elmhurst energy

SAP Report Submission for Building Regulations Compliance

Client: Foreman Homes

Project: Plot 167

Contact: Tobias Whiting
Abacus Energy (UK) Ltd
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Report Issue Date: 28/03/2023

EXCELLENCE IN ENERGY ASSESSMENT

PREDICTED ENERGY ASSESSMENT

Design SAP
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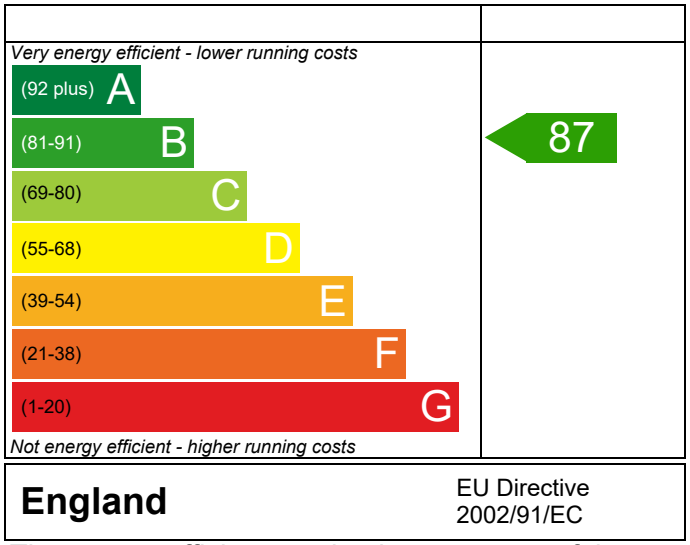
Plot 167

Dwelling type:	House, Detached
Date of assessment:	28/03/2023
Produced by:	Abacus Energy (UK) Ltd
Total floor area:	87.42 m²
DRRN:	9032-7768-7283

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 (CO_2) emissions.

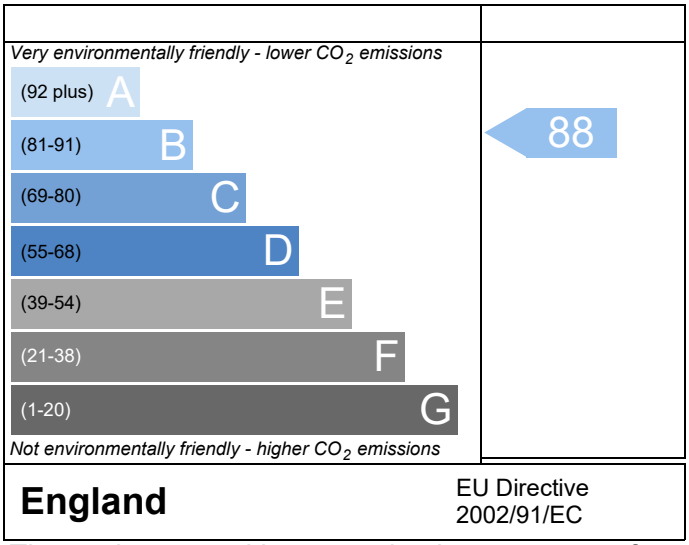
Energy Efficiency Rating



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 (CO_2) 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 (CO_2) 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.

elmhurst energy APPROVED ENERGY ASSESSOR

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

BUILDING REGULATION COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 167	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Property	Plot 167		

SAP Rating	87 B	**DER**	15.11	**TER**	18.74
Environmental	88 B	**% DER<TER**	19.36		
CO_2 Emissions (t/year)	0.96	**DFEE**	51.42	**TFEE**	57.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.47		

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

SUMARY 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)	18.74	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	15.11	$kgCO_2/m^2$	Pass
	-3.63 (-19.4%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	57.44	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	51.42	$kWh/m^2/yr$	
	-6.0 (-10.5%)	$kWh/m^2/yr$	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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elmhurstenergy APPROVED ENERGY ASSESSOR

ELMHURST ENERGY QUALITY PROMISE ACCREDITED MEMBER

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

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 Windows facing South Windows facing West	10.85 m² 2.62 m², No overhang 6.34 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)	$m^3/(h.m^2)$ @ 50 Pa	
Maximum	10.0	$m^3/(h.m^2)$ @ 50 Pa	Pass

10 Key features

Roof U-value	0.10	W/m^2K
Floor U-value	0.12	W/m^2K
Door U-value	1.10	W/m^2K
Photovoltaic array	0.95	kW

RECOMMENDATIONS

Design SAP
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	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	£80	B 88	B 90	Recommended
Photovoltaic			0	0	Already installed
Wind turbine			0	0	Not applicable
Totals	**£4,000 - £6,000**	**£80**	**B 88**	**B 90**	

THERMAL BRIDGING
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 167	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Property	Plot 167		

SAP Rating	87 B	**DER**	15.11	**TER**	18.74
Environmental	88 B	**% DER<TER**	19.36		
CO_2 Emissions (t/year)	0.96	**DFEE**	51.42	**TFEE**	57.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.47		

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

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.093	0.46	0.04	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.077	1.37	0.11	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	9.98	0.64	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.067	3.17	0.21	Birtley Supatherm
External wall	E3 Sill	Independently assessed	0.021	11.81	0.25	Knauf P5
External wall	E4 Jamb	Independently assessed	0.016	36.92	0.59	Knauf P6
External wall	E5 Ground floor (normal)	Table K1 - Default	0.320	26.86	8.60	
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.000	26.86	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	11.14	0.49	Knauf P21
External wall	E16 Corner (normal)	Independently assessed	0.039	19.99	0.78	Knauf P23

Total: 12.73 **W/mK:**

Y-Value: 0.057 **W/m²K:**

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
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Property Reference	SAP 0879 Plot 167	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Property	Plot 167		

SAP Rating	87 B	**DER**	15.11	**TER**	18.74
Environmental	88 B	**% DER<TER**	19.36		
CO_2 Emissions (t/year)	0.96	**DFEE**	51.42	**TFEE**	57.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.47		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	**Assessor ID**	E477-0001
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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Detached House, total floor area 87 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) 18.74 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.11 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)57.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.4 kWh/m²/yrOK

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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

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3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

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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

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5 Cylinder insulation
Hot water storage: No cylinder

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6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing East: 10.85 m², No overhang
Windows facing South: 2.62 m², No overhang
Windows facing West: 6.34 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Roof U-value 0.10 W/m²K
Floor U-value 0.12 W/m²K
Door U-value 1.10 W/m²K
Photovoltaic array 0.95 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7100	(1b)	x 2.3900	(2b) =	104.4669	(1b) - (3b)
First floor	43.7100	(1c)	x 2.6100	(2c) =	114.0831	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		218.5500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1830	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4330	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3681	(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	0.4693	0.4601	0.4509	0.4049	0.3957	0.3497	0.3497	0.3405	0.3681	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1600	1.1000	2.3760			(26)
Windows & Fully Glazed Do (Uw = 1.20)			19.8100	1.1450	22.6832			(27)
Ground Floor			43.7100	0.1200	5.2452	90.0000	3933.9000	(28a)
Brick and Block	134.3000	21.9700	112.3300	0.2400	26.9592	42.2200	4742.5726	(29a)
External Roof 1	43.7100		43.7100	0.1000	4.3710	9.1000	397.7610	(30)
Total net area of external elements Aum(A, m2)			221.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.6346			(33)
GF Block			52.8500			75.0000	3963.7500	(32c)
GF Timber Stud			19.9900			9.0000	179.9100	(32c)
FF Timber Stud			115.9200			9.0000	1043.2800	(32c)
Internal Floor			43.7100			18.0000	786.7800	(32d)
Internal Ceiling 1			43.7100			18.0000	786.7800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15834.7336	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	181.1340	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.7277	(36)
Total fabric heat loss	(33) + (36) = 74.3623	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.0025	43.6941	43.3919	41.9720	41.7064	40.4698	40.4698	40.2408	40.9461	41.7064	42.2438	42.8056	(38)
Heat transfer coeff	118.3648	118.0564	117.7542	116.3344	116.0687	114.8321	114.8321	114.6031	115.3084	116.0687	116.6061	117.1679	(39)
Average = Sum(39)m / 12 =												116.3331	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3505	1.3470	1.3308	1.3277	1.3136	1.3136	1.3109	1.3190	1.3277	1.3339	1.3403	(40)
HLP (average)												1.3307	(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	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.2507	101.4234	97.5961	93.7688	89.9415	86.1142	86.1142	89.9415	93.7688	97.5961	101.4234	105.2507	(44)
Energy conte	156.0837	136.5118	140.8680	122.8121	117.8411	101.6879	94.2288	108.1289	109.4204	127.5189	139.1968	151.1587	(45)
Energy content (annual)										Total = Sum(45)m =		1505.4571	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m

	23.4126	20.4768	21.1302	18.4218	17.6762	15.2532	14.1343	16.2193	16.4131	19.1278	20.8795	22.6738 (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	27.5604	24.8911	27.5367	26.6180	27.4831	26.5711	27.4409	27.4683	26.5966	27.5145	26.6571	27.5523 (61)

Total heat required for water heating calculated for each month

	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110 (64)

Total per year (kWh/year) = Sum(64)m = 1829.3472 (64)

Heat gains from water heating, kWh/month

	58.7879	51.6130	53.7228	47.4895	46.0530	40.4540	38.1913	42.8199	43.0314	49.2787	52.9472	57.1483 (65)

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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	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	20.8795	18.5450	15.0818	11.4179	8.5350	7.2056	7.7859	10.1204	13.5836	17.2475	20.1304	21.4598 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	234.2503	236.6811	230.5556	217.5151	201.0539	185.5826	175.2469	172.8161	178.9416	191.9821	208.4433	223.9146 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437 (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)

	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494 (71)

Water heating gains (Table 5)

	79.0160	76.8050	72.2080	65.9577	61.8991	56.1861	51.3324	57.5537	59.7659	66.2347	73.5378	76.8123 (72)

Total internal gains

	398.9769	396.8621	382.6764	359.7217	336.3190	313.8054	299.1962	305.3212	317.1221	340.2954	366.9425	387.0177 (73)

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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	10.8500	19.6403	0.6300	0.7000	0.7700	65.1252	(76)
South	2.6200	46.7521	0.6300	0.7000	0.7700	37.4347	(78)
West	6.3400	19.6403	0.6300	0.7000	0.7700	38.0547	(80)

Solar gains	140.6145	263.1501	410.5005	573.0576	686.1091	696.7152	665.5160	581.3680	468.1807	305.6290	173.0260	117.1971 (83)
Total gains	539.5914	660.0121	793.1769	932.7793	1022.4281	1010.5206	964.7122	886.6893	785.3028	645.9244	539.9686	504.2148 (84)

