

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-156				Issued on Date	12/11/2019
Assessment Reference	As Built		Prop Type Ref	P306i - Det (Op)		
Property	69, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	86 B	DER	15.13	TER	18.84	
Environmental	88 B	% DER<TER	19.68			
CO ₂ Emissions (t/year)	1.09	DFEE	51.77	TFEE	58.15	
General Requirements Compliance	Pass	% DFEE<TFEE	10.97			
Assessor Details	Mr. Fraser Browning, Fraser Browning, Tel: 01884 242050, Fraser.browning@aessc.co.uk				Assessor ID	T511-0001
Client						

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

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DWELLING AS BUILT

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) 18.84 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.13 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)58.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Floor	0.15 (max. 0.25)	0.15 (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: 4.97 (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

Door U-value 0.90 W/m²K
Thermal bridging y-value 0.036 W/m²K
Photovoltaic array 0.81 kW

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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					4.9700
Infiltration rate					0.4290 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.4290 (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	0.5470	0.5363	0.5256	0.4720	0.4612	0.4076	0.4076	0.3969	0.4290	0.4612	0.4827	0.5041 (22b)
Effective ac	0.6496	0.6438	0.6381	0.6114	0.6064	0.5831	0.5831	0.5788	0.5920	0.6064	0.6165	0.6271 (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)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (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)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418		(33)
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 1			45.7700			18.0000	823.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15039.5420 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 162.5194 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.1836 (36)
Total fabric heat loss (33) + (36) = 74.5254 (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	47.4946	47.0698	46.6535	44.6978	44.3319	42.6286	42.6286	42.3131	43.2847	44.3319	45.0721	45.8460 (38)
Heat transfer coeff	122.0200	121.5952	121.1788	119.2232	118.8573	117.1539	117.1539	116.8385	117.8100	118.8573	119.5975	120.3713 (39)
Average = Sum(39)m / 12 =												119.2214 (39)
HLP	1.3186	1.3140	1.3095	1.2883	1.2844	1.2660	1.2660	1.2626	1.2731	1.2844	1.2924	1.3007 (40)
HLP (average)												1.2883 (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												
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	0.7100	0.7000	0.7700		32.6050 (76)		
Southwest				0.6800	36.7938	0.7100	0.7000	0.7700		8.6173 (79)		
West				5.7600	19.6403	0.7100	0.7000	0.7700		38.9636 (80)		
Northwest				0.6800	11.2829	0.7100	0.7000	0.7700		2.6425 (81)		
East				3.1500	19.6403	0.7100	0.7000	0.7700		21.3082 (76)		
Solar gains	104.1367	201.7443	328.9873	477.1838	584.0710	597.9468	569.2258	489.1712	381.5517	238.3831	129.4531	85.9101 (83)
Total gains	514.3168	609.6723	722.1118	846.4048	928.9097	919.4274	875.6357	801.9216	706.6779	587.6352	506.3913	483.7196 (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	34.2374	34.3570	34.4751	35.0406	35.1485	35.6595	35.6595	35.7558	35.4609	35.1485	34.9309	34.7064
alpha	3.2825	3.2905	3.2983	3.3360	3.3432	3.3773	3.3773	3.3837	3.3641	3.3432	3.3287	3.3138
util living area	0.9918	0.9851	0.9679	0.9225	0.8317	0.6875	0.5438	0.6012	0.8216	0.9545	0.9866	0.9933 (86)
MIT	18.9441	19.1715	19.5728	20.1028	20.5483	20.8396	20.9465	20.9245	20.6839	20.0837	19.4251	18.9161 (87)
Th 2	19.8263	19.8299	19.8334	19.8500	19.8531	19.8676	19.8676	19.8703	19.8620	19.8531	19.8468	19.8402 (88)
util rest of house	0.9899	0.9815	0.9599	0.9022	0.7858	0.6016	0.4217	0.4794	0.7551	0.9387	0.9828	0.9917 (89)
MIT 2	17.0954	17.4283	18.0109	18.7740	19.3777	19.7399	19.8406	19.8283	19.5726	18.7635	17.8099	17.0629 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	17.4580	17.7702	18.3172	19.0346	19.6073	19.9556	20.0575	20.0433	19.7906	19.0224	18.1267	17.4264 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.3080	17.6202	18.1672	18.8846	19.4573	19.8056	19.9075	19.8933	19.6406	18.8724	17.9767	17.2764 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	505.6439	592.0874	681.3175	744.8610	712.3634	548.3292	373.3201	386.6467	522.4819	540.2726	492.7828	476.9621 (94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1587.2347	1546.7139	1413.8190	1190.4013	922.0156	609.8547	387.4811	408.1522	652.7332	983.2389	1300.8263	1574.0193 (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	804.7036	641.5090	544.9811	320.7890	155.9812	0.0000	0.0000	0.0000	0.0000	329.5670	581.7914	816.2105 (98)
Space heating												4195.5328 (98)

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Space heating per m2 (98) / (4) = 45.3375 (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													4661.7031 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	804.7036	641.5090	544.9811	320.7890	155.9812	0.0000	0.0000	0.0000	0.0000	329.5670	581.7914	816.2105	(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)	894.1151	712.7878	605.5346	356.4322	173.3125	0.0000	0.0000	0.0000	0.0000	366.1855	646.4349	906.9006	(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	89.3786	89.3285	89.2134	88.9453	88.4041	86.7000	86.7000	86.7000	86.7000	88.9380	89.2602	86.7000	(216)
Fuel for water heating, kWh/month	201.2218	176.7409	184.1622	163.2136	159.1887	142.5096	134.4811	150.8755	151.6607	169.3965	181.4215	195.5451	(219)
Water heating fuel used												2010.4174	(219)
Annual totals kWh/year													
Space heating fuel - main system												4661.7031	(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 * 853 * 1.00) =										-552.7634		-552.7634	(233)
Total delivered energy for all uses												6593.1303	(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	4661.7031	0.2160	1006.9279 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2010.4174	0.2160	434.2502 (264)
Space and water heating			1441.1780 (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	-552.7634	0.5190	-286.8842 (269)
Total CO2, kg/year			1400.1821 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.1300 (273)

