PREDICTED ENERGY ASSESSMENT

Design SAP
elmhurst energy

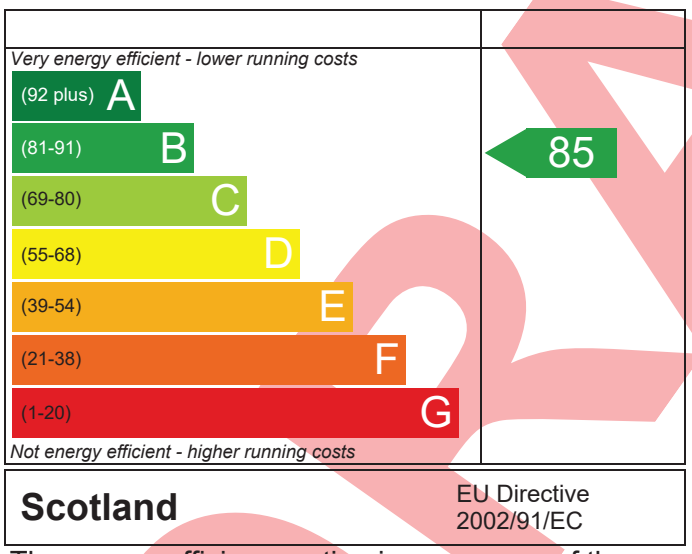
Bennachie, Plot 90, Phase 4 A,
Tarland Road,
Aboyne

Dwelling type:	House, Detached
Date of assessment:	31/01/2023
Produced by:	Northern Energy
Total floor area:	247.4 m²

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.

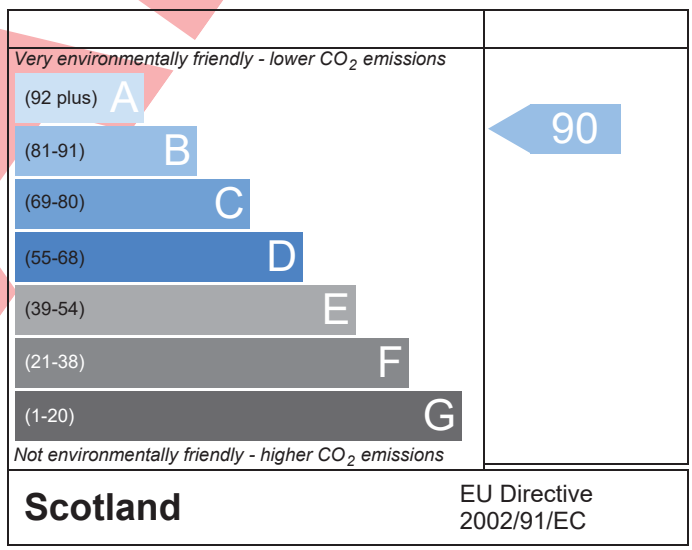
Energy Efficiency Rating



Scotland 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



Scotland 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 not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

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

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Property	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

6.1 Carbon Dioxide Emissions

1a TER and DER

Fuel for main heating	Bulk LPG		
Fuel package for TER	LPG		
Target Carbon Dioxide Emission Rate (TER)	10.06	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	9.40	$kgCO_2/m^2$	Pass
	-0.66 (-6.6%)	$kgCO_2/m^2$	

6.2 Building insulation envelope

2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.22)	0.20 (max. 0.70)	Pass
Floor	0.13 (max. 0.18)	0.15 (max. 0.70)	Pass
Roof	0.11 (max. 0.15)	0.15 (max. 0.35)	Pass
Openings	1.39 (max. 1.60)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	

6.3 Heating System

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Bulk LPG Data from database Baxi ASSURE 24 SYSTEM LPG Efficiency: 90.1% SEDBUK2009 Minimum: 88.0%	Pass
Secondary heating system	None	

6 Controls

Space heating controls	Time and temperature zone control	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass
Boiler interlock	Yes	Pass

6.4 Insulation of pipes, ducts and vessels

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 2.22 kWh/day Permitted by DBSCG 2.56	Pass
Primary pipework insulated	Yes	Pass

6.5 Artificial and display lighting

7 Low energy lights

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

6.6 Mechanical ventilation and air conditioning

8 Mechanical ventilation

Continuous extract system (decentralised)

Specific fan power	0.1600 0.2000	
Maximum	0.7	Pass

9 Summertime temperature

Overheating risk (North East Scotland)	Not significant	Pass

Based on:

Overshading	Average
Windows facing North	15.00 m², No overhang
Windows facing East	5.40 m², No overhang
Windows facing South	11.43 m², No overhang
Windows facing West	6.12 m², No overhang
Air change rate	2.50 ach
Blinds/curtains	None

	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	£83	B 86	B 91	Recommended
Photovoltaic			0	0	Already installed
Wind turbine			0	0	Not applicable
Totals	**£4,000 - £6,000**	**£83**	**B 86**	**B 91**	

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

THERMAL BRIDGING
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Property	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Scotland ACD 2015	0.037	23.75	0.88	
External wall	E3 Sill	Scotland ACD 2015	0.033	19.35	0.64	
External wall	E4 Jamb	Scotland ACD 2015	0.031	81.60	2.53	
External wall	E5 Ground floor (normal)	Scotland ACD 2015	0.173	51.04	8.83	
External wall	E6 Intermediate floor within a dwelling	Scotland ACD 2015	0.065	57.00	3.71	
External wall	E11 Eaves (insulation at rafter level)	Scotland ACD 2015	0.018	27.10	0.49	
External wall	E12 Gable (insulation at ceiling level)	Scotland ACD 2015	0.051	25.40	1.30	
External wall	E13 Gable (insulation at rafter level)	Scotland ACD 2015	0.036	5.80	0.21	
External wall	E16 Corner (normal)	Scotland ACD 2015	0.038	35.84	1.36	
External wall	E17 Corner (inverted – internal area greater than external area)	Scotland ACD 2015	-0.029	17.92	-0.52	
External roof	R1 Head of roof window	Table K1 - Default	0.080	2.75	0.22	
External roof	R2 Sill of roof window	Table K1 - Default	0.060	2.75	0.17	
External roof	R3 Jamb of roof window	Table K1 - Default	0.080	9.80	0.78	

Total: **20.59** **W/mK:**

Y-Value: **0.038** **W/m²K:**

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

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Property	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

REGULATIONS COMPLIANCE REPORT - Domestic Handbook Section 6, 2015 Edition

REGULATIONS COMPLIANCE REPORT - Domestic Handbook Section 6, 2015 Edition

Detached House, total floor area 247 m²

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

1 TER and DER
Fuel for main heating:Bulk LPG
Fuel package for TER:LPG
Target Carbon Dioxide Emission Rate (TER) 10.06 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.40 kgCO□/m²OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.22)	0.20 (max. 0.70)	OK
Floor	0.13 (max. 0.18)	0.15 (max. 0.70)	OK
Roof	0.11 (max. 0.15)	0.15 (max. 0.35)	OK
Openings	1.39 (max. 1.60)	1.40 (max. 3.30)	OK

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

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Bulk LPG
Data from database
Baxi ASSURE 24 SYSTEM LPG

Efficiency: 90.1% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 2.22 kWh/day
Permitted by DBSCG 2.56 OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Continuous extract system (decentralised)
Specific fan power: 0.1600 0.2000
Maximum: 0.7 OK

9 Summertime temperature
Overheating risk (North East Scotland): Not significant OK
Based on:
Overshading: Average
Windows facing North: 15.00 m², No overhang
Windows facing East: 5.40 m², No overhang
Windows facing South: 11.43 m², No overhang
Windows facing West: 6.12 m², No overhang
Air change rate: 2.50 ach
Blinds/curtains: None

10 Key features
Roof U-value: 0.10 W/m²K
Floor U-value: 0.12 W/m²K
Thermal bridging y-value: 0.038 W/m²K
Photovoltaic array: 2.35 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	120.5000 (1b)	x	2.4800 (2b)	=	298.8400 (1b) - (3b)	
First floor	126.9000 (1c)	x	2.5200 (2c)	=	319.7880 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	247.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	618.6280	(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							0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2000	(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) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Half hour door			1.8900	1.4000	2.6460			(26)
Part glazed doors			4.2000	1.4000	5.8800			(26a)
Windows and patios (Uw = 1.40)			37.9500	1.3258	50.3125			(27)
Velux roof lights (Uw = 1.30)			2.7000	1.2357	3.3365			(27a)
Insulated slab			120.5000	0.1200	14.4600			(28a)
Floor above garage			24.4700	0.1500	3.6705			(28b)
ACDS 2015 T/F	211.1800	40.3500	170.8300	0.1600	27.3328			(29a)
Hanging posts	16.3500		16.3500	0.1700	2.7795			(29a)
House to Garage	15.2500	1.8900	13.3600	0.1900	2.5384			(29a)
Dormer walls	5.6600	1.8000	3.8600	0.2000	0.7720			(29a)
M/Wool over / in ceiling	113.7000		113.7000	0.1000	11.3700			(30)
Sloping ceiling	31.1000	2.7000	28.4000	0.1500	4.2600			(30)
Total net area of external elements Aum(A, m2)			538.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		129.3582			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							20.5851	(36)
Total fabric heat loss					(33) + (36) =		149.9433	(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	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	(38)
Heat transfer coeff	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	(39)
Average = Sum(39)m / 12 =												252.0169	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	(40)
HLP (average)												1.0187	(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	3.0635	(42)
Average daily hot water use (litres/day)	112.5887	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Daily hot water use

	123.8476	119.3441	114.8405	110.3370	105.8334	101.3299	101.3299	105.8334	110.3370	114.8405	119.3441	123.8476	(44)
Energy conte	183.6624	160.6324	165.7582	144.5120	138.6627	119.6554	110.8783	127.2345	128.7541	150.0504	163.7918	177.8673	(45)
Energy content (annual)										Total = Sum(45)m =		1771.4594	(45)
Distribution loss (46)m = 0.15 x (45)m													
	27.5494	24.0949	24.8637	21.6768	20.7994	17.9483	16.6317	19.0852	19.3131	22.5076	24.5688	26.6801	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2200	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1988	(55)
Total storage loss													
	37.1628	33.5664	37.1628	35.9640	37.1628	35.9640	37.1628	37.1628	35.9640	37.1628	35.9640	37.1628	(56)
If cylinder contains dedicated solar storage													
	37.1628	33.5664	37.1628	35.9640	37.1628	35.9640	37.1628	37.1628	35.9640	37.1628	35.9640	37.1628	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	244.0876	215.2100	226.1834	202.9880	199.0879	178.1314	171.3035	187.6597	187.2301	210.4756	222.2678	238.2925	(62)
WWHRS	-48.0622	-42.2883	-43.1608	-35.5136	-32.9763	-27.2046	-23.0256	-27.8781	-28.6908	-35.4659	-41.0803	-46.4538	eq.(G10)
Total of WWHRS savings												-431.8002	
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)
FGHRS	-33.8193	-29.3106	-29.6938	-25.0450	-22.2819	-9.3025	-9.1848	-9.8257	-9.7267	-25.9222	-29.9229	-33.3588	eq.(G6)
Output from w/h													
	162.2061	143.6111	153.3288	142.4294	143.8298	141.6243	139.0932	149.9559	148.8126	149.0875	151.2646	158.4799	(64)
								Total per year (kWh/year) = Sum(64)m =				1783.7231	(64)
Heat gains from water heating, kWh/month													
	109.4079	97.0723	103.4548	94.8310	94.4455	86.5662	85.2072	90.6456	89.5915	98.2319	101.2416	107.4810	(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	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	38.2216	33.9480	27.6084	20.9013	15.6240	13.1904	14.2527	18.5262	24.8659	31.5729	36.8503	39.2839	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	414.1241	418.4214	407.5924	384.5385	355.4372	328.0860	309.8138	305.5164	316.3455	339.3994	368.5007	395.8519	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	(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)													
	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	(71)
Water heating gains (Table 5)													
	147.0537	144.4529	139.0521	131.7098	126.9429	120.2309	114.5258	121.8355	124.4327	132.0322	140.6133	144.4637	(72)
Total internal gains													
	671.3526	668.7756	646.2061	609.1029	569.9573	533.4605	510.5455	517.8314	537.5973	574.9577	617.9176	651.5527	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.0000	10.6334	0.6300	0.7000	0.7700	48.7455	(74)
East	5.4000	19.6403	0.6300	0.7000	0.7700	32.4125	(76)
South	11.4300	46.7521	0.6300	0.7000	0.7700	163.3123	(78)
West	6.1200	19.6403	0.6300	0.7000	0.7700	36.7342	(80)
North	0.5400	15.2954	0.6300	0.7000	1.0000	3.2782	(82)
South	2.1600	47.0123	0.6300	0.7000	1.0000	40.3038	(82)

