elmhurst energy

SAP Report Submission for Building Regulations Compliance

Client: Foreman Homes

Project: Plot 165

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

EXCELLENCE IN ENERGY ASSESSMENT

PREDICTED ENERGY ASSESSMENT

Design SAP
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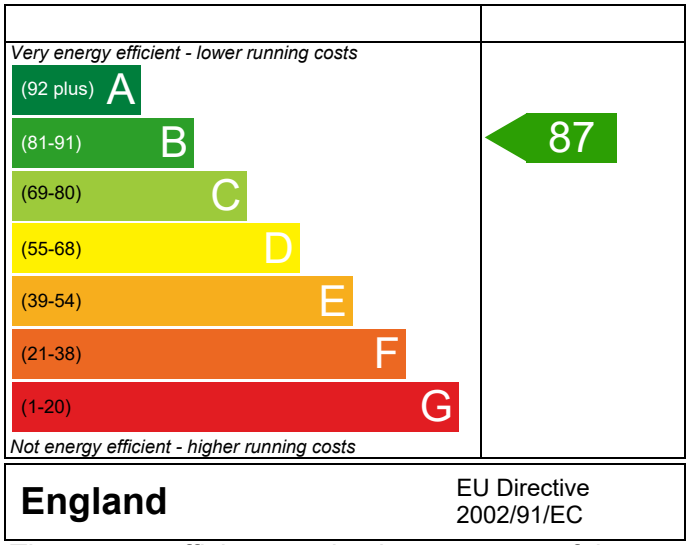
Plot 165

Dwelling type:	House, Detached
Date of assessment:	28/03/2023
Produced by:	Abacus Energy (UK) Ltd
Total floor area:	87.42 m²
DRRN:	8072-6778-7253

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.

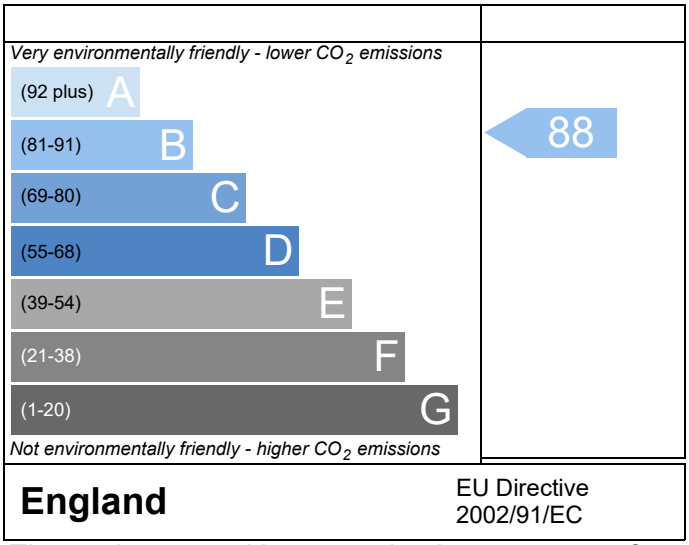
Energy Efficiency Rating



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
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Property Reference	SAP 0879 Plot 165	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Property	Plot 165		

SAP Rating	87 B	**DER**	15.30	**TER**	19.23
Environmental	88 B	**% DER<TER**	20.43		
CO_2 Emissions (t/year)	0.97	**DFEE**	53.14	**TFEE**	59.67
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.95		

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)	19.23	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	15.30	$kgCO_2/m^2$	Pass
	-3.93 (-20.4%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	59.67	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	53.14	$kWh/m^2/yr$	
	-6.6 (-11.1%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	Pass
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	Pass
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	Pass
Openings	1.19 (max. 2.00)	1.20 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	$m^3/(h.m^2)$ @ 50 Pa	
Maximum	10.0	$m^3/(h.m^2)$ @ 50 Pa	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Worcester Greenstar 36CDi Compact ErP Combi boiler Efficiency: 89.8% SEDBUK2009 Minimum: 88.0%		Pass
Secondary heating system	None		

5 Cylinder insulation

Hot water storage	No cylinder		

6 Controls

Space heating controls	Programmer, room thermostat and TRVs		Pass
Hot water controls	No cylinder		
Boiler interlock	Yes		Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Southern England)	Slight		Pass

Based on:

Overshading	Average		
Windows facing North East Windows facing South East Windows facing North West	2.62 m², No overhang 6.34 m², No overhang 10.85 m², No overhang		
Air change rate	4.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	$m^3/(h.m^2)$ @ 50 Pa	
Maximum	10.0	$m^3/(h.m^2)$ @ 50 Pa	Pass

10 Key features

Roof U-value	0.10	W/m^2K	
Floor U-value	0.12	W/m^2K	
Door U-value	1.10	W/m^2K	
Photovoltaic array	0.90	kW	

RECOMMENDATIONS

Design SAP
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	Typical cost	Typical savings per year	Energy efficiency	Environmental impact	Result
Low energy lights			0	0	Already installed
Solar water heating	£4,000 - £6,000	£80	B 88	B 90	Recommended
Photovoltaic			0	0	Already installed
Wind turbine			0	0	Not applicable
Totals	**£4,000 - £6,000**	**£80**	**B 88**	**B 90**	

THERMAL BRIDGING
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 165	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Property	Plot 165		

SAP Rating	87 B	**DER**	15.30	**TER**	19.23
Environmental	88 B	**% DER<TER**	20.43		
CO_2 Emissions (t/year)	0.97	**DFEE**	53.14	**TFEE**	59.67
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.95		

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

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.093	0.46	0.04	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.077	1.37	0.11	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.071	1.02	0.07	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.064	9.98	0.64	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.067	3.17	0.21	Birtley Supatherm
External wall	E3 Sill	Independently assessed	0.021	11.81	0.25	Knauf P5
External wall	E4 Jamb	Independently assessed	0.016	36.92	0.59	Knauf P6
External wall	E5 Ground floor (normal)	Table K1 - Default	0.320	26.86	8.60	
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.000	26.86	0.00	CD0029
External wall	E10 Eaves (insulation at ceiling level)	Table K1 - Approved	0.060	15.87	0.95	
External wall	E12 Gable (insulation at ceiling level)	Independently assessed	0.044	11.14	0.49	Knauf P21
External wall	E16 Corner (normal)	Independently assessed	0.039	19.99	0.78	Knauf P23

Total: 12.73 **W/mK:**

Y-Value: 0.057 **W/m²K:**

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

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 165	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Property	Plot 165		

SAP Rating	87 B	**DER**	15.30	**TER**	19.23
Environmental	88 B	**% DER<TER**	20.43		
CO_2 Emissions (t/year)	0.97	**DFEE**	53.14	**TFEE**	59.67
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.95		

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

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

DWELLING AS DESIGNED

Detached House, total floor area 87 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.23 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.30 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.1 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.19 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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

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

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Not applicable

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

10 Key features
Roof U-value 0.10 W/m²K
Floor U-value 0.12 W/m²K
Door U-value 1.10 W/m²K
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	43.7100	(1b)	x 2.3900	(2b) =	104.4669	(1b) - (3b)
First floor	43.7100	(1c)	x 2.6100	(2c) =	114.0831	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		218.5500	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1830	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4330	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3681	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3497	0.3497	0.3405	0.3681	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3505	1.3470	1.3308	1.3277	1.3136	1.3136	1.3109	1.3190	1.3277	1.3339	1.3403	(40)
HLP (average)												1.3307	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

	23.4126	20.4768	21.1302	18.4218	17.6762	15.2532	14.1343	16.2193	16.4131	19.1278	20.8795	22.6738 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	27.5604	24.8911	27.5367	26.6180	27.4831	26.5711	27.4409	27.4683	26.5966	27.5145	26.6571	27.5523 (61)

Total heat required for water heating calculated for each month

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

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

Output from w/h

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

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

Heat gains from water heating, kWh/month

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)

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

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

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

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

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

	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

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

Water heating gains (Table 5)

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

Total internal gains

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

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6200	11.2829	0.6300	0.7000	0.7700	9.0343	(75)
Southeast	6.3400	36.7938	0.6300	0.7000	0.7700	71.2912	(77)
Northwest	10.8500	11.2829	0.6300	0.7000	0.7700	37.4131	(81)

Solar gains	117.7387	215.9804	336.4933	485.6193	606.6291	629.8198	595.7370	501.2421	387.4709	249.7535	143.8334	98.9418 (83)
Total gains	516.7155	612.8425	719.1697	845.3410	942.9482	943.6251	894.9332	806.5634	704.5930	590.0489	510.7759	485.9594 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.1608	37.2579	37.3536	37.8094	37.8960	38.3041	38.3041	38.3806	38.1458	37.8960	37.7213	37.5405	
alpha	3.4774	3.4839	3.4902	3.5206	3.5264	3.5536	3.5536	3.5587	3.5431	3.5264	3.5148	3.5027	

util living area

	0.9930	0.9868	0.9711	0.9263	0.8285	0.6746	0.5298	0.5954	0.8246	0.9574	0.9881	0.9944 (86)

