



SAP Report Submission for Building Regulations Compliance

Client: Foreman Homes

Project: Plot 135

Contact: Tobias Whiting
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Report Issue Date: 28/03/2023

EXCELLENCE
IN ENERGY
ASSESSMENT

PREDICTED ENERGY ASSESSMENT

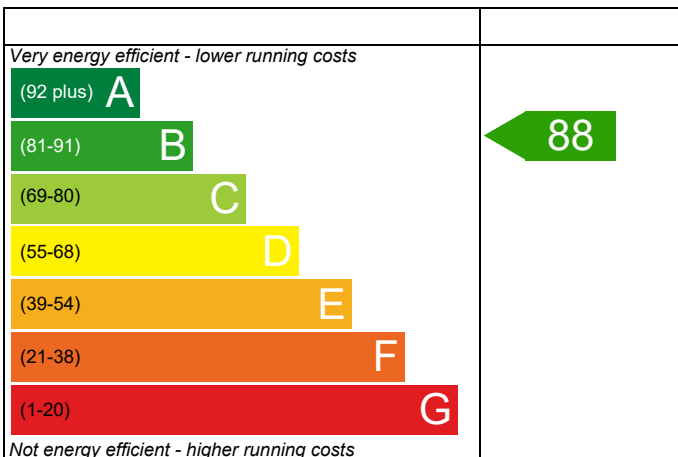
Plot 135

Dwelling type: House, Detached
Date of assessment: 28/03/2023
Produced by: Abacus Energy (UK) Ltd
Total floor area: 94.54 m²
DRRN: 3227-1174-8055

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO₂) emissions.

Energy Efficiency Rating

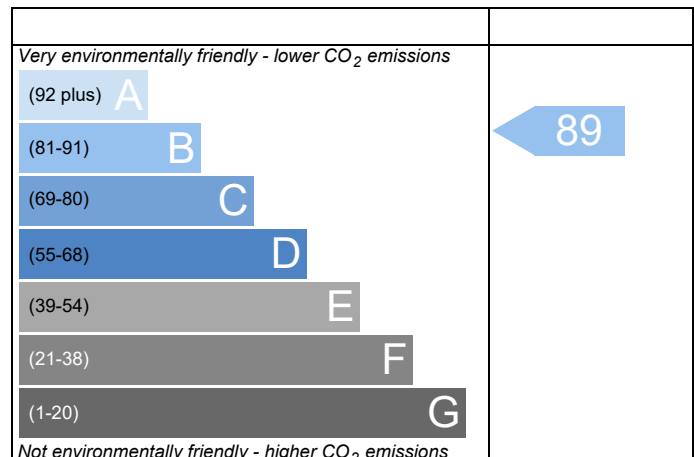


England

EU Directive
2002/91/EC

The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO₂) Rating



England

EU Directive
2002/91/EC

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

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 Designed)

Property Reference	SAP 0879 Plot 135			Issued on Date	28/03/2023
Assessment Reference	Rev A	Prop Type Ref	Ingleby		
Property	Plot 135				
SAP Rating	88 B	DER	14.06	TER	18.44
Environmental	89 B	% DER<TER	23.74		
CO ₂ Emissions (t/year)	0.94	DFEE	48.96	TFEE	57.17
General Requirements Compliance	Pass	% DFEE<TFEE	14.36		
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 Designed)

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)	18.44	kgCO ₂ /m ²	
Dwelling Carbon Dioxide Emission Rate (DER)	14.06	kgCO ₂ /m ²	Pass
	-4.38 (-23.8%)	kgCO ₂ /m ²	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	57.17	kWh/m ² /yr	
Dwelling Fabric Energy Efficiency (DFEE)	48.96	kWh/m ² /yr	
	-8.2 (-14.3%)	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	0.12 (max. 0.25)	0.12 (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	5.00 (design value)	m ³ /(h.m ²) @ 50 Pa	
Maximum	10.0	m ³ /(h.m ²) @ 50 Pa	Pass

Limiting System Efficiencies

4 Heating efficiency

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BUILDING REGULATION COMPLIANCE

Calculation Type: New Build (As Designed)

Main heating system

Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 36CDi Compact ErP
Combi boiler
Efficiency: 89.8% SEDBUK2009
Minimum: 88.0%

Pass

Secondary heating system

None

5 Cylinder insulation

Hot water storage

No cylinder

6 Controls

Space heating controls

Programmer, room thermostat and TRVs

Pass

Hot water controls

No cylinder

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 East

7.08 m², No overhang

Windows facing West

10.10 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

5.00 (design value)

m³/(h.m²) @ 50 Pa

Maximum

10.0

m³/(h.m²) @ 50 Pa

Pass

10 Key features

Roof U-value

0.10

W/m²K

Floor U-value

0.12

W/m²K

Door U-value

1.10

W/m²K

Thermal bridging y-value

0.036

W/m²K

Photovoltaic array

1.10

kW

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RECOMMENDATIONS

	Typical cost	Typical savings per year	Energy efficiency	Environmental impact	Result
Low energy lights			0	0	Already installed
Solar water heating	£4,000 - £6,000	£81	B 89	B 91	Recommended
Photovoltaic			0	0	Already installed
Wind turbine			0	0	Not applicable
Totals	£4,000 - £6,000	£81	B 89	B 91	

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THERMAL BRIDGING

Calculation Type: New Build (As Designed)

Property Reference	SAP 0879 Plot 135	Issued on Date	28/03/2023
Assessment Reference	Rev A	Prop Type Ref	Ingleby
Property	Plot 135		

SAP Rating	88 B	DER	14.06	TER	18.44
Environmental	89 B	% DER<TER	23.74		
CO ₂ Emissions (t/year)	0.94	DFEE	48.96	TFEE	57.17
General Requirements Compliance	Pass	% DFEE<TFEE	14.36		

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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	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.077	0.69	0.05	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.070	2.73	0.19	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.071	1.02	0.07	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.064	7.49	0.48	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.067	1.59	0.11	Birtley Supatherm
External wall	E3 Sill	Independently assessed	0.021	9.99	0.21	Knauf P5
External wall	E4 Jamb	Independently assessed	0.016	33.90	0.54	Knauf P6
External wall	E5 Ground floor (normal)	Table K1 - Approved	0.160	27.86	4.46	
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.000	27.86	0.00	CD0029
External wall	E10 Eaves (insulation at ceiling level)	Table K1 - Approved	0.060	15.87	0.95	
External wall	E12 Gable (insulation at ceiling level)	Independently assessed	0.044	12.05	0.53	Knauf P21
External wall	E16 Corner (normal)	Independently assessed	0.039	19.92	0.78	Knauf P23

Total: **8.37** W/mK:
Y-Value: **0.036** W/m²K:

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	SAP 0879 Plot 135				Issued on Date	28/03/2023
Assessment Reference	Rev A	Prop Type Ref	Ingleby			
Property	Plot 135					
SAP Rating	88 B	DER	14.06	TER	18.44	
Environmental	89 B	% DER<TER	23.74			
CO ₂ Emissions (t/year)	0.94	DFEE	48.96	TFEE	57.17	
General Requirements Compliance	Pass	% DFEE<TFEE	14.36			
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Client	Foreman Homes, FORE					

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Detached House, total floor area 95 m²

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

1a TER and DER

Fuel for main heating:Mains gas

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 18.44 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 14.06 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)57.2 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)49.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Floor	0.12 (max. 0.25)	0.12 (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:	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas

Data from database

Worcester Greenstar 36CDi Compact ErP

Combi boiler

Efficiency: 89.8% SEDBUK2009

Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Southern England): Slight OK

Based on:

Overshading:

Average

Windows facing East: 7.08 m², No overhang

Windows facing West: 10.10 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 0.12 W/m²K

Door U-value 1.10 W/m²K

Thermal bridging y-value 0.036 W/m²K

Photovoltaic array 1.10 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.2700 (1b)	x 2.3900 (2b)	= 112.9753 (1b) - (3b)
First floor	47.2700 (1c)	x 2.6100 (2c)	= 123.3747 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.3500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1692 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4192 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3878 (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	0.4944	0.4847	0.4751	0.4266	0.4169	0.3684	0.3684	0.3587	0.3878	0.4169	0.4363	0.4557 (22b)
Effective ac	0.6222	0.6175	0.6128	0.5910	0.5869	0.5679	0.5679	0.5643	0.5752	0.5869	0.5952	0.6038 (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			2.1500	1.1000	2.3650		(26)
Windows & Fully Glazed Do (Uw = 1.20)			17.1800	1.1450	19.6718		(27)
Ground Floor			47.2700	0.1200	5.6724	90.0000	4254.3000 (28a)
Brick and Block	139.3000	19.3300	119.9700	0.2400	28.7928	42.2200	5065.1334 (29a)
External Roof 1	47.2700		47.2700	0.1000	4.7270	9.1000	430.1570 (30)
Total net area of external elements Aum(A, m ²)			233.8400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.2290		(33)
GF Block			57.4300			75.0000	4307.2500 (32c)
GF Timber Stud			29.3300			9.0000	263.9700 (32c)
FF Timber Stud			129.3600			9.0000	1164.2400 (32c)
Internal Floor 1			47.2700			18.0000	850.8600 (32d)
Internal Ceiling 1			47.2700			18.0000	850.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17186.7704 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 181.7936 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3716 (36)
Total fabric heat loss (33) + (36) = 69.6006 (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	48.5316	48.1614	47.7985	46.0941	45.7752	44.2907	44.2907	44.0158	44.8625	45.7752	46.4203	47.0948 (38)
Heat transfer coeff	118.1322	117.7620	117.3991	115.6947	115.3758	113.8913	113.8913	113.6163	114.4631	115.3758	116.0209	116.6953 (39)
Average = Sum(39)m / 12 =												115.6931 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2495	1.2456	1.2418	1.2238	1.2204	1.2047	1.2047	1.2018	1.2107	1.2204	1.2272	1.2343 (40)
HLP (average)												1.2237 (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												2.6829 (42)
Average daily hot water use (litres/day)												97.9191 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.7110	103.7942	99.8774	95.9607	92.0439	88.1272	88.1272	92.0439	95.9607	99.8774	103.7942	107.7110 (44)
Energy conte	159.7323	139.7029	144.1608	125.6829	120.5957	104.0650	96.4315	110.6565	111.9781	130.4997	142.4506	154.6922 (45)
Energy content (annual)										Total = Sum(45)m =		1540.6482 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.9598	20.9554	21.6241	18.8524	18.0894	15.6097	14.4647	16.5985	16.7967	19.5750	21.3676	23.2038 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	27.5625	24.8932	27.5477	26.6272	27.4916	26.5781	27.4474	27.4761	26.6049	27.5245	26.6592	27.5543 (61)
Total heat required for water heating calculated for each month	187.2947	164.5961	171.7085	152.3101	148.0874	130.6431	123.8789	138.1326	138.5830	158.0242	169.1099	182.2465 (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	187.2947	164.5961	171.7085	152.3101	148.0874	130.6431	123.8789	138.1326	138.5830	158.0242	169.1099	182.2465 (64)
Heat gains from water heating, kWh/month	60.0016	52.6745	54.8204	48.4464	46.9710	41.2461	38.9253	43.6623	43.8839	50.2723	54.0296	58.3237 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1864.6150 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.4738	19.9610	16.2334	12.2897	9.1867	7.7558	8.3804	10.8932	14.6208	18.5645	21.6675	23.0984	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.1869	249.7519	243.2881	229.5275	212.1572	195.8315	184.9250	182.3600	188.8237	202.5844	219.9547	236.2804	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	(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)	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	(71)
Water heating gains (Table 5)	80.6473	78.3847	73.6833	67.2866	63.1331	57.2863	52.3190	58.6859	60.9499	67.5703	75.0412	78.3921	(72)
Total internal gains	416.5516	414.3412	399.4485	375.3475	350.7206	327.1172	311.8680	318.1827	330.6381	354.9627	382.9070	404.0144	(73)