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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	37.1608	37.2579	37.3536	37.8094	37.8960	38.3041	38.3041	38.3806	38.1458	37.8960	37.7213	37.5405	
alpha	3.4774	3.4839	3.4902	3.5206	3.5264	3.5536	3.5536	3.5587	3.5431	3.5264	3.5148	3.5027	

util living area

	0.9920	0.9835	0.9619	0.9062	0.7997	0.6437	0.4973	0.5527	0.7849	0.9455	0.9859	0.9937 (86)

MIT	19.1102	19.3577	19.7598	20.2588	20.6547	20.8883	20.9663	20.9509	20.7632	20.2135	19.5665	19.0702 (87)
Th 2	19.7988	19.8015	19.8042	19.8168	19.8192	19.8302	19.8302	19.8323	19.8260	19.8192	19.8144	19.8094 (88)

util rest of house

	0.9899	0.9792	0.9518	0.8809	0.7463	0.5525	0.3765	0.4296	0.7079	0.9256	0.9815	0.9920 (89)
MIT 2	18.0939	18.3412	18.7384	19.2260	19.5827	19.7742	19.8200	19.8158	19.6881	19.1964	18.5599	18.0620 (90)

Living area fraction fLA = Living area / (4) = 0.2008 (91)

MIT	18.2979	18.5453	18.9434	19.4333	19.7979	19.9979	20.0501	20.0437	19.9040	19.4006	18.7619	18.2644 (92)

Temperature adjustment 0.0000

adjusted MIT	18.2979	18.5453	18.9434	19.4333	19.7979	19.9979	20.0501	20.0437	19.9040	19.4006	18.7619	18.2644 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9731	0.9425	0.8711	0.7452	0.5666	0.4003	0.4533	0.7138	0.9165	0.9762	0.9890	(94)
Useful gains	532.1860	642.2878	747.5641	812.5113	761.9184	572.5460	386.1266	401.9218	560.5648	591.9732	527.0997	498.6608	(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

	1656.8607	1610.9128	1465.2666	1225.3871	939.9109	619.8516	396.1816	417.5778	669.2466	1021.4773	1359.8543	1647.8958	(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

	836.7580	650.9160	533.9707	297.2706	132.4264	0.0000	0.0000	0.0000	0.0000	319.5511	599.5833	855.0309	(98)

Space heating 4225.5070 (98)

Space heating per m2 (98) / (4) = 48.3357 (99)

8c. Space cooling requirement

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												4658.7729	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	836.7580	650.9160	533.9707	297.2706	132.4264	0.0000	0.0000	0.0000	0.0000	319.5511	599.5833	855.0309	(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)													
	922.5556	717.6582	588.7218	327.7515	146.0049	0.0000	0.0000	0.0000	0.0000	352.3165	661.0621	942.7022	(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													
	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(64)
Efficiency of water heater												87.9000	(216)
(217)m	90.1830	90.1295	90.0125	89.7437	89.2131	87.9000	87.9000	87.9000	87.9000	89.7659	90.0783	90.2033	(217)
Fuel for water heating, kWh/month													
	203.6350	179.0788	187.0902	166.5076	162.8956	145.9147	138.4183	154.2630	154.7406	172.7085	184.1221	198.1203	(219)
Water heating fuel used												2047.4948	(219)
Annual totals kWh/year													
Space heating fuel - main system												4658.7729	(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)												368.7383	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.95 * 908 * 1.00) =										-689.9692		-689.9692	(233)
Total delivered energy for all uses												6460.0367	(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	4658.7729	0.2160	1006.2949	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2047.4948	0.2160	442.2589	(264)
Space and water heating			1448.5538	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	368.7383	0.5190	191.3752	(268)
Energy saving/generation technologies				
PV Unit	-689.9692	0.5190	-358.0940	(269)
Total CO2, kg/year			1320.7600	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.1100	(273)

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

DER		15.1100	ZC1
Total Floor Area	TFA	87.4200	
Assumed number of occupants	N	2.5887	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.8787	ZC2
CO2 emissions from cooking, equation (L16)		2.0719	ZC3
Total CO2 emissions		33.0607	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		33.0607	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7100 (1b)	x	2.3900 (2b)	=	104.4669 (1b) - (3b)	
First floor	43.7100 (1c)	x	2.6100 (2c)	=	114.0831 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.5500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1373	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3873	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3292	(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	0.4197	0.4115	0.4032	0.3621	0.3539	0.3127	0.3127	0.3045	0.3292	0.3539	0.3703	0.3868	(22b)
Effective ac	0.5881	0.5847	0.5813	0.5656	0.5626	0.5489	0.5489	0.5464	0.5542	0.5626	0.5686	0.5748	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1600	1.0000	2.1600			(26)
TER Opening Type (Uw = 1.40)			19.7000	1.3258	26.1174			(27)
Ground Floor			43.7100	0.1300	5.6823			(28a)
Brick and Block	134.3000	21.8600	112.4400	0.1800	20.2392			(29a)
External Roof 1	43.7100		43.7100	0.1300	5.6823			(30)
Total net area of external elements Aum(A, m2)			221.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		59.8812			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.9538	(36)
Total fabric heat loss (33) + (36) =	70.8350	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.4128	42.1662	41.9244	40.7888	40.5763	39.5872	39.5872	39.4041	39.9682	40.5763	41.0062	41.4555	(38)
Heat transfer coeff	113.2479	113.0012	112.7594	111.6238	111.4114	110.4223	110.4223	110.2391	110.8033	111.4114	111.8412	112.2905	(39)
Average = Sum(39)m / 12 =												111.6228	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2954	1.2926	1.2899	1.2769	1.2744	1.2631	1.2631	1.2610	1.2675	1.2744	1.2794	1.2845	(40)
HLP (average)												1.2769	(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	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.2507	101.4234	97.5961	93.7688	89.9415	86.1142	86.1142	89.9415	93.7688	97.5961	101.4234	105.2507	(44)
Energy conte	156.0837	136.5118	140.8680	122.8121	117.8411	101.6879	94.2288	108.1289	109.4204	127.5189	139.1968	151.1587	(45)
Energy content (annual)										Total = Sum(45)m =		1505.4571	(45)
Distribution loss (46)m = 0.15 x (45)m	23.4126	20.4768	21.1302	18.4218	17.6762	15.2532	14.1343	16.2193	16.4131	19.1278	20.8795	22.6738	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	49.7339	46.2421	45.8332	42.4673	43.8828	45.8332	46.2421	49.7339	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	207.0426	182.5392	190.6018	169.0542	163.6743	144.1552	138.1117	153.9621	155.6625	177.2528	188.5119	202.1176	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	207.0426	182.5392	190.6018	169.0542	163.6743	144.1552	138.1117	153.9621	155.6625	177.2528	188.5119	202.1176	(64)
								Total per year (kWh/year) = Sum(64)m =				2072.6860	(64)
Heat gains from water heating, kWh/month													
	64.6376	56.8970	59.2721	52.3956	50.6405	44.4281	42.3018	47.4112	47.9428	54.8335	58.6117	63.0000	(65)

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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	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.8803	18.5457	15.0824	11.4183	8.5353	7.2059	7.7862	10.1208	13.5841	17.2482	20.1312	21.4606	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	234.2503	236.6811	230.5556	217.5151	201.0539	185.5826	175.2469	172.8161	178.9416	191.9821	208.4433	223.9146	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	(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)													
	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)													
	86.8784	84.6682	79.6668	72.7716	68.0652	61.7056	56.8572	63.7247	66.5872	73.7009	81.4052	84.6774	(72)
Total internal gains													
	406.8401	404.7260	390.1357	366.5361	342.4854	319.3252	304.7214	311.4926	323.9440	347.7622	374.8107	394.8836	(73)

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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	10.8000	19.6403	0.6300	0.7000	0.7700	64.8251	(76)
South	2.6000	46.7521	0.6300	0.7000	0.7700	37.1489	(78)
West	6.3000	19.6403	0.6300	0.7000	0.7700	37.8146	(80)

Solar gains	139.7886	261.6253	408.1640	569.8457	682.2963	692.8552	661.8242	578.1228	465.5339	303.8703	172.0137	116.5059	(83)
Total gains	546.6286	666.3513	798.2998	936.3818	1024.7817	1012.1804	966.5456	889.6155	789.4779	651.6325	546.8244	511.3896	(84)