Solar gains	324.7866	573.9147	837.7377	1121.9554	1330.4133	1352.4485	1290.7880	1130.9422	935.7527	648.6858	392.8456	275.4417	(83)
Total gains	996.1392	1242.6903	1483.9438	1731.0583	1900.3706	1885.9091	1801.3335	1648.7736	1473.3500	1223.6436	1010.7631	926.9944	(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	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	
alpha	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	
util living area													
	0.9868	0.9750	0.9516	0.9009	0.8098	0.6780	0.5441	0.5985	0.7958	0.9341	0.9784	0.9892	(86)
MIT	18.5595	18.8469	19.3037	19.8728	20.3911	20.7471	20.9025	20.8695	20.5715	19.8818	19.0979	18.4905	(87)
Th 2	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	(88)
util rest of house													
	0.9847	0.9712	0.9438	0.8840	0.7752	0.6143	0.4504	0.5065	0.7456	0.9195	0.9744	0.9875	(89)
MIT 2	16.7514	17.1693	17.8308	18.6448	19.3634	19.8245	19.9985	19.9688	19.6186	18.6706	17.5378	16.6509	(90)
Living area fraction									fLA = Living area / (4) =			0.1769	(91)
MIT	17.0713	17.4661	18.0914	18.8620	19.5452	19.9878	20.1584	20.1282	19.7871	18.8849	17.8138	16.9763	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0713	17.4661	18.0914	18.8620	19.5452	19.9878	20.1584	20.1282	19.7871	18.8849	17.8138	16.9763	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9744	0.9552	0.9211	0.8564	0.7525	0.6082	0.4602	0.5130	0.7278	0.8944	0.9598	0.9785	(94)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Useful gains	970.6034	1187.0322	1366.8538	1482.3931	1430.0480	1147.0302	828.9628	845.7520	1072.3234	1094.4754	970.1349	907.0621	(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	3218.5922	3166.8778	2921.2296	2510.6038	1977.1299	1357.8051	896.7823	939.5636	1433.2575	2087.9323	2700.0553	3219.8543	(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	1672.5037	1330.4562	1156.4556	740.3117	407.0289	0.0000	0.0000	0.0000	0.0000	739.1319	1245.5427	1720.7174	(98)
Space heating												9012.1482	(98)
Space heating per m2											(98) / (4) =	36.4274	(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 %)												91.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1672.5037	1330.4562	1156.4556	740.3117	407.0289	0.0000	0.0000	0.0000	0.0000	739.1319	1245.5427	1720.7174	(98)
Space heating efficiency (main heating system 1)	91.1000	91.1000	91.1000	91.1000	91.1000	0.0000	0.0000	0.0000	0.0000	91.1000	91.1000	91.1000	(210)
Space heating fuel (main heating system)	1835.8987	1460.4350	1269.4353	812.6363	446.7935	0.0000	0.0000	0.0000	0.0000	811.3413	1367.2258	1888.8227	(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	162.2061	143.6111	153.3288	142.4294	143.8298	141.6243	139.0932	149.9559	148.8126	149.0875	151.2646	158.4799	(64)
Efficiency of water heater												80.4000	(216)
(217)m	90.0406	89.9339	89.7025	89.1849	88.0407	80.4000	80.4000	80.4000	80.4000	89.1095	89.8057	90.0889	(217)
Fuel for water heating, kWh/month	180.1478	159.6851	170.9304	159.7012	163.3673	176.1496	173.0015	186.5123	185.0903	167.3083	168.4354	175.9150	(219)
Water heating fuel used												2066.2442	(219)
Annual totals kWh/year													
Space heating fuel - main system												9892.5885	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 13.1040, total flow = 53.0000, SFP = 0.2472)													
mechanical ventilation fans (SFP = 0.2472)												186.6025	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												261.6025	(231)
Electricity for lighting (calculated in Appendix L)												675.0046	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.35 * 1068 * 1.00) =										-2007.9725		-2007.9725	(233)
Total delivered energy for all uses												10887.4674	(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	9892.5885	0.2410	2384.1138	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2066.2442	0.2410	497.9649	(264)
Space and water heating			2882.0787	(265)
Pumps and fans	261.6025	0.5190	135.7717	(267)
Energy for lighting	675.0046	0.5190	350.3274	(268)
Energy saving/generation technologies				
PV Unit	-2007.9725	0.5190	-1042.1377	(269)
Total CO2, kg/year			2326.0401	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.4000	(273)

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

DER		9.4000	ZC1
Total Floor Area	TFA	247.4000	
Assumed number of occupants	N	3.0635	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		9.9192	ZC2
CO2 emissions from cooking, equation (L16)		0.7782	ZC3
Total CO2 emissions		20.0974	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		20.0974	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	120.5000 (1b)	x	2.4800 (2b)	=	298.8400 (1b) - (3b)	
First floor	126.9000 (1c)	x	2.5200 (2c)	=	319.7880 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	247.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	618.6280	(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	1	+	0	+	0	=	1 * 20 =	20.0000	(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) =	60.0000 / (5) =	0.0970	(8)
Pressure test		Yes	
Measured/design AP50		7.0000	
Infiltration rate		0.4470	(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) =	0.3799	(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	0.4844	0.4749	0.4654	0.4179	0.4084	0.3609	0.3609	0.3514	0.3799	0.4084	0.4274	0.4464	(22b)
Effective ac	0.6173	0.6128	0.6083	0.5873	0.5834	0.5651	0.5651	0.5618	0.5722	0.5834	0.5913	0.5996	(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			1.8500	1.4000	2.5900			(26)
TER Opening Type (Uw = 1.40)			60.0000	1.3258	79.5455			(27)
Insulated slab			120.5000	0.1500	18.0750			(28a)
Floor above garage			24.4700	0.1500	3.6705			(28b)
ACDS 2015 T/F	248.4400	61.8500	186.5900	0.1700	31.7203			(29a)
M/Wool over / in ceiling	144.8000		144.8000	0.1100	15.9280			(30)
Total net area of external elements Aum(A, m2)			538.2100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	151.5293			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (User defined value 0.080 * total exposed area)	43.0568	(36)
Total fabric heat loss (33) + (36) =	194.5861	(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	126.0269	125.0968	124.1851	119.9027	119.1015	115.3718	115.3718	114.6811	116.8084	119.1015	120.7224	122.4169	(38)
Heat transfer coeff	320.6130	319.6828	318.7711	314.4888	313.6876	309.9578	309.9578	309.2672	311.3945	313.6876	315.3084	317.0029	(39)
Average = Sum(39)m / 12 =												314.4850	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2959	1.2922	1.2885	1.2712	1.2679	1.2529	1.2529	1.2501	1.2587	1.2679	1.2745	1.2813	(40)
HLP (average)												1.2712	(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	3.0635 (42)
Average daily hot water use (litres/day)	112.5887 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.8476	119.3441	114.8405	110.3370	105.8334	101.3299	101.3299	105.8334	110.3370	114.8405	119.3441	123.8476	(44)
Energy conte	183.6624	160.6324	165.7582	144.5120	138.6627	119.6554	110.8783	127.2345	128.7541	150.0504	163.7918	177.8673	(45)
Energy content (annual)										Total = Sum(45)m =		1771.4594	(45)
Distribution loss (46)m = 0.15 x (45)m	27.5494	24.0949	24.8637	21.6768	20.7994	17.9483	16.6317	19.0852	19.3131	22.5076	24.5688	26.6801	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8900	(48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0206 (55)
Total storage loss												
	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386 (56)
If cylinder contains dedicated solar storage												
	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	238.5634	210.2204	220.6592	197.6420	193.5637	172.7854	165.7793	182.1355	181.8841	204.9514	216.9218	232.7683 (62)
WWHRS	-45.4445	-39.9850	-40.8101	-33.5794	-31.1802	-25.7229	-21.7715	-26.3598	-27.1281	-33.5343	-38.8429	-43.9237 eq.(G10)
Total of WWHRS savings												-408.2823
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												
	193.1190	170.2353	179.8491	164.0626	162.3835	147.0625	144.0078	155.7757	154.7559	171.4172	178.0789	188.8446 (64)
								Total per year (kWh/year) = Sum(64)m =				2009.5922 (64)
Heat gains from water heating, kWh/month												
	104.9886	93.0807	99.0354	90.5542	90.0262	82.2894	80.7878	86.2263	85.3147	93.8126	96.9648	103.0617 (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	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	36.9195	32.7915	26.6679	20.1893	15.0917	12.7411	13.7672	17.8951	24.0188	30.4974	35.5949	37.9456	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	414.1241	418.4214	407.5924	384.5385	355.4372	328.0860	309.8138	305.5164	316.3455	339.3994	368.5007	395.8519	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	(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)													
	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	(71)
Water heating gains (Table 5)													
	141.1137	138.5129	133.1121	125.7698	121.0029	114.2909	108.5858	115.8955	118.4927	126.0922	134.6733	138.5237	(72)
Total internal gains													
	664.1105	661.6791	639.3256	602.4508	563.4850	527.0712	504.1200	511.2603	530.8102	567.9421	610.7222	644.2745	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	60.0000	19.6403	0.6300	0.7000	0.7700	360.1392	(76)

Solar gains	360.1392	704.5087	1160.2254	1692.1196	2073.7561	2122.8584	2021.0477	1736.0501	1349.3902	835.9589	449.0512	296.1610	(83)
Total gains	1024.2497	1366.1878	1799.5510	2294.5704	2637.2411	2649.9296	2525.1677	2247.3104	1880.2004	1403.9010	1059.7734	940.4354	(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	21.4346	21.4970	21.5585	21.8520	21.9079	22.1715	22.1715	22.2210	22.0692	21.9079	21.7952	21.6787	
alpha	2.4290	2.4331	2.4372	2.4568	2.4605	2.4781	2.4781	2.4814	2.4713	2.4605	2.4530	2.4452	
util living area													
	0.9854	0.9706	0.9362	0.8613	0.7460	0.6039	0.4789	0.5392	0.7577	0.9244	0.9765	0.9881	(86)
MIT	18.0134	18.3703	18.9759	19.7324	20.3409	20.7327	20.8923	20.8529	20.4962	19.6370	18.6823	17.9634	(87)
Th 2	19.8440	19.8470	19.8499	19.8635	19.8660	19.8779	19.8779	19.8802	19.8734	19.8660	19.8609	19.8555	(88)
util rest of house													
	0.9829	0.9656	0.9253	0.8371	0.7006	0.5294	0.3761	0.4354	0.6958	0.9062	0.9718	0.9861	(89)
MIT 2	15.8402	16.3601	17.2354	18.3135	19.1406	19.6400	19.8101	19.7802	19.3744	18.2052	16.8254	15.7730	(90)
Living area fraction									fLA = Living area / (4) =			0.1769	(91)
MIT	16.2247	16.7157	17.5434	18.5645	19.3529	19.8333	20.0016	19.9700	19.5728	18.4585	17.1539	16.1605	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.0747	16.5657	17.3934	18.4145	19.2029	19.6833	19.8516	19.8200	19.4228	18.3085	17.0039	16.0105	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9690	0.9431	0.8916	0.7978	0.6696	0.5151	0.3734	0.4292	0.6658	0.8702	0.9522	0.9742	(94)
Useful gains	992.4915	1288.5142	1604.5121	1830.5417	1765.7951	1364.9484	943.0114	964.6549	1251.8602	1221.6124	1009.1409	916.2094	(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													
	3775.1143	3729.3394	3472.4914	2992.2109	2353.5796	1575.6163	1007.8542	1057.6854	1657.4979	2418.0546	3122.7914	3743.9711	(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													
	2070.2714	1640.2345	1389.7766	836.4019	437.3117	0.0000	0.0000	0.0000	0.0000	890.1530	1521.8283	2103.8547	(98)
Space heating												10889.8321	(98)
Space heating per m2											(98) / (4) =	44.0171	(99)