6. Solar gains

[Jan]	Area m2				Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W	
East	7.0800				19.6403		0.6300		0.7000		0.7700		42.4964	
West	10.1000				19.6403		0.6300		0.7000		0.7700		60.6234 (76)	
Solar gains	103.1199	201.7243	332.2112	484.5102	593.7855	607.8451	578.6933	497.0890	386.3754	239.3629	128.5783	84.8008 (83)		
Total gains	519.6714	616.0655	731.6597	859.8577	944.5061	934.9623	890.5613	815.2717	717.0135	594.3256	511.4853	488.8152 (84)		

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.4132	40.5403	40.6656	41.2647	41.3787	41.9181	41.9181	42.0195	41.7087	41.3787	41.1486	40.9108	
alpha	3.6942	3.7027	3.7110	3.7510	3.7586	3.7945	3.7945	3.8013	3.7806	3.7586	3.7432	3.7274	
util living area	0.9947	0.9894	0.9747	0.9312	0.8370	0.6838	0.5331	0.5929	0.8272	0.9627	0.9907	0.9958	(86)
MIT	19.1976	19.4061	19.7733	20.2539	20.6481	20.8879	20.9670	20.9509	20.7544	20.2177	19.6239	19.1693	(87)
Th 2	19.8806	19.8837	19.8867	19.9010	19.9037	19.9163	19.9163	19.9186	19.9114	19.9037	19.8983	19.8926	(88)
util rest of house	0.9933	0.9867	0.9678	0.9118	0.7907	0.5975	0.4145	0.4731	0.7602	0.9485	0.9878	0.9947	(89)
MIT 2	18.2410	18.4505	18.8159	19.2924	19.6549	19.8576	19.9056	19.9010	19.7614	19.2685	18.6794	18.2217	(90)
Living area fraction	18.4062	18.6155	18.9812	19.4584	19.8263	20.0355	20.0888	20.0823	19.9328	19.4324	18.8424	18.3853	(92)
MIT	18.4062	18.6155	18.9812	19.4584	19.8263	20.0355	20.0888	20.0823	19.9328	19.4324	18.8424	18.3853	(93)
Temperature adjustment												0.0000	
adjusted MIT	18.4062	18.6155	18.9812	19.4584	19.8263	20.0355	20.0888	20.0823	19.9328	19.4324	18.8424	18.3853	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9907	0.9824	0.9605	0.9022	0.7869	0.6078	0.4344	0.4925	0.7617	0.9405	0.9839	0.9925	(94)
Ext temp.	514.8209	605.2060	702.7283	775.7852	743.2664	568.2650	386.8312	401.5551	546.1668	558.9648	503.2441	485.1513	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	1666.3922	1615.1610	1465.2765	1221.5505	937.5793	619.0542	397.3443	418.3639	667.6399	1019.0444	1362.3660	1655.3591	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating	856.7691	678.6898	567.3358	320.9510	144.5688	0.0000	0.0000	0.0000	0.0000	342.2992	618.5678	870.6346	(98)
Space heating per m2												4399.8161	(98)
												46.5392	(99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 %)													90.7000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													4850.9549	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	856.7691	678.6898	567.3358	320.9510	144.5688	0.0000	0.0000	0.0000	0.0000	342.2992	618.5678	870.6346	(98)	
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)	
Space heating fuel (main heating system)	944.6186	748.2798	625.5081	353.8600	159.3923	0.0000	0.0000	0.0000	0.0000	377.3971	681.9931	959.9059	(211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating														
Water heating requirement	187.2947	164.5961	171.7085	152.3101	148.0874	130.6431	123.8789	138.1326	138.5830	158.0242	169.1099	182.2465	(64)	
Efficiency of water heater (217)m	90.1847	90.1396	90.0337	89.7796	89.2612	87.9000	87.9000	87.9000	87.9000	89.7966	90.0839	90.2026	(216)	
Fuel for water heating, kWh/month	207.6792	182.6013	190.7159	169.6489	165.9034	148.6269	140.9316	157.1475	157.6598	175.9803	187.7248	202.0412	(219)	
Water heating fuel used												2086.6609	(219)	
Annual totals kWh/year														
Space heating fuel - main system												4850.9549	(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)													396.8935	(232)
Energy saving/generation technologies (Appendices M, N and Q)														
PV Unit 0 (0.80 * 1.10 * 908 * 1.00) =										-798.9117			-798.9117	(233)
Total delivered energy for all uses													6610.5976	(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	4850.9549	0.2160	1047.8063	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2086.6609	0.2160	450.7187	(264)
Space and water heating			1498.5250	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.8935	0.5190	205.9877	(268)
Energy saving/generation technologies				
PV Unit	-798.9117	0.5190	-414.6352	(269)
Total CO2, kg/year			1328.8026	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.0600	(273)

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

DER			14.0600	ZC1
Total Floor Area		TFA	94.5400	
Assumed number of occupants		N	2.6829	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			15.4937	ZC2
CO2 emissions from cooking, equation (L16)			1.9398	ZC3
Total CO2 emissions			31.4935	ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000	ZC7
Net CO2 emissions			31.4935	ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.2700 (1b)	x 2.3900 (2b)	= 112.9753 (1b) - (3b)
First floor	47.2700 (1c)	x 2.6100 (2c)	= 123.3747 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.3500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1269 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3769 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3487 (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	0.4445	0.4358	0.4271	0.3835	0.3748	0.3312	0.3312	0.3225	0.3487	0.3748	0.3922	0.4097 (22b)
Effective ac	0.5988	0.5950	0.5912	0.5735	0.5702	0.5549	0.5549	0.5520	0.5608	0.5702	0.5769	0.5839 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Opening Type (Uw = 1.40)			17.1800	1.3258	22.7765		(27)
Ground Floor			47.2700	0.1300	6.1451		(28a)
Brick and Block	139.3000	19.3300	119.9700	0.1800	21.5946		(29a)
External Roof 1	47.2700		47.2700	0.1300	6.1451		(30)
Total net area of external elements Aum(A, m ²)			233.8400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8113		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.7961 (36)
Total fabric heat loss						(33) + (36) =	69.6074 (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	46.7044	46.4051	46.1118	44.7340	44.4763	43.2763	43.2763	43.0540	43.7385	44.4763	44.9977	45.5429 (38)
Heat transfer coeff	116.3118	116.0126	115.7192	114.3415	114.0837	112.8837	112.8837	112.6615	113.3459	114.0837	114.6052	115.1503 (39)
Average = Sum(39)m / 12 =												114.3402 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2303	1.2271	1.2240	1.2095	1.2067	1.1940	1.1940	1.1917	1.1989	1.2067	1.2122	1.2180 (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												2.6829 (42)
Average daily hot water use (litres/day)												97.9191 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.7110	103.7942	99.8774	95.9607	92.0439	88.1272	88.1272	92.0439	95.9607	99.8774	103.7942	107.7110 (44)
Energy conte	159.7323	139.7029	144.1608	125.6829	120.5957	104.0650	96.4315	110.6565	111.9781	130.4997	142.4506	154.6922 (45)
Energy content (annual)										Total = Sum(45)m =		1540.6482 (45)
Distribution loss (46)m = 0.15 x (45)m	23.9598	20.9554	21.6241	18.8524	18.0894	15.6097	14.4647	16.5985	16.7967	19.5750	21.3676	23.2038 (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												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
	50.9589	46.0274	50.8965	47.3231	46.9046	43.4600	44.9086	46.9046	47.3231	50.8965	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
Solar input	210.6912	185.7303	195.0573	173.0060	167.5003	147.5249	141.3401	157.5611	159.3012	181.3962	191.7657	205.6511 (62)
	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								Solar input (sum of months) =	Sum (63)m =			0.0000 (63)
	210.6912	185.7303	195.0573	173.0060	167.5003	147.5249	141.3401	157.5611	159.3012	181.3962	191.7657	205.6511 (64)
Heat gains from water heating, kWh/month								Total per year (kWh/year) =	Sum (64)m =			2116.5253 (64)
	65.8507	57.9580	60.6576	53.6203	51.8242	45.4666	43.2906	48.5194	49.0635	56.1153	59.6936	64.1749 (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	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	22.4738	19.9610	16.2334	12.2897	9.1867	7.7558	8.3804	10.8932	14.6208	18.5645	21.6675	23.0984 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	247.1869	249.7519	243.2881	229.5275	212.1572	195.8315	184.9250	182.3600	188.8237	202.5844	219.9547	236.2804 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145 (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)												
	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163 (71)
Water heating gains (Table 5)												
	88.5090	86.2471	81.5290	74.4727	69.6562	63.1480	58.1863	65.2143	68.1437	75.4237	82.9078	86.2565 (72)
Total internal gains												
	424.4133	422.2036	407.2941	382.5335	357.2437	332.9790	317.7353	324.7111	337.8319	362.8162	390.7736	411.8789 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W	
East				7.0800	19.6403		0.6300		0.7000	0.7700	42.4964 (76)	
West				10.1000	19.6403		0.6300		0.7000	0.7700	60.6234 (80)	

