elmhurst energy

SAP Report Submission for Building Regulations Compliance

Client: Foreman Homes

Project: Plot 102

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

Report Issue Date: 28/03/2023

EXCELLENCE IN ENERGY ASSESSMENT

PREDICTED ENERGY ASSESSMENT

Design SAP
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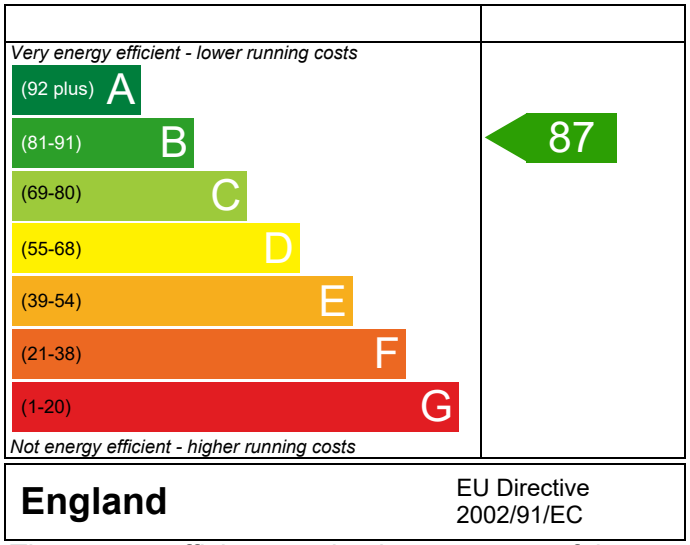
Plot 102

Dwelling type:	House, Semi-Detached
Date of assessment:	28/03/2023
Produced by:	Abacus Energy (UK) Ltd
Total floor area:	83.72 m²
DRRN:	7062-3738-7203

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.

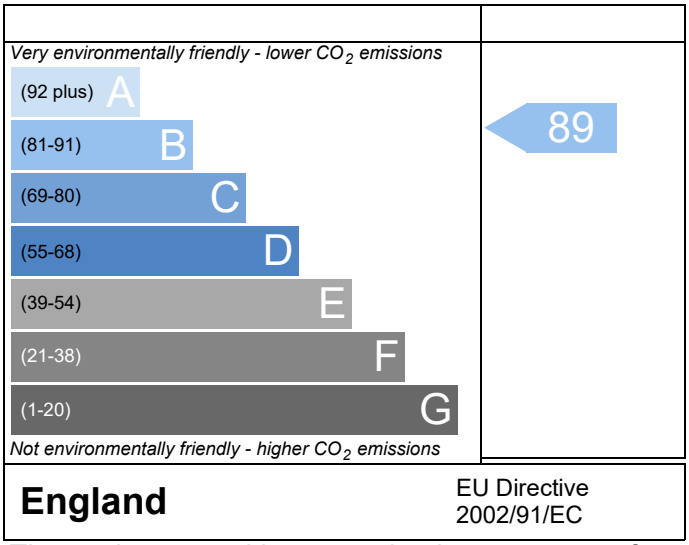
Energy Efficiency Rating



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 102	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Melbourne V1
Property	Plot 102		

SAP Rating	87 B	**DER**	14.16	**TER**	18.61
Environmental	89 B	**% DER<TER**	23.91		
CO_2 Emissions (t/year)	0.87	**DFEE**	44.96	**TFEE**	53.84
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.48		

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)	18.61	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	14.16	$kgCO_2/m^2$	Pass
	-4.45 (-23.9%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	53.84	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	44.96	$kWh/m^2/yr$	
	-8.8 (-16.4%)	$kWh/m^2/yr$	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
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	Pass
Roof	0.11 (max. 0.20)	0.17 (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

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Worcester Greenstar 32CDi 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 North Windows facing South	7.63 m², No overhang 5.55 m², No overhang		
Air change rate	4.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type	U-value		
Filled Cavity with Edge Sealing	0.00	W/m²K	Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	m³/(h.m²) @ 50 Pa	
Maximum	10.0	m³/(h.m²) @ 50 Pa	Pass

10 Key features

Party wall U-value	0.00	W/m²K
Roof U-value	0.10	W/m²K
Floor U-value	0.12	W/m²K
Door U-value	1.10	W/m²K
Photovoltaic array	0.90	kW

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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 89	B 91	Recommended
Photovoltaic			0	0	Already installed
Wind turbine			0	0	Not applicable
Totals	**£4,000 - £6,000**	**£80**	**B 89**	**B 91**	

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THERMAL BRIDGING
Calculation Type: New Build (As Designed)

Design SAP
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Property Reference	SAP 0879 Plot 102	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Melbourne V1
Property	Plot 102		

SAP Rating	87 B	**DER**	14.16	**TER**	18.61
Environmental	89 B	**% DER<TER**	23.91		
CO_2 Emissions (t/year)	0.87	**DFEE**	44.96	**TFEE**	53.84
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.48		

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	0.110	0.46	0.05	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.077	0.69	0.05	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.071	1.02	0.07	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.064	3.74	0.24	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.067	1.59	0.11	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.064	3.62	0.23	Birtley Supatherm
External wall	E3 Sill	Independently assessed	0.021	8.50	0.18	Knauf P5
External wall	E4 Jamb	Independently assessed	0.016	24.32	0.39	Knauf P6
External wall	E5 Ground floor (normal)	Table K1 - Approved	0.160	18.51	2.96	
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.000	18.51	0.00	CD0029
External wall	E10 Eaves (insulation at ceiling level)	Table K1 - Approved	0.060	8.05	0.48	
External wall	E24 Eaves (insulation at ceiling level - inverted)	Independently assessed	0.120	8.05	0.97	Value Halved
External wall	E12 Gable (insulation at ceiling level)	Independently assessed	0.044	9.86	0.43	Knauf P21
External wall	E13 Gable (insulation at rafter level)	Independently assessed	0.010	1.86	0.02	Knauf P20
External wall	E16 Corner (normal)	Independently assessed	0.039	10.60	0.41	Knauf P23
External wall	E18 Party wall between dwellings	Table K1 - Approved	0.060	9.40	0.56	
Party wall	P1 Party wall - Ground floor	Table K1 - Default	0.160	8.05	1.29	
Party wall	P2 Party wall - Intermediate floor within a dwelling	Table K1 - Default	0.000	8.05	0.00	
Party wall	P4 Party wall - Roof (insulation at ceiling level)	Independently assessed	0.069	8.05	0.56	Knauf P29
External roof	R6 Flat ceiling	Table K1 - Default	0.060	8.05	0.48	

Total: 9.49 **W/mK:**

Y-Value: 0.051 **W/m²K:**

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

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 102	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Melbourne V1
Property	Plot 102		

SAP Rating	87 B	**DER**	14.16	**TER**	18.61
Environmental	89 B	**% DER<TER**	23.91		
CO_2 Emissions (t/year)	0.87	**DFEE**	44.96	**TFEE**	53.84
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.48		

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

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

Semi-Detached House, total floor area 84 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) 18.61 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.16 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.0 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
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.17 (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 32CDi 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

---
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 North: 7.63 m², No overhang
Windows facing South: 5.55 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Floor U-value 0.12 W/m²K
Door U-value 1.10 W/m²K
Photovoltaic array 0.90 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	41.8600	(1b)	x 2.3900	(2b) =	100.0454	(1b) - (3b)
First floor	41.8600	(1c)	x 2.6100	(2c) =	109.2546	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		209.3000	(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) =	0.1433	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3933	(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) =	0.3343	(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	0.4263	0.4179	0.4096	0.3678	0.3594	0.3176	0.3176	0.3093	0.3343	0.3594	0.3761	0.3928	(22b)
Effective ac	0.5909	0.5873	0.5839	0.5676	0.5646	0.5504	0.5504	0.5478	0.5559	0.5646	0.5707	0.5772	(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			2.1200	1.1000	2.3320			(26)
Windows & Fully Glazed Do (Uw = 1.20)			13.1800	1.1450	15.0916			(27)
Ground Floor			41.8600	0.1200	5.0232	90.0000	3767.4000	(28a)
Brick and Block	96.4600	15.3000	81.1600	0.2400	19.4784	42.2200	3426.5752	(29a)
External Roof 1	40.5500		40.5500	0.1000	4.0550	9.1000	369.0050	(30)
Skeillins	7.4900		7.4900	0.1700	1.2733	9.1000	68.1590	(30)
Total net area of external elements Aum(A, m2)			186.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.2535			(33)
Party Wall 1			37.8900	0.0000	0.0000	45.0000	1705.0500	(32)
GF Timber Stud			73.5500			9.0000	661.9500	(32c)
FF Timber Stud			91.3600			9.0000	822.2400	(32c)
Internal Floor 1			41.8600			18.0000	753.4800	(32d)
Internal Ceiling 1			41.8600			18.0000	753.4800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12327.3392 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.2449 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.4882 (36)
Total fabric heat loss	(33) + (36) =	56.7417 (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	40.8098	40.5661	40.3273	39.2054	38.9955	38.0184	38.0184	37.8374	38.3948	38.9955	39.4201	39.8641	(38)
Heat transfer coeff	97.5516	97.3079	97.0690	95.9471	95.7372	94.7601	94.7601	94.5792	95.1365	95.7372	96.1619	96.6058	(39)
Average = Sum(39)m / 12 =												95.9461	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1652	1.1623	1.1594	1.1460	1.1435	1.1319	1.1319	1.1297	1.1364	1.1435	1.1486	1.1539	(40)
HLP (average)												1.1460	(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		2.5297 (42)
Average daily hot water use (litres/day)		94.2796 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.7075	99.9363	96.1652	92.3940	88.6228	84.8516	84.8516	88.6228	92.3940	96.1652	99.9363	103.7075	(44)
Energy conte	153.7953	134.5103	138.8026	121.0115	116.1134	100.1970	92.8473	106.5436	107.8161	125.6492	137.1560	148.9425	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1483.3847 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.0693	20.1765	20.8204	18.1517	17.4170	15.0296	13.9271	15.9815	16.1724	18.8474	20.5734	22.3414	(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	25.3182	22.8657	25.2742	24.4120	25.1916	24.3397	25.1265	25.1687	24.3791	25.2400	24.4802	25.3055	(61)
Total heat required for water heating calculated for each month													
	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480	(64)
								Total per year (kWh/year) = Sum(64)m =				1780.4860	(64)
Heat gains from water heating, kWh/month													
	57.4665	50.4411	52.4704	46.3393	44.9056	39.4004	37.1533	41.7179	41.9436	48.0884	51.7244	55.8497	(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	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.1849	18.8163	15.3024	11.5849	8.6599	7.3110	7.8998	10.2685	13.7823	17.4998	20.4249	21.7737	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	227.0394	229.3953	223.4584	210.8193	194.8648	179.8698	169.8522	167.4963	173.4332	186.0723	202.0268	217.0218	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	(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)													
	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	(71)
Water heating gains (Table 5)													
	77.2399	75.0612	70.5247	64.3602	60.3570	54.7228	49.9373	56.0725	58.2550	64.6349	71.8395	75.0669	(72)
Total internal gains													
	389.4092	387.2178	373.2305	350.7094	327.8267	305.8487	291.6343	297.7822	309.4156	332.1520	358.2361	377.8074	(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	
North	7.6300	10.6334	0.6300	0.7000	0.7700	24.7952	(74)
South	5.5500	46.7521	0.6300	0.7000	0.7700	79.2986	(78)

