

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-181				Issued on Date	03/12/2018
Assessment Reference	As Built		Prop Type Ref	P306i - Semi (Op)		
Property	4, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating		88 B	DER	13.26	TER	17.44
Environmental		90 B	% DER<TER	23.98		
CO ₂ Emissions (t/year)		0.91	DFEE	45.63	TFEE	50.87
General Requirements Compliance		Pass	% DFEE<TFEE	10.30		
Assessor	Silvio Junges, Tel: 01884 242050				Assessor ID	P637-0001
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 93 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating:Mains gas

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.44 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 13.26 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)50.9 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)45.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.20 (max. 0.35)	OK
Openings	1.34 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 4.57 (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 40 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 East: 7.97 m², No overhang

Windows facing South West: 0.68 m², No overhang

Windows facing West: 5.76 m², No overhang

Windows facing North West: 0.68 m², No overhang

Air change rate: 4.00 ach

Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K

Door U-value 0.90 W/m²K

Photovoltaic array

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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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.5700
Infiltration rate					0.4090 (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) =	0.3784 (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	0.4824	0.4730	0.4635	0.4162	0.4067	0.3595	0.3595	0.3500	0.3784	0.4067	0.4257	0.4446 (22b)
Effective ac	0.6164	0.6118	0.6074	0.5866	0.5827	0.5646	0.5646	0.5612	0.5716	0.5827	0.5906	0.5988 (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 Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500 (28a)
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			190.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296		(33)
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000 (32)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor			45.7700			18.0000	823.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17303.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 186.9871 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.5835 (36)
Total fabric heat loss (33) + (36) = 63.0131 (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	45.0630	44.7326	44.4088	42.8879	42.6033	41.2786	41.2786	41.0333	41.7889	42.6033	43.1790	43.7808 (38)
Heat transfer coeff	108.0761	107.7457	107.4219	105.9010	105.6164	104.2917	104.2917	104.0464	104.8019	105.6164	106.1921	106.7939 (39)
Average = Sum(39)m / 12 =												105.8996 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1679	1.1643	1.1608	1.1444	1.1413	1.1270	1.1270	1.1243	1.1325	1.1413	1.1475	1.1540 (40)
HLP (average)												1.1444 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month												
Solar input	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)
Total per year (kWh/year) = Sum (64)m =												1777.7885 (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	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains	410.1801	407.9280	393.1245	369.2209	344.8387	321.4806	306.4099	312.7503	325.1263	349.2521	376.9382	397.8095 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
East					4.8200	19.6403	0.6200	0.7000	0.7700		28.4720 (76)	
Southwest					0.6800	36.7938	0.6200	0.7000	0.7700		7.5250 (79)	
West					5.7600	19.6403	0.6200	0.7000	0.7700		34.0246 (80)	
Northwest					0.6800	11.2829	0.6200	0.7000	0.7700		2.3076 (81)	
East					3.1500	19.6403	0.6200	0.7000	0.7700		18.6072 (76)	
Solar gains	90.9363	176.1711	287.2847	416.6957	510.0338	522.1507	497.0705	427.1636	333.1860	208.1656	113.0436	75.0201 (83)
Total gains	501.1164	584.0991	680.4092	785.9167	854.8725	843.6313	803.4803	739.9139	658.3122	557.4177	489.9817	472.8296 (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	44.4743	44.6106	44.7451	45.3877	45.5100	46.0881	46.0881	46.1968	45.8637	45.5100	45.2633	45.0082
alpha	3.9650	3.9740	3.9830	4.0258	4.0340	4.0725	4.0725	4.0798	4.0576	4.0340	4.0176	4.0005
util living area	0.9955	0.9912	0.9789	0.9409	0.8528	0.6996	0.5445	0.6035	0.8380	0.9670	0.9920	0.9964 (86)
MIT	19.3515	19.5399	19.8728	20.3123	20.6784	20.9016	20.9728	20.9591	20.7818	20.2896	19.7446	19.3248 (87)
Th 2	19.9458	19.9487	19.9515	19.9648	19.9672	19.9789	19.9789	19.9810	19.9744	19.9672	19.9622	19.9570 (88)
util rest of house	0.9943	0.9889	0.9730	0.9238	0.8097	0.6166	0.4299	0.4879	0.7745	0.9543	0.9895	0.9955 (89)
MIT 2	17.7408	18.0173	18.5017	19.1363	19.6307	19.9027	19.9658	19.9593	19.7773	19.1165	18.3258	17.7091 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.0567	18.3159	18.7706	19.3669	19.8362	20.0986	20.1633	20.1554	19.9743	19.3466	18.6041	18.0260 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9067	18.1659	18.6206	19.2169	19.6862	19.9486	20.0133	20.0054	19.8243	19.1966	18.4541	17.8760 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9907	0.9829	0.9625	0.9079	0.7959	0.6138	0.4339	0.4908	0.7634	0.9410	0.9839	0.9925 (94)
Ext temp.	496.4684	574.1241	654.9096	713.5380	680.4240	517.8592	348.6594	363.1755	502.5355	524.5265	482.0872	469.3068 (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	1470.5590	1429.3457	1302.0173	1092.5733	843.4737	557.8134	355.9781	375.1291	599.9164	907.9415	1205.7146	1460.5115 (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	724.7234	574.7089	481.4481	272.9054	121.3090	0.0000	0.0000	0.0000	0.0000	285.2607	521.0117	737.4563 (98)
												3718.8237 (98)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 40.1861 (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													4132.0263 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	724.7234	574.7089	481.4481	272.9054	121.3090	0.0000	0.0000	0.0000	0.0000	285.2607	521.0117	737.4563	(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)	805.2482	638.5655	534.9424	303.2283	134.7878	0.0000	0.0000	0.0000	0.0000	316.9564	578.9019	819.3959	(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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(64)
Efficiency of water heater	89.3240	89.2678	89.1368	88.8260	88.1971	86.7000	86.7000	86.7000	86.7000	88.8314	89.1950	86.7000	(216)
Fuel for water heating, kWh/month	201.3446	176.8612	184.3206	163.4327	159.5623	142.5096	134.4811	150.8755	151.6607	169.5996	181.5543	195.6577	(219)
Water heating fuel used													(219)
Annual totals kWh/year													2011.8599
Space heating fuel - main system													4132.0263 (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)													398.7732 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1029 * 1.00) =													-666.9130 (233)
Total delivered energy for all uses													5950.7465 (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	4132.0263	0.2160	892.5177 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2011.8599	0.2160	434.5617 (264)
Space and water heating			1327.0794 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Energy saving/generation technologies			
PV Unit	-666.9130	0.5190	-346.1278 (269)
Total CO2, kg/year			1226.8399 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.2600 (273)

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

DER			13.2600 ZC1
Total Floor Area		TFA	92.5400
Assumed number of occupants		N	2.6589
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			15.6036 ZC2
CO2 emissions from cooking, equation (L16)			1.9755 ZC3
Total CO2 emissions			30.8391 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			30.8391 ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 221.5483 (5)
Dwelling volume			

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																3 * 10 =	30.0000 (7a)
Number of passive vents																0 * 10 =	0.0000 (7b)
Number of flueless gas fires																0 * 40 =	0.0000 (7c)
										Air changes per hour							
Infiltration due to chimneys, flues and fans										= (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000	/ (5) =	0.1354 (8)
Pressure test										Yes							
Measured/design AP50										5.0000							
Infiltration rate										0.3854 (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) =					0.3565 (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	0.4545	0.4456	0.4367	0.3922	0.3832	0.3387	0.3387	0.3298	0.3565	0.3832	0.4011	0.4189	(22b)				
Effective ac	0.6033	0.5993	0.5954	0.5769	0.5734	0.5574	0.5574	0.5544	0.5635	0.5734	0.5804	0.5877	(25)				

