8131	223.9522	238.8430 (219)
Water heating fuel used												2558.8452 (219)
Annual totals kWh/year												
Space heating fuel - main system												4523.4489 (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)												454.4468 (232)
Total delivered energy for all uses												7611.7409 (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	4523.4489	0.2160	977.0650 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2558.8452	0.2160	552.7106 (264)
Space and water heating			1529.7755 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)
Total CO2, kg/m2/year			1804.5584 (272)
Emissions per m2 for space and water heating			13.8818 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.1403 (272b)
Emissions per m2 for pumps and fans			0.3532 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.8818 * 1.00) + 2.1403 + 0.3532, rounded to 2 d.p.			16.3800 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.7100
Infiltration rate					0.3871 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3580 (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	0.4565	0.4475	0.4386	0.3938	0.3849	0.3401	0.3401	0.3312	0.3580	0.3849	0.4028	0.4207 (22b)
Effective ac	0.6042	0.6001	0.5962	0.5776	0.5741	0.5578	0.5578	0.5548	0.5641	0.5741	0.5811	0.5885 (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
Solid FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.7788		(33)
E-WM-28			54.5200	0.0000	0.0000	110.0000	5997.2000 (32)
GF Timber			65.3300			9.0000	587.9700 (32c)
1F Timber			64.3100			9.0000	578.7900 (32c)
2F Timber			63.1600			9.0000	568.4400 (32c)
Internal Floor 1F			39.0300			18.0000	702.5400 (32d)
Internal Floor 2F			32.1400			18.0000	578.5200 (32d)
Internal Ceiling GF			39.0300			9.0000	351.2700 (32e)
Internal Ceiling 1F			32.1400			9.0000	289.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18272.9300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							165.8161 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.9551 (36)
Total fabric heat loss						(33) + (36) =	67.7339 (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	52.6228	52.2704	51.9250	50.3027	49.9992	48.5862	48.5862	48.3246	49.1305	49.9992	50.6132	51.2552 (38)
Heat transfer coeff	120.3567	120.0043	119.6589	118.0366	117.7331	116.3201	116.3201	116.0584	116.8644	117.7331	118.3471	118.9891 (39)
Average = Sum(39)m / 12 =												118.0352 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0922	1.0890	1.0858	1.0711	1.0684	1.0555	1.0555	1.0532	1.0605	1.0684	1.0739	1.0798 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8160 (42)											
Average daily hot water use (litres/day)	101.0805 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Energy content (annual)	Total = Sum(45)m =											1590.3899 (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	35.0390	30.6453	31.6232	27.5699	26.4540	22.8278	21.1533	24.2737	24.5636	28.6265	31.2481	33.9334 (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	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.7327	22.8555	18.5874	14.0718	10.5189	8.8805	9.5957	12.4728	16.7410	21.2565	24.8095	26.4478 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.8431	274.6639	267.5554	252.4222	233.3192	215.3651	203.3707	200.5498	207.6584	222.7916	241.8945	259.8486 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801 (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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408 (71)
Water heating gains (Table 5)	47.0954	45.6032	42.5044	38.2915	35.5564	31.7052	28.4318	32.6260	34.1161	38.4765	43.4001	45.6094 (72)
Total internal gains	409.9115	408.3629	393.8874	370.0259	344.6348	321.1912	306.6385	310.8889	323.7557	347.7649	375.3444	397.1462 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
North					2.9100	10.6334	0.6200	0.7000			0.7700	9.3065 (74)
East					4.6800	19.6403	0.6200	0.7000			0.7700	27.6450 (76)
West					1.7600	19.6403	0.6200	0.7000			0.7700	10.3964 (80)
West					5.8000	19.6403	0.6200	0.7000			0.7700	34.2609 (80)
West					0.8600	26.0000	0.6300	0.7000			1.0000	8.8747 (82)
Solar gains	90.4834	177.6558	295.9186	439.4567	547.2599	564.4605	535.6198	453.9756	346.4956	211.5278	112.8972	74.3842 (83)
Total gains	500.3949	586.0187	689.8061	809.4826	891.8947	885.6517	842.2583	764.8645	670.2513	559.2926	488.2416	471.5304 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)											
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	42.1731	42.2969	42.4190	43.0020	43.1129	43.6366	43.6366	43.7350	43.4334	43.1129	42.8892	42.6578
alpha	3.8115	3.8198	3.8279	3.8668	3.8742	3.9091	3.9091	3.9157	3.8956	3.8742	3.8593	3.8439
util living area	0.9962	0.9927	0.9822	0.9485	0.8674	0.7221	0.5704	0.6358	0.8621	0.9733	0.9935	0.9970 (86)
MIT	19.2190	19.4076	19.7519	20.2177	20.6192	20.8752	20.9627	20.9434	20.7285	20.1938	19.6269	19.1928 (87)
Th 2	20.0072	20.0099	20.0124	20.0245	20.0268	20.0373	20.0373	20.0393	20.0332	20.0268	20.0222	20.0174 (88)
util rest of house	0.9954	0.9909	0.9776	0.9347	0.8306	0.6464	0.4608	0.5267	0.8090	0.9638	0.9917	0.9963 (89)
MIT 2	18.3665	18.5563	18.9001	19.3653	19.7428	19.9660	20.0234	20.0160	19.8537	19.3502	18.7850	18.3481 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.4889	18.6785	19.0224	19.4877	19.8686	20.0965	20.1582	20.1491	19.9793	19.4713	18.9059	18.4693 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.4889	18.6785	19.0224	19.4877	19.8686	20.0965	20.1582	20.1491	19.9793	19.4713	18.9059	18.4693 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9934	0.9876	0.9716	0.9253	0.8237	0.6515	0.4754	0.5402	0.8055	0.9566	0.9887	0.9947 (94)
Useful gains	497.0992	578.7739	670.2370	748.9923	734.6181	577.0260	400.3860	413.1418	539.8737	535.0283	482.7167	469.0509 (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	1707.7328	1653.4847	1498.4126	1249.7339	961.7187	639.3552	413.8929	435.1194	687.0800	1044.4422	1397.1900	1697.8938 (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	900.7114	722.2057	616.1626	360.5340	168.9628	0.0000	0.0000	0.0000	0.0000	379.0040	658.4207	914.2592 (98)
Space heating	4720.2604 (98)											

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Calculation Type: New Build (As Built)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space heating per m2