Solar gains	104.0938	177.2557	245.9509	316.3079	369.0630	374.0180	357.3375	316.0693	269.6230	196.4833	124.5840	89.1918	(83)
Total gains	493.5030	564.4734	619.1814	667.0173	696.8896	679.8666	648.9719	613.8516	579.0385	528.6354	482.8201	466.9992	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.1021	35.1900	35.2766	35.6890	35.7673	36.1361	36.1361	36.2052	35.9931	35.7673	35.6093	35.4457	
alpha	3.3401	3.3460	3.3518	3.3793	3.3845	3.4091	3.4091	3.4137	3.3995	3.3845	3.3740	3.3630	
util living area													
	0.9870	0.9787	0.9632	0.9283	0.8560	0.7272	0.5832	0.6272	0.8185	0.9413	0.9792	0.9892	(86)
MIT	19.1100	19.3203	19.6556	20.0987	20.5109	20.8128	20.9358	20.9163	20.6957	20.1709	19.5639	19.0727	(87)
Th 2	19.9479	19.9503	19.9526	19.9634	19.9654	19.9749	19.9749	19.9766	19.9712	19.9654	19.9613	19.9570	(88)
util rest of house													
	0.9843	0.9743	0.9551	0.9111	0.8183	0.6517	0.4694	0.5162	0.7586	0.9238	0.9741	0.9869	(89)
MIT 2	18.2256	18.4356	18.7684	19.2085	19.5975	19.8642	19.9495	19.9409	19.7723	19.2859	18.6872	18.1952	(90)
Living area fraction									fLA = Living area / (4) =			0.1765	(91)
MIT	18.3817	18.5918	18.9250	19.3657	19.7587	20.0317	20.1236	20.1131	19.9353	19.4421	18.8420	18.3501	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3817	18.5918	18.9250	19.3657	19.7587	20.0317	20.1236	20.1131	19.9353	19.4421	18.8420	18.3501	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9788	0.9666	0.9449	0.8989	0.8095	0.6563	0.4871	0.5323	0.7562	0.9126	0.9666	0.9821	(94)
Useful gains	483.0297	545.6414	585.0615	599.5677	564.1286	446.2074	316.1269	326.7721	437.8451	482.4332	466.7014	458.6215	(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													
	1373.6961	1332.3157	1206.0874	1004.1503	771.5190	514.7063	333.8988	351.1805	555.1475	846.5185	1129.1293	1366.9862	(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													
	662.6558	528.6451	462.0432	291.2995	154.2984	0.0000	0.0000	0.0000	0.0000	270.8795	476.9481	675.8233	(98)
Space heating												3522.5929	(98)
Space heating per m2											(98) / (4) =	42.0759	(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	3883.7849	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	662.6558	528.6451	462.0432	291.2995	154.2984	0.0000	0.0000	0.0000	0.0000	270.8795	476.9481	675.8233	(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)													
	730.6018	582.8502	509.4192	321.1681	170.1195	0.0000	0.0000	0.0000	0.0000	298.6544	525.8523	745.1194	(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													
	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.9319	89.8725	89.7559	89.5038	88.9925	87.2000	87.2000	87.2000	87.2000	89.4160	89.7878	89.9599	(217)
Fuel for water heating, kWh/month													
	199.1656	175.1104	182.8033	162.4775	158.7830	142.8173	135.2910	151.0462	151.5999	168.7496	180.0202	193.6952	(219)
Water heating fuel used												2001.5592	(219)
Annual totals kWh/year													
Space heating fuel - main system												3883.7849	(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)												374.1328	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.90 * 853 * 1.00) =										-614.1815		-614.1815	(233)
Total delivered energy for all uses												5720.2954	(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	3883.7849	0.2160	838.8975	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2001.5592	0.2160	432.3368	(264)
Space and water heating			1271.2343	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	374.1328	0.5190	194.1749	(268)
Energy saving/generation technologies				
PV Unit	-614.1815	0.5190	-318.7602	(269)
Total CO2, kg/year			1185.5740	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.1600	(273)

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

DER		14.1600	ZC1
Total Floor Area	TFA	83.7200	
Assumed number of occupants	N	2.5297	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.0701	ZC2
CO2 emissions from cooking, equation (L16)		2.1466	ZC3
Total CO2 emissions		32.3767	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.3767	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	41.8600	(1b)	x 2.3900	(2b) =	100.0454	(1b) - (3b)
First floor	41.8600	(1c)	x 2.6100	(2c) =	109.2546	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.7200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	209.3000	(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) =	0.1433	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3933	(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) =		0.3343	(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	0.4263	0.4179	0.4096	0.3678	0.3594	0.3176	0.3176	0.3093	0.3343	0.3594	0.3761	0.3928	(22b)
Effective ac	0.5909	0.5873	0.5839	0.5676	0.5646	0.5504	0.5504	0.5478	0.5559	0.5646	0.5707	0.5772	(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			2.1200	1.0000	2.1200			(26)
TER Opening Type (Uw = 1.40)			13.1800	1.3258	17.4735			(27)
Ground Floor			41.8600	0.1300	5.4418			(28a)
Brick and Block	96.4600	15.3000	81.1600	0.1800	14.6088			(29a)
External Roof 1	40.5500		40.5500	0.1300	5.2715			(30)
Skeillins	7.4900		7.4900	0.1300	0.9737			(30)
Total net area of external elements Aum(A, m2)			186.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8893			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.9250	(36)
Total fabric heat loss (33) + (36) =	57.8143	(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	40.8098	40.5661	40.3273	39.2054	38.9955	38.0184	38.0184	37.8374	38.3948	38.9955	39.4201	39.8641	(38)
Heat transfer coeff	98.6241	98.3804	98.1416	97.0197	96.8098	95.8327	95.8327	95.6517	96.2090	96.8098	97.2344	97.6784	(39)
Average = Sum(39)m / 12 =												97.0187	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1780	1.1751	1.1723	1.1589	1.1564	1.1447	1.1447	1.1425	1.1492	1.1564	1.1614	1.1667	(40)
HLP (average)												1.1588	(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	2.5297 (42)
Average daily hot water use (litres/day)	94.2796 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.7075	99.9363	96.1652	92.3940	88.6228	84.8516	84.8516	88.6228	92.3940	96.1652	99.9363	103.7075	(44)
Energy conte	153.7953	134.5103	138.8026	121.0115	116.1134	100.1970	92.8473	106.5436	107.8161	125.6492	137.1560	148.9425	(45)
Energy content (annual)										Total = Sum(45)m =		1483.3847	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0693	20.1765	20.8204	18.1517	17.4170	15.0296	13.9271	15.9815	16.1724	18.8474	20.5734	22.3414	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.9981	49.0047	45.5642	45.1612	41.8446	43.2395	45.1612	45.5642	49.0047	49.2837	50.9589 (61)
Total heat required for water heating calculated for each month												
	204.7542	180.5084	187.8073	166.5756	161.2746	142.0417	136.0867	151.7048	153.3802	174.6539	186.4396	199.9014 (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												
	204.7542	180.5084	187.8073	166.5756	161.2746	142.0417	136.0867	151.7048	153.3802	174.6539	186.4396	199.9014 (64)
								Total per year (kWh/year) = Sum(64)m =				2045.1285 (64)
Heat gains from water heating, kWh/month												
	63.8767	56.2242	58.4030	51.6274	49.8980	43.7767	41.6816	46.7160	47.2399	54.0295	57.9253	62.2631 (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	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.1849	18.8163	15.3024	11.5849	8.6599	7.3110	7.8998	10.2685	13.7823	17.4998	20.4249	21.7737	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	227.0394	229.3953	223.4584	210.8193	194.8648	179.8698	169.8522	167.4963	173.4332	186.0723	202.0268	217.0218	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	(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)													
	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	(71)
Water heating gains (Table 5)													
	85.8557	83.6670	78.4987	71.7047	67.0672	60.8009	56.0236	62.7904	65.6109	72.6204	80.4518	83.6870	(72)
Total internal gains													
	398.0250	395.8236	381.2045	358.0539	334.5369	311.9268	297.7207	304.5002	316.7715	340.1375	366.8484	386.4275	(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	
North	7.6300	10.6334	0.6300	0.7000	0.7700	24.7952	(74)
South	5.5500	46.7521	0.6300	0.7000	0.7700	79.2986	(78)