MIT	19.0811	19.2995	19.6750	20.1768	20.6067	20.8698	20.9588	20.9378	20.7164	20.1530	19.5301	19.0468 (87)
Th 2	19.7988	19.8015	19.8042	19.8168	19.8192	19.8302	19.8302	19.8323	19.8260	19.8192	19.8144	19.8094 (88)

util rest of house

	0.9912	0.9833	0.9632	0.9052	0.7788	0.5832	0.4037	0.4675	0.7539	0.9410	0.9844	0.9929 (89)
MIT 2	18.0651	18.2839	18.6566	19.1515	19.5449	19.7637	19.8174	19.8107	19.6554	19.1403	18.5240	18.0387 (90)

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

MIT	18.2690	18.4878	18.8610	19.3573	19.7581	19.9858	20.0466	20.0370	19.8684	19.3436	18.7260	18.2411 (92)

Temperature adjustment 0.0000

adjusted MIT	18.2690	18.4878	18.8610	19.3573	19.7581	19.9858	20.0466	20.0370	19.8684	19.3436	18.7260	18.2411 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9879	0.9781	0.9549	0.8951	0.7759	0.5965	0.4283	0.4917	0.7569	0.9324	0.9796	0.9901	(94)
Useful gains	510.4589	599.4060	686.7420	756.6290	731.6204	562.8529	383.3184	396.5922	533.3012	550.1323	500.3473	481.1590	(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

	1653.4418	1604.1260	1455.5618	1216.5475	935.2894	618.4609	395.7753	416.8121	665.1467	1014.8562	1355.6629	1645.1671	(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

	850.3793	675.1718	572.0020	331.1413	151.5297	0.0000	0.0000	0.0000	0.0000	345.7546	615.8272	866.0220	(98)

Space heating 4407.8279 (98)

Space heating per m2 (98) / (4) = 50.4213 (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												4859.7882	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	850.3793	675.1718	572.0020	331.1413	151.5297	0.0000	0.0000	0.0000	0.0000	345.7546	615.8272	866.0220	(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)													
	937.5737	744.4011	630.6527	365.0952	167.0669	0.0000	0.0000	0.0000	0.0000	381.2068	678.9716	954.8203	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(64)
Efficiency of water heater												87.9000	(216)
(217)m	90.1898	90.1460	90.0476	89.8104	89.3073	87.9000	87.9000	87.9000	87.9000	89.8143	90.0911	90.2085	(217)
Fuel for water heating, kWh/month													
	203.6197	179.0462	187.0174	166.3839	162.7238	145.9147	138.4183	154.2630	154.7406	172.6155	184.0958	198.1089	(219)
Water heating fuel used												2046.9477	(219)
Annual totals kWh/year													
Space heating fuel - main system												4859.7882	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												368.7383	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.90 * 1029 * 1.00) =										-741.0144		-741.0144	(233)
Total delivered energy for all uses												6609.4598	(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	4859.7882	0.2160	1049.7143	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2046.9477	0.2160	442.1407	(264)
Space and water heating			1491.8550	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	368.7383	0.5190	191.3752	(268)
Energy saving/generation technologies				
PV Unit	-741.0144	0.5190	-384.5865	(269)
Total CO2, kg/year			1337.5687	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.3000	(273)

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

DER		15.3000	ZC1
Total Floor Area	TFA	87.4200	
Assumed number of occupants	N	2.5887	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.8787	ZC2
CO2 emissions from cooking, equation (L16)		2.0719	ZC3
Total CO2 emissions		33.2507	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		33.2507	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1373	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3873	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3292	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4197	0.4115	0.4032	0.3621	0.3539	0.3127	0.3127	0.3045	0.3292	0.3539	0.3703	0.3868	(22b)
Effective ac	0.5881	0.5847	0.5813	0.5656	0.5626	0.5489	0.5489	0.5464	0.5542	0.5626	0.5686	0.5748	(25)

3. Heat losses and heat loss parameter

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2954	1.2926	1.2899	1.2769	1.2744	1.2631	1.2631	1.2610	1.2675	1.2744	1.2794	1.2845	(40)
HLP (average)												1.2769	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.2507	101.4234	97.5961	93.7688	89.9415	86.1142	86.1142	89.9415	93.7688	97.5961	101.4234	105.2507	(44)
Energy conte	156.0837	136.5118	140.8680	122.8121	117.8411	101.6879	94.2288	108.1289	109.4204	127.5189	139.1968	151.1587	(45)
Energy content (annual)										Total = Sum(45)m =		1505.4571	(45)
Distribution loss (46)m = 0.15 x (45)m	23.4126	20.4768	21.1302	18.4218	17.6762	15.2532	14.1343	16.2193	16.4131	19.1278	20.8795	22.6738	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.8803	18.5457	15.0824	11.4183	8.5353	7.2059	7.7862	10.1208	13.5841	17.2482	20.1312	21.4606	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	234.2503	236.6811	230.5556	217.5151	201.0539	185.5826	175.2469	172.8161	178.9416	191.9821	208.4433	223.9146	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)													
	86.8784	84.6682	79.6668	72.7716	68.0652	61.7056	56.8572	63.7247	66.5872	73.7009	81.4052	84.6774	(72)
Total internal gains													
	406.8401	404.7260	390.1357	366.5361	342.4854	319.3252	304.7214	311.4926	323.9440	347.7622	374.8107	394.8836	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6000	11.2829	0.6300	0.7000	0.7700	8.9654	(75)
Southeast	6.3000	36.7938	0.6300	0.7000	0.7700	70.8414	(77)
Northwest	10.8000	11.2829	0.6300	0.7000	0.7700	37.2407	(81)

