



SAP Report Submission for Building Regulations Compliance

Client: Foreman Homes

Project: 15, Fieldfare Crescent
Botley, Southampton, SO32 2TW

Contact: Tobias Whiting
Abacus Energy (UK) Ltd
toby@abacusenergyuk.com

Report Issue Date: 22/09/2023

EXCELLENCE
IN ENERGY
ASSESSMENT

BUILDING REGULATION COMPLIANCE

Calculation Type: New Build (As Built)

Property Reference	SAP 0645 Plot 41			Issued on Date	22/09/2023
Assessment Reference	As Built	Prop Type Ref	Kv		
Property	15, Fieldfare Crescent, Botley, Southampton, SO32 2TW				
SAP Rating	89 B	DER	12.52	TER	16.41
Environmental	89 B	% DER<TER	23.71		
CO ₂ Emissions (t/year)	1.29	DFEE	47.03	TFEE	58.54
General Requirements Compliance	Pass	% DFEE<TFEE	19.66		
Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com			Assessor ID	E477-0001
Client	Foreman Homes, FORE				

SUMMARY FOR INPUT DATA FOR New Build (As Built)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	16.41	kgCO ₂ /m ²	
Dwelling Carbon Dioxide Emission Rate (DER)	12.52	kgCO ₂ /m ²	Pass
	-3.89 (-23.7%)	kgCO ₂ /m ²	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	58.54	kWh/m ² /yr	
Dwelling Fabric Energy Efficiency (DFEE)	47.03	kWh/m ² /yr	
	-11.5 (-19.7%)	kWh/m ² /yr	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	Pass
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	Pass
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	Pass
Openings	1.19 (max. 2.00)	1.20 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.63 (measured in this dwelling)	m ³ /(h.m ²) @ 50 Pa	
Maximum	10.0	m ³ /(h.m ²) @ 50 Pa	Pass

Limiting System Efficiencies

4 Heating efficiency

This report has been produced by an accredited Elmhurst member whose work is subject to quality assurance audits. The data used to produce the report has been verified by the Elmhurst members' portal.

BUILDING REGULATION COMPLIANCE

Calculation Type: New Build (As Built)

Main heating system

Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 4000 GR4700iW 12 S NG

Efficiency: 89.8% SEDBUK2009
Minimum: 88.0%

Pass

Secondary heating system

None

5 Cylinder insulation

Hot water storage

Measured cylinder loss: 1.94 kWh/day
Permitted by DBSCG 2.24

Pass

Primary pipework insulated

Yes

Pass

6 Controls

Space heating controls

Programmer, room thermostat and TRVs

Pass

Hot water controls

Cylinderstat

Pass

Independent timer for DHW

Pass

Boiler interlock

Yes

Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings

100 %

Minimum

75 %

Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Southern England)

Slight

Pass

Based on:

Overshading

Average

Windows facing North East

4.39 m², No overhang

Windows facing South East

9.04 m², Overhang twice as wide as window, ratio 0.40

Windows facing South

0.80 m², No overhang

Windows facing South West

2.81 m², No overhang

Windows facing West

0.80 m², No overhang

Windows facing North West

17.45 m², No overhang

Air change rate

4.00 ach

Blinds/curtains

None

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals

4.63 (measured in this dwelling) m³/(h.m²) @ 50 Pa

Maximum

10.0 m³/(h.m²) @ 50 Pa

Pass

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BUILDING REGULATION COMPLIANCE

Calculation Type: New Build (As Built)

10 Key features

Roof U-value	0.10	W/m ² K
Floor U-value	0.11	W/m ² K
Door U-value	1.10	W/m ² K
Thermal bridging γ -value	0.029	W/m ² K
Photovoltaic array	1.30	kW

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THERMAL BRIDGING

Calculation Type: New Build (As Built)

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SAP Rating	89 B	DER	12.52	TER	16.41
Environmental	89 B	% DER<TER	23.71		
CO ₂ Emissions (t/year)	1.29	DFEE	47.03	TFEE	58.54
General Requirements Compliance	Pass	% DFEE<TFEE	19.66		

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Client	Foreman Homes, FORE
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	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.077	1.89	0.15	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.071	4.58	0.33	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.067	3.60	0.24	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.070	1.41	0.10	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.067	6.28	0.42	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.056	5.54	0.31	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Table K1 - Approved	0.300	1.96	0.59	
External wall	E3 Sill	Independently assessed	0.021	18.30	0.38	Knauf P5
External wall	E4 Jamb	Independently assessed	0.016	51.00	0.82	Knauf P6
External wall	E5 Ground floor (normal)	Independently assessed	0.062	36.22	2.25	BE-E5-23902
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.000	32.97	0.00	CD0029
External wall	E10 Eaves (insulation at ceiling level)	Table K1 - Approved	0.060	38.07	2.28	
External wall	E24 Eaves (insulation at ceiling level - inverted)	Table K1 - Default	0.240	4.66	1.12	
External wall	E12 Gable (insulation at ceiling level)	Independently assessed	0.044	2.48	0.11	Knauf P21
External wall	E16 Corner (normal)	Independently assessed	0.039	34.51	1.35	Knauf P23
External wall	E17 Corner (inverted – internal area greater than external area)	Independently assessed	-0.091	14.31	-1.30	Knauf P24

Total: **9.13** W/mK:
Y-Value: **0.029** W/m²K:

FULL SAP CALCULATION PRINTOUT

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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 138 m²

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

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.41 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.52 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)58.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.19 (max. 2.00)	1.20 (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: 4.63 (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
Worcester Greenstar 4000 GR4700iW 12 S NG

Efficiency: 89.8% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.94 kWh/day
Permitted by DBSCG 2.24 OK
Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls:

Cylinderstat OK
Independent timer for DHW OK

Boiler interlock

Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Southern England): Slight OK

Based on:

Overshading: Average
Windows facing North East: 4.39 m², No overhang
Windows facing South East: 9.04 m², Overhang twice as wide as window, ratio 0.40
Windows facing South: 0.80 m², No overhang
Windows facing South West: 2.81 m², No overhang
Windows facing West: 0.80 m², No overhang
Windows facing North West: 17.45 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Roof U-value 0.10 W/m²K
Floor U-value 0.11 W/m²K
Door U-value 1.10 W/m²K
Thermal bridging y-value 0.029 W/m²K
Photovoltaic array 1.30 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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	70.4400 (1b)	x 2.3900 (2b)	= 168.3516 (1b) - (3b)
First floor	67.9100 (1c)	x 2.6700 (2c)	= 181.3197 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	138.3500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 349.6713 (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					5 * 10 = 50.0000 (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)					50.0000 / (5) = 0.1430 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3745 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3183 (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	0.4059	0.3979	0.3899	0.3501	0.3422	0.3024	0.3024	0.2944	0.3183	0.3422	0.3581	0.3740 (22b)
Effective ac	0.5824	0.5792	0.5760	0.5613	0.5585	0.5457	0.5457	0.5433	0.5507	0.5585	0.5641	0.5699 (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
Front Door			2.1200	1.1000	2.3320		(26a)
Windows (Uw = 1.20)			35.2900	1.1450	40.4084		(27)
Ground Floor			70.4400	0.1100	7.7484	140.0000	9861.6000 (28a)
Brick and Block	174.6000	37.4100	137.1900	0.2400	32.9256	42.2200	5792.1618 (29a)
Pitched Roof	70.4400		70.4400	0.1000	7.0440	9.0000	633.9600 (30)
Total net area of external elements Aum(A, m ²)			315.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	90.4584		(33)
Ground Floor Block			56.0900			75.0000	4206.7500 (32c)
Ground Floor Stud			54.0900			9.0000	486.8100 (32c)
First Floor Stud			159.5500			9.0000	1435.9500 (32c)
Internal Floor 1			67.9100			18.0000	1222.3800 (32d)
Internal Ceiling 1			67.9100			18.0000	1222.3800 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 24861.9918 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 179.7036 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.1310 (36)
Total fabric heat loss (33) + (36) = 99.5893 (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	67.1993	66.8303	66.4686	64.7695	64.4517	62.9719	62.9719	62.6978	63.5419	64.4517	65.0947	65.7670 (38)
Heat transfer coeff	166.7887	166.4196	166.0579	164.3589	164.0410	162.5612	162.5612	162.2872	163.1312	164.0410	164.6841	165.3564 (39)
Average = Sum(39)m / 12 =												164.3574 (39)
HLP	1.2056	1.2029	1.2003	1.1880	1.1857	1.1750	1.1750	1.1730	1.1791	1.1857	1.1903	1.1952 (40)
HLP (average)												1.1880 (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												2.9139 (42)
Average daily hot water use (litres/day)												103.4046 (43)
Daily hot water use	113.7450	109.6089	105.4727	101.3365	97.2003	93.0641	93.0641	97.2003	101.3365	105.4727	109.6089	113.7450 (44)
Energy conte	168.6806	147.5291	152.2369	132.7238	127.3516	109.8948	101.8337	116.8556	118.2512	137.8104	150.4309	163.3582 (45)
Energy content (annual)										Total = Sum(45)m =		1626.9568 (45)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	25.3021	22.1294	22.8355	19.9086	19.1027	16.4842	15.2750	17.5283	17.7377	20.6716	22.5646	24.5037 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9400 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0476 (55)
Total storage loss												
	32.4756	29.3328	32.4756	31.4280	32.4756	31.4280	32.4756	32.4756	31.4280	32.4756	31.4280	32.4756 (56)
If cylinder contains dedicated solar storage												
	32.4756	29.3328	32.4756	31.4280	32.4756	31.4280	32.4756	32.4756	31.4280	32.4756	31.4280	32.4756 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	224.4186	197.8731	207.9749	186.6638	183.0896	163.8348	157.5717	172.5936	172.1912	193.5484	204.3709	219.0962 (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												
	224.4186	197.8731	207.9749	186.6638	183.0896	163.8348	157.5717	172.5936	172.1912	193.5484	204.3709	219.0962 (64)
								Total per year (kWh/year) =	Sum (64)m =			2283.2268 (64)
Heat gains from water heating, kWh/month												
	100.6767	89.3286	95.2092	87.2827	86.9348	79.6920	78.4501	83.4449	82.4705	90.4124	93.1703	98.9070 (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	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.4164	24.3510	19.8035	14.9925	11.2071	9.4615	10.2235	13.2889	17.8363	22.6473	26.4327	28.1783 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	307.5281	310.7193	302.6776	285.5579	263.9472	243.6363	230.0673	226.8762	234.9178	252.0376	273.6482	293.9591 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694 (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)	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551 (71)
Water heating gains (Table 5)	135.3182	132.9295	127.9693	121.2259	116.8479	110.6834	105.4437	112.1571	114.5424	121.5220	129.4031	132.9395 (72)
Total internal gains	539.9708	537.7079	520.1586	491.4845	461.7104	433.4893	415.4427	422.0303	437.0047	465.9150	499.1923	524.7852 (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		
Northeast					4.3900	11.2829	0.6300	0.7000	0.7700	15.1377 (75)		
Southeast					9.0400	36.7938	0.6300	0.7000	0.7700	101.6518 (77)		
South					0.8000	46.7521	0.6300	0.7000	0.7700	11.4304 (78)		
Southwest					2.8100	36.7938	0.6300	0.7000	0.7700	31.5975 (79)		
West					0.8000	19.6403	0.6300	0.7000	0.7700	4.8019 (80)		
Northwest					17.4500	11.2829	0.6300	0.7000	0.7700	60.1713 (81)		
Solar gains	224.7907	408.3802	626.0564	887.8821	1096.4308	1133.2163	1073.9423	911.5995	715.7040	469.5280	273.8965	189.3606 (83)
Total gains	764.7614	946.0881	1146.2151	1379.3665	1558.1412	1566.7056	1489.3850	1333.6298	1152.7087	935.4430	773.0888	714.1457 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	41.4063	41.4982	41.5886	42.0185	42.0999	42.4831	42.4831	42.5549	42.3347	42.0999	41.9355	41.7650
alpha	3.7604	3.7665	3.7726	3.8012	3.8067	3.8322	3.8322	3.8370	3.8223	3.8067	3.7957	3.7843
util living area	0.9944	0.9871	0.9672	0.9078	0.7835	0.6101	0.4648	0.5315	0.7831	0.9514	0.9892	0.9956 (86)
MIT	19.2552	19.4951	19.8792	20.3628	20.7362	20.9267	20.9800	20.9672	20.8067	20.2936	19.6819	19.2148 (87)
Th 2	19.9156	19.9177	19.9198	19.9296	19.9315	19.9401	19.9401	19.9416	19.9367	19.9315	19.9277	19.9238 (88)
util rest of house	0.9929	0.9838	0.9587	0.8842	0.7319	0.5268	0.3597	0.4211	0.7111	0.9342	0.9859	0.9945 (89)
MIT 2	18.3257	18.5654	18.9453	19.4164	19.7497	19.9030	19.9337	19.9302	19.8219	19.3629	18.7601	18.2916 (90)
Living area fraction	18.4505	18.6902	19.0707	19.5434	19.8821	20.0404	20.0742	20.0694	19.9541	19.4878	18.8839	18.4155 (91)
MIT	18.4505	18.6902	19.0707	19.5434	19.8821	20.0404	20.0742	20.0694	19.9541	19.4878	18.8839	18.4155 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4505	18.6902	19.0707	19.5434	19.8821	20.0404	20.0742	20.0694	19.9541	19.4878	18.8839	18.4155 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9902	0.9788	0.9502	0.8740	0.7292	0.5352	0.3734	0.4351	0.7124	0.9249	0.9815	0.9923 (94)
Useful gains	757.2608	926.0432	1089.1016	1205.6221	1136.2379	838.4468	556.1572	580.2460	821.2013	865.2193	758.7778	708.6507 (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	2360.1386	2294.9599	2087.4588	1749.3447	1342.2076	884.3923	564.7663	595.4977	954.9813	1457.9624	1940.6135	2350.6256 (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	1192.5410	919.9120	742.7778	391.4803	153.2414	0.0000	0.0000	0.0000	0.0000	441.0009	850.9217	1221.6293 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating
Space heating per m2 (98) / (4) = 5913.5044 (98)
42.7431 (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 %) 90.8000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 6512.6701 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1192.5410	919.9120	742.7778	391.4803	153.2414	0.0000	0.0000	0.0000	0.0000	441.0009	850.9217	1221.6293 (98)
Space heating efficiency (main heating system 1)	90.8000	90.8000	90.8000	90.8000	90.8000	0.0000	0.0000	0.0000	0.0000	90.8000	90.8000	90.8000 (210)
Space heating fuel (main heating system)	1313.3712	1013.1190	818.0372	431.1457	168.7681	0.0000	0.0000	0.0000	0.0000	485.6838	937.1384	1345.4067 (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	224.4186	197.8731	207.9749	186.6638	183.0896	163.8348	157.5717	172.5936	172.1912	193.5484	204.3709	219.0962 (64)
Efficiency of water heater (217)m	88.9188	88.7024	88.2221	87.0458	84.6447	80.1000	80.1000	80.1000	80.1000	87.2452	88.5102	88.9922 (216)
Fuel for water heating, kWh/month	252.3862	223.0752	235.7402	214.4433	216.3037	204.5378	196.7187	215.4727	214.9703	221.8443	230.9008	246.1971 (219)
Water heating fuel used												2672.5902 (219)
Annual totals kWh/year												
Space heating fuel - main system												6512.6701 (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)												484.1814 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.30 * 1004 * 1.00) =									-1044.1561			-1044.1561 (233)
Total delivered energy for all uses												8700.2856 (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	6512.6701	0.2160	1406.7367 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2672.5902	0.2160	577.2795 (264)
Space and water heating			1984.0162 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	484.1814	0.5190	251.2901 (268)
Energy saving/generation technologies			
PV Unit	-1044.1561	0.5190	-541.9170 (269)
Total CO2, kg/year			1732.3144 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.5200 (273)