Solar gains	104.0938	177.2557	245.9509	316.3079	369.0630	374.0180	357.3375	316.0693	269.6230	196.4833	124.5840	89.1918	(83)
Total gains	502.1189	573.0792	627.1554	674.3618	703.5999	685.9447	655.0582	620.5695	586.3945	536.6208	491.4325	475.6193	(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	58.9500	59.0960	59.2398	59.9248	60.0548	60.6671	60.6671	60.7819	60.4298	60.0548	59.7925	59.5208	
alpha	4.9300	4.9397	4.9493	4.9950	5.0037	5.0445	5.0445	5.0521	5.0287	5.0037	4.9862	4.9681	
util living area	0.9980	0.9958	0.9902	0.9723	0.9176	0.7846	0.6170	0.6675	0.8813	0.9795	0.9959	0.9985	(86)
MIT	19.7211	19.8685	20.1039	20.4196	20.7146	20.9157	20.9803	20.9711	20.8350	20.4608	20.0349	19.6959	(87)
Th 2	19.9376	19.9400	19.9423	19.9531	19.9551	19.9645	19.9645	19.9663	19.9609	19.9551	19.9510	19.9467	(88)
util rest of house	0.9973	0.9943	0.9866	0.9610	0.8817	0.6963	0.4851	0.5373	0.8174	0.9690	0.9942	0.9980	(89)
MIT 2	18.2352	18.4519	18.7960	19.2570	19.6616	19.9046	19.9569	19.9536	19.8219	19.3221	18.7033	18.2047	(90)
Living area fraction										fLA = Living area / (4) =		0.1765	(91)
MIT	18.4975	18.7020	19.0269	19.4623	19.8475	20.0831	20.1376	20.1332	20.0008	19.5231	18.9384	18.4680	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4975	18.7020	19.0269	19.4623	19.8475	20.0831	20.1376	20.1332	20.0008	19.5231	18.9384	18.4680	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9959	0.9918	0.9822	0.9540	0.8772	0.7077	0.5084	0.5599	0.8203	0.9629	0.9917	0.9968	(94)
Useful gains	500.0622	568.3793	615.9698	643.3176	617.1974	485.4147	333.0038	347.4587	481.0369	516.7079	487.3660	474.1159	(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	1400.2138	1357.8481	1229.4095	1024.7483	788.7608	525.4572	339.0131	357.0918	567.7064	863.8459	1151.0958	1393.6725	(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	669.7128	530.5231	456.3991	274.6301	127.6432	0.0000	0.0000	0.0000	0.0000	258.2707	477.8855	684.1502	(98)
Space heating												3479.2146	(98)
Space heating per m2											(98) / (4) =	41.5577	(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												3725.0691	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	669.7128	530.5231	456.3991	274.6301	127.6432	0.0000	0.0000	0.0000	0.0000	258.2707	477.8855	684.1502	(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)													
	717.0372	568.0119	488.6500	294.0365	136.6629	0.0000	0.0000	0.0000	0.0000	276.5211	511.6547	732.4948	(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													
	204.7542	180.5084	187.8073	166.5756	161.2746	142.0417	136.0867	151.7048	153.3802	174.6539	186.4396	199.9014	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8138	87.6027	87.2024	86.3018	84.4694	80.3000	80.3000	80.3000	80.3000	86.0344	87.3178	87.9000	(217)
Fuel for water heating, kWh/month													
	233.1685	206.0534	215.3694	193.0153	190.9266	176.8887	169.4729	188.9225	191.0090	203.0048	213.5186	227.4190	(219)
Water heating fuel used												2408.7687	(219)
Annual totals kWh/year													
Space heating fuel - main system												3725.0691	(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)												374.1328	(232)
Total delivered energy for all uses												6582.9706	(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	3725.0691	0.2160	804.6149	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2408.7687	0.2160	520.2940	(264)
Space and water heating			1324.9090	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	374.1328	0.5190	194.1749	(268)
Total CO2, kg/m2/year			1558.0089	(272)
Emissions per m2 for space and water heating			15.8255	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3193	(272b)
Emissions per m2 for pumps and fans			0.4649	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8255 * 1.00) + 2.3193 + 0.4649, rounded to 2 d.p.			18.6100	(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	41.8600	(1b)	x 2.3900	(2b) =	100.0454	(1b) - (3b)
First floor	41.8600	(1c)	x 2.6100	(2c) =	109.2546	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		209.3000	(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) =	0.1433	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3933	(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) =		0.3343	(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	0.4263	0.4179	0.4096	0.3678	0.3594	0.3176	0.3176	0.3093	0.3343	0.3594	0.3761	0.3928	(22b)
Effective ac	0.5909	0.5873	0.5839	0.5676	0.5646	0.5504	0.5504	0.5478	0.5559	0.5646	0.5707	0.5772	(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			2.1200	1.1000	2.3320			(26)
Windows & Fully Glazed Do (Uw = 1.20)			13.1800	1.1450	15.0916			(27)
Ground Floor			41.8600	0.1200	5.0232	90.0000	3767.4000	(28a)
Brick and Block	96.4600	15.3000	81.1600	0.2400	19.4784	42.2200	3426.5752	(29a)
External Roof 1	40.5500		40.5500	0.1000	4.0550	9.1000	369.0050	(30)
Skeillins	7.4900		7.4900	0.1700	1.2733	9.1000	68.1590	(30)
Total net area of external elements Aum(A, m2)			186.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.2535			(33)
Party Wall 1			37.8900	0.0000	0.0000	45.0000	1705.0500	(32)
GF Timber Stud			73.5500			9.0000	661.9500	(32c)
FF Timber Stud			91.3600			9.0000	822.2400	(32c)
Internal Floor 1			41.8600			18.0000	753.4800	(32d)
Internal Ceiling 1			41.8600			9.0000	376.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11950.5992 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		142.7449 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.4882 (36)
Total fabric heat loss	(33) + (36) =	56.7417 (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	40.8098	40.5661	40.3273	39.2054	38.9955	38.0184	38.0184	37.8374	38.3948	38.9955	39.4201	39.8641	(38)
Heat transfer coeff	97.5516	97.3079	97.0690	95.9471	95.7372	94.7601	94.7601	94.5792	95.1365	95.7372	96.1619	96.6058	(39)
Average = Sum(39)m / 12 =												95.9461	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1652	1.1623	1.1594	1.1460	1.1435	1.1319	1.1319	1.1297	1.1364	1.1435	1.1486	1.1539	(40)
HLP (average)												1.1460	(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		2.5297 (42)
Average daily hot water use (litres/day)		94.2796 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.7075	99.9363	96.1652	92.3940	88.6228	84.8516	84.8516	88.6228	92.3940	96.1652	99.9363	103.7075	(44)
Energy conte	153.7953	134.5103	138.8026	121.0115	116.1134	100.1970	92.8473	106.5436	107.8161	125.6492	137.1560	148.9425	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1483.3847 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.6815	28.5834	29.4956	25.7149	24.6741	21.2919	19.7300	22.6405	22.9109	26.7005	29.1456	31.6503	(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	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.1849	18.8163	15.3024	11.5849	8.6599	7.3110	7.8998	10.2685	13.7823	17.4998	20.4249	21.7737	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	227.0394	229.3953	223.4584	210.8193	194.8648	179.8698	169.8522	167.4963	173.4332	186.0723	202.0268	217.0218	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	(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)													
	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	(71)
Water heating gains (Table 5)													
	43.9267	42.5349	39.6446	35.7152	33.1641	29.5720	26.5189	30.4308	31.8207	35.8877	40.4801	42.5407	(72)
Total internal gains													
	353.0960	351.6915	339.3504	319.0644	297.6338	277.6979	265.2159	269.1406	279.9813	300.4048	323.8767	342.2812	(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	
North												7.6300	
												10.6334	
												0.6300	
												0.7000	
												0.7700	
												24.7952	(74)
South												5.5500	
												46.7521	
												0.6300	
												0.7000	
												0.7700	
												79.2986	(78)
Solar gains	104.0938	177.2557	245.9509	316.3079	369.0630	374.0180	357.3375	316.0693	269.6230	196.4833	124.5840	89.1918	(83)
Total gains	457.1899	528.9471	585.3012	635.3723	666.6968	651.7159	622.5535	585.2099	549.6043	496.8882	448.4607	431.4730	(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	34.0293	34.1145	34.1985	34.5983	34.6742	35.0317	35.0317	35.0988	34.8931	34.6742	34.5211	34.3624	
alpha	3.2686	3.2743	3.2799	3.3066	3.3116	3.3354	3.3354	3.3399	3.3262	3.3116	3.3014	3.2908	
util living area													
	0.9886	0.9809	0.9664	0.9333	0.8648	0.7409	0.5993	0.6455	0.8319	0.9472	0.9818	0.9906	(86)
MIT	19.0102	19.2273	19.5746	20.0349	20.4664	20.7892	20.9251	20.9022	20.6606	20.1072	19.4778	18.9727	(87)
Th 2	19.9479	19.9503	19.9526	19.9634	19.9654	19.9749	19.9749	19.9766	19.9712	19.9654	19.9613	19.9570	(88)
util rest of house													
	0.9863	0.9769	0.9590	0.9174	0.8291	0.6672	0.4850	0.5349	0.7750	0.9315	0.9773	0.9886	(89)
MIT 2	18.1298	18.3469	18.6920	19.1501	19.5597	19.8478	19.9444	19.9336	19.7453	19.2278	18.6054	18.0992	(90)
Living area fraction									fLA = Living area / (4) =			0.1765	(91)
MIT	18.2852	18.5023	18.8478	19.3063	19.7198	20.0140	20.1176	20.1046	19.9069	19.3830	18.7594	18.2534	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2852	18.5023	18.8478	19.3063	19.7198	20.0140	20.1176	20.1046	19.9069	19.3830	18.7594	18.2534	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9812	0.9696	0.9489	0.9048	0.8191	0.6704	0.5022	0.5502	0.7708	0.9201	0.9703	0.9842	(94)
Useful gains	448.5803	512.8695	555.3743	574.9034	546.0714	436.9039	312.6736	321.9631	423.6509	457.1767	435.1381	424.6533	(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													
	1364.2801	1323.6125	1198.5909	998.4507	767.7917	513.0322	333.3249	350.3773	552.4454	840.8643	1121.1908	1357.6385	(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													
	681.2806	544.8193	478.5531	304.9540	164.9599	0.0000	0.0000	0.0000	0.0000	285.4635	493.9580	694.1410	(98)
Space heating												3648.1295	(98)
Space heating per m2											(98) / (4) =	43.5754	(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	890.7451	701.2248	718.8016	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7542	0.8258	0.7994	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	671.7707	579.0770	574.6287	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	856.7769	820.7475	778.8291	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	133.2045	179.8029	151.9251	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												464.9325	(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	33.3011	44.9507	37.9813	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												116.2331	(107)
Space cooling per m2												1.3884	(108)
Energy for space heating												43.5754	(99)
Energy for space cooling												1.3884	(108)
Total												44.9637	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.0	(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	41.8600	(1b)	x 2.3900	(2b) =	100.0454	(1b) - (3b)
First floor	41.8600	(1c)	x 2.6100	(2c) =	109.2546	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.7200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	209.3000	(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) =	0.1433	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3933	(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) =		0.3343	(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	0.4263	0.4179	0.4096	0.3678	0.3594	0.3176	0.3176	0.3093	0.3343	0.3594	0.3761	0.3928	(22b)
Effective ac	0.5909	0.5873	0.5839	0.5676	0.5646	0.5504	0.5504	0.5478	0.5559	0.5646	0.5707	0.5772	(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			2.1200	1.0000	2.1200			(26)
TER Opening Type (Uw = 1.40)			13.1800	1.3258	17.4735			(27)
Ground Floor			41.8600	0.1300	5.4418			(28a)
Brick and Block	96.4600	15.3000	81.1600	0.1800	14.6088			(29a)
External Roof 1	40.5500		40.5500	0.1300	5.2715			(30)
Skeillins	7.4900		7.4900	0.1300	0.9737			(30)
Total net area of external elements Aum(A, m2)			186.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8893			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.9250	(36)
Total fabric heat loss (33) + (36) =	57.8143	(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	40.8098	40.5661	40.3273	39.2054	38.9955	38.0184	38.0184	37.8374	38.3948	38.9955	39.4201	39.8641	(38)
Heat transfer coeff	98.6241	98.3804	98.1416	97.0197	96.8098	95.8327	95.8327	95.6517	96.2090	96.8098	97.2344	97.6784	(39)
Average = Sum(39)m / 12 =												97.0187	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1780	1.1751	1.1723	1.1589	1.1564	1.1447	1.1447	1.1425	1.1492	1.1564	1.1614	1.1667	(40)
HLP (average)												1.1588	(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	2.5297 (42)
Average daily hot water use (litres/day)	94.2796 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.7075	99.9363	96.1652	92.3940	88.6228	84.8516	84.8516	88.6228	92.3940	96.1652	99.9363	103.7075	(44)
Energy conte	153.7953	134.5103	138.8026	121.0115	116.1134	100.1970	92.8473	106.5436	107.8161	125.6492	137.1560	148.9425	(45)
Energy content (annual)										Total = Sum(45)m =		1483.3847	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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