(98) / (4) = 42.8336 (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	1093.4089	860.7687	882.0441	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8108	0.8761	0.8418	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	886.4862	754.1242	742.5125	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1134.6129	1082.1493	995.7419	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	178.6513	244.0507	188.4026	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction												611.1045	(104)
Intermittency factor (Table 10b)												1.0000	(105)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	44.6628	61.0127	47.1007	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													
Space cooling per m2												152.7761	(107)
Energy for space heating												1.3864	(108)
Energy for space cooling												42.8336	(99)
Total												1.3864	(108)
Dwelling Fabric Energy Efficiency (DFEE)												44.2199	(109)
												44.2	(109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4016 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3714 (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	0.4736	0.4643	0.4550	0.4086	0.3993	0.3529	0.3529	0.3436	0.3714	0.3993	0.4179	0.4364 (22b)
Effective ac	0.6121	0.6078	0.6035	0.5835	0.5797	0.5623	0.5623	0.5590	0.5690	0.5797	0.5873	0.5952 (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			1.9600	1.0000	1.9600		(26)
TER Opening Type (Uw = 1.40)			15.1500	1.3258	20.0852		(27)
TER Room Window (Uw = 1.70)			0.8600	1.5918	1.3689		(27a)
Jet Floor Lo			39.0300	0.1300	5.0739		(28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.1800	15.4818		(29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.1800	0.5076		(29a)
Wall to void	14.0000		14.0000	0.1800	2.5200		(29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178		(30)
Ceiling to Void	6.8900		6.8900	0.1300	0.8957		(30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1300	2.1398		(30)
Dormer Flat Roof	1.7800		1.7800	0.1300	0.2314		(30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.4821		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.0261 (36)
Total fabric heat loss						(33) + (36) =	63.5082 (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	53.3154	52.9362	52.5644	50.8183	50.4916	48.9707	48.9707	48.6891	49.5565	50.4916	51.1525	51.8434 (38)
Heat transfer coeff	116.8237	116.4444	116.0727	114.3265	113.9998	112.4790	112.4790	112.1974	113.0648	113.9998	114.6607	115.3517 (39)
Average = Sum(39)m / 12 =												114.3250 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0601	1.0567	1.0533	1.0374	1.0345	1.0207	1.0207	1.0181	1.0260	1.0345	1.0405	1.0467 (40)
HLP (average)												1.0374 (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												2.8160 (42)
Average daily hot water use (litres/day)												101.0805 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy conte	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1590.3899 (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	35.0390	30.6453	31.6232	27.5699	26.4540	22.8278	21.1533	24.2737	24.5636	28.6265	31.2481	33.9334 (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	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.7327	22.8555	18.5874	14.0718	10.5189	8.8805	9.5957	12.4728	16.7410	21.2565	24.8095	26.4478	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.8431	274.6639	267.5554	252.4222	233.3192	215.3651	203.3707	200.5498	207.6584	222.7916	241.8945	259.8486	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	(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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	(71)
Water heating gains (Table 5)	47.0954	45.6032	42.5044	38.2915	35.5564	31.7052	28.4318	32.6260	34.1161	38.4765	43.4001	45.6094	(72)
Total internal gains	409.9115	408.3629	393.8874	370.0259	344.6348	321.1912	306.6385	310.8889	323.7557	347.7649	375.3444	397.1462	(73)

6. Solar gains

[Jan]			Area m2		Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North			2.9100		10.6334		0.6300		0.7000		0.7700		9.4566 (74)
East			4.6800		19.6403		0.6300		0.7000		0.7700		28.0909 (76)
West			7.5600		19.6403		0.6300		0.7000		0.7700		45.3775 (80)
West			0.8600		26.0000		0.6300		0.7000		1.0000		8.8747 (82)
Solar gains	91.7997	180.2239	300.1630	445.7189	555.0296	572.4636	543.2183	460.4334	351.4511	214.5761	114.5365		75.4684 (83)
Total gains	501.7112	588.5869	694.0504	815.7448	899.6644	893.6548	849.8568	771.3223	675.2068	562.3410	489.8809		472.6146 (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	65.5071	65.7204	65.9309	66.9379	67.1297	68.0374	68.0374	68.2082	67.6849	67.1297	66.7428	66.3430	
alpha	5.3671	5.3814	5.3954	5.4625	5.4753	5.5358	5.5358	5.5472	5.5123	5.4753	5.4495	5.4229	
util living area	0.9995	0.9987	0.9950	0.9763	0.9059	0.7430	0.5698	0.6434	0.9005	0.9911	0.9989	0.9996	(86)
MIT	19.7441	19.8842	20.1390	20.4893	20.7865	20.9512	20.9907	20.9827	20.8499	20.4531	20.0396	19.7271	(87)
Th 2	20.0335	20.0364	20.0392	20.0522	20.0547	20.0661	20.0661	20.0683	20.0617	20.0547	20.0497	20.0446	(88)
util rest of house	0.9993	0.9982	0.9932	0.9667	0.8686	0.6583	0.4554	0.5258	0.8457	0.9862	0.9984	0.9995	(89)
MIT 2	18.8754	19.0177	19.2738	19.6291	19.9059	20.0430	20.0637	20.0630	19.9719	19.5992	19.1839	18.8674	(90)
Living area fraction	19.0001	19.1421	19.3980	19.7526	20.0323	20.1734	20.1967	20.1951	20.0979	19.7218	19.3067	18.9908	(92)
Temperature adjustment	19.0001	19.1421	19.3980	19.7526	20.0323	20.1734	20.1967	20.1951	20.0979	19.7218	19.3067	18.9908	(93)
adjusted MIT	19.0001	19.1421	19.3980	19.7526	20.0323	20.1734	20.1967	20.1951	20.0979	19.7218	19.3067	18.9908	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9990	0.9975	0.9915	0.9629	0.8676	0.6689	0.4719	0.5427	0.8483	0.9838	0.9979	0.9993	(94)
Ext temp.	501.2299	587.1446	688.1245	785.4552	780.5230	597.7280	401.0487	418.5834	572.7670	553.2546	488.8363	472.2906	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	1717.3232	1658.4090	1497.1093	1240.7345	949.8784	626.8891	404.5574	425.7951	678.1564	1039.8802	1399.6314	1706.1443	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating per m2	904.7734	719.8897	601.8847	327.8011	126.0004	0.0000	0.0000	0.0000	0.0000	362.0495	655.7725	917.9871	(98)
Space heating per m2												4616.1584	(98)
												41.8889	(99)

8c. Space cooling requirement

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1057.3025	832.3445	852.6999	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8783	0.9361	0.9071	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	928.6193	779.1587	773.4512	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1143.9672	1091.0307	1003.2900	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	155.0505	232.0327	171.0000	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			558.0833 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	38.7626	58.0082	42.7500	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												139.5208 (107)
Energy for space heating												1.2661 (108)
Energy for space cooling												41.8889 (99)
Total												1.2661 (108)
Target Fabric Energy Efficiency (TFEE)												43.1550 (109)
												49.6 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	263.9292 (5)

