

elmhurst
energy



SAP Report Submission for Building Regulations Compliance

Client: K & J Contracts

Project: Plot 2

Contact: Tobias Whiting
Abacus Energy (UK) Ltd



Report Issue Date: 07/04/2022

EXCELLENCE
IN ENERGY
ASSESSMENT

PREDICTED ENERGY ASSESSMENT

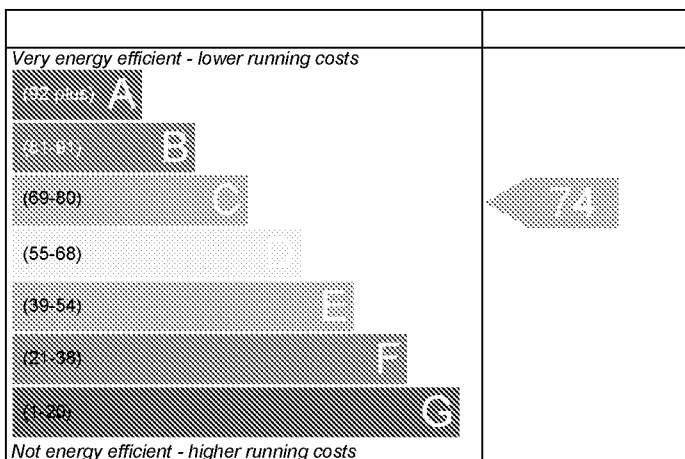
Design SAP
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Dwelling type: Bungalow, Detached
Date of assessment: 07/04/2022
Produced by: Abacus Energy (UK) Ltd
Total floor area: 119.17 m²
DRRN: 3223-2404-0620

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

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

Energy Efficiency Rating

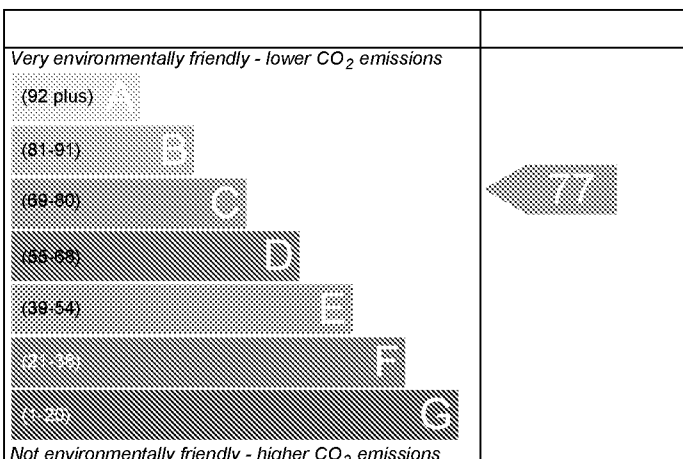


England

EU Directive
2002/91/EC

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

Environmental Impact (CO₂) Rating



England

EU Directive
2002/91/EC

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

This report has been produced by an accredited Elmhurst member whose work is subject to quality assurance audits. The data used to produce the report has been verified by the Elmhurst members' portal.

BUILDING REGULATION COMPLIANCE

Calculation Type: New Build (As Designed)

Design SAP
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Property Reference	SAP 0873 Plot 2		Issued on Date	07/04/2022	
Assessment Reference	Rev A	Prop Type Ref			
Property					
SAP Rating	74 C	DER	25.53	TER	28.70
Environmental	77 C	% DER<TER	11.06		
CO ₂ Emissions (t/year)	2.64	DFEE	65.14	TFEE	70.00
General Requirements Compliance	Pass	% DFEE<TFEE	6.94		
Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com			Assessor ID	E477-0001
Client	K & J Contracts, K&JC				

SUMMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	28.70	kgCO ₂ /m ²	
Dwelling Carbon Dioxide Emission Rate (DER)	25.53	kgCO ₂ /m ²	Pass
	-3.17 (-11.0%)	kgCO ₂ /m ²	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	70.00	kWh/m ² /yr	
Dwelling Fabric Energy Efficiency (DFEE)	65.14	kWh/m ² /yr	
	-4.9 (-7.0%)	kWh/m ² /yr	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.26 (max. 0.30)	0.45 (max. 0.70)	Pass
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	Pass
Roof	0.14 (max. 0.20)	0.19 (max. 0.35)	Pass
Openings	1.43 (max. 2.00)	1.80 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

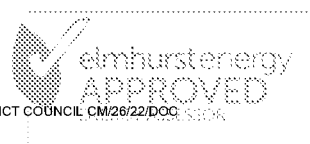
Air permeability at 50 pascals	5.00 (design value)	m ³ /(h.m ²) @ 50 Pa	
Maximum	10.0	m ³ /(h.m ²) @ 50 Pa	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
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BUILDING REGULATION COMPLIANCE

Calculation Type: New Build (As Designed)

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Secondary heating system

None

5 Cylinder insulation

Hot water storage

Measured cylinder loss: 1.73 kWh/day
Permitted by DB5CG 2.33

Pass

Primary pipework insulated

Yes

Pass

6 Controls

Space heating controls

Time and temperature zone control

Pass

Hot water controls

Cylinderstat

Pass

Independent timer for DHW

Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings

100

%

Minimum

75

%

Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (South East England)

Slight

Pass

Based on:

Overshading

Average

Windows facing North

0.66 m², No overhang

Windows facing East

10.54 m², No overhang

Windows facing South

3.29 m², No overhang

Windows facing West

17.25 m², No overhang

Air change rate

6.00 ach

Blinds/curtains

None

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals

5.00 (design value)

m³/(h.m²) @ 50 Pa

Maximum

10.0

m³/(h.m²) @ 50 Pa

Pass

10 Key features

Roof U-value

0.10

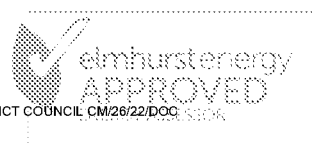
W/m²K

Floor U-value

0.12

W/m²K

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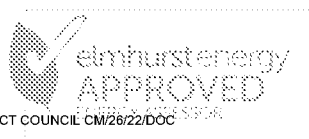


RECOMMENDATIONS

Design SAP
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	Typical cost	Typical savings per year	Energy efficiency	Environmental Impact	Result
Low energy lights			0	0	Already installed
Solar water heating	£4,000 - £6,000	£102	C 76	C 79	Recommended
Photovoltaic	£3,500 - £5,500	£375	B 84	B 86	Recommended
Wind turbine			0	0	Not applicable
Totals	£7,500 - £11,500	£477	B 84	B 86	

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THERMAL BRIDGING

Calculation Type: New Build (As Designed)

Design SAP
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Property Reference	SAP 0873 Plot 2	Issued on Date	07/04/2022
Assessment Reference	Rev A	Prop Type Ref	
Property			