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9600	1.0000	1.9600		(26)					
TER Opening Type (Uw = 1.40)			15.0900	1.3258	20.0057		(27)					
Heat Loss Floor			46.7700	0.1300	6.0801		(28a)					
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.1800	14.3712		(29a)					
External Plane Roof	45.7700		45.7700	0.1300	5.9501		(30)					
Bay	1.0100		1.0100	0.1300	0.1313		(30)					
Total net area of external elements Aum(A, m2)			190.4400				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	48.4984	(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6954 (36)					
Total fabric heat loss						(33) + (36) =	59.1938 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 44.1082	Feb 43.8149	Mar 43.5274	Apr 42.1772	May 41.9246	Jun 40.7485	Jul 40.7485	Aug 40.5307	Sep 41.2015	Oct 41.9246	Nov 42.4356	Dec 42.9699 (38)
Heat transfer coeff	103.3020	103.0087	102.7212	101.3710	101.1183	99.9423	99.9423	99.7245	100.3953	101.1183	101.6294	102.1637 (39)
Average = Sum(39)m / 12 =												101.3698 (39)
HLP	Jan 1.1163	Feb 1.1131	Mar 1.1100	Apr 1.0954	May 1.0927	Jun 1.0800	Jul 1.0800	Aug 1.0776	Sep 1.0849	Oct 1.0927	Nov 1.0982	Dec 1.1040 (40)
HLP (average)												1.0954 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
Daily hot water use	Jan 107.0842	Feb 103.1902	Mar 99.2962	Apr 95.4022	May 91.5083	Jun 87.6143	Jul 87.6143	Aug 91.5083	Sep 95.4022	Oct 99.2962	Nov 103.1902	Dec 107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)												Total = Sum(45)m = 1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.6003	47.0477	46.6316	43.2071	44.6473	46.6316	47.0477	50.6003	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	209.7616	184.9173	193.9222	171.9992	166.5256	146.6664	140.5176	156.6442	158.3742	180.3405	190.9367	204.7508 (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	209.7616	184.9173	193.9222	171.9992	166.5256	146.6664	140.5176	156.6442	158.3742	180.3405	190.9367	204.7508 (64)
Heat gains from water heating, kWh/month	65.5416	57.6877	60.3046	53.3083	51.5226	45.2020	43.0387	48.2371	48.7780	55.7887	59.4180	63.8755 (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	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	88.0936	85.8448	81.0546	74.0393	69.2509	62.7806	57.8477	64.8348	67.7472	74.9848	82.5250	85.8542 (72)
Total internal gains	420.2313	417.9865	403.0790	378.5364	353.5068	329.5051	314.4483	321.4315	334.4611	359.2261	387.0074	407.8680 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
East				7.9700	19.6403	0.6300	0.7000	0.7700	47.8385 (76)			
Southwest				0.6800	36.7938	0.6300	0.7000	0.7700	7.6464 (79)			
West				5.7600	19.6403	0.6300	0.7000	0.7700	34.5734 (80)			
Northwest				0.6800	11.2829	0.6300	0.7000	0.7700	2.3448 (81)			
Solar gains	92.4030	179.0126	291.9183	423.4166	518.2602	530.5725	505.0877	434.0533	338.5599	211.5231	114.8668	76.2301 (83)
Total gains	512.6343	596.9990	694.9973	801.9530	871.7669	860.0776	819.5361	755.4848	673.0210	570.7492	501.8743	484.0981 (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	62.2097	62.3869	62.5615	63.3948	63.5532	64.3010	64.3010	64.4414	64.0109	63.5532	63.2336	62.9029
alpha	5.1473	5.1591	5.1708	5.2263	5.2369	5.2867	5.2867	5.2961	5.2674	5.2369	5.2156	5.1935
util living area	0.9986	0.9967	0.9895	0.9596	0.8697	0.6965	0.5271	0.5895	0.8523	0.9809	0.9971	0.9990 (86)
MIT	19.7611	19.9135	20.1804	20.5315	20.8131	20.9583	20.9920	20.9862	20.8777	20.4957	20.0654	19.7384 (87)
Th 2	19.9875	19.9901	19.9927	20.0046	20.0068	20.0172	20.0172	20.0191	20.0132	20.0068	20.0023	19.9976 (88)
util rest of house	0.9982	0.9956	0.9857	0.9444	0.8237	0.6081	0.4143	0.4727	0.7834	0.9712	0.9959	0.9987 (89)
MIT 2	18.3291	18.5534	18.9432	19.4516	19.8237	19.9896	20.0143	20.0134	19.9133	19.4107	18.7846	18.3030 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.6100	18.8202	19.1858	19.6634	20.0177	20.1796	20.2060	20.2042	20.1025	19.6235	19.0358	18.5845 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6100	18.8202	19.1858	19.6634	20.0177	20.1796	20.2060	20.2042	20.1025	19.6235	19.0358	18.5845 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9972	0.9936	0.9815	0.9378	0.8242	0.6237	0.4365	0.4956	0.7907	0.9661	0.9941	0.9979 (94)
Ext temp.	511.1954	593.1899	682.1605	752.1056	718.5483	536.4006	357.7569	374.3893	532.1252	551.3965	498.9130	483.0813 (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	1478.2508	1433.8986	1303.1059	1091.0949	841.0740	557.6341	360.3957	379.3724	602.6199	912.4388	1213.0317	1469.5740 (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	719.4893	564.9562	461.9833	244.0723	91.1591	0.0000	0.0000	0.0000	0.0000	268.6155	514.1655	733.9506 (98)
Space heating per m2												3598.3918 (98)
										(98) / (4) =		38.8847 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3852.6679 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	719.4893	564.9562	461.9833	244.0723	91.1591	0.0000	0.0000	0.0000	0.0000	268.6155	514.1655	733.9506	(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)	770.3311	604.8782	494.6288	261.3194	97.6008	0.0000	0.0000	0.0000	0.0000	287.5969	550.4984	785.8143	(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	209.7616	184.9173	193.9222	171.9992	166.5256	146.6664	140.5176	156.6442	158.3742	180.3405	190.9367	204.7508	(64)
Efficiency of water heater (217)m	87.9042	87.6804	87.1588	85.9319	83.6044	80.3000	80.3000	80.3000	80.3000	86.0523	87.4224	80.3000	(216)
Fuel for water heating, kWh/month	238.6252	210.8991	222.4929	200.1575	199.1827	182.6481	174.9908	195.0737	197.2281	209.5708	218.4071	232.7082	(219)
Water heating fuel used												2481.9841	(219)
Annual totals kWh/year													
Space heating fuel - main system												3852.6679	(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)												398.7732	(232)
Total delivered energy for all uses												6808.4253	(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	3852.6679	0.2160	832.1763 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2481.9841	0.2160	536.1086 (264)
Space and water heating			1368.2848 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Total CO2, kg/m2/year			1614.1731 (272)
Emissions per m2 for space and water heating			14.7859 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2365 (272b)
Emissions per m2 for pumps and fans			0.4206 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7859 * 1.00) + 2.2365 + 0.4206, rounded to 2 d.p.			17.4400 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-181	Issued on Date	03/12/2018
Assessment Reference	As Built	Prop Type Ref	P306i - Semi (Op)
Property	4, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE		
SAP Rating	88 B	DER	13.26
Environmental	90 B	% DER<TER	23.98
CO ₂ Emissions (t/year)	0.91	DFEE	45.63
General Requirements Compliance	Pass	% DFEE<TFEE	10.30
Assessor	Silvio Junges, Tel: 01884 242050	Assessor ID	P637-0001
Client			