	32.6815	28.5834	29.4956	25.7149	24.6741	21.2919	19.7300	22.6405	22.9109	26.7005	29.1456	31.6503 (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	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	126.4833	(66)

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

	21.1849	18.8163	15.3024	11.5849	8.6599	7.3110	7.8998	10.2685	13.7823	17.4998	20.4249	21.7737	(67)

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

	227.0394	229.3953	223.4584	210.8193	194.8648	179.8698	169.8522	167.4963	173.4332	186.0723	202.0268	217.0218	(68)

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

	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	35.6483	(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)

	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	(71)

Water heating gains (Table 5)

	43.9267	42.5349	39.6446	35.7152	33.1641	29.5720	26.5189	30.4308	31.8207	35.8877	40.4801	42.5407	(72)

Total internal gains

	353.0960	351.6915	339.3504	319.0644	297.6338	277.6979	265.2159	269.1406	279.9813	300.4048	323.8767	342.2812	(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	
North	7.6300	10.6334	0.6300	0.7000	0.7700	24.7952	(74)
South	5.5500	46.7521	0.6300	0.7000	0.7700	79.2986	(78)

Solar gains	104.0938	177.2557	245.9509	316.3079	369.0630	374.0180	357.3375	316.0693	269.6230	196.4833	124.5840	89.1918	(83)
Total gains	457.1899	528.9471	585.3012	635.3723	666.6968	651.7159	622.5535	585.2099	549.6043	496.8882	448.4607	431.4730	(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	58.9500	59.0960	59.2398	59.9248	60.0548	60.6671	60.6671	60.7819	60.4298	60.0548	59.7925	59.5208	
alpha	4.9300	4.9397	4.9493	4.9950	5.0037	5.0445	5.0445	5.0521	5.0287	5.0037	4.9862	4.9681	
util living area	0.9987	0.9970	0.9927	0.9781	0.9309	0.8082	0.6435	0.6981	0.9020	0.9850	0.9973	0.9990	(86)
MIT	19.6714	19.8202	20.0593	20.3812	20.6866	20.9028	20.9764	20.9647	20.8114	20.4203	19.9876	19.6468	(87)
Th 2	19.9376	19.9400	19.9423	19.9531	19.9551	19.9645	19.9645	19.9663	19.9609	19.9551	19.9510	19.9467	(88)
util rest of house	0.9982	0.9960	0.9900	0.9688	0.8991	0.7227	0.5087	0.5664	0.8446	0.9770	0.9961	0.9987	(89)
MIT 2	18.7257	18.8760	19.1157	19.4414	19.7312	19.9161	19.9581	19.9554	19.8491	19.4842	19.0522	18.7084	(90)
Living area fraction									fLA = Living area / (4) =			0.1765	(91)
MIT	18.8927	19.0427	19.2823	19.6073	19.8999	20.0903	20.1378	20.1336	20.0190	19.6495	19.2174	18.8741	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8927	19.0427	19.2823	19.6073	19.8999	20.0903	20.1378	20.1336	20.0190	19.6495	19.2174	18.8741	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9948	0.9876	0.9648	0.8970	0.7345	0.5327	0.5896	0.8486	0.9738	0.9950	0.9982	(94)
Useful gains	456.0951	526.1786	578.0484	613.0268	598.0315	478.6975	331.6539	345.0336	466.3749	483.8588	446.2049	430.6978	(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

	1439.1876	1391.3622	1254.4714	1038.8237	793.8305	526.1516	339.0407	357.1224	569.4573	876.0786	1178.2264	1433.3422	(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

	731.4208	581.4034	503.2588	306.5738	145.6745	0.0000	0.0000	0.0000	0.0000	291.8115	527.0554	745.9674	(98)
Space heating												3833.1656	(98)
Space heating per m2											(98) / (4) =	45.7855	(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	900.8271	709.1617	726.9530	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8130	0.8891	0.8621	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	732.3323	630.5162	626.7410	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	856.7769	820.7475	778.8291	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	89.6001	141.5320	113.1536	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												344.2857	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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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   22.4000   35.3830   28.2884    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                          86.0714 (107)
Space cooling per m2                                                                                                    1.0281 (108)
Energy for space heating                                                                                               45.7855 (99)
Energy for space cooling                                                                                                1.0281 (108)
Total                                                                                                                  46.8136 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                    53.8 (109)


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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	41.8600	(1b)	x 2.3900	(2b) =	100.0454	(1b) - (3b)
First floor	41.8600	(1c)	x 2.6100	(2c) =	109.2546	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		209.3000	(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) =	0.1433	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3933	(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) =	0.3343	(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	0.4263	0.3928	0.3845	0.3594	0.3594	0.3343	0.3343	0.3260	0.3343	0.3761	0.3678	0.3928	(22b)
Effective ac	0.5909	0.5772	0.5739	0.5646	0.5646	0.5559	0.5559	0.5531	0.5559	0.5707	0.5676	0.5772	(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			2.1200	1.1000	2.3320			(26)
Windows & Fully Glazed Do (Uw = 1.20)			13.1800	1.1450	15.0916			(27)
Ground Floor			41.8600	0.1200	5.0232	90.0000	3767.4000	(28a)
Brick and Block	96.4600	15.3000	81.1600	0.2400	19.4784	42.2200	3426.5752	(29a)
External Roof 1	40.5500		40.5500	0.1000	4.0550	9.1000	369.0050	(30)
Skeillins	7.4900		7.4900	0.1700	1.2733	9.1000	68.1590	(30)
Total net area of external elements Aum(A, m2)			186.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.2535			(33)
Party Wall 1			37.8900	0.0000	0.0000	45.0000	1705.0500	(32)
GF Timber Stud			73.5500			9.0000	661.9500	(32c)
FF Timber Stud			91.3600			9.0000	822.2400	(32c)
Internal Floor 1			41.8600			18.0000	753.4800	(32d)
Internal Ceiling 1			41.8600			18.0000	753.4800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12327.3392	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.2449	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.4882	(36)
Total fabric heat loss	(33) + (36) =	56.7417	(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	40.8098	39.8641	39.6397	38.9955	38.9955	38.3948	38.3948	38.2042	38.3948	39.4201	39.2054	39.8641	(38)
Heat transfer coeff	97.5516	96.6058	96.3814	95.7372	95.7372	95.1365	95.1365	94.9459	95.1365	96.1619	95.9471	96.6058	(39)
Average = Sum(39)m / 12 =												95.9236	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1652	1.1539	1.1512	1.1435	1.1435	1.1364	1.1364	1.1341	1.1364	1.1486	1.1460	1.1539	(40)
HLP (average)												1.1458	(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		2.5297	(42)
Average daily hot water use (litres/day)		94.2796	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.7075	99.9363	96.1652	92.3940	88.6228	84.8516	84.8516	88.6228	92.3940	96.1652	99.9363	103.7075	(44)
Energy conte	153.7953	134.5103	138.8026	121.0115	116.1134	100.1970	92.8473	106.5436	107.8161	125.6492	137.1560	148.9425	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1483.3847 (45)
Distribution loss (46)m = 0.15 x (45)m

	23.0693	20.1765	20.8204	18.1517	17.4170	15.0296	13.9271	15.9815	16.1724	18.8474	20.5734	22.3414 (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	25.3182	22.8657	25.2742	24.4120	25.1916	24.3397	25.1265	25.1687	24.3791	25.2400	24.4802	25.3055 (61)

Total heat required for water heating calculated for each month

	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480 (64)

Total per year (kWh/year) = Sum(64)m = 1780.4860 (64)
RHI water heating demand 1780 (64)
Heat gains from water heating, kWh/month

	57.4665	50.4411	52.4704	46.3393	44.9056	39.4004	37.1533	41.7179	41.9436	48.0884	51.7244	55.8497 (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	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	(66)

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

	52.9624	47.0407	38.2561	28.9623	21.6497	18.2776	19.7495	25.6712	34.4558	43.7496	51.0623	54.4344 (67)

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

	338.8647	342.3811	333.5200	314.6557	290.8430	268.4624	253.5108	249.9945	258.8556	277.7198	301.5325	323.9131 (68)

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

	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077 (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)

	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866 (71)

Water heating gains (Table 5)

	77.2399	75.0612	70.5247	64.3602	60.3570	54.7228	49.9373	56.0725	58.2550	64.6349	71.8395	75.0669 (72)
Total internal gains												
	575.3680	570.7839	548.6018	514.2792	479.1507	447.7638	429.4986	438.0391	457.8674	492.4053	530.7352	559.7153 (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	
North	7.6300	13.8645	0.6300	0.7000	0.7700	32.3297	(74)
South	5.5500	58.2505	0.6300	0.7000	0.7700	98.8017	(78)