2. Ventilation rate

	main		secondary		other		total	m3 per hour				
	heating	+	heating	+		=						
Number of chimneys	0		0		0	=	0 * 40 =	0.0000 (6a)				
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)				
Number of intermittent fans							4 * 10 =	40.0000 (7a)				
Number of passive vents							0 * 10 =	0.0000 (7b)				
Number of flueless gas fires							0 * 40 =	0.0000 (7c)				
Air changes per hour												
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						40.0000 / (5) =	0.1516 (8)				
Pressure test							Yes					
Measured/design AP50							4.7100					
Infiltration rate							0.3871 (18)					
Number of sides sheltered							1 (19)					
Shelter factor	(20) = 1 - [0.075 x (19)] =						0.9250 (20)					
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =						0.3580 (21)					
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Adj infilt rate	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Effective ac	0.3759	0.3491	0.3580	0.3401	0.3401	0.3312	0.3222	0.3133	0.3043	0.3312	0.3133	0.3312 (22b)
	0.5707	0.5609	0.5641	0.5578	0.5578	0.5548	0.5519	0.5491	0.5463	0.5548	0.5491	0.5548 (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
Solid FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)	(26) ... (30) + (32) =				59.7788		(33)
E-WM-28			54.5200	0.0000	0.0000	110.0000	5997.2000 (32)
GF Timber			65.3300			9.0000	587.9700 (32c)
1F Timber			64.3100			9.0000	578.7900 (32c)
2F Timber			63.1600			9.0000	568.4400 (32c)
Internal Floor 1F			39.0300			18.0000	702.5400 (32d)
Internal Floor 2F			32.1400			18.0000	578.5200 (32d)
Internal Ceiling GF			39.0300			18.0000	702.5400 (32e)
Internal Ceiling 1F			32.1400			18.0000	578.5200 (32e)
Heat capacity Cm = Sum(A x k)	(28) ... (30) + (32) + (32a) ... (32e) =						18913.4600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							171.6285 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.9551 (36)
Total fabric heat loss	(33) + (36) =						67.7339 (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	49.7026	48.8549	49.1305	48.5862	48.5862	48.3246	48.0699	47.8222	47.5814	48.3246	47.8222	48.3246 (38)
Heat transfer coeff	117.4365	116.5887	116.8644	116.3201	116.3201	116.0584	115.8037	115.5560	115.3153	116.0584	115.5560	116.0584 (39)
Average = Sum(39)m / 12 =												116.1613 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0657	1.0580	1.0605	1.0555	1.0555	1.0532	1.0509	1.0486	1.0464	1.0532	1.0486	1.0532 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8160 (42)											
Average daily hot water use (litres/day)	101.0805 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content (annual)	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Distribution loss (46)m = 0.15 x (45)m	Total = Sum(45)m = 1590.3899 (45)											
Water storage loss:	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
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	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524 (61)
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
RHI water heating demand	Total per year (kWh/year) = Sum(64)m = 1846.2641 (64)											
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589 (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	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.3316	57.1388	46.4684	35.1796	26.2971	22.2012	23.9891	31.1820	41.8524	53.1412	62.0236	66.1196 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	405.7359	409.9462	399.3364	376.7495	348.2377	321.4405	303.5384	299.3281	309.9378	332.5247	361.0366	387.8338 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121 (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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408 (71)
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082 (72)
Total internal gains	665.1412	659.8159	633.6710	593.1798	551.4844	514.5397	493.2882	502.8599	526.4862	567.2089	612.3327	646.6941 (73)