SAP Rating	74 C	DER	25.53	TSL	28.70
Environmental	77 C	2 DER-TED	11.06		
CO ₂ Emissions (t/year)	2.64	DERED	65.14	TED	70.00
General Requirements Compliance	Pass	2 DER-TED	6.94		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com	Assessment ID	E477-0001
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Client	K & J Contracts, K&JC
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	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Table K1 - Approved	0.300	17.47	5.24	
External wall	E3 Sill	Table K1 - Approved	0.040	3.00	0.12	
External wall	E4 Jamb	Table K1 - Approved	0.050	43.12	2.16	
External wall	E5 Ground floor (normal)	Table K1 - Approved	0.160	50.82	8.13	
External wall	E10 Eaves (insulation at ceiling level)	Table K1 - Approved	0.060	26.82	1.61	
External wall	E11 Eaves (insulation at rafter level)	Table K1 - Approved	0.040	13.58	0.54	
External wall	E12 Gable (insulation at ceiling level)	Table K1 - Approved	0.240	6.07	1.46	
External wall	E13 Gable (insulation at rafter level)	Table K1 - Approved	0.040	5.14	0.21	
External wall	E16 Corner (normal)	Table K1 - Approved	0.090	23.80	2.14	
External wall	E17 Corner (inverted – internal area greater than external area)	Table K1 - Approved	-0.090	14.28	-1.29	
External roof	R1 Head of roof window	Table K1 - Default	0.080	2.46	0.20	
External roof	R2 Sill of roof window	Table K1 - Default	0.060	2.46	0.15	
External roof	R3 Jamb of roof window	Table K1 - Default	0.080	8.51	0.68	
External roof	R4 Ridge (vaulted ceiling)	Table K1 - Default	0.080	11.49	0.92	
External roof	R5 Ridge (inverted)	Table K1 - Default	0.040	8.15	0.33	
External roof	R6 Flat ceiling	Table K1 - Default	0.060	2.10	0.13	

Total: 22.72 W/mK:
Y-Value: 0.054 W/m²K:

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)


Design SAP
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Property Reference	SAP 0873 Plot 2		Issued on Date	07/04/2022	
Assessment Reference	Rev A	Prop Type Ref			
Property					
SAP Rating	74 C	DEI	25.53	TGI	28.70
Environmental	77 C	% DER-TGI	11.06		
CO ₂ Emissions (t/year)	2.64	DREE	65.14	TTEE	70.00
General Requirements Compliance	Pass	% DREE-TTEE	6.94		
Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com			Assessor ID	E477-0001
Client	K & J Contracts, K&JC				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Detached Bungalow, total floor area 119 m²

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

1a TER and DER

Fuel for main heating: Electricity
Fuel factor: 1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 28.70 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 25.53 kgCO₂/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 70.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 65.1 kWh/m²/yr OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.26 (max. 0.30)	0.45 (max. 0.70)	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.14 (max. 0.20)	0.19 (max. 0.35)	OK
Openings	1.43 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

Main heating system:	Heat pump with radiators or underfloor - Electric
Air-to-water heat pump	

Secondary heating system:	None
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5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.73 kWh/day	
Permitted by DBSCG 2.33	OK	
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls:	Time and temperature zone control	OK
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Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (South East England):	Slight	OK
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Based on:

Overshading:	Average
Windows facing North:	0.66 m ² , No overhang
Windows facing East:	10.54 m ² , No overhang
Windows facing South:	3.29 m ² , No overhang
Windows facing West:	17.25 m ² , No overhang
Air change rate:	6.00 ach
Blinds/curtains:	None