Solar gains	117.0475	214.7230	334.5598	482.8667	603.2201	626.2921	592.3956	498.4123	385.2572	248.3063	142.9909	98.3597	(83)
Total gains	523.8876	619.4490	724.6956	849.4028	945.7055	945.6173	897.1169	809.9049	709.2012	596.0685	517.8016	493.2433	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.6066	53.7236	53.8388	54.3865	54.4903	54.9783	54.9783	55.0697	54.7893	54.4903	54.2808	54.0636	
alpha	4.5738	4.5816	4.5893	4.6258	4.6327	4.6652	4.6652	4.6713	4.6526	4.6327	4.6187	4.6042	
util living area													
	0.9980	0.9953	0.9866	0.9531	0.8578	0.6873	0.5269	0.5979	0.8525	0.9771	0.9958	0.9985	(86)
MIT	19.5678	19.7405	20.0361	20.4319	20.7638	20.9402	20.9862	20.9759	20.8318	20.3947	19.9095	19.5382	(87)
Th 2	19.8444	19.8466	19.8488	19.8590	19.8609	19.8698	19.8698	19.8715	19.8664	19.8609	19.8570	19.8530	(88)
util rest of house													
	0.9972	0.9936	0.9816	0.9351	0.8059	0.5891	0.3990	0.4649	0.7776	0.9652	0.9941	0.9979	(89)
MIT 2	17.9468	18.2002	18.6307	19.1992	19.6346	19.8316	19.8650	19.8620	19.7317	19.1586	18.4550	17.9094	(90)
Living area fraction										fLA = Living area / (4) =		0.2008	(91)
MIT	18.2722	18.5095	18.9128	19.4467	19.8613	20.0541	20.0901	20.0856	19.9525	19.4067	18.7470	18.2364	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2722	18.5095	18.9128	19.4467	19.8613	20.0541	20.0901	20.0856	19.9525	19.4067	18.7470	18.2364	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9907	0.9759	0.9268	0.8059	0.6063	0.4248	0.4915	0.7844	0.9585	0.9915	0.9967	(94)
Useful gains	521.6496	613.6746	707.2133	787.2309	762.1727	573.3616	381.0827	398.0619	556.2786	571.3266	513.3752	491.6302	(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													
	1582.3273	1537.8849	1399.6652	1177.2613	909.2632	602.2575	385.3861	406.2969	648.4806	981.1710	1302.6162	1576.1570	(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													
	789.1442	621.0693	515.1842	280.8219	109.4353	0.0000	0.0000	0.0000	0.0000	304.9242	568.2536	806.8880	(98)
Space heating												3995.7207	(98)
Space heating per m2											(98) / (4) =	45.7072	(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												4278.0735	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	789.1442	621.0693	515.1842	280.8219	109.4353	0.0000	0.0000	0.0000	0.0000	304.9242	568.2536	806.8880	(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)													
	844.9081	664.9565	551.5891	300.6659	117.1684	0.0000	0.0000	0.0000	0.0000	326.4713	608.4085	863.9058	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	207.0426	182.5392	190.6018	169.0542	163.6743	144.1552	138.1117	153.9621	155.6625	177.2528	188.5119	202.1176	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.0970	87.8890	87.4302	86.3201	84.0634	80.3000	80.3000	80.3000	80.3000	86.4049	87.6537	88.1783	(217)
Fuel for water heating, kWh/month													
	235.0165	207.6930	218.0045	195.8458	194.7034	179.5208	171.9946	191.7337	193.8512	205.1421	215.0645	229.2146	(219)
Water heating fuel used												2437.7846	(219)
Annual totals kWh/year													
Space heating fuel - main system												4278.0735	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												368.7527	(232)
Total delivered energy for all uses												7159.6108	(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	4278.0735	0.2160	924.0639	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2437.7846	0.2160	526.5615	(264)
Space and water heating			1450.6254	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	368.7527	0.5190	191.3826	(268)
Total CO2, kg/m2/year			1680.9330	(272)
Emissions per m2 for space and water heating			16.5937	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1892	(272b)
Emissions per m2 for pumps and fans			0.4453	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.5937 * 1.00) + 2.1892 + 0.4453, rounded to 2 d.p.			19.2300	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1373	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3873	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3292	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4197	0.4115	0.4032	0.3621	0.3539	0.3127	0.3127	0.3045	0.3292	0.3539	0.3703	0.3868	(22b)
Effective ac	0.5881	0.5847	0.5813	0.5656	0.5626	0.5489	0.5489	0.5464	0.5542	0.5626	0.5686	0.5748	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3358	1.3330	1.3302	1.3172	1.3148	1.3035	1.3035	1.3014	1.3078	1.3148	1.3197	1.3248	(40)
HLP (average)												1.3172	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5887	(42)
Average daily hot water use (litres/day)	95.6824	(43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution 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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	33.1678	29.0088	29.9344	26.0976	25.0412	21.6087	20.0236	22.9774	23.2518	27.0978	29.5793	32.1212	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.8795	18.5450	15.0818	11.4179	8.5350	7.2056	7.7859	10.1204	13.5836	17.2475	20.1304	21.4598	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	234.2503	236.6811	230.5556	217.5151	201.0539	185.5826	175.2469	172.8161	178.9416	191.9821	208.4433	223.9146	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)	44.5804	43.1678	40.2345	36.2466	33.6576	30.0121	26.9135	30.8836	32.2942	36.4217	41.0824	43.1737	(72)
Total internal gains	361.5412	360.2249	347.7029	327.0107	305.0775	284.6313	271.7773	275.6512	286.6504	307.4823	331.4871	350.3791	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6200	11.2829	0.6300	0.7000	0.7700	9.0343	(75)
Southeast	6.3400	36.7938	0.6300	0.7000	0.7700	71.2912	(77)
Northwest	10.8500	11.2829	0.6300	0.7000	0.7700	37.4131	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	117.7387	215.9804	336.4933	485.6193	606.6291	629.8198	595.7370	501.2421	387.4709	249.7535	143.8334	98.9418	(83)
Total gains	479.2798	576.2053	684.1962	812.6300	911.7066	914.4511	867.5143	776.8933	674.1213	557.2359	475.3205	449.3208	(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	36.7309	36.8087	36.8852	37.2490	37.3178	37.6418	37.6418	37.7024	37.5163	37.3178	37.1788	37.0346	
alpha	3.4487	3.4539	3.4590	3.4833	3.4879	3.5095	3.5095	3.5135	3.5011	3.4879	3.4786	3.4690	
util living area	0.9940	0.9882	0.9733	0.9300	0.8345	0.6834	0.5391	0.6077	0.8346	0.9615	0.9897	0.9952	(86)
MIT	19.0255	19.2482	19.6313	20.1422	20.5852	20.8591	20.9545	20.9308	20.6949	20.1120	19.4762	18.9872	(87)
Th 2	19.8129	19.8151	19.8172	19.8274	19.8293	19.8381	19.8381	19.8398	19.8347	19.8293	19.8254	19.8214	(88)
util rest of house	0.9925	0.9851	0.9660	0.9101	0.7866	0.5933	0.4129	0.4802	0.7669	0.9468	0.9865	0.9940	(89)
MIT 2	18.0231	18.2460	18.6264	19.1295	19.5369	19.7648	19.8236	19.8151	19.6477	19.1114	18.4818	17.9912	(90)
Living area fraction									fLA = Living area / (4) =			0.2008	(91)
MIT	18.2244	18.4472	18.8282	19.3328	19.7473	19.9845	20.0506	20.0391	19.8580	19.3123	18.6814	18.1912	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2244	18.4472	18.8282	19.3328	19.7473	19.9845	20.0506	20.0391	19.8580	19.3123	18.6814	18.1912	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9895	0.9802	0.9580	0.8997	0.7827	0.6058	0.4374	0.5039	0.7685	0.9381	0.9821	0.9915	(94)
Useful gains	474.2547	564.8169	655.4477	731.1316	713.6351	553.9367	379.4300	391.5073	518.0700	522.7561	466.8307	445.5149	(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	1626.0207	1578.6337	1433.6038	1201.3449	924.9496	613.5608	393.1936	414.0028	658.3105	1001.3816	1336.1324	1620.4298	(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	856.9139	681.2849	578.9481	338.5536	157.2180	0.0000	0.0000	0.0000	0.0000	356.0974	625.8972	874.1367	(98)
Space heating												4469.0498	(98)
Space heating per m2										(98) / (4) =		51.1216	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1071.1258	843.2267	864.6246	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8101	0.8709	0.8329	0.0000	0.0000	0.0000	0.0000	(101)

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Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	867.6658	734.3390	720.1701	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1166.0639	1109.1526	1004.8824	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	214.8467	278.8613	211.8259	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												705.5339	(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	53.7117	69.7153	52.9565	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												176.3835	(107)
Space cooling per m2												2.0177	(108)
Energy for space heating												51.1216	(99)
Energy for space cooling												2.0177	(108)
Total												53.1393	(109)
Dwelling Fabric Energy Efficiency (DFEE)												53.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1373	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3873	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3292	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4197	0.4115	0.4032	0.3621	0.3539	0.3127	0.3127	0.3045	0.3292	0.3539	0.3703	0.3868	(22b)
Effective ac	0.5881	0.5847	0.5813	0.5656	0.5626	0.5489	0.5489	0.5464	0.5542	0.5626	0.5686	0.5748	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2954	1.2926	1.2899	1.2769	1.2744	1.2631	1.2631	1.2610	1.2675	1.2744	1.2794	1.2845	(40)
HLP (average)												1.2769	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5887	(42)
Average daily hot water use (litres/day)	95.6824	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.2507	101.4234	97.5961	93.7688	89.9415	86.1142	86.1142	89.9415	93.7688	97.5961	101.4234	105.2507	(44)
Energy conte	156.0837	136.5118	140.8680	122.8121	117.8411	101.6879	94.2288	108.1289	109.4204	127.5189	139.1968	151.1587	(45)
Energy content (annual)										Total = Sum(45)m =		1505.4571	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	33.1678	29.0088	29.9344	26.0976	25.0412	21.6087	20.0236	22.9774	23.2518	27.0978	29.5793	32.1212	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.8803	18.5457	15.0824	11.4183	8.5353	7.2059	7.7862	10.1208	13.5841	17.2482	20.1312	21.4606	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	234.2503	236.6811	230.5556	217.5151	201.0539	185.5826	175.2469	172.8161	178.9416	191.9821	208.4433	223.9146	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)													
	44.5804	43.1678	40.2345	36.2466	33.6576	30.0121	26.9135	30.8836	32.2942	36.4217	41.0824	43.1737	(72)
Total internal gains													
	361.5420	360.2256	347.7035	327.0111	305.0778	284.6316	271.7776	275.6515	286.6510	307.4830	331.4879	350.3799	(73)

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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	
Northeast	2.6000	11.2829	0.6300	0.7000	0.7700	8.9654	(75)
Southeast	6.3000	36.7938	0.6300	0.7000	0.7700	70.8414	(77)
Northwest	10.8000	11.2829	0.6300	0.7000	0.7700	37.2407	(81)