6. Solar gains

[Jan]			Area m2		Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North			2.9100		13.4839		0.6200		0.7000		0.7700		11.8013 (74)
East			4.6800		25.1925		0.6200		0.7000		0.7700		35.4602 (76)
West			1.7600		25.1925		0.6200		0.7000		0.7700		13.3354 (80)
West			5.8000		25.1925		0.6200		0.7000		0.7700		43.9464 (80)
West			0.8600		34.0000		0.6300		0.7000		1.0000		11.6054 (82)
Solar gains	116.1487	194.2209	325.7270	485.0623	572.3318	640.3516	603.2322	525.2437	402.3487	249.4563	144.4960		93.8219 (83)
Total gains	781.2898	854.0369	959.3980	1078.2421	1123.8162	1154.8912	1096.5204	1028.1036	928.8349	816.6652	756.8287	740.5160	(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	44.7368	45.0621	44.9559	45.1662	45.1662	45.2681	45.3676	45.4649	45.5598	45.2681	45.4649	45.2681
alpha	3.9825	4.0041	3.9971	4.0111	4.0111	4.0179	4.0245	4.0310	4.0373	4.0179	4.0310	4.0179
util living area	0.9824	0.9742	0.9474	0.8763	0.7462	0.5450	0.4050	0.4293	0.6931	0.9029	0.9685	0.9849 (86)
MIT	19.7009	19.8430	20.1578	20.5446	20.8259	20.9628	20.9912	20.9892	20.9039	20.5629	20.0930	19.6917 (87)
Th 2	20.0290	20.0353	20.0332	20.0373	20.0373	20.0393	20.0412	20.0430	20.0448	20.0393	20.0430	20.0393 (88)
util rest of house	0.9784	0.9684	0.9352	0.8482	0.6911	0.4633	0.3087	0.3282	0.6148	0.8735	0.9600	0.9814 (89)
MIT 2	18.3141	18.5232	18.9716	19.5089	19.8674	20.0138	20.0376	20.0385	19.9677	19.5476	18.8918	18.3082 (90)
Living area fraction	18.5132	18.7126	19.1419	19.6576	20.0050	20.1500	20.1745	20.1750	20.1021	19.6933	19.0643	18.5068 (91)
Temperature adjustment	18.3632	18.5626	18.9919	19.5076	19.8550	20.0000	20.0245	20.0250	19.9521	19.5433	18.9143	18.3568 (92)
adjusted MIT	18.3632	18.5626	18.9919	19.5076	19.8550	20.0000	20.0245	20.0250	19.9521	19.5433	18.9143	18.3568 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9685	0.9562	0.9184	0.8299	0.6796	0.4598	0.3070	0.3263	0.6064	0.8545	0.9462	0.9725 (94)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Useful gains	756.6974	816.6262	881.0677	894.7957	763.7479	531.0083	336.5880	335.4327	563.2337	697.8711	716.1058	720.1390 (95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
Heat loss rate W												
Month fracti	1581.0671	1546.2748	1401.4261	1164.0819	855.5364	545.4781	338.6630	338.0030	605.6440	945.1041	1272.7667	1550.1663 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating	613.3311	490.3238	387.1466	193.8861	68.2906	0.0000	0.0000	0.0000	0.0000	183.9413	400.7958	617.5403 (98)
RHI space heating demand												2955.2557 (98)
												2955 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.7100
Infiltration rate					0.3871 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3580 (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	0.4565	0.4475	0.4386	0.3938	0.3849	0.3401	0.3401	0.3312	0.3580	0.3849	0.4028	0.4207 (22b)
Effective ac	0.6042	0.6001	0.5962	0.5776	0.5741	0.5578	0.5578	0.5548	0.5641	0.5741	0.5811	0.5885 (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
Solid FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.7788		(33)
E-WM-28			54.5200	0.0000	0.0000	110.0000	5997.2000 (32)
GF Timber			65.3300			9.0000	587.9700 (32c)
1F Timber			64.3100			9.0000	578.7900 (32c)
2F Timber			63.1600			9.0000	568.4400 (32c)
Internal Floor 1F			39.0300			18.0000	702.5400 (32d)
Internal Floor 2F			32.1400			18.0000	578.5200 (32d)
Internal Ceiling GF			39.0300			18.0000	702.5400 (32e)
Internal Ceiling 1F			32.1400			18.0000	578.5200 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 18913.4600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 171.6285 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.9551 (36)
Total fabric heat loss (33) + (36) = 67.7339 (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	52.6228	52.2704	51.9250	50.3027	49.9992	48.5862	48.5862	48.3246	49.1305	49.9992	50.6132	51.2552 (38)
Heat transfer coeff	120.3567	120.0043	119.6589	118.0366	117.7331	116.3201	116.3201	116.0584	116.8644	117.7331	118.3471	118.9891 (39)
Average = Sum(39)m / 12 =												118.0352 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0922	1.0890	1.0858	1.0711	1.0684	1.0555	1.0555	1.0532	1.0605	1.0684	1.0739	1.0798 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8160 (42)
Average daily hot water use (litres/day)												101.0805 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content (annual)	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Energy content (annual)	Total = Sum(45)m =											1590.3899 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524 (61)
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
	Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
	Total per year (kWh/year) = Sum(64)m =											1846.2641 (64)
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589 (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	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.3316	57.1388	46.4684	35.1796	26.2971	22.2012	23.9891	31.1820	41.8524	53.1412	62.0236	66.1196	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	405.7359	409.9462	399.3364	376.7495	348.2377	321.4405	303.5384	299.3281	309.9378	332.5247	361.0366	387.8338	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	(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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	(71)
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082	(72)
Total internal gains	665.1412	659.8159	633.6710	593.1798	551.4844	514.5397	493.2882	502.8599	526.4862	567.2089	612.3327	646.6941	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				2.9100	10.6334	0.6200	0.7000	0.7700	9.3065 (74)			
East				4.6800	19.6403	0.6200	0.7000	0.7700	27.6450 (76)			
West				1.7600	19.6403	0.6200	0.7000	0.7700	10.3964 (80)			
West				5.8000	19.6403	0.6200	0.7000	0.7700	34.2609 (80)			
West				0.8600	26.0000	0.6300	0.7000	1.0000	8.8747 (82)			
Solar gains	90.4834	177.6558	295.9186	439.4567	547.2599	564.4605	535.6198	453.9756	346.4956	211.5278	112.8972	74.3842 (83)
Total gains	755.6246	837.4717	929.5896	1032.6365	1098.7442	1079.0002	1028.9080	956.8355	872.9818	778.7366	725.2299	721.0784 (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	43.6514	43.7796	43.9060	44.5094	44.6242	45.1662	45.1662	45.2681	44.9559	44.6242	44.3926	44.1531
alpha	3.9101	3.9186	3.9271	3.9673	3.9749	4.0111	4.0111	4.0179	3.9971	3.9749	3.9595	3.9435
util living area	0.9863	0.9782	0.9580	0.9044	0.7976	0.6328	0.4818	0.5330	0.7669	0.9327	0.9778	0.9885 (86)
MIT	19.5467	19.7202	20.0281	20.4290	20.7474	20.9285	20.9813	20.9723	20.8415	20.4242	19.9197	19.5174 (87)
Th 2	20.0072	20.0099	20.0124	20.0245	20.0268	20.0373	20.0373	20.0393	20.0332	20.0268	20.0222	20.0174 (88)
util rest of house	0.9832	0.9733	0.9483	0.8818	0.7511	0.5556	0.3832	0.4320	0.6991	0.9119	0.9719	0.9858 (89)
MIT 2	18.0758	18.3287	18.7728	19.3436	19.7642	19.9813	20.0279	20.0240	19.8923	19.3501	18.6283	18.0401 (90)
Living area fraction	18.2870	18.5284	18.9530	19.4994	19.9053	20.1173	20.1647	20.1601	20.0286	19.5043	18.8137	18.2522 (91)
MIT	18.2870	18.5284	18.9530	19.4994	19.9053	20.1173	20.1647	20.1601	20.0286	19.5043	18.8137	18.2522 (92)
Temperature adjustment									fLA = Living area / (4) =			-0.1500
adjusted MIT	18.1370	18.3784	18.8030	19.3494	19.7553	19.9673	20.0147	20.0101	19.8786	19.3543	18.6637	18.1022 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9746	0.9619	0.9324	0.8628	0.7364	0.5496	0.3808	0.4288	0.6867	0.8933	0.9603	0.9783	(94)
	736.4464	805.5993	866.7408	890.9482	809.0958	592.9920	391.7970	410.3174	599.4936	695.6644	696.4083	705.4295	(95)

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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	1665.3749	1617.4700	1472.1642	1233.4135	948.3796	624.3206	397.2022	418.9873	675.3074	1030.6714	1368.5340	1654.2123 (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	691.1229	545.5771	450.4350	246.5751	103.6272	0.0000	0.0000	0.0000	0.0000	249.2452	483.9305	705.8944 (98)
Space heating												3476.4073 (98)
Space heating per m2											(98) / (4) =	31.5463 (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 %)												90.0000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3862.6748 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	691.1229	545.5771	450.4350	246.5751	103.6272	0.0000	0.0000	0.0000	0.0000	249.2452	483.9305	705.8944 (98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)	767.9143	606.1968	500.4833	273.9723	115.1413	0.0000	0.0000	0.0000	0.0000	276.9391	537.7006	784.3271 (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	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
Efficiency of water heater	89.2771	89.2153	89.0686	88.7187	88.0392	86.7000	86.7000	86.7000	86.7000	88.6981	89.1252	86.7000 (216)
Fuel for water heating, kWh/month	209.1967	183.7698	191.5599	169.9459	166.0164	148.0073	139.6691	156.6973	157.5142	176.3912	188.6833	203.2805 (219)
Water heating fuel used												2090.7314 (219)
Annual totals kWh/year												
Space heating fuel - main system												3862.6748 (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)												454.4468 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.81 * 908 * 1.00) =									-588.2895			-588.2895 (233)
Total delivered energy for all uses												5894.5635 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3862.6748	3.4800	134.4211 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2090.7314	3.4800	72.7575 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	454.4468	13.1900	59.9415 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-588.2895	13.1900	-77.5954 (252)
Total energy cost			319.4172 (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] =	0.8644 (257)
SAP value		87.9416
SAP rating (Section 12)		88 (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	3862.6748	0.2160	834.3378 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2090.7314	0.2160	451.5980 (264)
Space and water heating			1285.9357 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)