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

DER		15.1300	ZC1
Total Floor Area		92.5400	
Assumed number of occupants	TFA	2.6589	
CO2 emission factor in Table 12 for electricity displaced from grid	N	0.5190	
CO2 emissions from appliances, equation (L14)	EF	15.6036	ZC2
CO2 emissions from cooking, equation (L16)		1.9755	ZC3
Total CO2 emissions		32.7091	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		32.7091	ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3854 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3854 (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	0.4914	0.4818	0.4721	0.4240	0.4143	0.3661	0.3661	0.3565	0.3854	0.4143	0.4336	0.4529 (22b)
Effective ac	0.6207	0.6160	0.6115	0.5899	0.5858	0.5670	0.5670	0.5635	0.5743	0.5858	0.5940	0.6025 (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 Semi-glazed door			1.8900	1.2000	2.2680		(26a)
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	134.7300	18.9400	115.7900	0.1800	20.8422		(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)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.2374		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.3958 (36)
Total fabric heat loss						(33) + (36) =	68.6332 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	45.3826	45.0398	44.7039	43.1258	42.8305	41.4560	41.4560	41.2015	41.9855	42.8305	43.4278	44.0523 (38)
Heat transfer coeff	114.0158	113.6730	113.3370	111.7590	111.4637	110.0892	110.0892	109.8347	110.6187	111.4637	112.0610	112.6854 (39)
Average = Sum(39)m / 12 =												111.7575 (39)
HLP	1.2321	1.2284	1.2247	1.2077	1.2045	1.1896	1.1896	1.1869	1.1954	1.2045	1.2109	1.2177 (40)
HLP (average)												1.2077 (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	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												