10 Key features

Roof U-value	0.10 W/m ² K
Floor U-value	0.12 W/m ² K

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	119.1700 (1b)	x 2.6100 (2b)	= 311.0337 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.1700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 311.0337 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ 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) =	0.1286 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3786 (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) =		0.3218 (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												
Effective ac	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front Door			2.2100	1.6000	3.5360		(26)
Personnel Door			1.6600	1.8000	2.9880		(26)
Windows (Uw = 1.40)			31.7400	1.3258	42.0795		(27)
Roof Windows (Uw = 1.40)			3.6300	1.3258	4.8125		(27a)
Ground Floor			119.1700	0.1200	14.3004		(28a)
Brick	82.5500	30.3800	52.1700	0.2100	10.9557		(29a)
Stone Clad	30.2400	3.5700	26.6700	0.2100	5.6007		(29a)
Wall to Garage	14.4500	1.6600	12.7900	0.4500	5.7555		(29a)
Wall to voids	31.4700		31.4700	0.2979	9.3740		(29a)
Pitched Roof	82.4400		82.4400	0.1000	8.2440		(30)
Skeillins	44.1000	3.6300	40.4700	0.1900	7.6893		(30)
Skeillin at Roof	16.2700		16.2700	0.1900	3.0913		(30)
Total net area of external elements Aum(A, m ²)			420.6900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	118.4270		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.7162 (36)
Total fabric heat loss (33) + (36) = 141.1432 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 59.9607	Feb 59.6252	Mar 59.2963	Apr 57.7516	May 57.4626	Jun 56.1173	Jul 56.1173	Aug 55.8682	Sep 56.6355	Oct 57.4626	Nov 58.0473	Dec 58.6585 (38)
Heat transfer coeff	201.1038	200.7683	200.4395	198.8948	198.6058	197.2605	197.2605	197.0113	197.7787	198.6058	199.1905	199.8017 (39)
Average = Sum(39)m / 12 =												198.8934 (39)
HLP	Jan 1.6875	Feb 1.6847	Mar 1.6820	Apr 1.6690	May 1.6666	Jun 1.6553	Jul 1.6553	Aug 1.6532	Sep 1.6596	Oct 1.6666	Nov 1.6715	Dec 1.6766 (40)
HLP (average)												1.6690 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8600 (42)
Average daily hot water use (litres/day)												102.1262 (43)
Daily hot water use	Jan 112.3388	Feb 108.2538	Mar 104.1687	Apr 100.0837	May 95.9986	Jun 91.9136	Jul 91.9136	Aug 95.9986	Sep 100.0837	Oct 104.1687	Nov 108.2538	Dec 112.3388 (44)
Energy conte	166.5952	145.7052	150.3547	131.0829	125.7772	108.5361	100.5747	115.4109	116.7893	136.1067	148.5711	161.3386 (45)
Energy content (annual)										Total = Sum(45)m =		1606.8425 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	24.9893	21.8558	22.5532	19.6624	18.8666	16.2804	15.0862	17.3116	17.5184	20.4160	22.2857	24.2008 (46)
Water storage loss:												
Store volume												215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7300 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9342 (55)
Total storage loss												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 (56)												
If cylinder contains dedicated solar storage												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 (57)												
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624 (59)
Total heat required for water heating calculated for each month												
218.8178 192.8740 202.5773 181.6209 177.9998 159.0741 152.7973 167.6335 167.3273 188.3293 199.1091 213.5612 (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	218.8178	192.8740	202.5773	181.6209	177.9998	159.0741	152.7973	167.6335	167.3273	188.3293	199.1091	213.5612 (64)
Total per year (kWh/year) = Sum(64)m =												2221.7215 (64)
Heat gains from water heating, kWh/month												
97.1710 86.1820 91.7710 84.0155 83.5990 76.5187 75.2192 80.1522 79.2628 87.0335 89.8303 95.4231 (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	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
25.3303 22.4981 18.2967 13.8518 10.3544 8.7416 9.4456 12.2778 16.4792 20.9241 24.4215 26.0343 (67)												
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
284.1287 287.0771 279.6473 263.8301 243.8638 225.0983 212.5618 209.6134 217.0432 232.8604 252.8267 271.5922 (68)												
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
37.3002 37.3002 37.3002 37.3002 37.3002 37.3002 37.3002 37.3002 37.3002 37.3002 37.3002 37.3002 (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)												
-114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 (71)												
Water heating gains (Table 5)												
130.6062 128.2471 123.3482 116.6881 112.3642 106.2759 101.1010 107.7315 110.0873 116.9806 124.7643 128.2569 (72)												
Total internal gains	508.9659	506.7230	490.1929	463.2708	435.4832	409.0166	392.0092	398.5234	412.5104	439.6658	470.9132	494.7841 (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					0.6600	10.6334		0.6300	0.7000	0.7700		2.1448 (74)
East					10.5400	19.6403		0.6300	0.7000	0.7700		63.2645 (76)
South					3.2900	46.7521		0.6300	0.7000	0.7700		47.0076 (78)
West					17.2500	19.6403		0.6300	0.7000	0.7700		103.5400 (80)
East					1.5600	26.6725		0.6300	0.7000	1.0000		16.5147 (82)
West					2.0700	26.6725		0.6300	0.7000	1.0000		21.9137 (82)
Solar gains	254.3853	485.3852	777.8296	1114.1510	1356.1048	1386.1049	1320.3600	1138.9059	896.8563	569.4890	314.7745	210.8557 (83)
Total gains	763.3512	992.1082	1268.0225	1577.4218	1791.5880	1795.1215	1712.3691	1537.4293	1309.3667	1009.1548	785.6877	705.6398 (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)												
tau	16.4605	16.4880	16.5151	16.6434	16.6676	16.7813	16.7813	16.8025	16.7373	16.6676	16.6187	16.5678
alpha	2.0974	2.0992	2.1010	2.1096	2.1112	2.1188	2.1188	2.1202	2.1158	2.1112	2.1079	2.1045
util living area	0.9651	0.9404	0.8932	0.8067	0.6889	0.5547	0.4395	0.4918	0.6930	0.8737	0.9486	0.9701 (86)
MIT	18.3879	18.6918	19.1891	19.7928	20.2892	20.6190	20.7639	20.7305	20.4370	19.7447	18.9466	18.3325 (87)
Th 2	19.5498	19.5518	19.5538	19.5631	19.5649	19.5730	19.5730	19.5746	19.5699	19.5649	19.5613	19.5576 (88)
util rest of house	0.9588	0.9299	0.8742	0.7719	0.6310	0.4652	0.3184	0.3687	0.6124	0.8424	0.9378	0.9647 (89)
MIT 2	16.1407	16.5765	17.2830	18.1244	18.7810	19.1861	19.3320	19.3093	18.9961	18.0875	16.9546	16.0645 (90)
Living area fraction									fLA = Living area / (4) =			0.2429 (91)
MIT	16.6866	17.0903	17.7460	18.5297	19.1474	19.5342	19.6798	19.6545	19.3461	18.4901	17.4385	16.6155 (92)
Temperature adjustment												0.0000
adjusted MIT	16.6866	17.0903	17.7460	18.5297	19.1474	19.5342	19.6798	19.6545	19.3461	18.4901	17.4385	16.6155 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.9404 0.9049 0.8430 0.7415 0.6117 0.4625 0.3283 0.3763 0.5974 0.8114 0.9146 0.9482 (94)												
Useful gains	717.8757	897.7256	1068.9636	1169.6157	1095.8741	830.3171	562.1040	578.5676	782.2649	818.8768	718.5816	669.0764 (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	2491.0004	2447.4318	2254.1518	1915.2992	1479.1000	973.3271	607.5249	641.1820	1037.5714	1567.0169	2059.3282	2480.6331 (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	1319.2048	1041.4026	881.7800	536.8921	285.1201	0.0000	0.0000	0.0000	0.0000	556.6162	965.3376	1347.7982 (98)

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Space heating 6934.1517 (98)
Space heating per m2 (98) / (4) = 58.1871 (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 %) 170.0000 (206)
 Efficiency of secondary/supplementary heating system, % 0.0000 (208)
 Space heating requirement 4078.9127 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1319.2048	1041.4026	881.7800	536.8921	285.1201	0.0000	0.0000	0.0000	0.0000	556.6162	965.3376	1347.7982 (98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)
Space heating fuel (main heating system)	776.0028	612.5898	518.6941	315.8189	167.7177	0.0000	0.0000	0.0000	0.0000	327.4213	567.8456	792.8225 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	218.8178	192.8740	202.5773	181.6209	177.9998	159.0741	152.7973	167.6335	167.3273	188.3293	199.1091	213.5612 (64)
Efficiency of water heater (217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000 (216)
Fuel for water heating, kWh/month	128.7164	113.4553	119.1631	106.8358	104.7057	93.5730	89.8808	98.6080	98.4278	110.7819	117.1230	125.6242 (219)
Water heating fuel used												1306.8950 (219)
Annual totals kWh/year												
Space heating fuel - main system												4078.9127 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
Total electricity for the above, kWh/year												30.0000 (231)
Electricity for lighting (calculated in Appendix L)												447.3406 (232)
Total delivered energy for all uses												5863.1484 (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	4078.9127	0.5190	2116.9557 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1306.8950	0.5190	678.2785 (264)
Space and water heating			2795.2342 (265)
Pumps and fans	30.0000	0.5190	15.5700 (267)
Energy for lighting	447.3406	0.5190	232.1698 (268)
Total CO2, kg/year			3042.9740 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			25.5300 (273)

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

	TFA	N	EF
DER			
Total Floor Area	119.1700		
Assumed number of occupants		2.8600	
CO2 emission factor in Table 12 for electricity displaced from grid			0.5190
CO2 emissions from appliances, equation (L14)			14.1284 ZC2
CO2 emissions from cooking, equation (L16)			1.5746 ZC3
Total CO2 emissions			41.2330 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			41.2330 ZC8