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Energy saving/generation technologies			
PV Unit	-588.2895	0.5190	-305.3223 (269)
Total kg/year			1255.3964 (272)
CO2 emissions per m2			11.3900 (273)
EI value			89.1609
EI rating			89 (274)
EI band			B

----- Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9000 = 3.867$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9000 = 0.2400$, stars = 4
Water heating energy efficiency	$3.48 / 0.8819 = 3.946$, stars = 4
Water heating environmental impact	$0.216 / 0.8819 = 0.2449$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

SAP 2012 WORKSHEET FOR New Build (As Built) (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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.7100
Infiltration rate					0.3871 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3580 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.3759	0.3491	0.3580	0.3401	0.3401	0.3312	0.3222	0.3133	0.3043	0.3312	0.3133	0.3312 (22b)
Effective ac	0.5707	0.5609	0.5641	0.5578	0.5578	0.5548	0.5519	0.5491	0.5463	0.5548	0.5491	0.5548 (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
Solid FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =				59.7788		(33)
E-WM-28			54.5200	0.0000	0.0000	110.0000	5997.2000 (32)
GF Timber			65.3300			9.0000	587.9700 (32c)
1F Timber			64.3100			9.0000	578.7900 (32c)
2F Timber			63.1600			9.0000	568.4400 (32c)
Internal Floor 1F			39.0300			18.0000	702.5400 (32d)
Internal Floor 2F			32.1400			18.0000	578.5200 (32d)
Internal Ceiling GF			39.0300			18.0000	702.5400 (32e)
Internal Ceiling 1F			32.1400			18.0000	578.5200 (32e)
Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =						18913.4600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							171.6285 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.9551 (36)
Total fabric heat loss	(33) + (36) =						67.7339 (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	49.7026	48.8549	49.1305	48.5862	48.5862	48.3246	48.0699	47.8222	47.5814	48.3246	47.8222	48.3246 (38)
Heat transfer coeff	117.4365	116.5887	116.8644	116.3201	116.3201	116.0584	115.8037	115.5560	115.3153	116.0584	115.5560	116.0584 (39)
Average = Sum(39)m / 12 =												116.1613 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0657	1.0580	1.0605	1.0555	1.0555	1.0532	1.0509	1.0486	1.0464	1.0532	1.0486	1.0532 (40)
HLP (average)												1.0541 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8160 (42)											
Average daily hot water use (litres/day)	101.0805 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content (annual)	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524 (61)
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589 (65)
Total per year (kWh/year) = Sum(64)m =	1846.2641 (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	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.3316	57.1388	46.4684	35.1796	26.2971	22.2012	23.9891	31.1820	41.8524	53.1412	62.0236	66.1196 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	405.7359	409.9462	399.3364	376.7495	348.2377	321.4405	303.5384	299.3281	309.9378	332.5247	361.0366	387.8338 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121 (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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408 (71)
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082 (72)
Total internal gains	665.1412	659.8159	633.6710	593.1798	551.4844	514.5397	493.2882	502.8599	526.4862	567.2089	612.3327	646.6941 (73)

6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W				
North			2.9100	13.4839	0.6200	0.7000	0.7700	11.8013 (74)				
East			4.6800	25.1925	0.6200	0.7000	0.7700	35.4602 (76)				
West			1.7600	25.1925	0.6200	0.7000	0.7700	13.3354 (80)				
West			5.8000	25.1925	0.6200	0.7000	0.7700	43.9464 (80)				
West			0.8600	34.0000	0.6300	0.7000	1.0000	11.6054 (82)				
Solar gains	116.1487	194.2209	325.7270	485.0623	572.3318	640.3516	603.2322	525.2437	402.3487	249.4563	144.4960	93.8219 (83)
Total gains	781.2898	854.0369	959.3980	1078.2421	1123.8162	1154.8912	1096.5204	1028.1036	928.8349	816.6652	756.8287	740.5160 (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	44.7368	45.0621	44.9559	45.1662	45.1662	45.2681	45.3676	45.4649	45.5598	45.2681	45.4649	45.2681
alpha	3.9825	4.0041	3.9971	4.0111	4.0111	4.0179	4.0245	4.0310	4.0373	4.0179	4.0310	4.0179
util living area	0.9824	0.9742	0.9474	0.8763	0.7462	0.5450	0.4050	0.4293	0.6931	0.9029	0.9685	0.9849 (86)
MIT	19.7009	19.8430	20.1578	20.5446	20.8259	20.9628	20.9912	20.9892	20.9039	20.5629	20.0930	19.6917 (87)
Th 2	20.0290	20.0353	20.0332	20.0373	20.0373	20.0393	20.0412	20.0430	20.0448	20.0393	20.0430	20.0393 (88)
util rest of house	0.9784	0.9684	0.9352	0.8482	0.6911	0.4633	0.3087	0.3282	0.6148	0.8735	0.9600	0.9814 (89)
MIT 2	18.3141	18.5232	18.9716	19.5089	19.8674	20.0138	20.0376	20.0385	19.9677	19.5476	18.8918	18.3082 (90)
Living area fraction	18.5132	18.7126	19.1419	19.6576	20.0050	20.1500	20.1745	20.1750	20.1021	19.6933	19.0643	0.1436 (91)
MIT	18.5132	18.7126	19.1419	19.6576	20.0050	20.1500	20.1745	20.1750	20.1021	19.6933	19.0643	18.5068 (92)
Temperature adjustment	18.3632	18.5626	18.9919	19.5076	19.8550	20.0000	20.0245	20.0250	19.9521	19.5433	18.9143	-0.1500
adjusted MIT	18.3632	18.5626	18.9919	19.5076	19.8550	20.0000	20.0245	20.0250	19.9521	19.5433	18.9143	18.3568 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9685	0.9562	0.9184	0.8299	0.6796	0.4598	0.3070	0.3263	0.6064	0.8545	0.9462	0.9725 (94)
	756.6974	816.6262	881.0677	894.7957	763.7479	531.0083	336.5880	335.4327	563.2337	697.8711	716.1058	720.1390 (95)

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Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
Heat loss rate W	1581.0671	1546.2748	1401.4261	1164.0819	855.5364	545.4781	338.6630	338.0030	605.6440	945.1041	1272.7667	1550.1663 (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	613.3311	490.3238	387.1466	193.8861	68.2906	0.0000	0.0000	0.0000	0.0000	183.9413	400.7958	617.5403 (98)
Space heating												2955.2557 (98)
Space heating per m2											(98) / (4) =	26.8172 (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 %)												90.0000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3283.6175 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	613.3311	490.3238	387.1466	193.8861	68.2906	0.0000	0.0000	0.0000	0.0000	183.9413	400.7958	617.5403 (98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)	681.4790	544.8043	430.1629	215.4290	75.8785	0.0000	0.0000	0.0000	0.0000	204.3793	445.3287	686.1559 (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	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
Efficiency of water heater	89.2074	89.1497	88.9642	88.5260	87.7243	86.7000	86.7000	86.7000	86.7000	88.4526	88.9988	86.7000 (216)
(217)m												89.2284 (217)
Fuel for water heating, kWh/month	209.3600	183.9051	191.7848	170.3158	166.6124	148.0073	139.6691	156.6973	157.5142	176.8807	188.9513	203.4542 (219)
Water heating fuel used												2093.1521 (219)
Annual totals kWh/year												
Space heating fuel - main system												3283.6175 (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)												454.4468 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.81 * 1031 * 1.00) =									-668.0993			-668.0993 (233)
Total delivered energy for all uses												5238.1170 (238)