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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	53.6066	53.7236	53.8388	54.3865	54.4903	54.9783	54.9783	55.0697	54.7893	54.4903	54.2808	54.0636	
alpha	4.5738	4.5816	4.5893	4.6258	4.6327	4.6652	4.6652	4.6713	4.6526	4.6327	4.6187	4.6042	
util living area													
	0.9976	0.9936	0.9806	0.9354	0.8270	0.6528	0.4924	0.5515	0.8096	0.9683	0.9948	0.9982	(86)
MIT	19.5914	19.7883	20.1072	20.5015	20.8018	20.9517	20.9895	20.9827	20.8681	20.4457	19.9393	19.5571	(87)
Th 2	19.8444	19.8466	19.8488	19.8590	19.8609	19.8698	19.8698	19.8715	19.8664	19.8609	19.8570	19.8530	(88)
util rest of house													
	0.9967	0.9914	0.9737	0.9124	0.7700	0.5556	0.3712	0.4254	0.7266	0.9526	0.9926	0.9976	(89)
MIT 2	17.9811	18.2695	18.7319	19.2916	19.6761	19.8397	19.8663	19.8649	19.7659	19.2285	18.4981	17.9370	(90)
Living area fraction										fLA = Living area / (4) =		0.2008	(91)
MIT	18.3044	18.5744	19.0080	19.5345	19.9021	20.0629	20.0918	20.0893	19.9871	19.4729	18.7875	18.2622	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3044	18.5744	19.0080	19.5345	19.9021	20.0629	20.0918	20.0893	19.9871	19.4729	18.7875	18.2622	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9950	0.9878	0.9668	0.9043	0.7723	0.5732	0.3956	0.4507	0.7368	0.9453	0.9895	0.9962	(94)
Useful gains	543.8778	658.2411	771.7704	846.7936	791.4676	580.2123	382.3685	400.9338	581.6508	616.0126	541.1002	509.4615	(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													
	1585.9684	1545.2223	1410.3919	1187.0644	913.8038	603.2293	385.5707	406.7043	652.3145	988.5381	1307.1385	1579.0543	(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													
	775.3154	596.0514	475.1343	244.9949	91.0181	0.0000	0.0000	0.0000	0.0000	277.1590	551.5475	795.7771	(98)
Space heating												3806.9978	(98)
Space heating per m2											(98) / (4) =	43.5484	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4076.0148	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	775.3154	596.0514	475.1343	244.9949	91.0181	0.0000	0.0000	0.0000	0.0000	277.1590	551.5475	795.7771	(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)													
	830.1022	638.1707	508.7092	262.3072	97.4498	0.0000	0.0000	0.0000	0.0000	296.7441	590.5220	852.0097	(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													
	207.0426	182.5392	190.6018	169.0542	163.6743	144.1552	138.1117	153.9621	155.6625	177.2528	188.5119	202.1176	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.0655	87.8106	87.2578	85.9843	83.6395	80.3000	80.3000	80.3000	80.3000	86.1722	87.5936	88.1542	(217)
Fuel for water heating, kWh/month													
	235.1008	207.8783	218.4353	196.6106	195.6903	179.5208	171.9946	191.7337	193.8512	205.6960	215.2120	229.2773	(219)
Water heating fuel used												2441.0009	(219)
Annual totals kWh/year													
Space heating fuel - main system												4076.0148	(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)												368.7527	(232)
Total delivered energy for all uses												6960.7684	(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	4076.0148	0.2160	880.4192	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2441.0009	0.2160	527.2562	(264)
Space and water heating			1407.6754	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	368.7527	0.5190	191.3826	(268)
Total CO2, kg/m2/year			1637.9830	(272)
Emissions per m2 for space and water heating			16.1024	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1892	(272b)
Emissions per m2 for pumps and fans			0.4453	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1024 * 1.00) + 2.1892 + 0.4453, rounded to 2 d.p.			18.7400	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7100	(1b)	x 2.3900	(2b) =	104.4669	(1b) - (3b)
First floor	43.7100	(1c)	x 2.6100	(2c) =	114.0831	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	218.5500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1373	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3873	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3292	(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	0.4197	0.4115	0.4032	0.3621	0.3539	0.3127	0.3127	0.3045	0.3292	0.3539	0.3703	0.3868	(22b)
Effective ac	0.5881	0.5847	0.5813	0.5656	0.5626	0.5489	0.5489	0.5464	0.5542	0.5626	0.5686	0.5748	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1600	1.1000	2.3760			(26)
Windows & Fully Glazed Do (Uw = 1.20)			19.8100	1.1450	22.6832			(27)
Ground Floor			43.7100	0.1200	5.2452	90.0000	3933.9000	(28a)
Brick and Block	134.3000	21.9700	112.3300	0.2400	26.9592	42.2200	4742.5726	(29a)
External Roof 1	43.7100		43.7100	0.1000	4.3710	9.1000	397.7610	(30)
Total net area of external elements Aum(A, m2)			221.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.6346			(33)
GF Block			52.8500			75.0000	3963.7500	(32c)
GF Timber Stud			19.9900			9.0000	179.9100	(32c)
FF Timber Stud			115.9200			9.0000	1043.2800	(32c)
Internal Floor			43.7100			18.0000	786.7800	(32d)
Internal Ceiling 1			43.7100			9.0000	393.3900	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		15441.3436	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							176.6340	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.7277	(36)
Total fabric heat loss					(33) + (36) =		74.3623	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.4128	42.1662	41.9244	40.7888	40.5763	39.5872	39.5872	39.4041	39.9682	40.5763	41.0062	41.4555	(38)
Heat transfer coeff	116.7752	116.5285	116.2867	115.1511	114.9386	113.9496	113.9496	113.7664	114.3305	114.9386	115.3685	115.8178	(39)
Average = Sum(39)m / 12 =												115.1501	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3330	1.3302	1.3172	1.3148	1.3035	1.3035	1.3014	1.3078	1.3148	1.3197	1.3248	(40)
HLP (average)												1.3172	(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	2.5887	(42)
Average daily hot water use (litres/day)	95.6824	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.2507	101.4234	97.5961	93.7688	89.9415	86.1142	86.1142	89.9415	93.7688	97.5961	101.4234	105.2507	(44)
Energy conte	156.0837	136.5118	140.8680	122.8121	117.8411	101.6879	94.2288	108.1289	109.4204	127.5189	139.1968	151.1587	(45)
Energy content (annual)										Total = Sum(45)m =		1505.4571	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	(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	(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	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	33.1678	29.0088	29.9344	26.0976	25.0412	21.6087	20.0236	22.9774	23.2518	27.0978	29.5793	32.1212 (65)

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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	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	20.8795	18.5450	15.0818	11.4179	8.5350	7.2056	7.7859	10.1204	13.5836	17.2475	20.1304	21.4598	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	234.2503	236.6811	230.5556	217.5151	201.0539	185.5826	175.2469	172.8161	178.9416	191.9821	208.4433	223.9146	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	(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)

	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)

Water heating gains (Table 5)

	44.5804	43.1678	40.2345	36.2466	33.6576	30.0121	26.9135	30.8836	32.2942	36.4217	41.0824	43.1737	(72)

Total internal gains

	361.5412	360.2249	347.7029	327.0107	305.0775	284.6313	271.7773	275.6512	286.6504	307.4823	331.4871	350.3791	(73)

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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	10.8500	19.6403	0.6300	0.7000	0.7700	65.1252	(76)
South	2.6200	46.7521	0.6300	0.7000	0.7700	37.4347	(78)
West	6.3400	19.6403	0.6300	0.7000	0.7700	38.0547	(80)

Solar gains	140.6145	263.1501	410.5005	573.0576	686.1091	696.7152	665.5160	581.3680	468.1807	305.6290	173.0260	117.1971	(83)
Total gains	502.1557	623.3749	758.2034	900.0683	991.1866	981.3465	937.2933	857.0192	754.8312	613.1113	504.5132	467.5762	(84)

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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	36.7309	36.8087	36.8852	37.2490	37.3178	37.6418	37.6418	37.7024	37.5163	37.3178	37.1788	37.0346	
alpha	3.4487	3.4539	3.4590	3.4833	3.4879	3.5095	3.5095	3.5135	3.5011	3.4879	3.4786	3.4690	
util living area	0.9931	0.9850	0.9643	0.9101	0.8056	0.6519	0.5055	0.5635	0.7947	0.9501	0.9877	0.9946	(86)
MIT	19.0553	19.3080	19.7189	20.2274	20.6359	20.8791	20.9628	20.9455	20.7451	20.1749	19.5136	19.0112	(87)
Th 2	19.8129	19.8151	19.8172	19.8274	19.8293	19.8381	19.8381	19.8398	19.8347	19.8293	19.8254	19.8214	(88)
util rest of house	0.9913	0.9812	0.9550	0.8860	0.7537	0.5617	0.3845	0.4403	0.7202	0.9318	0.9839	0.9932	(89)
MIT 2	18.0528	18.3050	18.7111	19.2073	19.5771	19.7764	19.8265	19.8209	19.6836	19.1703	18.5187	18.0151	(90)
Living area fraction									fLA = Living area / (4) =			0.2008	(91)
MIT	18.2540	18.5064	18.9134	19.4121	19.7897	19.9978	20.0546	20.0467	19.8967	19.3720	18.7185	18.2151	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2540	18.5064	18.9134	19.4121	19.7897	19.9978	20.0546	20.0467	19.8967	19.3720	18.7185	18.2151	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9880	0.9755	0.9457	0.8757	0.7517	0.5751	0.4081	0.4638	0.7248	0.9226	0.9789	0.9905	(94)
Useful gains	496.1284	608.0866	717.0592	788.2082	745.0863	564.3558	382.5559	397.4840	547.0702	565.6287	493.8694	463.1204	(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	1629.4860	1585.5318	1443.5163	1210.4808	929.8148	615.0773	393.6497	414.8707	662.7432	1008.2406	1340.4053	1623.1974	(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	843.2180	656.8432	540.4841	304.0363	137.4380	0.0000	0.0000	0.0000	0.0000	329.3033	609.5058	863.0973	(98)
Space heating												4283.9261	(98)
Space heating per m2											(98) / (4) =	49.0040	(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	1071.1258	843.2267	864.6246	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8326	0.8898	0.8610	0.0000	0.0000	0.0000	0.0000	(101)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	891.7694	750.3213	744.4697	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1244.2534	1190.7124	1098.5361	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	253.7884	327.6510	263.4254	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												844.8648	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	63.4471	81.9127	65.8563	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												211.2162	(107)
Space cooling per m2												2.4161	(108)
Energy for space heating												49.0040	(99)
Energy for space cooling												2.4161	(108)
Total												51.4201	(109)
Dwelling Fabric Energy Efficiency (DFEE)												51.4	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7100 (1b)	x	2.3900 (2b)	=	104.4669	(1b) - (3b)
First floor	43.7100 (1c)	x	2.6100 (2c)	=	114.0831	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.5500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1373	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3873	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3292	(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	0.4197	0.4115	0.4032	0.3621	0.3539	0.3127	0.3127	0.3045	0.3292	0.3539	0.3703	0.3868	(22b)
Effective ac	0.5881	0.5847	0.5813	0.5656	0.5626	0.5489	0.5489	0.5464	0.5542	0.5626	0.5686	0.5748	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1600	1.0000	2.1600			(26)
TER Opening Type (Uw = 1.40)			19.7000	1.3258	26.1174			(27)
Ground Floor			43.7100	0.1300	5.6823			(28a)
Brick and Block	134.3000	21.8600	112.4400	0.1800	20.2392			(29a)
External Roof 1	43.7100		43.7100	0.1300	5.6823			(30)
Total net area of external elements Aum(A, m2)			221.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		59.8812			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9538	(36)
Total fabric heat loss					(33) + (36) =		70.8350	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.4128	42.1662	41.9244	40.7888	40.5763	39.5872	39.5872	39.4041	39.9682	40.5763	41.0062	41.4555	(38)
Heat transfer coeff	113.2479	113.0012	112.7594	111.6238	111.4114	110.4223	110.4223	110.2391	110.8033	111.4114	111.8412	112.2905	(39)
Average = Sum(39)m / 12 =												111.6228	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2954	1.2926	1.2899	1.2769	1.2744	1.2631	1.2631	1.2610	1.2675	1.2744	1.2794	1.2845	(40)
HLP (average)												1.2769	(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	2.5887	(42)
Average daily hot water use (litres/day)	95.6824	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.2507	101.4234	97.5961	93.7688	89.9415	86.1142	86.1142	89.9415	93.7688	97.5961	101.4234	105.2507	(44)
Energy conte	156.0837	136.5118	140.8680	122.8121	117.8411	101.6879	94.2288	108.1289	109.4204	127.5189	139.1968	151.1587	(45)
Energy content (annual)										Total = Sum(45)m =		1505.4571	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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													
	33.1678	29.0088	29.9344	26.0976	25.0412	21.6087	20.0236	22.9774	23.2518	27.0978	29.5793	32.1212	(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	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.8803	18.5457	15.0824	11.4183	8.5353	7.2059	7.7862	10.1208	13.5841	17.2482	20.1312	21.4606	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	234.2503	236.6811	230.5556	217.5151	201.0539	185.5826	175.2469	172.8161	178.9416	191.9821	208.4433	223.9146	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	(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)													
	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)													
	44.5804	43.1678	40.2345	36.2466	33.6576	30.0121	26.9135	30.8836	32.2942	36.4217	41.0824	43.1737	(72)
Total internal gains													
	361.5420	360.2256	347.7035	327.0111	305.0778	284.6316	271.7776	275.6515	286.6510	307.4830	331.4879	350.3799	(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	10.8000	19.6403	0.6300	0.7000	0.7700	64.8251	(76)
South	2.6000	46.7521	0.6300	0.7000	0.7700	37.1489	(78)
West	6.3000	19.6403	0.6300	0.7000	0.7700	37.8146	(80)