Solar gains	117.0475	214.7230	334.5598	482.8667	603.2201	626.2921	592.3956	498.4123	385.2572	248.3063	142.9909	98.3597	(83)
Total gains	478.5895	574.9486	682.2633	809.8778	908.2979	910.9237	864.1732	774.0639	671.9081	555.7893	474.4788	448.7396	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.6066	53.7236	53.8388	54.3865	54.4903	54.9783	54.9783	55.0697	54.7893	54.4903	54.2808	54.0636	
alpha	4.5738	4.5816	4.5893	4.6258	4.6327	4.6652	4.6652	4.6713	4.6526	4.6327	4.6187	4.6042	
util living area													
	0.9986	0.9965	0.9894	0.9602	0.8720	0.7060	0.5448	0.6207	0.8718	0.9824	0.9971	0.9990	(86)
MIT	19.5208	19.6949	19.9943	20.3983	20.7436	20.9331	20.9841	20.9719	20.8120	20.3564	19.8649	19.4919	(87)
Th 2	19.8444	19.8466	19.8488	19.8590	19.8609	19.8698	19.8698	19.8715	19.8664	19.8609	19.8570	19.8530	(88)
util rest of house													
	0.9981	0.9953	0.9853	0.9444	0.8229	0.6078	0.4136	0.4849	0.8018	0.9729	0.9959	0.9986	(89)
MIT 2	18.5020	18.6772	18.9762	19.3776	19.6909	19.8401	19.8660	19.8638	19.7610	19.3451	18.8555	18.4798	(90)
Living area fraction									fLA = Living area / (4) =			0.2008	(91)
MIT	18.7065	18.8815	19.1806	19.5825	19.9023	20.0596	20.0905	20.0862	19.9720	19.5481	19.0581	18.6829	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7065	18.8815	19.1806	19.5825	19.9023	20.0596	20.0905	20.0862	19.9720	19.5481	19.0581	18.6829	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9974	0.9938	0.9822	0.9396	0.8250	0.6257	0.4402	0.5124	0.8096	0.9693	0.9946	0.9981	(94)
Useful gains	477.3492	571.3731	670.1121	760.9235	749.3009	569.9632	380.4393	396.6005	543.9738	538.7386	471.9169	447.8739	(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													
	1631.5070	1579.9314	1429.8541	1192.4227	913.8255	602.8568	385.4288	406.3663	650.6334	996.9203	1337.4109	1626.2980	(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													
	858.6934	677.7512	565.2480	310.6794	122.4063	0.0000	0.0000	0.0000	0.0000	340.8872	623.1557	876.7475	(98)
Space heating												4375.5688	(98)
Space heating per m2											(98) / (4) =	50.0523	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1037.9694	817.1248	837.8172	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8665	0.9222	0.8885	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	899.4429	753.5911	744.3728	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1161.9413	1105.2478	1001.5758	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	188.9988	261.6326	191.3590	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												641.9905	(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   47.2497   65.4082   47.8398    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        160.4976 (107)
Space cooling per m2                                                                                                   1.8359 (108)
Energy for space heating                                                                                              50.0523 (99)
Energy for space cooling                                                                                               1.8359 (108)
Total                                                                                                                 51.8882 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                   59.7 (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	43.7100	(1b)	x 2.3900	(2b) =	104.4669	(1b) - (3b)
First floor	43.7100	(1c)	x 2.6100	(2c) =	114.0831	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	218.5500	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1830	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4330	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3681	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000	(22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750	(22a)
Adj infilt rate	0.4693	0.4325	0.4233	0.3957	0.3957	0.3681	0.3681	0.3589	0.3681	0.4141	0.4049	0.4325	(22b)
Effective ac	0.6101	0.5935	0.5896	0.5783	0.5783	0.5677	0.5677	0.5644	0.5677	0.5857	0.5820	0.5935	(25)

3. Heat losses and heat loss parameter

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3403	1.3370	1.3277	1.3277	1.3190	1.3190	1.3163	1.3190	1.3339	1.3308	1.3403	(40)
HLP (average)												1.3304	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

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

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m													
	23.4126	20.4768	21.1302	18.4218	17.6762	15.2532	14.1343	16.2193	16.4131	19.1278	20.8795	22.6738	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	27.5604	24.8911	27.5367	26.6180	27.4831	26.5711	27.4409	27.4683	26.5966	27.5145	26.6571	27.5523	(61)
Total heat required for water heating calculated for each month													
	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(64)
Total per year (kWh/year) = Sum(64)m =												1829.3472	(64)
RHI water heating demand												1829	(64)
Heat gains from water heating, kWh/month													
	58.7879	51.6130	53.7228	47.4895	46.0530	40.4540	38.1913	42.8199	43.0314	49.2787	52.9472	57.1483	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.1987	46.3624	37.7045	28.5447	21.3375	18.0140	19.4648	25.3011	33.9590	43.1188	50.3260	53.6495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	349.6273	353.2554	344.1128	324.6495	300.0804	276.9890	261.5625	257.9345	267.0770	286.5404	311.1094	334.2009	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)													
	79.0160	76.8050	72.2080	65.9577	61.8991	56.1861	51.3324	57.5537	59.7659	66.2347	73.5378	76.8123	(72)
Total internal gains													
	588.7379	584.3186	561.9211	527.0476	491.2129	459.0850	440.2555	448.6851	468.6978	503.7898	542.8691	572.5585	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6200	15.0428	0.6300	0.7000	0.7700	12.0449	(75)
Southeast	6.3400	46.3896	0.6300	0.7000	0.7700	89.8838	(77)
Northwest	10.8500	15.0428	0.6300	0.7000	0.7700	49.8806	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	151.8093	239.2264	373.3218	551.3438	658.6889	739.9226	683.2448	586.9184	456.9053	293.3726	184.0268	121.6487	(83)
Total gains	740.5472	823.5450	935.2429	1078.3914	1149.9018	1199.0076	1123.5003	1035.6035	925.6031	797.1624	726.8959	694.2072	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.1608	37.5405	37.6317	37.8960	37.8960	38.1458	38.1458	38.2258	38.1458	37.7213	37.8094	37.5405	
alpha	3.4774	3.5027	3.5088	3.5264	3.5264	3.5431	3.5431	3.5484	3.5431	3.5148	3.5206	3.5027	
util living area													
	0.9746	0.9634	0.9308	0.8511	0.7109	0.5090	0.3720	0.4006	0.6557	0.8775	0.9555	0.9784	(86)
MIT	19.5253	19.6859	20.0383	20.4654	20.7923	20.9532	20.9885	20.9856	20.8878	20.5084	19.9835	19.5049	(87)
Th 2	19.7988	19.8094	19.8119	19.8192	19.8192	19.8260	19.8260	19.8281	19.8260	19.8144	19.8168	19.8094	(88)
util rest of house													
	0.9681	0.9543	0.9134	0.8146	0.6436	0.4135	0.2576	0.2787	0.5573	0.8359	0.9420	0.9728	(89)
MIT 2	18.5042	18.6689	19.0115	19.4134	19.6902	19.8068	19.8236	19.8251	19.7723	19.4612	18.9688	18.4926	(90)
Living area fraction									fLA = Living area / (4) =			0.2008	(91)
MIT	18.7092	18.8730	19.2176	19.6246	19.9114	20.0369	20.0574	20.0580	19.9962	19.6714	19.1725	18.6958	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7092	18.8730	19.2176	19.6246	19.9114	20.0369	20.0574	20.0580	19.9962	19.6714	19.1725	18.6958	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9603	0.9451	0.9026	0.8077	0.6494	0.4314	0.2807	0.3032	0.5729	0.8299	0.9325	0.9657	(94)
Useful gains	711.1137	778.3210	844.1890	870.9989	746.7010	517.2919	315.3450	314.0331	530.2439	661.5287	677.8535	670.4101	(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													
	1575.3400	1543.4588	1392.9760	1163.5423	848.6299	534.6788	317.9570	317.3600	576.1094	917.8537	1253.2133	1546.1273	(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													
	642.9844	514.1726	408.2976	210.6313	75.8351	0.0000	0.0000	0.0000	0.0000	190.7058	414.2591	651.5336	(98)
Space heating												3108.4195	(98)
RHI space heating demand												3108	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1830	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4330	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3681	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3497	0.3497	0.3405	0.3681	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3505	1.3470	1.3308	1.3277	1.3136	1.3136	1.3109	1.3190	1.3277	1.3339	1.3403	(40)
HLP (average)												1.3307	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss	23.4126	20.4768	21.1302	18.4218	17.6762	15.2532	14.1343	16.2193	16.4131	19.1278	20.8795	22.6738	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	27.5604	24.8911	27.5367	26.6180	27.4831	26.5711	27.4409	27.4683	26.5966	27.5145	26.6571	27.5523	(61)
Total heat required for water heating calculated for each month	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from w/h	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	58.7879	51.6130	53.7228	47.4895	46.0530	40.4540	38.1913	42.8199	43.0314	49.2787	52.9472	57.1483	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.1987	46.3624	37.7045	28.5447	21.3375	18.0140	19.4648	25.3011	33.9590	43.1188	50.3260	53.6495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	349.6273	353.2554	344.1128	324.6495	300.0804	276.9890	261.5625	257.9345	267.0770	286.5404	311.1094	334.2009	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)	79.0160	76.8050	72.2080	65.9577	61.8991	56.1861	51.3324	57.5537	59.7659	66.2347	73.5378	76.8123	(72)
Total internal gains	588.7379	584.3186	561.9211	527.0476	491.2129	459.0850	440.2555	448.6851	468.6978	503.7898	542.8691	572.5585	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6200	11.2829	0.6300	0.7000	0.7700	9.0343	(75)
Southeast	6.3400	36.7938	0.6300	0.7000	0.7700	71.2912	(77)
Northwest	10.8500	11.2829	0.6300	0.7000	0.7700	37.4131	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	117.7387	215.9804	336.4933	485.6193	606.6291	629.8198	595.7370	501.2421	387.4709	249.7535	143.8334	98.9418	(83)
Total gains	706.4766	800.2991	898.4145	1012.6670	1097.8420	1088.9047	1035.9925	949.9272	856.1687	753.5433	686.7024	671.5002	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.1608	37.2579	37.3536	37.8094	37.8960	38.3041	38.3041	38.3806	38.1458	37.8960	37.7213	37.5405	
alpha	3.4774	3.4839	3.4902	3.5206	3.5264	3.5536	3.5536	3.5587	3.5431	3.5264	3.5148	3.5027	
util living area	0.9819	0.9710	0.9466	0.8863	0.7724	0.6098	0.4675	0.5224	0.7504	0.9191	0.9712	0.9846	(86)
MIT	19.3178	19.5256	19.8747	20.3278	20.6948	20.9062	20.9722	20.9590	20.7977	20.3214	19.7437	19.2808	(87)
Th 2	19.7988	19.8015	19.8042	19.8168	19.8192	19.8302	19.8302	19.8323	19.8260	19.8192	19.8144	19.8094	(88)
util rest of house	0.9774	0.9639	0.9333	0.8575	0.7162	0.5196	0.3520	0.4034	0.6697	0.8920	0.9630	0.9809	(89)
MIT 2	18.2989	18.5054	18.8480	19.2875	19.6133	19.7841	19.8220	19.8188	19.7112	19.2945	18.7327	18.2704	(90)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	18.5034	18.7102	19.0541	19.4963	19.8304	20.0094	20.0529	20.0477	19.9293	19.5006	18.9357	18.4732	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5034	18.7102	19.0541	19.4963	19.8304	20.0094	20.0529	20.0477	19.9293	19.5006	18.9357	18.4732	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9710	0.9555	0.9228	0.8483	0.7168	0.5343	0.3748	0.4265	0.6777	0.8830	0.9549	0.9751	(94)
Useful gains	685.9601	764.6794	829.0319	859.0510	786.9519	581.8158	388.3362	405.1195	580.2547	665.3884	655.7031	654.7808	(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	1681.1887	1630.3815	1478.2988	1232.7173	943.6907	621.1723	396.5017	418.0368	672.1704	1033.0856	1380.1151	1672.3642	(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	740.4500	581.7518	483.0545	269.0398	116.6136	0.0000	0.0000	0.0000	0.0000	273.5667	521.5767	757.0821	(98)