Solar gains	131.1315	191.1771	265.4777	351.2775	394.6619	434.1451	404.3566	363.0460	309.7797	224.5201	155.5595	107.2699 (83)
Total gains	706.4994	761.9611	814.0795	865.5567	873.8125	881.9089	833.8552	801.0852	767.6471	716.9254	686.2947	666.9853 (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	35.1021	35.4457	35.5282	35.7673	35.7673	35.9931	35.9931	36.0654	35.9931	35.6093	35.6890	35.4457	
alpha	3.3401	3.3630	3.3685	3.3845	3.3845	3.3995	3.3995	3.4044	3.3995	3.3740	3.3793	3.3630	
util living area													
	0.9572	0.9447	0.9145	0.8520	0.7389	0.5557	0.4088	0.4232	0.6480	0.8449	0.9304	0.9624	(86)
MIT	19.6007	19.7414	20.0432	20.4109	20.7361	20.9288	20.9815	20.9796	20.8776	20.5362	20.0511	19.5799	(87)
Th 2	19.9479	19.9570	19.9592	19.9654	19.9654	19.9712	19.9712	19.9731	19.9712	19.9613	19.9634	19.9570	(88)
util rest of house													
	0.9486	0.9340	0.8973	0.8216	0.6833	0.4695	0.3010	0.3125	0.5644	0.8049	0.9143	0.9547	(89)
MIT 2	18.7085	18.8521	19.1459	19.4973	19.7855	19.9365	19.9660	19.9673	19.9050	19.6160	19.1616	18.6957	(90)
Living area fraction									fLA = Living area / (4) =			0.1765	(91)
MIT	18.8660	19.0091	19.3043	19.6586	19.9533	20.1117	20.1453	20.1460	20.0767	19.7785	19.3186	18.8518	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8660	19.0091	19.3043	19.6586	19.9533	20.1117	20.1453	20.1460	20.0767	19.7785	19.3186	18.8518	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9375	0.9219	0.8844	0.8112	0.6826	0.4819	0.3198	0.3317	0.5737	0.7968	0.9020	0.9443	(94)
Useful gains	662.3738	702.4627	719.9828	702.1590	596.4553	424.9794	266.6737	265.7487	440.3628	571.2412	619.0630	629.8433	(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													
	1313.6255	1285.7352	1156.9890	962.9786	703.9894	448.2501	270.6919	270.2145	482.9815	767.2251	1047.6114	1289.8585	(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													
	484.5313	391.9592	325.1327	187.7902	80.0054	0.0000	0.0000	0.0000	0.0000	145.8121	308.5548	491.0513	(98)
Space heating												2414.8367	(98)
RHI space heating demand												2415	(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	41.8600	(1b)	x 2.3900	(2b) =	100.0454	(1b) - (3b)
First floor	41.8600	(1c)	x 2.6100	(2c) =	109.2546	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		209.3000	(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) =	0.1433	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3933	(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) =	0.3343	(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	0.4263	0.4179	0.4096	0.3678	0.3594	0.3176	0.3176	0.3093	0.3343	0.3594	0.3761	0.3928	(22b)
Effective ac	0.5909	0.5873	0.5839	0.5676	0.5646	0.5504	0.5504	0.5478	0.5559	0.5646	0.5707	0.5772	(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			2.1200	1.1000	2.3320			(26)
Windows & Fully Glazed Do (Uw = 1.20)			13.1800	1.1450	15.0916			(27)
Ground Floor			41.8600	0.1200	5.0232	90.0000	3767.4000	(28a)
Brick and Block	96.4600	15.3000	81.1600	0.2400	19.4784	42.2200	3426.5752	(29a)
External Roof 1	40.5500		40.5500	0.1000	4.0550	9.1000	369.0050	(30)
Skeillins	7.4900		7.4900	0.1700	1.2733	9.1000	68.1590	(30)
Total net area of external elements Aum(A, m2)			186.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.2535			(33)
Party Wall 1			37.8900	0.0000	0.0000	45.0000	1705.0500	(32)
GF Timber Stud			73.5500			9.0000	661.9500	(32c)
FF Timber Stud			91.3600			9.0000	822.2400	(32c)
Internal Floor 1			41.8600			18.0000	753.4800	(32d)
Internal Ceiling 1			41.8600			18.0000	753.4800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12327.3392 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.2449 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.4882 (36)
Total fabric heat loss	(33) + (36) =	56.7417 (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	40.8098	40.5661	40.3273	39.2054	38.9955	38.0184	38.0184	37.8374	38.3948	38.9955	39.4201	39.8641	(38)
Heat transfer coeff	97.5516	97.3079	97.0690	95.9471	95.7372	94.7601	94.7601	94.5792	95.1365	95.7372	96.1619	96.6058	(39)
Average = Sum(39)m / 12 =												95.9461	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1652	1.1623	1.1594	1.1460	1.1435	1.1319	1.1319	1.1297	1.1364	1.1435	1.1486	1.1539	(40)
HLP (average)												1.1460	(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		2.5297 (42)
Average daily hot water use (litres/day)		94.2796 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.7075	99.9363	96.1652	92.3940	88.6228	84.8516	84.8516	88.6228	92.3940	96.1652	99.9363	103.7075	(44)
Energy conte	153.7953	134.5103	138.8026	121.0115	116.1134	100.1970	92.8473	106.5436	107.8161	125.6492	137.1560	148.9425	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1483.3847	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.0693	20.1765	20.8204	18.1517	17.4170	15.0296	13.9271	15.9815	16.1724	18.8474	20.5734	22.3414	(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	25.3182	22.8657	25.2742	24.4120	25.1916	24.3397	25.1265	25.1687	24.3791	25.2400	24.4802	25.3055	(61)
Total heat required for water heating calculated for each month													
	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480	(64)
								Total per year (kWh/year) = Sum(64)m =				1780.4860	(64)
Heat gains from water heating, kWh/month													
	57.4665	50.4411	52.4704	46.3393	44.9056	39.4004	37.1533	41.7179	41.9436	48.0884	51.7244	55.8497	(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	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.9624	47.0407	38.2561	28.9623	21.6497	18.2776	19.7495	25.6712	34.4558	43.7496	51.0623	54.4344	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	338.8647	342.3811	333.5200	314.6557	290.8430	268.4624	253.5108	249.9945	258.8556	277.7198	301.5325	323.9131	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	(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)													
	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	(71)
Water heating gains (Table 5)													
	77.2399	75.0612	70.5247	64.3602	60.3570	54.7228	49.9373	56.0725	58.2550	64.6349	71.8395	75.0669	(72)
Total internal gains													
	575.3680	570.7839	548.6018	514.2792	479.1507	447.7638	429.4986	438.0391	457.8674	492.4053	530.7352	559.7153	(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	
North	7.6300	10.6334	0.6300	0.7000	0.7700	24.7952	(74)
South	5.5500	46.7521	0.6300	0.7000	0.7700	79.2986	(78)

Solar gains	104.0938	177.2557	245.9509	316.3079	369.0630	374.0180	357.3375	316.0693	269.6230	196.4833	124.5840	89.1918	(83)
Total gains	679.4618	748.0396	794.5526	830.5871	848.2136	821.7818	786.8362	754.1085	727.4904	688.8886	655.3192	648.9071	(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	35.1021	35.1900	35.2766	35.6890	35.7673	36.1361	36.1361	36.2052	35.9931	35.7673	35.6093	35.4457	
alpha	3.3401	3.3460	3.3518	3.3793	3.3845	3.4091	3.4091	3.4137	3.3995	3.3845	3.3740	3.3630	
util living area													
	0.9679	0.9541	0.9301	0.8807	0.7903	0.6450	0.4995	0.5360	0.7315	0.8894	0.9519	0.9720	(86)
MIT	19.3923	19.5873	19.8920	20.2856	20.6337	20.8724	20.9600	20.9484	20.7927	20.3625	19.8149	19.3529	(87)
Th 2	19.9479	19.9503	19.9526	19.9634	19.9654	19.9749	19.9749	19.9766	19.9712	19.9654	19.9613	19.9570	(88)
util rest of house													
	0.9617	0.9454	0.9163	0.8558	0.7444	0.5673	0.3950	0.4321	0.6622	0.8614	0.9412	0.9666	(89)
MIT 2	18.5031	18.6960	18.9949	19.3800	19.6993	19.9028	19.9599	19.9558	19.8431	19.4607	18.9307	18.4714	(90)
Living area fraction									fLA = Living area / (4) =			0.1765	(91)
MIT	18.6601	18.8533	19.1533	19.5399	19.8643	20.0740	20.1364	20.1311	20.0107	19.6199	19.0868	18.6270	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6601	18.8533	19.1533	19.5399	19.8643	20.0740	20.1364	20.1311	20.0107	19.6199	19.0868	18.6270	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9520	0.9340	0.9035	0.8439	0.7394	0.5754	0.4123	0.4486	0.6651	0.8503	0.9299	0.9576	(94)
Useful gains	646.8334	698.6323	717.8694	700.9522	627.1726	472.8270	324.3824	338.3201	483.8563	585.7389	609.3657	621.4104	(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													
	1400.8477	1357.7689	1228.2427	1020.8673	781.6228	518.7176	335.1139	352.8821	562.3238	863.5417	1152.6729	1393.7308	(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													
	560.9867	442.9398	379.7178	230.3388	114.9109	0.0000	0.0000	0.0000	0.0000	206.6853	391.1812	574.6064	(98)
Space heating												2901.3669	(98)
Space heating per m2											(98) / (4) =	34.6556	(99)

8c. Space cooling requirement

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	3198.8610	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	560.9867	442.9398	379.7178	230.3388	114.9109	0.0000	0.0000	0.0000	0.0000	206.6853	391.1812	574.6064	(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)													
	618.5079	488.3570	418.6525	253.9568	126.6934	0.0000	0.0000	0.0000	0.0000	227.8780	431.2913	633.5241	(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													
	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.8274	89.7556	89.6147	89.3127	88.7357	87.2000	87.2000	87.2000	87.2000	89.1894	89.6479	89.8607	(217)
Fuel for water heating, kWh/month													
	199.3973	175.3385	183.0913	162.8251	159.2425	142.8173	135.2910	151.0462	151.5999	169.1785	180.3011	193.9089	(219)
Water heating fuel used												2004.0376	(219)
Annual totals kWh/year													
Space heating fuel - main system												3198.8610	(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)												374.1328	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.90 * 853 * 1.00) =										-614.1815		-614.1815	(233)
Total delivered energy for all uses												5037.8498	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3198.8610	3.4800	111.3204	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2004.0376	3.4800	69.7405	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	374.1328	13.1900	49.3481	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-614.1815	13.1900	-81.0105	(252)
Total energy cost			279.2909	(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] =	0.9113	(257)
SAP value		87.2874	
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	3198.8610	0.2160	690.9540	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2004.0376	0.2160	432.8721	(264)
Space and water heating			1123.8261	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	374.1328	0.5190	194.1749	(268)
Energy saving/generation technologies				
PV Unit	-614.1815	0.5190	-318.7602	(269)
Total kg/year			1038.1658	(272)
CO2 emissions per m2			12.4000	(273)
EI value			89.1925	
EI rating			89	(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 / 0.8873 = 3.922, stars = 4
Water heating environmental impact	0.216 / 0.8873 = 0.2434, 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	41.8600	(1b)	x 2.3900	(2b) =	100.0454	(1b) - (3b)
First floor	41.8600	(1c)	x 2.6100	(2c) =	109.2546	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.7200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	209.3000	(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) =	0.1433	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3933	(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) =	0.3343	(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	0.4263	0.3928	0.3845	0.3594	0.3594	0.3343	0.3343	0.3260	0.3343	0.3761	0.3678	0.3928	(22b)
Effective ac	0.5909	0.5772	0.5739	0.5646	0.5646	0.5559	0.5559	0.5531	0.5559	0.5707	0.5676	0.5772	(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			2.1200	1.1000	2.3320			(26)
Windows & Fully Glazed Do (Uw = 1.20)			13.1800	1.1450	15.0916			(27)
Ground Floor			41.8600	0.1200	5.0232	90.0000	3767.4000	(28a)
Brick and Block	96.4600	15.3000	81.1600	0.2400	19.4784	42.2200	3426.5752	(29a)
External Roof 1	40.5500		40.5500	0.1000	4.0550	9.1000	369.0050	(30)
Skeillins	7.4900		7.4900	0.1700	1.2733	9.1000	68.1590	(30)
Total net area of external elements Aum(A, m2)			186.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.2535			(33)
Party Wall 1			37.8900	0.0000	0.0000	45.0000	1705.0500	(32)
GF Timber Stud			73.5500			9.0000	661.9500	(32c)
FF Timber Stud			91.3600			9.0000	822.2400	(32c)
Internal Floor 1			41.8600			18.0000	753.4800	(32d)
Internal Ceiling 1			41.8600			18.0000	753.4800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12327.3392 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.2449 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.4882 (36)
Total fabric heat loss	(33) + (36) =	56.7417 (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	40.8098	39.8641	39.6397	38.9955	38.9955	38.3948	38.3948	38.2042	38.3948	39.4201	39.2054	39.8641	(38)
Heat transfer coeff	97.5516	96.6058	96.3814	95.7372	95.7372	95.1365	95.1365	94.9459	95.1365	96.1619	95.9471	96.6058	(39)
Average = Sum(39)m / 12 =												95.9236	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1652	1.1539	1.1512	1.1435	1.1435	1.1364	1.1364	1.1341	1.1364	1.1486	1.1460	1.1539	(40)
HLP (average)												1.1458	(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		2.5297 (42)
Average daily hot water use (litres/day)		94.2796 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.7075	99.9363	96.1652	92.3940	88.6228	84.8516	84.8516	88.6228	92.3940	96.1652	99.9363	103.7075	(44)
Energy conte	153.7953	134.5103	138.8026	121.0115	116.1134	100.1970	92.8473	106.5436	107.8161	125.6492	137.1560	148.9425	(45)