Solar gains	139.7886	261.6253	408.1640	569.8457	682.2963	692.8552	661.8242	578.1228	465.5339	303.8703	172.0137	116.5059	(83)
Total gains	501.3306	621.8509	755.8675	896.8568	987.3742	977.4868	933.6018	853.7744	752.1848	611.3533	503.5016	466.8859	(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	53.6066	53.7236	53.8388	54.3865	54.4903	54.9783	54.9783	55.0697	54.7893	54.4903	54.2808	54.0636	
alpha	4.5738	4.5816	4.5893	4.6258	4.6327	4.6652	4.6652	4.6713	4.6526	4.6327	4.6187	4.6042	
util living area													
	0.9983	0.9952	0.9842	0.9438	0.8417	0.6705	0.5083	0.5716	0.8297	0.9749	0.9963	0.9988	(86)
MIT	19.5445	19.7430	20.0665	20.4706	20.7846	20.9460	20.9881	20.9799	20.8523	20.4089	19.8948	19.5108	(87)
Th 2	19.8444	19.8466	19.8488	19.8590	19.8609	19.8698	19.8698	19.8715	19.8664	19.8609	19.8570	19.8530	(88)
util rest of house													
	0.9977	0.9935	0.9784	0.9231	0.7870	0.5727	0.3839	0.4423	0.7501	0.9619	0.9947	0.9984	(89)
MIT 2	18.5255	18.7250	19.0467	19.4438	19.7220	19.8466	19.8670	19.8662	19.7878	19.3948	18.8852	18.4986	(90)
Living area fraction									fLA = Living area / (4) =			0.2008	(91)
MIT	18.7301	18.9293	19.2514	19.6499	19.9353	20.0673	20.0921	20.0898	20.0015	19.5984	19.0879	18.7018	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7301	18.9293	19.2514	19.6499	19.9353	20.0673	20.0921	20.0898	20.0015	19.5984	19.0879	18.7018	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9916	0.9745	0.9185	0.7910	0.5909	0.4091	0.4685	0.7611	0.9579	0.9932	0.9977	(94)
Useful gains	499.7658	616.6312	736.5929	823.7211	781.0268	577.6317	381.9228	399.9874	572.4568	585.6436	500.0761	465.8270	(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													
	1634.1747	1585.3323	1437.8435	1199.9501	917.5114	603.7094	385.6052	406.7584	653.9043	1002.5240	1340.7409	1628.4186	(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													
	844.0002	650.9671	521.7304	270.8849	101.5446	0.0000	0.0000	0.0000	0.0000	310.1590	605.2787	864.9681	(98)
Space heating												4169.5330	(98)
Space heating per m2											(98) / (4) =	47.6954	(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	1037.9694	817.1248	837.8172	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8880	0.9378	0.9138	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	921.7147	766.3217	765.6113	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1239.7424	1186.3981	1094.7440	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	228.9800	312.5369	244.8747	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												786.3915	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	57.2450	78.1342	61.2187	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												196.5979 (107)
Space cooling per m2												2.2489 (108)
Energy for space heating												47.6954 (99)
Energy for space cooling												2.2489 (108)
Total												49.9443 (109)
Target Fabric Energy Efficiency (TFEE)												57.4 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7100	(1b)	x 2.3900	(2b) =	104.4669	(1b) - (3b)
First floor	43.7100	(1c)	x 2.6100	(2c) =	114.0831	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	218.5500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1830	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4330	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3681	(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	0.4693	0.4325	0.4233	0.3957	0.3957	0.3681	0.3681	0.3589	0.3681	0.4141	0.4049	0.4325	(22b)
Effective ac	0.6101	0.5935	0.5896	0.5783	0.5783	0.5677	0.5677	0.5644	0.5677	0.5857	0.5820	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1600	1.1000	2.3760			(26)
Windows & Fully Glazed Do (Uw = 1.20)			19.8100	1.1450	22.6832			(27)
Ground Floor			43.7100	0.1200	5.2452	90.0000	3933.9000	(28a)
Brick and Block	134.3000	21.9700	112.3300	0.2400	26.9592	42.2200	4742.5726	(29a)
External Roof 1	43.7100		43.7100	0.1000	4.3710	9.1000	397.7610	(30)
Total net area of external elements Aum(A, m2)			221.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.6346			(33)
GF Block			52.8500			75.0000	3963.7500	(32c)
GF Timber Stud			19.9900			9.0000	179.9100	(32c)
FF Timber Stud			115.9200			9.0000	1043.2800	(32c)
Internal Floor			43.7100			18.0000	786.7800	(32d)
Internal Ceiling 1			43.7100			18.0000	786.7800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15834.7336	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	181.1340	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.7277	(36)
Total fabric heat loss	(33) + (36) = 74.3623	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.0025	42.8056	42.5217	41.7064	41.7064	40.9461	40.9461	40.7049	40.9461	42.2438	41.9720	42.8056	(38)
Heat transfer coeff	118.3648	117.1679	116.8840	116.0687	116.0687	115.3084	115.3084	115.0672	115.3084	116.6061	116.3344	117.1679	(39)
Average = Sum(39)m / 12 =												116.3046	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3403	1.3370	1.3277	1.3277	1.3190	1.3190	1.3163	1.3190	1.3339	1.3308	1.3403	(40)
HLP (average)												1.3304	(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	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.2507	101.4234	97.5961	93.7688	89.9415	86.1142	86.1142	89.9415	93.7688	97.5961	101.4234	105.2507	(44)
Energy conte	156.0837	136.5118	140.8680	122.8121	117.8411	101.6879	94.2288	108.1289	109.4204	127.5189	139.1968	151.1587	(45)
Energy content (annual)										Total = Sum(45)m =		1505.4571	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	23.4126	20.4768	21.1302	18.4218	17.6762	15.2532	14.1343	16.2193	16.4131	19.1278	20.8795	22.6738	(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	27.5604	24.8911	27.5367	26.6180	27.4831	26.5711	27.4409	27.4683	26.5966	27.5145	26.6571	27.5523	(61)
Total heat required for water heating calculated for each month	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(64)
Total per year (kWh/year) = Sum(64)m =												1829.3472	(64)
RHI water heating demand												1829	(64)
Heat gains from water heating, kWh/month	58.7879	51.6130	53.7228	47.4895	46.0530	40.4540	38.1913	42.8199	43.0314	49.2787	52.9472	57.1483	(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	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.1987	46.3624	37.7045	28.5447	21.3375	18.0140	19.4648	25.3011	33.9590	43.1188	50.3260	53.6495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	349.6273	353.2554	344.1128	324.6495	300.0804	276.9890	261.5625	257.9345	267.0770	286.5404	311.1094	334.2009	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	(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)	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)	79.0160	76.8050	72.2080	65.9577	61.8991	56.1861	51.3324	57.5537	59.7659	66.2347	73.5378	76.8123	(72)
Total internal gains	588.7379	584.3186	561.9211	527.0476	491.2129	459.0850	440.2555	448.6851	468.6978	503.7898	542.8691	572.5585	(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	10.8500	25.9136	0.6300	0.7000	0.7700	85.9271	(76)
South	2.6200	58.2505	0.6300	0.7000	0.7700	46.6415	(78)
West	6.3400	25.9136	0.6300	0.7000	0.7700	50.2099	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	182.7786	292.4322	453.3460	643.3265	735.0808	807.6995	753.0953	672.2361	547.8457	359.1485	222.8945	145.4300	(83)
Total gains	771.5165	876.7508	1015.2671	1170.3742	1226.2937	1266.7845	1193.3509	1120.9211	1016.5434	862.9382	765.7636	717.9885	(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	37.1608	37.5405	37.6317	37.8960	37.8960	38.1458	38.1458	38.2258	38.1458	37.7213	37.8094	37.5405	
alpha	3.4774	3.5027	3.5088	3.5264	3.5264	3.5431	3.5431	3.5484	3.5431	3.5148	3.5206	3.5027	
util living area	0.9714	0.9565	0.9152	0.8242	0.6827	0.4857	0.3515	0.3721	0.6133	0.8545	0.9487	0.9762	(86)
MIT	19.5617	19.7454	20.1154	20.5271	20.8183	20.9597	20.9904	20.9886	20.9096	20.5583	20.0256	19.5334	(87)
Th 2	19.7988	19.8094	19.8119	19.8192	19.8192	19.8260	19.8260	19.8281	19.8260	19.8144	19.8168	19.8094	(88)
util rest of house	0.9642	0.9460	0.8947	0.7843	0.6145	0.3931	0.2428	0.2579	0.5161	0.8084	0.9336	0.9700	(89)
MIT 2	18.5396	18.7260	19.0827	19.4654	19.7080	19.8096	19.8240	19.8257	19.7839	19.5024	19.0086	18.5204	(90)
Living area fraction									fLA = Living area / (4) =			0.2008	(91)
MIT	18.7448	18.9307	19.2901	19.6786	19.9309	20.0405	20.0582	20.0592	20.0099	19.7144	19.2128	18.7238	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7448	18.9307	19.2901	19.6786	19.9309	20.0405	20.0582	20.0592	20.0099	19.7144	19.2128	18.7238	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9559	0.9361	0.8840	0.7789	0.6215	0.4107	0.2647	0.2809	0.5324	0.8039	0.9237	0.9626	(94)
Useful gains	737.4725	820.7045	897.4470	911.5861	762.1221	520.2062	315.8811	314.8950	541.2083	693.6907	707.3712	691.1024	(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	1579.5514	1550.2087	1401.4445	1169.8050	850.8852	535.0902	318.0399	317.4925	577.6803	922.8662	1257.8945	1549.4024	(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	626.5067	490.2268	374.9742	185.9177	66.0398	0.0000	0.0000	0.0000	0.0000	170.5065	396.3768	638.5752	(98)
Space heating												2949.1236	(98)
RHI space heating demand												2949	(98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7100	(1b)	x 2.3900	(2b) =	104.4669	(1b) - (3b)
First floor	43.7100	(1c)	x 2.6100	(2c) =	114.0831	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		218.5500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1830	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4330	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3681	(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	0.4693	0.4601	0.4509	0.4049	0.3957	0.3497	0.3497	0.3405	0.3681	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1600	1.1000	2.3760			(26)
Windows & Fully Glazed Do (Uw = 1.20)			19.8100	1.1450	22.6832			(27)
Ground Floor			43.7100	0.1200	5.2452	90.0000	3933.9000	(28a)
Brick and Block	134.3000	21.9700	112.3300	0.2400	26.9592	42.2200	4742.5726	(29a)
External Roof 1	43.7100		43.7100	0.1000	4.3710	9.1000	397.7610	(30)
Total net area of external elements Aum(A, m2)			221.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.6346			(33)
GF Block			52.8500			75.0000	3963.7500	(32c)
GF Timber Stud			19.9900			9.0000	179.9100	(32c)
FF Timber Stud			115.9200			9.0000	1043.2800	(32c)
Internal Floor			43.7100			18.0000	786.7800	(32d)
Internal Ceiling 1			43.7100			18.0000	786.7800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15834.7336	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	181.1340	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.7277	(36)
Total fabric heat loss	(33) + (36) = 74.3623	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.0025	43.6941	43.3919	41.9720	41.7064	40.4698	40.4698	40.2408	40.9461	41.7064	42.2438	42.8056	(38)
Heat transfer coeff	118.3648	118.0564	117.7542	116.3344	116.0687	114.8321	114.8321	114.6031	115.3084	116.0687	116.6061	117.1679	(39)
Average = Sum(39)m / 12 =												116.3331	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3505	1.3470	1.3308	1.3277	1.3136	1.3136	1.3109	1.3190	1.3277	1.3339	1.3403	(40)
HLP (average)												1.3307	(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	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.2507	101.4234	97.5961	93.7688	89.9415	86.1142	86.1142	89.9415	93.7688	97.5961	101.4234	105.2507	(44)
Energy conte	156.0837	136.5118	140.8680	122.8121	117.8411	101.6879	94.2288	108.1289	109.4204	127.5189	139.1968	151.1587	(45)
Energy content (annual)										Total = Sum(45)m =		1505.4571	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
               23.4126    20.4768    21.1302    18.4218    17.6762    15.2532    14.1343    16.2193    16.4131    19.1278    20.8795    22.6738 (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     27.5604    24.8911    27.5367    26.6180    27.4831    26.5711    27.4409    27.4683    26.5966    27.5145    26.6571    27.5523 (61)
Total heat required for water heating calculated for each month
              183.6441   161.4029   168.4046   149.4301   145.3242   128.2590   121.6697   135.5972   136.0170   155.0334   165.8539   178.7110 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                        Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              183.6441   161.4029   168.4046   149.4301   145.3242   128.2590   121.6697   135.5972   136.0170   155.0334   165.8539   178.7110 (64)
                                                                                          Total per year (kWh/year) = Sum(64)m =   1829.3472 (64)
Heat gains from water heating, kWh/month
               58.7879    51.6130    53.7228    47.4895    46.0530    40.4540    38.1913    42.8199    43.0314    49.2787    52.9472    57.1483 (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         155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               52.1987    46.3624    37.7045    28.5447    21.3375    18.0140    19.4648    25.3011    33.9590    43.1188    50.3260    53.6495 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              349.6273   353.2554   344.1128   324.6495   300.0804   276.9890   261.5625   257.9345   267.0770   286.5404   311.1094   334.2009 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211 (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)
             -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494 (71)
Water heating gains (Table 5)
               79.0160    76.8050    72.2080    65.9577    61.8991    56.1861    51.3324    57.5537    59.7659    66.2347    73.5378    76.8123 (72)
Total internal gains
              588.7379   584.3186   561.9211   527.0476   491.2129   459.0850   440.2555   448.6851   468.6978   503.7898   542.8691   572.5585 (73)