10a. Fuel costs - using BEDF prices (442)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3283.6175	3.9200	128.7178 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2093.1521	3.9200	82.0516 (247)
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)
Energy for lighting	454.4468	16.9600	77.0742 (250)
Additional standing charges			88.0000 (251)
Energy saving/generation technologies			
PV Unit	-668.0993	16.9600	-113.3096 (252)
Total energy cost			275.2539 (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	3283.6175	0.2160	709.2614 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2093.1521	0.2160	452.1209 (264)
Space and water heating			1161.3822 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)
Energy saving/generation technologies			
PV Unit	-668.0993	0.5190	-346.7435 (269)
Total kg/year			1089.4216 (272)

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

Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
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Space heating - main system 1	3283.6175	1.2200	4006.0133 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2093.1521	1.2200	2553.6455 (264)
Space and water heating			6559.6589 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	454.4468	3.0700	1395.1517 (268)
Energy saving/generation technologies			
PV Unit	-668.0993	3.0700	-2051.0649 (269)
Primary energy kWh/year			6133.9957 (272)
Primary energy kWh/m2/year			55.6624 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 88
Current environmental impact rating: B 89

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 32	-199 kg (18.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£32 1.81 kg/m²	B 89	B 91
Total Savings	£32 1.81 kg/m²		

Potential energy efficiency rating: B 89
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 442 TEST (29 Apr 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£90	£98	-£8
Mains gas	£299	£258	£41
Space heating	£229	£229	£0
Water heating	£82	£50	£32
Lighting	£77	£77	£0
Generated (PV)	-£113	-£113	£0
Total cost of fuels	£276	£243	£33
Total cost of uses	£275	£243	£32
Delivered energy	48 kWh/m²	39 kWh/m²	9 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.9 tonnes	0.2 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	56 kWh/m²	46 kWh/m²	10 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.7100
Infiltration rate					0.3871 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3580 (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	0.4565	0.4475	0.4386	0.3938	0.3849	0.3401	0.3401	0.3312	0.3580	0.3849	0.4028	0.4207 (22b)
Effective ac	0.6042	0.6001	0.5962	0.5776	0.5741	0.5578	0.5578	0.5548	0.5641	0.5741	0.5811	0.5885 (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
Solid FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.7788		(33)
E-WM-28			54.5200	0.0000	0.0000	110.0000	5997.2000 (32)
GF Timber			65.3300			9.0000	587.9700 (32c)
1F Timber			64.3100			9.0000	578.7900 (32c)
2F Timber			63.1600			9.0000	568.4400 (32c)
Internal Floor 1F			39.0300			18.0000	702.5400 (32d)
Internal Floor 2F			32.1400			18.0000	578.5200 (32d)
Internal Ceiling GF			39.0300			18.0000	702.5400 (32e)
Internal Ceiling 1F			32.1400			18.0000	578.5200 (32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		18913.4600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							171.6285 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.9551 (36)
Total fabric heat loss						(33) + (36) =	67.7339 (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	52.6228	52.2704	51.9250	50.3027	49.9992	48.5862	48.5862	48.3246	49.1305	49.9992	50.6132	51.2552 (38)
Heat transfer coeff	120.3567	120.0043	119.6589	118.0366	117.7331	116.3201	116.3201	116.0584	116.8644	117.7331	118.3471	118.9891 (39)
Average = Sum(39)m / 12 =												118.0352 (39)
HLP	1.0922	1.0890	1.0858	1.0711	1.0684	1.0555	1.0555	1.0532	1.0605	1.0684	1.0739	1.0798 (40)
HLP (average)												1.0711 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8160 (42)
Average daily hot water use (litres/day)												101.0805 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content (annual)	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1590.3899 (45)
	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524 (61)
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1079.5246 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1813.6014 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1404 (H8)
Utilisation factor												0.5839 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												101.0805 (H14)
Volume ratio Veff/V												0.7420 (H15)
Solar storage volume factor												0.9403 (H16)
Solar input												-875.6211 (H17)
Solar input	-25.3913	-42.3707	-72.1622	-96.7116	-119.4790	-117.4669	-115.9145	-101.2751	-79.3187	-54.1653	-30.1177	-21.2482 (63)
Output from w/h	161.3734	121.5801	98.4576	54.0622	26.6805	10.8554	5.1786	34.5814	57.2461	102.2902	138.0466	160.2908 (64)
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589 (65)
Total per year (kWh/year) = Sum(64)m = 970.6431 (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	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.3316	57.1388	46.4684	35.1796	26.2971	22.2012	23.9891	31.1820	41.8524	53.1412	62.0236	66.1196 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	405.7359	409.9462	399.3364	376.7495	348.2377	321.4405	303.5384	299.3281	309.9378	332.5247	361.0366	387.8338 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121 (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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408 (71)
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082 (72)
Total internal gains	665.1412	659.8159	633.6710	593.1798	551.4844	514.5397	493.2882	502.8599	526.4862	567.2089	612.3327	646.6941 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				2.9100	10.6334		0.6200		0.7000		0.7700		9.3065 (74)
East				4.6800	19.6403		0.6200		0.7000		0.7700		27.6450 (76)
West				1.7600	19.6403		0.6200		0.7000		0.7700		10.3964 (80)
West				5.8000	19.6403		0.6200		0.7000		0.7700		34.2609 (80)
West				0.8600	26.0000		0.6300		0.7000		1.0000		8.8747 (82)
Solar gains	90.4834	177.6558	295.9186	439.4567	547.2599	564.4605	535.6198	453.9756	346.4956	211.5278	112.8972		74.3842 (83)
Total gains	755.6246	837.4717	929.5896	1032.6365	1098.7442	1079.0002	1028.9080	956.8355	872.9818	778.7366	725.2299		721.0784 (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	43.6514	43.7796	43.9060	44.5094	44.6242	45.1662	45.1662	45.2681	44.9559	44.6242	44.3926	44.1531
alpha	3.9101	3.9186	3.9271	3.9673	3.9749	4.0111	4.0111	4.0179	3.9971	3.9749	3.9595	3.9435
util living area	0.9863	0.9782	0.9580	0.9044	0.7976	0.6328	0.4818	0.5330	0.7669	0.9327	0.9778	0.9885 (86)