FULL SAP CALCULATION PRINTOUT

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	119.1700 (1b)	x 2.6100 (2b)	= 311.0337 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.1700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 311.0337 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ 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) =	0.1286 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3786 (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) =		0.3218 (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												
Effective ac	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			3.8700	1.0000	3.8700		(26)
TER Opening Type (Uw = 1.40)			23.2800	1.3258	30.8636		(27)
TER Room Window (Uw = 1.70)			2.6600	1.5918	4.2341		(27a)
Ground Floor			119.1700	0.1300	15.4921		(28a)
Brick	82.5500	22.8700	59.6800	0.1800	10.7424		(29a)
Stone Clad	30.2400	2.6200	27.6200	0.1800	4.9716		(29a)
Wall to Garage	14.4500	1.6600	12.7900	0.1800	2.3022		(29a)
Wall to voids	31.4700		31.4700	0.1800	5.6646		(29a)
Pitched Roof	82.4400		82.4400	0.1300	10.7172		(30)
Skeillins	44.1000	2.6600	41.4400	0.1300	5.3872		(30)
Skeillins at Roof	16.2700		16.2700	0.1300	2.1151		(30)
Total net area of external elements Aum (m ²)			420.6900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	96.3601		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss

250.0000 (35)
17.4917 (36)
(33) + (36) = 113.8518 (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	59.9607	59.6252	59.2963	57.7516	57.4626	56.1173	56.1173	55.8682	56.6355	57.4626	58.0473	58.6585 (38)
Heat transfer coeff	173.8125	173.4770	173.1481	171.6035	171.3145	169.9691	169.9691	169.7200	170.4873	171.3145	171.8991	172.5103 (39)
Average = Sum(39)m / 12 =												171.6021 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.4585	1.4557	1.4530	1.4400	1.4376	1.4263	1.4263	1.4242	1.4306	1.4376	1.4425	1.4476 (40)
HLP (average)												1.4400 (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
Average daily hot water use (litres/day)

2.8600 (42)
102.1262 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.3388	108.2538	104.1687	100.0837	95.9986	91.9136	91.9136	95.9986	100.0837	104.1687	108.2538	112.3388 (44)
Energy conte	166.9952	145.7052	150.3547	131.0829	125.7772	108.5361	100.5747	115.4109	116.7893	136.1067	148.5711	161.3386 (45)
Energy content (annual)												Total = Sum(45)m = 1606.8425 (45)
Distribution loss (46)m = 0.15 x (45)m												

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24.9893	21.8558	22.5532	19.6624	18.8666	16.2804	15.0862	17.3116	17.5184	20.4160	22.2857	24.2008 (46)
Water storage loss:											215.0000 (47)
Store volume											1.7258 (48)
a) If manufacturer declared loss factor is known (kWh/day):											0.5400 (49)
Temperature factor from Table 2b											0.9319 (55)
Enter (49) or (54) in (55)											
Total storage loss											
28.8896	26.0938	28.8896	27.9576	28.8896	27.9576	28.8896	28.8896	27.9576	28.8896	27.9576	28.8896 (56)
If cylinder contains dedicated solar storage											
28.8896	26.0938	28.8896	27.9576	28.8896	27.9576	28.8896	28.8896	27.9576	28.8896	27.9576	28.8896 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month											
218.7471	192.8102	202.5067	181.5525	177.9291	159.0058	152.7266	167.5629	167.2589	188.2586	199.0407	213.4905 (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 (63)
Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h											
218.7471	192.8102	202.5067	181.5525	177.9291	159.0058	152.7266	167.5629	167.2589	188.2586	199.0407	213.4905 (64)
Heat gains from water heating, kWh/month											
97.1145	86.1310	91.7145	83.9608	83.5425	76.4640	75.1626	80.0957	79.2081	86.9770	89.7756	95.3666 (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	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	25.3320	22.4997	18.2979	13.8527	10.3551	8.7422	9.4462	12.2786	16.4803	20.9255	24.4232	26.0360 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	284.1287	287.0771	279.6473	263.8301	243.8638	225.0983	212.5618	209.6134	217.0432	232.8604	252.8267	271.5922 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002 (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)												
	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020 (71)
Water heating gains (Table 5)												
	130.5302	128.1711	123.2722	116.6122	112.2883	106.2000	101.0251	107.6555	110.0113	116.9046	124.6883	128.1810 (72)
Total internal gains												
	508.8916	506.6485	490.1181	463.1958	435.4079	408.9412	391.9339	398.4483	412.4356	439.5912	470.8389	494.7099 (73)

6. Solar gains

[Jan]					Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
North					0.4800	10.6334	0.6300	0.7000			0.7700			1.5599 (74)
East					7.7400	19.6403	0.6300	0.7000			0.7700			46.4580 (76)
South					2.4200	46.7521	0.6300	0.7000			0.7700			34.5771 (78)
West					12.6400	19.6403	0.6300	0.7000			0.7700			75.8693 (80)
East					1.1400	26.6725	0.6300	0.7000			1.0000			12.0684 (82)
West					1.5200	26.6725	0.6300	0.7000			1.0000			16.0912 (82)
Solar gains	186.6238	356.0608	570.5231	817.1273	994.5200	1016.4987	968.2936	835.2598	657.7985	417.7381	230.9211	154.6933	(83)	
Total gains	695.5154	862.7093	1060.6412	1280.3231	1429.9279	1425.4399	1360.2275	1233.7081	1070.2340	857.3293	701.7600	649.4032	(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	47.6128	47.7049	47.7955	48.2257	48.3070	48.6894	48.6894	48.7609	48.5414	48.3070	48.1427	47.9722
alpha	4.1742	4.1803	4.1864	4.2150	4.2205	4.2460	4.2460	4.2507	4.2361	4.2205	4.2095	4.1981
util living area												
	0.9980	0.9949	0.9842	0.9457	0.8495	0.6874	0.5294	0.5963	0.8452	0.9758	0.9959	0.9985 (86)
MIT												
	19.3521	19.5557	19.9045	20.3520	20.7165	20.9190	20.9792	20.9662	20.7962	20.2923	19.7351	19.3182 (87)
Th 2												
	19.7187	19.7209	19.7230	19.7328	19.7347	19.7432	19.7432	19.7448	19.7399	19.7347	19.7309	19.7270 (88)
util rest of house												
	0.9973	0.9931	0.9782	0.9246	0.7927	0.5811	0.3882	0.4508	0.7634	0.9627	0.9942	0.9980 (89)
MIT 2												
	17.5480	17.8464	18.3534	18.9925	19.4682	19.6928	19.7365	19.7322	19.5812	18.9235	18.1160	17.5039 (90)
Living area fraction												
	17.9863	18.2617	18.7302	19.3228	19.7715	19.9907	20.0383	20.0320	19.8764	19.2560	18.5094	17.9446 (92)
Temperature adjustment												
	17.9863	18.2617	18.7302	19.3228	19.7715	19.9907	20.0383	20.0320	19.8764	19.2560	18.5094	17.9446 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9958	0.9899	0.9716	0.9158	0.7946	0.6038	0.4228	0.4862	0.7739	0.9557	0.9915	0.9968 (94)
Useful gains	692.6074	853.9606	1030.5178	1172.5742	1136.2913	860.6572	575.0749	599.8300	828.3007	819.3463	695.7758	647.3480 (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												
	2378.8465	2317.9421	2117.6320	1788.5905	1382.7609	916.2462	584.4129	616.4169	984.7988	1482.9028	1961.2596	2371.0875 (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												
	1254.5619	983.7956	808.8129	443.5317	183.3734	0.0000	0.0000	0.0000	0.0000	493.6860	911.1484	1282.4623 (98)
Space heating												
												6361.3721 (98)