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

	DER	TFA	N	EF	CO2 emissions
Total Floor Area		138.3500			12.5200 ZC1
Assumed number of occupants			2.9139		138.3500
CO2 emission factor in Table 12 for electricity displaced from grid				0.5190	2.9139
CO2 emissions from appliances, equation (L14)					0.5190
CO2 emissions from cooking, equation (L16)					13.1720 ZC2
Total CO2 emissions					1.3656 ZC3
Residual CO2 emissions offset from biofuel CHP					27.0576 ZC4
Additional allowable electricity generation, kWh/m²/year					0.0000 ZC5
Resulting CO2 emissions offset from additional allowable electricity generation					0.0000 ZC6
Net CO2 emissions					0.0000 ZC7
					27.0576 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.4400 (1b)	x 2.3900 (2b)	= 168.3516 (1b) - (3b)
First floor	67.9100 (1c)	x 2.6700 (2c)	= 181.3197 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	138.3500		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 349.6713 (5)
Dwelling volume			

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
Number of chimneys										0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues										0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans																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) =	0.1144 (8)
Pressure test										Yes							
Measured/design AP50										5.0000							
Infiltration rate										0.3644 (18)							
Number of sides sheltered										2 (19)							
Shelter factor										(20) = 1 - [0.075 x (19)] =							0.8500 (20)
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =							0.3097 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
	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	0.3949	0.3872	0.3794	0.3407	0.3330	0.2942	0.2942	0.2865	0.3097	0.3330	0.3485	0.3639	(22b)				
Effective ac	0.5780	0.5749	0.5720	0.5580	0.5554	0.5433	0.5433	0.5410	0.5480	0.5554	0.5607	0.5662	(25)				

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Semi-glazed door			2.1200	1.2000	2.5440			(26a)				
TER Opening Type (Uw = 1.40)			32.4700	1.3258	43.0473			(27)				
Ground Floor			70.4400	0.1300	9.1572			(28a)				
Brick and Block	174.6000	34.5900	140.0100	0.1800	25.2018			(29a)				
Pitched Roof	70.4400		70.4400	0.1300	9.1572			(30)				
Total net area of external elements Aum(A, m2)			315.4800					(31)				
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	89.1075			(33)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								15.8926 (36)				
Total fabric heat loss						(33) + (36) =		105.0001 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 66.6937	Feb 66.3443	Mar 66.0018	Apr 64.3932	May 64.0922	Jun 62.6912	Jul 62.6912	Aug 62.4317	Sep 63.2308	Oct 64.0922	Nov 64.7011	Dec 65.3376 (38)
Heat transfer coeff	171.6938	171.3444	171.0020	169.3933	169.0924	167.6913	167.6913	167.4318	168.2310	169.0924	169.7012	170.3378 (39)
Average = Sum(39)m / 12 =												169.3919 (39)
HLP	Jan 1.2410	Feb 1.2385	Mar 1.2360	Apr 1.2244	May 1.2222	Jun 1.2121	Jul 1.2121	Aug 1.2102	Sep 1.2160	Oct 1.2222	Nov 1.2266	Dec 1.2312 (40)
HLP (average)												1.2244 (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												2.9139 (42)
Average daily hot water use (litres/day)												103.4046 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.7450	109.6089	105.4727	101.3365	97.2003	93.0641	93.0641	97.2003	101.3365	105.4727	109.6089	113.7450 (44)
Energy conte	168.6806	147.5291	152.2369	132.7238	127.3516	109.8948	101.8337	116.8556	118.2512	137.8104	150.4309	163.3582 (45)
Energy content (annual)											Total = Sum(45)m =	1626.9568 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.3021	22.1294	22.8355	19.9086	19.1027	16.4842	15.2750	17.5283	17.7377	20.6716	22.5646	24.5037 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525 (48)
Temperature factor from Table 2b												0.5400 (49)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55)												0.8924 (55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	219.6067	193.5269	203.1629	182.0071	178.2777	159.1781	152.7597	167.7817	167.5345	188.7365	199.7142	214.2842 (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	219.6067	193.5269	203.1629	182.0071	178.2777	159.1781	152.7597	167.7817	167.5345	188.7365	199.7142	214.2842 (64)
Heat gains from water heating, kWh/month	96.8272	85.8516	91.3596	83.5573	83.0853	75.9667	74.6006	79.5954	78.7452	86.5628	89.4449	95.0575 (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	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.4164	24.3510	19.8035	14.9925	11.2071	9.4615	10.2235	13.2889	17.8363	22.6473	26.4327	28.1783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	307.5281	310.7193	302.6776	285.5579	263.9472	243.6363	230.0673	226.8762	234.9178	252.0376	273.6482	293.9591	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	(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)	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	(71)
Water heating gains (Table 5)	130.1440	127.7554	122.7952	116.0518	111.6738	105.5092	100.2696	106.9830	109.3683	116.3479	124.2290	127.7654	(72)
Total internal gains	534.7967	532.5338	514.9845	486.3104	456.5363	428.3152	410.2685	416.8562	431.8306	460.7409	494.0181	519.6110	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	4.0400	11.2829	0.6300	0.7000	0.7700	13.9308 (75)
Southeast	8.3200	36.7938	0.6300	0.7000	0.7700	93.5557 (77)
South	0.7400	46.7521	0.6300	0.7000	0.7700	10.5731 (78)
Southwest	2.5800	36.7938	0.6300	0.7000	0.7700	29.0113 (79)
West	0.7400	19.6403	0.6300	0.7000	0.7700	4.4417 (80)
Northwest	16.0500	11.2829	0.6300	0.7000	0.7700	55.3438 (81)

Solar gains	206.8564	375.7924	576.0807	816.9760	1008.8441	1042.6801	988.1461	838.7895	658.5623	432.0561	252.0434	174.2537	(83)
Total gains	741.6531	908.3262	1091.0652	1303.2863	1465.3804	1470.9953	1398.4147	1255.6457	1090.3929	892.7970	746.0616	693.8648	(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	55.9580	56.0721	56.1844	56.7179	56.8189	57.2936	57.2936	57.3824	57.1098	56.8189	56.6150	56.4035
alpha	4.7305	4.7381	4.7456	4.7812	4.7879	4.8196	4.8196	4.8255	4.8073	4.7879	4.7743	4.7602
util living area	0.9988	0.9965	0.9885	0.9549	0.8551	0.6782	0.5159	0.5896	0.8526	0.9804	0.9972	0.9991 (86)
MIT	19.5800	19.7618	20.0636	20.4608	20.7859	20.9493	20.9890	20.9799	20.8450	20.4082	19.9189	19.5495 (87)
Th 2	19.8873	19.8893	19.8913	19.9005	19.9023	19.9103	19.9103	19.9118	19.9072	19.9023	19.8988	19.8951 (88)
util rest of house	0.9983	0.9953	0.9843	0.9377	0.8037	0.5829	0.3942	0.4618	0.7794	0.9702	0.9960	0.9988 (89)
MIT 2	17.9940	18.2609	18.7009	19.2715	19.6970	19.8778	19.9065	19.9038	19.7824	19.2087	18.4977	17.9548 (90)
Living area fraction	18.2069	18.4623	18.8838	19.4311	19.8431	20.0217	20.0518	20.0483	fLA = Living area / (4) =	19.9250	19.3697	18.6884 (91)
MIT	18.2069	18.4623	18.8838	19.4311	19.8431	20.0217	20.0518	20.0483	19.9250	19.3697	18.6884	18.1688 (92)
Temperature adjustment												0.0000
adjusted MIT	18.2069	18.4623	18.8838	19.4311	19.8431	20.0217	20.0518	20.0483	19.9250	19.3697	18.6884	18.1688 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9973	0.9929	0.9787	0.9283	0.8005	0.5933	0.4104	0.4786	0.7808	0.9630	0.9939	0.9980 (94)
Useful gains	739.6249	901.8406	1067.8188	1209.7774	1173.0522	872.7952	573.9744	600.9991	851.4147	859.7458	741.5165	692.4708 (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	2387.7285	2323.8294	2117.6554	1783.8958	1376.9426	909.1647	578.8362	610.8386	979.9470	1482.8857	1966.5681	2379.4170 (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	1226.1891	955.5765	781.0784	413.3653	151.6945	0.0000	0.0000	0.0000	0.0000	463.6161	882.0371	1255.0880 (98)
Space heating												6128.6451 (98)
Space heating per m2											(98) / (4) =	44.2981 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)

0.0000 (201)

Fraction of space heat from main system(s)

1.0000 (202)

Efficiency of main space heating system 1 (in %)

93.5000 (206)

Efficiency of secondary/supplementary heating system, %

0.0000 (208)