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If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
Combi 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)
Total heat required for water heating calculated for each month	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)
Solar input	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)
Output from w/h	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)
Heat gains from water heating, kWh/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 (64)
	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, 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	56.3640	56.5340	56.7016	57.5022	57.6545	58.3744	58.3744	58.5096	58.0950	57.6545	57.3472	57.0294	
alpha	4.7576	4.7689	4.7801	4.8335	4.8436	4.8916	4.8916	4.9006	4.8730	4.8436	4.8231	4.8020	
util living area	0.9986	0.9968	0.9905	0.9658	0.8920	0.7384	0.5717	0.6348	0.8774	0.9833	0.9971	0.9989	(86)
MIT	19.6080	19.7642	20.0438	20.4198	20.7398	20.9300	20.9840	20.9741	20.8261	20.3991	19.9388	19.5869	(87)
Th 2	19.8944	19.8974	19.9003	19.9139	19.9164	19.9283	19.9283	19.9305	19.9237	19.9164	19.9113	19.9059	(88)
util rest of house	0.9981	0.9956	0.9869	0.9521	0.8486	0.6448	0.4422	0.5036	0.8111	0.9744	0.9959	0.9986	(89)
MIT 2	18.0398	18.2701	18.6789	19.2264	19.6574	19.8810	19.9224	19.9197	19.7787	19.2066	18.5355	18.0170	(90)
Living area fraction	18.3474	18.5631	18.9466	19.4605	19.8696	20.0867	20.1306	20.1265	19.9842	19.4405	18.8107	18.3249	(92)
Temperature adjustment	18.3474	18.5631	18.9466	19.4605	19.8696	20.0867	20.1306	20.1265	19.9842	19.4405	18.8107	18.3249	(93)
adjusted MIT	18.3474	18.5631	18.9466	19.4605	19.8696	20.0867	20.1306	20.1265	19.9842	19.4405	18.8107	18.3249	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9970	0.9935	0.9825	0.9447	0.8464	0.6599	0.4677	0.5291	0.8156	0.9688	0.9940	0.9977	(94)
Ext temp.	511.0889	593.1370	682.8358	757.5911	737.8865	567.5629	383.3021	399.7374	548.8962	552.9657	498.8578	482.9872	(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	1601.6216	1553.1274	1410.6656	1180.2281	910.6190	604.0306	388.6849	409.2977	650.8984	985.3897	1312.3164	1591.6713	(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 per m2	811.3563	645.1135	541.5054	304.2986	128.5130	0.0000	0.0000	0.0000	0.0000	321.7234	585.6902	824.8609	(98)
												4163.0614	(98)
												44.9866	(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													4457.2392 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	811.3563	645.1135	541.5054	304.2986	128.5130	0.0000	0.0000	0.0000	0.0000	321.7234	585.6902	824.8609	(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)	868.6899	690.6997	579.7702	325.8015	137.5942	0.0000	0.0000	0.0000	0.0000	344.4576	627.0773	883.1488	(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	88.1231	87.9359	87.4980	86.4724	84.4077	80.3000	80.3000	80.3000	80.3000	86.4923	87.6884	88.1940	(216)
Fuel for water heating, kWh/month	238.0325	210.2864	221.6303	198.9065	197.2871	182.6481	174.9908	195.0737	197.2281	208.5047	217.7446	232.1595	(219)
Water heating fuel used												2474.4922	(219)
Annual totals kWh/year													
Space heating fuel - main system												4457.2392	(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												7405.5046	(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	4457.2392	0.2160	962.7637 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2474.4922	0.2160	534.4903 (264)
Space and water heating			1497.2540 (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			1743.1423 (272)
Emissions per m2 for space and water heating			16.1795 (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) = (16.1795 * 1.00) + 2.2365 + 0.4206, rounded to 2 d.p.			18.8400 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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					4.9700
Infiltration rate					0.3839 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3839 (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	0.4895	0.4799	0.4703	0.4223	0.4127	0.3647	0.3647	0.3551	0.3839	0.4127	0.4319	0.4511 (22b)
Effective ac	0.6198	0.6151	0.6106	0.5892	0.5852	0.5665	0.5665	0.5631	0.5737	0.5852	0.5933	0.6017 (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)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (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)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.3418		(33)
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 1			45.7700			9.0000	411.9300 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 14627.6120 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 158.0680 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.1836 (36)
Total fabric heat loss (33) + (36) = 74.5254 (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	45.3140	44.9739	44.6406	43.0747	42.7818	41.4180	41.4180	41.1654	41.9433	42.7818	43.3744	43.9940 (38)
Heat transfer coeff	119.8394	119.4993	119.1659	117.6001	117.3071	115.9433	115.9433	115.6908	116.4686	117.3071	117.8998	118.5194 (39)
Average = Sum(39)m / 12 =												117.5987 (39)
HLP	1.2950	1.2913	1.2877	1.2708	1.2676	1.2529	1.2529	1.2502	1.2586	1.2676	1.2740	1.2807 (40)
HLP (average)												1.2708 (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 FABRIC ENERGY EFFICIENCY 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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.7456	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		0.7100		0.7000		0.7700		32.6050 (76)
Southwest				0.6800	36.7938		0.7100		0.7000		0.7700		8.6173 (79)
West				5.7600	19.6403		0.7100		0.7000		0.7700		38.9636 (80)
Northwest				0.6800	11.2829		0.7100		0.7000		0.7700		2.6425 (81)
East				3.1500	19.6403		0.7100		0.7000		0.7700		21.3082 (76)
Solar gains	104.1367	201.7443	328.9873	477.1838	584.0710	597.9468	569.2258	489.1712	381.5517	238.3831	129.4531	85.9101	(83)
Total gains	478.6314	574.8057	688.9471	815.5589	899.5708	892.2062	850.2088	774.1895	678.1223	556.6806	472.7336	448.8497	(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	33.9056	34.0021	34.0972	34.5512	34.6375	35.0449	35.0449	35.1214	34.8869	34.6375	34.4634	34.2832
alpha	3.2604	3.2668	3.2731	3.3034	3.3092	3.3363	3.3363	3.3414	3.3258	3.3092	3.2976	3.2855
util living area	0.9928	0.9864	0.9698	0.9253	0.8358	0.6941	0.5510	0.6110	0.8294	0.9580	0.9881	0.9942 (86)
MIT	18.8948	19.1264	19.5354	20.0725	20.5291	20.8289	20.9419	20.9175	20.6642	20.0463	19.3753	18.8614 (87)
Th 2	19.8448	19.8476	19.8505	19.8638	19.8663	19.8779	19.8779	19.8801	19.8734	19.8663	19.8612	19.8560 (88)
util rest of house	0.9911	0.9832	0.9623	0.9060	0.7915	0.6098	0.4296	0.4902	0.7656	0.9436	0.9848	0.9928 (89)
MIT 2	17.9294	18.1617	18.5681	19.0999	19.5246	19.7833	19.8573	19.8479	19.6601	19.0861	18.4205	17.9042 (90)
Living area fraction									fLA =	Living area / (4) =		0.1961 (91)
MIT	18.1187	18.3509	18.7578	19.2906	19.7217	19.9884	20.0700	20.0576	19.8570	19.2744	18.6078	18.0919 (92)
Temperature adjustment												0.0000
adjusted MIT	18.1187	18.3509	18.7578	19.2906	19.7217	19.9884	20.0700	20.0576	19.8570	19.2744	18.6078	18.0919 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9875	0.9774	0.9530	0.8939	0.7849	0.6190	0.4518	0.5111	0.7645	0.9335	0.9796	0.9898 (94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1656.0301	1607.3704	1460.7159	1221.9388	940.9973	624.7482	402.3289	423.1559	670.5117	1017.5721	1356.7651	1646.4604 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	880.4316	702.6169	598.3092	354.8859	174.7736	0.0000	0.0000	0.0000	0.0000	370.4386	643.4321	894.4310 (98)
Space heating												4619.3189 (98)
Space heating per m2										(98) / (4) =		49.9170 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	1089.8673	857.9807	879.2499	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7876	0.8524	0.8184	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	858.4035	731.3473	719.5830	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1143.8376	1092.6370	1005.6436	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	205.5125	268.7995	212.8290	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction									fC = cooled area / (4) =			687.1410	(104)
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	(105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	51.3781	67.1999	53.2073	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling													
Space cooling per m2													(107)
Energy for space heating													171.7853 (107)
Energy for space cooling													49.9170 (99)
Total													1.8563 (108)
Dwelling Fabric Energy Efficiency (DFEE)													51.7733 (109)
													51.8 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3854 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3854 (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	0.4914	0.4818	0.4721	0.4240	0.4143	0.3661	0.3661	0.3565	0.3854	0.4143	0.4336	0.4529 (22b)
Effective ac	0.6207	0.6160	0.6115	0.5899	0.5858	0.5670	0.5670	0.5635	0.5743	0.5858	0.5940	0.6025 (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 Semi-glazed door			1.8900	1.2000	2.2680		(26a)
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	134.7300	18.9400	115.7900	0.1800	20.8422		(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)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.2374		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.3958 (36)
Total fabric heat loss						(33) + (36) =	68.6332 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	45.3826	45.0398	44.7039	43.1258	42.8305	41.4560	41.4560	41.2015	41.9855	42.8305	43.4278	44.0523 (38)
Heat transfer coeff	114.0158	113.6730	113.3370	111.7590	111.4637	110.0892	110.0892	109.8347	110.6187	111.4637	112.0610	112.6854 (39)
Average = Sum(39)m / 12 =												111.7575 (39)
HLP	1.2321	1.2284	1.2247	1.2077	1.2045	1.1896	1.1896	1.1869	1.1954	1.2045	1.2109	1.2177 (40)
HLP (average)												1.2077 (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	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												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	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	Specific data g 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, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	56.3640	56.5340	56.7016	57.5022	57.6545	58.3744	58.3744	58.5096	58.0950	57.6545	57.3472	57.0294
alpha	4.7576	4.7689	4.7801	4.8335	4.8436	4.8916	4.8916	4.9006	4.8730	4.8436	4.8231	4.8020
util living area	0.9991	0.9977	0.9927	0.9717	0.9053	0.7589	0.5927	0.6603	0.8962	0.9876	0.9981	0.9993 (86)
MIT	19.5625	19.7199	20.0025	20.3853	20.7168	20.9208	20.9814	20.9693	20.8046	20.3609	19.8955	19.5421 (87)
Th 2	19.8944	19.8974	19.9003	19.9139	19.9164	19.9283	19.9283	19.9305	19.9237	19.9164	19.9113	19.9059 (88)
util rest of house	0.9987	0.9969	0.9899	0.9601	0.8653	0.6664	0.4601	0.5269	0.8356	0.9808	0.9972	0.9991 (89)
MIT 2	18.5828	18.7422	19.0257	19.4122	19.7211	19.8911	19.9235	19.9215	19.8095	19.3951	18.9288	18.5715 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.7750	18.9340	19.2173	19.6031	19.9164	20.0930	20.1310	20.1270	20.0046	19.5845	19.1184	18.7618 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7750	18.9340	19.2173	19.6031	19.9164	20.0930	20.1310	20.1270	20.0046	19.5845	19.1184	18.7618 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	466.0732	549.7791	643.7507	728.1262	721.4707	562.6105	382.3537	397.7921	534.2276	518.1125	456.4779	438.5960 (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	1650.3752	1595.2869	1441.3421	1196.1626	915.8295	604.7252	388.7263	409.3580	653.1630	1001.4472	1346.7982	1640.9075 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	881.1207	702.5813	593.4080	336.9862	144.6029	0.0000	0.0000	0.0000	0.0000	359.6011	641.0307	894.5198 (98)
Space heating												4553.8505 (98)
Space heating per m2										(98) / (4) =		49.2095 (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	1034.8387	814.6603	834.7437	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8420	0.9080	0.8762	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	871.3353	739.7340	731.4398	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)