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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour				
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							3 * 10 =	30.0000 (7a)				
Number of passive vents							0 * 10 =	0.0000 (7b)				
Number of flueless gas fires							0 * 40 =	0.0000 (7c)				
Air changes per hour												
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						30.0000 / (5) =	0.1354 (8)				
Pressure test							Yes					
Measured/design AP50							4.5700					
Infiltration rate							0.3639	(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) =	0.3366 (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	0.4292	0.4208	0.4124	0.3703	0.3619	0.3198	0.3198	0.3114	0.3366	0.3619	0.3787	0.3955 (22b)
Effective ac	0.5921	0.5885	0.5850	0.5686	0.5655	0.5511	0.5511	0.5485	0.5567	0.5655	0.5717	0.5782 (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 Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500 (28a)
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			190.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296		(33)
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000 (32)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor			45.7700			9.0000	411.9300 (32e)
Heat capacity Cm = Sum (A x k)						(28)...(30) + (32) + (32a)...(32e) =	16891.8520 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							182.5357 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835 (36)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total fabric heat loss	(33) + (36) =											63.0131 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	43.2890	43.0276	42.7713	41.5675	41.3422	40.2938	40.2938	40.0996	40.6976	41.3422	41.7979	42.2742 (38)
Average = Sum(39)m / 12 =	106.3021	106.0407	105.7844	104.5805	104.3553	103.3068	103.3068	103.1127	103.7107	104.3553	104.8110	105.2873 (39)
HLP	1.1487	1.1459	1.1431	1.1301	1.1277	1.1163	1.1163	1.1142	1.1207	1.1277	1.1326	1.1377 (40)
HLP (average)												1.1301 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy content (annual)	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (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												
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 (57)
Heat gains from water heating, kWh/month	33.7456	29.5141	30.4559	26.5522	25.4775	21.9851	20.3724	23.3777	23.6569	27.5698	30.0946	32.6808 (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	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	45.3570	43.9198	40.9354	36.8780	34.2439	30.5349	27.3823	31.4216	32.8568	37.0562	41.7981	43.9258 (72)
Total internal gains	374.4947	373.0614	359.9598	338.3751	315.4998	294.2595	280.9829	285.0183	296.5707	318.2975	343.2805	362.9396 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
East					4.8200	19.6403	0.6200	0.7000			0.7700			28.4720 (76)
Southwest					0.6800	36.7938	0.6200	0.7000			0.7700			7.5250 (79)
West					5.7600	19.6403	0.6200	0.7000			0.7700			34.0246 (80)
Northwest					0.6800	11.2829	0.6200	0.7000			0.7700			2.3076 (81)
East					3.1500	19.6403	0.6200	0.7000			0.7700			18.6072 (76)
Solar gains	90.9363	176.1711	287.2847	416.6957	510.0338	522.1507	497.0705	427.1636	333.1860	208.1656	113.0436			75.0201 (83)
Total gains	465.4310	549.2325	647.2445	755.0708	825.5336	816.4102	778.0534	712.1819	629.7566	526.4631	456.3241			437.9596 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	44.1400	44.2489	44.3561	44.8667	44.9635	45.4199	45.4199	45.5054	45.2430	44.9635	44.7680	44.5655
alpha	3.9427	3.9499	3.9571	3.9911	3.9976	4.0280	4.0280	4.0337	4.0162	3.9976	3.9845	3.9710
util living area	0.9962	0.9923	0.9807	0.9444	0.8589	0.7091	0.5543	0.6164	0.8483	0.9706	0.9932	0.9971 (86)
MIT	19.3075	19.4992	19.8382	20.2842	20.6610	20.8931	20.9698	20.9541	20.7644	20.2553	19.7000	19.2765 (87)
Th 2	19.9612	19.9635	19.9658	19.9763	19.9783	19.9875	19.9875	19.9892	19.9840	19.9783	19.9743	19.9701 (88)
util rest of house	0.9953	0.9903	0.9755	0.9285	0.8176	0.6275	0.4397	0.5012	0.7878	0.9594	0.9912	0.9963 (89)
MIT 2	18.4106	18.6032	18.9410	19.3836	19.7333	19.9299	19.9773	19.9721	19.8358	19.3642	18.8123	18.3865 (90)
Living area fraction	18.5865	18.7789	19.1169	19.5602	19.9153	20.1188	20.1720	20.1647	20.0179	19.5389	18.9864	18.5611 (92)
Temperature adjustment												0.0000

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adjusted MIT 18.5865 18.7789 19.1169 19.5602 19.9153 20.1188 20.1720 20.1647 20.0179 19.5389 18.9864 18.5611 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9934	0.9871	0.9698	0.9205	0.8147	0.6390	0.4616	0.5226	0.7902	0.9531	0.9883	0.9948	(94)
Useful gains	462.3749	542.1635	627.6844	695.0342	672.5750	521.6677	359.1638	372.1584	497.6388	501.7459	451.0018	435.6851	(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													
	1518.6870	1471.7293	1334.6746	1114.8530	857.3073	570.1303	369.0076	388.1862	613.7500	932.8259	1245.8261	1512.0363	(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													
	785.8962	624.6682	526.0007	302.2695	137.4408	0.0000	0.0000	0.0000	0.0000	320.7235	572.2735	800.8053	(98)
Space heating												4070.0777	(98)
Space heating per m2											(98) / (4) =	43.9818	(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	971.0843	764.4706	783.6563	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8329	0.8945	0.8645	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	808.8532	683.8025	677.4979	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1055.2447	1008.2995	933.1671	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	177.4019	241.4257	190.2179	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												609.0456 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	44.3505	60.3564	47.5545	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												152.2614 (107)
Space cooling per m2												1.6454 (108)
Energy for space heating												43.9818 (99)
Energy for space cooling												1.6454 (108)
Total												45.6272 (109)
Dwelling Fabric Energy Efficiency (DFEE)												45.6 (109)

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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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3854 (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) =	0.3565 (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	0.4545	0.4456	0.4367	0.3922	0.3832	0.3387	0.3387	0.3298	0.3565	0.3832	0.4011	0.4189 (22b)
Effective ac	0.6033	0.5993	0.5954	0.5769	0.5734	0.5574	0.5574	0.5544	0.5635	0.5734	0.5804	0.5877 (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)			15.0900	1.3258	20.0057		(27)
Heat Loss Floor			46.7700	0.1300	6.0801		(28a)
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.1800	14.3712		(29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501		(30)
Bay	1.0100		1.0100	0.1300	0.1313		(30)
Total net area of external elements Aum(A, m ²)			190.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.4984		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6954 (36)
Total fabric heat loss						(33) + (36) =	59.1938 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	44.1082	43.8149	43.5274	42.1772	41.9246	40.7485	40.7485	40.5307	41.2015	41.9246	42.4356	42.9699 (38)
Heat transfer coeff	103.3020	103.0087	102.7212	101.3710	101.1183	99.9423	99.9423	99.7245	100.3953	101.1183	101.6294	102.1637 (39)
Average = Sum(39)m / 12 =												101.3698 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1163	1.1131	1.1100	1.0954	1.0927	1.0800	1.0800	1.0776	1.0849	1.0927	1.0982	1.1040 (40)
HLP (average)												1.0954 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum(45)m =		1531.6825 (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)

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If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	33.7456	29.5141	30.4559	26.5522	25.4775	21.9851	20.3724	23.3777	23.6569	27.5698	30.0946	(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	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	(71)
Water heating gains (Table 5)	45.3570	43.9198	40.9354	36.8780	34.2439	30.5349	27.3823	31.4216	32.8568	37.0562	41.7981	43.9258	(72)
Total internal gains	374.4947	373.0614	359.9598	338.3751	315.4998	294.2595	280.9829	285.0183	296.5707	318.2975	343.2805	362.9396	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.9700	19.6403	0.6300	0.7000	0.7700	47.8385	(76)
Southwest	0.6800	36.7938	0.6300	0.7000	0.7700	7.6464	(79)
West	5.7600	19.6403	0.6300	0.7000	0.7700	34.5734	(80)
Northwest	0.6800	11.2829	0.6300	0.7000	0.7700	2.3448	(81)