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Space heating per m²

(98) / (4) = 53.3807 (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 %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													6803.6065 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1254.5619	983.7956	808.8129	443.5317	183.3734	0.0000	0.0000	0.0000	0.0000	493.6860	911.1484	1282.4623	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	1341.7774	1052.1878	865.0405	474.3655	196.1213	0.0000	0.0000	0.0000	0.0000	528.0064	974.4902	1371.6174	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	218.7471	192.8102	202.5067	181.5525	177.9291	159.0058	152.7266	167.5629	167.2589	188.2586	199.0407	213.4905	(64)
Efficiency of water heater (217)m	88.7335	88.5542	88.1337	87.1076	84.8942	79.8000	79.8000	79.8000	79.8000	87.2696	88.3755	79.8000	(216)
Fuel for water heating, kWh/month	246.5215	217.7312	229.7722	208.4232	209.5892	199.2553	191.3868	209.9785	209.5976	215.7206	225.2216	240.4152	(219)
Water heating fuel used												2603.6130	(219)
Annual totals kWh/year													
Space heating fuel - main system												6803.6065	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												447.3709	(232)
Total delivered energy for all uses												9929.5904	(238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	6803.6065	0.2160	1469.5790 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2603.6130	0.2160	562.3804 (264)
Space and water heating			2031.9594 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	447.3709	0.5190	232.1855 (268)
Total CO ₂ , kg/m ² /year			2303.0699 (272)
Emissions per m ² for space and water heating			17.0509 (272a)
Fuel factor (electricity)			1.5500
Emissions per m ² for lighting			1.9484 (272b)
Emissions per m ² for pumps and fans			0.3266 (272c)
Target Carbon Dioxide Emission Rate (TER) = (17.0509 * 1.55) + 1.9484 + 0.3266, rounded to 2 d.p.			28.7000 (273)

FULL SAP CALCULATION PRINTOUT

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	119.1700 (1b)	x 2.6100 (2b)	= 311.0337 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.1700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 311.0337 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ 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) =	0.1286 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3786 (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) =		0.3218 (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												
Effective ac	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front Door			2.2100	1.6000	3.5360		(26)
Personnel Door			1.6600	1.8000	2.9880		(26)
Windows (Uw = 1.40)			31.7400	1.3258	42.0795		(27)
Roof Windows (Uw = 1.40)			3.6300	1.3258	4.8125		(27a)
Ground Floor			119.1700	0.1200	14.3004		(28a)
Brick	82.5500	30.3800	52.1700	0.2100	10.9557		(29a)
Stone Clad	30.2400	3.5700	26.6700	0.2100	5.6007		(29a)
Wall to Garage	14.4500	1.6600	12.7900	0.4500	5.7555		(29a)
Wall to voids	31.4700		31.4700	0.2979	9.3740		(29a)
Pitched Roof	82.4400		82.4400	0.1000	8.2440		(30)
Skeillins	44.1000	3.6300	40.4700	0.1900	7.6893		(30)
Skeillin at Roof	16.2700		16.2700	0.1900	3.0913		(30)
Total net area of external elements Aum(A, m ²)			420.6900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	118.4270		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.7162 (36)
Total fabric heat loss (33) + (36) = 141.1432 (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	59.9607	59.6252	59.2963	57.7516	57.4626	56.1173	56.1173	55.8682	56.6355	57.4626	58.0473	58.6585 (38)
Heat transfer coeff	201.1038	200.7683	200.4395	198.8948	198.6058	197.2605	197.2605	197.0113	197.7787	198.6058	199.1905	199.8017 (39)
Average = Sum(39)m / 12 =												198.8934 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.6875	1.6847	1.6820	1.6690	1.6666	1.6553	1.6553	1.6532	1.6596	1.6666	1.6715	1.6766 (40)
HLP (average)												1.6690 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8600 (42)
Average daily hot water use (litres/day)												102.1262 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.3388	108.2538	104.1687	100.0837	95.9986	91.9136	91.9136	95.9986	100.0837	104.1687	108.2538	112.3388 (44)
Energy conte	166.5952	145.7052	150.3547	131.0829	125.7772	108.5361	100.5747	115.4109	116.7893	136.1067	148.5711	161.3386 (45)
Energy content (annual)										Total = Sum(45)m =		1606.8425 (45)