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Calculation Type: New Build (As Built)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	139.5022	206.7846	156.0765	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												502.3634 (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	34.8756	51.6962	39.0191	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling												125.5909 (107)
Space cooling per m2												1.3572 (108)
Energy for space heating												49.2095 (99)
Energy for space cooling												1.3572 (108)
Total												50.5667 (109)
Target Fabric Energy Efficiency (TFEE)												58.2 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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																	4.9700
Infiltration rate																	0.4290 (18)
Number of sides sheltered																	0 (19)
Shelter factor										(20) = 1 - [0.075 x (19)] =							1.0000 (20)
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =							0.4290 (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)				
	0.4505	0.4183	0.4290	0.4076	0.4076	0.3969	0.3861	0.3754	0.3647	0.3969	0.3754	0.3969	(22b)				
Effective ac	0.6015	0.5875	0.5920	0.5831	0.5831	0.5788	0.5746	0.5705	0.5665	0.5788	0.5705	0.5788	(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)					
Half Glazed Door			1.8900	1.3000	2.4570			(26a)					
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120	(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)			228.2800					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418			(33)					
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 1			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15039.5420	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							162.5194	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836	(36)					
Total fabric heat loss						(33) + (36) =	74.5254	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.9744	42.9524	43.2847	42.6286	42.6286	42.3131	42.0061	41.7075	41.4173	42.3131	41.7075	42.3131	(38)
Heat transfer coeff	118.4998	117.4778	117.8100	117.1539	117.1539	116.8385	116.5315	116.2329	115.9427	116.8385	116.2329	116.8385	(39)
Average = Sum(39)m / 12 =												116.9626	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2805	1.2695	1.2731	1.2660	1.2660	1.2626	1.2593	1.2560	1.2529	1.2626	1.2560	1.2626	(40)
HLP (average)												1.2639	(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 HEAT DEMAND 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)
RHI water heating demand												
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)
												1778 (64)
												1777.7885 (64)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts												
(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	Solar flux	g	FF	Access	Gains
		m2	Table 6a	W/m2	Specific data	factor	W
				or Table 6b	Specific data	Table 6d	
East		4.8200	25.1925	0.7100	0.7000	0.7700	41.8224 (76)
Southwest		0.6800	45.1778	0.7100	0.7000	0.7700	10.5809 (79)
West		5.7600	25.1925	0.7100	0.7000	0.7700	49.9786 (80)
Northwest		0.6800	14.6176	0.7100	0.7000	0.7700	3.4235 (81)
East		3.1500	25.1925	0.7100	0.7000	0.7700	27.3320 (76)