Space heating 3743.1352 (98)

Space heating per m2 (98) / (4) = 42.8178 (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	4126.9407	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	740.4500	581.7518	483.0545	269.0398	116.6136	0.0000	0.0000	0.0000	0.0000	273.5667	521.5767	757.0821	(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)													
	816.3727	641.4022	532.5849	296.6260	128.5707	0.0000	0.0000	0.0000	0.0000	301.6171	575.0570	834.7101	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(64)
Efficiency of water heater												87.9000	(216)
(217)m	90.1294	90.0768	89.9592	89.6799	89.1249	87.9000	87.9000	87.9000	87.9000	89.6668	90.0083	90.1516	(217)
Fuel for water heating, kWh/month													
	203.7559	179.1836	187.2010	166.6260	163.0568	145.9147	138.4183	154.2630	154.7406	172.8994	184.2653	198.2339	(219)
Water heating fuel used												2048.5587	(219)
Annual totals kWh/year													
Space heating fuel - main system												4126.9407	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												368.7383	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.90 * 1029 * 1.00) =										-741.0144		-741.0144	(233)
Total delivered energy for all uses												5878.2233	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4126.9407	3.4800	143.6175	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2048.5587	3.4800	71.2898	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	368.7383	13.1900	48.6366	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-741.0144	13.1900	-97.7398	(252)
Total energy cost			295.6967	(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] =	0.9379	(257)
SAP value		86.9167	
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	4126.9407	0.2160	891.4192	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2048.5587	0.2160	442.4887	(264)
Space and water heating			1333.9079	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	368.7383	0.5190	191.3752	(268)
Energy saving/generation technologies				
PV Unit	-741.0144	0.5190	-384.5865	(269)
Total kg/year			1179.6216	(272)
CO2 emissions per m2			13.4900	(273)
EI value			88.0630	
EI rating			88	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9070 = 3.837, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9070 = 0.2381, stars = 4
Water heating energy efficiency	3.48 / 0.8920 = 3.901, stars = 4
Water heating environmental impact	0.216 / 0.8920 = 0.2422, stars = 4

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

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1830	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4330	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3681	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000	(22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750	(22a)
Adj infilt rate	0.4693	0.4325	0.4233	0.3957	0.3957	0.3681	0.3681	0.3589	0.3681	0.4141	0.4049	0.4325	(22b)
Effective ac	0.6101	0.5935	0.5896	0.5783	0.5783	0.5677	0.5677	0.5644	0.5677	0.5857	0.5820	0.5935	(25)

3. Heat losses and heat loss parameter

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3403	1.3370	1.3277	1.3277	1.3190	1.3190	1.3163	1.3190	1.3339	1.3308	1.3403	(40)
HLP (average)												1.3304	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

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

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

Distribution loss (46)m = 0.15 x (45)m													
	23.4126	20.4768	21.1302	18.4218	17.6762	15.2532	14.1343	16.2193	16.4131	19.1278	20.8795	22.6738	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	27.5604	24.8911	27.5367	26.6180	27.4831	26.5711	27.4409	27.4683	26.5966	27.5145	26.6571	27.5523	(61)
Total heat required for water heating calculated for each month													
	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(64)
Total per year (kWh/year) = Sum(64)m =												1829.3472	(64)
Heat gains from water heating, kWh/month													
	58.7879	51.6130	53.7228	47.4895	46.0530	40.4540	38.1913	42.8199	43.0314	49.2787	52.9472	57.1483	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	155.3240	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.1987	46.3624	37.7045	28.5447	21.3375	18.0140	19.4648	25.3011	33.9590	43.1188	50.3260	53.6495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	349.6273	353.2554	344.1128	324.6495	300.0804	276.9890	261.5625	257.9345	267.0770	286.5404	311.1094	334.2009	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	53.1211	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)													
	79.0160	76.8050	72.2080	65.9577	61.8991	56.1861	51.3324	57.5537	59.7659	66.2347	73.5378	76.8123	(72)
Total internal gains													
	588.7379	584.3186	561.9211	527.0476	491.2129	459.0850	440.2555	448.6851	468.6978	503.7898	542.8691	572.5585	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6200	15.0428	0.6300	0.7000	0.7700	12.0449	(75)
Southeast	6.3400	46.3896	0.6300	0.7000	0.7700	89.8838	(77)
Northwest	10.8500	15.0428	0.6300	0.7000	0.7700	49.8806	(81)