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Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	35.4015	30.9624	31.9504	27.8551	26.7276	23.0639	21.3721	24.5248	24.8177	28.9227	31.5714	34.2844 (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	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.3303	22.4981	19.2967	13.8518	10.3544	8.7416	9.4456	12.2778	16.4792	20.9241	24.4215	26.0343	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	284.1287	287.0771	279.6473	263.8301	243.8638	225.0983	212.5618	209.6134	217.0432	232.8604	252.8267	271.5922	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	(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)	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	(71)
Water heating gains (Table 5)	47.5826	46.0749	42.9441	38.6877	35.9243	32.0332	28.7260	32.9635	34.4691	38.8745	43.8491	46.0812	(72)
Total internal gains	422.9423	421.5509	406.7888	382.2703	356.0432	331.7739	316.6341	320.7554	333.8922	358.5598	386.9980	409.6084	(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				0.6600	10.6334	0.6300	0.7000	0.7700	2.1448 (74)			
East				10.5400	19.6403	0.6300	0.7000	0.7700	63.2645 (76)			
South				3.2900	46.7521	0.6300	0.7000	0.7700	47.0076 (78)			
West				17.2500	19.6403	0.6300	0.7000	0.7700	103.5400 (80)			
East				1.5600	26.6725	0.6300	0.7000	1.0000	16.5147 (82)			
West				2.0700	26.6725	0.6300	0.7000	1.0000	21.9137 (82)			
Solar gains	254.3853	485.3852	777.8296	1114.1510	1356.1048	1386.1049	1320.3600	1138.9059	896.8563	569.4890	314.7745	210.8557 (83)
Total gains	677.3276	906.9361	1184.6184	1496.4214	1712.1480	1717.8788	1636.9941	1459.6613	1230.7485	928.0487	701.7725	620.4641 (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	16.4605	16.4880	16.5151	16.6434	16.6676	16.7813	16.7813	16.8025	16.7373	16.6676	16.6187	16.5678	
alpha	2.0974	2.0992	2.1010	2.1096	2.1112	2.1188	2.1188	2.1202	2.1158	2.1112	2.1079	2.1045	
util living area	0.9720	0.9491	0.9042	0.8201	0.7039	0.5706	0.4548	0.5102	0.7134	0.8891	0.9581	0.9765	(86)
MIT	17.5877	18.0003	18.6768	19.5014	20.1839	20.6399	20.8426	20.7937	20.3799	19.4227	18.3381	17.5125	(87)
Th 2	19.5498	19.5518	19.5538	19.5631	19.5649	19.5730	19.5730	19.5746	19.5699	19.5649	19.5613	19.5576	(88)
util rest of house	0.9669	0.9399	0.8868	0.7869	0.6470	0.4805	0.3310	0.3848	0.6344	0.8607	0.9490	0.9722	(89)
MIT 2	16.5016	16.9093	17.5714	18.3644	18.9872	19.3747	19.5162	19.4931	19.1862	18.3165	17.2552	16.4321	(90)
Living area fraction										fLA = Living area / (4) =		0.2429	(91)
MIT	16.7655	17.1744	17.8399	18.6406	19.2779	19.6820	19.8384	19.8091	19.4762	18.5852	17.5183	16.6945	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.7655	17.1744	17.8399	18.6406	19.2779	19.6820	19.8384	19.8091	19.4762	18.5852	17.5183	16.6945	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	644.9967	833.3097	1018.3193	1138.6101	1085.3554	838.5697	582.7863	594.8854	773.2132	774.9362	652.8395	595.2278	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2506.8527	2464.3050	2272.9729	1937.3599	1505.0121	1002.4856	638.8096	671.6243	1063.3003	1585.9172	2075.2165	2496.4275	(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	1385.2209	1096.0288	933.4623	575.0998	312.2246	0.0000	0.0000	0.0000	0.0000	603.3698	1024.1115	1414.4926	(98)
Space heating												7344.0105	(98)
Space heating per m2											(98) / (4) =	61.6263	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	

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Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1854.2485	1459.7276	1497.2862	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7168	0.7757	0.7366	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1329.1019	1132.2550	1102.9630	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2075.6720	1981.0960	1783.2187	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	537.5305	631.5377	506.1102	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												1675.1784 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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	134.3826	157.8844	126.5276	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												418.7946 (107)
Space cooling per m2												3.5143 (108)
Energy for space heating												61.6263 (99)
Energy for space cooling												3.5143 (108)
Total												65.1406 (109)
Dwelling Fabric Energy Efficiency (DFEE)												65.1 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	119.1700 (1b)	x 2.6100 (2b)	= 311.0337 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.1700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 311.0337 (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)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				Air changes per hour
Pressure test					40.0000 / (5) =
Measured/design AP50					Yes
Infiltration rate					5.0000
Number of sides sheltered					0.3786 (18)
					2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3218 (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												
Effective ac	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			3.8700	1.0000	3.8700		(26)
TER Opening Type (Uw = 1.40)			23.2800	1.3258	30.8636		(27)
TER Room Window (Uw = 1.70)			2.6600	1.5918	4.2341		(27a)
Ground Floor			119.1700	0.1300	15.4921		(28a)
Brick	82.5500	22.8700	59.6800	0.1800	10.7424		(29a)
Stone Clad	30.2400	2.6200	27.6200	0.1800	4.9716		(29a)
Wall to Garage	14.4500	1.6600	12.7900	0.1800	2.3022		(29a)
Wall to voids	31.4700		31.4700	0.1800	5.6646		(29a)
Pitched Roof	82.4400		82.4400	0.1300	10.7172		(30)
Skeillins	44.1000	2.6600	41.4400	0.1300	5.3872		(30)
Skeilllin at Roof	16.2700		16.2700	0.1300	2.1151		(30)
Total net area of external elements Aum(A, m ²)			420.6900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	96.3601		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss

250.0000 (35)
17.4917 (36)
(33) + (36) = 113.8518 (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	59.9607	59.6252	59.2963	57.7516	57.4626	56.1173	56.1173	55.8682	56.6355	57.4626	58.0473	58.6585 (38)
Heat transfer coeff	173.8125	173.4770	173.1481	171.6035	171.3145	169.9691	169.9691	169.7200	170.4873	171.3145	171.8991	172.5103 (39)
Average = Sum(39)m / 12 =												171.6021 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.4585	1.4557	1.4530	1.4400	1.4376	1.4263	1.4263	1.4242	1.4306	1.4376	1.4425	1.4476 (40)
HLP (average)												1.4400 (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
Average daily hot water use (litres/day)

2.8600 (42)
102.1262 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.3388	108.2538	104.1687	100.0837	95.9986	91.9136	91.9136	95.9986	100.0837	104.1687	108.2538	112.3388 (44)
Energy conte	166.5952	145.7052	150.3547	131.0829	125.7772	108.5361	100.5747	115.4109	116.7893	136.1067	148.5711	161.3386 (45)
Energy content (annual)												Total = Sum(45)m = 1606.8425 (45)
Distribution loss (46)m = 0.15 x (45)m												