Solar gains	133.1375	219.5422	360.2956	524.0978	608.1362	675.6123	638.3866	563.2690	440.7991	279.7715	164.9897	107.9449 (83)
Total gains	741.1133	822.7244	939.9179	1067.1918	1113.7374	1147.7722	1091.1215	1024.8860	923.5484	799.2714	725.2862	699.1960 (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	35.2545	35.5612	35.4609	35.6595	35.6595	35.7558	35.8500	35.9421	36.0320	35.7558	35.9421	35.7558
alpha	3.3503	3.3707	3.3641	3.3773	3.3773	3.3837	3.3900	3.3961	3.4021	3.3837	3.3961	3.3837
util living area	0.9738	0.9625	0.9290	0.8520	0.7266	0.5377	0.4038	0.4264	0.6753	0.8820	0.9561	0.9772 (86)
MIT	19.3889	19.5664	19.9438	20.4029	20.7457	20.9334	20.9810	20.9777	20.8540	20.4315	19.8669	19.3818 (87)
Th 2	19.8561	19.8648	19.8620	19.8676	19.8676	19.8703	19.8729	19.8754	19.8779	19.8703	19.8754	19.8703 (88)
util rest of house	0.9679	0.9541	0.9130	0.8187	0.6653	0.4459	0.2928	0.3105	0.5882	0.8465	0.9445	0.9720 (89)
MIT 2	17.7573	18.0175	18.5523	19.1870	19.6237	19.8259	19.8655	19.8667	19.7635	19.2446	18.4606	17.7566 (90)
Living area fraction	18.0773	18.3213	18.8252	19.4254	19.8438	20.0431	20.0843	20.0846	19.9774	19.4774	18.7364	18.0753 (91)
MIT	18.0773	18.3213	18.8252	19.4254	19.8438	20.0431	20.0843	20.0846	19.9774	19.4774	18.7364	18.0753 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9273	18.1713	18.6752	19.2754	19.6938	19.8931	19.9343	19.9346	19.8274	19.3274	18.5864	17.9253 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9536	0.9370	0.8914	0.7980	0.6548	0.4478	0.2990	0.3168	0.5839	0.8251	0.9261	0.9589 (94)
Ext temp.	706.7307	770.8865	837.8657	851.5951	729.3183	514.0271	326.2543	324.7006	539.2142	659.5066	671.7043	670.4829 (95)
Heat loss rate W	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)
Month fracti	1543.7346	1512.0900	1375.4593	1145.2316	842.7815	536.6511	330.2837	329.4709	594.4855	926.2246	1242.1165	1510.1759 (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)
	622.7309	498.0888	399.9697	211.4183	84.4166	0.0000	0.0000	0.0000	0.0000	198.4381	410.6968	624.7315 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating	3050.4907 (98)
RHI space heating demand	3050 (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 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					4.9700
Infiltration rate					0.4290 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.4290 (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												
Effective ac	0.5470	0.5363	0.5256	0.4720	0.4612	0.4076	0.4076	0.3969	0.4290	0.4612	0.4827	0.5041 (22b)
	0.6496	0.6438	0.6381	0.6114	0.6064	0.5831	0.5831	0.5788	0.5920	0.6064	0.6165	0.6271 (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)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (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)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418		(33)
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 1			45.7700			18.0000	823.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15039.5420 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 162.5194 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.1836 (36)
Total fabric heat loss (33) + (36) = 74.5254 (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	47.4946	47.0698	46.6535	44.6978	44.3319	42.6286	42.6286	42.3131	43.2847	44.3319	45.0721	45.8460 (38)
Heat transfer coeff	122.0200	121.5952	121.1788	119.2232	118.8573	117.1539	117.1539	116.8385	117.8100	118.8573	119.5975	120.3713 (39)
Average = Sum(39)m / 12 =												119.2214 (39)
HLP	1.3186	1.3140	1.3095	1.2883	1.2844	1.2660	1.2660	1.2626	1.2731	1.2844	1.2924	1.3007 (40)
HLP (average)												1.2883 (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)
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	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	0.7100	0.7000			0.7700			32.6050 (76)		
Southwest					0.6800	36.7938	0.7100	0.7000			0.7700			8.6173 (79)		
West					5.7600	19.6403	0.7100	0.7000			0.7700			38.9636 (80)		
Northwest					0.6800	11.2829	0.7100	0.7000			0.7700			2.6425 (81)		
East					3.1500	19.6403	0.7100	0.7000			0.7700			21.3082 (76)		
Solar gains					104.1367	201.7443	328.9873	477.1838	584.0710	597.9468	569.2258	489.1712	381.5517	238.3831	129.4531	85.9101 (83)
Total gains					712.1125	804.9264	908.6096	1020.2778	1089.6722	1070.1067	1021.9608	950.7883	864.3009	757.8831	689.7496	677.1612 (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	34.2374	34.3570	34.4751	35.0406	35.1485	35.6595	35.6595	35.7558	35.4609	35.1485	34.9309	34.7064
alpha	3.2825	3.2905	3.2983	3.3360	3.3432	3.3773	3.3773	3.3837	3.3641	3.3432	3.3287	3.3138
util living area	0.9791	0.9677	0.9417	0.8814	0.7752	0.6207	0.4783	0.5264	0.7467	0.9144	0.9680	0.9821 (86)
MIT	19.1959	19.4118	19.7841	20.2634	20.6463	20.8834	20.9637	20.9496	20.7720	20.2630	19.6527	19.1655 (87)
Th 2	19.8263	19.8299	19.8334	19.8500	19.8531	19.8676	19.8676	19.8703	19.8620	19.8531	19.8468	19.8402 (88)
util rest of house	0.9745	0.9605	0.9284	0.8538	0.7227	0.5349	0.3660	0.4124	0.6706	0.8883	0.9596	0.9781 (89)
MIT 2	17.4597	17.7731	18.3080	18.9874	19.4923	19.7783	19.8500	19.8436	19.6643	19.0052	18.1357	17.4244 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	17.8003	18.0945	18.5975	19.2377	19.7186	19.9950	20.0684	20.0606	19.8815	19.2519	18.4332	17.7659 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6503	17.9445	18.4475	19.0877	19.5686	19.8450	19.9184	19.9106	19.7315	19.1019	18.2832	17.6159 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9617	0.9441	0.9074	0.8314	0.7078	0.5330	0.3713	0.4168	0.6606	0.8661	0.9433	0.9666 (94)
Ext temp.	684.8199	759.9301	824.4617	848.2560	771.3192	570.4086	379.4216	396.2584	570.9492	656.3656	650.6738	654.5569 (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	1628.9981	1586.1464	1447.7869	1214.6084	935.2439	614.4762	388.7658	410.1687	663.4506	1010.5149	1337.4828	1614.8905 (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	702.4686	555.2174	463.7540	263.7737	121.9600	0.0000	0.0000	0.0000	0.0000	263.4871	494.5025	714.4882 (98)
												3579.6514 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating per m2 (98) / (4) = 38.6822 (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													3977.3905 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	702.4686	555.2174	463.7540	263.7737	121.9600	0.0000	0.0000	0.0000	0.0000	263.4871	494.5025	714.4882	(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)	780.5206	616.9082	515.2822	293.0819	135.5111	0.0000	0.0000	0.0000	0.0000	292.7635	549.4472	793.8758	(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	89.3071	89.2479	89.1127	88.8002	88.2015	86.7000	86.7000	86.7000	86.7000	88.7709	89.1628	86.7000	(216)
Fuel for water heating, kWh/month	201.3828	176.9005	184.3704	163.4803	159.5543	142.5096	134.4811	150.8755	151.6607	169.7154	181.6198	195.6943	(219)
Water heating fuel used												2012.2448	(219)
Annual totals kWh/year													
Space heating fuel - main system												3977.3905	(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 * 853 * 1.00) =										-552.7634		-552.7634	(233)
Total delivered energy for all uses												5910.6451	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3977.3905	3.4800	138.4132 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2012.2448	3.4800	70.0261 (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	-552.7634	13.1900	-72.9095 (252)
Total energy cost			318.0205 (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] =	0.9711 (257)
SAP value		86.4528
SAP rating (Section 12)		86 (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	3977.3905	0.2160	859.1163 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2012.2448	0.2160	434.6449 (264)
Space and water heating			1293.7612 (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	-552.7634	0.5190	-286.8842 (269)
Total kg/year			1252.7653 (272)
CO2 emissions per m2			13.5400 (273)
EI value			87.7948
EI rating			88 (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
Main heating environmental impact
Water heating energy efficiency
Water heating environmental impact

$3.48 \times (1 + 0.29 \times 0.00) / 0.9000 = 3.867$, stars = 4
 $0.216 \times (1 + 0.29 \times 0.00) / 0.9000 = 0.2400$, stars = 4
 $3.48 / 0.8823 = 3.944$, stars = 4
 $0.216 / 0.8823 = 0.2448$, 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	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																	4.9700
Infiltration rate																	0.4290 (18)
Number of sides sheltered																	0 (19)
Shelter factor										(20) = 1 - [0.075 x (19)] =							1.0000 (20)
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =							0.4290 (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)				
	0.4505	0.4183	0.4290	0.4076	0.4076	0.3969	0.3861	0.3754	0.3647	0.3969	0.3754	0.3969	(22b)				
Effective ac	0.6015	0.5875	0.5920	0.5831	0.5831	0.5788	0.5746	0.5705	0.5665	0.5788	0.5705	0.5788	(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)					
Half Glazed Door			1.8900	1.3000	2.4570			(26a)					
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120	(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)			228.2800					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418			(33)					
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 1			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15039.5420	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							162.5194	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836	(36)					
Total fabric heat loss						(33) + (36) =	74.5254	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.9744	42.9524	43.2847	42.6286	42.6286	42.3131	42.0061	41.7075	41.4173	42.3131	41.7075	42.3131	(38)
Heat transfer coeff	118.4998	117.4778	117.8100	117.1539	117.1539	116.8385	116.5315	116.2329	115.9427	116.8385	116.2329	116.8385	(39)
Average = Sum(39)m / 12 =												116.9626	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2805	1.2695	1.2731	1.2660	1.2660	1.2626	1.2593	1.2560	1.2529	1.2626	1.2560	1.2626	(40)
HLP (average)												1.2639	(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)
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	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	0.7100	0.7000	0.7700	41.8224 (76)		
Southwest					0.6800	45.1778	0.7100	0.7000	0.7700	10.5809 (79)		
West					5.7600	25.1925	0.7100	0.7000	0.7700	49.9786 (80)		
Northwest					0.6800	14.6176	0.7100	0.7000	0.7700	3.4235 (81)		
East					3.1500	25.1925	0.7100	0.7000	0.7700	27.3320 (76)		