Solar gains	151.8093	239.2264	373.3218	551.3438	658.6889	739.9226	683.2448	586.9184	456.9053	293.3726	184.0268	121.6487	(83)
Total gains	740.5472	823.5450	935.2429	1078.3914	1149.9018	1199.0076	1123.5003	1035.6035	925.6031	797.1624	726.8959	694.2072	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.1608	37.5405	37.6317	37.8960	37.8960	38.1458	38.1458	38.2258	38.1458	37.7213	37.8094	37.5405	
alpha	3.4774	3.5027	3.5088	3.5264	3.5264	3.5431	3.5431	3.5484	3.5431	3.5148	3.5206	3.5027	
util living area													
	0.9746	0.9634	0.9308	0.8511	0.7109	0.5090	0.3720	0.4006	0.6557	0.8775	0.9555	0.9784	(86)
MIT	19.5253	19.6859	20.0383	20.4654	20.7923	20.9532	20.9885	20.9856	20.8878	20.5084	19.9835	19.5049	(87)
Th 2	19.7988	19.8094	19.8119	19.8192	19.8192	19.8260	19.8260	19.8281	19.8260	19.8144	19.8168	19.8094	(88)
util rest of house													
	0.9681	0.9543	0.9134	0.8146	0.6436	0.4135	0.2576	0.2787	0.5573	0.8359	0.9420	0.9728	(89)
MIT 2	18.5042	18.6689	19.0115	19.4134	19.6902	19.8068	19.8236	19.8251	19.7723	19.4612	18.9688	18.4926	(90)
Living area fraction										fLA = Living area / (4) =		0.2008	(91)
MIT	18.7092	18.8730	19.2176	19.6246	19.9114	20.0369	20.0574	20.0580	19.9962	19.6714	19.1725	18.6958	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7092	18.8730	19.2176	19.6246	19.9114	20.0369	20.0574	20.0580	19.9962	19.6714	19.1725	18.6958	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9603	0.9451	0.9026	0.8077	0.6494	0.4314	0.2807	0.3032	0.5729	0.8299	0.9325	0.9657	(94)
Useful gains	711.1137	778.3210	844.1890	870.9989	746.7010	517.2919	315.3450	314.0331	530.2439	661.5287	677.8535	670.4101	(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													
	1575.3400	1543.4588	1392.9760	1163.5423	848.6299	534.6788	317.9570	317.3600	576.1094	917.8537	1253.2133	1546.1273	(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													
	642.9844	514.1726	408.2976	210.6313	75.8351	0.0000	0.0000	0.0000	0.0000	190.7058	414.2591	651.5336	(98)
Space heating												3108.4195	(98)
Space heating per m2											(98) / (4) =	35.5573	(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	3427.1439	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	642.9844	514.1726	408.2976	210.6313	75.8351	0.0000	0.0000	0.0000	0.0000	190.7058	414.2591	651.5336	(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)													
	708.9134	566.8937	450.1627	232.2286	83.6110	0.0000	0.0000	0.0000	0.0000	210.2600	456.7355	718.3391	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	183.6441	161.4029	168.4046	149.4301	145.3242	128.2590	121.6697	135.5972	136.0170	155.0334	165.8539	178.7110	(64)
Efficiency of water heater												87.9000	(216)
(217)m	90.0626	90.0150	89.8641	89.5166	88.8404	87.9000	87.9000	87.9000	87.9000	89.4227	89.8814	90.0823	(217)
Fuel for water heating, kWh/month													
	203.9071	179.3068	187.3992	166.9300	163.5790	145.9147	138.4183	154.2630	154.7406	173.3714	184.5253	198.3863	(219)
Water heating fuel used												2050.7416	(219)
Annual totals kWh/year													
Space heating fuel - main system												3427.1439	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												368.7383	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.90 * 1182 * 1.00) =										-850.8287		-850.8287	(233)
Total delivered energy for all uses												5070.7951	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3427.1439	9.7400	333.8038	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2050.7416	9.7400	199.7422	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	368.7383	36.8500	135.8801	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-850.8287	36.8500	-313.5304	(252)
Total energy cost			487.5332	(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	3427.1439	0.2160	740.2631	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2050.7416	0.2160	442.9602	(264)
Space and water heating			1183.2233	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	368.7383	0.5190	191.3752	(268)
Energy saving/generation technologies				
PV Unit	-850.8287	0.5190	-441.5801	(269)
Total kg/year			971.9434	(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	3427.1439	1.2200	4181.1155	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2050.7416	1.2200	2501.9048	(264)
Space and water heating			6683.0203	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	368.7383	3.0700	1132.0267	(268)
Energy saving/generation technologies				
PV Unit	-850.8287	3.0700	-2612.0442	(269)
Primary energy kWh/year			5433.2528	(272)
Primary energy kWh/m2/year			62.1511	(273)

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

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 80	-192 kg (19.8%)

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

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

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

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

	Current	Potential	Saving
Electricity	£164	£182	-£18
Mains gas	£638	£539	£98
Space heating	£465	£465	£0
Water heating	£200	£120	£80
Lighting	£136	£136	£0
Generated (PV)	-£314	-£314	£0
Total cost of fuels	£488	£407	£80
Total cost of uses	£487	£407	£80
Delivered energy	58 kWh/m²	47 kWh/m²	11 kWh/m²
Carbon dioxide emissions	1.0 tonnes	0.8 tonnes	0.2 tonnes
CO2 emissions per m²	11 kg/m²	9 kg/m²	2 kg/m²
Primary energy	62 kWh/m²	50 kWh/m²	12 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1830	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4330	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3681	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4693	0.4601	0.4509	0.4049	0.3957	0.3497	0.3497	0.3405	0.3681	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3505	1.3470	1.3308	1.3277	1.3136	1.3136	1.3109	1.3190	1.3277	1.3339	1.3403	(40)
HLP (average)												1.3307	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5887 (42)
Average daily hot water use (litres/day)	95.6824 (43)

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Distribution loss  (46)m = 0.15 x (45)m
                23.4126    20.4768    21.1302    18.4218    17.6762    15.2532    14.1343    16.2193    16.4131    19.1278    20.8795    22.6738 (46)
Water storage loss:
Total storage loss
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss      27.5604    24.8911    27.5367    26.6180    27.4831    26.5711    27.4409    27.4683    26.5966    27.5145    26.6571    27.5523 (61)
Total heat required for water heating calculated for each month
               183.6441   161.4029   168.4046   149.4301   145.3242   128.2590   121.6697   135.5972   136.0170   155.0334   165.8539   178.7110 (62)
Aperture area of solar collector                                                                                                     3.0000 (H1)
Zero-loss collector efficiency                                                                                                       0.7000 (H2)
Collector heat loss coefficient                                                                                                      1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                            0.0050 (H3a)
Collector effective heat loss coefficient                                                                                            1.8063 (H3b)
Collector performance ratio                                                                                                          2.5804 (H4)
Annual solar radiation per m2                                                                                                     1079.5246 (H5)
Overshading factor                                                                                                                   0.8000 (H6)
Solar energy available                                                                                                            1813.6014 (H7)
Adjustment factor for showers                                                                                                        1.0000 (H7a)
Solar-to-load ratio                                                                                                                  1.2047 (H8)
Utilisation factor                                                                                                                   0.5640 (H9)
Collector performance factor                                                                                                         0.8793 (H10)
Dedicated solar storage volume                                                                                                      75.0000 (H11)
Effective solar volume                                                                                                              75.0000 (H13)
Daily hot water demand                                                                                                              95.6824 (H14)
Volume ratio Veff/V                                                                                                                  0.7838 (H15)
Solar storage volume factor                                                                                                          0.9513 (H16)
Solar input                                                                                                                       -855.5811 (H17)
Solar input     -24.8101   -41.4010   -70.5106   -94.4982  -116.7445  -114.7785  -113.2616   -98.9572   -77.5034   -52.9257   -29.4284   -20.7619 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =   -855.5811 (63)
Output from w/h
               158.8340   120.0019    97.8940    54.9319    28.5797    13.4805     8.4081    36.6400    58.5136   102.1077   136.4255   157.9491 (64)
                                                                                            Total per year (kWh/year) = Sum(64)m =   973.7661 (64)
Heat gains from water heating, kWh/month
                58.7879    51.6130    53.7228    47.4895    46.0530    40.4540    38.1913    42.8199    43.0314    49.2787    52.9472    57.1483 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                52.1987    46.3624    37.7045    28.5447    21.3375    18.0140    19.4648    25.3011    33.9590    43.1188    50.3260    53.6495 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               349.6273   353.2554   344.1128   324.6495   300.0804   276.9890   261.5625   257.9345   267.0770   286.5404   311.1094   334.2009 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494 (71)
Water heating gains (Table 5)
                79.0160    76.8050    72.2080    65.9577    61.8991    56.1861    51.3324    57.5537    59.7659    66.2347    73.5378    76.8123 (72)
Total internal gains
               588.7379   584.3186   561.9211   527.0476   491.2129   459.0850   440.2555   448.6851   468.6978   503.7898   542.8691   572.5585 (73)


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6. Solar gains
----------------------------------------------------------------------------------------------------
[Jan]                                        Area           Solar flux               g                 FF            Access              Gains
                                               m2           Table 6a       Specific data      Specific data          factor                  W
                                                                W/m2         or Table 6b        or Table 6c        Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                  2.6200            11.2829           0.6300             0.7000          0.7700             9.0343 (75)
Southeast                                  6.3400            36.7938           0.6300             0.7000          0.7700            71.2912 (77)
Northwest                                 10.8500            11.2829           0.6300             0.7000          0.7700            37.4131 (81)
----------------------------------------------------------------------------------------------------

Solar gains    117.7387   215.9804   336.4933   485.6193   606.6291   629.8198   595.7370   501.2421   387.4709   249.7535   143.8334    98.9418 (83)
Total gains    706.4766   800.2991   898.4145  1012.6670  1097.8420  1088.9047  1035.9925   949.9272   856.1687   753.5433   686.7024   671.5002 (84)


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7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                         21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             37.1608    37.2579    37.3536    37.8094    37.8960    38.3041    38.3041    38.3806    38.1458    37.8960    37.7213    37.5405
alpha            3.4774     3.4839     3.4902     3.5206     3.5264     3.5536     3.5536     3.5587     3.5431     3.5264     3.5148     3.5027
util living area
                 0.9819     0.9710     0.9466     0.8863     0.7724     0.6098     0.4675     0.5224     0.7504     0.9191     0.9712     0.9846 (86)