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

Energy content (annual) Total = Sum(45)m = 1483.3847 (45)
Distribution loss (46)m = 0.15 x (45)m

	23.0693	20.1765	20.8204	18.1517	17.4170	15.0296	13.9271	15.9815	16.1724	18.8474	20.5734	22.3414 (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	25.3182	22.8657	25.2742	24.4120	25.1916	24.3397	25.1265	25.1687	24.3791	25.2400	24.4802	25.3055 (61)

Total heat required for water heating calculated for each month

	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h

	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480 (64)

Total per year (kWh/year) = Sum(64)m = 1780.4860 (64)
Heat gains from water heating, kWh/month

	57.4665	50.4411	52.4704	46.3393	44.9056	39.4004	37.1533	41.7179	41.9436	48.0884	51.7244	55.8497 (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	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	(66)

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

	52.9624	47.0407	38.2561	28.9623	21.6497	18.2776	19.7495	25.6712	34.4558	43.7496	51.0623	54.4344 (67)

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

	338.8647	342.3811	333.5200	314.6557	290.8430	268.4624	253.5108	249.9945	258.8556	277.7198	301.5325	323.9131 (68)

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

	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077 (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)

	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866 (71)

Water heating gains (Table 5)

	77.2399	75.0612	70.5247	64.3602	60.3570	54.7228	49.9373	56.0725	58.2550	64.6349	71.8395	75.0669 (72)
Total internal gains												
	575.3680	570.7839	548.6018	514.2792	479.1507	447.7638	429.4986	438.0391	457.8674	492.4053	530.7352	559.7153 (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	
North	7.6300	13.8645	0.6300	0.7000	0.7700	32.3297	(74)
South	5.5500	58.2505	0.6300	0.7000	0.7700	98.8017	(78)

Solar gains	131.1315	191.1771	265.4777	351.2775	394.6619	434.1451	404.3566	363.0460	309.7797	224.5201	155.5595	107.2699 (83)
Total gains	706.4994	761.9611	814.0795	865.5567	873.8125	881.9089	833.8552	801.0852	767.6471	716.9254	686.2947	666.9853 (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	35.1021	35.4457	35.5282	35.7673	35.7673	35.9931	35.9931	36.0654	35.9931	35.6093	35.6890	35.4457	
alpha	3.3401	3.3630	3.3685	3.3845	3.3845	3.3995	3.3995	3.4044	3.3995	3.3740	3.3793	3.3630	
util living area													
	0.9572	0.9447	0.9145	0.8520	0.7389	0.5557	0.4088	0.4232	0.6480	0.8449	0.9304	0.9624	(86)
MIT	19.6007	19.7414	20.0432	20.4109	20.7361	20.9288	20.9815	20.9796	20.8776	20.5362	20.0511	19.5799	(87)
Th 2	19.9479	19.9570	19.9592	19.9654	19.9654	19.9712	19.9712	19.9731	19.9712	19.9613	19.9634	19.9570	(88)
util rest of house													
	0.9486	0.9340	0.8973	0.8216	0.6833	0.4695	0.3010	0.3125	0.5644	0.8049	0.9143	0.9547	(89)
MIT 2	18.7085	18.8521	19.1459	19.4973	19.7855	19.9365	19.9660	19.9673	19.9050	19.6160	19.1616	18.6957	(90)
Living area fraction									fLA = Living area / (4) =			0.1765	(91)
MIT	18.8660	19.0091	19.3043	19.6586	19.9533	20.1117	20.1453	20.1460	20.0767	19.7785	19.3186	18.8518	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8660	19.0091	19.3043	19.6586	19.9533	20.1117	20.1453	20.1460	20.0767	19.7785	19.3186	18.8518	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9375	0.9219	0.8844	0.8112	0.6826	0.4819	0.3198	0.3317	0.5737	0.7968	0.9020	0.9443	(94)
Useful gains	662.3738	702.4627	719.9828	702.1590	596.4553	424.9794	266.6737	265.7487	440.3628	571.2412	619.0630	629.8433	(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													
	1313.6255	1285.7352	1156.9890	962.9786	703.9894	448.2501	270.6919	270.2145	482.9815	767.2251	1047.6114	1289.8585	(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													
	484.5313	391.9592	325.1327	187.7902	80.0054	0.0000	0.0000	0.0000	0.0000	145.8121	308.5548	491.0513	(98)
Space heating												2414.8367	(98)
Space heating per m2										(98) / (4) =		28.8442	(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												2662.4440	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	484.5313	391.9592	325.1327	187.7902	80.0054	0.0000	0.0000	0.0000	0.0000	145.8121	308.5548	491.0513	(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)													
	534.2131	432.1490	358.4704	207.0454	88.2088	0.0000	0.0000	0.0000	0.0000	160.7630	340.1927	541.4016	(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													
	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.7280	89.6689	89.4952	89.1385	88.4337	87.2000	87.2000	87.2000	87.2000	88.8856	89.4656	89.7564	(217)
Fuel for water heating, kWh/month													
	199.6183	175.5079	183.3358	163.1432	159.7864	142.8173	135.2910	151.0462	151.5999	169.7566	180.6686	194.1342	(219)
Water heating fuel used												2006.7054	(219)
Annual totals kWh/year													
Space heating fuel - main system												2662.4440	(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)												374.1328	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.90 * 989 * 1.00) =										-711.8164		-711.8164	(233)
Total delivered energy for all uses												4406.4658	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2662.4440	9.7400	259.3220	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2006.7054	9.7400	195.4531	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	374.1328	36.8500	137.8679	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-711.8164	36.8500	-262.3044	(252)
Total energy cost			461.9762	(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	2662.4440	0.2160	575.0879	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2006.7054	0.2160	433.4484	(264)
Space and water heating			1008.5363	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	374.1328	0.5190	194.1749	(268)
Energy saving/generation technologies				
PV Unit	-711.8164	0.5190	-369.4327	(269)
Total kg/year			872.2035	(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	2662.4440	1.2200	3248.1817	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2006.7054	1.2200	2448.1806	(264)
Space and water heating			5696.3623	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	374.1328	3.0700	1148.5876	(268)
Energy saving/generation technologies				
PV Unit	-711.8164	3.0700	-2185.2764	(269)
Primary energy kWh/year			4889.9236	(272)
Primary energy kWh/m2/year			58.4081	(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 89

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 80	-192 kg (22.1%)

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£80	2.30 kg/m²	B 89	B 91
Total Savings	£80	2.30 kg/m²		

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

Fuel prices for cost data on this page from database revision number 513 TEST (28 Feb 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£166	£184	-£18
Mains gas	£559	£460	£98
Space heating	£391	£391	£0
Water heating	£195	£115	£80
Lighting	£138	£138	£0
Generated (PV)	-£262	-£262	£0
Total cost of fuels	£463	£382	£80
Total cost of uses	£462	£382	£80
Delivered energy	53 kWh/m²	41 kWh/m²	11 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	58 kWh/m²	46 kWh/m²	13 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	41.8600	(1b)	x 2.3900	(2b) =	100.0454	(1b) - (3b)
First floor	41.8600	(1c)	x 2.6100	(2c) =	109.2546	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		209.3000	(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) =	0.1433	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3933	(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) =		0.3343	(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	0.4263	0.4179	0.4096	0.3678	0.3594	0.3176	0.3176	0.3093	0.3343	0.3594	0.3761	0.3928	(22b)
Effective ac	0.5909	0.5873	0.5839	0.5676	0.5646	0.5504	0.5504	0.5478	0.5559	0.5646	0.5707	0.5772	(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			2.1200	1.1000	2.3320			(26)
Windows & Fully Glazed Do (Uw = 1.20)			13.1800	1.1450	15.0916			(27)
Ground Floor			41.8600	0.1200	5.0232	90.0000	3767.4000	(28a)
Brick and Block	96.4600	15.3000	81.1600	0.2400	19.4784	42.2200	3426.5752	(29a)
External Roof 1	40.5500		40.5500	0.1000	4.0550	9.1000	369.0050	(30)
Skeillins	7.4900		7.4900	0.1700	1.2733	9.1000	68.1590	(30)
Total net area of external elements Aum(A, m2)			186.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.2535			(33)
Party Wall 1			37.8900	0.0000	0.0000	45.0000	1705.0500	(32)
GF Timber Stud			73.5500			9.0000	661.9500	(32c)
FF Timber Stud			91.3600			9.0000	822.2400	(32c)
Internal Floor 1			41.8600			18.0000	753.4800	(32d)
Internal Ceiling 1			41.8600			18.0000	753.4800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12327.3392 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.2449 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.4882 (36)
Total fabric heat loss	(33) + (36) =	56.7417 (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	40.8098	40.5661	40.3273	39.2054	38.9955	38.0184	38.0184	37.8374	38.3948	38.9955	39.4201	39.8641	(38)
Heat transfer coeff	97.5516	97.3079	97.0690	95.9471	95.7372	94.7601	94.7601	94.5792	95.1365	95.7372	96.1619	96.6058	(39)
Average = Sum(39)m / 12 =												95.9461	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1652	1.1623	1.1594	1.1460	1.1435	1.1319	1.1319	1.1297	1.1364	1.1435	1.1486	1.1539	(40)
HLP (average)												1.1460	(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		2.5297 (42)
Average daily hot water use (litres/day)		94.2796 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.7075	99.9363	96.1652	92.3940	88.6228	84.8516	84.8516	88.6228	92.3940	96.1652	99.9363	103.7075	(44)
Energy conte	153.7953	134.5103	138.8026	121.0115	116.1134	100.1970	92.8473	106.5436	107.8161	125.6492	137.1560	148.9425	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1483.3847 (45)

Distribution loss (46)m = 0.15 x (45)m													
	23.0693	20.1765	20.8204	18.1517	17.4170	15.0296	13.9271	15.9815	16.1724	18.8474	20.5734	22.3414	(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	25.3182	22.8657	25.2742	24.4120	25.1916	24.3397	25.1265	25.1687	24.3791	25.2400	24.4802	25.3055	(61)
Total heat required for water heating calculated for each month													
	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480	(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	1.2226	(H8)
Utilisation factor	0.5587	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	94.2796	(H14)
Volume ratio Veff/V	0.7955	(H15)
Solar storage volume factor	0.9542	(H16)
Solar input	-850.1136	(H17)