Solar gains	103.1199	201.7243	332.2112	484.5102	593.7855	607.8451	578.6933	497.0890	386.3754	239.3629	128.5783	84.8008 (83)
Total gains	527.5331	623.9279	739.5054	867.0438	951.0292	940.8241	896.4287	821.8001	724.2073	602.1791	519.3519	496.6796 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	56.4455	56.5911	56.7345	57.4182	57.5479	58.1597	58.1597	58.2744	57.9225	57.5479	57.2861	57.0148
alpha	4.7630	4.7727	4.7823	4.8279	4.8365	4.8773	4.8773	4.8850	4.8615	4.8365	4.8191	4.8010
util living area	0.9985	0.9964	0.9888	0.9581	0.8706	0.7055	0.5398	0.6044	0.8596	0.9811	0.9970	0.9989 (86)
MIT	19.6140	19.7793	20.0720	20.4568	20.7709	20.9422	20.9874	20.9787	20.8429	20.4143	19.9438	19.5886 (87)
Th 2	19.8958	19.8984	19.9008	19.9124	19.9146	19.9248	19.9248	19.9267	19.9209	19.9146	19.9102	19.9056 (88)
util rest of house	0.9980	0.9952	0.9846	0.9420	0.8225	0.6109	0.4152	0.4762	0.7886	0.9712	0.9957	0.9985 (89)
MIT 2	18.0496	18.2927	18.7199	19.2756	19.6915	19.8868	19.9202	19.9180	19.7930	19.2265	18.5420	18.0192 (90)
Living area fraction									fLA = Living area / (4) =			0.1726 (91)
MIT	18.3196	18.5493	18.9533	19.4795	19.8779	20.0690	20.1045	20.1011	19.9742	19.4315	18.7840	18.2902 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3196	18.5493	18.9533	19.4795	19.8779	20.0690	20.1045	20.1011	19.9742	19.4315	18.7840	18.2902 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9969	0.9929	0.9795	0.9337	0.8206	0.6246	0.4367	0.4981	0.7928	0.9649	0.9936	0.9976 (94)
Useful gains	525.8783	619.4701	724.3722	809.5964	780.4349	587.6719	391.4722	409.3666	574.1232	581.0317	516.0266	495.5058 (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	1630.6480	1583.4914	1441.0872	1209.6777	932.9606	617.3608	395.5956	416.9754	665.8202	1007.5354	1339.0479	1622.4860 (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	821.9486	647.8223	533.2360	288.0585	113.4792	0.0000	0.0000	0.0000	0.0000	317.3188	592.5753	838.4732 (98)
Space heating												4152.9119 (98)
Space heating per m2										(98) / (4) =		43.9276 (99)

8c. Space cooling requirement

Not applicable

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4446.3725 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	821.9486	647.8223	533.2360	288.0585	113.4792	0.0000	0.0000	0.0000	0.0000	317.3188	592.5753	838.4732	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	880.0306	693.5999	570.9165	308.4138	121.4980	0.0000	0.0000	0.0000	0.0000	339.7417	634.4489	897.7230	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	210.6912	185.7303	195.0573	173.0060	167.5003	147.5249	141.3401	157.5611	159.3012	181.3962	191.7657	205.6511	(64)
Efficiency of water heater (217)m	88.1381	87.9356	87.4539	86.3258	84.0946	80.3000	80.3000	80.3000	80.3000	86.4452	87.7030	88.2146	(217)
Fuel for water heating, kWh/month	239.0466	211.2118	223.0400	200.4106	199.1809	183.7172	176.0151	196.2156	198.3826	209.8394	218.6536	233.1258	(219)
Water heating fuel used													(219)
Annual totals kWh/year													
Space heating fuel - main system													4446.3725 (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)													396.8935 (232)
Total delivered energy for all uses													7407.1052 (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	4446.3725	0.2160	960.4165 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2488.8392	0.2160	537.5893 (264)
Space and water heating			1498.0057 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	396.8935	0.5190	205.9877 (268)
Total CO2, kg/m2/year			1742.9185 (272)
Emissions per m2 for space and water heating			15.8452 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.1788 (272b)
Emissions per m2 for pumps and fans			0.4117 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8452 * 1.00) + 2.1788 + 0.4117, rounded to 2 d.p.			18.4400 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.2700 (1b)	x 2.3900 (2b)	= 112.9753 (1b) - (3b)
First floor	47.2700 (1c)	x 2.6100 (2c)	= 123.3747 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.3500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1269 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3769 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3487 (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	0.4445	0.4358	0.4271	0.3835	0.3748	0.3312	0.3312	0.3225	0.3487	0.3748	0.3922	0.4097 (22b)
Effective ac	0.5988	0.5950	0.5912	0.5735	0.5702	0.5549	0.5549	0.5520	0.5608	0.5702	0.5769	0.5839 (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			2.1500	1.1000	2.3650		(26)
Windows & Fully Glazed Do (Uw = 1.20)			17.1800	1.1450	19.6718		(27)
Ground Floor			47.2700	0.1200	5.6724	90.0000	4254.3000 (28a)
Brick and Block	139.3000	19.3300	119.9700	0.2400	28.7928	42.2200	5065.1334 (29a)
External Roof 1	47.2700		47.2700	0.1000	4.7270	9.1000	430.1570 (30)
Total net area of external elements Aum(A, m ²)			233.8400				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	61.2290	(33)
GF Block			57.4300			75.0000	4307.2500 (32c)
GF Timber Stud			29.3300			9.0000	263.9700 (32c)
FF Timber Stud			129.3600			9.0000	1164.2400 (32c)
Internal Floor 1			47.2700			18.0000	850.8600 (32d)
Internal Ceiling 1			47.2700			9.0000	425.4300 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16761.3404 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 177.2936 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3716 (36)
Total fabric heat loss (33) + (36) = 69.6006 (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	46.7044	46.4051	46.1118	44.7340	44.4763	43.2763	43.2763	43.0540	43.7385	44.4763	44.9977	45.5429 (38)
Heat transfer coeff	116.3050	116.0057	115.7124	114.3346	114.0768	112.8768	112.8768	112.6546	113.3390	114.0768	114.5983	115.1435 (39)
Average = Sum(39)m / 12 =												114.3334 (39)
HLP	1.2302	1.2271	1.2240	1.2094	1.2067	1.1940	1.1940	1.1916	1.1988	1.2067	1.2122	1.2179 (40)
HLP (average)												1.2094 (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												2.6829 (42)
Average daily hot water use (litres/day)												97.9191 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.7110	103.7942	99.8774	95.9607	92.0439	88.1272	88.1272	92.0439	95.9607	99.8774	103.7942	107.7110 (44)
Energy conte	159.7323	139.7029	144.1608	125.6829	120.5957	104.0650	96.4315	110.6565	111.9781	130.4997	142.4506	154.6922 (45)
Energy content (annual)										Total = Sum(45)m =		1540.6482 (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	33.9431	29.6869	30.6342	26.7076	25.6266	22.1138	20.4917	23.5145	23.7954	27.7312	30.2708	32.8721 (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	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.4738	19.9610	16.2334	12.2897	9.1867	7.7558	8.3804	10.8932	14.6208	18.5645	21.6675	23.0984	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.1869	249.7519	243.2881	229.5275	212.1572	195.8315	184.9250	182.3600	188.8237	202.5844	219.9547	236.2804	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	(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)	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	(71)
Water heating gains (Table 5)	45.6225	44.1769	41.1750	37.0939	34.4443	30.7136	27.5426	31.6055	33.0491	37.2731	42.0427	44.1829	(72)
Total internal gains	378.5267	377.1334	363.9401	342.1547	319.0318	297.5446	284.0916	288.1023	299.7373	321.6656	346.9085	366.8053	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
East				7.0800	19.6403	0.6300	0.7000	0.7700	42.4964			
West				10.1000	19.6403	0.6300	0.7000	0.7700	60.6234 (76)			
Solar gains	103.1199	201.7243	332.2112	484.5102	593.7855	607.8451	578.6933	497.0890	386.3754	239.3629	128.5783	84.8008 (83)
Total gains	481.6466	578.8577	696.1513	826.6650	912.8173	905.3897	862.7849	785.1913	686.1126	561.0285	475.4868	451.6060 (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	40.0321	40.1353	40.2371	40.7219	40.8140	41.2479	41.2479	41.3292	41.0796	40.8140	40.6282	40.4359	
alpha	3.6688	3.6757	3.6825	3.7148	3.7209	3.7499	3.7499	3.7553	3.7386	3.7209	3.7085	3.6957	
util living area	0.9955	0.9907	0.9767	0.9348	0.8430	0.6928	0.5424	0.6053	0.8373	0.9665	0.9921	0.9965	(86)
MIT	19.1481	19.3603	19.7349	20.2232	20.6291	20.8785	20.9634	20.9451	20.7353	20.1801	19.5746	19.1154	(87)
Th 2	19.8959	19.8984	19.9009	19.9125	19.9147	19.9248	19.9248	19.9267	19.9209	19.9147	19.9103	19.9057	(88)
util rest of house	0.9943	0.9882	0.9704	0.9166	0.7984	0.6078	0.4239	0.4858	0.7732	0.9539	0.9896	0.9955	(89)
MIT 2	18.2059	18.4189	18.7915	19.2747	19.6495	19.8601	19.9127	19.9065	19.7561	19.2433	18.6422	18.1806	(90)
Living area fraction									fLA = Living area / (4) =			0.1726	(91)
MIT	18.3685	18.5814	18.9543	19.4384	19.8186	20.0359	20.0941	20.0858	19.9252	19.4050	18.8031	18.3419	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3685	18.5814	18.9543	19.4384	19.8186	20.0359	20.0941	20.0858	19.9252	19.4050	18.8031	18.3419	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9920	0.9843	0.9633	0.9068	0.7939	0.6174	0.4436	0.5049	0.7735	0.9460	0.9861	0.9937	(94)
Ext temp.	477.8079	569.7513	670.6166	749.6007	724.6421	559.0072	382.7437	396.4328	530.7316	530.7319	468.8769	448.7466	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	1636.2414	1587.1211	1441.1185	1204.9027	926.1462	613.5851	394.3978	415.2225	660.2193	1004.4487	1341.1611	1628.3526	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating	861.8745	683.6725	573.2535	327.8174	149.9190	0.0000	0.0000	0.0000	0.0000	352.4453	628.0446	877.6268	(98)
Space heating per m2										(98) / (4) =		4454.6536	(98)
												47.1192	(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	1061.0422	835.2885	856.1750	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8232	0.8846	0.8526	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	873.4900	738.8800	729.9363	0.0000	0.0000	0.0000	0.0000	(102)

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Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1160.2958	1108.3344	1019.4692	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	206.5002	274.8741	215.4125	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												696.7867 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
Intermittency factor	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	51.6250	68.7185	53.8531	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												174.1967 (107)
Space cooling per m2												1.8426 (108)
Energy for space heating												47.1192 (99)
Energy for space cooling												1.8426 (108)
Total												48.9618 (109)
Dwelling Fabric Energy Efficiency (DFEE)												49.0 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.2700 (1b)	x 2.3900 (2b)	= 112.9753 (1b) - (3b)
First floor	47.2700 (1c)	x 2.6100 (2c)	= 123.3747 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.3500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1269 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3769 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3487 (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	0.4445	0.4358	0.4271	0.3835	0.3748	0.3312	0.3312	0.3225	0.3487	0.3748	0.3922	0.4097 (22b)
Effective ac	0.5988	0.5950	0.5912	0.5735	0.5702	0.5549	0.5549	0.5520	0.5608	0.5702	0.5769	0.5839 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Opening Type (Uw = 1.40)			17.1800	1.3258	22.7765		(27)
Ground Floor			47.2700	0.1300	6.1451		(28a)
Brick and Block	139.3000	19.3300	119.9700	0.1800	21.5946		(29a)
External Roof 1	47.2700		47.2700	0.1300	6.1451		(30)
Total net area of external elements Aum(A, m ²)			233.8400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.8113		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.7961 (36)
Total fabric heat loss						(33) + (36) =	69.6074 (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	46.7044	46.4051	46.1118	44.7340	44.4763	43.2763	43.2763	43.0540	43.7385	44.4763	44.9977	45.5429 (38)
Heat transfer coeff	116.3118	116.0126	115.7192	114.3415	114.0837	112.8837	112.8837	112.6615	113.3459	114.0837	114.6052	115.1503 (39)
Average = Sum(39)m / 12 =												114.3402 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2303	1.2271	1.2240	1.2095	1.2067	1.1940	1.1940	1.1917	1.1989	1.2067	1.2122	1.2180 (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												2.6829 (42)
Average daily hot water use (litres/day)												97.9191 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.7110	103.7942	99.8774	95.9607	92.0439	88.1272	88.1272	92.0439	95.9607	99.8774	103.7942	107.7110 (44)
Energy conte	159.7323	139.7029	144.1608	125.6829	120.5957	104.0650	96.4315	110.6565	111.9781	130.4997	142.4506	154.6922 (45)
Energy content (annual)										Total = Sum(45)m =		1540.6482 (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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Calculation Type: New Build (As Designed)