Space heating requirement

6554.7006 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1226.1891	955.5765	781.0784	413.3653	151.6945	0.0000	0.0000	0.0000	0.0000	463.6161	882.0371	1255.0880	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	1311.4322	1022.0070	835.3780	442.1019	162.2401	0.0000	0.0000	0.0000	0.0000	495.8461	943.3552	1342.3401	(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	219.6067	193.5269	203.1629	182.0071	178.2777	159.1781	152.7597	167.7817	167.5345	188.7365	199.7142	214.2842	(64)
Efficiency of water heater (217)m	88.6936	88.5015	88.0627	86.9365	84.3867	79.8000	79.8000	79.8000	79.8000	87.1203	88.3138	88.7643	(216)
Fuel for water heating, kWh/month	247.6015	218.6709	230.7027	209.3565	211.2628	199.4713	191.4282	210.2527	209.9430	216.6389	226.1415	241.4082	(219)
Water heating fuel used												2612.8781	(219)
Annual totals kWh/year													
Space heating fuel - main system												6554.7006	(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)												484.1814	(232)
Total delivered energy for all uses												9726.7601	(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	6554.7006	0.2160	1415.8153 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2612.8781	0.2160	564.3817 (264)
Space and water heating			1980.1970 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	484.1814	0.5190	251.2901 (268)
Total CO2, kg/m2/year			2270.4121 (272)
Emissions per m2 for space and water heating			14.3130 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.8163 (272b)
Emissions per m2 for pumps and fans			0.2814 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.3130 * 1.00) + 1.8163 + 0.2814, rounded to 2 d.p.			16.4100 (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)
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1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.4400 (1b)	x 2.3900 (2b)	= 168.3516 (1b) - (3b)
First floor	67.9100 (1c)	x 2.6700 (2c)	= 181.3197 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	138.3500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 349.6713 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1144 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3459 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2940 (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	0.3749	0.3675	0.3602	0.3234	0.3161	0.2793	0.2793	0.2720	0.2940	0.3161	0.3308	0.3455 (22b)
Effective ac	0.5703	0.5675	0.5649	0.5523	0.5499	0.5390	0.5390	0.5370	0.5432	0.5499	0.5547	0.5597 (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
Front Door			2.1200	1.1000	2.3320		(26a)
Windows (Uw = 1.20)			35.2900	1.1450	40.4084		(27)
Ground Floor			70.4400	0.1100	7.7484	140.0000	9861.6000 (28a)
Brick and Block	174.6000	37.4100	137.1900	0.2400	32.9256	42.2200	5792.1618 (29a)
Pitched Roof	70.4400		70.4400	0.1000	7.0440	9.0000	633.9600 (30)
Total net area of external elements Aum(A, m ²)			315.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	90.4584		(33)
Ground Floor Block			56.0900			75.0000	4206.7500 (32c)
Ground Floor Stud			54.0900			9.0000	486.8100 (32c)
First Floor Stud			159.5500			9.0000	1435.9500 (32c)
Internal Floor 1			67.9100			18.0000	1222.3800 (32d)
Internal Ceiling 1			67.9100			9.0000	611.1900 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 24250.8018 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 175.2859 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.1310 (36)
Total fabric heat loss (33) + (36) = 99.5893 (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	65.8032	65.4884	65.1798	63.7304	63.4592	62.1968	62.1968	61.9630	62.6831	63.4592	64.0078	64.5814 (38)
Heat transfer coeff	165.3926	165.0778	164.7692	163.3197	163.0486	161.7862	161.7862	161.5524	162.2724	163.0486	163.5972	164.1707 (39)
Average = Sum(39)m / 12 =												163.3184 (39)
HLP	1.1955	1.1932	1.1910	1.1805	1.1785	1.1694	1.1694	1.1677	1.1729	1.1785	1.1825	1.1866 (40)
HLP (average)												1.1805 (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												2.9139 (42)
Average daily hot water use (litres/day)												103.4046 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.7450	109.6089	105.4727	101.3365	97.2003	93.0641	93.0641	97.2003	101.3365	105.4727	109.6089	113.7450 (44)
Energy conte	168.6806	147.5291	152.2369	132.7238	127.3516	109.8948	101.8337	116.8556	118.2512	137.8104	150.4309	163.3582 (45)
Energy content (annual)										Total = Sum(45)m =		1626.9568 (45)

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Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	35.8446	31.3499	32.3503	28.2038	27.0622	23.3526	21.6397	24.8318	25.1284	29.2847	31.9666	34.7136 (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	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.4164	24.3510	19.8035	14.9925	11.2071	9.4615	10.2235	13.2889	17.8363	22.6473	26.4327	28.1783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	307.5281	310.7193	302.6776	285.5579	263.9472	243.6363	230.0673	226.8762	234.9178	252.0376	273.6482	293.9591	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	(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)	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	(71)
Water heating gains (Table 5)	48.1783	46.6517	43.4816	39.1720	36.3740	32.4342	29.0856	33.3761	34.9005	39.3612	44.3980	46.6581	(72)
Total internal gains	449.8309	448.4301	432.6709	406.4305	378.2364	352.2402	336.0845	340.2493	354.3628	380.7542	411.1871	435.5037	(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
Northeast				4.3900	11.2829		0.6300		0.7000		0.7700		15.1377 (75)
Southeast				9.0400	36.7938		0.6300		0.7000		0.7700		101.6518 (77)
South				0.8000	46.7521		0.6300		0.7000		0.7700		11.4304 (78)
Southwest				2.8100	36.7938		0.6300		0.7000		0.7700		31.5975 (79)
West				0.8000	19.6403		0.6300		0.7000		0.7700		4.8019 (80)
Northwest				17.4500	11.2829		0.6300		0.7000		0.7700		60.1713 (81)
Solar gains	224.7907	408.3802	626.0564	887.8821	1096.4308	1133.2163	1073.9423	911.5995	715.7040	469.5280	273.8965	189.3606	(83)
Total gains	674.6215	856.8103	1058.7274	1294.3126	1474.6673	1485.4565	1410.0269	1251.8488	1070.0668	850.2822	685.0837	624.8643	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.7294	40.8070	40.8835	41.2463	41.3149	41.6373	41.6373	41.6975	41.5125	41.3149	41.1763	41.0325	
alpha	3.7153	3.7205	3.7256	3.7498	3.7543	3.7758	3.7758	3.7798	3.7675	3.7543	3.7451	3.7355	
util living area	0.9960	0.9899	0.9726	0.9185	0.8005	0.6313	0.4852	0.5570	0.8078	0.9612	0.9922	0.9970	(86)
MIT	19.1622	19.4080	19.8034	20.3052	20.7035	20.9135	20.9754	20.9594	20.7743	20.2245	19.5939	19.1187	(87)
Th 2	19.9236	19.9255	19.9272	19.9356	19.9372	19.9446	19.9446	19.9459	19.9417	19.9372	19.9340	19.9307	(88)
util rest of house	0.9950	0.9874	0.9655	0.8972	0.7513	0.5480	0.3773	0.4444	0.7399	0.9471	0.9898	0.9962	(89)
MIT 2	18.2417	18.4876	18.8796	19.3700	19.7296	19.8997	19.9365	19.9312	19.8037	19.3042	18.6803	18.2037	(90)
Living area fraction									fLA = Living area / (4) =			0.1342	(91)
MIT	18.3653	18.6111	19.0036	19.4955	19.8603	20.0358	20.0760	20.0693	19.9340	19.4277	18.8029	18.3265	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3653	18.6111	19.0036	19.4955	19.8603	20.0358	20.0760	20.0693	19.9340	19.4277	18.8029	18.3265	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	669.7883	842.3172	1013.7020	1147.5786	1101.9926	825.4496	551.7237	573.7451	791.1609	797.7513	675.6389	621.4541	(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	2326.2911	2263.4038	2060.2023	1730.4586	1330.5296	879.4399	562.3676	592.7765	946.6905	1439.3419	1914.5610	2319.1591	(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	1232.4381	954.9702	778.5962	419.6736	170.0315	0.0000	0.0000	0.0000	0.0000	477.3434	892.0239	1263.0926	(98)
Space heating												6188.1694	(98)
Space heating per m2										(98) / (4) =		44.7284	(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	

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Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1520.7898	1197.2175	1227.7980	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8616	0.9122	0.8781	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1310.3410	1092.0516	1078.1573	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1857.9375	1766.9603	1584.4000	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	394.2694	502.1321	376.6446	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1273.0462	(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	98.5674	125.5330	94.1612	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												318.2615	(107)
Space cooling per m2												2.3004	(108)
Energy for space heating												44.7284	(99)
Energy for space cooling												2.3004	(108)
Total												47.0288	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.0	(109)

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1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.4400 (1b)	x 2.3900 (2b)	= 168.3516 (1b) - (3b)
First floor	67.9100 (1c)	x 2.6700 (2c)	= 181.3197 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	138.3500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 349.6713 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1144 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3644 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3097 (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	0.3949	0.3872	0.3794	0.3407	0.3330	0.2942	0.2942	0.2865	0.3097	0.3330	0.3485	0.3639 (22b)
Effective ac	0.5780	0.5749	0.5720	0.5580	0.5554	0.5433	0.5433	0.5410	0.5480	0.5554	0.5607	0.5662 (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 Semi-glazed door			2.1200	1.2000	2.5440		(26a)
TER Opening Type (Uw = 1.40)			32.4700	1.3258	43.0473		(27)
Ground Floor			70.4400	0.1300	9.1572		(28a)
Brick and Block	174.6000	34.5900	140.0100	0.1800	25.2018		(29a)
Pitched Roof	70.4400		70.4400	0.1300	9.1572		(30)
Total net area of external elements Aum(A, m ²)			315.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	89.1075		(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)							15.8926 (36)
Total fabric heat loss						(33) + (36) =	105.0001 (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	66.6937	66.3443	66.0018	64.3932	64.0922	62.6912	62.6912	62.4317	63.2308	64.0922	64.7011	65.3376 (38)
Heat transfer coeff	171.6938	171.3444	171.0020	169.3933	169.0924	167.6913	167.6913	167.4318	168.2310	169.0924	169.7012	170.3378 (39)
Average = Sum(39)m / 12 =												169.3919 (39)
HLP	Jan 1.2410	Feb 1.2385	Mar 1.2360	Apr 1.2244	May 1.2222	Jun 1.2121	Jul 1.2121	Aug 1.2102	Sep 1.2160	Oct 1.2222	Nov 1.2266	Dec 1.2312 (40)
HLP (average)												1.2244 (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												2.9139 (42)
Average daily hot water use (litres/day)												103.4046 (43)
Daily hot water use	Jan 113.7450	Feb 109.6089	Mar 105.4727	Apr 101.3365	May 97.2003	Jun 93.0641	Jul 93.0641	Aug 97.2003	Sep 101.3365	Oct 105.4727	Nov 109.6089	Dec 113.7450 (44)
Energy conte	168.6806	147.5291	152.2369	132.7238	127.3516	109.8948	101.8337	116.8556	118.2512	137.8104	150.4309	163.3582 (45)
Energy content (annual)										Total = Sum(45)m =		1626.9568 (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												

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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)
	35.8446	31.3499	32.3503	28.2038	27.0622	23.3526	21.6397	24.8318	25.1284	29.2847	31.9666	34.7136 (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	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939	145.6939 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.4164	24.3510	19.8035	14.9925	11.2071	9.4615	10.2235	13.2889	17.8363	22.6473	26.4327	28.1783 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	307.5281	310.7193	302.6776	285.5579	263.9472	243.6363	230.0673	226.8762	234.9178	252.0376	273.6482	293.9591 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694	37.5694 (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)	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551 (71)
Water heating gains (Table 5)	48.1783	46.6517	43.4816	39.1720	36.3740	32.4342	29.0856	33.3761	34.9005	39.3612	44.3980	46.6581 (72)
Total internal gains	449.8309	448.4301	432.6709	406.4305	378.2364	352.2402	336.0845	340.2493	354.3628	380.7542	411.1871	435.5037 (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
Northeast	4.0400	11.2829	0.6300	0.7000	0.7700	13.9308 (75)
Southeast	8.3200	36.7938	0.6300	0.7000	0.7700	93.5557 (77)
South	0.7400	46.7521	0.6300	0.7000	0.7700	10.5731 (78)
Southwest	2.5800	36.7938	0.6300	0.7000	0.7700	29.0113 (79)
West	0.7400	19.6403	0.6300	0.7000	0.7700	4.4417 (80)
Northwest	16.0500	11.2829	0.6300	0.7000	0.7700	55.3438 (81)