MIT             19.3178    19.5256    19.8747    20.3278    20.6948    20.9062    20.9722    20.9590    20.7977    20.3214    19.7437    19.2808 (87)
Th 2            19.7988    19.8015    19.8042    19.8168    19.8192    19.8302    19.8302    19.8323    19.8260    19.8192    19.8144    19.8094 (88)
util rest of house
                 0.9774     0.9639     0.9333     0.8575     0.7162     0.5196     0.3520     0.4034     0.6697     0.8920     0.9630     0.9809 (89)
MIT 2           18.2989    18.5054    18.8480    19.2875    19.6133    19.7841    19.8220    19.8188    19.7112    19.2945    18.7327    18.2704 (90)
Living area fraction                                                                               fLA = Living area / (4) =     0.2008 (91)
MIT             18.5034    18.7102    19.0541    19.4963    19.8304    20.0094    20.0529    20.0477    19.9293    19.5006    18.9357    18.4732 (92)
Temperature adjustment                                                                                                          0.0000
adjusted MIT    18.5034    18.7102    19.0541    19.4963    19.8304    20.0094    20.0529    20.0477    19.9293    19.5006    18.9357    18.4732 (93)


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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	0.9710	0.9555	0.9228	0.8483	0.7168	0.5343	0.3748	0.4265	0.6777	0.8830	0.9549	0.9751	(94)
Useful gains	685.9601	764.6794	829.0319	859.0510	786.9519	581.8158	388.3362	405.1195	580.2547	665.3884	655.7031	654.7808	(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													
	1681.1887	1630.3815	1478.2988	1232.7173	943.6907	621.1723	396.5017	418.0368	672.1704	1033.0856	1380.1151	1672.3642	(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													
	740.4500	581.7518	483.0545	269.0398	116.6136	0.0000	0.0000	0.0000	0.0000	273.5667	521.5767	757.0821	(98)
Space heating												3743.1352	(98)
Space heating per m2											(98) / (4) =	42.8178	(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	4126.9407	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	740.4500	581.7518	483.0545	269.0398	116.6136	0.0000	0.0000	0.0000	0.0000	273.5667	521.5767	757.0821	(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)													
	816.3727	641.4022	532.5849	296.6260	128.5707	0.0000	0.0000	0.0000	0.0000	301.6171	575.0570	834.7101	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	158.8340	120.0019	97.8940	54.9319	28.5797	13.4805	8.4081	36.6400	58.5136	102.1077	136.4255	157.9491	(64)
Efficiency of water heater												87.9000	(216)
(217)m	90.1926	90.2086	90.2157	90.2127	90.1348	87.9000	87.9000	87.9000	87.9000	89.9215	90.1049	90.2040	(217)
Fuel for water heating, kWh/month													
	176.1054	133.0271	108.5109	60.8915	31.7078	15.3362	9.5655	41.6837	66.5684	113.5521	151.4075	175.1021	(219)
Water heating fuel used												1083.4583	(219)
Annual totals kWh/year													
Space heating fuel - main system												4126.9407	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												368.7383	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.90 * 1029 * 1.00) =										-741.0144		-741.0144	(233)
Total delivered energy for all uses												4963.1229	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4126.9407	3.4800	143.6175	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1083.4583	3.4800	37.7043	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	368.7383	13.1900	48.6366	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-741.0144	13.1900	-97.7398	(252)
Total energy cost			268.7062	(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] =	0.8523	(257)
SAP value	88.1109	
SAP rating (Section 12)	88	(258)
SAP band	B	

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

	Energy	Emission factor	Emissions	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	4126.9407	0.2160	891.4192	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1083.4583	0.2160	234.0270	(264)
Space and water heating			1125.4462	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	368.7383	0.5190	191.3752	(268)
Energy saving/generation technologies				
PV Unit	-741.0144	0.5190	-384.5865	(269)
Total kg/year			997.1099	(272)
CO2 emissions per m2			11.4100	(273)
EI value			89.9099	
EI rating			90	(274)
EI band			B	

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

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

1. Overall dwelling dimensions

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

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1830	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4330	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3681	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000	(22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750	(22a)
Adj infilt rate	0.4693	0.4325	0.4233	0.3957	0.3957	0.3681	0.3681	0.3589	0.3681	0.4141	0.4049	0.4325	(22b)
Effective ac	0.6101	0.5935	0.5896	0.5783	0.5783	0.5677	0.5677	0.5644	0.5677	0.5857	0.5820	0.5935	(25)

3. Heat losses and heat loss parameter

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3540	1.3403	1.3370	1.3277	1.3277	1.3190	1.3190	1.3163	1.3190	1.3339	1.3308	1.3403	(40)
HLP (average)												1.3304	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5887	(42)
Average daily hot water use (litres/day)	95.6824	(43)

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

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

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Distribution loss  (46)m = 0.15 x (45)m
                23.4126    20.4768    21.1302    18.4218    17.6762    15.2532    14.1343    16.2193    16.4131    19.1278    20.8795    22.6738 (46)
Water storage loss:
Total storage loss
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss      27.5604    24.8911    27.5367    26.6180    27.4831    26.5711    27.4409    27.4683    26.5966    27.5145    26.6571    27.5523 (61)
Total heat required for water heating calculated for each month
               183.6441   161.4029   168.4046   149.4301   145.3242   128.2590   121.6697   135.5972   136.0170   155.0334   165.8539   178.7110 (62)
Aperture area of solar collector                                                                                                       3.0000 (H1)
Zero-loss collector efficiency                                                                                                         0.7000 (H2)
Collector heat loss coefficient                                                                                                        1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                              0.0050 (H3a)
Collector effective heat loss coefficient                                                                                              1.8063 (H3b)
Collector performance ratio                                                                                                            2.5804 (H4)
Annual solar radiation per m2                                                                                                       1234.4649 (H5)
Overshading factor                                                                                                                     0.8000 (H6)
Solar energy available                                                                                                              2073.9010 (H7)
Adjustment factor for showers                                                                                                          1.0000 (H7a)
Solar-to-load ratio                                                                                                                    1.3776 (H8)
Utilisation factor                                                                                                                     0.5161 (H9)
Collector performance factor                                                                                                           0.8793 (H10)
Dedicated solar storage volume                                                                                                        75.0000 (H11)
Effective solar volume                                                                                                                75.0000 (H13)
Daily hot water demand                                                                                                                95.6824 (H14)
Volume ratio Veff/V                                                                                                                    0.7838 (H15)
Solar storage volume factor                                                                                                            0.9513 (H16)
Solar input                                                                                                                         -895.3251 (H17)
Solar input    -29.3817   -41.9432   -71.0866   -97.0020  -114.4836  -121.8322  -117.3342  -104.6776   -82.8462   -56.7246   -34.5440   -23.4694 (63)
                                                                                    Solar input (sum of months) = Sum(63)m =   -895.3251 (63)
Output from w/h
               154.2624   119.4597    97.3180    52.4280    30.8407     6.4268     4.3355    30.9197    53.1708    98.3088   131.3100   155.2416 (64)
                                                                                      Total per year (kWh/year) = Sum(64)m =    934.0221 (64)
Heat gains from water heating, kWh/month
                58.7879    51.6130    53.7228    47.4895    46.0530    40.4540    38.1913    42.8199    43.0314    49.2787    52.9472    57.1483 (65)
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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240   155.3240 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                52.1987    46.3624    37.7045    28.5447    21.3375    18.0140    19.4648    25.3011    33.9590    43.1188    50.3260    53.6495 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               349.6273   353.2554   344.1128   324.6495   300.0804   276.9890   261.5625   257.9345   267.0770   286.5404   311.1094   334.2009 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211    53.1211 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494  -103.5494 (71)
Water heating gains (Table 5)
                79.0160    76.8050    72.2080    65.9577    61.8991    56.1861    51.3324    57.5537    59.7659    66.2347    73.5378    76.8123 (72)
Total internal gains
               588.7379   584.3186   561.9211   527.0476   491.2129   459.0850   440.2555   448.6851   468.6978   503.7898   542.8691   572.5585 (73)
```

```
----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------
[Jan]                                          Area        Solar flux              g               FF            Access              Gains
                                                 m2          Table 6a    Specific data    Specific data           factor                  W
                                                                 W/m2      or Table 6b      or Table 6c         Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                    2.6200           15.0428          0.6300           0.7000           0.7700            12.0449 (75)
Southeast                                    6.3400           46.3896          0.6300           0.7000           0.7700            89.8838 (77)
Northwest                                   10.8500           15.0428          0.6300           0.7000           0.7700            49.8806 (81)
----------------------------------------------------------------------------------------------------

Solar gains    151.8093   239.2264   373.3218   551.3438   658.6889   739.9226   683.2448   586.9184   456.9053   293.3726   184.0268   121.6487 (83)
Total gains    740.5472   823.5450   935.2429  1078.3914  1149.9018  1199.0076  1123.5003  1035.6035   925.6031   797.1624   726.8959   694.2072 (84)
```

```
----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                           21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             37.1608    37.5405    37.6317    37.8960    37.8960    38.1458    38.1458    38.2258    38.1458    37.7213    37.8094    37.5405
alpha            3.4774     3.5027     3.5088     3.5264     3.5264     3.5431     3.5431     3.5484     3.5431     3.5148     3.5206     3.5027
util living area
                 0.9746     0.9634     0.9308     0.8511     0.7109     0.5090     0.3720     0.4006     0.6557     0.8775     0.9555     0.9784 (86)