8c. Space cooling requirement

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.1000	(201)
Fraction of space heat from main system(s)												0.9000	(202)
Efficiency of main space heating system 1 (in %)												92.0000	(206)
Efficiency of secondary/supplementary heating system, %												60.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2070.2714	1640.2345	1389.7766	836.4019	437.3117	0.0000	0.0000	0.0000	0.0000	890.1530	1521.8283	2103.8547	(98)
Space heating efficiency (main heating system 1)													
	92.0000	92.0000	92.0000	92.0000	92.0000	0.0000	0.0000	0.0000	0.0000	92.0000	92.0000	92.0000	(210)
Space heating fuel (main heating system)													
	2025.2655	1604.5773	1359.5640	818.2192	427.8049	0.0000	0.0000	0.0000	0.0000	870.8019	1488.7451	2058.1187	(211)
Water heating requirement													
	345.0452	273.3724	231.6294	139.4003	72.8853	0.0000	0.0000	0.0000	0.0000	148.3588	253.6381	350.6425	(215)
Water heating													
Water heating requirement													
	193.1190	170.2353	179.8491	164.0626	162.3835	147.0625	144.0078	155.7757	154.7559	171.4172	178.0789	188.8446	(64)
Efficiency of water heater												79.3000	(216)
(217)m	89.3153	89.1974	88.9212	88.2691	86.9146	79.3000	79.3000	79.3000	79.3000	88.3019	89.0529	89.3555	(217)
Fuel for water heating, kWh/month													
	216.2215	190.8523	202.2567	185.8664	186.8310	185.4508	181.5988	196.4385	195.1525	194.1264	199.9699	211.3408	(219)
Water heating fuel used												2346.1055	(219)
Annual totals kWh/year													
Space heating fuel - main system												10653.0967	(211)
Space heating fuel - secondary												1814.9720	(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)												652.0093	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.47 * 1029 * 1.00) =										-2033.6729		-2033.6729	(233)
Total delivered energy for all uses												13507.5106	(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	10653.0967	0.2410	2567.3963	(261)
Space heating - secondary	1814.9720	0.0190	34.4845	(263)
Water heating (other fuel)	2346.1055	0.2410	565.4114	(264)
Space and water heating			3167.2922	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	652.0093	0.5190	338.3928	(268)
Energy saving/generation technologies				
PV Unit	-2033.6729	0.5190	-1055.4763	(269)
Total CO2, kg/m2/year			2489.1338	(272)
Target Carbon Dioxide Emission Rate (TER) = 2489.1338 / 247.40, rounded to 2 d.p.			10.0600	(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	120.5000 (1b)	x	2.4800 (2b)	=	298.8400 (1b) - (3b)	
First floor	126.9000 (1c)	x	2.5200 (2c)	=	319.7880 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	247.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	618.6280	(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) =	0.0647	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2647	(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) =	0.2250	(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	0.2868	0.2812	0.2756	0.2475	0.2418	0.2137	0.2137	0.2081	0.2250	0.2418	0.2531	0.2643	(22b)
Effective ac	0.5411	0.5395	0.5380	0.5306	0.5292	0.5228	0.5228	0.5217	0.5253	0.5292	0.5320	0.5349	(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	
Half hour door			1.8900	1.4000	2.6460			(26)
Part glazed doors			4.2000	1.4000	5.8800			(26a)
Windows and patios (Uw = 1.40)			37.9500	1.3258	50.3125			(27)
Velux roof lights (Uw = 1.30)			2.7000	1.2357	3.3365			(27a)
Insulated slab			120.5000	0.1200	14.4600			(28a)
Floor above garage			24.4700	0.1500	3.6705			(28b)
ACDS 2015 T/F	211.1800	40.3500	170.8300	0.1600	27.3328			(29a)
Hanging posts	16.3500		16.3500	0.1700	2.7795			(29a)
House to Garage	15.2500	1.8900	13.3600	0.1900	2.5384			(29a)
Dormer walls	5.6600	1.8000	3.8600	0.2000	0.7720			(29a)
M/Wool over / in ceiling	113.7000		113.7000	0.1000	11.3700			(30)
Sloping ceiling	31.1000	2.7000	28.4000	0.1500	4.2600			(30)
Total net area of external elements Aum(A, m2)			538.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		129.3582			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.5851	(36)
Total fabric heat loss (33) + (36) =	149.9433	(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	110.4710	110.1450	109.8253	108.3241	108.0432	106.7356	106.7356	106.4935	107.2393	108.0432	108.6114	109.2055	(38)
Heat transfer coeff	260.4143	260.0882	259.7686	258.2673	257.9864	256.6789	256.6789	256.4367	257.1825	257.9864	258.5547	259.1487	(39)
Average = Sum(39)m / 12 =												258.2660	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0526	1.0513	1.0500	1.0439	1.0428	1.0375	1.0375	1.0365	1.0395	1.0428	1.0451	1.0475	(40)
HLP (average)												1.0439	(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	3.0635	(42)
Average daily hot water use (litres/day)	112.5887	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.8476	119.3441	114.8405	110.3370	105.8334	101.3299	101.3299	105.8334	110.3370	114.8405	119.3441	123.8476	(44)
Energy conte	183.6624	160.6324	165.7582	144.5120	138.6627	119.6554	110.8783	127.2345	128.7541	150.0504	163.7918	177.8673	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1771.4594	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	39.0283	34.1344	35.2236	30.7088	29.4658	25.4268	23.5616	27.0373	27.3602	31.8857	34.8058	37.7968	(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	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	153.1775	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	38.2216	33.9480	27.6084	20.9013	15.6240	13.1904	14.2527	18.5262	24.8659	31.5729	36.8503	39.2839	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	414.1241	418.4214	407.5924	384.5385	355.4372	328.0860	309.8138	305.5164	316.3455	339.3994	368.5007	395.8519	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	38.3177	(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)													
	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	(71)
Water heating gains (Table 5)													
	52.4574	50.7952	47.3436	42.6511	39.6046	35.3150	31.6689	36.3405	38.0003	42.8571	48.3413	50.8021	(72)
Total internal gains													
	573.7563	572.1179	551.4976	517.0442	479.6190	445.5446	424.6886	429.3364	448.1650	482.7827	522.6456	554.8911	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.0000	10.6334	0.6300	0.7000	0.7700	48.7455	(74)
East	5.4000	19.6403	0.6300	0.7000	0.7700	32.4125	(76)
South	11.4300	46.7521	0.6300	0.7000	0.7700	163.3123	(78)
West	6.1200	19.6403	0.6300	0.7000	0.7700	36.7342	(80)
North	0.5400	15.2954	0.6300	0.7000	1.0000	3.2782	(82)
South	2.1600	47.0123	0.6300	0.7000	1.0000	40.3038	(82)

Solar gains	324.7866	573.9147	837.7377	1121.9554	1330.4133	1352.4485	1290.7880	1130.9422	935.7527	648.6858	392.8456	275.4417	(83)
Total gains	898.5429	1146.0326	1389.2352	1638.9996	1810.0323	1797.9932	1715.4766	1560.2786	1383.9177	1131.4685	915.4912	830.3328	(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	26.3896	26.4227	26.4552	26.6089	26.6379	26.7736	26.7736	26.7989	26.7212	26.6379	26.5794	26.5184	
alpha	2.7593	2.7615	2.7637	2.7739	2.7759	2.7849	2.7849	2.7866	2.7814	2.7759	2.7720	2.7679	
util living area													
	0.9897	0.9796	0.9590	0.9130	0.8285	0.7017	0.5700	0.6265	0.8191	0.9453	0.9831	0.9917	(86)
MIT	18.4144	18.7084	19.1789	19.7790	20.3253	20.7137	20.8861	20.8481	20.5187	19.7899	18.9812	18.3568	(87)
Th 2	20.0397	20.0408	20.0419	20.0469	20.0478	20.0522	20.0522	20.0530	20.0505	20.0478	20.0459	20.0439	(88)
util rest of house													
	0.9881	0.9763	0.9521	0.8975	0.7954	0.6382	0.4733	0.5327	0.7714	0.9326	0.9799	0.9904	(89)
MIT 2	17.6400	17.9330	18.3999	18.9914	19.5123	19.8629	19.9965	19.9736	19.7029	19.0112	18.2098	17.5854	(90)
Living area fraction										fLA = Living area / (4) =		0.1769	(91)
MIT	17.7770	18.0702	18.5377	19.1308	19.6561	20.0134	20.1539	20.1283	19.8473	19.1490	18.3463	17.7219	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7770	18.0702	18.5377	19.1308	19.6561	20.0134	20.1539	20.1283	19.8473	19.1490	18.3463	17.7219	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9826	0.9671	0.9380	0.8791	0.7795	0.6353	0.4845	0.5409	0.7593	0.9170	0.9718	0.9858	(94)
Useful gains	882.8767	1108.3375	1303.1674	1440.8531	1410.9297	1142.2927	831.2184	843.9623	1050.7605	1037.5080	889.6824	818.5063	(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													
	3509.5982	3425.4023	3127.0154	2642.2716	2052.5785	1389.5025	912.2034	956.0764	1478.0982	2205.5158	2907.7836	3504.1836	(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													
	1954.2808	1557.0675	1356.9429	865.0214	477.3867	0.0000	0.0000	0.0000	0.0000	868.9978	1453.0329	1998.1439	(98)
Space heating												10530.8738	(98)
Space heating per m2											(98) / (4) =	42.5662	(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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	2412.7815	1899.4238	1948.9193	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7051	0.7756	0.7364	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1701.3714	1473.2356	1435.1050	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2224.0508	2125.2233	1951.2998	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	376.3291	485.0788	384.0490	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1245.4570	(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	94.0823	121.2697	96.0122	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												311.3642	(107)
Space cooling per m2												1.2585	(108)
Energy for space heating												42.5662	(99)
Energy for space cooling												1.2585	(108)
Total												43.8247	(109)
Dwelling Fabric Energy Efficiency (DFEE)												43.8	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	120.5000 (1b)	x	2.4800 (2b)	=	298.8400	(1b) - (3b)
First floor	126.9000 (1c)	x	2.5200 (2c)	=	319.7880	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	247.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	618.6280	(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							0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2000	(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) =	0.1700	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.7000	5.8000	5.7000	5.0000	4.6000	4.4000	4.0000	4.1000	4.6000	5.2000	5.3000	5.1000	(22)
Wind factor	1.4250	1.4500	1.4250	1.2500	1.1500	1.1000	1.0000	1.0250	1.1500	1.3000	1.3250	1.2750	(22a)
Adj infilt rate	0.2423	0.2465	0.2423	0.2125	0.1955	0.1870	0.1700	0.1743	0.1955	0.2210	0.2253	0.2168	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Half hour door			1.8900	1.4000	2.6460			(26)
Part glazed doors			4.2000	1.4000	5.8800			(26a)
Windows and patios (Uw = 1.40)			37.9500	1.3258	50.3125			(27)
Velux roof lights (Uw = 1.30)			2.7000	1.2357	3.3365			(27a)
Insulated slab			120.5000	0.1200	14.4600			(28a)
Floor above garage			24.4700	0.1500	3.6705			(28b)
ACDS 2015 T/F	211.1800	40.3500	170.8300	0.1600	27.3328			(29a)
Hanging posts	16.3500		16.3500	0.1700	2.7795			(29a)
House to Garage	15.2500	1.8900	13.3600	0.1900	2.5384			(29a)
Dormer walls	5.6600	1.8000	3.8600	0.2000	0.7720			(29a)
M/Wool over / in ceiling	113.7000		113.7000	0.1000	11.3700			(30)
Sloping ceiling	31.1000	2.7000	28.4000	0.1500	4.2600			(30)
Total net area of external elements Aum(A, m2)			538.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		129.3582			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.5851	(36)
Total fabric heat loss (33) + (36) =	149.9433	(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	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	(38)
Heat transfer coeff	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	(39)
Average = Sum(39)m / 12 =												252.0169	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	(40)
HLP (average)												1.0187	(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	3.0635	(42)
Average daily hot water use (litres/day)	112.5887	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF HEAT DEMAND 09 Jan 2014

Daily hot water use

	123.8476	119.3441	114.8405	110.3370	105.8334	101.3299	101.3299	105.8334	110.3370	114.8405	119.3441	123.8476	(44)
Energy conte	183.6624	160.6324	165.7582	144.5120	138.6627	119.6554	110.8783	127.2345	128.7541	150.0504	163.7918	177.8673	(45)
Energy content (annual)										Total = Sum(45)m =		1771.4594	(45)
Distribution loss (46)m = 0.15 x (45)m													
	27.5494	24.0949	24.8637	21.6768	20.7994	17.9483	16.6317	19.0852	19.3131	22.5076	24.5688	26.6801	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2200	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1988	(55)
Total storage loss													
	37.1628	33.5664	37.1628	35.9640	37.1628	35.9640	37.1628	37.1628	35.9640	37.1628	35.9640	37.1628	(56)
If cylinder contains dedicated solar storage													
	37.1628	33.5664	37.1628	35.9640	37.1628	35.9640	37.1628	37.1628	35.9640	37.1628	35.9640	37.1628	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	244.0876	215.2100	226.1834	202.9880	199.0879	178.1314	171.3035	187.6597	187.2301	210.4756	222.2678	238.2925	(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													
	244.0876	215.2100	226.1834	202.9880	199.0879	178.1314	171.3035	187.6597	187.2301	210.4756	222.2678	238.2925	(64)
								Total per year (kWh/year) = Sum(64)m =				2482.9174	(64)
RHI water heating demand												2483	(64)
Heat gains from water heating, kWh/month													
	109.4079	97.0723	103.4548	94.8310	94.4455	86.5662	85.2072	90.6456	89.5915	98.2319	101.2416	107.4810	(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	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	95.5539	84.8701	69.0210	52.2534	39.0600	32.9761	35.6318	46.3156	62.1647	78.9324	92.1257	98.2096	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	618.0957	624.5096	608.3468	573.9381	530.5032	489.6806	462.4086	455.9947	472.1575	506.5662	550.0011	590.8237	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	(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)													
	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	(71)
Water heating gains (Table 5)													
	147.0537	144.4529	139.0521	131.7098	126.9429	120.2309	114.5258	121.8355	124.4327	132.0322	140.6133	144.4637	(72)
Total internal gains													
	981.4191	974.5485	937.1358	878.6171	817.2220	763.6034	733.2821	744.8616	779.4707	838.2466	903.4559	954.2129	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.0000	8.2005	0.6300	0.7000	0.7700	37.5927	(74)
East	5.4000	14.7869	0.6300	0.7000	0.7700	24.4030	(76)
South	11.4300	38.1750	0.6300	0.7000	0.7700	133.3512	(78)
West	6.1200	14.7869	0.6300	0.7000	0.7700	27.6568	(80)
North	0.5400	12.1077	0.6300	0.7000	1.0000	2.5950	(82)
South	2.1600	37.0090	0.6300	0.7000	1.0000	31.7280	(82)