Solar gains	133.1375	219.5422	360.2956	524.0978	608.1362	675.6123	638.3866	563.2690	440.7991	279.7715	164.9897	107.9449 (83)
Total gains	741.1133	822.7244	939.9179	1067.1918	1113.7374	1147.7722	1091.1215	1024.8860	923.5484	799.2714	725.2862	699.1960 (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	35.2545	35.5612	35.4609	35.6595	35.6595	35.7558	35.8500	35.9421	36.0320	35.7558	35.9421	35.7558
alpha	3.3503	3.3707	3.3641	3.3773	3.3773	3.3837	3.3900	3.3961	3.4021	3.3837	3.3961	3.3837
util living area	0.9738	0.9625	0.9290	0.8520	0.7266	0.5377	0.4038	0.4264	0.6753	0.8820	0.9561	0.9772 (86)
MIT	19.3889	19.5664	19.9438	20.4029	20.7457	20.9334	20.9810	20.9777	20.8540	20.4315	19.8669	19.3818 (87)
Th 2	19.8561	19.8648	19.8620	19.8676	19.8676	19.8703	19.8729	19.8754	19.8779	19.8703	19.8754	19.8703 (88)
util rest of house	0.9679	0.9541	0.9130	0.8187	0.6653	0.4459	0.2928	0.3105	0.5882	0.8465	0.9445	0.9720 (89)
MIT 2	17.7573	18.0175	18.5523	19.1870	19.6237	19.8259	19.8655	19.8667	19.7635	19.2446	18.4606	17.7566 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.0773	18.3213	18.8252	19.4254	19.8438	20.0431	20.0843	20.0846	19.9774	19.4774	18.7364	18.0753 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9273	18.1713	18.6752	19.2754	19.6938	19.8931	19.9343	19.9346	19.8274	19.3274	18.5864	17.9253 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	9536	0.9370	0.8914	0.7980	0.6548	0.4478	0.2990	0.3168	0.5839	0.8251	0.9261	0.9589 (94)
Useful gains	706.7307	770.8865	837.8657	851.5951	729.3183	514.0271	326.2543	324.7006	539.2142	659.5066	671.7043	670.4829 (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	1543.7346	1512.0900	1375.4593	1145.2316	842.7815	536.6511	330.2837	329.4709	594.4855	926.2246	1242.1165	1510.1759 (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	622.7309	498.0888	399.9697	211.4183	84.4166	0.0000	0.0000	0.0000	0.0000	198.4381	410.6968	624.7315 (98)
Space heating												3050.4907 (98)

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Space heating per m2 (98) / (4) = 32.9640 (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												3389.4341	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	622.7309	498.0888	399.9697	211.4183	84.4166	0.0000	0.0000	0.0000	0.0000	198.4381	410.6968	624.7315	(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)	691.9232	553.4320	444.4107	234.9092	93.7962	0.0000	0.0000	0.0000	0.0000	220.4868	456.3298	694.1462	(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	89.2389	89.1830	89.0135	88.6267	87.9086	86.7000	86.7000	86.7000	86.7000	88.5455	89.0416	86.7000	(216)
Fuel for water heating, kWh/month	201.5368	177.0293	184.5759	163.8003	160.0860	142.5096	134.4811	150.8755	151.6607	170.1473	181.8671	195.8574	(219)
Water heating fuel used												2014.4270	(219)
Annual totals kWh/year													
Space heating fuel - main system												3389.4341	(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 * 967 * 1.00) =										-626.4799		-626.4799	(233)
Total delivered energy for all uses												5251.1545	(238)

10a. Fuel costs - using BEDF prices (450)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3389.4341	3.9300	133.2048	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2014.4270	3.9300	79.1670	(247)
Pumps and fans for heating	75.0000	17.5600	13.1700	(249)
Energy for lighting	398.7732	17.5600	70.0246	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-626.4799	17.5600	-110.0099	(252)
Total energy cost			273.5565	(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	3389.4341	0.2160	732.1178	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2014.4270	0.2160	435.1162	(264)
Space and water heating			1167.2340	(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	-626.4799	0.5190	-325.1430	(269)
Total kg/year			1087.9793	(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	3389.4341	1.2200	4135.1096	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2014.4270	1.2200	2457.6010	(264)
Space and water heating			6592.7106	(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	-626.4799	3.0700	-1923.2932 (269)
Primary energy kWh/year			6123.9012 (272)
Primary energy kWh/m2/year			66.1757 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 86
Current environmental impact rating:	B 88

(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	-£ 31	-195 kg (17.9%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£31 2.11 kg/m²	B 88	B 90
Total Savings	£31 2.11 kg/m²		