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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	35.4015	30.9624	31.9504	27.8551	26.7276	23.0639	21.3721	24.5248	24.8177	28.9227	31.5714	34.2844 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025	143.0025 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.3320	22.4997	18.2979	13.8527	10.3551	8.7422	9.4462	12.2786	16.4803	20.9255	24.4232	26.0360 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	284.1287	287.0771	279.6473	263.8301	243.8638	225.0983	212.5618	209.6134	217.0432	232.8604	252.8267	271.5922 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002	37.3002 (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)	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020 (71)
Water heating gains (Table 5)	47.5826	46.0749	42.9441	38.6877	35.9243	32.0332	28.7260	32.9635	34.4691	38.8745	43.8491	46.0812 (72)
Total internal gains	422.9441	421.5524	406.7900	382.2713	356.0439	331.7745	316.6348	320.7562	333.8933	358.5612	386.9997	409.6102 (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					0.4800	10.6334	0.6300	0.7000			0.7700	1.5599 (74)
East					7.7400	19.6403	0.6300	0.7000			0.7700	46.4580 (76)
South					2.4200	46.7521	0.6300	0.7000			0.7700	34.5771 (78)
West					12.6400	19.6403	0.6300	0.7000			0.7700	75.8693 (80)
East					1.1400	26.6725	0.6300	0.7000			1.0000	12.0684 (82)
West					1.5200	26.6725	0.6300	0.7000			1.0000	16.0912 (82)
Solar gains	186.6238	356.0608	570.5231	817.1273	994.5200	1016.4987	968.2936	835.2598	657.7985	417.7381	230.9211	154.6933 (83)
Total gains	609.5679	777.6131	977.3131	1199.3986	1350.5639	1348.2732	1284.9284	1156.0161	991.6918	776.2992	617.9208	564.3035 (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	47.6128	47.7049	47.7955	48.2257	48.3070	48.6894	48.6894	48.7609	48.5414	48.3070	48.1427	47.9722
alpha	4.1742	4.1803	4.1864	4.2150	4.2205	4.2460	4.2460	4.2507	4.2361	4.2205	4.2095	4.1981
util living area	0.9988	0.9966	0.9881	0.9557	0.8688	0.7141	0.5561	0.6280	0.8712	0.9828	0.9975	0.9992 (86)
MIT	19.2885	19.4935	19.8461	20.3037	20.6856	20.9062	20.9750	20.9589	20.7657	20.2371	19.6734	19.2549 (87)
Th 2	19.7187	19.7209	19.7230	19.7328	19.7347	19.7432	19.7432	19.7448	19.7399	19.7347	19.7309	19.7270 (88)
util rest of house	0.9984	0.9953	0.9836	0.9377	0.8160	0.6080	0.4099	0.4786	0.7963	0.9732	0.9964	0.9989 (89)
MIT 2	18.1732	18.3793	18.7309	19.1832	19.5292	19.7024	19.7375	19.7340	19.6111	19.1285	18.5670	18.1460 (90)
Living area fraction	18.4441	18.6500	19.0018	19.4554	19.8101	19.9948	20.0382	20.0316	19.8916	19.3978	18.8358	18.4154 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4441	18.6500	19.0018	19.4554	19.8101	19.9948	20.0382	20.0316	19.8916	19.3978	18.8358	18.4154 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9978	0.9938	0.9800	0.9327	0.8197	0.6313	0.4459	0.5153	0.8073	0.9696	0.9952	0.9984 (94)
Useful gains	608.2078	772.7621	957.7917	1118.7090	1107.0889	851.1727	572.9683	595.7349	800.5502	752.6702	614.9699	563.3926 (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	2458.4240	2385.3021	2164.6695	1811.3420	1389.3823	916.9561	584.3807	616.3533	987.3942	1507.1941	2017.3710	2452.3018 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	1376.5608	1083.6269	897.9171	498.6958	210.0263	0.0000	0.0000	0.0000	0.0000	561.3658	1009.7288	1405.3485 (98)
Space heating												7043.2699 (98)
Space heating per m2												59.1027 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

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Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1597.7097	1257.7714	1289.8718	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8236	0.8893	0.8508	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1315.8968	1118.5035	1097.4592	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1656.0990	1581.3490	1438.1180	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	244.9456	344.3571	253.4501	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									FC = cooled area / (4) =			842.7528 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	61.2364	86.0893	63.3625	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												210.6882 (107)
Energy for space heating												1.7680 (108)
Energy for space cooling												59.1027 (99)
Total												1.7680 (108)
Target Fabric Energy Efficiency (TFEE)												60.8707 (109)
												70.0 (109)

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CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	119.1700 (1b)	x 2.6100 (2b)	= 311.0337 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.1700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 311.0337 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ 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)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				Air changes per hour
Pressure test					40.0000 / (5) =
Measured/design AP50					Yes
Infiltration rate					5.0000
Number of sides sheltered					0.3786 (18)
					2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3218 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate	0.3862	0.3620	0.3540	0.3138	0.3138	0.2896	0.2977	0.2816	0.2977	0.3218	0.3299	0.3540 (22b)
Effective ac	0.5746	0.5655	0.5627	0.5492	0.5492	0.5419	0.5443	0.5396	0.5443	0.5518	0.5544	0.5627 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front Door			2.2100	1.6000	3.5360		(26)
Personnel Door			1.6600	1.8000	2.9880		(26)
Windows (Uw = 1.40)			31.7400	1.3258	42.0795		(27)
Roof Windows (Uw = 1.40)			3.6300	1.3258	4.8125		(27a)
Ground Floor			119.1700	0.1200	14.3004		(28a)
Brick	82.5500	30.3800	52.1700	0.2100	10.9557		(29a)
Stone Clad	30.2400	3.5700	26.6700	0.2100	5.6007		(29a)
Wall to Garage	14.4500	1.6600	12.7900	0.4500	5.7555		(29a)
Wall to voids	31.4700		31.4700	0.2979	9.3740		(29a)
Pitched Roof	82.4400		82.4400	0.1000	8.2440		(30)
Skeillins	44.1000	3.6300	40.4700	0.1900	7.6893		(30)
Skeillin at Roof	16.2700		16.2700	0.1900	3.0913		(30)
Total net area of external elements Aum(A, m ²)			420.6900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	118.4270		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.7162 (36)
Total fabric heat loss (33) + (36) = 141.1432 (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	58.9741	58.0473	57.7516	56.3731	56.3731	55.6257	55.8682	55.3898	55.8682	56.6355	56.9046	57.7516 (38)
Heat transfer coeff	200.1173	199.1905	198.8948	197.5163	197.5163	196.7688	197.0113	196.5330	197.0113	197.7787	198.0478	198.8948 (39)
Average = Sum(39)m / 12 =												197.9401 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.6793	1.6715	1.6690	1.6574	1.6574	1.6512	1.6532	1.6492	1.6532	1.6596	1.6619	1.6690 (40)
HLP (average)												1.6610 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8600 (42)
Average daily hot water use (litres/day)												102.1262 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.3388	108.2538	104.1687	100.0837	95.9986	91.9136	91.9136	95.9986	100.0837	104.1687	108.2538	112.3388 (44)
Energy conte	166.5952	145.7052	150.3547	131.0829	125.7772	108.5361	100.5747	115.4109	116.7893	136.1067	148.5711	161.3386 (45)
Energy content (annual)										Total = Sum(45)m =		1606.8425 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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CALCULATION OF HEAT DEMAND 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	24.9893	21.8558	22.5532	19.6624	18.8666	16.2804	15.0862	17.3116	17.5184	20.4160	22.2857	24.2008 (46)
Water storage loss:												
Store volume												215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7300 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9342 (55)
Total storage loss												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 (56)												
If cylinder contains dedicated solar storage												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 (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												
218.8178 192.8740 202.5773 181.6209 177.9998 159.0741 152.7973 167.6335 167.3273 188.3293 199.1091 213.5612 (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	218.8178	192.8740	202.5773	181.6209	177.9998	159.0741	152.7973	167.6335	167.3273	188.3293	199.1091	213.5612 (64)
RHI water heating demand												2221.7215 (64)
Heat gains from water heating, kWh/month	97.1710	86.1820	91.7710	84.0155	83.5990	76.5187	75.2192	80.1522	79.2628	87.0335	89.8303	95.4231 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	63.3257	56.2453	45.7418	34.6295	25.8859	21.8540	23.6140	30.6944	41.1979	52.3102	61.0538	65.0857 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	424.0727	428.4732	417.3840	393.7763	363.9759	335.9676	317.2564	312.8559	323.9451	347.5528	377.3532	405.3615 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0203	55.0203	55.0203	55.0203	55.0203	55.0203	55.0203	55.0203	55.0203	55.0203	55.0203	55.0203 (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)	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020	-114.4020 (71)
Water heating gains (Table 5)	130.6062	128.2471	123.3482	116.6881	112.3642	106.2759	101.1010	107.7315	110.0873	116.9806	124.7643	128.2569 (72)
Total internal gains	733.2259	728.1869	701.6952	660.3153	617.4474	579.3189	557.1928	566.5031	590.4517	632.0649	678.3926	713.9254 (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					0.6600	12.7054	0.6300	0.7000	0.7700	2.5627 (74)		
East					10.5400	23.7288	0.6300	0.7000	0.7700	76.4343 (76)		
South					3.2900	53.5774	0.6300	0.7000	0.7700	53.8702 (78)		
West					17.2500	23.7288	0.6300	0.7000	0.7700	125.0941 (80)		
East					1.5600	32.5812	0.6300	0.7000	1.0000	20.1731 (82)		
West					2.0700	32.5812	0.6300	0.7000	1.0000	26.7682 (82)		
Solar gains	304.9026	517.6387	825.9651	1244.0563	1453.0946	1586.2661	1494.0050	1303.0113	1018.7724	649.4500	381.0799	244.3286 (83)
Total gains	1038.1285	1245.8256	1527.6603	1904.3715	2070.5419	2165.5850	2051.1978	1869.5144	1609.2241	1281.5149	1059.4726	958.2540 (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	16.5417	16.6187	16.6434	16.7595	16.7595	16.8232	16.8025	16.8434	16.8025	16.7373	16.7145	16.6434
alpha	2.1028	2.1079	2.1096	2.1173	2.1173	2.1215	2.1202	2.1229	2.1202	2.1158	2.1143	2.1096
util living area	0.9347	0.9073	0.8479	0.7368	0.6016	0.4410	0.3211	0.3388	0.5705	0.7910	0.9027	0.9418 (86)
MIT	18.7530	18.9908	19.4734	20.0438	20.4786	20.7336	20.8257	20.8222	20.6215	20.0850	19.3474	18.7388 (87)
Th 2	19.5557	19.5613	19.5631	19.5715	19.5715	19.5760	19.5746	19.5775	19.5746	19.5699	19.5683	19.5631 (88)
util rest of house	0.9234	0.8917	0.8224	0.6939	0.5345	0.3478	0.2028	0.2116	0.4738	0.7423	0.8827	0.9314 (89)
MIT 2	16.6654	17.0039	17.6808	18.4568	19.0111	19.2969	19.3740	19.3765	19.1975	18.5429	17.5243	16.6505 (90)
Living area fraction									fLA = Living area / (4) =			0.2429 (91)
MIT	17.1725	17.4866	18.1162	18.8423	19.3676	19.6459	19.7266	19.7277	19.5434	18.9175	17.9672	17.1578 (92)
Temperature adjustment												0.0000
adjusted MIT	17.1725	17.4866	18.1162	18.8423	19.3676	19.6459	19.7266	19.7277	19.5434	18.9175	17.9672	17.1578 (93)