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MIT	19.5467	19.7202	20.0281	20.4290	20.7474	20.9285	20.9813	20.9723	20.8415	20.4242	19.9197	19.5174 (87)
Th 2	20.0072	20.0099	20.0124	20.0245	20.0268	20.0373	20.0373	20.0393	20.0332	20.0268	20.0222	20.0174 (88)
util rest of house												
	0.9832	0.9733	0.9483	0.8818	0.7511	0.5556	0.3832	0.4320	0.6991	0.9119	0.9719	0.9858 (89)
MIT 2	18.0758	18.3287	18.7728	19.3436	19.7642	19.9813	20.0279	20.0240	19.8923	19.3501	18.6283	18.0401 (90)
Living area fraction									fLA = Living area / (4) =			0.1436 (91)
MIT	18.2870	18.5284	18.9530	19.4994	19.9053	20.1173	20.1647	20.1601	20.0286	19.5043	18.8137	18.2522 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1370	18.3784	18.8030	19.3494	19.7553	19.9673	20.0147	20.0101	19.8786	19.3543	18.6637	18.1022 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9746	0.9619	0.9324	0.8628	0.7364	0.5496	0.3808	0.4288	0.6867	0.8933	0.9603	0.9783	(94)
Useful gains	736.4464	805.5993	866.7408	890.9482	809.0958	592.9920	391.7970	410.3174	599.4936	695.6644	696.4083	705.4295	(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	1665.3749	1617.4700	1472.1642	1233.4135	948.3796	624.3206	397.2022	418.9873	675.3074	1030.6714	1368.5340	1654.2123	(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	691.1229	545.5771	450.4350	246.5751	103.6272	0.0000	0.0000	0.0000	0.0000	249.2452	483.9305	705.8944	(98)
Space heating												3476.4073	(98)
Space heating per m2												31.5463	(99)
												(98) / (4) =	

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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3862.6748 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	691.1229	545.5771	450.4350	246.5751	103.6272	0.0000	0.0000	0.0000	0.0000	249.2452	483.9305	705.8944	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	767.9143	606.1968	500.4833	273.9723	115.1413	0.0000	0.0000	0.0000	0.0000	276.9391	537.7006	784.3271	(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	161.3734	121.5801	98.4576	54.0622	26.6805	10.8554	5.1786	34.5814	57.2461	102.2902	138.0466	160.2908	(64)
Efficiency of water heater (217)m	89.3562	89.3800	89.3897	89.3882	89.3040	86.7000	86.7000	86.7000	86.7000	89.0141	89.2461	86.7000	(216)
Fuel for water heating, kWh/month	180.5957	136.0261	110.1442	60.4802	29.8761	12.5207	5.9730	39.8863	66.0278	114.9146	154.6809	179.3554	(219)
Water heating fuel used												1090.4809	(219)
Annual totals kWh/year													
Space heating fuel - main system												3862.6748	(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)												454.4468	(232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV Unit 0 (0.80 * 0.81 * 908 * 1.00) =										-588.2895		-588.2895	(233)
Total delivered energy for all uses												4944.3130	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3862.6748	3.4800	134.4211	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1090.4809	3.4800	37.9487	(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	454.4468	13.1900	59.9415	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-588.2895	13.1900	-77.5954	(252)
Total energy cost			291.2035	(255)

11a. SAP rating - Individual heating systems

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Calculation Type: New Build (As Built)



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Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.7881 (257)
SAP value		89.0067
SAP rating (Section 12)		89 (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	3862.6748	0.2160	834.3378 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1090.4809	0.2160	235.5439 (264)
Space and water heating			1069.8816 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)
Energy saving/generation technologies			
PV Unit	-588.2895	0.5190	-305.3223 (269)
Total kg/year			1065.2922 (272)
CO2 emissions per m2			9.6700 (273)
EI value			90.8022
EI rating			91 (274)
EI band			B

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Calculation Type: New Build (As Built)



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

SAP 2012 WORKSHEET FOR New Build (As Built) (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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n)	= 263.9292 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.7100
Infiltration rate					0.3871 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3580 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.3759	0.3491	0.3580	0.3401	0.3401	0.3312	0.3222	0.3133	0.3043	0.3312	0.3133	0.3312 (22b)
Effective ac	0.5707	0.5609	0.5641	0.5578	0.5578	0.5548	0.5519	0.5491	0.5463	0.5548	0.5491	0.5548 (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
Solid FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	59.7788	(33)
E-WM-28					0.0000	0.0000	110.0000 (32)
GF Timber						9.0000	587.9700 (32c)
1F Timber						9.0000	578.7900 (32c)
2F Timber						9.0000	568.4400 (32c)
Internal Floor 1F						18.0000	702.5400 (32d)
Internal Floor 2F						18.0000	578.5200 (32d)
Internal Ceiling GF						18.0000	702.5400 (32e)
Internal Ceiling 1F						18.0000	578.5200 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 18913.4600 (34)
 Thermal mass parameter (TMP) = Cm / TFA in kJ/m²K 171.6285 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.9551 (36)
 Total fabric heat loss (33) + (36) = 67.7339 (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	49.7026	48.8549	49.1305	48.5862	48.5862	48.3246	48.0699	47.8222	47.5814	48.3246	47.8222	48.3246 (38)
Heat transfer coeff	117.4365	116.5887	116.8644	116.3201	116.3201	116.0584	115.8037	115.5560	115.3153	116.0584	115.5560	116.0584 (39)
Average = Sum(39)m / 12 =												116.1613 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0657	1.0580	1.0605	1.0555	1.0555	1.0532	1.0509	1.0486	1.0464	1.0532	1.0486	1.0532 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8160 (42)
Average daily hot water use (litres/day)												101.0805 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Energy content (annual)												Total = Sum(45)m = 1590.3899 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524 (61)
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (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												1208.1510 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2029.6937 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2762 (H8)
Utilisation factor												0.5432 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												101.0805 (H14)
Volume ratio Veff/V												0.7420 (H15)
Solar storage volume factor												0.9403 (H16)
Solar input												-911.6246 (H17)
Solar input	-29.7394	-42.2875	-72.6821	-98.0650	-115.1832	-123.0339	-120.4464	-107.8032	-84.4025	-58.3530	-35.1739	-24.4544 (63)
Output from w/h	157.0253	121.6633	97.9377	52.7087	30.9763	5.2884	0.6466	28.0533	52.1623	98.1025	132.9905	157.0845 (64)
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589 (65)
												Total per year (kWh/year) = Sum(64)m = 934.6395 (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	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.3316	57.1388	46.4684	35.1796	26.2971	22.2012	23.9891	31.1820	41.8524	53.1412	62.0236	66.1196 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	405.7359	409.9462	399.3364	376.7495	348.2377	321.4405	303.5384	299.3281	309.9378	332.5247	361.0366	387.8338 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121 (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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408 (71)
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082 (72)
Total internal gains	665.1412	659.8159	633.6710	593.1798	551.4844	514.5397	493.2882	502.8599	526.4862	567.2089	612.3327	646.6941 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
North	2.9100	13.4839	0.6200	0.7000	0.7700	11.8013 (74)
East	4.6800	25.1925	0.6200	0.7000	0.7700	35.4602 (76)
West	1.7600	25.1925	0.6200	0.7000	0.7700	13.3354 (80)
West	5.8000	25.1925	0.6200	0.7000	0.7700	43.9464 (80)
West	0.8600	34.0000	0.6300	0.7000	1.0000	11.6054 (82)