Solar gains	92.4030	179.0126	291.9183	423.4166	518.2602	530.5725	505.0877	434.0533	338.5599	211.5231	114.8668	76.2301	(83)
Total gains	466.8977	552.0740	651.8781	761.7917	833.7600	824.8319	786.0707	719.0717	635.1306	529.8206	458.1474	439.1696	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	62.2097	62.3869	62.5615	63.3948	63.5532	64.3010	64.3010	64.4414	64.0109	63.5532	63.2336	62.9029		
alpha	5.1473	5.1591	5.1708	5.2263	5.2369	5.2867	5.2867	5.2961	5.2674	5.2369	5.2156	5.1935		
util living area	0.9991	0.9977	0.9921	0.9669	0.8856	0.7186	0.5477	0.6152	0.8746	0.9861	0.9981	0.9994	(86)	
MIT	19.7147	19.8683	20.1385	20.4977	20.7928	20.9518	20.9905	20.9832	20.8590	20.4573	20.0212	19.6926	(87)	
Th 2	19.9875	19.9901	19.9927	20.0046	20.0068	20.0172	20.0172	20.0191	20.0132	20.0068	20.0023	19.9976	(88)	
util rest of house	0.9988	0.9969	0.9892	0.9539	0.8428	0.6302	0.4315	0.4953	0.8108	0.9788	0.9973	0.9992	(89)	
MIT 2	18.8089	18.9643	19.2350	19.5956	19.8660	19.9950	20.0148	20.0143	19.9324	19.5631	19.1270	18.7949	(90)	
Living area fraction									fLA = Living area / (4) =			0.1961	(91)	
MIT	18.9866	19.1416	19.4122	19.7725	20.0478	20.1826	20.2061	20.2043	20.1141	19.7385	19.3024	18.9710	(92)	
Temperature adjustment												0.0000		
adjusted MIT	18.9866	19.1416	19.4122	19.7725	20.0478	20.1826	20.2061	20.2043	20.1141	19.7385	19.3024	18.9710	(93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	466.1472	549.8440	643.3513	723.8520	704.3593	532.9453	357.2212	373.2099	519.8146	517.1489	456.5400	438.6575	(95)	
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)	
Heat loss rate W	1517.1547	1467.0055	1326.3538	1102.1583	844.1124	557.9414	360.4068	379.3832	603.7875	924.0688	1240.1191	1509.0549	(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	781.9496	616.3325	508.1538	272.3805	103.9763	0.0000	0.0000	0.0000	0.0000	302.7484	564.1770	796.3757	(98)	
Space heating												3946.0937	(98)	
Space heating per m2												42.6420	(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	939.4577	739.5731	757.9064	0.0000	0.0000	0.0000	0.0000	(100)	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8887	0.9416	0.9169	0.0000	0.0000	0.0000	0.0000	(101)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	834.8790	696.3824	694.9377	0.0000	0.0000	0.0000	0.0000	(102)	
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1065.0884	1017.6703	941.2201	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														

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Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	165.7508	239.0382	183.2341	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												588.0230 (104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			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	41.4377	59.7595	45.8085	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												147.0058 (107)
Energy for space heating												1.5886 (108)
Energy for space cooling												42.6420 (99)
Total												1.5886 (108)
Target Fabric Energy Efficiency (TFEE)												44.2306 (109)
												50.9 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-181	Issued on Date	03/12/2018
Assessment Reference	As Built	Prop Type Ref	P306i - Semi (Op)
Property	4, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE		
SAP Rating	88 B	DER	13.26
Environmental	90 B	% DER<TER	23.98
CO ₂ Emissions (t/year)	0.91	DFEE	45.63
General Requirements Compliance	Pass	% DFEE<TFEE	10.30
Assessor	Silvio Junges, Tel: 01884 242050	Assessor ID	P637-0001
Client			

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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour				
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) =	0.1805 (8)				
Pressure test							Yes					
Measured/design AP50							4.5700					
Infiltration rate							0.4090	(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) =	0.3784 (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	0.3973	0.3689	0.3784	0.3595	0.3595	0.3500	0.3405	0.3311	0.3216	0.3500	0.3311	0.3500 (22b)
Effective ac	0.5789	0.5680	0.5716	0.5646	0.5646	0.5612	0.5580	0.5548	0.5517	0.5612	0.5548	0.5612 (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 Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500 (28a)
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			190.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296		(33)
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000 (32)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor			45.7700			18.0000	823.8600 (32e)
Heat capacity Cm = Sum (A x k)					(28)...(30) + (32) + (32a)...(32e) =		17303.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							186.9871 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835 (36)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Total fabric heat loss (33) + (36) = 63.0131 (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	42.3253	41.5305	41.7889	41.2786	41.2786	41.0333	40.7945	40.5623	40.3366	41.0333	40.5623	41.0333	(38)
Heat transfer coeff	105.3384	104.5435	104.8019	104.2917	104.2917	104.0464	103.8076	103.5754	103.3497	104.0464	103.5754	104.0464	(39)
Average = Sum(39)m / 12 =													(39)
HLP	1.1383	1.1297	1.1325	1.1270	1.1270	1.1243	1.1218	1.1192	1.1168	1.1243	1.1192	1.1243	(40)
HLP (average)													(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													2.6589 (42)
Average daily hot water use (litres/day)													97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842	(44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919	(45)
Energy content (annual)													(45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688	(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	0.0000	(57)
Combi loss	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249	(61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(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 =													(63)
Output from w/h	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(64)
RHI water heating demand													(64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920	(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	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	(71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958	(72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511	(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	
East	4.8200	25.1925	0.6200	0.7000	0.7700	36.5209	(76)
Southwest	0.6800	45.1778	0.6200	0.7000	0.7700	9.2397	(79)
West	5.7600	25.1925	0.6200	0.7000	0.7700	43.6433	(80)
Northwest	0.6800	14.6176	0.6200	0.7000	0.7700	2.9896	(81)
East	3.1500	25.1925	0.6200	0.7000	0.7700	23.8674	(76)

Solar gains	116.2609	191.7129	314.6243	457.6629	531.0485	589.9713	557.4643	491.8687	384.9232	244.3075	144.0755	94.2618	(83)
Total gains	724.2367	794.8951	894.2466	1000.7568	1036.6497	1062.1312	1010.1993	953.4857	867.6725	763.8075	704.3720	685.5129	(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	45.6302	45.9771	45.8637	46.0881	46.0881	46.1968	46.3030	46.4068	46.5082	46.1968	46.4068	46.1968	
alpha	4.0420	4.0651	4.0576	4.0725	4.0725	4.0798	4.0869	4.0938	4.1005	4.0798	4.0938	4.0798	
util living area	0.9814	0.9722	0.9430	0.8681	0.7356	0.5342	0.3950	0.4163	0.6754	0.8942	0.9660	0.9841	(86)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

MIT	19.7480	19.8941	20.2060	20.5788	20.8421	20.9673	20.9926	20.9911	20.9168	20.5973	20.1366	19.7377 (87)
Th 2	19.9697	19.9766	19.9744	19.9789	19.9789	19.9810	19.9831	19.9851	19.9871	19.9810	19.9851	19.9810 (88)
util rest of house												
MIT 2	0.9768	0.9655	0.9290	0.8365	0.6758	0.4480	0.2948	0.3115	0.5911	0.8604	0.9561	0.9801 (89)
Living area fraction	18.3317	18.5465	18.9884	19.5017	19.8307	19.9602	19.9804	19.9818	19.9244	19.5410	18.9041	18.3250 (90)
MIT	18.6095	18.8108	19.2272	19.7130	20.0291	20.1577	20.1789	20.1798	20.1190	19.7481	19.1459	18.6021 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.4595	18.6608	19.0772	19.5630	19.8791	20.0077	20.0289	20.0298	19.9690	19.5981	18.9959	18.4521 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9673	0.9538	0.9134	0.8215	0.6694	0.4504	0.2994	0.3162	0.5895	0.8448	0.9431	0.9715	(94)
Useful gains	700.5299	758.1494	816.7828	822.0876	693.9614	478.3708	302.4665	301.5391	511.4555	645.2714	664.3157	665.9805	(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	1428.3379	1396.7863	1265.7164	1049.4828	769.5779	489.8180	304.0411	303.4509	544.5529	852.9863	1149.2589	1399.6425	(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	541.4891	429.1640	334.0066	163.7246	56.2587	0.0000	0.0000	0.0000	0.0000	154.5399	349.1591	545.8445	(98)
Space heating												2574.1865	(98)
RHI space heating demand												2574	(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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (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) =	0.1805 (8)	
Pressure test															Yes		
Measured/design AP50																4.5700	
Infiltration rate																0.4090 (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) =	0.3784 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Wind factor	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)				
Adj infilt rate	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)				
	0.4824	0.4730	0.4635	0.4162	0.4067	0.3595	0.3595	0.3500	0.3784	0.4067	0.4257	0.4446	(22b)				
Effective ac	0.6164	0.6118	0.6074	0.5866	0.5827	0.5646	0.5646	0.5612	0.5716	0.5827	0.5906	0.5988	(25)				