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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)
	33.9431	29.6869	30.6342	26.7076	25.6266	22.1138	20.4917	23.5145	23.7954	27.7312	30.2708	32.8721 (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	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	134.1454	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.4738	19.9610	16.2334	12.2897	9.1867	7.7558	8.3804	10.8932	14.6208	18.5645	21.6675	23.0984	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.1869	249.7519	243.2881	229.5275	212.1572	195.8315	184.9250	182.3600	188.8237	202.5844	219.9547	236.2804	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	36.4145	(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)	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	(71)
Water heating gains (Table 5)	45.6225	44.1769	41.1750	37.0939	34.4443	30.7136	27.5426	31.6055	33.0491	37.2731	42.0427	44.1829	(72)
Total internal gains	378.5267	377.1334	363.9401	342.1547	319.0318	297.5446	284.0916	288.1023	299.7373	321.6656	346.9085	366.8053	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
East					7.0800	19.6403	0.6300	0.7000	0.7700		42.4964 (76)	
West					10.1000	19.6403	0.6300	0.7000	0.7700		60.6234 (80)	
Solar gains	103.1199	201.7243	332.2112	484.5102	593.7855	607.8451	578.6933	497.0890	386.3754	239.3629	128.5783	84.8008 (83)
Total gains	481.6466	578.8577	696.1513	826.6650	912.8173	905.3897	862.7849	785.1913	686.1126	561.0285	475.4868	451.6060 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.4455	56.5911	56.7345	57.4182	57.5479	58.1597	58.1597	58.2744	57.9225	57.5479	57.2861	57.0148	
alpha	4.7630	4.7727	4.7823	4.8279	4.8365	4.8773	4.8773	4.8850	4.8615	4.8365	4.8191	4.8010	
util living area	0.9990	0.9974	0.9912	0.9648	0.8845	0.7250	0.5585	0.6277	0.8788	0.9857	0.9979	0.9993	(86)
MIT	19.5693	19.7358	20.0317	20.4241	20.7507	20.9349	20.9854	20.9750	20.8236	20.3772	19.9013	19.5446	(87)
Th 2	19.8958	19.8984	19.9008	19.9124	19.9146	19.9248	19.9248	19.9267	19.9209	19.9146	19.9102	19.9056	(88)
util rest of house	0.9987	0.9965	0.9879	0.9507	0.8394	0.6306	0.4307	0.4969	0.8128	0.9780	0.9970	0.9990	(89)
MIT 2	18.5908	18.7589	19.0549	19.4474	19.7465	19.8951	19.9211	19.9196	19.8203	19.4093	18.9338	18.5737	(90)
Living area fraction												0.1726	(91)
MIT	18.7597	18.9275	19.2236	19.6160	19.9199	20.0746	20.1049	20.1018	19.9935	19.5763	19.1008	18.7413	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7597	18.9275	19.2236	19.6160	19.9199	20.0746	20.1049	20.1018	19.9935	19.5763	19.1008	18.7413	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	480.7555	576.1648	685.8074	781.9206	766.4350	583.9226	390.8124	407.9384	561.3197	546.7904	473.6210	450.9948	(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	1681.8318	1627.3693	1472.3596	1225.2790	937.7541	617.9925	395.6414	417.0482	668.0049	1024.0549	1375.3570	1674.4394	(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	893.6008	706.4094	585.1948	319.2181	127.4614	0.0000	0.0000	0.0000	0.0000	355.0848	649.2500	910.2428	(98)
Space heating												4546.4621	(98)
Space heating per m2												48.0904	(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	1061.1065	835.3392	856.2270	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8647	0.9235	0.8936	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	917.5242	771.4004	765.1573	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1160.2958	1108.3344	1019.4692	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	174.7955	250.6789	189.2080	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												614.6824	(104)
Cooled fraction												1.0000	(105)

fC = cooled area / (4) =

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	43.6989	62.6697	47.3020	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling											153.6706 (107)
Space cooling per m2											1.6255 (108)
Energy for space heating											48.0904 (99)
Energy for space cooling											1.6255 (108)
Total											49.7158 (109)
Target Fabric Energy Efficiency (TFEE)											57.2 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.2700 (1b)	x 2.3900 (2b)	= 112.9753 (1b) - (3b)
First floor	47.2700 (1c)	x 2.6100 (2c)	= 123.3747 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.3500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1692 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4192 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3878 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000 (22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750 (22a)
Adj infilt rate	0.4944	0.4557	0.4460	0.4169	0.4169	0.3878	0.3878	0.3781	0.3878	0.4363	0.4266	0.4557 (22b)
Effective ac	0.6222	0.6038	0.5994	0.5869	0.5869	0.5752	0.5752	0.5715	0.5752	0.5952	0.5910	0.6038 (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			2.1500	1.1000	2.3650		(26)
Windows & Fully Glazed Do (Uw = 1.20)			17.1800	1.1450	19.6718		(27)
Ground Floor			47.2700	0.1200	5.6724	90.0000	4254.3000 (28a)
Brick and Block	139.3000	19.3300	119.9700	0.2400	28.7928	42.2200	5065.1334 (29a)
External Roof 1	47.2700		47.2700	0.1000	4.7270	9.1000	430.1570 (30)
Total net area of external elements Aum(A, m ²)			233.8400				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	61.2290	(33)
GF Block			57.4300			75.0000	4307.2500 (32c)
GF Timber Stud			29.3300			9.0000	263.9700 (32c)
FF Timber Stud			129.3600			9.0000	1164.2400 (32c)
Internal Floor 1			47.2700			18.0000	850.8600 (32d)
Internal Ceiling 1			47.2700			18.0000	850.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17186.7704 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 181.7936 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3716 (36)
Total fabric heat loss (33) + (36) = 69.6006 (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	48.5316	47.0948	46.7539	45.7752	45.7752	44.8625	44.8625	44.5729	44.8625	46.4203	46.0941	47.0948 (38)
Heat transfer coeff	118.1322	116.6953	116.3544	115.3758	115.3758	114.4631	114.4631	114.1735	114.4631	116.0209	115.6947	116.6953 (39)
Average = Sum(39)m / 12 =												115.6589 (39)
HLP	1.2495	1.2343	1.2307	1.2204	1.2204	1.2107	1.2107	1.2077	1.2107	1.2272	1.2238	1.2343 (40)
HLP (average)												1.2234 (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												2.6829 (42)
Average daily hot water use (litres/day)												97.9191 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.7110	103.7942	99.8774	95.9607	92.0439	88.1272	88.1272	92.0439	95.9607	99.8774	103.7942	107.7110 (44)
Energy conte	159.7323	139.7029	144.1608	125.6829	120.5957	104.0650	96.4315	110.6565	111.9781	130.4997	142.4506	154.6922 (45)
Energy content (annual)										Total = Sum(45)m =		1540.6482 (45)