Solar gains	206.8564	375.7924	576.0807	816.9760	1008.8441	1042.6801	988.1461	838.7895	658.5623	432.0561	252.0434	174.2537 (83)
Total gains	656.6873	824.2225	1008.7516	1223.4065	1387.0806	1394.9203	1324.2307	1179.0388	1012.9251	812.8103	663.2305	609.7574 (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	55.9580	56.0721	56.1844	56.7179	56.8189	57.2936	57.2936	57.3824	57.1098	56.8189	56.6150	56.4035
alpha	4.7305	4.7381	4.7456	4.7812	4.7879	4.8196	4.8196	4.8255	4.8073	4.7879	4.7743	4.7602
util living area	0.9993	0.9977	0.9916	0.9640	0.8748	0.7053	0.5420	0.6216	0.8790	0.9865	0.9983	0.9995 (86)
MIT	19.5235	19.7064	20.0114	20.4171	20.7593	20.9400	20.9865	20.9749	20.8186	20.3590	19.8641	19.4934 (87)
Th 2	19.8873	19.8893	19.8913	19.9005	19.9023	19.9103	19.9103	19.9118	19.9072	19.9023	19.8988	19.8951 (88)
util rest of house	0.9990	0.9969	0.9885	0.9496	0.8272	0.6097	0.4155	0.4898	0.8125	0.9791	0.9976	0.9993 (89)
MIT 2	18.5383	18.7224	19.0272	19.4306	19.7418	19.8835	19.9070	19.9048	19.8040	19.3816	18.8876	18.5143 (90)
Living area fraction									fLA = Living area / (4) =			0.1342 (91)
MIT	18.6706	18.8545	19.1593	19.5630	19.8783	20.0253	20.0519	20.0485	19.9402	19.5128	19.0187	18.6458 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6706	18.8545	19.1593	19.5630	19.8783	20.0253	20.0519	20.0485	19.9402	19.5128	19.0187	18.6458 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9986	0.9958	0.9856	0.9440	0.8260	0.6207	0.4325	0.5074	0.8149	0.9753	0.9967	0.9990 (94)
Useful gains	655.7674	820.7402	994.1973	1154.9237	1145.6928	865.7886	572.7722	598.2692	825.4725	792.7715	661.0537	609.1584 (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	2467.3366	2391.0286	2164.7692	1806.2475	1382.8952	909.7810	578.8592	610.8689	982.4954	1507.0797	2022.6150	2460.6587 (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	1347.8075	1055.2338	870.9055	468.9531	176.4786	0.0000	0.0000	0.0000	0.0000	531.4453	980.3242	1377.5162 (98)
Space heating												6808.6641 (98)
Space heating per m2										(98) / (4) =		49.2133 (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	1576.2982	1240.9156	1272.4820	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8688	0.9249	0.8886	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1369.5461	1147.6694	1130.7289	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1752.1160	1666.6791	1499.2975	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)

FULL SAP CALCULATION PRINTOUT

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	275.4503	386.1432	274.2150	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												935.8085 (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	68.8626	96.5358	68.5538	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling												233.9521 (107)
Space cooling per m2												1.6910 (108)
Energy for space heating												49.2133 (99)
Energy for space cooling												1.6910 (108)
Total												50.9043 (109)
Target Fabric Energy Efficiency (TFEE)												58.5 (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	70.4400 (1b)	x 2.3900 (2b)	= 168.3516 (1b) - (3b)
First floor	67.9100 (1c)	x 2.6700 (2c)	= 181.3197 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	138.3500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 349.6713 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.1430 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3745 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3183 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.3342	0.3104	0.3183	0.3024	0.3024	0.2944	0.2865	0.2785	0.2706	0.2944	0.2785	0.2944 (22b)
Effective ac	0.5559	0.5482	0.5507	0.5457	0.5457	0.5433	0.5410	0.5388	0.5366	0.5433	0.5388	0.5433 (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
Front Door			2.1200	1.1000	2.3320		(26a)
Windows (Uw = 1.20)			35.2900	1.1450	40.4084		(27)
Ground Floor			70.4400	0.1100	7.7484	140.0000	9861.6000 (28a)
Brick and Block	174.6000	37.4100	137.1900	0.2400	32.9256	42.2200	5792.1618 (29a)
Pitched Roof	70.4400		70.4400	0.1000	7.0440	9.0000	633.9600 (30)
Total net area of external elements Aum(A, m ²)			315.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	90.4584		(33)
Ground Floor Block			56.0900			75.0000	4206.7500 (32c)
Ground Floor Stud			54.0900			9.0000	486.8100 (32c)
First Floor Stud			159.5500			9.0000	1435.9500 (32c)
Internal Floor 1			67.9100			18.0000	1222.3800 (32d)
Internal Ceiling 1			67.9100			18.0000	1222.3800 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 24861.9918 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 179.7036 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.1310 (36)
Total fabric heat loss (33) + (36) = 99.5893 (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	64.1411	63.2532	63.5419	62.9719	62.9719	62.6978	62.4311	62.1717	61.9196	62.6978	62.1717	62.6978 (38)
Heat transfer coeff	163.7304	162.8426	163.1312	162.5612	162.5612	162.2872	162.0204	161.7610	161.5089	162.2872	161.7610	162.2872 (39)
Average = Sum(39)m / 12 =												162.3950 (39)
HLP	1.1835	1.1770	1.1791	1.1750	1.1750	1.1730	1.1711	1.1692	1.1674	1.1730	1.1692	1.1730 (40)
HLP (average)												1.1738 (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												2.9139 (42)
Average daily hot water use (litres/day)												103.4046 (43)
Daily hot water use	113.7450	109.6089	105.4727	101.3365	97.2003	93.0641	93.0641	97.2003	101.3365	105.4727	109.6089	113.7450 (44)
Energy conte	168.6806	147.5291	152.2369	132.7238	127.3516	109.8948	101.8337	116.8556	118.2512	137.8104	150.4309	163.3582 (45)
Energy content (annual)										Total = Sum(45)m =		1626.9568 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	25.3021	22.1294	22.8355	19.9086	19.1027	16.4842	15.2750	17.5283	17.7377	20.6716	22.5646	24.5037 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9400 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0476 (55)
Total storage loss												
32.4756 29.3328 32.4756 31.4280 32.4756 31.4280 32.4756 32.4756 31.4280 32.4756 31.4280 32.4756 (56)												
If cylinder contains dedicated solar storage												
32.4756 29.3328 32.4756 31.4280 32.4756 31.4280 32.4756 32.4756 31.4280 32.4756 31.4280 32.4756 (57)												
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
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	224.4186	197.8731	207.9749	186.6638	183.0896	163.8348	157.5717	172.5936	172.1912	193.5484	204.3709	219.0962 (62)
RHI water heating demand												2283 (64)
Heat gains from water heating, kWh/month	100.6767	89.3286	95.2092	87.2827	86.9348	79.6920	78.4501	83.4449	82.4705	90.4124	93.1703	98.9070 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.5409	60.8774	49.5088	37.4814	28.0178	23.6538	25.5587	33.2222	44.5908	56.6183	66.0819	70.4458 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	458.9972	463.7601	451.7576	426.2057	393.9511	363.6362	343.3841	338.6211	350.6236	376.1755	408.4302	438.7450 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971 (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)	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551 (71)
Water heating gains (Table 5)	135.3182	132.9295	127.9693	121.2259	116.8479	110.6834	105.4437	112.1571	114.5424	121.5220	129.4031	132.9395 (72)
Total internal gains	779.5309	774.2417	745.9105	701.5877	655.4914	614.6481	591.0612	600.6751	626.4315	670.9904	720.5899	758.8050 (73)

6. Solar gains

[Jan]				Area	Solar flux	g			FF	Access		Gains
				m2	Table 6a	Specific data			Specific data	factor		W
					W/m2	or Table 6b			or Table 6c	Table 6d		
Northeast				4.3900	14.6176		0.6300		0.7000	0.7700		19.6116 (75)
Southeast				9.0400	45.1778		0.6300		0.7000	0.7700		124.8147 (77)
South				0.8000	56.7559		0.6300		0.7000	0.7700		13.8763 (78)
Southwest				2.8100	45.1778		0.6300		0.7000	0.7700		38.7975 (79)
West				0.8000	25.1925		0.6300		0.7000	0.7700		6.1593 (80)
Northwest				17.4500	14.6176		0.6300		0.7000	0.7700		77.9551 (81)
Solar gains	281.2145	436.8110	679.7734	975.7023	1147.6132	1288.6687	1211.6707	1052.7634	822.9947	543.2556	341.9599	232.5971 (83)
Total gains	1060.7454	1211.0527	1425.6838	1677.2900	1803.1046	1903.3168	1802.7318	1653.4386	1449.4262	1214.2460	1062.5497	991.4021 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.1798	42.4097	42.3347	42.4831	42.4831	42.5549	42.6249	42.6933	42.7599	42.5549	42.6933	42.5549
alpha	3.8120	3.8273	3.8223	3.8322	3.8322	3.8370	3.8417	3.8462	3.8507	3.8370	3.8462	3.8370
util living area	0.9812	0.9690	0.9308	0.8337	0.6771	0.4698	0.3464	0.3757	0.6367	0.8790	0.9637	0.9845 (86)
MIT	19.6184	19.8003	20.1705	20.5912	20.8604	20.9733	20.9936	20.9916	20.9177	20.5740	20.0484	19.5931 (87)
Th 2	19.9333	19.9384	19.9367	19.9401	19.9401	19.9416	19.9432	19.9447	19.9462	19.9416	19.9447	19.9416 (88)
util rest of house	0.9766	0.9617	0.9147	0.7977	0.6148	0.3889	0.2545	0.2768	0.5514	0.8422	0.9534	0.9806 (89)
MIT 2	18.6987	18.8810	19.2377	19.6284	19.8525	19.9302	19.9416	19.9426	19.9044	19.6261	19.1319	18.6805 (90)
Living area fraction									fLA = Living area / (4) =			0.1342 (91)
MIT	18.8221	19.0044	19.3629	19.7576	19.9878	20.0702	20.0828	20.0834	20.0404	19.7533	19.2550	18.8030 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8221	19.0044	19.3629	19.7576	19.9878	20.0702	20.0828	20.0834	20.0404	19.7533	19.2550	18.8030 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9703	0.9535	0.9042	0.7907	0.6178	0.3990	0.2668	0.2901	0.5596	0.8345	0.9448	0.9751 (94)
Useful gains	1029.2437	1154.7274	1289.0484	1326.2750	1114.0358	759.4041	481.0239	479.5921	811.0427	1013.3114	1003.8526	966.7069 (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	2279.4781	2231.6634	2016.7740	1667.4886	1217.2297	774.1491	483.2781	482.5971	862.5194	1355.6326	1836.7894	2240.0486 (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												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating	930.1744	723.7010	541.4279	245.6737	76.7763	0.0000	0.0000	0.0000	0.0000	254.6870	599.7145	947.3662 (98)
RHI space heating demand												4319.5210 (98)
												4320 (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	70.4400 (1b)	x 2.3900 (2b)	= 168.3516 (1b) - (3b)
First floor	67.9100 (1c)	x 2.6700 (2c)	= 181.3197 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	138.3500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 349.6713 (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					5 * 10 = 50.0000 (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)					50.0000 / (5) = 0.1430 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3745 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3183 (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	0.4059	0.3979	0.3899	0.3501	0.3422	0.3024	0.3024	0.2944	0.3183	0.3422	0.3581	0.3740 (22b)
Effective ac	0.5824	0.5792	0.5760	0.5613	0.5585	0.5457	0.5457	0.5433	0.5507	0.5585	0.5641	0.5699 (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
Front Door			2.1200	1.1000	2.3320		(26a)
Windows (Uw = 1.20)			35.2900	1.1450	40.4084		(27)
Ground Floor			70.4400	0.1100	7.7484	140.0000	9861.6000 (28a)
Brick and Block	174.6000	37.4100	137.1900	0.2400	32.9256	42.2200	5792.1618 (29a)
Pitched Roof	70.4400		70.4400	0.1000	7.0440	9.0000	633.9600 (30)
Total net area of external elements Aum(A, m ²)			315.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	90.4584		(33)
Ground Floor Block			56.0900			75.0000	4206.7500 (32c)
Ground Floor Stud			54.0900			9.0000	486.8100 (32c)
First Floor Stud			159.5500			9.0000	1435.9500 (32c)
Internal Floor 1			67.9100			18.0000	1222.3800 (32d)
Internal Ceiling 1			67.9100			18.0000	1222.3800 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss

(28)...(30) + (32) + (32a)...(32e) =	24861.9918 (34)
	179.7036 (35)
	9.1310 (36)
(33) + (36) =	99.5893 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	
(38)m	Jan 67.1993 Feb 66.8303 Mar 66.4686 Apr 64.7695 May 64.4517 Jun 62.9719 Jul 62.9719 Aug 62.6978 Sep 63.5419 Oct 64.4517 Nov 65.0947 Dec 65.7670 (38)
Heat transfer coeff	166.7887 166.4196 166.0579 164.3589 164.0410 162.5612 162.5612 162.2872 163.1312 164.0410 164.6841 165.3564 (39)
Average = Sum(39)m / 12 =	164.3574 (39)

HLP	Jan 1.2056 Feb 1.2029 Mar 1.2003 Apr 1.1880 May 1.1857 Jun 1.1750 Jul 1.1750 Aug 1.1730 Sep 1.1791 Oct 1.1857 Nov 1.1903 Dec 1.1952 (40)
HLP (average)	1.1880 (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												2.9139	(42)
Average daily hot water use (litres/day)												103.4046	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.7450	109.6089	105.4727	101.3365	97.2003	93.0641	93.0641	97.2003	101.3365	105.4727	109.6089	113.7450	(44)
Energy conte	168.6806	147.5291	152.2369	132.7238	127.3516	109.8948	101.8337	116.8556	118.2512	137.8104	150.4309	163.3582	(45)
Energy content (annual)	Total = Sum(45)m =											1626.9568	(45)

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Distribution loss (46)m = 0.15 x (45)m	25.3021	22.1294	22.8355	19.9086	19.1027	16.4842	15.2750	17.5283	17.7377	20.6716	22.5646	24.5037 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9400 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0476 (55)
Total storage loss												
32.4756 29.3328 32.4756 31.4280 32.4756 31.4280 32.4756 32.4756 31.4280 32.4756 31.4280 32.4756 (56)												
If cylinder contains dedicated solar storage												
32.4756 29.3328 32.4756 31.4280 32.4756 31.4280 32.4756 32.4756 31.4280 32.4756 31.4280 32.4756 (57)												
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
224.4186 197.8731 207.9749 186.6638 183.0896 163.8348 157.5717 172.5936 172.1912 193.5484 204.3709 219.0962 (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												
224.4186 197.8731 207.9749 186.6638 183.0896 163.8348 157.5717 172.5936 172.1912 193.5484 204.3709 219.0962 (64)												
Total per year (kWh/year) = Sum(64)m =												2283.2268 (64)
Heat gains from water heating, kWh/month												
100.6767 89.3286 95.2092 87.2827 86.9348 79.6920 78.4501 83.4449 82.4705 90.4124 93.1703 98.9070 (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	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326 (66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
68.5409 60.8774 49.5088 37.4814 28.0178 23.6538 25.5587 33.2222 44.5908 56.6183 66.0819 70.4458 (67)													
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
458.9972 463.7601 451.7576 426.2057 393.9511 363.6362 343.3841 338.6211 350.6236 376.1755 408.4302 438.7450 (68)													
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
55.3971 55.3971 55.3971 55.3971 55.3971 55.3971 55.3971 55.3971 55.3971 55.3971 55.3971 55.3971 (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)													
-116.5551 -116.5551 -116.5551 -116.5551 -116.5551 -116.5551 -116.5551 -116.5551 -116.5551 -116.5551 -116.5551 -116.5551 (71)													
Water heating gains (Table 5)													
135.3182 132.9295 127.9693 121.2259 116.8479 110.6834 105.4437 112.1571 114.5424 121.5220 129.4031 132.9395 (72)													
Total internal gains	779.5309	774.2417	745.9105	701.5877	655.4914	614.6481	591.0612	600.6751	626.4315	670.9904	720.5899	758.8050 (73)	

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a		g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast				4.3900	11.2829		0.6300	0.7000		0.7700		15.1377 (75)
Southeast				9.0400	36.7938		0.6300	0.7000		0.7700		101.6518 (77)
South				0.8000	46.7521		0.6300	0.7000		0.7700		11.4304 (78)
Southwest				2.8100	36.7938		0.6300	0.7000		0.7700		31.5975 (79)
West				0.8000	19.6403		0.6300	0.7000		0.7700		4.8019 (80)
Northwest				17.4500	11.2829		0.6300	0.7000		0.7700		60.1713 (81)
Solar gains	224.7907	408.3802	626.0564	887.8821	1096.4308	1133.2163	1073.9423	911.5995	715.7040	469.5280	273.8965	189.3606 (83)
Total gains	1004.3215	1182.6219	1371.9669	1589.4698	1751.9223	1747.8644	1665.0035	1512.2746	1342.1355	1140.5184	994.4864	948.1656 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec													
tau	41.4063	41.4982	41.5886	42.0185	42.0999	42.4831	42.4831	42.5549	42.3347	42.0999	41.9355	41.7650	
alpha	3.7604	3.7665	3.7726	3.8012	3.8067	3.8322	3.8322	3.8370	3.8223	3.8067	3.7957	3.7843	
util living area	0.9861	0.9738	0.9447	0.8700	0.7340	0.5593	0.4198	0.4764	0.7179	0.9164	0.9757	0.9887 (86)	
MIT	19.4533	19.6828	20.0409	20.4758	20.7925	20.9455	20.9859	20.9774	20.8595	20.4279	19.8596	19.4103 (87)	
Th 2	19.9156	19.9177	19.9198	19.9296	19.9315	19.9401	19.9401	19.9416	19.9367	19.9315	19.9277	19.9238 (88)	
util rest of house	0.9827	0.9676	0.9316	0.8403	0.6789	0.4789	0.3231	0.3743	0.6408	0.8901	0.9688	0.9859 (89)	
MIT 2	18.5218	18.7495	19.0999	19.5168	19.7922	19.9132	19.9357	19.9340	19.8569	19.4852	18.9342	18.4856 (90)	
Living area fraction	18.6469	18.8748	19.2262	19.6455	19.9264	20.0518	20.0767	20.0741	19.9915	19.6117	19.0584	18.6097 (92)	
MIT	18.6469	18.8748	19.2262	19.6455	19.9264	20.0518	20.0767	20.0741	19.9915	19.6117	19.0584	18.6097 (93)	
Temperature adjustment												0.0000	
adjusted MIT	18.6469	18.8748	19.2262	19.6455	19.9264	20.0518	20.0767	20.0741	19.9915	19.6117	19.0584	18.6097 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.9775 0.9599 0.9212 0.8313 0.6786 0.4878 0.3359 0.3875 0.6452 0.8806 0.9615 0.9814 (94)													
Useful gains	981.6925	1135.2240	1263.8980	1321.2515	1188.8930	852.6193	559.1962	585.9819	865.9410	1004.2890	956.2345	930.4893 (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	2392.8961	2325.6821	2113.2885	1766.1242	1349.4745	886.2443	565.1697	596.2535	961.0854	1478.2956	1969.3594	2382.7339 (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	1049.9355	799.9878	631.9466	320.3083	119.4726	0.0000	0.0000	0.0000	0.0000	352.6610	729.4499	1080.4699 (98)	

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Space heating
Space heating per m2 (98) / (4) = 5084.2317 (98)
36.7491 (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 %) 90.8000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5599.3741 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1049.9355	799.9878	631.9466	320.3083	119.4726	0.0000	0.0000	0.0000	0.0000	352.6610	729.4499	1080.4699 (98)
Space heating efficiency (main heating system 1)	90.8000	90.8000	90.8000	90.8000	90.8000	0.0000	0.0000	0.0000	0.0000	90.8000	90.8000	90.8000 (210)
Space heating fuel (main heating system)	1156.3167	881.0439	695.9764	352.7625	131.5777	0.0000	0.0000	0.0000	0.0000	388.3931	803.3590	1189.9449 (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	224.4186	197.8731	207.9749	186.6638	183.0896	163.8348	157.5717	172.5936	172.1912	193.5484	204.3709	219.0962 (64)
Efficiency of water heater (217)m	88.7131	88.4569	87.8928	86.5434	84.0091	80.1000	80.1000	80.1000	80.1000	86.6962	88.2208	88.1000 (216)
Fuel for water heating, kWh/month	252.9713	223.6945	236.6234	215.6880	217.9402	204.5378	196.7187	215.4727	214.9703	223.2489	231.6582	246.7296 (219)
Water heating fuel used												2680.2537 (219)
Annual totals kWh/year												
Space heating fuel - main system												5599.3741 (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)												484.1814 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.30 * 1004 * 1.00) =									-1044.1561			-1044.1561 (233)
Total delivered energy for all uses												7794.6531 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5599.3741	3.4800	194.8582 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2680.2537	3.4800	93.2728 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	484.1814	13.1900	63.8635 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-1044.1561	13.1900	-137.7242 (252)
Total energy cost			344.1629 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.4200 (256)
SAP value 0.7884 (257)
SAP rating (Section 12) 89.0022
SAP band B (258)

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	5599.3741	0.2160	1209.4648 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2680.2537	0.2160	578.9348 (264)
Space and water heating			1788.3996 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	484.1814	0.5190	251.2901 (268)
Energy saving/generation technologies			
PV Unit	-1044.1561	0.5190	-541.9170 (269)
Total kg/year			1536.6977 (272)
CO2 emissions per m2			11.1100 (273)
EI value			88.7692
EI rating			89 (274)

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EI band

B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9080 = 3.833$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9080 = 0.2379$, stars = 4
Water heating energy efficiency	$3.48 / 0.8498 = 4.095$, stars = 4
Water heating environmental impact	$0.216 / 0.8498 = 0.2542$, stars = 4

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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	70.4400 (1b)	x 2.3900 (2b)	= 168.3516 (1b) - (3b)
First floor	67.9100 (1c)	x 2.6700 (2c)	= 181.3197 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	138.3500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 349.6713 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.1430 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3745 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3183 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.3342	0.3104	0.3183	0.3024	0.3024	0.2944	0.2865	0.2785	0.2706	0.2944	0.2785	0.2944 (22b)
Effective ac	0.5559	0.5482	0.5507	0.5457	0.5457	0.5433	0.5410	0.5388	0.5366	0.5433	0.5388	0.5433 (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
Front Door			2.1200	1.1000	2.3320		(26a)
Windows (Uw = 1.20)			35.2900	1.1450	40.4084		(27)
Ground Floor			70.4400	0.1100	7.7484	140.0000	9861.6000 (28a)
Brick and Block	174.6000	37.4100	137.1900	0.2400	32.9256	42.2200	5792.1618 (29a)
Pitched Roof	70.4400		70.4400	0.1000	7.0440	9.0000	633.9600 (30)
Total net area of external elements Aum(A, m ²)			315.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	90.4584		(33)
Ground Floor Block			56.0900			75.0000	4206.7500 (32c)
Ground Floor Stud			54.0900			9.0000	486.8100 (32c)
First Floor Stud			159.5500			9.0000	1435.9500 (32c)
Internal Floor 1			67.9100			18.0000	1222.3800 (32d)
Internal Ceiling 1			67.9100			18.0000	1222.3800 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 24861.9918 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 179.7036 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.1310 (36)
Total fabric heat loss (33) + (36) = 99.5893 (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	64.1411	63.2532	63.5419	62.9719	62.9719	62.6978	62.4311	62.1717	61.9196	62.6978	62.1717	62.6978 (38)
Heat transfer coeff	163.7304	162.8426	163.1312	162.5612	162.5612	162.2872	162.0204	161.7610	161.5089	162.2872	161.7610	162.2872 (39)
Average = Sum(39)m / 12 =												162.3950 (39)
HLP	1.1835	1.1770	1.1791	1.1750	1.1750	1.1730	1.1711	1.1692	1.1674	1.1730	1.1692	1.1730 (40)
HLP (average)												1.1738 (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												2.9139 (42)
Average daily hot water use (litres/day)												103.4046 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.7450	109.6089	105.4727	101.3365	97.2003	93.0641	93.0641	97.2003	101.3365	105.4727	109.6089	113.7450 (44)
Energy conte	168.6806	147.5291	152.2369	132.7238	127.3516	109.8948	101.8337	116.8556	118.2512	137.8104	150.4309	163.3582 (45)
Energy content (annual)										Total = Sum(45)m =		1626.9568 (45)