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Solid Door			1.9600	0.9000	1.7640			(26)					
Window (Uw = 1.40)			11.9400	1.3258	15.8295			(27)					
French (Uw = 1.40)			3.1500	1.3258	4.1761			(27)					
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520	(29a)					
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300	(30)					
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900	(30)					
Total net area of external elements Aum(A, m2)			190.4400					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296			(33)					
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000	(32)					
GF Masonry			41.2600			39.0000	1609.1400	(32c)					
GF Timber			34.3700			9.0000	309.3300	(32c)					
1F Timber			81.4300			9.0000	732.8700	(32c)					
1F Metal			34.9000			20.0000	698.0000	(32c)					
Internal Floor			45.7700			18.0000	823.8600	(32d)					
Internal Floor			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17303.7820	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							186.9871	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835	(36)					
Total fabric heat loss						(33) + (36) =	63.0131	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 45.0630	Feb 44.7326	Mar 44.4088	Apr 42.8879	May 42.6033	Jun 41.2786	Jul 41.2786	Aug 41.0333	Sep 41.7889	Oct 42.6033	Nov 43.1790	Dec 43.7808	(38)
Heat transfer coeff	108.0761	107.7457	107.4219	105.9010	105.6164	104.2917	104.2917	104.0464	104.8019	105.6164	106.1921	106.7939	(39)
Average = Sum(39)m / 12 =												105.8996	(39)
HLP	Jan 1.1679	Feb 1.1643	Mar 1.1608	Apr 1.1444	May 1.1413	Jun 1.1270	Jul 1.1270	Aug 1.1243	Sep 1.1325	Oct 1.1413	Nov 1.1475	Dec 1.1540	(40)
HLP (average)												1.1444	(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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)
										Total per year (kWh/year) = Sum (64)m =		1777.7885 (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	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	

East					4.8200	19.6403	0.6200	0.7000	0.7700		28.4720 (76)	
Southwest					0.6800	36.7938	0.6200	0.7000	0.7700		7.5250 (79)	
West					5.7600	19.6403	0.6200	0.7000	0.7700		34.0246 (80)	
Northwest					0.6800	11.2829	0.6200	0.7000	0.7700		2.3076 (81)	
East					3.1500	19.6403	0.6200	0.7000	0.7700		18.6072 (76)	

Solar gains	90.9363	176.1711	287.2847	416.6957	510.0338	522.1507	497.0705	427.1636	333.1860	208.1656	113.0436	75.0201 (83)
Total gains	698.9121	779.3532	866.9070	959.7897	1015.6350	994.3106	949.8054	888.7806	815.9352	727.6655	673.3401	666.2712 (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	44.4743	44.6106	44.7451	45.3877	45.5100	46.0881	46.0881	46.1968	45.8637	45.5100	45.2633	45.0082
alpha	3.9650	3.9740	3.9830	4.0258	4.0340	4.0725	4.0725	4.0798	4.0576	4.0340	4.0176	4.0005
util living area	0.9856	0.9767	0.9546	0.8976	0.7877	0.6211	0.4699	0.5177	0.7511	0.9267	0.9763	0.9880 (86)
MIT	19.5913	19.7701	20.0769	20.4672	20.7686	20.9364	20.9840	20.9764	20.8597	20.4614	19.9618	19.5617 (87)
Th 2	19.9458	19.9487	19.9515	19.9648	19.9672	19.9789	19.9789	19.9810	19.9744	19.9672	19.9622	19.9570 (88)
util rest of house	0.9821	0.9710	0.9433	0.8721	0.7367	0.5389	0.3669	0.4121	0.6767	0.9027	0.9695	0.9850 (89)
MIT 2	18.0886	18.3487	18.7900	19.3425	19.7348	19.9319	19.9715	19.9692	19.8561	19.3488	18.6379	18.0533 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.3834	18.6275	19.0424	19.5631	19.9376	20.1290	20.1701	20.1668	20.0529	19.5670	18.8975	18.3491 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.2334	18.4775	18.8924	19.4131	19.7876	19.9790	20.0201	20.0168	19.9029	19.4170	18.7475	18.1991 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9739	0.9600	0.9284	0.8556	0.7267	0.5389	0.3712	0.4160	0.6709	0.8863	0.9584	0.9778 (94)
Useful gains	680.6549	748.1774	804.8038	821.2413	738.0724	535.8374	352.5317	369.7168	547.4272	644.9655	645.3584	651.4477 (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	1505.8622	1462.9198	1331.2129	1113.3472	854.1820	560.9799	356.6868	376.3117	608.1586	931.2224	1236.8754	1495.0209 (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	613.9542	480.3069	391.6484	210.3162	86.3856	0.0000	0.0000	0.0000	0.0000	212.9751	425.8923	627.6185 (98)
Space heating												3049.0972 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating per m2 (98) / (4) = 32.9490 (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													3387.8857 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	613.9542	480.3069	391.6484	210.3162	86.3856	0.0000	0.0000	0.0000	0.0000	212.9751	425.8923	627.6185	(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)	682.1714	533.6743	435.1648	233.6847	95.9840	0.0000	0.0000	0.0000	0.0000	236.6390	473.2136	697.3539	(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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(64)
Efficiency of water heater (217)m	89.2305	89.1605	88.9989	88.6225	87.9263	86.7000	86.7000	86.7000	86.7000	88.6028	89.0661	86.7000	(216)
Fuel for water heating, kWh/month	201.5557	177.0740	184.6061	163.8081	160.0538	142.5096	134.4811	150.8755	151.6607	170.0374	181.8170	195.8516	(219)
Water heating fuel used												2014.3306	(219)
Annual totals kWh/year													
Space heating fuel - main system												3387.8857	(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)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1029 * 1.00) =										-666.9130		-666.9130	(233)
Total delivered energy for all uses												5209.0766	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3387.8857	3.4800	117.8984	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2014.3306	3.4800	70.0987	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	398.7732	13.1900	52.5982	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-666.9130	13.1900	-87.9658	(252)
Total energy cost			282.5220	(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] =	0.8627 (257)
SAP value		87.9650
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	3387.8857	0.2160	731.7833	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2014.3306	0.2160	435.0954	(264)
Space and water heating			1166.8787	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.7732	0.5190	206.9633	(268)
Energy saving/generation technologies				
PV Unit	-666.9130	0.5190	-346.1278	(269)
Total kg/year			1066.6392	(272)
CO2 emissions per m2			11.5300	(273)
EI value			89.6081	
EI rating			90	(274)
EI band			B	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	$3.48 / 0.8814 = 3.948$, stars = 4
Water heating environmental impact	$0.216 / 0.8814 = 0.2451$, 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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.5700
Infiltration rate					0.4090 (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)	=	0.3784 (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	0.3973	0.3689	0.3784	0.3595	0.3595	0.3500	0.3405	0.3311	0.3216	0.3500	0.3311	0.3500 (22b)
Effective ac	0.5789	0.5680	0.5716	0.5646	0.5646	0.5612	0.5580	0.5548	0.5517	0.5612	0.5548	0.5612 (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 Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500 (28a)
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			190.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296		(33)
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000 (32)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor			45.7700			18.0000	823.8600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17303.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							186.9871 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835 (36)
Total fabric heat loss						(33) + (36) =	63.0131 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	42.3253	41.5305	41.7889	41.2786	41.2786	41.0333	40.7945	40.5623	40.3366	41.0333	40.5623	41.0333 (38)
Average = Sum(39)m / 12 =	105.3384	104.5435	104.8019	104.2917	104.2917	104.0464	103.8076	103.5754	103.3497	104.0464	103.5754	104.0464 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1383	1.1297	1.1325	1.1270	1.1270	1.1243	1.1218	1.1192	1.1168	1.1243	1.1192	1.1243 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month												
Solar input	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)
										Total per year (kWh/year) = Sum (64)m =		1777.7885 (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	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	