Solar input	-24.6516	-41.1364	-70.0601	-93.8943	-115.9985	-114.0450	-112.5378	-98.3249	-77.0081	-52.5875	-29.2403	-20.6292	(63)

Solar input (sum of months) = Sum(63)m = -850.1136 (63)

Output from w/h													
	154.4619	116.2396	94.0167	51.5292	25.3065	10.4917	5.4359	33.3874	55.1870	98.3018	132.3958	153.6188	(64)

Total per year (kWh/year) = Sum(64)m = 930.3723 (64)

Heat gains from water heating, kWh/month													
	57.4665	50.4411	52.4704	46.3393	44.9056	39.4004	37.1533	41.7179	41.9436	48.0884	51.7244	55.8497	(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	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.9624	47.0407	38.2561	28.9623	21.6497	18.2776	19.7495	25.6712	34.4558	43.7496	51.0623	54.4344	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	338.8647	342.3811	333.5200	314.6557	290.8430	268.4624	253.5108	249.9945	258.8556	277.7198	301.5325	323.9131	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	(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)													
	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	(71)
Water heating gains (Table 5)													
	77.2399	75.0612	70.5247	64.3602	60.3570	54.7228	49.9373	56.0725	58.2550	64.6349	71.8395	75.0669	(72)
Total internal gains													
	575.3680	570.7839	548.6018	514.2792	479.1507	447.7638	429.4986	438.0391	457.8674	492.4053	530.7352	559.7153	(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	
North	7.6300	10.6334	0.6300	0.7000	0.7700	24.7952	(74)
South	5.5500	46.7521	0.6300	0.7000	0.7700	79.2986	(78)

Solar gains	104.0938	177.2557	245.9509	316.3079	369.0630	374.0180	357.3375	316.0693	269.6230	196.4833	124.5840	89.1918	(83)
Total gains	679.4618	748.0396	794.5526	830.5871	848.2136	821.7818	786.8362	754.1085	727.4904	688.8886	655.3192	648.9071	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.1021	35.1900	35.2766	35.6890	35.7673	36.1361	36.1361	36.2052	35.9931	35.7673	35.6093	35.4457	
alpha	3.3401	3.3460	3.3518	3.3793	3.3845	3.4091	3.4091	3.4137	3.3995	3.3845	3.3740	3.3630	
util living area													
	0.9679	0.9541	0.9301	0.8807	0.7903	0.6450	0.4995	0.5360	0.7315	0.8894	0.9519	0.9720	(86)
MIT	19.3923	19.5873	19.8920	20.2856	20.6337	20.8724	20.9600	20.9484	20.7927	20.3625	19.8149	19.3529	(87)
Th 2	19.9479	19.9503	19.9526	19.9634	19.9654	19.9749	19.9749	19.9766	19.9712	19.9654	19.9613	19.9570	(88)
util rest of house													
	0.9617	0.9454	0.9163	0.8558	0.7444	0.5673	0.3950	0.4321	0.6622	0.8614	0.9412	0.9666	(89)
MIT 2	18.5031	18.6960	18.9949	19.3800	19.6993	19.9028	19.9599	19.9558	19.8431	19.4607	18.9307	18.4714	(90)

Living area fraction fLA = Living area / (4) = 0.1765 (91)

MIT	18.6601	18.8533	19.1533	19.5399	19.8643	20.0740	20.1364	20.1311	20.0107	19.6199	19.0868	18.6270	(92)

Temperature adjustment 0.0000

adjusted MIT	18.6601	18.8533	19.1533	19.5399	19.8643	20.0740	20.1364	20.1311	20.0107	19.6199	19.0868	18.6270	(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	0.9520	0.9340	0.9035	0.8439	0.7394	0.5754	0.4123	0.4486	0.6651	0.8503	0.9299	0.9576	(94)
Useful gains	646.8334	698.6323	717.8694	700.9522	627.1726	472.8270	324.3824	338.3201	483.8563	585.7389	609.3657	621.4104	(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													
	1400.8477	1357.7689	1228.2427	1020.8673	781.6228	518.7176	335.1139	352.8821	562.3238	863.5417	1152.6729	1393.7308	(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													
	560.9867	442.9398	379.7178	230.3388	114.9109	0.0000	0.0000	0.0000	0.0000	206.6853	391.1812	574.6064	(98)
Space heating												2901.3669	(98)
Space heating per m2											(98) / (4) =	34.6556	(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	3198.8610	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	560.9867	442.9398	379.7178	230.3388	114.9109	0.0000	0.0000	0.0000	0.0000	206.6853	391.1812	574.6064	(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)													
	618.5079	488.3570	418.6525	253.9568	126.6934	0.0000	0.0000	0.0000	0.0000	227.8780	431.2913	633.5241	(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													
	154.4619	116.2396	94.0167	51.5292	25.3065	10.4917	5.4359	33.3874	55.1870	98.3018	132.3958	153.6188	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.9208	89.9495	89.9832	90.0393	90.0477	87.2000	87.2000	87.2000	87.2000	89.5416	89.7887	89.9385	(217)
Fuel for water heating, kWh/month													
	171.7755	129.2276	104.4825	57.2296	28.1035	12.0318	6.2339	38.2884	63.2879	109.7834	147.4527	170.8043	(219)
Water heating fuel used												1038.7008	(219)
Annual totals kWh/year													
Space heating fuel - main system												3198.8610	(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)												374.1328	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.90 * 853 * 1.00) =										-614.1815		-614.1815	(233)
Total delivered energy for all uses												4122.5130	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3198.8610	3.4800	111.3204	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1038.7008	3.4800	36.1468	(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	374.1328	13.1900	49.3481	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-614.1815	13.1900	-81.0105	(252)
Total energy cost			252.2922	(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] =	0.8232	(257)
SAP value	88.5163	
SAP rating (Section 12)	89	(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	3198.8610	0.2160	690.9540	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1038.7008	0.2160	224.3594	(264)
Space and water heating			915.3133	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	374.1328	0.5190	194.1749	(268)
Energy saving/generation technologies				
PV Unit	-614.1815	0.5190	-318.7602	(269)
Total kg/year			855.6030	(272)
CO2 emissions per m2			10.2200	(273)
EI value			91.0930	
EI rating			91	(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	41.8600	(1b)	x 2.3900	(2b) =	100.0454	(1b) - (3b)
First floor	41.8600	(1c)	x 2.6100	(2c) =	109.2546	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		209.3000	(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) =	0.1433	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3933	(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) =	0.3343	(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	0.4263	0.3928	0.3845	0.3594	0.3594	0.3343	0.3343	0.3260	0.3343	0.3761	0.3678	0.3928	(22b)
Effective ac	0.5909	0.5772	0.5739	0.5646	0.5646	0.5559	0.5559	0.5531	0.5559	0.5707	0.5676	0.5772	(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			2.1200	1.1000	2.3320			(26)
Windows & Fully Glazed Do (Uw = 1.20)			13.1800	1.1450	15.0916			(27)
Ground Floor			41.8600	0.1200	5.0232	90.0000	3767.4000	(28a)
Brick and Block	96.4600	15.3000	81.1600	0.2400	19.4784	42.2200	3426.5752	(29a)
External Roof 1	40.5500		40.5500	0.1000	4.0550	9.1000	369.0050	(30)
Skeillins	7.4900		7.4900	0.1700	1.2733	9.1000	68.1590	(30)
Total net area of external elements Aum(A, m2)			186.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.2535			(33)
Party Wall 1			37.8900	0.0000	0.0000	45.0000	1705.0500	(32)
GF Timber Stud			73.5500			9.0000	661.9500	(32c)
FF Timber Stud			91.3600			9.0000	822.2400	(32c)
Internal Floor 1			41.8600			18.0000	753.4800	(32d)
Internal Ceiling 1			41.8600			18.0000	753.4800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12327.3392 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.2449 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.4882 (36)
Total fabric heat loss	(33) + (36) =	56.7417 (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	40.8098	39.8641	39.6397	38.9955	38.9955	38.3948	38.3948	38.2042	38.3948	39.4201	39.2054	39.8641	(38)
Heat transfer coeff	97.5516	96.6058	96.3814	95.7372	95.7372	95.1365	95.1365	94.9459	95.1365	96.1619	95.9471	96.6058	(39)
Average = Sum(39)m / 12 =												95.9236	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1652	1.1539	1.1512	1.1435	1.1435	1.1364	1.1364	1.1341	1.1364	1.1486	1.1460	1.1539	(40)
HLP (average)												1.1458	(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		2.5297 (42)
Average daily hot water use (litres/day)		94.2796 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.7075	99.9363	96.1652	92.3940	88.6228	84.8516	84.8516	88.6228	92.3940	96.1652	99.9363	103.7075	(44)
Energy conte	153.7953	134.5103	138.8026	121.0115	116.1134	100.1970	92.8473	106.5436	107.8161	125.6492	137.1560	148.9425	(45)

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

Energy content (annual) Total = Sum(45)m = 1483.3847 (45)

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Distribution loss (46)m = 0.15 x (45)m	23.0693	20.1765	20.8204	18.1517	17.4170	15.0296	13.9271	15.9815	16.1724	18.8474	20.5734	22.3414	(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	25.3182	22.8657	25.2742	24.4120	25.1916	24.3397	25.1265	25.1687	24.3791	25.2400	24.4802	25.3055	(61)
Total heat required for water heating calculated for each month	179.1135	157.3760	164.0768	145.4235	141.3050	124.5367	117.9738	131.7123	132.1951	150.8892	161.6362	174.2480	(62)

Item	Value	Ref
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	1.3981	(H8)
Utilisation factor	0.5109	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	94.2796	(H14)
Volume ratio Veff/V	0.7955	(H15)
Solar storage volume factor	0.9542	(H16)
Solar input	-889.0959	(H17)

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Solar input	-29.1772	-41.6514	-70.5920	-96.3271	-113.6871	-120.9845	-116.5179	-103.9493	-82.2698	-56.3299	-34.3037	-23.3061	(63)
Output from w/h	149.9363	115.7247	93.4848	49.0963	27.6179	3.5522	1.4559	27.7630	49.9254	94.5593	127.3325	150.9419	(64)
Heat gains from water heating, kWh/month	57.4665	50.4411	52.4704	46.3393	44.9056	39.4004	37.1533	41.7179	41.9436	48.0884	51.7244	55.8497	(65)

Solar input (sum of months) = Sum(63)m = -889.0959 (63)

Total per year (kWh/year) = Sum(64)m = 891.3901 (64)