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6. Solar gains
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[Jan]                                        Area          Solar flux              g                FF              Access                Gains
                                               m2          Table 6a       Specific data     Specific data          factor                    W
                                                               W/m2         or Table 6b       or Table 6c        Table 6d
----------------------------------------------------------------------------------------------------
East                                      10.8500           19.6403            0.6300            0.7000             0.7700              65.1252 (76)
South                                      2.6200           46.7521            0.6300            0.7000             0.7700              37.4347 (78)
West                                       6.3400           19.6403            0.6300            0.7000             0.7700              38.0547 (80)
----------------------------------------------------------------------------------------------------

Solar gains   140.6145   263.1501   410.5005   573.0576   686.1091   696.7152   665.5160   581.3680   468.1807   305.6290   173.0260   117.1971 (83)
Total gains   729.3525   847.4687   972.4217  1100.1053  1177.3220  1155.8002  1105.7715  1030.0531   936.8785   809.4188   715.8951   689.7556 (84)


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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           37.1608    37.2579    37.3536    37.8094    37.8960    38.3041    38.3041    38.3806    38.1458    37.8960    37.7213    37.5405
alpha          3.4774     3.4839     3.4902     3.5206     3.5264     3.5536     3.5536     3.5587     3.5431     3.5264     3.5148     3.5027
util living area
                0.9801     0.9659     0.9344     0.8635     0.7441     0.5828     0.4411     0.4876     0.7123     0.9038     0.9676     0.9834 (86)

MIT            19.3455    19.5800    19.9511    20.3968    20.7318    20.9188    20.9769    20.9670    20.8305    20.3728    19.7777    19.3033 (87)
Th 2           19.7988    19.8015    19.8042    19.8168    19.8192    19.8302    19.8302    19.8323    19.8260    19.8192    19.8144    19.8094 (88)
util rest of house
                0.9752     0.9577     0.9186     0.8310     0.6857     0.4940     0.3308     0.3741     0.6291     0.8731     0.9584     0.9793 (89)
MIT 2          18.3261    18.5582    18.9200    19.3479    19.6410    19.7910    19.8234    19.8217    19.7323    19.3400    18.7655    18.2925 (90)
Living area fraction                                                                                      fLA = Living area / (4) =      0.2008 (91)
MIT            18.5308    18.7633    19.1270    19.5585    19.8600    20.0174    20.0550    20.0516    19.9528    19.5473    18.9687    18.4954 (92)
Temperature adjustment                                                                                                                  0.0000
adjusted MIT   18.5308    18.7633    19.1270    19.5585    19.8600    20.0174    20.0550    20.0516    19.9528    19.5473    18.9687    18.4954 (93)


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8. Space heating requirement
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                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9684     0.9486     0.9077     0.8229     0.6879     0.5090     0.3527     0.3963     0.6390     0.8646     0.9499     0.9732 (94)
Useful gains  706.2955   803.9310   882.6586   905.2427   809.8748   588.2890   390.0208   408.2433   598.6696   699.7928   679.9952   671.2772 (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
             1684.4231  1636.6521  1486.8850  1239.9499   947.1175   622.0891   396.7461   418.4853   674.8735  1038.5071  1383.9606  1674.9634 (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
              727.7270   559.5886   449.5445   240.9892   102.1086     0.0000     0.0000     0.0000     0.0000   252.0034   506.8551   746.7426 (98)
Space heating                                                                                                                        3585.5588 (98)
Space heating per m2                                                                                                  (98) / (4) =     41.0153 (99)