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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.2700 (1b)	x 2.3900 (2b)	= 112.9753 (1b) - (3b)
First floor	47.2700 (1c)	x 2.6100 (2c)	= 123.3747 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.3500 (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) = 0.1692 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4192 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3878 (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	0.4944	0.4847	0.4751	0.4266	0.4169	0.3684	0.3684	0.3587	0.3878	0.4169	0.4363	0.4557 (22b)
Effective ac	0.6222	0.6175	0.6128	0.5910	0.5869	0.5679	0.5679	0.5643	0.5752	0.5869	0.5952	0.6038 (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			2.1500	1.1000	2.3650		(26)
Windows & Fully Glazed Do (Uw = 1.20)			17.1800	1.1450	19.6718		(27)
Ground Floor			47.2700	0.1200	5.6724	90.0000	4254.3000 (28a)
Brick and Block	139.3000	19.3300	119.9700	0.2400	28.7928	42.2200	5065.1334 (29a)
External Roof 1	47.2700		47.2700	0.1000	4.7270	9.1000	430.1570 (30)
Total net area of external elements Aum(A, m ²)			233.8400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.2290		(33)
GF Block			57.4300			75.0000	4307.2500 (32c)
GF Timber Stud			29.3300			9.0000	263.9700 (32c)
FF Timber Stud			129.3600			9.0000	1164.2400 (32c)
Internal Floor 1			47.2700			18.0000	850.8600 (32d)
Internal Ceiling 1			47.2700			18.0000	850.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17186.7704 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 181.7936 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3716 (36)
Total fabric heat loss (33) + (36) = 69.6006 (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	48.5316	48.1614	47.7985	46.0941	45.7752	44.2907	44.2907	44.0158	44.8625	45.7752	46.4203	47.0948 (38)
Heat transfer coeff	118.1322	117.7620	117.3991	115.6947	115.3758	113.8913	113.8913	113.6163	114.4631	115.3758	116.0209	116.6953 (39)
Average = Sum(39)m / 12 =												115.6931 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2495	1.2456	1.2418	1.2238	1.2204	1.2047	1.2047	1.2018	1.2107	1.2204	1.2272	1.2343 (40)
HLP (average)												1.2237 (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												2.6829 (42)
Average daily hot water use (litres/day)												97.9191 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.7110	103.7942	99.8774	95.9607	92.0439	88.1272	88.1272	92.0439	95.9607	99.8774	103.7942	107.7110 (44)
Energy conte	159.7323	139.7029	144.1608	125.6829	120.5957	104.0650	96.4315	110.6565	111.9781	130.4997	142.4506	154.6922 (45)
Energy content (annual)										Total = Sum(45)m =		1540.6482 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.9598	20.9554	21.6241	18.8524	18.0894	15.6097	14.4647	16.5985	16.7967	19.5750	21.3676	23.2038 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	27.5625	24.8932	27.5477	26.6272	27.4916	26.5781	27.4474	27.4761	26.6049	27.5245	26.6592	27.5543 (61)
Total heat required for water heating calculated for each month	187.2947	164.5961	171.7085	152.3101	148.0874	130.6431	123.8789	138.1326	138.5830	158.0242	169.1099	182.2465 (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	187.2947	164.5961	171.7085	152.3101	148.0874	130.6431	123.8789	138.1326	138.5830	158.0242	169.1099	182.2465 (64)
Heat gains from water heating, kWh/month	60.0016	52.6745	54.8204	48.4464	46.9710	41.2461	38.9253	43.6623	43.8839	50.2723	54.0296	58.3237 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1864.6150 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.1844	49.9025	40.5834	30.7243	22.9667	19.3895	20.9510	27.2329	36.5520	46.4112	54.1687	57.7459	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	368.9357	372.7641	363.1166	342.5784	316.6525	292.2859	276.0074	272.1790	281.8265	302.3647	328.2906	352.6572	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	(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)	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	(71)
Water heating gains (Table 5)	80.6473	78.3847	73.6833	67.2866	63.1331	57.2863	52.3190	58.6859	60.9499	67.5703	75.0412	78.3921	(72)
Total internal gains	616.2059	611.4897	587.8219	551.0278	513.1908	479.4002	459.7160	468.5364	489.7669	526.7847	567.9390	599.2338	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c				Access factor Table 6d			Gains W
East				7.0800	19.6403	0.6300	0.7000				0.7700			42.4964
West				10.1000	19.6403	0.6300	0.7000				0.7700			60.6234 (80)
Solar gains	103.1199	201.7243	332.2112	484.5102	593.7855	607.8451	578.6933	497.0890	386.3754	239.3629	128.5783			84.8008 (83)
Total gains	719.3257	813.2140	920.0331	1035.5380	1106.9763	1087.2453	1038.4093	965.6254	876.1423	766.1476	696.5173			684.0345 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.4132	40.5403	40.6656	41.2647	41.3787	41.9181	41.9181	42.0195	41.7087	41.3787	41.1486	40.9108	
alpha	3.6942	3.7027	3.7110	3.7510	3.7586	3.7945	3.7945	3.8013	3.7806	3.7586	3.7432	3.7274	
util living area	0.9846	0.9747	0.9504	0.8896	0.7774	0.6136	0.4664	0.5158	0.7480	0.9241	0.9750	0.9871	(86)
MIT	19.4345	19.6329	19.9733	20.4040	20.7352	20.9227	20.9789	20.9693	20.8321	20.3869	19.8384	19.4033	(87)
Th 2	19.8806	19.8837	19.8867	19.9010	19.9037	19.9163	19.9163	19.9186	19.9114	19.9037	19.8983	19.8926	(88)
util rest of house	0.9808	0.9686	0.9382	0.8624	0.7241	0.5284	0.3587	0.4054	0.6711	0.8991	0.9679	0.9839	(89)
MIT 2	18.4754	18.6733	19.0082	19.4282	19.7231	19.8775	19.9097	19.9082	19.8150	19.4245	18.8896	18.4538	(90)
Living area fraction	18.6410	18.8389	19.1748	19.5966	19.8978	20.0579	20.0943	20.0913	19.9905	19.5906	19.0533	18.6177	(91)
MIT	18.6410	18.8389	19.1748	19.5966	19.8978	20.0579	20.0943	20.0913	19.9905	19.5906	19.0533	18.6177	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6410	18.8389	19.1748	19.5966	19.8978	20.0579	20.0943	20.0913	19.9905	19.5906	19.0533	18.6177	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9753	0.9611	0.9285	0.8535	0.7238	0.5402	0.3770	0.4238	0.6773	0.8904	0.9607	0.9790	(94)
Ext temp.	701.5255	781.5926	854.2272	883.8634	801.1890	587.3578	391.4557	409.2479	593.4252	682.1621	669.1481	669.6555	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	1694.1345	1641.4762	1488.0091	1237.5400	945.8260	621.6125	397.9698	419.3967	674.2495	1037.3021	1386.8375	1682.4812	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating per m ²	738.5011	577.8417	471.5337	254.6471	107.6099	0.0000	0.0000	0.0000	0.0000	264.2242	516.7364	753.5423	(98)
Space heating												3684.6366	(98)
Space heating per m ²												38.9744	(99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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 %)													90.7000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4062.4439 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	738.5011	577.8417	471.5337	254.6471	107.6099	0.0000	0.0000	0.0000	0.0000	264.2242	516.7364	753.5423	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	814.2239	637.0912	519.8828	280.7576	118.6438	0.0000	0.0000	0.0000	0.0000	291.3167	569.7204	830.8074	(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	187.2947	164.5961	171.7085	152.3101	148.0874	130.6431	123.8789	138.1326	138.5830	158.0242	169.1099	182.2465	(64)
Efficiency of water heater (217)m	90.1192	90.0640	89.9353	89.6314	89.0570	87.9000	87.9000	87.9000	87.9000	89.6315	89.9932	90.1408	(216)
Fuel for water heating, kWh/month	207.8299	182.7546	190.9246	169.9294	166.2838	148.6269	140.9316	157.1475	157.6598	176.3044	187.9141	202.1798	(219)
Water heating fuel used												2088.4865	(219)
Annual totals kWh/year													
Space heating fuel - main system												4062.4439	(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)												396.8935	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.10 * 908 * 1.00) =										-798.9117		-798.9117	(233)
Total delivered energy for all uses												5823.9122	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4062.4439	3.4800	141.3730 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2088.4865	3.4800	72.6793 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	396.8935	13.1900	52.3503 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-798.9117	13.1900	-105.3765 (252)
Total energy cost			290.9187 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.8756 (257)
SAP value		87.7849
SAP rating (Section 12)		88 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4062.4439	0.2160	877.4879 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2088.4865	0.2160	451.1131 (264)
Space and water heating			1328.6010 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	396.8935	0.5190	205.9877 (268)
Energy saving/generation technologies			
PV Unit	-798.9117	0.5190	-414.6352 (269)
Total kg/year			1158.8785 (272)
CO2 emissions per m2			12.2600 (273)
EI value			88.8713
EI rating			89 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency $3.48 \times (1 + 0.29 \times 0.00) / 0.9070 = 3.837$, stars = 4

FULL SAP CALCULATION PRINTOUT

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CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating environmental impact $0.216 \times (1 + 0.29 \times 0.00) / 0.9070 = 0.2381$, stars = 4
Water heating energy efficiency $3.48 / 0.8918 = 3.902$, stars = 4
Water heating environmental impact $0.216 / 0.8918 = 0.2422$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.2700 (1b)	x 2.3900 (2b)	= 112.9753 (1b) - (3b)
First floor	47.2700 (1c)	x 2.6100 (2c)	= 123.3747 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.3500 (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) = 0.1692 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4192 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3878 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000 (22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750 (22a)
Adj infilt rate	0.4944	0.4557	0.4460	0.4169	0.4169	0.3878	0.3878	0.3781	0.3878	0.4363	0.4266	0.4557 (22b)
Effective ac	0.6222	0.6038	0.5994	0.5869	0.5869	0.5752	0.5752	0.5715	0.5752	0.5952	0.5910	0.6038 (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			2.1500	1.1000	2.3650		(26)
Windows & Fully Glazed Do (Uw = 1.20)			17.1800	1.1450	19.6718		(27)
Ground Floor			47.2700	0.1200	5.6724	90.0000	4254.3000 (28a)
Brick and Block	139.3000	19.3300	119.9700	0.2400	28.7928	42.2200	5065.1334 (29a)
External Roof 1	47.2700		47.2700	0.1000	4.7270	9.1000	430.1570 (30)
Total net area of external elements Aum(A, m ²)			233.8400				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	61.2290	(33)
GF Block			57.4300			75.0000	4307.2500 (32c)
GF Timber Stud			29.3300			9.0000	263.9700 (32c)
FF Timber Stud			129.3600			9.0000	1164.2400 (32c)
Internal Floor 1			47.2700			18.0000	850.8600 (32d)
Internal Ceiling 1			47.2700			18.0000	850.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17186.7704 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 181.7936 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3716 (36)
Total fabric heat loss (33) + (36) = 69.6006 (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	48.5316	47.0948	46.7539	45.7752	45.7752	44.8625	44.8625	44.5729	44.8625	46.4203	46.0941	47.0948 (38)
Heat transfer coeff	118.1322	116.6953	116.3544	115.3758	115.3758	114.4631	114.4631	114.1735	114.4631	116.0209	115.6947	116.6953 (39)
Average = Sum(39)m / 12 =												115.6589 (39)
HLP	1.2495	1.2343	1.2307	1.2204	1.2204	1.2107	1.2107	1.2077	1.2107	1.2272	1.2238	1.2343 (40)
HLP (average)												1.2234 (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												2.6829 (42)
Average daily hot water use (litres/day)												97.9191 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.7110	103.7942	99.8774	95.9607	92.0439	88.1272	88.1272	92.0439	95.9607	99.8774	103.7942	107.7110 (44)
Energy conte	159.7323	139.7029	144.1608	125.6829	120.5957	104.0650	96.4315	110.6565	111.9781	130.4997	142.4506	154.6922 (45)
Energy content (annual)										Total = Sum(45)m =		1540.6482 (45)

FULL SAP CALCULATION PRINTOUT

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Distribution loss (46)m = 0.15 x (45)m	23.9598	20.9554	21.6241	18.8524	18.0894	15.6097	14.4647	16.5985	16.7967	19.5750	21.3676	23.2038 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	27.5625	24.8932	27.5477	26.6272	27.4916	26.5781	27.4474	27.4761	26.6049	27.5245	26.6592	27.5543 (61)
Total heat required for water heating calculated for each month	187.2947	164.5961	171.7085	152.3101	148.0874	130.6431	123.8789	138.1326	138.5830	158.0242	169.1099	182.2465 (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	187.2947	164.5961	171.7085	152.3101	148.0874	130.6431	123.8789	138.1326	138.5830	158.0242	169.1099	182.2465 (64)
Heat gains from water heating, kWh/month	60.0016	52.6745	54.8204	48.4464	46.9710	41.2461	38.9253	43.6623	43.8839	50.2723	54.0296	58.3237 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1864.6150 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.1844	49.9025	40.5834	30.7243	22.9667	19.3895	20.9510	27.2329	36.5520	46.4112	54.1687	57.7459	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	368.9357	372.7641	363.1166	342.5784	316.6525	292.2859	276.0074	272.1790	281.8265	302.3647	328.2906	352.6572	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	(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)	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	(71)
Water heating gains (Table 5)	80.6473	78.3847	73.6833	67.2866	63.1331	57.2863	52.3190	58.6859	60.9499	67.5703	75.0412	78.3921	(72)
Total internal gains	616.2059	611.4897	587.8219	551.0278	513.1908	479.4002	459.7160	468.5364	489.7669	526.7847	567.9390	599.2338	(73)