MIT             19.5253    19.6859    20.0383    20.4654    20.7923    20.9532    20.9885    20.9856    20.8878    20.5084    19.9835    19.5049 (87)
Th 2            19.7988    19.8094    19.8119    19.8192    19.8192    19.8260    19.8260    19.8281    19.8260    19.8144    19.8168    19.8094 (88)
util rest of house
                 0.9681     0.9543     0.9134     0.8146     0.6436     0.4135     0.2576     0.2787     0.5573     0.8359     0.9420     0.9728 (89)
MIT 2           18.5042    18.6689    19.0115    19.4134    19.6902    19.8068    19.8236    19.8251    19.7723    19.4612    18.9688    18.4926 (90)
Living area fraction                                                                       fLA = Living area / (4) =     0.2008 (91)
MIT             18.7092    18.8730    19.2176    19.6246    19.9114    20.0369    20.0574    20.0580    19.9962    19.6714    19.1725    18.6958 (92)
Temperature adjustment                                                                                                                 0.0000
adjusted MIT    18.7092    18.8730    19.2176    19.6246    19.9114    20.0369    20.0574    20.0580    19.9962    19.6714    19.1725    18.6958 (93)

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

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9603	0.9451	0.9026	0.8077	0.6494	0.4314	0.2807	0.3032	0.5729	0.8299	0.9325	0.9657	(94)
Useful gains	711.1137	778.3210	844.1890	870.9989	746.7010	517.2919	315.3450	314.0331	530.2439	661.5287	677.8535	670.4101	(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	1575.3400	1543.4588	1392.9760	1163.5423	848.6299	534.6788	317.9570	317.3600	576.1094	917.8537	1253.2133	1546.1273	(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	642.9844	514.1726	408.2976	210.6313	75.8351	0.0000	0.0000	0.0000	0.0000	190.7058	414.2591	651.5336	(98)
Space heating												3108.4195	(98)
Space heating per m2											(98) / (4) =	35.5573	(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	3427.1439	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	642.9844	514.1726	408.2976	210.6313	75.8351	0.0000	0.0000	0.0000	0.0000	190.7058	414.2591	651.5336	(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)	708.9134	566.8937	450.1627	232.2286	83.6110	0.0000	0.0000	0.0000	0.0000	210.2600	456.7355	718.3391	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.2624	119.4597	97.3180	52.4280	30.8407	6.4268	4.3355	30.9197	53.1708	98.3088	131.3100	155.2416	(64)
Efficiency of water heater												87.9000	(216)
(217)m	90.1444	90.1585	90.1473	90.1278	89.8723	87.9000	87.9000	87.9000	87.9000	89.7278	90.0099	90.1474	(217)
Fuel for water heating, kWh/month	171.1282	132.4996	107.9545	58.1708	34.3161	7.3115	4.9323	35.1759	60.4901	109.5634	145.8839	172.2086	(219)
Water heating fuel used												1039.6349	(219)
Annual totals kWh/year													
Space heating fuel - main system												3427.1439	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												368.7383	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.90 * 1182 * 1.00) =										-850.8287		-850.8287	(233)
Total delivered energy for all uses												4109.6884	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3427.1439	9.7400	333.8038	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1039.6349	9.7400	101.2604	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	368.7383	36.8500	135.8801	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-850.8287	36.8500	-313.5304	(252)
Total energy cost			407.4764	(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	3427.1439	0.2160	740.2631	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1039.6349	0.2160	224.5611	(264)
Space and water heating			964.8242	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	368.7383	0.5190	191.3752	(268)
Energy saving/generation technologies				
PV Unit	-850.8287	0.5190	-441.5801	(269)
Total kg/year			779.4943	(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	3427.1439	1.2200	4181.1155	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1039.6349	1.2200	1268.3545	(264)
Space and water heating			5449.4701	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	368.7383	3.0700	1132.0267	(268)
Energy saving/generation technologies				
PV Unit	-850.8287	3.0700	-2612.0442	(269)
Primary energy kWh/year			4353.2026	(272)
Primary energy kWh/m2/year			49.7964	(273)

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 165	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Project	Plot 165		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	15.30	**TER**	19.23
Environmental	88 B	**% DER<TER**	20.43		
CO_2 Emissions (t/year)	0.97	**DFEE**	53.14	**TFEE**	59.67
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.95		

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 165	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Project	Plot 165		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	15.30	**TER**	19.23
Environmental	88 B	**% DER<TER**	20.43		
CO_2 Emissions (t/year)	0.97	**DFEE**	53.14	**TFEE**	59.67
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.95		

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 165	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Project	Plot 165		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	15.30	**TER**	19.23
Environmental	88 B	**% DER<TER**	20.43		
CO_2 Emissions (t/year)	0.97	**DFEE**	53.14	**TFEE**	59.67
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.95		

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

Building Elements

Floor 000003

Floor Type: Suspended Floor
Area = 64.80 m², Perimeter = 34.61 m, Wall thickness = 275.00 mm, Soil: Unknown
Depth of underfloor space below ground:0.200 m Floor wind shielding: Average (suburban)
Floor height above ground:h = 0.200 m
U-value of walls above ground:Uw = 1.500 m
Ventilation openings per perimeter length:e = 0.0015 %
Mean wind speed:v = 5.000 m/s
Resistance on solum:Rg = 0.000 m²K/W

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)	Density (kg/m³)	Heat Cap. (J/kgK)
Ext surface				0.1700			
Layer 1	**EPS 200 Lower portion**						
	Main construction	55	0.0340	1.6176	80.65		
	Main construction	55	2.0000	0.0275	19.35		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 2	**EPS Upper portion**						
	Main construction	100	0.0340	2.9412	87.10		
	Main construction	100	2.0000	0.0500	12.90		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 3	**Grey EPS 100 Topsheet**						
	Main construction	155	0.0300	5.1667	100.00	15	1450
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	**Screed**						
	Main construction	75	1.1500	0.0652	100.00	1200	1000
Int surface				0.1700			

Total resistance: **Upper limit =** 9.271 m² K/W **Lower limit =** 6.052 m² K/W **Average =** 7.661 m² K/W

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

Unheated space: None

Total thickness: 385 mm **U-value: 0.12 W/m² K** **Kappa: 90.00 kJ/m² K**

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

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 165	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Castleton
Property	Plot 165		

SAP Rating	87 B	**DER**	15.30	**TER**	19.23
Environmental	88 B	**% DER<TER**	20.43		
CO_2 Emissions (t/year)	0.97	**DFEE**	53.14	**TFEE**	59.67
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.95		

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 East
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Detached
2.0 Number of Storeys	2
3.0 Date Built	2022
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

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

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

9.0 External Walls

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

9.2 Internal Walls

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

10.0 External Roofs

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

10.2 Internal Ceilings

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

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

Design SAP
elmhurst energy

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Ground Floor	Ground Floor - Solid	Other	0.12	90.00	43.71

11.2 Internal Floors

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

12.0 Opening Types

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

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front Door	Solid Door	[1] Brick and Block	South East							2.16	
Front Elevation	Window	[1] Brick and Block	South East	None	0.00					6.34	
Side Elevation	Window	[1] Brick and Block	North East	None	0.00					2.62	
Rear Elevation	Window	[1] Brick and Block	North West	None	0.00					10.85	

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Calculate Bridges	

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported	Reference:
Independently assessed	E2 Other lintels (including other steel lintels)	0.46	0.093	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.37	0.077	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.02	0.071	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	9.98	0.064	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	3.17	0.067	No	Birtley Supatherm
Independently assessed	E3 Sill	11.81	0.021	No	Knauf P5
Independently assessed	E4 Jamb	36.92	0.016	No	Knauf P6
Table K1 - Default	E5 Ground floor (normal)	26.86	0.320	No	
Independently assessed	E6 Intermediate floor within a dwelling	26.86	0.000	No	CD0029
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	15.87	0.060	No	
Independently assessed	E12 Gable (insulation at ceiling level)	11.14	0.044	No	Knauf P21
Independently assessed	E16 Corner (normal)	19.99	0.039	No	Knauf P23

Y-value	0.057	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

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

Mechanical Ventilation

Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				4
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System	No	

22.0 Lighting

Internal

Total number of light fittings	19	
Total number of L.E.L. fittings	19	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	Yes	
Light and motion sensor	Yes	

23.0 Electricity Tariff	Standard	

24.0 Main Heating 1	Database	
Description	Gas System	
Percentage of Heat	100	%
Database Ref. No.	17515	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.7	
In Summer	87.9	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	No	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	Gas/Oil, time clock	

25.0 Main Heating 2	None	

Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	

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

29.0 Hot Water Cylinder None

32.0 Photovoltaic Unit One Dwelling

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.90	South East	30°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

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