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

Fuel prices for cost data on this page from database revision number 450 TEST (30 Oct 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£83	£92	-£9
Mains gas	£300	£260	£40
Space heating	£234	£234	£0
Water heating	£79	£48	£31
Lighting	£70	£70	£0
Generated (PV)	-£110	-£110	£0
Total cost of fuels	£273	£242	£31
Total cost of uses	£273	£242	£31
Delivered energy	57 kWh/m²	46 kWh/m²	11 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.9 tonnes	0.2 tonnes
CO2 emissions per m²	12 kg/m²	10 kg/m²	2 kg/m²
Primary energy	66 kWh/m²	54 kWh/m²	12 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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					4.9700
Infiltration rate					0.4290 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.4290 (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												
Effective ac	0.5470	0.5363	0.5256	0.4720	0.4612	0.4076	0.4076	0.3969	0.4290	0.4612	0.4827	0.5041 (22b)
	0.6496	0.6438	0.6381	0.6114	0.6064	0.5831	0.5831	0.5788	0.5920	0.6064	0.6165	0.6271 (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)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (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)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418		(33)
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 1			45.7700			18.0000	823.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15039.5420 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 162.5194 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.1836 (36)
Total fabric heat loss (33) + (36) = 74.5254 (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	47.4946	47.0698	46.6535	44.6978	44.3319	42.6286	42.6286	42.3131	43.2847	44.3319	45.0721	45.8460 (38)
Heat transfer coeff	122.0200	121.5952	121.1788	119.2232	118.8573	117.1539	117.1539	116.8385	117.8100	118.8573	119.5975	120.3713 (39)
Average = Sum(39)m / 12 =												119.2214 (39)
HLP	1.3186	1.3140	1.3095	1.2883	1.2844	1.2660	1.2660	1.2626	1.2731	1.2844	1.2924	1.3007 (40)
HLP (average)												1.2883 (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 ENERGY RATINGS 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												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		0.7100		0.7000		0.7700		32.6050 (76)
Southwest				0.6800	36.7938		0.7100		0.7000		0.7700		8.6173 (79)
West				5.7600	19.6403		0.7100		0.7000		0.7700		38.9636 (80)
Northwest				0.6800	11.2829		0.7100		0.7000		0.7700		2.6425 (81)
East				3.1500	19.6403		0.7100		0.7000		0.7700		21.3082 (76)

Solar gains	104.1367	201.7443	328.9873	477.1838	584.0710	597.9468	569.2258	489.1712	381.5517	238.3831	129.4531		85.9101 (83)
Total gains	712.1125	804.9264	908.6096	1020.2778	1089.6722	1070.1067	1021.9608	950.7883	864.3009	757.8831	689.7496		677.1612 (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	34.2374	34.3570	34.4751	35.0406	35.1485	35.6595	35.6595	35.7558	35.4609	35.1485	34.9309	34.7064
alpha	3.2825	3.2905	3.2983	3.3360	3.3432	3.3773	3.3773	3.3837	3.3641	3.3432	3.3287	3.3138
util living area	0.9791	0.9677	0.9417	0.8814	0.7752	0.6207	0.4783	0.5264	0.7467	0.9144	0.9680	0.9821 (86)
MIT	19.1959	19.4118	19.7841	20.2634	20.6463	20.8834	20.9637	20.9496	20.7720	20.2630	19.6527	19.1655 (87)
Th 2	19.8263	19.8299	19.8334	19.8500	19.8531	19.8676	19.8676	19.8703	19.8620	19.8531	19.8468	19.8402 (88)
util rest of house	0.9745	0.9605	0.9284	0.8538	0.7227	0.5349	0.3660	0.4124	0.6706	0.8883	0.9596	0.9781 (89)
MIT 2	17.4597	17.7731	18.3080	18.9874	19.4923	19.7783	19.8500	19.8436	19.6643	19.0052	18.1357	17.4244 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	17.8003	18.0945	18.5975	19.2377	19.7186	19.9950	20.0684	20.0606	19.8815	19.2519	18.4332	17.7659 (92)

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Temperature adjustment													-0.1500
adjusted MIT	17.6503	17.9445	18.4475	19.0877	19.5686	19.8450	19.9184	19.9106	19.7315	19.1019	18.2832		17.6159 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9617	0.9441	0.9074	0.8314	0.7078	0.5330	0.3713	0.4168	0.6606	0.8661	0.9433	0.9666	(94)
Useful gains	684.8199	759.9301	824.4617	848.2560	771.3192	570.4086	379.4216	396.2584	570.9492	656.3656	650.6738	654.5569	(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													
	1628.9981	1586.1464	1447.7869	1214.6084	935.2439	614.4762	388.7658	410.1687	663.4506	1010.5149	1337.4828	1614.8905	(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													
	702.4686	555.2174	463.7540	263.7737	121.9600	0.0000	0.0000	0.0000	0.0000	263.4871	494.5025	714.4882	(98)
Space heating													
Space heating per m2													(98) / (4) = 38.6822 (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													3977.3905 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	702.4686	555.2174	463.7540	263.7737	121.9600	0.0000	0.0000	0.0000	0.0000	263.4871	494.5025	714.4882	(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)	780.5206	616.9082	515.2822	293.0819	135.5111	0.0000	0.0000	0.0000	0.0000	292.7635	549.4472	793.8758	(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	89.3855	89.4111	89.4301	89.4577	89.4574	86.7000	86.7000	86.7000	86.7000	89.0853	89.2828	86.7000	(216)
Fuel for water heating, kWh/month	173.2437	129.9296	104.2860	55.8597	25.8421	9.1406	2.8745	35.8902	61.6042	109.2650	148.1701	172.1544	(219)
Water heating fuel used													1028.2602 (219)
Annual totals kWh/year													
Space heating fuel - main system													3977.3905 (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 * 853 * 1.00) =										-552.7634			-552.7634 (233)
Total delivered energy for all uses													4976.6605 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3977.3905	3.4800	138.4132	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1028.2602	3.4800	35.7835	(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	-552.7634	13.1900	-72.9095	(252)
Total energy cost			290.3728	(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] =	0.8867 (257)
SAP value			87.6305
SAP rating (Section 12)			88 (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	3977.3905	0.2160	859.1163 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1028.2602	0.2160	222.1042 (264)
Space and water heating			1081.2205 (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	-552.7634	0.5190	-286.8842 (269)
Total kg/year			1066.1746 (272)
CO2 emissions per m2			11.5200 (273)
EI value			89.6127
EI rating			90 (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 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											4.9700	
Infiltration rate											0.4290 (18)	
Number of sides sheltered											0 (19)	
Shelter factor											(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =	0.4290 (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)
	0.4505	0.4183	0.4290	0.4076	0.4076	0.3969	0.3861	0.3754	0.3647	0.3969	0.3754	0.3969 (22b)
Effective ac	0.6015	0.5875	0.5920	0.5831	0.5831	0.5788	0.5746	0.5705	0.5665	0.5788	0.5705	0.5788 (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)					
Half Glazed Door			1.8900	1.3000	2.4570			(26a)					
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120	(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)			228.2800					(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.3418			(33)					
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 1			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		15039.5420	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							162.5194	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836	(36)					
Total fabric heat loss						(33) + (36) =	74.5254	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 43.9744	Feb 42.9524	Mar 43.2847	Apr 42.6286	May 42.6286	Jun 42.3131	Jul 42.0061	Aug 41.7075	Sep 41.4173	Oct 42.3131	Nov 41.7075	Dec 42.3131	(38)
Heat transfer coeff	118.4998	117.4778	117.8100	117.1539	117.1539	116.8385	116.5315	116.2329	115.9427	116.8385	116.2329	116.8385	(39)
Average = Sum(39)m / 12 =												116.9626	(39)
HLP	Jan 1.2805	Feb 1.2695	Mar 1.2731	Apr 1.2660	May 1.2660	Jun 1.2626	Jul 1.2593	Aug 1.2560	Sep 1.2529	Oct 1.2626	Nov 1.2560	Dec 1.2626	(40)
HLP (average)												1.2639	(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 content	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)	