Solar gains	257.3267	516.1729	827.4195	1117.2595	1382.2084	1298.5242	1238.2220	1075.9421	868.9959	570.5501	322.3713	199.2072	(83)
Total gains	1238.7458	1490.7213	1764.5552	1995.8765	2199.4304	2062.1276	1971.5041	1820.8038	1648.4667	1408.7967	1225.8272	1153.4201	(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	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	
alpha	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	
util living area													
	0.9803	0.9679	0.9428	0.9002	0.8348	0.7643	0.6958	0.7316	0.8422	0.9367	0.9727	0.9844	(86)
MIT	18.5439	18.7740	19.2079	19.7090	20.1584	20.5145	20.7032	20.6541	20.3343	19.6722	18.9848	18.4079	(87)
Th 2	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	(88)
util rest of house													
	0.9775	0.9635	0.9347	0.8856	0.8100	0.7234	0.6387	0.6773	0.8099	0.9249	0.9682	0.9822	(89)
MIT 2	16.7270	17.0605	17.6877	18.4050	19.0348	19.5237	19.7686	19.7119	19.2941	18.3651	17.3706	16.5289	(90)
Living area fraction									fLA = Living area / (4) =			0.1769	(91)
MIT	17.0485	17.3637	17.9566	18.6357	19.2336	19.6990	19.9339	19.8786	19.4782	18.5963	17.6562	16.8613	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0485	17.3637	17.9566	18.6357	19.2336	19.6990	19.9339	19.8786	19.4782	18.5963	17.6562	16.8613	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9639	0.9450	0.9103	0.8575	0.7838	0.7051	0.6296	0.6648	0.7853	0.8999	0.9514	0.9706	(94)
Useful gains	1194.0041	1408.7702	1606.2979	1711.4099	1723.9280	1454.0014	1241.2043	1210.5143	1294.5223	1267.7514	1166.2347	1119.4772	(95)
Ext temp.	3.3000	3.6000	5.0000	7.1000	9.3000	12.2000	14.0000	13.9000	12.0000	8.8000	5.7000	2.9000	(96)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Heat loss rate W													
	3464.8468	3468.6831	3265.2913	2907.1943	2503.4370	1889.8811	1495.4466	1506.6985	1884.6259	2468.8375	3013.1685	3518.4882	(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													
	1689.5069	1384.2615	1234.2910	860.9648	579.9547	0.0000	0.0000	0.0000	0.0000	893.6080	1329.7923	1784.8642	(98)
Space heating												9757.2434	(98)
RHI space heating demand												9757	(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	120.5000 (1b)	x	2.4800 (2b)	=	298.8400 (1b) - (3b)	
First floor	126.9000 (1c)	x	2.5200 (2c)	=	319.7880 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	247.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	618.6280	(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							0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2000	(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) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Half hour door			1.8900	1.4000	2.6460			(26)
Part glazed doors			4.2000	1.4000	5.8800			(26a)
Windows and patios (Uw = 1.40)			37.9500	1.3258	50.3125			(27)
Velux roof lights (Uw = 1.30)			2.7000	1.2357	3.3365			(27a)
Insulated slab			120.5000	0.1200	14.4600			(28a)
Floor above garage			24.4700	0.1500	3.6705			(28b)
ACDS 2015 T/F	211.1800	40.3500	170.8300	0.1600	27.3328			(29a)
Hanging posts	16.3500		16.3500	0.1700	2.7795			(29a)
House to Garage	15.2500	1.8900	13.3600	0.1900	2.5384			(29a)
Dormer walls	5.6600	1.8000	3.8600	0.2000	0.7720			(29a)
M/Wool over / in ceiling	113.7000		113.7000	0.1000	11.3700			(30)
Sloping ceiling	31.1000	2.7000	28.4000	0.1500	4.2600			(30)
Total net area of external elements Aum(A, m2)			538.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		129.3582			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							20.5851	(36)
Total fabric heat loss					(33) + (36) =		149.9433	(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	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	(38)
Heat transfer coeff	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	(39)
Average = Sum(39)m / 12 =												252.0169	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	(40)
HLP (average)												1.0187	(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	3.0635	(42)
Average daily hot water use (litres/day)	112.5887	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Daily hot water use													
	123.8476	119.3441	114.8405	110.3370	105.8334	101.3299	101.3299	105.8334	110.3370	114.8405	119.3441	123.8476	(44)
Energy conte	183.6624	160.6324	165.7582	144.5120	138.6627	119.6554	110.8783	127.2345	128.7541	150.0504	163.7918	177.8673	(45)
Energy content (annual)										Total = Sum(45)m =		1771.4594	(45)
Distribution loss (46)m = 0.15 x (45)m													
	27.5494	24.0949	24.8637	21.6768	20.7994	17.9483	16.6317	19.0852	19.3131	22.5076	24.5688	26.6801	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2200	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1988	(55)
Total storage loss													
	37.1628	33.5664	37.1628	35.9640	37.1628	35.9640	37.1628	37.1628	35.9640	37.1628	35.9640	37.1628	(56)
If cylinder contains dedicated solar storage													
	37.1628	33.5664	37.1628	35.9640	37.1628	35.9640	37.1628	37.1628	35.9640	37.1628	35.9640	37.1628	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	244.0876	215.2100	226.1834	202.9880	199.0879	178.1314	171.3035	187.6597	187.2301	210.4756	222.2678	238.2925	(62)
WWHRS	-48.0622	-42.2883	-43.1608	-35.5136	-32.9763	-27.2046	-23.0256	-27.8781	-28.6908	-35.4659	-41.0803	-46.4538	eq.(G10)
Total of WWHRS savings												-431.8002	
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)
FGHRS	-33.1680	-28.8452	-29.2415	-24.4245	-21.8841	-9.3025	-9.1848	-9.8257	-9.7267	-25.1958	-29.4310	-32.7318	eq.(G6)
Output from w/h													
	162.8575	144.0765	153.7810	143.0499	144.2275	141.6243	139.0932	149.9559	148.8126	149.8140	151.7565	159.1068	(64)
								Total per year (kWh/year) = Sum(64)m =				1788.1557	(64)
Heat gains from water heating, kWh/month													
	109.4079	97.0723	103.4548	94.8310	94.4455	86.5662	85.2072	90.6456	89.5915	98.2319	101.2416	107.4810	(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	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	95.5539	84.8701	69.0210	52.2534	39.0600	32.9761	35.6318	46.3156	62.1647	78.9324	92.1257	98.2096	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	618.0957	624.5096	608.3468	573.9381	530.5032	489.6806	462.4086	455.9947	472.1575	506.5662	550.0011	590.8237	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	(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)													
	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	(71)
Water heating gains (Table 5)													
	147.0537	144.4529	139.0521	131.7098	126.9429	120.2309	114.5258	121.8355	124.4327	132.0322	140.6133	144.4637	(72)
Total internal gains													
	981.4191	974.5485	937.1358	878.6171	817.2220	763.6034	733.2821	744.8616	779.4707	838.2466	903.4559	954.2129	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.0000	10.6334	0.6300	0.7000	0.7700	48.7455	(74)
East	5.4000	19.6403	0.6300	0.7000	0.7700	32.4125	(76)
South	11.4300	46.7521	0.6300	0.7000	0.7700	163.3123	(78)
West	6.1200	19.6403	0.6300	0.7000	0.7700	36.7342	(80)
North	0.5400	15.2954	0.6300	0.7000	1.0000	3.2782	(82)
South	2.1600	47.0123	0.6300	0.7000	1.0000	40.3038	(82)

Solar gains	324.7866	573.9147	837.7377	1121.9554	1330.4133	1352.4485	1290.7880	1130.9422	935.7527	648.6858	392.8456	275.4417	(83)
Total gains	1306.2057	1548.4632	1774.8734	2000.5724	2147.6353	2116.0519	2024.0701	1875.8038	1715.2234	1486.9324	1296.3015	1229.6546	(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	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	
alpha	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	
util living area													
	0.9742	0.9580	0.9282	0.8689	0.7694	0.6316	0.4973	0.5457	0.7431	0.9010	0.9609	0.9780	(86)
MIT	18.7786	19.0525	19.4818	20.0081	20.4770	20.7908	20.9226	20.8973	20.6487	20.0307	19.2921	18.7067	(87)
Th 2	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	(88)
util rest of house													
	0.9704	0.9519	0.9175	0.8483	0.7313	0.5670	0.4078	0.4563	0.6879	0.8811	0.9541	0.9748	(89)
MIT 2	17.0690	17.4653	18.0833	18.8295	19.4714	19.8704	20.0140	19.9920	19.7086	18.8755	17.8169	16.9647	(90)
Living area fraction									fLA = Living area / (4) =			0.1769	(91)
MIT	17.3715	17.7461	18.3307	19.0380	19.6493	20.0332	20.1748	20.1522	19.8749	19.0799	18.0779	17.2729	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3715	17.7461	18.3307	19.0380	19.6493	20.0332	20.1748	20.1522	19.8749	19.0799	18.0779	17.2729	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9541	0.9306	0.8911	0.8206	0.7119	0.5644	0.4187	0.4650	0.6748	0.8540	0.9336	0.9601	(94)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Useful gains	1246.2966	1440.9289	1581.6707	1641.5951	1528.9075	1194.3386	847.3872	872.1892	1157.5141	1269.7999	1210.1810	1180.5677	(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	3294.2307	3237.4323	2981.5303	2554.9578	2003.3559	1369.2683	900.9022	945.6122	1455.3795	2137.0735	2766.6143	3294.5975	(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	1523.6629	1207.2503	1041.4955	657.6211	352.9897	0.0000	0.0000	0.0000	0.0000	645.2516	1120.6320	1572.8381	(98)
Space heating												8121.7412	(98)
Space heating per m2											(98) / (4) =	32.8284	(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 %)												91.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1523.6629	1207.2503	1041.4955	657.6211	352.9897	0.0000	0.0000	0.0000	0.0000	645.2516	1120.6320	1572.8381	(98)
Space heating efficiency (main heating system 1)	91.1000	91.1000	91.1000	91.1000	91.1000	0.0000	0.0000	0.0000	0.0000	91.1000	91.1000	91.1000	(210)
Space heating fuel (main heating system)	1672.5169	1325.1924	1143.2442	721.8673	387.4749	0.0000	0.0000	0.0000	0.0000	708.2893	1230.1119	1726.4963	(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	162.8575	144.0765	153.7810	143.0499	144.2275	141.6243	139.0932	149.9559	148.8126	149.8140	151.7565	159.1068	(64)
Efficiency of water heater												80.4000	(216)
(217)m	89.9441	89.8254	89.5664	88.9842	87.7139	80.4000	80.4000	80.4000	80.4000	88.8714	89.6766	89.9997	(217)
Fuel for water heating, kWh/month	181.0652	160.3961	171.6950	160.7588	164.4295	176.1496	173.0015	186.5123	185.0903	168.5739	169.2265	176.7860	(219)
Water heating fuel used												2073.6846	(219)
Annual totals kWh/year													
Space heating fuel - main system												8915.1934	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 13.1040, total flow = 53.0000, SFP = 0.2472)													
mechanical ventilation fans (SFP = 0.2472)												186.6025	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												261.6025	(231)
Electricity for lighting (calculated in Appendix L)												675.0046	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.35 * 1068 * 1.00) =										-2007.9725		-2007.9725	(233)
Total delivered energy for all uses												9917.5126	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	8915.1934	7.6000	677.5547	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2073.6846	7.6000	157.6000	(247)
Mechanical ventilation fans	186.6025	13.1900	24.6129	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	675.0046	13.1900	89.0331	(250)
Additional standing charges			70.0000	(251)
Energy saving/generation technologies				
PV Unit	-2007.9725	13.1900	-264.8516	(252)
Total energy cost			763.8416	(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] =	1.0972	(257)
SAP value		84.6944	
SAP rating (Section 12)		85	(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	8915.1934	0.2410	2148.5616	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2073.6846	0.2410	499.7580	(264)
Space and water heating			2648.3196	(265)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Pumps and fans	261.6025	0.5190	135.7717 (267)
Energy for lighting	675.0046	0.5190	350.3274 (268)
Energy saving/generation technologies			
PV Unit	-2007.9725	0.5190	-1042.1377 (269)
Total kg/year			2092.2810 (272)
CO2 emissions per m2			8.4600 (273)
EI value			90.4116
EI rating			90 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	7.60 × (1 + 0.29 × 0.00) / 0.9110 = 8.342, stars = 2
Main heating environmental impact	0.241 × (1 + 0.29 × 0.00) / 0.9110 = 0.2645, stars = 4
Water heating energy efficiency	7.60 / 0.8635 = 8.802, stars = 3
Water heating environmental impact	0.241 / 0.8635 = 0.2791, stars = 5