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8c. Space cooling requirement
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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	3953.2070	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	727.7270	559.5886	449.5445	240.9892	102.1086	0.0000	0.0000	0.0000	0.0000	252.0034	506.8551	746.7426	(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)													
	802.3451	616.9665	495.6389	265.6992	112.5784	0.0000	0.0000	0.0000	0.0000	277.8428	558.8259	823.3104	(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													
	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(64)
Efficiency of water heater												87.9000	(216)
(217)m	90.1215	90.0578	89.9194	89.6075	89.0343	87.9000	87.9000	87.9000	87.9000	89.6127	89.9932	90.1455	(217)
Fuel for water heating, kWh/month													
	203.7738	179.2215	187.2839	166.7607	163.2228	145.9147	138.4183	154.2630	154.7406	173.0037	184.2960	198.2473	(219)
Water heating fuel used												2049.1464	(219)
Annual totals kWh/year													
Space heating fuel - main system												3953.2070	(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)												368.7383	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.95 * 908 * 1.00) =										-689.9692		-689.9692	(233)
Total delivered energy for all uses												5756.1226	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3953.2070	3.4800	137.5716	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2049.1464	3.4800	71.3103	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	368.7383	13.1900	48.6366	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-689.9692	13.1900	-91.0069	(252)
Total energy cost			296.4040	(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] =	0.9401	(257)
SAP value		86.8854	
SAP rating (Section 12)		87	(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	3953.2070	0.2160	853.8927	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2049.1464	0.2160	442.6156	(264)
Space and water heating			1296.5083	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	368.7383	0.5190	191.3752	(268)
Energy saving/generation technologies				
PV Unit	-689.9692	0.5190	-358.0940	(269)
Total kg/year			1168.7145	(272)
CO2 emissions per m2			13.3700	(273)
EI value			88.1734	
EI rating			88	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9070 = 3.837, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9070 = 0.2381, stars = 4
Water heating energy efficiency	3.48 / 0.8917 = 3.902, stars = 4
Water heating environmental impact	0.216 / 0.8917 = 0.2422, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7100	(1b)	x 2.3900	(2b) =	104.4669	(1b) - (3b)
First floor	43.7100	(1c)	x 2.6100	(2c) =	114.0831	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	218.5500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1830	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4330	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3681	(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	0.4693	0.4325	0.4233	0.3957	0.3957	0.3681	0.3681	0.3589	0.3681	0.4141	0.4049	0.4325	(22b)
Effective ac	0.6101	0.5935	0.5896	0.5783	0.5783	0.5677	0.5677	0.5644	0.5677	0.5857	0.5820	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1600	1.1000	2.3760			(26)
Windows & Fully Glazed Do (Uw = 1.20)			19.8100	1.1450	22.6832			(27)
Ground Floor			43.7100	0.1200	5.2452	90.0000	3933.9000	(28a)
Brick and Block	134.3000	21.9700	112.3300	0.2400	26.9592	42.2200	4742.5726	(29a)
External Roof 1	43.7100		43.7100	0.1000	4.3710	9.1000	397.7610	(30)
Total net area of external elements Aum(A, m2)			221.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.6346			(33)
GF Block			52.8500			75.0000	3963.7500	(32c)
GF Timber Stud			19.9900			9.0000	179.9100	(32c)
FF Timber Stud			115.9200			9.0000	1043.2800	(32c)
Internal Floor			43.7100			18.0000	786.7800	(32d)
Internal Ceiling 1			43.7100			18.0000	786.7800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15834.7336	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	181.1340	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.7277	(36)
Total fabric heat loss	(33) + (36) = 74.3623	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.0025	42.8056	42.5217	41.7064	41.7064	40.9461	40.9461	40.7049	40.9461	42.2438	41.9720	42.8056	(38)
Heat transfer coeff	118.3648	117.1679	116.8840	116.0687	116.0687	115.3084	115.3084	115.0672	115.3084	116.6061	116.3344	117.1679	(39)
Average = Sum(39)m / 12 =												116.3046	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3403	1.3370	1.3277	1.3277	1.3190	1.3190	1.3163	1.3190	1.3339	1.3308	1.3403	(40)
HLP (average)												1.3304	(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	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.2507	101.4234	97.5961	93.7688	89.9415	86.1142	86.1142	89.9415	93.7688	97.5961	101.4234	105.2507	(44)
Energy conte	156.0837	136.5118	140.8680	122.8121	117.8411	101.6879	94.2288	108.1289	109.4204	127.5189	139.1968	151.1587	(45)
Energy content (annual)										Total = Sum(45)m =		1505.4571	(45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	23.4126	20.4768	21.1302	18.4218	17.6762	15.2532	14.1343	16.2193	16.4131	19.1278	20.8795	22.6738	(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	27.5604	24.8911	27.5367	26.6180	27.4831	26.5711	27.4409	27.4683	26.5966	27.5145	26.6571	27.5523	(61)
Total heat required for water heating calculated for each month	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(64)
								Total per year (kWh/year) = Sum(64)m =				1829.3472	(64)
Heat gains from water heating, kWh/month	58.7879	51.6130	53.7228	47.4895	46.0530	40.4540	38.1913	42.8199	43.0314	49.2787	52.9472	57.1483	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.1987	46.3624	37.7045	28.5447	21.3375	18.0140	19.4648	25.3011	33.9590	43.1188	50.3260	53.6495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	349.6273	353.2554	344.1128	324.6495	300.0804	276.9890	261.5625	257.9345	267.0770	286.5404	311.1094	334.2009	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	(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)	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)	79.0160	76.8050	72.2080	65.9577	61.8991	56.1861	51.3324	57.5537	59.7659	66.2347	73.5378	76.8123	(72)
Total internal gains	588.7379	584.3186	561.9211	527.0476	491.2129	459.0850	440.2555	448.6851	468.6978	503.7898	542.8691	572.5585	(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	10.8500	25.9136	0.6300	0.7000	0.7700	85.9271	(76)
South	2.6200	58.2505	0.6300	0.7000	0.7700	46.6415	(78)
West	6.3400	25.9136	0.6300	0.7000	0.7700	50.2099	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	182.7786	292.4322	453.3460	643.3265	735.0808	807.6995	753.0953	672.2361	547.8457	359.1485	222.8945	145.4300	(83)
Total gains	771.5165	876.7508	1015.2671	1170.3742	1226.2937	1266.7845	1193.3509	1120.9211	1016.5434	862.9382	765.7636	717.9885	(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	37.1608	37.5405	37.6317	37.8960	37.8960	38.1458	38.1458	38.2258	38.1458	37.7213	37.8094	37.5405	
alpha	3.4774	3.5027	3.5088	3.5264	3.5264	3.5431	3.5431	3.5484	3.5431	3.5148	3.5206	3.5027	
util living area	0.9714	0.9565	0.9152	0.8242	0.6827	0.4857	0.3515	0.3721	0.6133	0.8545	0.9487	0.9762	(86)
MIT	19.5617	19.7454	20.1154	20.5271	20.8183	20.9597	20.9904	20.9886	20.9096	20.5583	20.0256	19.5334	(87)
Th 2	19.7988	19.8094	19.8119	19.8192	19.8192	19.8260	19.8260	19.8281	19.8260	19.8144	19.8168	19.8094	(88)
util rest of house	0.9642	0.9460	0.8947	0.7843	0.6145	0.3931	0.2428	0.2579	0.5161	0.8084	0.9336	0.9700	(89)
MIT 2	18.5396	18.7260	19.0827	19.4654	19.7080	19.8096	19.8240	19.8257	19.7839	19.5024	19.0086	18.5204	(90)
Living area fraction									fLA = Living area / (4) =			0.2008	(91)
MIT	18.7448	18.9307	19.2901	19.6786	19.9309	20.0405	20.0582	20.0592	20.0099	19.7144	19.2128	18.7238	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7448	18.9307	19.2901	19.6786	19.9309	20.0405	20.0582	20.0592	20.0099	19.7144	19.2128	18.7238	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9559	0.9361	0.8840	0.7789	0.6215	0.4107	0.2647	0.2809	0.5324	0.8039	0.9237	0.9626	(94)
Useful gains	737.4725	820.7045	897.4470	911.5861	762.1221	520.2062	315.8811	314.8950	541.2083	693.6907	707.3712	691.1024	(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	1579.5514	1550.2087	1401.4445	1169.8050	850.8852	535.0902	318.0399	317.4925	577.6803	922.8662	1257.8945	1549.4024	(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	626.5067	490.2268	374.9742	185.9177	66.0398	0.0000	0.0000	0.0000	0.0000	170.5065	396.3768	638.5752	(98)
Space heating												2949.1236	(98)
Space heating per m2											(98) / (4) =	33.7351	(99)

8c. Space cooling requirement

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	3251.5145	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	626.5067	490.2268	374.9742	185.9177	66.0398	0.0000	0.0000	0.0000	0.0000	170.5065	396.3768	638.5752	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	690.7461	540.4927	413.4225	204.9809	72.8112	0.0000	0.0000	0.0000	0.0000	187.9895	437.0196	704.0520	(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													
	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(64)
Efficiency of water heater												87.9000	(216)
(217)m	90.0498	89.9900	89.8133	89.4306	88.7561	87.9000	87.9000	87.9000	87.9000	89.3446	89.8556	90.0726	(217)
Fuel for water heating, kWh/month													
	203.9362	179.3566	187.5051	167.0905	163.7344	145.9147	138.4183	154.2630	154.7406	173.5229	184.5782	198.4077	(219)
Water heating fuel used												2051.4683	(219)
Annual totals kWh/year													
Space heating fuel - main system												3251.5145	(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)												368.7383	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.95 * 1054 * 1.00) =										-801.3765		-801.3765	(233)
Total delivered energy for all uses												4945.3446	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3251.5145	9.7400	316.6975	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2051.4683	9.7400	199.8130	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	368.7383	36.8500	135.8801	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-801.3765	36.8500	-295.3072	(252)
Total energy cost			488.7209	(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	3251.5145	0.2160	702.3271	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2051.4683	0.2160	443.1171	(264)
Space and water heating			1145.4443	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	368.7383	0.5190	191.3752	(268)
Energy saving/generation technologies				
PV Unit	-801.3765	0.5190	-415.9144	(269)
Total kg/year			959.8301	(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	3251.5145	1.2200	3966.8477	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2051.4683	1.2200	2502.7913	(264)
Space and water heating			6469.6390	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	368.7383	3.0700	1132.0267	(268)
Energy saving/generation technologies				
PV Unit	-801.3765	3.0700	-2460.2257	(269)
Primary energy kWh/year			5371.6900	(272)
Primary energy kWh/m2/year			61.4469	(273)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: B 88

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 80	-193 kg (20.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£80	2.20 kg/m²	B 88	B 90
Total Savings	£80	2.20 kg/m²		