FULL SAP CALCULATION PRINTOUT

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

Distribution loss (46)m = 0.15 x (45)m	25.3021	22.1294	22.8355	19.9086	19.1027	16.4842	15.2750	17.5283	17.7377	20.6716	22.5646	24.5037 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9400 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0476 (55)
Total storage loss												
32.4756	29.3328	32.4756	31.4280	32.4756	31.4280	32.4756	32.4756	31.4280	32.4756	31.4280	32.4756	(56)
If cylinder contains dedicated solar storage												
32.4756	29.3328	32.4756	31.4280	32.4756	31.4280	32.4756	32.4756	31.4280	32.4756	31.4280	32.4756	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
224.4186	197.8731	207.9749	186.6638	183.0896	163.8348	157.5717	172.5936	172.1912	193.5484	204.3709	219.0962 (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	224.4186	197.8731	207.9749	186.6638	183.0896	163.8348	157.5717	172.5936	172.1912	193.5484	204.3709	219.0962 (64)
Total per year (kWh/year) = Sum(64)m =												2283.2268 (64)
Heat gains from water heating, kWh/month												
100.6767	89.3286	95.2092	87.2827	86.9348	79.6920	78.4501	83.4449	82.4705	90.4124	93.1703	98.9070	(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	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.5409	60.8774	49.5088	37.4814	28.0178	23.6538	25.5587	33.2222	44.5908	56.6183	66.0819	70.4458	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	458.9972	463.7601	451.7576	426.2057	393.9511	363.6362	343.3841	338.6211	350.6236	376.1755	408.4302	438.7450	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	(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)	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	(71)
Water heating gains (Table 5)	135.3182	132.9295	127.9693	121.2259	116.8479	110.6834	105.4437	112.1571	114.5424	121.5220	129.4031	132.9395	(72)
Total internal gains	779.5309	774.2417	745.9105	701.5877	655.4914	614.6481	591.0612	600.6751	626.4315	670.9904	720.5899	758.8050	(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			

Northeast				4.3900	14.6176	0.6300	0.7000	0.7700	19.6116 (75)			
Southeast				9.0400	45.1778	0.6300	0.7000	0.7700	124.8147 (77)			
South				0.8000	56.7559	0.6300	0.7000	0.7700	13.8763 (78)			
Southwest				2.8100	45.1778	0.6300	0.7000	0.7700	38.7975 (79)			
West				0.8000	25.1925	0.6300	0.7000	0.7700	6.1593 (80)			
Northwest				17.4500	14.6176	0.6300	0.7000	0.7700	77.9551 (81)			

Solar gains	281.2145	436.8110	679.7734	975.7023	1147.6132	1288.6687	1211.6707	1052.7634	822.9947	543.2556	341.9599	232.5971 (83)
Total gains	1060.7454	1211.0527	1425.6838	1677.2900	1803.1046	1903.3168	1802.7318	1653.4386	1449.4262	1214.2460	1062.5497	991.4021 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	42.1798	42.4097	42.3347	42.4831	42.4831	42.5549	42.6249	42.6933	42.7599	42.5549	42.6933	42.5549
alpha	3.8120	3.8273	3.8223	3.8322	3.8322	3.8370	3.8417	3.8462	3.8507	3.8370	3.8462	3.8370
util living area	0.9812	0.9690	0.9308	0.8337	0.6771	0.4698	0.3464	0.3757	0.6367	0.8790	0.9637	0.9845 (86)
MIT	19.6184	19.8003	20.1705	20.5912	20.8604	20.9733	20.9936	20.9916	20.9177	20.5740	20.0484	19.5931 (87)
Th 2	19.9333	19.9384	19.9367	19.9401	19.9401	19.9416	19.9432	19.9447	19.9462	19.9416	19.9447	19.9416 (88)
util rest of house	0.9766	0.9617	0.9147	0.7977	0.6148	0.3889	0.2545	0.2768	0.5514	0.8422	0.9534	0.9806 (89)
MIT 2	18.6987	18.8810	19.2377	19.6284	19.8525	19.9302	19.9416	19.9426	19.9044	19.6261	19.1319	18.6805 (90)
Living area fraction												
MIT	18.8221	19.0044	19.3629	19.7576	19.9878	20.0702	20.0828	20.0834	20.0404	19.7533	19.2550	18.8030 (91)
Temperature adjustment												
adjusted MIT	18.8221	19.0044	19.3629	19.7576	19.9878	20.0702	20.0828	20.0834	20.0404	19.7533	19.2550	18.8030 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9703	0.9535	0.9042	0.7907	0.6178	0.3990	0.2668	0.2901	0.5596	0.8345	0.9448	0.9751	(94)
Useful gains	1029.2437	1154.7274	1289.0484	1326.2750	1114.0358	759.4041	481.0239	479.5921	811.0427	1013.3114	1003.8526	966.7069	(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	2279.4781	2231.6634	2016.7740	1667.4886	1217.2297	774.1491	483.2781	482.5971	862.5194	1355.6326	1836.7894	2240.0486	(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	930.1744	723.7010	541.4279	245.6737	76.7763	0.0000	0.0000	0.0000	0.0000	254.6870	599.7145	947.3662	(98)

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Space heating 4319.5210 (98)
Space heating per m2 (98) / (4) = 31.2217 (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 %)													90.8000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4757.1817 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	930.1744	723.7010	541.4279	245.6737	76.7763	0.0000	0.0000	0.0000	0.0000	254.6870	599.7145	947.3662	(98)
Space heating efficiency (main heating system 1)	90.8000	90.8000	90.8000	90.8000	90.8000	0.0000	0.0000	0.0000	0.0000	90.8000	90.8000	90.8000	(210)
Space heating fuel (main heating system)	1024.4211	797.0275	596.2862	270.5658	84.5553	0.0000	0.0000	0.0000	0.0000	280.4923	660.4785	1043.3549	(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	224.4186	197.8731	207.9749	186.6638	183.0896	163.8348	157.5717	172.5936	172.1912	193.5484	204.3709	219.0962	(64)
Efficiency of water heater	88.5021	88.2683	87.5542	85.8487	82.9893	80.1000	80.1000	80.1000	80.1000	85.8482	87.8184	88.5775	(216)
(217)m													(217)
Fuel for water heating, kWh/month	253.5744	224.1724	237.5385	217.4335	220.6183	204.5378	196.7187	215.4727	214.9703	225.4543	232.7199	247.3496	(219)
Water heating fuel used												2690.5605	(219)
Annual totals kWh/year													
Space heating fuel - main system												4757.1817	(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)												484.1814	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.30 * 1122 * 1.00) =										-1166.7975		-1166.7975	(233)
Total delivered energy for all uses												6840.1261	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4757.1817	10.2300	486.6597 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2690.5605	10.2300	275.2443 (247)
Pumps and fans for heating	75.0000	36.7200	27.5400 (249)
Energy for lighting	484.1814	36.7200	177.7914 (250)
Additional standing charges			103.0000 (251)
Energy saving/generation technologies			
PV Unit	-1166.7975	36.7200	-428.4480 (252)
Total energy cost			641.7874 (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	4757.1817	0.2160	1027.5513 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2690.5605	0.2160	581.1611 (264)
Space and water heating			1608.7123 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	484.1814	0.5190	251.2901 (268)
Energy saving/generation technologies			
PV Unit	-1166.7975	0.5190	-605.5679 (269)
Total kg/year			1293.3596 (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	4757.1817	1.2200	5803.7617 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2690.5605	1.2200	3282.4838 (264)
Space and water heating			9086.2455 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	484.1814	3.0700	1486.4368 (268)

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Energy saving/generation technologies
PV Unit -1166.7975 3.0700 -3582.0682 (269)
Primary energy kWh/year 7220.8641 (272)
Primary energy kWh/m2/year 52.1927 (273)

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 124	-275 kg (21.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£124 1.99 kg/m²	B 90	B 91
Total Savings	£124 1.99 kg/m²		

Potential energy efficiency rating: B 90
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
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	£205	£224	-£18
Mains gas	£865	£722	£143
Space heating	£617	£622	-£5
Water heating	£275	£146	£130
Lighting	£178	£178	£0
Generated (PV)	-£428	-£428	£0
Total cost of fuels	£642	£518	£125
Total cost of uses	£642	£518	£125
Delivered energy	49 kWh/m²	40 kWh/m²	10 kWh/m²
Carbon dioxide emissions	1.3 tonnes	1.0 tonnes	0.3 tonnes
CO2 emissions per m²	9 kg/m²	7 kg/m²	2 kg/m²
Primary energy	52 kWh/m²	41 kWh/m²	11 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	70.4400 (1b)	x 2.3900 (2b)	= 168.3516 (1b) - (3b)
First floor	67.9100 (1c)	x 2.6700 (2c)	= 181.3197 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	138.3500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 349.6713 (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					5 * 10 = 50.0000 (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)					50.0000 / (5) = 0.1430 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3745 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3183 (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	0.4059	0.3979	0.3899	0.3501	0.3422	0.3024	0.3024	0.2944	0.3183	0.3422	0.3581	0.3740 (22b)
Effective ac	0.5824	0.5792	0.5760	0.5613	0.5585	0.5457	0.5457	0.5433	0.5507	0.5585	0.5641	0.5699 (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
Front Door			2.1200	1.1000	2.3320		(26a)
Windows (Uw = 1.20)			35.2900	1.1450	40.4084		(27)
Ground Floor			70.4400	0.1100	7.7484	140.0000	9861.6000 (28a)
Brick and Block	174.6000	37.4100	137.1900	0.2400	32.9256	42.2200	5792.1618 (29a)
Pitched Roof	70.4400		70.4400	0.1000	7.0440	9.0000	633.9600 (30)
Total net area of external elements Aum(A, m ²)			315.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	90.4584		(33)
Ground Floor Block			56.0900			75.0000	4206.7500 (32c)
Ground Floor Stud			54.0900			9.0000	486.8100 (32c)
First Floor Stud			159.5500			9.0000	1435.9500 (32c)
Internal Floor 1			67.9100			18.0000	1222.3800 (32d)
Internal Ceiling 1			67.9100			18.0000	1222.3800 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 24861.9918 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 179.7036 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.1310 (36)
Total fabric heat loss (33) + (36) = 99.5893 (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	67.1993	66.8303	66.4686	64.7695	64.4517	62.9719	62.9719	62.6978	63.5419	64.4517	65.0947	65.7670 (38)
Heat transfer coeff	166.7887	166.4196	166.0579	164.3589	164.0410	162.5612	162.5612	162.2872	163.1312	164.0410	164.6841	165.3564 (39)
Average = Sum(39)m / 12 =												164.3574 (39)
HLP	1.2056	1.2029	1.2003	1.1880	1.1857	1.1750	1.1750	1.1730	1.1791	1.1857	1.1903	1.1952 (40)
HLP (average)												1.1880 (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												2.9139 (42)
Average daily hot water use (litres/day)												103.4046 (43)
Daily hot water use	113.7450	109.6089	105.4727	101.3365	97.2003	93.0641	93.0641	97.2003	101.3365	105.4727	109.6089	113.7450 (44)
Energy conte	168.6806	147.5291	152.2369	132.7238	127.3516	109.8948	101.8337	116.8556	118.2512	137.8104	150.4309	163.3582 (45)
Energy content (annual)										Total = Sum(45)m =		1626.9568 (45)