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	120.5000 (1b)	x	2.4800 (2b)	=	298.8400 (1b) - (3b)	
First floor	126.9000 (1c)	x	2.5200 (2c)	=	319.7880 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	247.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	618.6280	(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							0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2000	(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) =	0.1700	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.7000	5.8000	5.7000	5.0000	4.6000	4.4000	4.0000	4.1000	4.6000	5.2000	5.3000	5.1000	(22)
Wind factor	1.4250	1.4500	1.4250	1.2500	1.1500	1.1000	1.0000	1.0250	1.1500	1.3000	1.3250	1.2750	(22a)
Adj infilt rate	0.2423	0.2465	0.2423	0.2125	0.1955	0.1870	0.1700	0.1743	0.1955	0.2210	0.2253	0.2168	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Half hour door			1.8900	1.4000	2.6460			(26)
Part glazed doors			4.2000	1.4000	5.8800			(26a)
Windows and patios (Uw = 1.40)			37.9500	1.3258	50.3125			(27)
Velux roof lights (Uw = 1.30)			2.7000	1.2357	3.3365			(27a)
Insulated slab			120.5000	0.1200	14.4600			(28a)
Floor above garage			24.4700	0.1500	3.6705			(28b)
ACDS 2015 T/F	211.1800	40.3500	170.8300	0.1600	27.3328			(29a)
Hanging posts	16.3500		16.3500	0.1700	2.7795			(29a)
House to Garage	15.2500	1.8900	13.3600	0.1900	2.5384			(29a)
Dormer walls	5.6600	1.8000	3.8600	0.2000	0.7720			(29a)
M/Wool over / in ceiling	113.7000		113.7000	0.1000	11.3700			(30)
Sloping ceiling	31.1000	2.7000	28.4000	0.1500	4.2600			(30)
Total net area of external elements Aum(A, m2)			538.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		129.3582			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							20.5851	(36)
Total fabric heat loss					(33) + (36) =		149.9433	(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	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	(38)
Heat transfer coeff	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	(39)
Average = Sum(39)m / 12 =												252.0169	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	(40)
HLP (average)												1.0187	(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	3.0635	(42)
Average daily hot water use (litres/day)	112.5887	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

Daily hot water use

	123.8476	119.3441	114.8405	110.3370	105.8334	101.3299	101.3299	105.8334	110.3370	114.8405	119.3441	123.8476	(44)
Energy conte	183.6624	160.6324	165.7582	144.5120	138.6627	119.6554	110.8783	127.2345	128.7541	150.0504	163.7918	177.8673	(45)
Energy content (annual)										Total = Sum(45)m =		1771.4594	(45)
Distribution loss (46)m = 0.15 x (45)m													
	27.5494	24.0949	24.8637	21.6768	20.7994	17.9483	16.6317	19.0852	19.3131	22.5076	24.5688	26.6801	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2200	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1988	(55)
Total storage loss													
	37.1628	33.5664	37.1628	35.9640	37.1628	35.9640	37.1628	37.1628	35.9640	37.1628	35.9640	37.1628	(56)
If cylinder contains dedicated solar storage													
	37.1628	33.5664	37.1628	35.9640	37.1628	35.9640	37.1628	37.1628	35.9640	37.1628	35.9640	37.1628	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	244.0876	215.2100	226.1834	202.9880	199.0879	178.1314	171.3035	187.6597	187.2301	210.4756	222.2678	238.2925	(62)
WWHRS	-48.0622	-42.2883	-43.1608	-35.5136	-32.9763	-27.2046	-23.0256	-27.8781	-28.6908	-35.4659	-41.0803	-46.4538	eq.(G10)
Total of WWHRS savings												-431.8002	
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)
FGHRS	-33.8937	-29.5138	-30.0000	-25.9505	-23.5547	-9.3025	-9.1848	-9.8257	-9.7267	-27.1175	-30.2547	-33.6307	eq.(G6)
Output from w/h													
	162.1317	143.4079	153.0226	141.5239	142.5570	141.6243	139.0932	149.9559	148.8126	147.8922	150.9328	158.2080	(64)
								Total per year (kWh/year) = Sum(64)m =				1779.1620	(64)
Heat gains from water heating, kWh/month													
	109.4079	97.0723	103.4548	94.8310	94.4455	86.5662	85.2072	90.6456	89.5915	98.2319	101.2416	107.4810	(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	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	183.8130	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	95.5539	84.8701	69.0210	52.2534	39.0600	32.9761	35.6318	46.3156	62.1647	78.9324	92.1257	98.2096	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	618.0957	624.5096	608.3468	573.9381	530.5032	489.6806	462.4086	455.9947	472.1575	506.5662	550.0011	590.8237	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	56.4448	(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)													
	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	-122.5420	(71)
Water heating gains (Table 5)													
	147.0537	144.4529	139.0521	131.7098	126.9429	120.2309	114.5258	121.8355	124.4327	132.0322	140.6133	144.4637	(72)
Total internal gains													
	981.4191	974.5485	937.1358	878.6171	817.2220	763.6034	733.2821	744.8616	779.4707	838.2466	903.4559	954.2129	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.0000	8.2005	0.6300	0.7000	0.7700	37.5927	(74)
East	5.4000	14.7869	0.6300	0.7000	0.7700	24.4030	(76)
South	11.4300	38.1750	0.6300	0.7000	0.7700	133.3512	(78)
West	6.1200	14.7869	0.6300	0.7000	0.7700	27.6568	(80)
North	0.5400	12.1077	0.6300	0.7000	1.0000	2.5950	(82)
South	2.1600	37.0090	0.6300	0.7000	1.0000	31.7280	(82)

Solar gains	257.3267	516.1729	827.4195	1117.2595	1382.2084	1298.5242	1238.2220	1075.9421	868.9959	570.5501	322.3713	199.2072	(83)
Total gains	1238.7458	1490.7213	1764.5552	1995.8765	2199.4304	2062.1276	1971.5041	1820.8038	1648.4667	1408.7967	1225.8272	1153.4201	(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	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	27.2689	
alpha	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	2.8179	
util living area													
	0.9803	0.9679	0.9428	0.9002	0.8348	0.7643	0.6958	0.7316	0.8422	0.9367	0.9727	0.9844	(86)
MIT	18.5439	18.7740	19.2079	19.7090	20.1584	20.5145	20.7032	20.6541	20.3343	19.6722	18.9848	18.4079	(87)
Th 2	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	(88)
util rest of house													
	0.9775	0.9635	0.9347	0.8856	0.8100	0.7234	0.6387	0.6773	0.8099	0.9249	0.9682	0.9822	(89)
MIT 2	16.7270	17.0605	17.6877	18.4050	19.0348	19.5237	19.7686	19.7119	19.2941	18.3651	17.3706	16.5289	(90)
Living area fraction									fLA = Living area / (4) =			0.1769	(91)
MIT	17.0485	17.3637	17.9566	18.6357	19.2336	19.6990	19.9339	19.8786	19.4782	18.5963	17.6562	16.8613	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0485	17.3637	17.9566	18.6357	19.2336	19.6990	19.9339	19.8786	19.4782	18.5963	17.6562	16.8613	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9639	0.9450	0.9103	0.8575	0.7838	0.7051	0.6296	0.6648	0.7853	0.8999	0.9514	0.9706	(94)

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

Useful gains	1194.0041	1408.7702	1606.2979	1711.4099	1723.9280	1454.0014	1241.2043	1210.5143	1294.5223	1267.7514	1166.2347	1119.4772	(95)
Ext temp.	3.3000	3.6000	5.0000	7.1000	9.3000	12.2000	14.0000	13.9000	12.0000	8.8000	5.7000	2.9000	(96)
Heat loss rate W	3464.8468	3468.6831	3265.2913	2907.1943	2503.4370	1889.8811	1495.4466	1506.6985	1884.6259	2468.8375	3013.1685	3518.4882	(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	1689.5069	1384.2615	1234.2910	860.9648	579.9547	0.0000	0.0000	0.0000	0.0000	893.6080	1329.7923	1784.8642	(98)
Space heating												9757.2434	(98)
Space heating per m2											(98) / (4) =	39.4391	(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 %)												91.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1689.5069	1384.2615	1234.2910	860.9648	579.9547	0.0000	0.0000	0.0000	0.0000	893.6080	1329.7923	1784.8642	(98)
Space heating efficiency (main heating system 1)	91.1000	91.1000	91.1000	91.1000	91.1000	0.0000	0.0000	0.0000	0.0000	91.1000	91.1000	91.1000	(210)
Space heating fuel (main heating system)	1854.5631	1519.4967	1354.8749	945.0766	636.6133	0.0000	0.0000	0.0000	0.0000	980.9089	1459.7062	1959.2362	(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	162.1317	143.4079	153.0226	141.5239	142.5570	141.6243	139.0932	149.9559	148.8126	147.8922	150.9328	158.2080	(64)
Efficiency of water heater												80.4000	(216)
(217)m	90.0506	89.9759	89.7821	89.4200	88.7691	80.4000	80.4000	80.4000	80.4000	89.4103	89.8807	90.1234	(217)
Fuel for water heating, kWh/month	180.0451	159.3848	170.4378	158.2688	160.5931	176.1496	173.0015	186.5123	185.0903	165.4084	167.9257	175.5459	(219)
Water heating fuel used												2058.3632	(219)
Annual totals kWh/year													
Space heating fuel - main system												10710.4757	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 13.1040, total flow = 53.0000, SFP = 0.2472)													
mechanical ventilation fans (SFP = 0.2472)												186.6025	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												261.6025	(231)
Electricity for lighting (calculated in Appendix L)												675.0046	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.35 * 1017 * 1.00) =										-1912.0982		-1912.0982	(233)
Total delivered energy for all uses												11793.3479	(238)

10a. Fuel costs - using BEDF prices (554)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	10710.4757	9.4500	1012.1400	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2058.3632	9.4500	194.5153	(247)
Mechanical ventilation fans	186.6025	25.0500	46.7439	(249)
Pumps and fans for heating	75.0000	25.0500	18.7875	(249)
Energy for lighting	675.0046	25.0500	169.0887	(250)
Additional standing charges			70.0000	(251)
Energy saving/generation technologies				
PV Unit	-1912.0982	25.0500	-478.9806	(252)
Total energy cost			1032.2948	(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	10710.4757	0.2410	2581.2246	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2058.3632	0.2410	496.0655	(264)
Space and water heating			3077.2902	(265)
Pumps and fans	261.6025	0.5190	135.7717	(267)
Energy for lighting	675.0046	0.5190	350.3274	(268)
Energy saving/generation technologies				
PV Unit	-1912.0982	0.5190	-992.3789	(269)
Total kg/year			2571.0103	(272)

13a. Primary energy - Individual heating systems including micro-CHP

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	10710.4757	1.0900	11674.4185	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2058.3632	1.0900	2243.6158	(264)
Space and water heating			13918.0344	(265)
Pumps and fans	261.6025	3.0700	803.1196	(267)
Energy for lighting	675.0046	3.0700	2072.2643	(268)
Energy saving/generation technologies				
PV Unit	-1912.0982	3.0700	-5870.1413	(269)
Primary energy kWh/year			10923.2769	(272)
Primary energy kWh/m2/year			44.1523	(273)

SAP 2012 EPC IMPROVEMENTS

(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	+ 1.5	-£ 83	-218 kg (8.5%)

Current energy efficiency rating: B 85
Current environmental impact rating: B 90

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£83	0.88 kg/m²	B 86	B 91
Total Savings	£83	0.88 kg/m²		

Potential energy efficiency rating: B 86
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 554 TEST (31 Oct 2024)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, North East Scotland):