East					4.8200	25.1925	0.6200	0.7000	0.7700		36.5209 (76)	
Southwest					0.6800	45.1778	0.6200	0.7000	0.7700		9.2397 (79)	
West					5.7600	25.1925	0.6200	0.7000	0.7700		43.6433 (80)	
Northwest					0.6800	14.6176	0.6200	0.7000	0.7700		2.9896 (81)	
East					3.1500	25.1925	0.6200	0.7000	0.7700		23.8674 (76)	

Solar gains	116.2609	191.7129	314.6243	457.6629	531.0485	589.9713	557.4643	491.8687	384.9232	244.3075	144.0755	94.2618 (83)
Total gains	724.2367	794.8951	894.2466	1000.7568	1036.6497	1062.1312	1010.1993	953.4857	867.6725	763.8075	704.3720	685.5129 (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	45.6302	45.9771	45.8637	46.0881	46.0881	46.1968	46.3030	46.4068	46.5082	46.1968	46.4068	46.1968
alpha	4.0420	4.0651	4.0576	4.0725	4.0725	4.0798	4.0869	4.0938	4.1005	4.0798	4.0938	4.0798
util living area	0.9814	0.9722	0.9430	0.8681	0.7356	0.5342	0.3950	0.4163	0.6754	0.8942	0.9660	0.9841 (86)
MIT	19.7480	19.8941	20.2060	20.5788	20.8421	20.9673	20.9926	20.9911	20.9168	20.5973	20.1366	19.7377 (87)
Th 2	19.9697	19.9766	19.9744	19.9789	19.9789	19.9810	19.9831	19.9851	19.9871	19.9810	19.9851	19.9810 (88)
util rest of house	0.9768	0.9655	0.9290	0.8365	0.6758	0.4480	0.2948	0.3115	0.5911	0.8604	0.9561	0.9801 (89)
MIT 2	18.3317	18.5465	18.9884	19.5017	19.8307	19.9602	19.9804	19.9818	19.9244	19.5410	18.9041	18.3250 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.6095	18.8108	19.2272	19.7130	20.0291	20.1577	20.1789	20.1798	20.1190	19.7481	19.1459	18.6021 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.4595	18.6608	19.0772	19.5630	19.8791	20.0077	20.0289	20.0298	19.9690	19.5981	18.9959	18.4521 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9673	0.9538	0.9134	0.8215	0.6694	0.4504	0.2994	0.3162	0.5895	0.8448	0.9431	0.9715 (94)
Useful gains	700.5299	758.1494	816.7828	822.0876	693.9614	478.3708	302.4665	301.5391	511.4555	645.2714	664.3157	665.9805 (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	1428.3379	1396.7863	1265.7164	1049.4828	769.5779	489.8180	304.0411	303.4509	544.5529	852.9863	1149.2589	1399.6425 (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	541.4891	429.1640	334.0066	163.7246	56.2587	0.0000	0.0000	0.0000	0.0000	154.5399	349.1591	545.8445 (98)
Space heating												2574.1865 (98)

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Space heating per m2 (98) / (4) = 27.8170 (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													2860.2073 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	541.4891	429.1640	334.0066	163.7246	56.2587	0.0000	0.0000	0.0000	0.0000	154.5399	349.1591	545.8445	(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)	601.6546	476.8489	371.1184	181.9162	62.5097	0.0000	0.0000	0.0000	0.0000	171.7110	387.9545	606.4939	(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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(64)
Efficiency of water heater (217)m	89.1539	89.0881	88.8845	88.4184	87.6175	86.7000	86.7000	86.7000	86.7000	88.3402	88.9276	86.7000	(216)
Fuel for water heating, kWh/month	201.7288	177.2179	184.8437	164.1862	160.6178	142.5096	134.4811	150.8755	151.6607	170.5428	182.1003	196.0344	(219)
Water heating fuel used												2016.7988	(219)
Annual totals kWh/year													
Space heating fuel - main system												2860.2073	(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)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1156 * 1.00) =										-749.2375		-749.2375	(233)
Total delivered energy for all uses												4601.5418	(238)

10a. Fuel costs - using BEDF prices (435)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2860.2073	3.9400	112.6922	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2016.7988	3.9400	79.4619	(247)
Pumps and fans for heating	75.0000	16.5500	12.4125	(249)
Energy for lighting	398.7732	16.5500	65.9970	(250)
Additional standing charges			87.0000	(251)
Energy saving/generation technologies				
PV Unit	-749.2375	16.5500	-123.9988	(252)
Total energy cost			233.5647	(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	2860.2073	0.2160	617.8048	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2016.7988	0.2160	435.6285	(264)
Space and water heating			1053.4333	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.7732	0.5190	206.9633	(268)
Energy saving/generation technologies				
PV Unit	-749.2375	0.5190	-388.8543	(269)
Total kg/year			910.4674	(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	2860.2073	1.2200	3489.4529	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2016.7988	1.2200	2460.4945	(264)
Space and water heating			5949.9474	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	398.7732	3.0700	1224.2338	(268)

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Energy saving/generation technologies			
PV Unit	-749.2375	3.0700	-2300.1591 (269)
Primary energy kWh/year			5104.2721 (272)
Primary energy kWh/m2/year			55.1575 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 88
Current environmental impact rating:	B 90

(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	+ 1.2	-£ 32	-195 kg (21.4%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£32 2.11 kg/m²	B 89	B 91
Total Savings	£32 2.11 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 435 TEST (16 Nov 2018)
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	£78	£87	-£8
Mains gas	£279	£239	£40
Space heating	£212	£212	£0
Water heating	£79	£47	£32
Lighting	£66	£66	£0
Generated (PV)	-£124	-£124	£0
Total cost of fuels	£233	£202	£32
Total cost of uses	£233	£201	£32
Delivered energy	50 kWh/m²	39 kWh/m²	11 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	55 kWh/m²	43 kWh/m²	12 kWh/m²

FULL SAP CALCULATION PRINTOUT

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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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.5700
Infiltration rate					0.4090 (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) =		0.3784 (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	0.4824	0.4730	0.4635	0.4162	0.4067	0.3595	0.3595	0.3500	0.3784	0.4067	0.4257	0.4446 (22b)
Effective ac	0.6164	0.6118	0.6074	0.5866	0.5827	0.5646	0.5646	0.5612	0.5716	0.5827	0.5906	0.5988 (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 Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500 (28a)
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			190.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296		(33)
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000 (32)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor			45.7700			18.0000	823.8600 (32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		17303.7820 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							186.9871 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835 (36)
Total fabric heat loss						(33) + (36) =	63.0131 (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	45.0630	44.7326	44.4088	42.8879	42.6033	41.2786	41.2786	41.0333	41.7889	42.6033	43.1790	43.7808 (38)
Heat transfer coeff	108.0761	107.7457	107.4219	105.9010	105.6164	104.2917	104.2917	104.0464	104.8019	105.6164	106.1921	106.7939 (39)
Average = Sum(39)m / 12 =												105.8996 (39)
HLP	1.1679	1.1643	1.1608	1.1444	1.1413	1.1270	1.1270	1.1243	1.1325	1.1413	1.1475	1.1540 (40)
HLP (average)												1.1444 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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												1.1841 (H8)
Utilisation factor												0.5703 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												97.3492 (H14)
Volume ratio Veff/V												0.7704 (H15)
Solar storage volume factor												0.9478 (H16)
Solar input												-861.9358 (H17)
Solar input	-24.9944	-41.7085	-71.0344	-95.2000	-117.6116	-115.6310	-114.1028	-99.6922	-78.0790	-53.3188	-29.6470	-20.9161 (63)
Solar input (sum of months) = Sum (63)m =												-861.9358 (63)
Output from w/h	154.8547	116.1715	93.2631	49.9708	23.1177	7.9249	2.4922	31.1168	53.4109	97.3390	132.2903	153.9008 (64)
Total per year (kWh/year) = Sum (64)m =												915.8527 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (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	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	(71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958	(72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W