Solar gains	116.1487	194.2209	325.7270	485.0623	572.3318	640.3516	603.2322	525.2437	402.3487	249.4563	144.4960	93.8219 (83)
Total gains	781.2898	854.0369	959.3980	1078.2421	1123.8162	1154.8912	1096.5204	1028.1036	928.8349	816.6652	756.8287	740.5160 (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	44.7368	45.0621	44.9559	45.1662	45.1662	45.2681	45.3676	45.4649	45.5598	45.2681	45.4649	45.2681
alpha	3.9825	4.0041	3.9971	4.0111	4.0111	4.0179	4.0245	4.0310	4.0373	4.0179	4.0310	4.0179
util living area	0.9824	0.9742	0.9474	0.8763	0.7462	0.5450	0.4050	0.4293	0.6931	0.9029	0.9685	0.9849 (86)

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MIT	19.7009	19.8430	20.1578	20.5446	20.8259	20.9628	20.9912	20.9892	20.9039	20.5629	20.0930	19.6917 (87)
Th 2	20.0290	20.0353	20.0332	20.0373	20.0373	20.0393	20.0412	20.0430	20.0448	20.0393	20.0430	20.0393 (88)
util rest of house												
	0.9784	0.9684	0.9352	0.8482	0.6911	0.4633	0.3087	0.3282	0.6148	0.8735	0.9600	0.9814 (89)
MIT 2	18.3141	18.5232	18.9716	19.5089	19.8674	20.0138	20.0376	20.0385	19.9677	19.5476	18.8918	18.3082 (90)
Living area fraction									fLA = Living area / (4) =			0.1436 (91)
MIT	18.5132	18.7126	19.1419	19.6576	20.0050	20.1500	20.1745	20.1750	20.1021	19.6933	19.0643	18.5068 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.3632	18.5626	18.9919	19.5076	19.8550	20.0000	20.0245	20.0250	19.9521	19.5433	18.9143	18.3568 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9685	0.9562	0.9184	0.8299	0.6796	0.4598	0.3070	0.3263	0.6064	0.8545	0.9462	0.9725 (94)	
Useful gains	756.6974	816.6262	881.0677	894.7957	763.7479	531.0083	336.5880	335.4327	563.2337	697.8711	716.1058	720.1390 (95)	
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)	
Heat loss rate W	1581.0671	1546.2748	1401.4261	1164.0819	855.5364	545.4781	338.6630	338.0030	605.6440	945.1041	1272.7667	1550.1663 (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	613.3311	490.3238	387.1466	193.8861	68.2906	0.0000	0.0000	0.0000	0.0000	183.9413	400.7958	617.5403 (98)	
Space heating												2955.2557 (98)	
Space heating per m2												26.8172 (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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3283.6175 (211)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
613.3311	490.3238	387.1466	193.8861	68.2906	0.0000	0.0000	0.0000	0.0000	0.0000	183.9413	400.7958	617.5403 (98)	
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)	
Space heating fuel (main heating system)	681.4790	544.8043	430.1629	215.4290	75.8785	0.0000	0.0000	0.0000	0.0000	204.3793	445.3287	686.1559 (211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)	
Water heating requirement	157.0253	121.6633	97.9377	52.7087	30.9763	5.2884	0.6466	28.0533	52.1623	98.1025	132.9905	157.0845 (64)	
Efficiency of water heater (217)m	89.3071	89.3241	89.3137	89.2737	88.9436	86.7000	86.7000	86.7000	86.7000	88.8240	89.1545	86.7000 (216)	
Fuel for water heating, kWh/month	175.8262	136.2044	109.6559	59.0417	34.8269	6.0997	0.7458	32.3567	60.1641	110.4459	149.1685	175.8855 (219)	
Water heating fuel used												1050.4214 (219)	
Annual totals kWh/year													
Space heating fuel - main system												3283.6175 (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)													454.4468 (232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV Unit 0 (0.80 * 0.81 * 1031 * 1.00) =									-668.0993				-668.0993 (233)
Total delivered energy for all uses													4245.3864 (238)

10a. Fuel costs - using BEDF prices (442)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3283.6175	3.9200	128.7178 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	1050.4214	3.9200	41.1765 (247)	
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)	
Pump for solar water heating	50.0000	16.9600	8.4800 (249)	
Energy for lighting	454.4468	16.9600	77.0742 (250)	
Additional standing charges			88.0000 (251)	
Energy saving/generation technologies				
PV Unit	-668.0993	16.9600	-113.3096 (252)	
Total energy cost			242.8589 (255)	

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

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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3283.6175	0.2160	709.2614 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1050.4214	0.2160	226.8910 (264)
Space and water heating			936.1524 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)
Energy saving/generation technologies			
PV Unit	-668.0993	0.5190	-346.7435 (269)
Total kg/year			890.1417 (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	3283.6175	1.2200	4006.0133 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1050.4214	1.2200	1281.5141 (264)
Space and water heating			5287.5274 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	454.4468	3.0700	1395.1517 (268)
Energy saving/generation technologies			
PV Unit	-668.0993	3.0700	-2051.0649 (269)
Primary energy kWh/year			5015.3642 (272)
Primary energy kWh/m2/year			45.5115 (273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	171.6 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	348.39 (P1)
Transmission heat loss coefficient	67.73 (37)
Summer heat loss coefficient	416.12 (P2)

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

Solar shading	Z_blinds	Solar access	Z_overhangs	Z_summer
Orientation				
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)
West	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	2.9100	87.1704	0.6200	0.7000	0.9000	89.1737
East	4.6800	125.2818	0.6200	0.7000	0.9000	206.1145
West	1.7600	125.2818	0.6200	0.7000	0.9000	77.5131
West	5.8000	125.2818	0.6200	0.7000	0.9000	255.4410
West	0.8600	217.0000	0.6300	0.7000	1.0000	74.0695
total:						702.3119

	Jun	Jul	Aug	
Solar gains	758	702	610	(P3)
Internal gains	512	490	500	
Total summer gains	1269	1193	1110	(P5)
Summer gain/loss ratio	3.05	2.87	2.67	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 171.6)	0.80	0.80	0.80	
Threshold temperature	19.25	20.96	20.77	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

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Assessment of likelihood of high internal temperature: Slight