6. Solar gains

[Jan]													
	Area m2				Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
East	7.0800				25.9136		0.6300		0.7000		0.7700		56.0704
West	10.1000				25.9136		0.6300		0.7000		0.7700		79.9874 (80)
Solar gains	136.0578	227.2728	370.9873	548.1167	639.4178	707.5031	657.7834	578.5468	456.5565	284.9240	168.0816	106.8367 (83)	
Total gains	752.2637	838.7625	958.8092	1099.1444	1152.6086	1186.9033	1117.4994	1047.0832	946.3234	811.7087	736.0205	706.0705 (84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.4132	40.9108	41.0307	41.3787	41.3787	41.7087	41.7087	41.8145	41.7087	41.1486	41.2647	40.9108	
alpha	3.6942	3.7274	3.7354	3.7586	3.7586	3.7806	3.7806	3.7876	3.7806	3.7432	3.7510	3.7274	
util living area	0.9781	0.9674	0.9344	0.8543	0.7167	0.5145	0.3729	0.3956	0.6502	0.8818	0.9603	0.9815	(86)
MIT	19.6295	19.7900	20.1320	20.5311	20.8216	20.9622	20.9915	20.9897	20.9107	20.5625	20.0649	19.6139	(87)
Th 2	19.8806	19.8926	19.8955	19.9037	19.9037	19.9114	19.9114	19.9139	19.9114	19.8983	19.9010	19.8926	(88)
util rest of house	0.9725	0.9593	0.9182	0.8196	0.6529	0.4243	0.2661	0.2833	0.5573	0.8427	0.9484	0.9767	(89)
MIT 2	18.6685	18.8347	19.1679	19.5450	19.7914	19.8955	19.9095	19.9116	19.8680	19.5803	19.1134	18.6629	(90)
Living area fraction	18.8344	18.9996	19.3344	19.7152	19.9692	20.0796	20.0963	20.0977	20.0480	19.7499	19.2776	18.8271	(92)
MIT	18.8344	18.9996	19.3344	19.7152	19.9692	20.0796	20.0963	20.0977	20.0480	19.7499	19.2776	18.8271	(93)
Temperature adjustment												0.0000	
adjusted MIT	18.8344	18.9996	19.3344	19.7152	19.9692	20.0796	20.0963	20.0977	20.0480	19.7499	19.2776	18.8271	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9656	0.9510	0.9081	0.8128	0.6570	0.4388	0.2846	0.3027	0.5699	0.8364	0.9398	0.9705	(94)
Ext temp.	726.3886	797.6312	870.6899	893.4389	757.3142	520.7927	318.0485	316.9393	539.3221	678.9311	691.6959	685.2600	(95)
Heat loss rate W	5.4000	5.7000	7.3000	9.6000	12.6000	15.4000	17.3000	17.3000	15.0000	11.8000	8.4000	5.5000	(96)
Month fracti	1587.0372	1552.0046	1400.2503	1167.0472	850.2328	535.6403	320.0760	319.4215	577.8114	922.3512	1258.4825	1555.2046	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating per m2	640.3225	506.9389	393.9929	196.9980	69.1314	0.0000	0.0000	0.0000	0.0000	181.1046	408.0863	647.2388	(98)
Space heating												3043.8135	(98)
Space heating per m2												32.1960	(99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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 %)													90.7000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3355.9134 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	640.3225	506.9389	393.9929	196.9980	69.1314	0.0000	0.0000	0.0000	0.0000	181.1046	408.0863	647.2388	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	705.9785	558.9183	434.3913	217.1973	76.2199	0.0000	0.0000	0.0000	0.0000	199.6743	449.9298	713.6040	(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	187.2947	164.5961	171.7085	152.3101	148.0874	130.6431	123.8789	138.1326	138.5830	158.0242	169.1099	182.2465	(64)
Efficiency of water heater (217)m	90.0508	89.9973	89.8314	89.4575	88.7722	87.9000	87.9000	87.9000	87.9000	89.3734	89.8613	90.0696	(216)
Fuel for water heating, kWh/month	207.9878	182.8899	191.1453	170.2598	166.8173	148.6269	140.9316	157.1475	157.6598	176.8135	188.1898	202.3395	(219)
Water heating fuel used												2090.8088	(219)
Annual totals kWh/year													
Space heating fuel - main system												3355.9134	(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)												396.8935	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.10 * 1054 * 1.00) =										-927.9096		-927.9096	(233)
Total delivered energy for all uses												4990.7062	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3355.9134	9.7400	326.8660 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2090.8088	9.7400	203.6448 (247)
Pumps and fans for heating	75.0000	36.8500	27.6375 (249)
Energy for lighting	396.8935	36.8500	146.2553 (250)
Additional standing charges			104.0000 (251)
Energy saving/generation technologies			
PV Unit	-927.9096	36.8500	-341.9347 (252)
Total energy cost			466.4688 (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	3355.9134	0.2160	724.8773 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2090.8088	0.2160	451.6147 (264)
Space and water heating			1176.4920 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	396.8935	0.5190	205.9877 (268)
Energy saving/generation technologies			
PV Unit	-927.9096	0.5190	-481.5851 (269)
Total kg/year			939.8197 (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	3355.9134	1.2200	4094.2144 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2090.8088	1.2200	2550.7867 (264)
Space and water heating			6645.0012 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	396.8935	3.0700	1218.4631 (268)
Energy saving/generation technologies			
PV Unit	-927.9096	3.0700	-2848.6824 (269)
Primary energy kWh/year			5245.0319 (272)
Primary energy kWh/m2/year			55.4795 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

SAP 2012 EPC IMPROVEMENTS

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

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 81	-195 kg (20.7%)

		Typical annual savings	Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	2.06 kg/m²	B 89	B 91
Total Savings	£81	2.06 kg/m²		

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

Fuel prices for cost data on this page from database revision number 513 TEST (28 Feb 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	£174	£192	-£18
Mains gas	£635	£535	£100
Space heating	£459	£459	£0
Water heating	£204	£122	£81
Lighting	£146	£146	£0
Generated (PV)	-£342	-£342	£0
Total cost of fuels	£467	£385	£82
Total cost of uses	£467	£385	£81
Delivered energy	53 kWh/m²	43 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	55 kWh/m²	44 kWh/m²	12 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.2700 (1b)	x 2.3900 (2b)	= 112.9753 (1b) - (3b)
First floor	47.2700 (1c)	x 2.6100 (2c)	= 123.3747 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.3500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1692 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4192 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3878 (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	0.4944	0.4847	0.4751	0.4266	0.4169	0.3684	0.3684	0.3587	0.3878	0.4169	0.4363	0.4557 (22b)
Effective ac	0.6222	0.6175	0.6128	0.5910	0.5869	0.5679	0.5679	0.5643	0.5752	0.5869	0.5952	0.6038 (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			2.1500	1.1000	2.3650		(26)
Windows & Fully Glazed Do (Uw = 1.20)			17.1800	1.1450	19.6718		(27)
Ground Floor			47.2700	0.1200	5.6724	90.0000	4254.3000 (28a)
Brick and Block	139.3000	19.3300	119.9700	0.2400	28.7928	42.2200	5065.1334 (29a)
External Roof 1	47.2700		47.2700	0.1000	4.7270	9.1000	430.1570 (30)
Total net area of external elements Aum(A, m ²)			233.8400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.2290		(33)
GF Block			57.4300			75.0000	4307.2500 (32c)
GF Timber Stud			29.3300			9.0000	263.9700 (32c)
FF Timber Stud			129.3600			9.0000	1164.2400 (32c)
Internal Floor 1			47.2700			18.0000	850.8600 (32d)
Internal Ceiling 1			47.2700			18.0000	850.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17186.7704 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 181.7936 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3716 (36)
Total fabric heat loss (33) + (36) = 69.6006 (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	48.5316	48.1614	47.7985	46.0941	45.7752	44.2907	44.2907	44.0158	44.8625	45.7752	46.4203	47.0948 (38)
Heat transfer coeff	118.1322	117.7620	117.3991	115.6947	115.3758	113.8913	113.8913	113.6163	114.4631	115.3758	116.0209	116.6953 (39)
Average = Sum(39)m / 12 =												115.6931 (39)
HLP	1.2495	1.2456	1.2418	1.2238	1.2204	1.2047	1.2047	1.2018	1.2107	1.2204	1.2272	1.2343 (40)
HLP (average)												1.2237 (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												2.6829 (42)
Average daily hot water use (litres/day)												97.9191 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.7110	103.7942	99.8774	95.9607	92.0439	88.1272	88.1272	92.0439	95.9607	99.8774	103.7942	107.7110 (44)
Energy conte	159.7323	139.7029	144.1608	125.6829	120.5957	104.0650	96.4315	110.6565	111.9781	130.4997	142.4506	154.6922 (45)
Energy content (annual)										Total = Sum(45)m =		1540.6482 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.9598	20.9554	21.6241	18.8524	18.0894	15.6097	14.4647	16.5985	16.7967	19.5750	21.3676	23.2038 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	27.5625	24.8932	27.5477	26.6272	27.4916	26.5781	27.4474	27.4761	26.6049	27.5245	26.6592	27.5543 (61)
Total heat required for water heating calculated for each month	187.2947	164.5961	171.7085	152.3101	148.0874	130.6431	123.8789	138.1326	138.5830	158.0242	169.1099	182.2465 (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												1.1772 (H8)
Utilisation factor												0.5724 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												97.9191 (H14)
Volume ratio Veff/V												0.7659 (H15)
Solar storage volume factor												0.9467 (H16)
Solar input												-864.0736 (H17)
Solar input	-25.0564	-41.8119	-71.2105	-95.4362	-117.9033	-115.9178	-114.3859	-99.9395	-78.2727	-53.4510	-29.7205	-20.9679 (63)
Solar input (sum of months) = Sum (63)m =												-864.0736 (63)
Output from w/h	162.2383	122.7841	100.4980	56.8740	30.1841	14.7253	9.4930	38.1931	60.3103	104.5732	139.3894	161.2785 (64)
Total per year (kWh/year) = Sum (64)m =												1000.5414 (64)
Heat gains from water heating, kWh/month	60.0016	52.6745	54.8204	48.4464	46.9710	41.2461	38.9253	43.6623	43.8839	50.2723	54.0296	58.3237 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
(66)m	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.1844	49.9025	40.5834	30.7243	22.9667	19.3895	20.9510	27.2329	36.5520	46.4112	54.1687	57.7459	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	368.9357	372.7641	363.1166	342.5784	316.6525	292.2859	276.0074	272.1790	281.8265	302.3647	328.2906	352.6572	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	(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)	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	(71)
Water heating gains (Table 5)	80.6473	78.3847	73.6833	67.2866	63.1331	57.2863	52.3190	58.6859	60.9499	67.5703	75.0412	78.3921	(72)
Total internal gains	616.2059	611.4897	587.8219	551.0278	513.1908	479.4002	459.7160	468.5364	489.7669	526.7847	567.9390	599.2338	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
East					7.0800	19.6403	0.6300	0.7000			0.7700	42.4964 (76)
West					10.1000	19.6403	0.6300	0.7000			0.7700	60.6234 (80)