East					4.8200	19.6403	0.6200	0.7000			0.7700			28.4720 (76)
Southwest					0.6800	36.7938	0.6200	0.7000			0.7700			7.5250 (79)
West					5.7600	19.6403	0.6200	0.7000			0.7700			34.0246 (80)
Northwest					0.6800	11.2829	0.6200	0.7000			0.7700			2.3076 (81)
East					3.1500	19.6403	0.6200	0.7000			0.7700			18.6072 (76)

Solar gains	90.9363	176.1711	287.2847	416.6957	510.0338	522.1507	497.0705	427.1636	333.1860	208.1656	113.0436			75.0201 (83)
Total gains	698.9121	779.3532	866.9070	959.7897	1015.6350	994.3106	949.8054	888.7806	815.9352	727.6655	673.3401			666.2712 (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	44.4743	44.6106	44.7451	45.3877	45.5100	46.0881	46.0881	46.1968	45.8637	45.5100	45.2633	45.0082
alpha	3.9650	3.9740	3.9830	4.0258	4.0340	4.0725	4.0725	4.0798	4.0576	4.0340	4.0176	4.0005
util living area	0.9856	0.9767	0.9546	0.8976	0.7877	0.6211	0.4699	0.5177	0.7511	0.9267	0.9763	0.9880 (86)
MIT	19.5913	19.7701	20.0769	20.4672	20.7686	20.9364	20.9840	20.9764	20.8597	20.4614	19.9618	19.5617 (87)
Th 2	19.9458	19.9487	19.9515	19.9648	19.9672	19.9789	19.9789	19.9810	19.9744	19.9672	19.9622	19.9570 (88)
util rest of house	0.9821	0.9710	0.9433	0.8721	0.7367	0.5389	0.3669	0.4121	0.6767	0.9027	0.9695	0.9850 (89)
MIT 2	18.0886	18.3487	18.7900	19.3425	19.7348	19.9319	19.9715	19.9692	19.8561	19.3488	18.6379	18.0533 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.3834	18.6275	19.0424	19.5631	19.9376	20.1290	20.1701	20.1668	20.0529	19.5670	18.8975	18.3491 (92)

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Temperature adjustment													-0.1500
adjusted MIT	18.2334	18.4775	18.8924	19.4131	19.7876	19.9790	20.0201	20.0168	19.9029	19.4170	18.7475	18.1991	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9739	0.9600	0.9284	0.8556	0.7267	0.5389	0.3712	0.4160	0.6709	0.8863	0.9584	0.9778	(94)
Useful gains	680.6549	748.1774	804.8038	821.2413	738.0724	535.8374	352.5317	369.7168	547.4272	644.9655	645.3584	651.4477	(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	1505.8622	1462.9198	1331.2129	1113.3472	854.1820	560.9799	356.6868	376.3117	608.1586	931.2224	1236.8754	1495.0209	(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	613.9542	480.3069	391.6484	210.3162	86.3856	0.0000	0.0000	0.0000	0.0000	212.9751	425.8923	627.6185	(98)
Space heating												3049.0972	(98)
Space heating per m2												32.9490	(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													3387.8857 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	613.9542	480.3069	391.6484	210.3162	86.3856	0.0000	0.0000	0.0000	0.0000	212.9751	425.8923	627.6185	(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)	682.1714	533.6743	435.1648	233.6847	95.9840	0.0000	0.0000	0.0000	0.0000	236.6390	473.2136	697.3539	(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	154.8547	116.1715	93.2631	49.9708	23.1177	7.9249	2.4922	31.1168	53.4109	97.3390	132.2903	153.9008	(64)
Efficiency of water heater (217)m	89.3153	89.3377	89.3459	89.3471	89.2826	86.7000	86.7000	86.7000	86.7000	88.9381	89.1954	86.7000	(216)
Fuel for water heating, kWh/month	173.3799	130.0363	104.3842	55.9288	25.8927	9.1406	2.8745	35.8902	61.6042	109.4458	148.3152	172.2826	(219)
Water heating fuel used												1029.1752	(219)
Annual totals kWh/year													
Space heating fuel - main system												3387.8857	(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)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1029 * 1.00) =										-666.9130		-666.9130	(233)
Total delivered energy for all uses												4273.9211	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3387.8857	3.4800	117.8984	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1029.1752	3.4800	35.8153	(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	398.7732	13.1900	52.5982	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-666.9130	13.1900	-87.9658	(252)
Total energy cost			254.8336	(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] =	0.7782 (257)
SAP value		89.1445
SAP rating (Section 12)		89 (258)
SAP band		B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	3387.8857	0.2160	731.7833	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1029.1752	0.2160	222.3018	(264)
Space and water heating			954.0852	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	398.7732	0.5190	206.9633	(268)
Energy saving/generation technologies				
PV Unit	-666.9130	0.5190	-346.1278	(269)
Total kg/year			879.7956	(272)
CO2 emissions per m2			9.5100	(273)
EI value			91.4285	
EI rating			91	(274)
EI band			B	

FULL SAP CALCULATION PRINTOUT

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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (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) =	0.1805 (8)	
Pressure test															Yes		
Measured/design AP50															4.5700		
Infiltration rate															0.4090 (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) =					0.3784 (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)					
	0.3973	0.3689	0.3784	0.3595	0.3595	0.3500	0.3405	0.3311	0.3216	0.3500	0.3311	0.3500 (22b)					
Effective ac	0.5789	0.5680	0.5716	0.5646	0.5646	0.5612	0.5580	0.5548	0.5517	0.5612	0.5548	0.5612 (25)					

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Solid Door			1.9600	0.9000	1.7640			(26)					
Window (Uw = 1.40)			11.9400	1.3258	15.8295			(27)					
French (Uw = 1.40)			3.1500	1.3258	4.1761			(27)					
Heat Loss Floor			46.7700	0.1400	6.5478	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	96.8900	17.0500	79.8400	0.2500	19.9600	52.8000	4215.5520	(29a)					
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300	(30)					
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900	(30)					
Total net area of external elements Aum(A, m2)			190.4400					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.4296			(33)					
E-WM-30			37.8400	0.0000	0.0000	110.0000	4162.4000	(32)					
GF Masonry			41.2600			39.0000	1609.1400	(32c)					
GF Timber			34.3700			9.0000	309.3300	(32c)					
1F Timber			81.4300			9.0000	732.8700	(32c)					
1F Metal			34.9000			20.0000	698.0000	(32c)					
Internal Floor			45.7700			18.0000	823.8600	(32d)					
Internal Floor			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17303.7820	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							186.9871	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5835	(36)					
Total fabric heat loss						(33) + (36) =	63.0131	(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	42.3253	41.5305	41.7889	41.2786	41.2786	41.0333	40.7945	40.5623	40.3366	41.0333	40.5623	41.0333	(38)
Heat transfer coeff	105.3384	104.5435	104.8019	104.2917	104.2917	104.0464	103.8076	103.5754	103.3497	104.0464	103.5754	104.0464	(39)
Average = Sum(39)m / 12 =												104.1429	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1383	1.1297	1.1325	1.1270	1.1270	1.1243	1.1218	1.1192	1.1168	1.1243	1.1192	1.1243	(40)
HLP (average)												1.1254	(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											
2.6589 (42)											
Average daily hot water use (litres/day)											
97.3492 (43)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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												1.3251 (H8)
Utilisation factor												0.5298 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												97.3492 (H14)
Volume ratio Veff/V												0.7704 (H15)
Solar storage volume factor												0.9478 (H16)
Solar input												-896.2419 (H17)
Solar input	-29.2376	-41.5740	-71.4557	-96.4103	-113.2396	-120.9578	-118.4140	-105.9842	-82.9783	-57.3683	-34.5804	-24.0418 (63)
Solar input (sum of months) = Sum (63)m =												-896.2419 (63)
Output from w/h	150.6116	116.3060	92.8418	48.7605	27.4897	2.5980	0.0000	24.8249	48.5116	93.2895	127.3570	150.7750 (64)
Total per year (kWh/year) = Sum (64)m =												883.3655 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (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	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	(71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958	(72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W