	Current	Potential	Saving
Electricity	£235	£247	-£13
Bulk LPG	£1277	£1181	£96
Space heating	£1148	£1152	-£5
Water heating	£195	£107	£88
Lighting	£169	£169	£0
Generated (PV)	-£479	-£479	£0
Total cost of fuels	£1033	£949	£83
Total cost of uses	£1033	£949	£83
Delivered energy	48 kWh/m²	44 kWh/m²	4 kWh/m²
Carbon dioxide emissions	2.6 tonnes	2.4 tonnes	0.2 tonnes
CO2 emissions per m²	10 kg/m²	10 kg/m²	1 kg/m²
Primary energy	44 kWh/m²	40 kWh/m²	4 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	120.5000 (1b)	x	2.4800 (2b)	=	298.8400	(1b) - (3b)
First floor	126.9000 (1c)	x	2.5200 (2c)	=	319.7880	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	247.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	618.6280	(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							0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2000	(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) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Half hour door			1.8900	1.4000	2.6460			(26)
Part glazed doors			4.2000	1.4000	5.8800			(26a)
Windows and patios (Uw = 1.40)			37.9500	1.3258	50.3125			(27)
Velux roof lights (Uw = 1.30)			2.7000	1.2357	3.3365			(27a)
Insulated slab			120.5000	0.1200	14.4600			(28a)
Floor above garage			24.4700	0.1500	3.6705			(28b)
ACDS 2015 T/F	211.1800	40.3500	170.8300	0.1600	27.3328			(29a)
Hanging posts	16.3500		16.3500	0.1700	2.7795			(29a)
House to Garage	15.2500	1.8900	13.3600	0.1900	2.5384			(29a)
Dormer walls	5.6600	1.8000	3.8600	0.2000	0.7720			(29a)
M/Wool over / in ceiling	113.7000		113.7000	0.1000	11.3700			(30)
Sloping ceiling	31.1000	2.7000	28.4000	0.1500	4.2600			(30)
Total net area of external elements Aum(A, m2)			538.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		129.3582			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.5851	(36)
Total fabric heat loss (33) + (36) =	149.9433	(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	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	(38)
Heat transfer coeff	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	(39)
Average = Sum(39)m / 12 =												252.0169	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	(40)
HLP (average)												1.0187	(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	3.0635	(42)
Average daily hot water use (litres/day)	112.5887	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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Daily hot water use
              123.8476   119.3441   114.8405   110.3370   105.8334   101.3299   101.3299   105.8334   110.3370   114.8405   119.3441   123.8476 (44)
Energy conte   183.6624   160.6324   165.7582   144.5120   138.6627   119.6554   110.8783   127.2345   128.7541   150.0504   163.7918   177.8673 (45)
Energy content (annual)                                                                                                 Total = Sum(45)m =   1771.4594 (45)
Distribution loss  (46)m = 0.15 x (45)m
               27.5494    24.0949    24.8637    21.6768    20.7994    17.9483    16.6317    19.0852    19.3131    22.5076    24.5688    26.6801 (46)
Water storage loss:
Store volume                                                                                                                                250.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                 2.2200 (48)
  Temperature factor from Table 2b                                                                                                            0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                    1.1988 (55)
Total storage loss
               37.1628    33.5664    37.1628    35.9640    37.1628    35.9640    37.1628    37.1628    35.9640    37.1628    35.9640    37.1628 (56)
If cylinder contains dedicated solar storage
               26.0140    23.4965    26.0140    25.1748    26.0140    25.1748    26.0140    26.0140    25.1748    26.0140    25.1748    26.0140 (57)
Primary loss   23.2624    21.0112    21.8667    15.7584    10.4681     9.9053    10.2355    11.1660    17.1091    21.8667    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              232.9388   205.1400   213.6388   185.4452   175.1448   154.7355   147.1277   164.4144   171.0380   197.9311   211.4786   227.1436 (62)
WWHRS         -48.0622   -42.2883   -43.1608   -35.5136   -32.9763   -27.2046   -23.0256   -27.8781   -28.6908   -35.4659   -41.0803   -46.4538 eq.(G10)
Total of WWHRS savings                                                                                                                      -431.8002
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                                                                                                                           1.3538 (H8)
Utilisation factor                                                                                                                            0.5223 (H9)
Collector performance factor                                                                                                                  0.8793 (H10)
Dedicated solar storage volume                                                                                                               75.0000 (H11)
Effective solar volume                                                                                                                      127.5000 (H13)
Daily hot water demand                                                                                                                      112.5887 (H14)
Volume ratio Veff/V                                                                                                                           1.1324 (H15)
Solar storage volume factor                                                                                                                   1.0000 (H16)
Solar input                                                                                                                                -832.8301 (H17)
Solar input    -24.1504   -40.3001   -68.6357   -91.9853  -113.6401  -111.7264  -110.2498   -96.3258   -75.4425   -51.5183   -28.6459   -20.2098 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =   -832.8301 (63)
FGHRS         -28.1846   -21.2380   -15.6780    -6.3249     0.0000     0.0000     0.0000    -2.7986    -4.2923   -16.0078   -24.0246   -28.3170 eq.(G6)
Output from w/h
              132.5416   101.3137    86.1643    51.6213    28.5284    15.8045    13.8523    37.4118    62.6125    94.9390   117.7278   132.1631 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =    874.6803 (64)
Heat gains from water heating, kWh/month
              100.4889    89.0164    93.4191    80.7968    75.2910    67.8495    65.8666    72.0494    76.6379    88.1963    92.6102    98.5620 (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         183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               95.5539    84.8701    69.0210    52.2534    39.0600    32.9761    35.6318    46.3156    62.1647    78.9324    92.1257    98.2096 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              618.0957   624.5096   608.3468   573.9381   530.5032   489.6806   462.4086   455.9947   472.1575   506.5662   550.0011   590.8237 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448 (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)
             -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420 (71)
Water heating gains (Table 5)
              135.0657   132.4649   125.5633   112.2178   101.1976    94.2354    88.5303    96.8406   106.4415   118.5434   128.6253   132.4757 (72)
Total internal gains
              969.4311   962.5605   923.6470   859.1251   791.4766   737.6079   707.2866   719.8667   761.4795   824.7578   891.4679   942.2249 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.0000	10.6334	0.6300	0.7000	0.7700	48.7455	(74)
East	5.4000	19.6403	0.6300	0.7000	0.7700	32.4125	(76)
South	11.4300	46.7521	0.6300	0.7000	0.7700	163.3123	(78)
West	6.1200	19.6403	0.6300	0.7000	0.7700	36.7342	(80)
North	0.5400	15.2954	0.6300	0.7000	1.0000	3.2782	(82)
South	2.1600	47.0123	0.6300	0.7000	1.0000	40.3038	(82)

```
Solar gains    324.7866   573.9147   837.7377  1121.9554  1330.4133  1352.4485  1290.7880  1130.9422   935.7527   648.6858   392.8456   275.4417 (83)
Total gains   1294.2177  1536.4752  1761.3846  1981.0804  2121.8899  2090.0564  1998.0746  1850.8089  1697.2322  1473.4436  1284.3135  1217.6666 (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           27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689
alpha          2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179
util living area
               0.9748     0.9587     0.9294     0.8713     0.7736     0.6366     0.5024     0.5511     0.7470     0.9028     0.9617     0.9786 (86)
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT	18.7703	19.0447	19.4738	19.9988	20.4687	20.7864	20.9206	20.8947	20.6435	20.0235	19.2842	18.6983 (87)
Th 2	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678 (88)
util rest of house	0.9710	0.9527	0.9188	0.8509	0.7358	0.5721	0.4124	0.4614	0.6920	0.8831	0.9551	0.9754 (89)
MIT 2	17.0570	17.4541	18.0721	18.8170	19.4611	19.8658	20.0125	19.9898	19.7027	18.8657	17.8056	16.9526 (90)
Living area fraction									fLA = Living area / (4) =			0.1769 (91)
MIT	17.3602	17.7355	18.3201	19.0261	19.6393	20.0287	20.1731	20.1499	19.8691	19.0705	18.0672	17.2614 (92)
Temperature adjustment												0.0000
adjusted MIT	17.3602	17.7355	18.3201	19.0261	19.6393	20.0287	20.1731	20.1499	19.8691	19.0705	18.0672	17.2614 (93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9550	0.9316	0.8926	0.8231	0.7160	0.5691	0.4232	0.4699	0.6786	0.8561	0.9347	0.9609	(94)
Useful gains	1235.9777	1431.3526	1572.1655	1630.7247	1519.3445	1189.5203	845.5137	869.6635	1151.8097	1261.3781	1200.5104	1170.0519	(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	3291.3793	3234.7574	2978.8588	2551.9446	2000.8453	1368.1141	900.4865	945.0403	1453.9200	2134.7195	2763.9167	3291.7028	(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	1529.2188	1211.8880	1046.5798	663.2784	358.2366	0.0000	0.0000	0.0000	0.0000	649.7660	1125.6526	1578.5083	(98)
Space heating												8163.1284	(98)
Space heating per m2											(98) / (4) =	32.9957	(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 %)	91.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1529.2188	1211.8880	1046.5798	663.2784	358.2366	0.0000	0.0000	0.0000	0.0000	649.7660	1125.6526	1578.5083	(98)
Space heating efficiency (main heating system 1)	91.1000	91.1000	91.1000	91.1000	91.1000	0.0000	0.0000	0.0000	0.0000	91.1000	91.1000	91.1000	(210)
Space heating fuel (main heating system)	1678.6156	1330.2832	1148.8253	728.0772	393.2344	0.0000	0.0000	0.0000	0.0000	713.2448	1235.6230	1732.7204	(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	132.5416	101.3137	86.1643	51.6213	28.5284	15.8045	13.8523	37.4118	62.6125	94.9390	117.7278	132.1631	(64)
Efficiency of water heater												80.4000	(216)
(217)m	90.1431	90.1741	90.1870	90.2329	90.2144	80.4000	80.4000	80.4000	80.4000	89.5802	89.9663	90.1729	(217)
Fuel for water heating, kWh/month	147.0345	112.3534	95.5396	57.2090	31.6229	19.6574	17.2292	46.5321	77.8762	105.9822	130.8576	146.5664	(219)
Water heating fuel used												988.4605	(219)
Annual totals kWh/year													
Space heating fuel - main system												8960.6239	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 13.1040, total flow = 53.0000, SFP = 0.2472)													
mechanical ventilation fans (SFP = 0.2472)												186.6025	(230a)
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												311.6025	(231)
Electricity for lighting (calculated in Appendix L)												675.0046	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.35 * 1068 * 1.00) =										-2007.9725		-2007.9725	(233)
Total delivered energy for all uses												8927.7190	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	8960.6239	7.6000	681.0074	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.4605	7.6000	75.1230	(247)
Mechanical ventilation fans	186.6025	13.1900	24.6129	(249)
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	675.0046	13.1900	89.0331	(250)
Additional standing charges			70.0000	(251)
Energy saving/generation technologies				
PV Unit	-2007.9725	13.1900	-264.8516	(252)
Total energy cost			691.4123	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9931	(257)
SAP value		86.1457	
SAP rating (Section 12)		86	(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	8960.6239	0.2410	2159.5104	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.4605	0.2410	238.2190	(264)
Space and water heating			2397.7293	(265)
Pumps and fans	311.6025	0.5190	161.7217	(267)
Energy for lighting	675.0046	0.5190	350.3274	(268)
Energy saving/generation technologies				
PV Unit	-2007.9725	0.5190	-1042.1377	(269)
Total kg/year			1867.6407	(272)
CO2 emissions per m2			7.5500	(273)
EI value			91.4410	
EI rating			91	(274)
EI band			B	

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	120.5000 (1b)	x	2.4800 (2b)	=	298.8400 (1b) - (3b)	
First floor	126.9000 (1c)	x	2.5200 (2c)	=	319.7880 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	247.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	618.6280	(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							0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2000	(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) =	0.1700	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.7000	5.8000	5.7000	5.0000	4.6000	4.4000	4.0000	4.1000	4.6000	5.2000	5.3000	5.1000	(22)
Wind factor	1.4250	1.4500	1.4250	1.2500	1.1500	1.1000	1.0000	1.0250	1.1500	1.3000	1.3250	1.2750	(22a)
Adj infilt rate	0.2423	0.2465	0.2423	0.2125	0.1955	0.1870	0.1700	0.1743	0.1955	0.2210	0.2253	0.2168	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Half hour door			1.8900	1.4000	2.6460			(26)
Part glazed doors			4.2000	1.4000	5.8800			(26a)
Windows and patios (Uw = 1.40)			37.9500	1.3258	50.3125			(27)
Velux roof lights (Uw = 1.30)			2.7000	1.2357	3.3365			(27a)
Insulated slab			120.5000	0.1200	14.4600			(28a)
Floor above garage			24.4700	0.1500	3.6705			(28b)
ACDS 2015 T/F	211.1800	40.3500	170.8300	0.1600	27.3328			(29a)
Hanging posts	16.3500		16.3500	0.1700	2.7795			(29a)
House to Garage	15.2500	1.8900	13.3600	0.1900	2.5384			(29a)
Dormer walls	5.6600	1.8000	3.8600	0.2000	0.7720			(29a)
M/Wool over / in ceiling	113.7000		113.7000	0.1000	11.3700			(30)
Sloping ceiling	31.1000	2.7000	28.4000	0.1500	4.2600			(30)