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

Fuel prices for cost data on this page from database revision number 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	£164	£182	-£18
Mains gas	£621	£522	£99
Space heating	£448	£448	£0
Water heating	£200	£120	£80
Lighting	£136	£136	£0
Generated (PV)	-£295	-£295	£0
Total cost of fuels	£490	£409	£81
Total cost of uses	£489	£409	£80
Delivered energy	57 kWh/m²	46 kWh/m²	11 kWh/m²
Carbon dioxide emissions	1.0 tonnes	0.8 tonnes	0.2 tonnes
CO2 emissions per m²	11 kg/m²	9 kg/m²	2 kg/m²
Primary energy	61 kWh/m²	49 kWh/m²	12 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7100	(1b)	x 2.3900	(2b) =	104.4669	(1b) - (3b)
First floor	43.7100	(1c)	x 2.6100	(2c) =	114.0831	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		218.5500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1830	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4330	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3681	(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	0.4693	0.4601	0.4509	0.4049	0.3957	0.3497	0.3497	0.3405	0.3681	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1600	1.1000	2.3760			(26)
Windows & Fully Glazed Do (Uw = 1.20)			19.8100	1.1450	22.6832			(27)
Ground Floor			43.7100	0.1200	5.2452	90.0000	3933.9000	(28a)
Brick and Block	134.3000	21.9700	112.3300	0.2400	26.9592	42.2200	4742.5726	(29a)
External Roof 1	43.7100		43.7100	0.1000	4.3710	9.1000	397.7610	(30)
Total net area of external elements Aum(A, m2)			221.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.6346			(33)
GF Block			52.8500			75.0000	3963.7500	(32c)
GF Timber Stud			19.9900			9.0000	179.9100	(32c)
FF Timber Stud			115.9200			9.0000	1043.2800	(32c)
Internal Floor			43.7100			18.0000	786.7800	(32d)
Internal Ceiling 1			43.7100			18.0000	786.7800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15834.7336	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	181.1340	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.7277	(36)
Total fabric heat loss	(33) + (36) = 74.3623	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.0025	43.6941	43.3919	41.9720	41.7064	40.4698	40.4698	40.2408	40.9461	41.7064	42.2438	42.8056	(38)
Heat transfer coeff	118.3648	118.0564	117.7542	116.3344	116.0687	114.8321	114.8321	114.6031	115.3084	116.0687	116.6061	117.1679	(39)
Average = Sum(39)m / 12 =												116.3331	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3505	1.3470	1.3308	1.3277	1.3136	1.3136	1.3109	1.3190	1.3277	1.3339	1.3403	(40)
HLP (average)												1.3307	(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	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.2507	101.4234	97.5961	93.7688	89.9415	86.1142	86.1142	89.9415	93.7688	97.5961	101.4234	105.2507	(44)
Energy conte	156.0837	136.5118	140.8680	122.8121	117.8411	101.6879	94.2288	108.1289	109.4204	127.5189	139.1968	151.1587	(45)
Energy content (annual)										Total = Sum(45)m =		1505.4571	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m													
	23.4126	20.4768	21.1302	18.4218	17.6762	15.2532	14.1343	16.2193	16.4131	19.1278	20.8795	22.6738	(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	27.5604	24.8911	27.5367	26.6180	27.4831	26.5711	27.4409	27.4683	26.5966	27.5145	26.6571	27.5523	(61)
Total heat required for water heating calculated for each month													
	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(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	1.2047	(H8)
Utilisation factor	0.5640	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	95.6824	(H14)
Volume ratio Veff/V	0.7838	(H15)
Solar storage volume factor	0.9513	(H16)
Solar input	-855.5811	(H17)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar input	-24.8101	-41.4010	-70.5106	-94.4982	-116.7445	-114.7785	-113.2616	-98.9572	-77.5034	-52.9257	-29.4284	-20.7619	(63)
Solar input (sum of months) = Sum(63)m =												-855.5811	(63)
Output from w/h													
	158.8340	120.0019	97.8940	54.9319	28.5797	13.4805	8.4081	36.6400	58.5136	102.1077	136.4255	157.9491	(64)
Total per year (kWh/year) = Sum(64)m =												973.7661	(64)
Heat gains from water heating, kWh/month													
	58.7879	51.6130	53.7228	47.4895	46.0530	40.4540	38.1913	42.8199	43.0314	49.2787	52.9472	57.1483	(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	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.1987	46.3624	37.7045	28.5447	21.3375	18.0140	19.4648	25.3011	33.9590	43.1188	50.3260	53.6495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	349.6273	353.2554	344.1128	324.6495	300.0804	276.9890	261.5625	257.9345	267.0770	286.5404	311.1094	334.2009	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	(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)													
	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)													
	79.0160	76.8050	72.2080	65.9577	61.8991	56.1861	51.3324	57.5537	59.7659	66.2347	73.5378	76.8123	(72)
Total internal gains													
	588.7379	584.3186	561.9211	527.0476	491.2129	459.0850	440.2555	448.6851	468.6978	503.7898	542.8691	572.5585	(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	10.8500	19.6403	0.6300	0.7000	0.7700	65.1252	(76)
South	2.6200	46.7521	0.6300	0.7000	0.7700	37.4347	(78)
West	6.3400	19.6403	0.6300	0.7000	0.7700	38.0547	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	140.6145	263.1501	410.5005	573.0576	686.1091	696.7152	665.5160	581.3680	468.1807	305.6290	173.0260	117.1971	(83)
Total gains	729.3525	847.4687	972.4217	1100.1053	1177.3220	1155.8002	1105.7715	1030.0531	936.8785	809.4188	715.8951	689.7556	(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	37.1608	37.2579	37.3536	37.8094	37.8960	38.3041	38.3041	38.3806	38.1458	37.8960	37.7213	37.5405	
alpha	3.4774	3.4839	3.4902	3.5206	3.5264	3.5536	3.5536	3.5587	3.5431	3.5264	3.5148	3.5027	
util living area													
	0.9801	0.9659	0.9344	0.8635	0.7441	0.5828	0.4411	0.4876	0.7123	0.9038	0.9676	0.9834	(86)
MIT	19.3455	19.5800	19.9511	20.3968	20.7318	20.9188	20.9769	20.9670	20.8305	20.3728	19.7777	19.3033	(87)
Th 2	19.7988	19.8015	19.8042	19.8168	19.8192	19.8302	19.8302	19.8323	19.8260	19.8192	19.8144	19.8094	(88)
util rest of house													
	0.9752	0.9577	0.9186	0.8310	0.6857	0.4940	0.3308	0.3741	0.6291	0.8731	0.9584	0.9793	(89)
MIT 2	18.3261	18.5582	18.9200	19.3479	19.6410	19.7910	19.8234	19.8217	19.7323	19.3400	18.7655	18.2925	(90)
Living area fraction									fLA = Living area / (4) =			0.2008	(91)
MIT	18.5308	18.7633	19.1270	19.5585	19.8600	20.0174	20.0550	20.0516	19.9528	19.5473	18.9687	18.4954	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5308	18.7633	19.1270	19.5585	19.8600	20.0174	20.0550	20.0516	19.9528	19.5473	18.9687	18.4954	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9684	0.9486	0.9077	0.8229	0.6879	0.5090	0.3527	0.3963	0.6390	0.8646	0.9499	0.9732	(94)
Useful gains	706.2955	803.9310	882.6586	905.2427	809.8748	588.2890	390.0208	408.2433	598.6696	699.7928	679.9952	671.2772	(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	1684.4231	1636.6521	1486.8850	1239.9499	947.1175	622.0891	396.7461	418.4853	674.8735	1038.5071	1383.9606	1674.9634	(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	727.7270	559.5886	449.5445	240.9892	102.1086	0.0000	0.0000	0.0000	0.0000	252.0034	506.8551	746.7426	(98)
Space heating												3585.5588	(98)
Space heating per m2											(98) / (4) =	41.0153	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3953.2070	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	727.7270	559.5886	449.5445	240.9892	102.1086	0.0000	0.0000	0.0000	0.0000	252.0034	506.8551	746.7426	(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)	802.3451	616.9665	495.6389	265.6992	112.5784	0.0000	0.0000	0.0000	0.0000	277.8428	558.8259	823.3104	(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	158.8340	120.0019	97.8940	54.9319	28.5797	13.4805	8.4081	36.6400	58.5136	102.1077	136.4255	157.9491	(64)
Efficiency of water heater												87.9000	(216)
(217)m	90.1853	90.1927	90.1863	90.1668	90.0725	87.9000	87.9000	87.9000	87.9000	89.8745	90.0914	90.1984	(217)
Fuel for water heating, kWh/month	176.1195	133.0506	108.5464	60.9225	31.7297	15.3362	9.5655	41.6837	66.5684	113.6114	151.4302	175.1131	(219)
Water heating fuel used												1083.6773	(219)
Annual totals kWh/year													
Space heating fuel - main system												3953.2070	(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)												368.7383	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.95 * 908 * 1.00) =										-689.9692		-689.9692	(233)
Total delivered energy for all uses												4840.6535	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3953.2070	3.4800	137.5716	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1083.6773	3.4800	37.7120	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	368.7383	13.1900	48.6366	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-689.9692	13.1900	-91.0069	(252)
Total energy cost			269.4007	(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] =	0.8545	(257)
SAP value	88.0802	
SAP rating (Section 12)	88	(258)
SAP band	B	

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

	Energy	Emission factor	Emissions	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	3953.2070	0.2160	853.8927	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1083.6773	0.2160	234.0743	(264)
Space and water heating			1087.9670	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	368.7383	0.5190	191.3752	(268)
Energy saving/generation technologies				
PV Unit	-689.9692	0.5190	-358.0940	(269)
Total kg/year			986.1232	(272)
CO2 emissions per m2			11.2800	(273)
EI value			90.0211	
EI rating			90	(274)
EI band			B	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7100	(1b)	x 2.3900	(2b) =	104.4669	(1b) - (3b)
First floor	43.7100	(1c)	x 2.6100	(2c) =	114.0831	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	218.5500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1830	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4330	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3681	(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	0.4693	0.4325	0.4233	0.3957	0.3957	0.3681	0.3681	0.3589	0.3681	0.4141	0.4049	0.4325	(22b)
Effective ac	0.6101	0.5935	0.5896	0.5783	0.5783	0.5677	0.5677	0.5644	0.5677	0.5857	0.5820	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1600	1.1000	2.3760			(26)
Windows & Fully Glazed Do (Uw = 1.20)			19.8100	1.1450	22.6832			(27)
Ground Floor			43.7100	0.1200	5.2452	90.0000	3933.9000	(28a)
Brick and Block	134.3000	21.9700	112.3300	0.2400	26.9592	42.2200	4742.5726	(29a)
External Roof 1	43.7100		43.7100	0.1000	4.3710	9.1000	397.7610	(30)
Total net area of external elements Aum(A, m2)			221.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.6346			(33)
GF Block			52.8500			75.0000	3963.7500	(32c)
GF Timber Stud			19.9900			9.0000	179.9100	(32c)
FF Timber Stud			115.9200			9.0000	1043.2800	(32c)
Internal Floor			43.7100			18.0000	786.7800	(32d)
Internal Ceiling 1			43.7100			18.0000	786.7800	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		15834.7336	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							181.1340	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.7277	(36)
Total fabric heat loss					(33) + (36) =		74.3623	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.0025	42.8056	42.5217	41.7064	41.7064	40.9461	40.9461	40.7049	40.9461	42.2438	41.9720	42.8056	(38)
Heat transfer coeff	118.3648	117.1679	116.8840	116.0687	116.0687	115.3084	115.3084	115.0672	115.3084	116.6061	116.3344	117.1679	(39)
Average = Sum(39)m / 12 =												116.3046	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3403	1.3370	1.3277	1.3277	1.3190	1.3190	1.3163	1.3190	1.3339	1.3308	1.3403	(40)
HLP (average)												1.3304	(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	2.5887	(42)
Average daily hot water use (litres/day)	95.6824	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.2507	101.4234	97.5961	93.7688	89.9415	86.1142	86.1142	89.9415	93.7688	97.5961	101.4234	105.2507	(44)
Energy conte	156.0837	136.5118	140.8680	122.8121	117.8411	101.6879	94.2288	108.1289	109.4204	127.5189	139.1968	151.1587	(45)
Energy content (annual)										Total = Sum(45)m =		1505.4571	(45)

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

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Distribution loss  (46)m = 0.15 x (45)m
                23.4126    20.4768    21.1302    18.4218    17.6762    15.2532    14.1343    16.2193    16.4131    19.1278    20.8795    22.6738 (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      27.5604    24.8911    27.5367    26.6180    27.4831    26.5711    27.4409    27.4683    26.5966    27.5145    26.6571    27.5523 (61)
Total heat required for water heating calculated for each month
               183.6441   161.4029   168.4046   149.4301   145.3242   128.2590   121.6697   135.5972   136.0170   155.0334   165.8539   178.7110 (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                                                                                                                      1.3776 (H8)
Utilisation factor                                                                                                                       0.5161 (H9)
Collector performance factor                                                                                                             0.8793 (H10)
Dedicated solar storage volume                                                                                                          75.0000 (H11)
Effective solar volume                                                                                                                  75.0000 (H13)
Daily hot water demand                                                                                                                  95.6824 (H14)
Volume ratio Veff/V                                                                                                                      0.7838 (H15)
Solar storage volume factor                                                                                                              0.9513 (H16)
Solar input                                                                                                                           -895.3251 (H17)
Solar input     -29.3817   -41.9432   -71.0866   -97.0020  -114.4836  -121.8322  -117.3342  -104.6776   -82.8462   -56.7246   -34.5440   -23.4694 (63)
                                                                                         Solar input (sum of months) = Sum(63)m =    -895.3251 (63)
Output from w/h
               154.2624   119.4597    97.3180    52.4280    30.8407     6.4268     4.3355    30.9197    53.1708    98.3088   131.3100   155.2416 (64)
                                                                                           Total per year (kWh/year) = Sum(64)m =     934.0221 (64)
Heat gains from water heating, kWh/month
                58.7879    51.6130    53.7228    47.4895    46.0530    40.4540    38.1913    42.8199    43.0314    49.2787    52.9472    57.1483 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                52.1987    46.3624    37.7045    28.5447    21.3375    18.0140    19.4648    25.3011    33.9590    43.1188    50.3260    53.6495 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               349.6273   353.2554   344.1128   324.6495   300.0804   276.9890   261.5625   257.9345   267.0770   286.5404   311.1094   334.2009 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211 (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)
              -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494 (71)
Water heating gains (Table 5)
                79.0160    76.8050    72.2080    65.9577    61.8991    56.1861    51.3324    57.5537    59.7659    66.2347    73.5378    76.8123 (72)
Total internal gains
               588.7379   584.3186   561.9211   527.0476   491.2129   459.0850   440.2555   448.6851   468.6978   503.7898   542.8691   572.5585 (73)