Solar gains	103.1199	201.7243	332.2112	484.5102	593.7855	607.8451	578.6933	497.0890	386.3754	239.3629	128.5783	84.8008 (83)
Total gains	719.3257	813.2140	920.0331	1035.5380	1106.9763	1087.2453	1038.4093	965.6254	876.1423	766.1476	696.5173	684.0345 (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	40.4132	40.5403	40.6656	41.2647	41.3787	41.9181	41.9181	42.0195	41.7087	41.3787	41.1486	40.9108	
alpha	3.6942	3.7027	3.7110	3.7510	3.7586	3.7945	3.7945	3.8013	3.7806	3.7586	3.7432	3.7274	
util living area	0.9846	0.9747	0.9504	0.8896	0.7774	0.6136	0.4664	0.5158	0.7480	0.9241	0.9750	0.9871	(86)
MIT	19.4345	19.6329	19.9733	20.4040	20.7352	20.9227	20.9789	20.9693	20.8321	20.3869	19.8384	19.4033	(87)
Th 2	19.8806	19.8837	19.8867	19.9010	19.9037	19.9163	19.9163	19.9186	19.9114	19.9037	19.8983	19.8926	(88)
util rest of house	0.9808	0.9686	0.9382	0.8624	0.7241	0.5284	0.3587	0.4054	0.6711	0.8991	0.9679	0.9839	(89)
MIT 2	18.4754	18.6733	19.0082	19.4282	19.7231	19.8775	19.9097	19.9082	19.8150	19.4245	18.8896	18.4538	(90)
Living area fraction									fLA = Living area / (4) =			0.1726	(91)
MIT	18.6410	18.8389	19.1748	19.5966	19.8978	20.0579	20.0943	20.0913	19.9905	19.5906	19.0533	18.6177	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6410	18.8389	19.1748	19.5966	19.8978	20.0579	20.0943	20.0913	19.9905	19.5906	19.0533	18.6177	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9753	0.9611	0.9285	0.8535	0.7238	0.5402	0.3770	0.4238	0.6773	0.8904	0.9607	0.9790 (94)
Utilising gains	701.5255	781.5926	854.2272	883.8634	801.1890	587.3578	391.4557	409.2479	593.4252	682.1621	669.1481	669.6555 (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	1694.1345	1641.4762	1488.0091	1237.5400	945.8260	621.6125	397.9698	419.3967	674.2495	1037.3021	1386.8375	1682.4812 (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	738.5011	577.8417	471.5337	254.6471	107.6099	0.0000	0.0000	0.0000	0.0000	264.2242	516.7364	753.5423 (98)
Space heating												3684.6366 (98)
Space heating per m2												38.9744 (99)
										(98) / (4) =		

Not applicable

Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design
System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	4062.4439	0.2160	877.4879 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1113.5218	0.2160	240.5207 (264)
Space and water heating			1118.0086 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	396.8935	0.5190	205.9877 (268)
Energy saving/generation technologies			
PV Unit			
Total kg/year	-798.9117	0.5190	-414.6352 (269)
CO2 emissions per m2			974.2361 (272)
EI value			10.3100 (273)
EI rating			90.6444
EI band			91 (274)
			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.2700 (1b)	x 2.3900 (2b)	= 112.9753 (1b) - (3b)
First floor	47.2700 (1c)	x 2.6100 (2c)	= 123.3747 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.3500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1692 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4192 (18)
Number of sides sheltered					1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3878 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000 (22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750 (22a)
Adj infilt rate	0.4944	0.4557	0.4460	0.4169	0.4169	0.3878	0.3878	0.3781	0.3878	0.4363	0.4266	0.4557 (22b)
Effective ac	0.6222	0.6038	0.5994	0.5869	0.5869	0.5752	0.5752	0.5715	0.5752	0.5952	0.5910	0.6038 (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			2.1500	1.1000	2.3650		(26)
Windows & Fully Glazed Do (Uw = 1.20)			17.1800	1.1450	19.6718		(27)
Ground Floor			47.2700	0.1200	5.6724	90.0000	4254.3000 (28a)
Brick and Block	139.3000	19.3300	119.9700	0.2400	28.7928	42.2200	5065.1334 (29a)
External Roof 1	47.2700		47.2700	0.1000	4.7270	9.1000	430.1570 (30)
Total net area of external elements Aum(A, m ²)			233.8400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.2290		(33)
GF Block			57.4300			75.0000	4307.2500 (32c)
GF Timber Stud			29.3300			9.0000	263.9700 (32c)
FF Timber Stud			129.3600			9.0000	1164.2400 (32c)
Internal Floor 1			47.2700			18.0000	850.8600 (32d)
Internal Ceiling 1			47.2700			18.0000	850.8600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17186.7704 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 181.7936 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3716 (36)
Total fabric heat loss (33) + (36) = 69.6006 (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	48.5316	47.0948	46.7539	45.7752	45.7752	44.8625	44.8625	44.5729	44.8625	46.4203	46.0941	47.0948 (38)
Heat transfer coeff	118.1322	116.6953	116.3544	115.3758	115.3758	114.4631	114.4631	114.1735	114.4631	116.0209	115.6947	116.6953 (39)
Average = Sum(39)m / 12 =												115.6589 (39)
HLP	1.2495	1.2343	1.2307	1.2204	1.2204	1.2107	1.2107	1.2077	1.2107	1.2272	1.2238	1.2343 (40)
HLP (average)												1.2234 (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												2.6829 (42)
Average daily hot water use (litres/day)												97.9191 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.7110	103.7942	99.8774	95.9607	92.0439	88.1272	88.1272	92.0439	95.9607	99.8774	103.7942	107.7110 (44)
Energy conte	159.7323	139.7029	144.1608	125.6829	120.5957	104.0650	96.4315	110.6565	111.9781	130.4997	142.4506	154.6922 (45)
Energy content (annual)										Total = Sum(45)m =		1540.6482 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Distribution loss (46)m = 0.15 x (45)m	23.9598	20.9554	21.6241	18.8524	18.0894	15.6097	14.4647	16.5985	16.7967	19.5750	21.3676	23.2038 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	27.5625	24.8932	27.5477	26.6272	27.4916	26.5781	27.4474	27.4761	26.6049	27.5245	26.6592	27.5543 (61)
Total heat required for water heating calculated for each month	187.2947	164.5961	171.7085	152.3101	148.0874	130.6431	123.8789	138.1326	138.5830	158.0242	169.1099	182.2465 (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												1234.4649 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2073.9010 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.3461 (H8)
Utilisation factor												0.5243 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												97.9191 (H14)
Volume ratio Veff/V												0.7659 (H15)
Solar storage volume factor												0.9467 (H16)
Solar input	-29.7002	-42.3979	-71.8572	-98.0535	-115.7246	-123.1529	-118.6061	-105.8123	-83.7442	-57.3395	-34.9185	-905.0306 (H17)
Solar input (sum of months) = Sum (63)m =												-905.0306 (63)
Output from w/h	157.5946	122.1982	99.8514	54.2566	32.3628	7.4902	5.2727	32.3203	54.8388	100.6848	134.1914	158.5227 (64)
Total per year (kWh/year) = Sum (64)m =												959.5845 (64)
Heat gains from water heating, kWh/month	60.0016	52.6745	54.8204	48.4464	46.9710	41.2461	38.9253	43.6623	43.8839	50.2723	54.0296	58.3237 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
(66)m	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	160.9745	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.1844	49.9025	40.5834	30.7243	22.9667	19.3895	20.9510	27.2329	36.5520	46.4112	54.1687	57.7459	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	368.9357	372.7641	363.1166	342.5784	316.6525	292.2859	276.0074	272.1790	281.8265	302.3647	328.2906	352.6572	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	53.7804	(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)	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	-107.3163	(71)
Water heating gains (Table 5)	80.6473	78.3847	73.6833	67.2866	63.1331	57.2863	52.3190	58.6859	60.9499	67.5703	75.0412	78.3921	(72)
Total internal gains	616.2059	611.4897	587.8219	551.0278	513.1908	479.4002	459.7160	468.5364	489.7669	526.7847	567.9390	599.2338	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
East					7.0800	25.9136	0.6300	0.7000	0.7700	56.0704 (76)		
West					10.1000	25.9136	0.6300	0.7000	0.7700	79.9874 (80)		

Solar gains	136.0578	227.2728	370.9873	548.1167	639.4178	707.5031	657.7834	578.5468	456.5565	284.9240	168.0816	106.8367 (83)
Total gains	752.2637	838.7625	958.8092	1099.1444	1152.6086	1186.9033	1117.4994	1047.0832	946.3234	811.7087	736.0205	706.0705 (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	40.4132	40.9108	41.0307	41.3787	41.3787	41.7087	41.7087	41.8145	41.7087	41.1486	41.2647	40.9108	
alpha	3.6942	3.7274	3.7354	3.7586	3.7586	3.7806	3.7806	3.7876	3.7806	3.7432	3.7510	3.7274	
util living area	0.9781	0.9674	0.9344	0.8543	0.7167	0.5145	0.3729	0.3956	0.6502	0.8818	0.9603	0.9815	(86)
MIT	19.6295	19.7900	20.1320	20.5311	20.8216	20.9622	20.9915	20.9897	20.9107	20.5625	20.0649	19.6139	(87)
Th 2	19.8806	19.8926	19.8955	19.9037	19.9037	19.9114	19.9114	19.9139	19.9114	19.8983	19.9010	19.8926	(88)
util rest of house	0.9725	0.9593	0.9182	0.8196	0.6529	0.4243	0.2661	0.2833	0.5573	0.8427	0.9484	0.9767	(89)
MIT 2	18.6685	18.8347	19.1679	19.5450	19.7914	19.8955	19.9095	19.9116	19.8680	19.5803	19.1134	18.6629	(90)
Living area fraction									fLA = Living area / (4) =			0.1726	(91)
MIT	18.8344	18.9996	19.3344	19.7152	19.9692	20.0796	20.0963	20.0977	20.0480	19.7499	19.2776	18.8271	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8344	18.9996	19.3344	19.7152	19.9692	20.0796	20.0963	20.0977	20.0480	19.7499	19.2776	18.8271	(93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9656	0.9510	0.9081	0.8128	0.6570	0.4388	0.2846	0.3027	0.5699	0.8364	0.9398	0.9705	(94)
Useful gains	726.3886	797.6312	870.6899	893.4389	757.3142	520.7927	318.0485	316.9393	539.3221	678.9311	691.6959	685.2600	(95)
Ext temp.	5.4000	5.7000	7.3000	9.6000	12.6000	15.4000	17.3000	17.3000	15.0000	11.8000	8.4000	5.5000	(96)
Heat loss rate W													
	1587.0372	1552.0046	1400.2503	1167.0472	850.2328	535.6403	320.0760	319.4215	577.8114	922.3512	1258.4825	1555.2046	(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													
	640.3225	506.9389	393.9929	196.9980	69.1314	0.0000	0.0000	0.0000	0.0000	181.1046	408.0863	647.2388	(98)
Space heating													3043.8135 (98)
Space heating per m2													32.1960 (99)
										(98) / (4) =			