Total net area of external elements Aum(A, m2)			538.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		129.3582			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							20.5851	(36)
Total fabric heat loss						(33) + (36) =	149.9433	(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	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	102.0736	(38)
Heat transfer coeff	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	252.0169	(39)
Average = Sum(39)m / 12 =												252.0169	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	1.0187	(40)
HLP (average)												1.0187	(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	3.0635	(42)
Average daily hot water use (litres/day)	112.5887	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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Daily hot water use
               123.8476   119.3441   114.8405   110.3370   105.8334   101.3299   101.3299   105.8334   110.3370   114.8405   119.3441   123.8476 (44)
Energy conte   183.6624   160.6324   165.7582   144.5120   138.6627   119.6554   110.8783   127.2345   128.7541   150.0504   163.7918   177.8673 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =   1771.4594 (45)
Distribution loss  (46)m = 0.15 x (45)m
                27.5494    24.0949    24.8637    21.6768    20.7994    17.9483    16.6317    19.0852    19.3131    22.5076    24.5688    26.6801 (46)
Water storage loss:
Store volume                                                                                                                          250.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                           2.2200 (48)
  Temperature factor from Table 2b                                                                                                      0.5400 (49)
Enter (49) or (54) in (55)                                                                                                              1.1988 (55)
Total storage loss
                37.1628    33.5664    37.1628    35.9640    37.1628    35.9640    37.1628    37.1628    35.9640    37.1628    35.9640    37.1628 (56)
If cylinder contains dedicated solar storage
                26.0140    23.4965    26.0140    25.1748    26.0140    25.1748    26.0140    26.0140    25.1748    26.0140    25.1748    26.0140 (57)
Primary loss    23.2624    21.0112    21.8667    15.7584    10.4681     9.9053    10.2355    11.1660    17.1091    21.8667    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               232.9388   205.1400   213.6388   185.4452   175.1448   154.7355   147.1277   164.4144   171.0380   197.9311   211.4786   227.1436 (62)
WWHRS          -48.0622   -42.2883   -43.1608   -35.5136   -32.9763   -27.2046   -23.0256   -27.8781   -28.6908   -35.4659   -41.0803   -46.4538 eq.(G10)
Total of WWHRS savings                                                                                                               -431.8002
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                                                                                                        1017.1843 (H5)
Overshading factor                                                                                                                      0.8000 (H6)
Solar energy available                                                                                                               1708.8697 (H7)
Adjustment factor for showers                                                                                                           1.0000 (H7a)
Solar-to-load ratio                                                                                                                     1.2756 (H8)
Utilisation factor                                                                                                                      0.5434 (H9)
Collector performance factor                                                                                                            0.8793 (H10)
Dedicated solar storage volume                                                                                                         75.0000 (H11)
Effective solar volume                                                                                                                127.5000 (H13)
Daily hot water demand                                                                                                                112.5887 (H14)
Volume ratio Veff/V                                                                                                                     1.1324 (H15)
Solar storage volume factor                                                                                                             1.0000 (H16)
Solar input                                                                                                                          -816.5097 (H17)
Solar input    -19.4747   -36.9282   -69.3961   -94.5431  -122.6346  -111.6907  -110.0084   -94.8605   -71.9417   -46.2270   -23.9278   -14.8768 (63)
                                                                                        Solar input (sum of months) = Sum(63)m =   -816.5097 (63)
FGHRS          -29.5525   -22.3010   -15.7596    -6.0338     0.0000     0.0000     0.0000    -2.8754    -4.4757   -18.3522   -25.3766   -29.9750 eq.(G6)
Output from w/h
               135.8494   103.6225    85.3223    49.3546    19.5339    15.8402    14.0938    38.8003    65.9298    97.8859   121.0938   135.8380 (64)
                                                                                          Total per year (kWh/year) = Sum(64)m =    883.1646 (64)
Heat gains from water heating, kWh/month
               100.4889    89.0164    93.4191    80.7968    75.2910    67.8495    65.8666    72.0494    76.6379    88.1963    92.6102    98.5620 (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          183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130   183.8130 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                95.5539    84.8701    69.0210    52.2534    39.0600    32.9761    35.6318    46.3156    62.1647    78.9324    92.1257    98.2096 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               618.0957   624.5096   608.3468   573.9381   530.5032   489.6806   462.4086   455.9947   472.1575   506.5662   550.0011   590.8237 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448    56.4448 (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)
              -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420  -122.5420 (71)
Water heating gains (Table 5)
               135.0657   132.4649   125.5633   112.2178   101.1976    94.2354    88.5303    96.8406   106.4415   118.5434   128.6253   132.4757 (72)
Total internal gains
               969.4311   962.5605   923.6470   859.1251   791.4766   737.6079   707.2866   719.8667   761.4795   824.7578   891.4679   942.2249 (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
----------------------------------------------------------------------------------------------------
North                                   15.0000          8.2005          0.6300           0.7000             0.7700             37.5927 (74)
East                                     5.4000         14.7869          0.6300           0.7000             0.7700             24.4030 (76)
South                                   11.4300         38.1750          0.6300           0.7000             0.7700            133.3512 (78)
West                                     6.1200         14.7869          0.6300           0.7000             0.7700             27.6568 (80)
North                                    0.5400         12.1077          0.6300           0.7000             1.0000              2.5950 (82)
South                                    2.1600         37.0090          0.6300           0.7000             1.0000             31.7280 (82)
----------------------------------------------------------------------------------------------------

Solar gains    257.3267   516.1729   827.4195  1117.2595  1382.2084  1298.5242  1238.2220  1075.9421   868.9959   570.5501   322.3713   199.2072 (83)
Total gains   1226.7578  1478.7333  1751.0664  1976.3845  2173.6850  2036.1321  1945.5086  1795.8088  1630.4755  1395.3079  1213.8392  1141.4321 (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             27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689    27.2689
alpha            2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179     2.8179
util living area
                 0.9808     0.9685     0.9437     0.9021     0.8382     0.7687     0.7010     0.7367     0.8452     0.9380     0.9733     0.9848 (86)
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CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

MIT	18.5355	18.7659	19.1996	19.6986	20.1476	20.5063	20.6971	20.6472	20.3266	19.6641	18.9766	18.3994 (87)
Th 2	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678	20.0678 (88)
util rest of house	0.9781	0.9642	0.9358	0.8877	0.8136	0.7282	0.6441	0.6827	0.8133	0.9264	0.9690	0.9827 (89)
MIT 2	16.7148	17.0489	17.6758	18.3906	19.0205	19.5137	19.7618	19.7040	19.2842	18.3536	17.3588	16.5164 (90)
Living area fraction									fLA = Living area / (4) =			0.1769 (91)
MIT	17.0369	17.3526	17.9454	18.6220	19.2199	19.6893	19.9273	19.8709	19.4686	18.5854	17.6450	16.8495 (92)
Temperature adjustment												0.0000
adjusted MIT	17.0369	17.3526	17.9454	18.6220	19.2199	19.6893	19.9273	19.8709	19.4686	18.5854	17.6450	16.8495 (93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9646	0.9459	0.9116	0.8597	0.7873	0.7095	0.6345	0.6698	0.7885	0.9016	0.9524	0.9712	(94)
Useful gains	1183.3607	1398.7458	1596.1919	1699.0936	1711.3123	1444.6085	1234.4845	1202.9117	1285.6642	1257.9708	1156.0041	1108.6034	(95)
Ext temp.	3.3000	3.6000	5.0000	7.1000	9.3000	12.2000	14.0000	13.9000	12.0000	8.8000	5.7000	2.9000	(96)
Heat loss rate W	3461.9247	3465.8992	3262.4546	2903.7439	2499.9916	1887.4261	1493.7721	1504.7633	1882.2107	2466.0913	3010.3375	3515.5186	(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	1695.2516	1389.1270	1239.6994	867.3482	586.7774	0.0000	0.0000	0.0000	0.0000	898.8417	1335.1200	1790.7449	(98)
Space heating												9802.9102	(98)
Space heating per m2											(98) / (4) =	39.6237	(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 %)	91.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1695.2516	1389.1270	1239.6994	867.3482	586.7774	0.0000	0.0000	0.0000	0.0000	898.8417	1335.1200	1790.7449	(98)
Space heating efficiency (main heating system 1)	91.1000	91.1000	91.1000	91.1000	91.1000	0.0000	0.0000	0.0000	0.0000	91.1000	91.1000	91.1000	(210)
Space heating fuel (main heating system)	1860.8690	1524.8376	1360.8116	952.0837	644.1025	0.0000	0.0000	0.0000	0.0000	986.6539	1465.5543	1965.6914	(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	135.8494	103.6225	85.3223	49.3546	19.5339	15.8402	14.0938	38.8003	65.9298	97.8859	121.0938	135.8380	(64)
Efficiency of water heater												80.4000	(216)
(217)m	90.2093	90.2661	90.3259	90.4519	90.7111	80.4000	80.4000	80.4000	80.4000	89.9247	90.1028	90.2531	(217)
Fuel for water heating, kWh/month	150.5935	114.7967	94.4604	54.5645	21.5342	19.7017	17.5296	48.2591	82.0022	108.8532	134.3951	150.5079	(219)
Water heating fuel used												997.1983	(219)
Annual totals kWh/year													
Space heating fuel - main system												10760.6040	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 13.1040, total flow = 53.0000, SFP = 0.2472)													
mechanical ventilation fans (SFP = 0.2472)												186.6025	(230a)
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												311.6025	(231)
Electricity for lighting (calculated in Appendix L)												675.0046	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.35 * 1017 * 1.00) =										-1912.0982		-1912.0982	(233)
Total delivered energy for all uses												10832.3112	(238)

10a. Fuel costs - using BEDF prices (554)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	10760.6040	9.4500	1016.8771	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	997.1983	9.4500	94.2352	(247)
Mechanical ventilation fans	186.6025	25.0500	46.7439	(249)
Pumps and fans for heating	75.0000	25.0500	18.7875	(249)
Pump for solar water heating	50.0000	25.0500	12.5250	(249)
Energy for lighting	675.0046	25.0500	169.0887	(250)
Additional standing charges			70.0000	(251)
Energy saving/generation technologies				
PV Unit	-1912.0982	25.0500	-478.9806	(252)
Total energy cost			949.2768	(255)

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

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	10760.6040	0.2410	2593.3056	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	997.1983	0.2410	240.3248	(264)
Space and water heating			2833.6303	(265)
Pumps and fans	311.6025	0.5190	161.7217	(267)
Energy for lighting	675.0046	0.5190	350.3274	(268)
Energy saving/generation technologies				
PV Unit	-1912.0982	0.5190	-992.3789	(269)
Total kg/year			2353.3005	(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	10760.6040	1.0900	11729.0583	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	997.1983	1.0900	1086.9462	(264)
Space and water heating			12816.0045	(265)
Pumps and fans	311.6025	3.0700	956.6196	(267)
Energy for lighting	675.0046	3.0700	2072.2643	(268)
Energy saving/generation technologies				
PV Unit	-1912.0982	3.0700	-5870.1413	(269)
Primary energy kWh/year			9974.7470	(272)
Primary energy kWh/m2/year			40.3183	(273)

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Project	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		
Calculation Type	New Build (As Designed)		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Roof Horizontal

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Earthwool Loft Roll 40 over ties**				
	Main construction	200	0.0400	5.0000	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 2	**Earthwool Loft Roll 40 in ties**				
	Main construction	200	0.0400	5.0000	92.17
	Main construction	200	0.1300	1.5385	7.83
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Int surface				0.1000	

Total resistance: **Upper limit =** 9.805 m² K/W **Lower limit =** 9.450 m² K/W **Average =** 9.628 m² K/W

Total correction = 0.0019 m² K/W **U-value (unrounded) =** 0.1 W/m² K

Unheated space: None

Total thickness: 413 mm **U-value: 0.10 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Project	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		
Calculation Type	New Build (As Designed)		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Roof Vented lie ins