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6. Solar gains
----------------------------------------------------------------------------------------------------
[Jan]                                      Area          Solar flux             g               FF             Access             Gains
                                             m2            Table 6a   Specific data   Specific data             factor                 W
                                                               W/m2     or Table 6b     or Table 6c           Table 6d
----------------------------------------------------------------------------------------------------
East                                    10.8500             25.9136          0.6300          0.7000             0.7700           85.9271 (76)
South                                    2.6200             58.2505          0.6300          0.7000             0.7700           46.6415 (78)
West                                     6.3400             25.9136          0.6300          0.7000             0.7700           50.2099 (80)
----------------------------------------------------------------------------------------------------

Solar gains    182.7786   292.4322   453.3460   643.3265   735.0808   807.6995   753.0953   672.2361   547.8457   359.1485   222.8945   145.4300 (83)
Total gains    771.5165   876.7508  1015.2671  1170.3742  1226.2937  1266.7845  1193.3509  1120.9211  1016.5434   862.9382   765.7636   717.9885 (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             37.1608    37.5405    37.6317    37.8960    37.8960    38.1458    38.1458    38.2258    38.1458    37.7213    37.8094    37.5405
alpha            3.4774     3.5027     3.5088     3.5264     3.5264     3.5431     3.5431     3.5484     3.5431     3.5148     3.5206     3.5027
util living area
                 0.9714     0.9565     0.9152     0.8242     0.6827     0.4857     0.3515     0.3721     0.6133     0.8545     0.9487     0.9762 (86)

MIT             19.5617    19.7454    20.1154    20.5271    20.8183    20.9597    20.9904    20.9886    20.9096    20.5583    20.0256    19.5334 (87)
Th 2            19.7988    19.8094    19.8119    19.8192    19.8192    19.8260    19.8260    19.8281    19.8260    19.8144    19.8168    19.8094 (88)
util rest of house
                 0.9642     0.9460     0.8947     0.7843     0.6145     0.3931     0.2428     0.2579     0.5161     0.8084     0.9336     0.9700 (89)
MIT 2           18.5396    18.7260    19.0827    19.4654    19.7080    19.8096    19.8240    19.8257    19.7839    19.5024    19.0086    18.5204 (90)
Living area fraction                                                                              fLA = Living area / (4) =      0.2008 (91)
MIT             18.7448    18.9307    19.2901    19.6786    19.9309    20.0405    20.0582    20.0592    20.0099    19.7144    19.2128    18.7238 (92)
Temperature adjustment                                                                                                           0.0000
adjusted MIT    18.7448    18.9307    19.2901    19.6786    19.9309    20.0405    20.0582    20.0592    20.0099    19.7144    19.2128    18.7238 (93)


----------------------------------------------------------------------------------------------------
```

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9559	0.9361	0.8840	0.7789	0.6215	0.4107	0.2647	0.2809	0.5324	0.8039	0.9237	0.9626	(94)
Useful gains	737.4725	820.7045	897.4470	911.5861	762.1221	520.2062	315.8811	314.8950	541.2083	693.6907	707.3712	691.1024	(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													
	1579.5514	1550.2087	1401.4445	1169.8050	850.8852	535.0902	318.0399	317.4925	577.6803	922.8662	1257.8945	1549.4024	(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													
	626.5067	490.2268	374.9742	185.9177	66.0398	0.0000	0.0000	0.0000	0.0000	170.5065	396.3768	638.5752	(98)
Space heating												2949.1236	(98)
Space heating per m2											(98) / (4) =	33.7351	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3251.5145	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	626.5067	490.2268	374.9742	185.9177	66.0398	0.0000	0.0000	0.0000	0.0000	170.5065	396.3768	638.5752	(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)													
	690.7461	540.4927	413.4225	204.9809	72.8112	0.0000	0.0000	0.0000	0.0000	187.9895	437.0196	704.0520	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	154.2624	119.4597	97.3180	52.4280	30.8407	6.4268	4.3355	30.9197	53.1708	98.3088	131.3100	155.2416	(64)
Efficiency of water heater												87.9000	(216)
(217)m	90.1327	90.1374	90.1086	90.0689	89.7895	87.9000	87.9000	87.9000	87.9000	89.6556	89.9867	90.1385	(217)
Fuel for water heating, kWh/month													
	171.1503	132.5307	108.0009	58.2088	34.3477	7.3115	4.9323	35.1759	60.4901	109.6517	145.9215	172.2257	(219)
Water heating fuel used												1039.9472	(219)
Annual totals kWh/year													
Space heating fuel - main system												3251.5145	(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)												368.7383	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.95 * 1054 * 1.00) =										-801.3765		-801.3765	(233)
Total delivered energy for all uses												3983.8235	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3251.5145	9.7400	316.6975	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1039.9472	9.7400	101.2909	(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	368.7383	36.8500	135.8801	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-801.3765	36.8500	-295.3072	(252)
Total energy cost			408.6237	(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	3251.5145	0.2160	702.3271	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1039.9472	0.2160	224.6286	(264)
Space and water heating			926.9557	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	368.7383	0.5190	191.3752	(268)
Energy saving/generation technologies				
PV Unit	-801.3765	0.5190	-415.9144	(269)
Total kg/year			767.2915	(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	3251.5145	1.2200	3966.8477	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1039.9472	1.2200	1268.7356	(264)
Space and water heating			5235.5832	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	368.7383	3.0700	1132.0267	(268)
Energy saving/generation technologies				
PV Unit	-801.3765	3.0700	-2460.2257	(269)
Primary energy kWh/year			4291.1342	(272)
Primary energy kWh/m2/year			49.0864	(273)

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 167	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Project	Plot 167		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	15.11	**TER**	18.74
Environmental	88 B	**% DER<TER**	19.36		
CO_2 Emissions (t/year)	0.96	**DFEE**	51.42	**TFEE**	57.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.47		

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/m²K)	Resistance (m²K/W)	Fraction (%)	Density (kg/m³)	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 m² K/W **Lower limit =** 10.901 m² K/W **Average =** 11.050 m² K/W

Total correction = 0.0065 m² K/W **U-value (unrounded) =** 0.1 W/m² K

Unheated space: None

Total thickness: 463 mm **U-value: 0.10 W/m² K** **Kappa: 9.10 kJ/m² K**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 167	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Project	Plot 167		
Calculation Type	New Build (As Designed)		

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Environmental	88 B	**% DER<TER**	19.36		
CO_2 Emissions (t/year)	0.96	**DFEE**	51.42	**TFEE**	57.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.47		

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

Building Elements

Wall 000001

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)	Density (kg/m³)	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 m² K/W **Lower limit =** 4.110 m² K/W **Average =** 4.215 m² K/W

Total correction = 0.0002 m² K/W **U-value (unrounded) =** 0.24 W/m² 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

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 167	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Project	Plot 167		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	15.11	**TER**	18.74
Environmental	88 B	**% DER<TER**	19.36		
CO_2 Emissions (t/year)	0.96	**DFEE**	51.42	**TFEE**	57.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.47		

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

Building Elements

Floor 000003

Floor Type: Suspended Floor
Area = 64.80 m², Perimeter = 34.61 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:Uw = 1.500 m
Ventilation openings per perimeter length:e = 0.0015 %
Mean wind speed:v = 5.000 m/s
Resistance on solum:Rg = 0.000 m²K/W

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)	Density (kg/m³)	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 m² K/W **Lower limit =** 6.052 m² K/W **Average =** 7.661 m² K/W

Total correction = 0.0046 m² K/W **U-value (unrounded) =** 0.12 W/m² 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)

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 167	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Property	Plot 167		

SAP Rating	87 B	**DER**	15.11	**TER**	18.74
Environmental	88 B	**% DER<TER**	19.36		
CO_2 Emissions (t/year)	0.96	**DFEE**	51.42	**TFEE**	57.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.47		

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	West
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	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	26.86 m	43.71 m²	2.39 m
1st Storey:	26.86 m	43.71 m²	2.61 m

7.0 Living Area	17.55	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	181.13	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
Brick and Block	Cavity Wall	Other	0.24	42.22	134.30	112.33

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
GF Block	Dense block, plasterboard on dabs	75.00	52.85
GF Timber Stud	Plasterboard on timber frame	9.00	19.99
FF Timber Stud	Plasterboard on timber frame	9.00	115.92

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Plane Roof	Other	0.10	9.10	43.71	43.71

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Ceiling 1	Plasterboard ceiling, carpeted chipboard floor	9.00	43.71

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

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	43.71

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor	Plasterboard ceiling, carpeted chipboard floor	18.00	43.71

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	Manufacturer	Solid Door							1.10
Windows & Fully Glazed Do	Manufacturer	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	West							2.16	
Front Elevation	Window	[1] Brick and Block	West	None	0.00					6.34	
Side Elevation	Window	[1] Brick and Block	South	None	0.00					2.62	
Rear Elevation	Window	[1] Brick and Block	East	None	0.00					10.85	

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)	0.46	0.093	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.37	0.077	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)	9.98	0.064	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	3.17	0.067	No	Birtley Supatherm
Independently assessed	E3 Sill	11.81	0.021	No	Knauf P5
Independently assessed	E4 Jamb	36.92	0.016	No	Knauf P6
Table K1 - Default	E5 Ground floor (normal)	26.86	0.320	No	
Independently assessed	E6 Intermediate floor within a dwelling	26.86	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)	11.14	0.044	No	Knauf P21
Independently assessed	E16 Corner (normal)	19.99	0.039	No	Knauf P23

Y-value	0.057	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
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

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	19	
Total number of L.E.L. fittings	19	
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	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	

Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	Yes
SAP Code	901

29.0 Hot Water Cylinder None

32.0 Photovoltaic Unit One Dwelling

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.95	West	30°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£80	B 88	