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CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	25.3021	22.1294	22.8355	19.9086	19.1027	16.4842	15.2750	17.5283	17.7377	20.6716	22.5646	24.5037 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9400 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0476 (55)
Total storage loss												
32.4756 29.3328 32.4756 31.4280 32.4756 31.4280 32.4756 32.4756 31.4280 32.4756 31.4280 32.4756 (56)												
If cylinder contains dedicated solar storage												
20.2973 18.3330 20.2973 19.6425 20.2973 19.6425 20.2973 20.2973 19.6425 20.2973 19.6425 20.2973 (57)												
Primary loss												
23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120 23.2624 (59)												
Total heat required for water heating calculated for each month												
212.2403 186.8733 194.4008 168.1247 158.1170 139.4426 132.3664 148.3188 155.0029 179.9743 192.5854 206.9178 (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												1.1147 (H8)
Utilisation factor												0.5922 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												112.5000 (H13)
Daily hot water demand												103.4046 (H14)
Volume ratio Veff/V												1.0880 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-944.4442 (H17)
Solar input	-27.3870	-45.7010	-77.8341	-104.3130	-128.8699	-126.6997	-125.0253	-109.2352	-85.5531	-58.4227	-32.4849	-22.9182 (63)
Solar input (sum of months) = Sum (63)m =												-944.4442 (63)
Output from w/h												
184.8533 141.1723 116.5667 63.8117 29.2470 12.7429 7.3411 39.0836 69.4498 121.5516 160.1004 183.9996 (64)												
Total per year (kWh/year) = Sum (64)m =												1129.9200 (64)
Heat gains from water heating, kWh/month												
90.9340 80.5288 84.3499 72.4514 66.9567 60.1782 58.2859 64.0251 68.7198 79.5531 83.7419 89.1643 (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	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.5409	60.8774	49.5088	37.4814	28.0178	23.6538	25.5587	33.2222	44.5908	56.6183	66.0819	70.4458 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	458.9972	463.7601	451.7576	426.2057	393.9511	363.6362	343.3841	338.6211	350.6236	376.1755	408.4302	438.7450 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971 (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)	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551 (71)
Water heating gains (Table 5)	122.2232	119.8345	113.3735	100.6269	89.9955	83.5809	78.3412	86.0552	95.4442	106.9262	116.3081	119.8445 (72)
Total internal gains	766.4359	761.1467	731.3147	680.9887	628.6391	587.5456	563.9587	574.5732	607.3333	656.3946	707.4949	745.7100 (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
Northeast				4.3900	11.2829		0.6300		0.7000		0.7700		15.1377 (75)
Southeast				9.0400	36.7938		0.6300		0.7000		0.7700		101.6518 (77)
South				0.8000	46.7521		0.6300		0.7000		0.7700		11.4304 (78)
Southwest				2.8100	36.7938		0.6300		0.7000		0.7700		31.5975 (79)
West				0.8000	19.6403		0.6300		0.7000		0.7700		4.8019 (80)
Northwest				17.4500	11.2829		0.6300		0.7000		0.7700		60.1713 (81)
Solar gains	224.7907	408.3802	626.0564	887.8821	1096.4308	1133.2163	1073.9423	911.5995	715.7040	469.5280	273.8965		189.3606 (83)
Total gains	991.2265	1169.5269	1357.3711	1568.8708	1725.0699	1720.7619	1637.9010	1486.1727	1323.0373	1125.9226	981.3914		935.0706 (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)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	41.4063	41.4982	41.5886	42.0185	42.0999	42.4831	42.4831	42.5549	42.3347	42.0999	41.9355	41.7650
util living area	3.7604	3.7665	3.7726	3.8012	3.8067	3.8322	3.8322	3.8370	3.8223	3.8067	3.7957	3.7843
0.9867 0.9747 0.9463 0.8739 0.7408 0.5665 0.4262 0.4838 0.7243 0.9191 0.9767 0.9892 (86)												
MIT	19.4427	19.6727	20.0309	20.4656	20.7856	20.9431	20.9851	20.9762	20.8549	20.4190	19.8494	19.3995 (87)
Th 2	19.9156	19.9177	19.9198	19.9296	19.9315	19.9401	19.9401	19.9416	19.9367	19.9315	19.9277	19.9238 (88)
util rest of house												
0.9835 0.9687 0.9335 0.8447 0.6860 0.4856 0.3283 0.3805 0.6475 0.8935 0.9701 0.9865 (89)												
MIT 2	18.5114	18.7397	19.0905	19.5078	19.7870	19.9119	19.9355	19.9336	19.8540	19.4773	18.9243	18.4749 (90)
Living area fraction												
fLA = Living area / (4) =												0.1342 (91)

MIT	18.6364	18.8649	19.2167	19.6364	19.9210	20.0503	20.0763	20.0735	19.9883	19.6037	19.0484	18.5990 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6364	18.8649	19.2167	19.6364	19.9210	20.0503	20.0763	20.0735	19.9883	19.6037	19.0484	18.5990 (93)

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	5656.3322	0.2160	1221.7678 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1288.1219	0.2160	278.2343 (264)
Space and water heating			1500.0021 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	484.1814	0.5190	251.2901 (268)
Energy saving/generation technologies			
PV Unit	-1044.1561	0.5190	-541.9170 (269)
Total kg/year			1274.2502 (272)
CO2 emissions per m2			9.2100 (273)
EI value			90.6872
EI rating			91 (274)
EI band			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.4400 (1b)	x 2.3900 (2b)	= 168.3516 (1b) - (3b)
First floor	67.9100 (1c)	x 2.6700 (2c)	= 181.3197 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	138.3500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 349.6713 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.1430 (8)
Pressure test					Yes
Measured/design AP50					4.6300
Infiltration rate					0.3745 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3183 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.3342	0.3104	0.3183	0.3024	0.3024	0.2944	0.2865	0.2785	0.2706	0.2944	0.2785	0.2944 (22b)
Effective ac	0.5559	0.5482	0.5507	0.5457	0.5457	0.5433	0.5410	0.5388	0.5366	0.5433	0.5388	0.5433 (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
Front Door			2.1200	1.1000	2.3320		(26a)
Windows (Uw = 1.20)			35.2900	1.1450	40.4084		(27)
Ground Floor			70.4400	0.1100	7.7484	140.0000	9861.6000 (28a)
Brick and Block	174.6000	37.4100	137.1900	0.2400	32.9256	42.2200	5792.1618 (29a)
Pitched Roof	70.4400		70.4400	0.1000	7.0440	9.0000	633.9600 (30)
Total net area of external elements Aum(A, m ²)			315.4800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	90.4584		(33)
Ground Floor Block			56.0900			75.0000	4206.7500 (32c)
Ground Floor Stud			54.0900			9.0000	486.8100 (32c)
First Floor Stud			159.5500			9.0000	1435.9500 (32c)
Internal Floor 1			67.9100			18.0000	1222.3800 (32d)
Internal Ceiling 1			67.9100			18.0000	1222.3800 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 24861.9918 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 179.7036 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.1310 (36)
Total fabric heat loss (33) + (36) = 99.5893 (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	64.1411	63.2532	63.5419	62.9719	62.9719	62.6978	62.4311	62.1717	61.9196	62.6978	62.1717	62.6978 (38)
Heat transfer coeff	163.7304	162.8426	163.1312	162.5612	162.5612	162.2872	162.0204	161.7610	161.5089	162.2872	161.7610	162.2872 (39)
Average = Sum(39)m / 12 =												162.3950 (39)
HLP	1.1835	1.1770	1.1791	1.1750	1.1750	1.1730	1.1711	1.1692	1.1674	1.1730	1.1692	1.1730 (40)
HLP (average)												1.1738 (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												2.9139 (42)
Average daily hot water use (litres/day)												103.4046 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.7450	109.6089	105.4727	101.3365	97.2003	93.0641	93.0641	97.2003	101.3365	105.4727	109.6089	113.7450 (44)
Energy conte	168.6806	147.5291	152.2369	132.7238	127.3516	109.8948	101.8337	116.8556	118.2512	137.8104	150.4309	163.3582 (45)
Energy content (annual)										Total = Sum(45)m =		1626.9568 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Distribution loss (46)m = 0.15 x (45)m	25.3021	22.1294	22.8355	19.9086	19.1027	16.4842	15.2750	17.5283	17.7377	20.6716	22.5646	24.5037 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9400 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0476 (55)
Total storage loss												
32.4756 29.3328 32.4756 31.4280 32.4756 31.4280 32.4756 32.4756 31.4280 32.4756 31.4280 32.4756 (56)												
If cylinder contains dedicated solar storage												
20.2973 18.3330 20.2973 19.6425 20.2973 19.6425 20.2973 20.2973 19.6425 20.2973 19.6425 20.2973 (57)												
Primary loss												
23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120 23.2624 (59)												
Total heat required for water heating calculated for each month												
212.2403 186.8733 194.4008 168.1247 158.1170 139.4426 132.3664 148.3188 155.0029 179.9743 192.5854 206.9178 (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												1.2475 (H8)
Utilisation factor												0.5514 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												112.5000 (H13)
Daily hot water demand												103.4046 (H14)
Volume ratio Veff/V												1.0880 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-984.0446 (H17)
Solar input	-32.1019	-45.6469	-78.4560	-105.8553	-124.3335	-132.8078	-130.0148	-116.3672	-91.1075	-62.9886	-37.9681	-26.3971 (63)
Solar input (sum of months) = Sum (63)m =												-984.0446 (63)
Output from w/h												
180.1384 141.2265 115.9448 62.2693 33.7835 6.6348 2.3516 31.9516 63.8954 116.9857 154.6173 180.5207 (64)												
Total per year (kWh/year) = Sum (64)m =												1090.3195 (64)
Heat gains from water heating, kWh/month												
90.9340 80.5288 84.3499 72.4514 66.9567 60.1782 58.2859 64.0251 68.7198 79.5531 83.7419 89.1643 (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	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326	174.8326 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.5409	60.8774	49.5088	37.4814	28.0178	23.6538	25.5587	33.2222	44.5908	56.6183	66.0819	70.4458 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	458.9972	463.7601	451.7576	426.2057	393.9511	363.6362	343.3841	338.6211	350.6236	376.1755	408.4302	438.7450 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971	55.3971 (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)	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551	-116.5551 (71)
Water heating gains (Table 5)	122.2232	119.8345	113.3735	100.6269	89.9955	83.5809	78.3412	86.0552	95.4442	106.9262	116.3081	119.8445 (72)
Total internal gains	766.4359	761.1467	731.3147	680.9887	628.6391	587.5456	563.9587	574.5732	607.3333	656.3946	707.4949	745.7100 (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
Northeast	4.3900	14.6176	0.6300	0.7000	0.7700	19.6116 (75)
Southeast	9.0400	45.1778	0.6300	0.7000	0.7700	124.8147 (77)
South	0.8000	56.7559	0.6300	0.7000	0.7700	13.8763 (78)
Southwest	2.8100	45.1778	0.6300	0.7000	0.7700	38.7975 (79)
West	0.8000	25.1925	0.6300	0.7000	0.7700	6.1593 (80)
Northwest	17.4500	14.6176	0.6300	0.7000	0.7700	77.9551 (81)

Solar gains	281.2145	436.8110	679.7734	975.7023	1147.6132	1288.6687	1211.6707	1052.7634	822.9947	543.2556	341.9599	232.5971 (83)
Total gains	1047.6504	1197.9577	1411.0880	1656.6910	1776.2523	1876.2143	1775.6294	1627.3366	1430.3280	1199.6502	1049.4547	978.3071 (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)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	42.1798	42.4097	42.3347	42.4831	42.4831	42.5549	42.6249	42.6933	42.7599	42.5549	42.6933	42.5549
util living area	3.8120	3.8273	3.8223	3.8322	3.8322	3.8370	3.8417	3.8462	3.8507	3.8370	3.8462	3.8370
0.9819 0.9700 0.9327 0.8380 0.6840 0.4759 0.3515 0.3814 0.6429 0.8824 0.9650 0.9851 (86)												
MIT	19.6079	19.7904	20.1611	20.5825	20.8553	20.9721	20.9933	20.9911	20.9149	20.5665	20.0387	19.5824 (87)
Th 2	19.9333	19.9384	19.9367	19.9401	19.9401	19.9416	19.9432	19.9447	19.9462	19.9416	19.9447	19.9416 (88)
util rest of house												
0.9775 0.9629 0.9169 0.8025 0.6219 0.3942 0.2584 0.2812 0.5575 0.8463 0.9550 0.9814 (89)												
MIT 2	18.6884	18.8714	19.2289	19.6210	19.8491	19.9297	19.9415	19.9425	19.9028	19.6196	19.1226	18.6700 (90)
Living area fraction												fLA = Living area / (4) = 0.1342 (91)

MIT	18.8119	18.9947	19.3540	19.7501	19.9841	20.0696	20.0827	20.0832	20.0386	19.7467	19.2456	18.7925 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8119	18.9947	19.3540	19.7501	19.9841	20.0696	20.0827	20.0832	20.0386	19.7467	19.2456	18.7925 (93)

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4808.8877	0.2160	1038.7197 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1244.3294	0.2160	268.7751 (264)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Space and water heating			1307.4949 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	484.1814	0.5190	251.2901 (268)
Energy saving/generation technologies			
PV Unit	-1166.7975	0.5190	-605.5679 (269)
Total kg/year			1018.0921 (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	4808.8877	1.2200	5866.8429 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1244.3294	1.2200	1518.0818 (264)
Space and water heating			7384.9248 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	484.1814	3.0700	1486.4368 (268)
Energy saving/generation technologies			
PV Unit	-1166.7975	3.0700	-3582.0682 (269)
Primary energy kWh/year			5673.0434 (272)
Primary energy kWh/m2/year			41.0050 (273)