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

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Metabolic gains (Table 5), Watts (66)m	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	151.7800	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.9624	47.0407	38.2561	28.9623	21.6497	18.2776	19.7495	25.6712	34.4558	43.7496	51.0623	54.4344	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	338.8647	342.3811	333.5200	314.6557	290.8430	268.4624	253.5108	249.9945	258.8556	277.7198	301.5325	323.9131	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	52.7077	(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)	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	-101.1866	(71)
Water heating gains (Table 5)	77.2399	75.0612	70.5247	64.3602	60.3570	54.7228	49.9373	56.0725	58.2550	64.6349	71.8395	75.0669	(72)
Total internal gains	575.3680	570.7839	548.6018	514.2792	479.1507	447.7638	429.4986	438.0391	457.8674	492.4053	530.7352	559.7153	(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	Ref
North	7.6300	13.8645	0.6300	0.7000	0.7700	32.3297	(74)
South	5.5500	58.2505	0.6300	0.7000	0.7700	98.8017	(78)

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Solar gains	131.1315	191.1771	265.4777	351.2775	394.6619	434.1451	404.3566	363.0460	309.7797	224.5201	155.5595	107.2699	(83)
Total gains	706.4994	761.9611	814.0795	865.5567	873.8125	881.9089	833.8552	801.0852	767.6471	716.9254	686.2947	666.9853	(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)

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
tau	35.1021	35.4457	35.5282	35.7673	35.7673	35.9931	35.9931	36.0654	35.9931	35.6093	35.6890	35.4457	
alpha	3.3401	3.3630	3.3685	3.3845	3.3845	3.3995	3.3995	3.4044	3.3995	3.3740	3.3793	3.3630	
util living area	0.9572	0.9447	0.9145	0.8520	0.7389	0.5557	0.4088	0.4232	0.6480	0.8449	0.9304	0.9624	(86)
MIT	19.6007	19.7414	20.0432	20.4109	20.7361	20.9288	20.9815	20.9796	20.8776	20.5362	20.0511	19.5799	(87)
Th 2	19.9479	19.9570	19.9592	19.9654	19.9654	19.9712	19.9712	19.9731	19.9712	19.9613	19.9634	19.9570	(88)
util rest of house	0.9486	0.9340	0.8973	0.8216	0.6833	0.4695	0.3010	0.3125	0.5644	0.8049	0.9143	0.9547	(89)
MIT 2	18.7085	18.8521	19.1459	19.4973	19.7855	19.9365	19.9660	19.9673	19.9050	19.6160	19.1616	18.6957	(90)
MIT	18.8660	19.0091	19.3043	19.6586	19.9533	20.1117	20.1453	20.1460	20.0767	19.7785	19.3186	18.8518	(92)
adjusted MIT	18.8660	19.0091	19.3043	19.6586	19.9533	20.1117	20.1453	20.1460	20.0767	19.7785	19.3186	18.8518	(93)

Living area fraction fLA = Living area / (4) = 0.1765 (91)

Temperature adjustment 0.0000

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	0.9375	0.9219	0.8844	0.8112	0.6826	0.4819	0.3198	0.3317	0.5737	0.7968	0.9020	0.9443	(94)
Useful gains	662.3738	702.4627	719.9828	702.1590	596.4553	424.9794	266.6737	265.7487	440.3628	571.2412	619.0630	629.8433	(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	1313.6255	1285.7352	1156.9890	962.9786	703.9894	448.2501	270.6919	270.2145	482.9815	767.2251	1047.6114	1289.8585	(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	484.5313	391.9592	325.1327	187.7902	80.0054	0.0000	0.0000	0.0000	0.0000	145.8121	308.5548	491.0513	(98)
Space heating												2414.8367	(98)
Space heating per m2											(98) / (4) =	28.8442	(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	2662.4440	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	484.5313	391.9592	325.1327	187.7902	80.0054	0.0000	0.0000	0.0000	0.0000	145.8121	308.5548	491.0513	(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)	534.2131	432.1490	358.4704	207.0454	88.2088	0.0000	0.0000	0.0000	0.0000	160.7630	340.1927	541.4016	(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	149.9363	115.7247	93.4848	49.0963	27.6179	3.5522	1.4559	27.7630	49.9254	94.5593	127.3325	150.9419	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.8478	89.8777	89.8942	89.9517	89.7753	87.2000	87.2000	87.2000	87.2000	89.2901	89.6489	89.8521	(217)
Fuel for water heating, kWh/month	166.8781	128.7579	103.9942	54.5807	30.7634	4.0736	1.6696	31.8384	57.2539	105.9012	142.0347	167.9893	(219)
Water heating fuel used												995.7350	(219)
Annual totals kWh/year													
Space heating fuel - main system												2662.4440	(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)												374.1328	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.90 * 989 * 1.00) =										-711.8164		-711.8164	(233)
Total delivered energy for all uses												3445.4954	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2662.4440	9.7400	259.3220	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	995.7350	9.7400	96.9846	(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	374.1328	36.8500	137.8679	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-711.8164	36.8500	-262.3044	(252)
Total energy cost			381.9327	(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	2662.4440	0.2160	575.0879	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	995.7350	0.2160	215.0788	(264)
Space and water heating			790.1667	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	374.1328	0.5190	194.1749	(268)
Energy saving/generation technologies				
PV Unit	-711.8164	0.5190	-369.4327	(269)
Total kg/year			679.7839	(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	2662.4440	1.2200	3248.1817	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	995.7350	1.2200	1214.7967	(264)
Space and water heating			4462.9784	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	374.1328	3.0700	1148.5876	(268)
Energy saving/generation technologies				
PV Unit	-711.8164	3.0700	-2185.2764	(269)
Primary energy kWh/year			3810.0396	(272)
Primary energy kWh/m2/year			45.5093	(273)

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 102	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Melbourne V1
Project	Plot 102		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	14.16	**TER**	18.61
Environmental	89 B	**% DER<TER**	23.91		
CO_2 Emissions (t/year)	0.87	**DFEE**	44.96	**TFEE**	53.84
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.48		

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 102	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Melbourne V1
Project	Plot 102		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	14.16	**TER**	18.61
Environmental	89 B	**% DER<TER**	23.91		
CO_2 Emissions (t/year)	0.87	**DFEE**	44.96	**TFEE**	53.84
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.48		

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 000005 - Insulation between and below

Roof Type: Pitched Roof, insulated sloping 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	**Tiling**						
	Main construction	30	1.5000	0.0200	100.00		
Layer 2	**airspace/timber battens**						
	Main construction	25	0.2500	0.1000	91.59		
	Main construction	25	0.1563	0.1600	8.41		
	Corrections - Cavity Unventilated, Emissivity: Normal						
Layer 3	**Breather membrane**						
	Main construction	1	0.0000	0.0000	100.00		
Layer 4	**Standard cavity**						
	Main construction	50	0.2948	0.1696	87.50		
	Main construction	50	0.1300	0.3846	12.50		
	Corrections - Cavity Unventilated, Emissivity: Low Emissivity (BR443)						
Layer 5	**Celotex GA4000**						
	Main construction	100	0.0220	4.5455	87.50		
	Main construction	100	0.1300	0.7692	12.50		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 6	**Celotex GA4000**						
	Main construction	50	0.0220	2.2727	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 7	**Plasterboard, standard**						
	Main construction	12.5	0.2100	0.0595	100.00	700	1000
Int surface				0.1000			

Total resistance: **Upper limit =** 6.480 m² K/W **Lower limit =** 5.595 m² K/W **Average =** 6.037 m² K/W

Total correction = 0.0036 m² K/W **U-value (unrounded) =** 0.17 W/m² K

Unheated space: None

Total thickness: 269 mm **U-value: 0.17 W/m² K** **Kappa: 9.10 kJ/m² K**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 102	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Melbourne V1
Project	Plot 102		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	14.16	**TER**	18.61
Environmental	89 B	**% DER<TER**	23.91		
CO_2 Emissions (t/year)	0.87	**DFEE**	44.96	**TFEE**	53.84
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.48		

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 102	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Melbourne V1
Project	Plot 102		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	14.16	**TER**	18.61
Environmental	89 B	**% DER<TER**	23.91		
CO_2 Emissions (t/year)	0.87	**DFEE**	44.96	**TFEE**	53.84
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.48		

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 = 41.86 m², Perimeter = 18.51 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 102	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Melbourne V1
Property	Plot 102		

SAP Rating	87 B	**DER**	14.16	**TER**	18.61
Environmental	89 B	**% DER<TER**	23.91		
CO_2 Emissions (t/year)	0.87	**DFEE**	44.96	**TFEE**	53.84
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.48		

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	South
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Semi-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:	18.51 m	41.86 m²	2.39 m
1st Storey:	18.51 m	41.86 m²	2.61 m

7.0 Living Area	14.78	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	147.24	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	96.46	81.16

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Party Wall 1	Filled Cavity with Edge Sealing	Plasterboard on dabs mounted on cement render on both sides, AAC blocks, cavity	0.00	45.00	37.89

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
GF Timber Stud	Plasterboard on timber frame	9.00	73.55
FF Timber Stud	Plasterboard on timber frame	9.00	91.36

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	40.55	40.55
Skeillins	External Slope Roof	Other	0.17	9.10	7.49	7.49

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Ceiling 1	Plasterboard ceiling, carpeted chipboard floor	9.00	41.86

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	41.86

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Plasterboard ceiling, carpeted chipboard floor	18.00	41.86

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	South							2.12	
Front Elevation	Window	[1] Brick and Block	South	None	0.00					5.55	
Rear Elevation	Window	[1] Brick and Block	North	None	0.00					7.63	

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	0.110	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	0.69	0.077	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.02	0.071	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	3.74	0.064	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.59	0.067	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	3.62	0.064	No	Birtley Supatherm
Independently assessed	E3 Sill	8.50	0.021	No	Knauf P5
Independently assessed	E4 Jamb	24.32	0.016	No	Knauf P6
Table K1 - Approved	E5 Ground floor (normal)	18.51	0.160	No	
Independently assessed	E6 Intermediate floor within a dwelling	18.51	0.000	No	CD0029
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	8.05	0.060	No	
Independently assessed	E24 Eaves (insulation at ceiling level - inverted)	8.05	0.120	No	Value Halved
Independently assessed	E12 Gable (insulation at ceiling level)	9.86	0.044	No	Knauf P21
Independently assessed	E13 Gable (insulation at rafter level)	1.86	0.010	No	Knauf P20
Independently assessed	E16 Corner (normal)	10.60	0.039	No	Knauf P23
Table K1 - Approved	E18 Party wall between dwellings	9.40	0.060	No	
Table K1 - Default	P1 Party wall - Ground floor	8.05	0.160	No	
Table K1 - Default	P2 Party wall - Intermediate floor within a dwelling	8.05	0.000	No	
Independently assessed	P4 Party wall - Roof (insulation at ceiling level)	8.05	0.069	No	Knauf P29
Table K1 - Default	R6 Flat ceiling	8.05	0.060	No	

Y-value 0.051 W/m²K

18.0 Pressure Testing Yes

Designed AP_{50}	5.00	$m^3/(h.m^2)$ @ 50 Pa
Property Tested ?		
As Built AP_{50}		$m^3/(h.m^2)$ @ 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				3
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	17	
Total number of L.E.L. fittings	17	
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 Combi	
Percentage of Heat	100	%
Database Ref. No.	17513	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.7	
In Summer	87.2	
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
0.90	West	45°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£80	B 89	