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)

[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	0.7100	0.7000	0.7700	41.8224 (76)
Southwest	0.6800	45.1778	0.7100	0.7000	0.7700	10.5809 (79)
West	5.7600	25.1925	0.7100	0.7000	0.7700	49.9786 (80)
Northwest	0.6800	14.6176	0.7100	0.7000	0.7700	3.4235 (81)
East	3.1500	25.1925	0.7100	0.7000	0.7700	27.3320 (76)

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	35.2545	35.5612	35.4609	35.6595	35.6595	35.7558	35.8500	35.9421	36.0320	35.7558	35.9421	35.7558
alpha	3.3503	3.3707	3.3641	3.3773	3.3773	3.3837	3.3900	3.3961	3.4021	3.3837	3.3961	3.3837
util living area	0.9738	0.9625	0.9290	0.8520	0.7266	0.5377	0.4038	0.4264	0.6753	0.8820	0.9561	0.9772 (86)
MIT	19.3889	19.5664	19.9438	20.4029	20.7457	20.9334	20.9810	20.9777	20.8540	20.4315	19.8669	19.3818 (87)
Th 2	19.8561	19.8648	19.8620	19.8676	19.8676	19.8703	19.8729	19.8754	19.8779	19.8703	19.8754	19.8703 (88)
util rest of house	0.9679	0.9541	0.9130	0.8187	0.6653	0.4459	0.2928	0.3105	0.5882	0.8465	0.9445	0.9720 (89)
MIT 2	17.7573	18.0175	18.5523	19.1870	19.6237	19.8259	19.8655	19.8667	19.7635	19.2446	18.4606	17.7566 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.0773	18.3213	18.8252	19.4254	19.8438	20.0431	20.0843	20.0846	19.9774	19.4774	18.7364	18.0753 (92)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Temperature adjustment													-0.1500
adjusted MIT	17.9273	18.1713	18.6752	19.2754	19.6938	19.8931	19.9343	19.9346	19.8274	19.3274	18.5864	17.9253	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9536	0.9370	0.8914	0.7980	0.6548	0.4478	0.2990	0.3168	0.5839	0.8251	0.9261	0.9589	(94)
Useful gains	706.7307	770.8865	837.8657	851.5951	729.3183	514.0271	326.2543	324.7006	539.2142	659.5066	671.7043	670.4829	(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	1543.7346	1512.0900	1375.4593	1145.2316	842.7815	536.6511	330.2837	329.4709	594.4855	926.2246	1242.1165	1510.1759	(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	622.7309	498.0888	399.9697	211.4183	84.4166	0.0000	0.0000	0.0000	0.0000	198.4381	410.6968	624.7315	(98)
Space heating												3050.4907	(98)
Space heating per m2											(98) / (4) =	32.9640	(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													3389.4341	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	622.7309	498.0888	399.9697	211.4183	84.4166	0.0000	0.0000	0.0000	0.0000	198.4381	410.6968	624.7315	(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)	691.9232	553.4320	444.4107	234.9092	93.7962	0.0000	0.0000	0.0000	0.0000	220.4868	456.3298	694.1462	(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	89.3378	89.3562	89.3592	89.3625	89.1663	86.7000	86.7000	86.7000	86.7000	88.9177	89.1964	89.3389	(216)	
Fuel for water heating, kWh/month	168.5867	130.1601	103.8972	54.5648	30.8297	2.9966	0.0000	28.6331	55.9534	104.9166	142.7826	168.7676	(219)	
Water heating fuel used												992.0883	(219)	
Annual totals kWh/year														
Space heating fuel - main system												3389.4341	(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 * 967 * 1.00) =										-626.4799		-626.4799	(233)	
Total delivered energy for all uses												4278.8158	(238)	

10a. Fuel costs - using BEDF prices (450)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3389.4341	3.9300	133.2048	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	992.0883	3.9300	38.9891	(247)
Pumps and fans for heating	75.0000	17.5600	13.1700	(249)
Pump for solar water heating	50.0000	17.5600	8.7800	(249)
Energy for lighting	398.7732	17.5600	70.0246	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-626.4799	17.5600	-110.0099	(252)
Total energy cost			242.1585	(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	3389.4341	0.2160	732.1178	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	992.0883	0.2160	214.2911	(264)
Space and water heating			946.4088	(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	-626.4799	0.5190	-325.1430 (269)
Total kg/year			893.1041 (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	3389.4341	1.2200	4135.1096 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	992.0883	1.2200	1210.3477 (264)
Space and water heating			5345.4573 (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	-626.4799	3.0700	-1923.2932 (269)
Primary energy kWh/year			5030.1480 (272)
Primary energy kWh/m2/year			54.3565 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached 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	162.5 (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	74.53 (37)
Summer heat loss coefficient	366.97 (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	0.7100	0.7000	0.9000	243.0952
South West	0.6800	127.3119	0.7100	0.7000	0.9000	34.8513
West	5.7600	125.2818	0.7100	0.7000	0.9000	290.5038
North West	0.6800	106.0502	0.7100	0.7000	0.9000	29.0310
East	3.1500	125.2818	0.7100	0.7000	0.9000	158.8693

total: 756.3506

	Jun	Jul	Aug	
Solar gains	814	756	665	(P3)
Internal gains	469	450	459	
Total summer gains	1283	1206	1124	(P5)
Summer gain/loss ratio	3.50	3.29	3.06	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 162.5)	0.86	0.86	0.86	
Threshold temperature	19.76	21.45	21.22	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			