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.7000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3355.9134 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	640.3225	506.9389	393.9929	196.9980	69.1314	0.0000	0.0000	0.0000	0.0000	181.1046	408.0863	647.2388 (98)	
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000 (210)	
Space heating fuel (main heating system)	705.9785	558.9183	434.3913	217.1973	76.2199	0.0000	0.0000	0.0000	0.0000	199.6743	449.9298	713.6040 (211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)	
Water heating													
Water heating requirement	157.5946	122.1982	99.8514	54.2566	32.3628	7.4902	5.2727	32.3203	54.8388	100.6848	134.1914	158.5227 (64)	
Efficiency of water heater	(217)m	90.1329	90.1423	90.1196	90.0804	89.7880	87.9000	87.9000	87.9000	89.6793	89.9906	87.9000 (216)	
Fuel for water heating, kWh/month	174.8469	135.5615	110.7988	60.2313	36.0435	8.5213	5.9986	36.7694	62.3877	112.2720	149.1171	175.8722 (219)	
Water heating fuel used												1068.4203 (219)	
Annual totals kWh/year													
Space heating fuel - main system												3355.9134 (211)	
Space heating fuel - secondary												0.0000 (215)	
Electricity for pumps and fans:													
central heating pump												30.0000 (230c)	
main heating flue fan												45.0000 (230e)	
pump for solar water heating												50.0000 (230g)	
Total electricity for the above, kWh/year												125.0000 (231)	
Electricity for lighting (calculated in Appendix L)												396.8935 (232)	
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.10 * 1054 * 1.00) =									-927.9096			-927.9096 (233)	
Total delivered energy for all uses												4018.3177 (238)	

10a. Fuel costs - using BEDF prices (£13)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3355.9134	9.7400	326.8660 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	1068.4203	9.7400	104.0641 (247)	
Pumps and fans for heating	75.0000	36.8500	27.6375 (249)	
Pump for solar water heating	50.0000	36.8500	18.4250 (249)	
Energy for lighting	396.8935	36.8500	146.2553 (250)	
Additional standing charges			104.0000 (251)	
Energy saving/generation technologies				
PV Unit	-927.9096	36.8500	-341.9347 (252)	
Total energy cost			385.3132 (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	3355.9134	0.2160	724.8773 (261)	
Space heating - secondary	0.0000	0.0000	0.0000 (263)	
Water heating (other fuel)	1068.4203	0.2160	230.7788 (264)	
Space and water heating			955.6561 (265)	
Pumps and fans	125.0000	0.5190	64.8750 (267)	
Energy for lighting	396.8935	0.5190	205.9877 (268)	
Energy saving/generation technologies				
PV Unit	-927.9096	0.5190	-481.5851 (269)	
Total kg/year			744.9338 (272)	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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	3355.9134	1.2200	4094.2144 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1068.4203	1.2200	1303.4728 (264)
Space and water heating			5397.6872 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	396.8935	3.0700	1218.4631 (268)
Energy saving/generation technologies			
PV Unit	-927.9096	3.0700	-2848.6824 (269)
Primary energy kWh/year			4151.2179 (272)
Primary energy kWh/m2/year			43.9096 (273)

U-VALUE CALCULATOR REPORT

Property Reference	SAP 0879 Plot 135	Issued on Date	28/03/2023
Assessment Reference	Rev A	Prop Type Ref	Ingleby
Project	Plot 135		
Calculation Type	New Build (As Designed)		

SAP Rating	88 B	DER	14.06	TER	18.44
Environmental	89 B	% DER<TER	23.74		
CO ₂ Emissions (t/year)	0.94	DFEE	48.96	TFEE	57.17
General Requirements Compliance	Pass	% DFEE<TFEE	14.36		

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 (%)	Density (kg/m ³)	Heat Cap. (J/kgK)
Ext surface				0.0400			
Layer 1	Earthwool Loft Roll 40						
	Main construction	150	0.0400	3.7500	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 2	Earthwool Loft Roll 40						
	Main construction	200	0.0400	5.0000	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 3	Earthwool Loft Roll 40						
	Main construction	100	0.0400	2.5000	87.50		
	Main construction	100	0.1300	0.7692	12.50		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	Plasterboard, standard						
	Main construction	12.5	0.2100	0.0595	100.00	700	1000
Int surface				0.1000			

Total resistance:	Upper limit = 11.200 m ² K/W	Lower limit = 10.901 m ² K/W	Average = 11.050 m ² K/W
	Total correction = 0.0065 m ² K/W	U-value (unrounded) = 0.1 W/m ² K	

Unheated space: None

Total thickness: 463 mm

U-value: 0.10 W/m² K

Kappa: 9.10 kJ/m² K

U-VALUE CALCULATOR REPORT

Property Reference	SAP 0879 Plot 135	Issued on Date	28/03/2023
Assessment Reference	Rev A	Prop Type Ref	Ingleby
Project	Plot 135		
Calculation Type	New Build (As Designed)		

SAP Rating	88 B	DER	14.06	TER	18.44
Environmental	89 B	% DER<TER	23.74		
CO ₂ Emissions (t/year)	0.94	DFEE	48.96	TFEE	57.17
General Requirements Compliance	Pass	% DFEE<TFEE	14.36		

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 000001

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 0879 Plot 135	Issued on Date	28/03/2023
Assessment Reference	Rev A	Prop Type Ref	Ingleby
Project	Plot 135		
Calculation Type	New Build (As Designed)		

SAP Rating	88 B	DER	14.06	TER	18.44
Environmental	89 B	% DER<TER	23.74		
CO ₂ Emissions (t/year)	0.94	DFEE	48.96	TFEE	57.17
General Requirements Compliance	Pass	% DFEE<TFEE	14.36		

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

Floor 000003

Floor Type: Suspended Floor

Area = 47.90 m², Perimeter = 27.96 m, Wall thickness = 275.00 mm, Soil: Unknown

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

Floor height above ground: h = 0.200 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	EPS 200 Lower portion						
	Main construction	55	0.0340	1.6176	80.65		
	Main construction	55	2.0000	0.0275	19.35		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 2	EPS Upper portion						
	Main construction	100	0.0340	2.9412	87.10		
	Main construction	100	2.0000	0.0500	12.90		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 3	Grey EPS 100 Topsheet						
	Main construction	155	0.0300	5.1667	100.00	15	1450
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	Screed						
	Main construction	75	1.1500	0.0652	100.00	1200	1000
Int surface				0.1700			

Total resistance:	Upper limit = 9.271 m ² K/W	Lower limit = 6.052 m ² K/W	Average = 7.661 m ² K/W
	Total correction = 0.0046 m ² K/W	U-value (unrounded) = 0.12 W/m ² K	

Unheated space: None

Total thickness: 385 mm

U-value: 0.12 W/m² K

Kappa: 90.00 kJ/m² K

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)

Property Reference	SAP 0879 Plot 135				Issued on Date	28/03/2023
Assessment Reference	Rev A	Prop Type Ref	Ingleby			
Property	Plot 135					
SAP Rating	88 B	DER	14.06	TER	18.44	
Environmental	89 B	% DER<TER	23.74			
CO ₂ Emissions (t/year)	0.94	DFEE	48.96	TFEE	57.17	
General Requirements Compliance	Pass	% DFEE<TFEE	14.36			
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 Designed)

Orientation	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	2022
4.0 Sheltered Sides	1
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements		Heat Loss Perimeter	Internal Floor Area	Average Storey Height
	Ground Floor:	27.86 m	47.27 m ²	2.39 m
	1st Storey:	27.86 m	47.27 m ²	2.61 m

7.0 Living Area	16.32	m ²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	181.79	kJ/m ² K

9.0 External Walls				U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area (m ²)	Nett Area (m ²)
Description	Type	Construction					
Brick and Block	Cavity Wall	Other		0.24	42.22	139.30	119.97

9.2 Internal Walls				Kappa (kJ/m ² K)	Area (m ²)
Description	Construction				
GF Block	Dense block, plasterboard on dabs			75.00	57.43
GF Timber Stud	Plasterboard on timber frame			9.00	29.33
FF Timber Stud	Plasterboard on timber frame			9.00	129.36

10.0 External Roofs				U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area (m ²)	Nett Area (m ²)
Description	Type	Construction					
External Roof 1	External Plane Roof	Other		0.10	9.10	47.27	47.27

10.2 Internal Ceilings				Kappa (kJ/m ² K)	Area (m ²)
Description	Construction				
Internal Ceiling 1	Plasterboard ceiling, carpeted chipboard floor			9.00	47.27

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Ground Floor	Ground Floor - Solid	Other	0.12	90.00	47.27

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Plasterboard ceiling, carpeted chipboard floor	18.00	47.27

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	Solid Door							1.10
Windows & Fully Glazed Do	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 Door	Solid Door	[1] Brick and Block	East							2.15	
Front Elevation	Window	[1] Brick and Block	East	None	0.00					7.08	
Rear Elevation	Window	[1] Brick and Block	West	None	0.00					10.10	

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)	0.69	0.077	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	2.73	0.070	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.02	0.071	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	7.49	0.064	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.59	0.067	No	Birtley Supatherm
Independently assessed	E3 Sill	9.99	0.021	No	Knauf P5
Independently assessed	E4 Jamb	33.90	0.016	No	Knauf P6
Table K1 - Approved	E5 Ground floor (normal)	27.86	0.160	No	
Independently assessed	E6 Intermediate floor within a dwelling	27.86	0.000	No	CD0029
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	15.87	0.060	No	
Independently assessed	E12 Gable (insulation at ceiling level)	12.05	0.044	No	Knauf P21
Independently assessed	E16 Corner (normal)	19.92	0.039	No	Knauf P23

Y-value	0.036	W/m²K
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18.0 Pressure Testing

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

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

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)

Mechanical Ventilation System Present

No

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				4
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	21	
Total number of L.E.L. fittings	21	
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

	Database	
Description	Gas System	
Percentage of Heat	100	%
Database Ref. No.	17515	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.7	
In Summer	87.9	
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)	
Combi boiler type	Standard Combi	
Combi keep hot type	Gas/Oil, time clock	

25.0 Main Heating 2

None

Community Heating	None
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28.0 Water Heating

	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery	No

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)

Instantaneous System 1

Waste Water Heat Recovery

No

Instantaneous System 2

Waste Water Heat Recovery

No

Storage System

Solar Panel

No

Water use <= 125 litres/person/day

Yes

SAP Code

901

29.0 Hot Water Cylinder

None

32.0 Photovoltaic Unit

One Dwelling

PV Cells kWp

Orientation

Elevation

Overshading

Connected to Dwelling

1.10

West

30°

None Or Little

Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

Solar water heating

Typical Cost

£4,000 - £6,000

Typical savings
per year

£81

Ratings after improvement
SAP rating
B 89

Environmental Impact