U-VALUE CALCULATOR REPORT

Property Reference	SAP 0645 Plot 41	Issued on Date	22/09/2023
Assessment Reference	As Built	Prop Type Ref	Kv
Project	15, Fieldfare Crescent, Botley, Southampton, SO32 2TW		
Calculation Type	New Build (As Built)		

SAP Rating	89 B	DER	12.52	TER	16.41
Environmental	89 B	% DER<TER	23.71		
CO ₂ Emissions (t/year)	1.29	DFEE	47.03	TFEE	58.54
General Requirements Compliance	Pass	% DFEE<TFEE	19.66		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	Assessor ID	E477-0001
Client	Foreman Homes, FORE		

Building Elements

Roof 000002 - Mineral Wool between and above

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	Mineral wool batt				
	Main construction	350	0.0380	9.2105	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 2	Mineral wool batt				
	Main construction	100	0.0380	2.6316	87.50
	Main construction	100	0.1300	0.7692	12.50
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	Plasterboard, standard				
	Main construction	12.5	0.2100	0.0595	100.00
Int surface				0.1000	

Total resistance: Upper limit = 11.772 m² K/W Lower limit = 11.430 m² K/W Average = 11.601 m² K/W
Total correction = 0.0096 m² K/W U-value (unrounded) = 0.1 W/m² K

Unheated space: None

Total thickness: 463 mm

U-value: 0.10 W/m² K

Kappa: n/a

U-VALUE CALCULATOR REPORT

Property Reference	SAP 0645 Plot 41	Issued on Date	22/09/2023
Assessment Reference	As Built	Prop Type Ref	Kv
Project	15, Fieldfare Crescent, Botley, Southampton, SO32 2TW		
Calculation Type	New Build (As Built)		

SAP Rating	89 B	DER	12.52	TER	16.41
Environmental	89 B	% DER<TER	23.71		
CO ₂ Emissions (t/year)	1.29	DFEE	47.03	TFEE	58.54
General Requirements Compliance	Pass	% DFEE<TFEE	19.66		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	Assessor ID	E477-0001
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Client	Foreman Homes, FORE
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Building Elements

Wall 000003

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)	Density (kg/m ³)	Heat Cap. (J/kgK)
Ext surface				0.0400			
Layer 1	Brick, outer leaf						
	Main construction	102	0.7700	0.1325	82.81		
	Main construction	102	0.9407	0.1084	17.19		
Layer 2	Supafil 34						
	Main construction	100	0.0340	2.9412	100.00		
	Corrections - Air Gap: Level 0, Fasteners: None or plastic						
Layer 3	Supabloc						
	Main construction	100	0.1100	0.9091	94.04	460	1000
	Main construction	100	0.8803	0.1136	5.96	460	1000
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	airspace/plaster dabs						
	Main construction	15	0.0882	0.1700	80.00		
	Main construction	15	0.0882	0.1700	20.00		
	Corrections - Cavity Unventilated, Emissivity: Normal						
Layer 5	Plasterboard, standard						
	Main construction	12.5	0.2100	0.0595	100.00	700	1000
Int surface				0.1300			

Total resistance:	Upper limit = 4.321 m ² K/W	Lower limit = 4.110 m ² K/W	Average = 4.215 m ² K/W
	Total correction = 0.0002 m ² K/W	U-value (unrounded) = 0.24 W/m ² K	

Unheated space: None		
Total thickness: 330 mm	U-value: 0.24 W/m² K	Kappa: 42.22 kJ/m² K

U-VALUE CALCULATOR REPORT

Property Reference	SAP 0645 Plot 41	Issued on Date	22/09/2023
Assessment Reference	As Built	Prop Type Ref	Kv
Project	15, Fieldfare Crescent, Botley, Southampton, SO32 2TW		
Calculation Type	New Build (As Built)		

SAP Rating	89 B	DER	12.52	TER	16.41
Environmental	89 B	% DER<TER	23.71		
CO ₂ Emissions (t/year)	1.29	DFEE	47.03	TFEE	58.54
General Requirements Compliance	Pass	% DFEE<TFEE	19.66		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	Assessor ID	E477-0001
Client	Foreman Homes, FORE		

Building Elements

Floor 000004 - Floor - suspended beam-and-block floor

Floor Type: Suspended Floor

Area = 70.35 m², Perimeter = 36.36 m, Wall thickness = 300.00 mm, Soil: Clay

Depth of underfloor space below ground: 0.200 m Floor wind shielding: Average (suburban)

Floor height above ground: h = 0.000 m

U-value of walls above ground: U_w = 1.500 m

Ventilation openings per perimeter length: e = 0.0015 %

Mean wind speed: v = 5.000 m/s

Resistance on solum: R_g = 0.000 m²K/W

Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)	Density (kg/m ³)	Heat Cap. (J/kgK)
Ext surface				0.1700			
Layer 1	Extruded polystyrene						
	Main construction	100	0.0270	3.7037	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 2	Extruded polystyrene						
	Main construction	200	0.0270	7.4074	91.67		
	Main construction	200	2.3000	0.0870	8.33		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 3	Concrete, reinforced (1% steel)						
	Main construction	75	2.3000	0.0326	100.00	2000	1000
Layer 4	Screed						
	Main construction	75	1.1500	0.0652	100.00	1200	1000
Int surface				0.1700			

Total resistance:	Upper limit = 10.093 m ² K/W	Lower limit = 5.066 m ² K/W	Average = 7.579 m ² K/W
	Total correction = 0.0025 m ² K/W	U-value (unrounded) = 0.11 W/m ² K	

Unheated space: None

Total thickness: 450 mm

U-value: 0.11 W/m² K

Kappa: 140.00 kJ/m² K

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

Property Reference	SAP 0645 Plot 41	Issued on Date	22/09/2023
Assessment Reference	As Built	Prop Type Ref	Kv
Property	15, Fieldfare Crescent, Botley, Southampton, SO32 2TW		
SAP Rating	89 B	DER	12.52
Environmental	89 B	TER	16.41
CO ₂ Emissions (t/year)	1.29	% DER<TER	23.71
General Requirements Compliance	Pass	DFEE	47.03
		TFEE	58.54
		% DFEE<TFEE	19.66
Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com		Assessor ID
			E477-0001
Client	Foreman Homes, FORE		

SUMMARY FOR INPUT DATA FOR: New Build (As Built)

Orientation	South East
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Detached
2.0 Number of Storeys	2
3.0 Date Built	2019
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements		Heat Loss Perimeter	Internal Floor Area	Average Storey Height
	Ground Floor:	36.22 m	70.44 m ²	2.39 m
	1st Storey:	32.97 m	67.91 m ²	2.67 m

7.0 Living Area	18.57	m ²
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8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	179.7	kJ/m ² K

9.0 External Walls			U-Value	Kappa	Gross Area	Nett Area
Description	Type	Construction	(W/m ² K)	(kJ/m ² K)	(m ²)	(m ²)
Brick and Block	Cavity Wall	Other	0.24	42.22	174.60	137.19

9.2 Internal Walls		Construction	Kappa	Area
Description			(kJ/m ² K)	(m ²)
Ground Floor Block		Dense block, plasterboard on dabs	75.00	56.09
Ground Floor Stud		Plasterboard on timber frame	9.00	54.09
First Floor Stud		Plasterboard on timber frame	9.00	159.55

10.0 External Roofs			U-Value	Kappa	Gross Area	Nett Area
Description	Type	Construction	(W/m ² K)	(kJ/m ² K)	(m ²)	(m ²)
Pitched Roof	External Plane Roof	Plasterboard, insulated at ceiling level	0.10	9.00	70.44	70.44

10.2 Internal Ceilings		Construction	Kappa	Area
Description			(kJ/m ² K)	(m ²)
Internal Ceiling 1		Plasterboard ceiling, carpeted chipboard floor	9.00	67.91

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Ground Floor	Ground Floor - Solid	Other	0.11	140.00	70.44

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Plasterboard ceiling, carpeted chipboard floor	18.00	67.91

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Front Door	Manufacture	Half Glazed Door	Double Low-E Soft 0.1			0.63		0.70	1.10
Windows	Manufacture	Window	Double Low-E Soft 0.1			0.63		0.70	1.20

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front Elevation	Half Glazed Door	[1] Brick and Block	South East							2.12	
Front Elevation	Window	[1] Brick and Block	South East	None	0.40	Yes				0.84	
Front Elevation	Window	[1] Brick and Block	South East	None	0.00					8.20	
Side Bay	Window	[1] Brick and Block	South	None	0.00					0.80	
Side Bay	Window	[1] Brick and Block	West	None	0.00					0.80	
Side	Window	[1] Brick and Block	South West	None	0.00					2.81	
Rear Elevation	Window	[1] Brick and Block	North West	None	0.00					17.45	
Side Elevation	Window	[1] Brick and Block	North East	None	0.00					4.39	

14.0 Conservatory

None

15.0 Draught Proofing

100

%

16.0 Draught Lobby

No

17.0 Thermal Bridging

Calculate Bridges

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported	Reference:
Independently assessed	E2 Other lintels (including other steel lintels)	1.89	0.077	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	4.58	0.071	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	3.60	0.067	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.41	0.070	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	6.28	0.067	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	5.54	0.056	No	Birtley Supatherm
Table K1 - Approved	E2 Other lintels (including other steel lintels)	1.96	0.300	No	
Independently assessed	E3 Sill	18.30	0.021	No	Knauf P5
Independently assessed	E4 Jamb	51.00	0.016	No	Knauf P6
Independently assessed	E5 Ground floor (normal)	36.22	0.062	No	BE-E5-23902
Independently assessed	E6 Intermediate floor within a dwelling	32.97	0.000	No	CD0029
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	38.07	0.060	No	
Table K1 - Default	E24 Eaves (insulation at ceiling level - inverted)	4.66	0.240	No	
Independently assessed	E12 Gable (insulation at ceiling level)	2.48	0.044	No	Knauf P21
Independently assessed	E16 Corner (normal)	34.51	0.039	No	Knauf P23
Independently assessed	E17 Corner (inverted – internal area greater than external area)	14.31	-0.091	No	Knauf P24

Y-value	0.029	W/m²K
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18.0 Pressure Testing

Designed AP ₅₀	5.00	m³/(h.m²) @ 50 Pa
Property Tested ?	Yes	
As Built AP ₅₀	4.63	m³/(h.m²) @ 50 Pa

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows half open
Cross ventilation possible	Yes
Night Ventilation	Yes
Air change rate	4.00

Mechanical Ventilation

Mechanical Ventilation System Present	No
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20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				5
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System

No

22.0 Lighting

Internal

Total number of light fittings	28	
Total number of L.E.L. fittings	28	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	Yes
Light and motion sensor	Yes

23.0 Electricity Tariff

Standard

24.0 Main Heating 1

0 Main Heating 1		Database	
Description		System Boiler	
Percentage of Heat		100	%
Database Ref. No.		18913	
Fuel Type		Mains gas	
Main Heating		BGB	
SAP Code		102	
In Winter		90.8	
In Summer		80.1	
Controls		CBE Programmer, room thermostat and TRVs	
PCDF Controls		0	
Delayed Start Stat		No	
Sap Code		2106	
Flue Type		Balanced	
Fan Assisted Flue		Yes	
Is MHS Pumped		Pump in heated space	
Heat Emitter		Radiators	
Flow Temperature		Normal (> 45°C)	

25.0 Main Heating 2

None

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

Community Heating	None			
28.0 Water Heating	HWP From main heating 1			
Water Heating	Main Heating 1			
Flue Gas Heat Recovery System	No			
Waste Water Heat Recovery Instantaneous System 1	No			
Waste Water Heat Recovery Instantaneous System 2	No			
Waste Water Heat Recovery Storage System	No			
Solar Panel	No			
Water use <= 125 litres/person/day	Yes			
SAP Code	901			
29.0 Hot Water Cylinder	Hot Water Cylinder			
Cylinder Stat	Yes			
Cylinder In Heated Space	Yes			
Independent Time Control	Yes			
Insulation Type	Measured Loss			
Cylinder Volume	200.00	L		
Loss	1.94	kWh/day		
Pipes insulation	Fully insulated primary pipework			
31.0 Thermal Store	None			
32.0 Photovoltaic Unit	One Dwelling			
PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
1.30	South West	45°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£124	B 90	