Roof Type: Pitched Roof, insulated sloping ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.1000	
Layer 1	**Tiling, concrete**				
	Main construction	12	1.5000	0.0000	100.00
Layer 2	**Battens and counter battens cavity**				
	Main construction	38	0.0000	0.0000	79.43
	Main construction	38	0.1300	0.0000	20.57
	Corrections - Cavity Ventilated, Emissivity: Normal				
Layer 3	**Sarking felt**				
	Main construction	2	0.2300	0.0000	100.00
Layer 4	**Orientated Strand Board**				
	Main construction	9	0.1300	0.0000	100.00
Layer 5	**Vented rafters cavity**				
	Main construction	25	0.0000	0.0000	92.17
	Main construction	25	0.1300	0.0000	7.83
	Corrections - Cavity Ventilated, Emissivity: Normal				
Layer 6	**PIR in rafters**				
	Main construction	75	0.0220	3.4091	92.17
	Main construction	75	0.1300	0.5769	7.83
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 7	**PIR in rafters**				
	Main construction	100	0.0220	4.5455	92.17
	Main construction	100	0.1300	0.7692	7.83
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 8	**Reflective VCL**				
	Main construction	0.4	0.0000	0.0000	100.00
Layer 9	**Plasterboard**				
	Main construction	12.5	0.2500	0.0500	100.00
Int surface				0.1000	

Total resistance: **Upper limit =** 7.293 m² K/W **Lower limit =** 5.995 m² K/W **Average =** 6.644 m² K/W

Total correction = 0.0038 m² K/W **U-value (unrounded) =** 0.15 W/m² K

Unheated space: None

Total thickness: 274 mm **U-value: 0.15 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Project	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		
Calculation Type	New Build (As Designed)		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Wall Masonry clad T/Frame

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Render - Cement and Sand**				
	Main construction	20	1.0000	0.0200	100.00
Layer 2	**Blockwork, dense**				
	Main construction	100	1.5900	0.0629	100.00
Layer 3	**Low E perp vented cavity**				
	Main construction	50	0.0649	0.7700	100.00
Layer 4	**Reflective breather membrane**				
	Main construction	0.5	0.0000	0.0000	100.00
Layer 5	**Orientated Strand Board**				
	Main construction	9	0.1300	0.0692	100.00
Layer 6	**Earthwool Frametherm Roll 35 in T/Frame**				
	Main construction	140	0.0350	4.0000	85.00
	Main construction	140	0.1300	1.0769	15.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 7	**Thermawall TW55 over T/Frame**				
	Main construction	30	0.0220	1.3636	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 8	**Reflective VCL**				
	Main construction	0.3	0.0000	0.0000	100.00
Layer 9	**Low E battens cavity**				
	Main construction	38	0.0571	0.6651	90.70
	Main construction	38	0.1300	0.2923	9.30
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 10	**Plasterboard**				
	Main construction	12.5	0.2500	0.0500	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 6.461 m² K/W **Lower limit =** 5.943 m² K/W **Average =** 6.202 m² K/W

Total correction = 0.0021 m² K/W **U-value (unrounded) =** 0.16 W/m² K

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Unheated space: None

Total thickness: 400 mm	U-value: 0.16 W/m² K	Kappa: n/a

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Project	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		
Calculation Type	New Build (As Designed)		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Wall Hanging Posts

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Earthwool Frametherm Roll 35 in posts**				
	Main construction	140	0.0350	4.0000	88.56
	Main construction	140	0.1300	1.0769	11.44
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 2	**Thermawall TW55 over T/Frame**				
	Main construction	30	0.0220	1.3636	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 3	**Reflective VCL**				
	Main construction	0.3	0.0000	0.0000	100.00
Layer 4	**Low E batten cavity**				
	Main construction	38	0.0571	0.6651	87.85
	Main construction	38	0.1300	0.2923	12.15
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 5	**Plasterboard**				
	Main construction	12.5	0.2500	0.0500	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 5.626 m² K/W **Lower limit =** 5.212 m² K/W **Average =** 5.419 m² K/W

Total correction = 0.0032 m² K/W **U-value (unrounded) =** 0.17 W/m² K

Unheated space: RoomInRoof

Total thickness: 221 mm **U-value: 0.17 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Project	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		
Calculation Type	New Build (As Designed)		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Wall House to Garage wall

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Plasterboard**				
	Main construction	12.5	0.2500	0.0500	100.00
Layer 2	**Orientated Strand Board**				
	Main construction	9	0.1300	0.0692	100.00
Layer 3	**Earthwool Frametherm Roll 35 in T/Frame**				
	Main construction	140	0.0350	4.0000	85.00
	Main construction	140	0.1300	1.0769	15.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 4	**Plasterboard**				
	Main construction	12.5	0.2500	0.0500	100.00
Layer 5	**VCL**				
	Main construction	0.4	0.0000	0.0000	100.00
Layer 6	**Thermawall TW55 over T/Frame**				
	Main construction	30	0.0220	1.3636	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 7	**Low E batten cavity**				
	Main construction	38	0.0571	0.6651	87.85
	Main construction	38	0.1300	0.2923	12.15
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 8	**Plasterboard**				
	Main construction	12.5	0.2500	0.0500	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 5.650 m² K/W **Lower limit =** 5.171 m² K/W **Average =** 5.411 m² K/W

Total correction = 0.0028 m² K/W **U-value (unrounded) =** 0.19 W/m² K

Unheated space: None

Total thickness: 255 mm **U-value: 0.19 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Project	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		
Calculation Type	New Build (As Designed)		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Wall Tile clad dormers

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Tiling, concrete**				
	Main construction	20	1.5000	0.0133	100.00
Layer 2	**Batten cavity**				
	Main construction	25	0.0324	0.7717	87.33
	Main construction	25	0.1300	0.1923	12.67
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 3	**Reflective breather membrane**				
	Main construction	0.5	0.0000	0.0000	100.00
Layer 4	**Orientated Strand Board**				
	Main construction	9	0.1300	0.0692	100.00
Layer 5	**PIR in T/Frame**				
	Main construction	140	0.0200	7.0000	85.00
	Main construction	140	0.1300	1.0769	15.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 6	**Reflective VCL**				
	Main construction	0.4	0.0000	0.0000	100.00
Layer 7	**Plasterboard**				
	Main construction	12.5	0.2500	0.0500	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 5.578 m² K/W **Lower limit =** 4.697 m² K/W **Average =** 5.137 m² K/W

Total correction = 0.0056 m² K/W **U-value (unrounded) =** 0.2 W/m² K

Unheated space: None

Total thickness: 207 mm **U-value: 0.20 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Project	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		
Calculation Type	New Build (As Designed)		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Floor Insulated conc slab

Floor Type: Slab On Ground Floor
Area = 120.50 m², Perimeter = 51.04 m, Wall thickness = 370.00 mm, Soil: Unknown
Horizontal edge insulation: none
Vertical edge insulation: Width D = 125.0 mm, Thickness dn = 25.0 mm, Lambda = 0.022

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Sand blinded hardcore**				
	Main construction	200	2.3000	0.0870	100.00
Layer 2	**Polythene,1200 gauge**				
	Main construction	0.4	0.0000	0.0000	100.00
Layer 3	**Thermafloor TF70 zero ODP**				
	Main construction	150	0.0220	6.8182	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 4	**Concrete, reinforced (1% steel)**				
	Main construction	125	2.3000	0.0543	100.00
Int surface				0.1700	

Total resistance: **Upper limit =** 6.959 m² K/W **Lower limit =** 6.959 m² K/W **Average =** 6.959 m² K/W

Total correction = 0.0096 m² K/W **U-value (unrounded) =** 0.12 W/m² K

Unheated space: None

Total thickness: 475 mm **U-value: 0.12 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Project	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		
Calculation Type	New Build (As Designed)		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Floor Garage ceiling

Floor Type: Exposed Floor

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Plasterboard**				
	Main construction	12.5	0.2500	0.0500	100.00
Layer 2	**Frametherm Roll 35 in I joists flanges**				
	Main construction	90	0.0350	2.5714	92.17
	Main construction	90	0.1300	0.6923	7.83
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Frametherm Roll 35 in I joists webs**				
	Main construction	140	0.0350	4.0000	98.50
	Main construction	140	0.1300	1.0769	1.50
Layer 4	**Chipboard**				
	Main construction	22	0.1300	0.1692	100.00
Int surface				0.1700	

Total resistance: **Upper limit =** 6.726 m² K/W **Lower limit =** 6.393 m² K/W **Average =** 6.560 m² K/W

Total correction = 0.0010 m² K/W **U-value (unrounded) =** 0.15 W/m² K

Unheated space: None

Total thickness: 265 mm **U-value: 0.15 W/m² K** **Kappa: n/a**

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

Design SAP
elmhurst energy

Property Reference	ajc 4A 90 bennachie	**Issued on Date**	31/01/2023
Assessment Reference	Bennachie	**Prop Type Ref**	
Property	Bennachie, Plot 90, Phase 4 A, Tarland Road, Aboyne		

SAP Rating	85 B	**DER**	9.40	**TER**	10.06
Environmental	90 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	2.57	**FEE**	43.82	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

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

Orientation	North
Property Tenure	Owner-occupied
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Detached
2.0 Number of Storeys	2
3.0 Date Built	2020
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:	51.04 m	120.50 m²	2.48 m
1st Storey:	57.00 m	126.90 m²	2.52 m

7.0 Living Area	43.77	m²
8.0 Thermal Mass Parameter	Simple calculation - Low	
Thermal Mass	100.00	kJ/m²K

9.0 External Walls

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
ACDS 2015 T/F	Timber Frame	0.16	211.18	170.83
Hanging posts	Timber Frame	0.17	16.35	16.35
House to Garage	Timber Frame	0.19	15.25	13.36
Dormer walls	Timber Frame	0.20	5.66	3.86

10.0 External Roofs

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
M/Wool over / in ceiling	External Plane Roof	0.10	113.70	113.70
Sloping ceiling	External Slope Roof	0.15	31.10	28.40

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Insulated slab	Ground Floor - Solid		0.12	120.50
Floor above garage	Exposed Floor - Timber		0.15	24.47

12.0 Opening Types

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

Design SAP
elmhurst energy

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Half hour door	Manufacturer	Solid Door							1.40
Part glazed doors	Manufacturer	Half Glazed Door	Double Low-E Soft 0.05			0.63		0.70	1.40
Windows and patios	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.40
Velux roof lights	Manufacturer	Roof Window	Double Low-E Soft 0.05			0.63		0.70	1.30

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	Half Glazed Door	[1] ACDS 2015 T/F	North							2.10	
Front glass	Window	[1] ACDS 2015 T/F	North	None	0.00					13.20	
To house/garage	Solid Door	[3] House to Garage	West							1.89	
Front dormer	Window	[4] Dormer walls	North	None	0.00					1.80	
Rear glass	Window	[1] ACDS 2015 T/F	South	None	0.00					11.43	
LHS glass	Window	[1] ACDS 2015 T/F	East	None	0.00					5.40	
RHS glass	Window	[1] ACDS 2015 T/F	West	None	0.00					6.12	
Rear door	Half Glazed Door	[1] ACDS 2015 T/F	South							2.10	
Rear velux	Roof Window	[2] Sloping ceiling	South	None						2.16	
Front velux	Roof Window	[2] Sloping ceiling	North	None						0.54	

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
Scotland ACD 2015	E2 Other lintels (including other steel lintels)	23.75	0.037	No
Scotland ACD 2015	E3 Sill	19.35	0.033	No
Scotland ACD 2015	E4 Jamb	81.60	0.031	No
Scotland ACD 2015	E5 Ground floor (normal)	51.04	0.173	No
Scotland ACD 2015	E6 Intermediate floor within a dwelling	57.00	0.065	No
Scotland ACD 2015	E11 Eaves (insulation at rafter level)	27.10	0.018	No
Scotland ACD 2015	E12 Gable (insulation at ceiling level)	25.40	0.051	No
Scotland ACD 2015	E13 Gable (insulation at rafter level)	5.80	0.036	No
Scotland ACD 2015	E16 Corner (normal)	35.84	0.038	No
Scotland ACD 2015	E17 Corner (inverted – internal area greater than external area)	17.92	-0.029	No
Table K1 - Default	R1 Head of roof window	2.75	0.080	No
Table K1 - Default	R2 Sill of roof window	2.75	0.060	No
Table K1 - Default	R3 Jamb of roof window	9.80	0.080	No

Y-value 0.038 W/m²K

18.0 Pressure Testing Yes

Designed AP_{50} 4.00 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: No

Night Ventilation: No

Air change rate	2.50

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Mechanical extract ventilation - decentralised
MV Reference Number	500339
Duct Type	Rigid

19.1 Mechanical extract ventilation - Decentralised

SFP	Fan/Room Type	Count
0.16	In Room Fan Kitchen	1
0.20	In Room Fan Other Wet Room	5

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				0
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	38	
Total number of L.E.L. fittings	38	
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	LPG condensing system	
Percentage of Heat	100	%
Database Ref. No.	18747	
Fuel Type	Bulk LPG	
Main Heating	BLB	
SAP Code	102	
In Winter	91.1	
In Summer	80.4	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	No	
Sap Code	2110	
Flue Type	Balanced	

Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	Yes	
Waste Water Heat Recovery Instantaneous System 1	Yes	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
SAP Code	901	

28.1 Flue Gas Heat Recovery System

Database ID	60048
Brand Model	Baxi, Assure
Details	Year: 2021 + current Applicable Fuel: 2 Boiler Types: RCSK Heat Store Volume: 0 PV module: 0

28.2 Waste Water Heat Recovery System

Total rooms with shower and/or bath	1	

Instantaneous System 1

Database ID	80177	
Brand Model	Baxi, Assure VSHRU	
Details	Year: 2020 + current Efficiency: 47 Utilisation factor: 0.941	
Number of mixer showers in rooms with a bath	1	
Number of mixer showers in rooms without a bath	0	

29.0 Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	250.00	L
Loss	2.22	kWh/day
Pipes insulation	Fully insulated primary pipework	
31.0 Thermal Store	None	
32.0 Photovoltaic Unit	One Dwelling	

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
2.35	South	45°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£83	B 86	