East					4.8200	25.1925	0.6200	0.7000			0.7700			36.5209 (76)
Southwest					0.6800	45.1778	0.6200	0.7000			0.7700			9.2397 (79)
West					5.7600	25.1925	0.6200	0.7000			0.7700			43.6433 (80)
Northwest					0.6800	14.6176	0.6200	0.7000			0.7700			2.9896 (81)
East					3.1500	25.1925	0.6200	0.7000			0.7700			23.8674 (76)

Solar gains	116.2609	191.7129	314.6243	457.6629	531.0485	589.9713	557.4643	491.8687	384.9232	244.3075	144.0755			94.2618 (83)
Total gains	724.2367	794.8951	894.2466	1000.7568	1036.6497	1062.1312	1010.1993	953.4857	867.6725	763.8075	704.3720			685.5129 (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	45.6302	45.9771	45.8637	46.0881	46.0881	46.1968	46.3030	46.4068	46.5082	46.1968	46.4068	46.1968
alpha	4.0420	4.0651	4.0576	4.0725	4.0725	4.0798	4.0869	4.0938	4.1005	4.0798	4.0938	4.0798
util living area	0.9814	0.9722	0.9430	0.8681	0.7356	0.5342	0.3950	0.4163	0.6754	0.8942	0.9660	0.9841 (86)
MIT	19.7480	19.8941	20.2060	20.5788	20.8421	20.9673	20.9926	20.9911	20.9168	20.5973	20.1366	19.7377 (87)
Th 2	19.9697	19.9766	19.9744	19.9789	19.9789	19.9810	19.9831	19.9851	19.9871	19.9810	19.9851	19.9810 (88)
util rest of house	0.9768	0.9655	0.9290	0.8365	0.6758	0.4480	0.2948	0.3115	0.5911	0.8604	0.9561	0.9801 (89)
MIT 2	18.3317	18.5465	18.9884	19.5017	19.8307	19.9602	19.9804	19.9818	19.9244	19.5410	18.9041	18.3250 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.6095	18.8108	19.2272	19.7130	20.0291	20.1577	20.1789	20.1798	20.1190	19.7481	19.1459	18.6021 (92)

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Temperature adjustment													-0.1500
adjusted MIT	18.4595	18.6608	19.0772	19.5630	19.8791	20.0077	20.0289	20.0298	19.9690	19.5981	18.9959		18.4521 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9673	0.9538	0.9134	0.8215	0.6694	0.4504	0.2994	0.3162	0.5895	0.8448	0.9431	0.9715	(94)
Useful gains	700.5299	758.1494	816.7828	822.0876	693.9614	478.3708	302.4665	301.5391	511.4555	645.2714	664.3157	665.9805	(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													
	1428.3379	1396.7863	1265.7164	1049.4828	769.5779	489.8180	304.0411	303.4509	544.5529	852.9863	1149.2589	1399.6425	(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													
	541.4891	429.1640	334.0066	163.7246	56.2587	0.0000	0.0000	0.0000	0.0000	154.5399	349.1591	545.8445	(98)
Space heating												2574.1865	(98)
Space heating per m2											(98) / (4) =	27.8170	(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													2860.2073 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	541.4891	429.1640	334.0066	163.7246	56.2587	0.0000	0.0000	0.0000	0.0000	154.5399	349.1591	545.8445	(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)	601.6546	476.8489	371.1184	181.9162	62.5097	0.0000	0.0000	0.0000	0.0000	171.7110	387.9545	606.4939	(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	150.6116	116.3060	92.8418	48.7605	27.4897	2.5980	0.0000	24.8249	48.5116	93.2895	127.3570	150.7750	(64)
Efficiency of water heater (217)m	89.2607	89.2607	89.2610	89.2207	88.8895	86.7000	86.7000	86.7000	86.7000	88.7287	89.0937	86.7000	(216)
Fuel for water heating, kWh/month	168.7323	130.2777	104.0115	54.6516	30.9257	2.9966	0.0000	28.6331	55.9534	105.1401	142.9473	168.9079	(219)
Water heating fuel used												993.1772	(219)
Annual totals kWh/year													
Space heating fuel - main system												2860.2073	(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)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1156 * 1.00) =										-749.2375		-749.2375	(233)
Total delivered energy for all uses												3627.9202	(238)

10a. Fuel costs - using BEDF prices (435)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2860.2073	3.9400	112.6922	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	993.1772	3.9400	39.1312	(247)
Pumps and fans for heating	75.0000	16.5500	12.4125	(249)
Pump for solar water heating	50.0000	16.5500	8.2750	(249)
Energy for lighting	398.7732	16.5500	65.9970	(250)
Additional standing charges			87.0000	(251)
Energy saving/generation technologies				
PV Unit	-749.2375	16.5500	-123.9988	(252)
Total energy cost			201.5090	(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	2860.2073	0.2160	617.8048	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	993.1772	0.2160	214.5263	(264)
Space and water heating			832.3310	(265)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



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

Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Energy saving/generation technologies			
PV Unit	-749.2375	0.5190	-388.8543 (269)
Total kg/year			715.3151 (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	2860.2073	1.2200	3489.4529 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	993.1772	1.2200	1211.6761 (264)
Space and water heating			4701.1290 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	398.7732	3.0700	1224.2338 (268)
Energy saving/generation technologies			
PV Unit	-749.2375	3.0700	-2300.1591 (269)
Primary energy kWh/year			4008.9537 (272)
Primary energy kWh/m2/year			43.3213 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-181				Issued on Date	03/12/2018
Assessment Reference	As Built	Prop Type Ref	P306i - Semi (Op)			
Property	4, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	88 B	DER	13.26	TER	17.44	
Environmental	90 B	% DER<TER	23.98			
CO ₂ Emissions (t/year)	0.91	DFEE	45.63	TFEE	50.87	
General Requirements Compliance	Pass	% DFEE<TFEE	10.30			
Assessor	Silvio Junges, Tel: 01884 242050				Assessor ID	P637-0001
Client						

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

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	187.0 (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	292.44 (P1)
Transmission heat loss coefficient	63.01 (37)
Summer heat loss coefficient	355.46 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.8200	125.2818	0.6200	0.7000	0.9000	212.2803
South West	0.6800	127.3119	0.6200	0.7000	0.9000	30.4335
West	5.7600	125.2818	0.6200	0.7000	0.9000	253.6794
North West	0.6800	106.0502	0.6200	0.7000	0.9000	25.3510
East	3.1500	125.2818	0.6200	0.7000	0.9000	138.7309
total:						660.4752

	Jun	Jul	Aug	
Solar gains	711	660	581	(P3)
Internal gains	469	450	459	
Total summer gains	1180	1110	1040	(P5)
Summer gain/loss ratio	3.32	3.12	2.92	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 187.0)	0.69	0.69	0.69	
Threshold temperature	19.41	21.11	20.92	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			