8. Space heating requirement

Utilisation	0.8972	0.8618	0.7901	0.6684	0.5239	0.3527	0.2162	0.2259	0.4715	0.7149	0.8526	0.9067 (94)
Useful gains	931.4510	1073.6831	1207.0745	1272.9572	1084.7375	763.7767	443.3883	422.2667	758.6967	916.1191	903.3275	868.8853 (95)
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000 (96)
Heat loss rate W	2435.9358	2407.5296	2191.0731	1845.2555	1336.7161	835.4701	458.3737	437.8179	895.1102	1427.4715	1954.1753	2378.3478 (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												

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1119.3367	896.3448	732.0950	412.0548	187.4721	0.0000	0.0000	0.0000	0.0000	380.4462	756.6104	1123.0401 (98)
Space heating												5607.4000 (98)
RHI space heating demand												5607 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	119.1700 (1b)	x 2.6100 (2b)	= 311.0337 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.1700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 311.0337 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ 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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour
Pressure test				40.0000 / (5) =	0.1286 (8)
Measured/design AP50				Yes	5.0000
Infiltration rate					0.3786 (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) =	0.3218 (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												
Effective ac	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front Door			2.2100	1.6000	3.5360		(26)
Personnel Door			1.6600	1.8000	2.9880		(26)
Windows (Uw = 1.40)			31.7400	1.3258	42.0795		(27)
Roof Windows (Uw = 1.40)			3.6300	1.3258	4.8125		(27a)
Ground Floor			119.1700	0.1200	14.3004		(28a)
Brick	82.5500	30.3800	52.1700	0.2100	10.9557		(29a)
Stone Clad	30.2400	3.5700	26.6700	0.2100	5.6007		(29a)
Wall to Garage	14.4500	1.6600	12.7900	0.4500	5.7555		(29a)
Wall to voids	31.4700		31.4700	0.2979	9.3740		(29a)
Pitched Roof	82.4400		82.4400	0.1000	8.2440		(30)
Skeillins	44.1000	3.6300	40.4700	0.1900	7.6893		(30)
Skeillin at Roof	16.2700		16.2700	0.1900	3.0913		(30)
Total net area of external elements Aum(A, m ²)			420.6900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	118.4270		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.7162 (36)
Total fabric heat loss (33) + (36) = 141.1432 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	59.9607	59.6252	59.2963	57.7516	57.4626	56.1173	56.1173	55.8682	56.6355	57.4626	58.0473	58.6585 (38)
Average = Sum(39)m / 12 =	201.1038	200.7683	200.4395	198.8948	198.6058	197.2605	197.2605	197.0113	197.7787	198.6058	199.1905	199.8017 (39)
												198.8934 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.6875	1.6847	1.6820	1.6690	1.6666	1.6553	1.6553	1.6532	1.6596	1.6666	1.6715	1.6766 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8600 (42)
Average daily hot water use (litres/day)												102.1262 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	112.3388	108.2538	104.1687	100.0837	95.9986	91.9136	91.9136	95.9986	100.0837	104.1687	108.2538	112.3388 (44)
Energy content (annual)	166.5952	145.7052	150.3547	131.0829	125.7772	108.5361	100.5747	115.4109	116.7893	136.1067	148.5711	161.3386 (45)
										Total = Sum(45)m =		1606.8425 (45)

FULL SAP CALCULATION PRINTOUT

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Distribution loss (46)m = 0.15 x (45)m	24.9893	21.8558	22.5532	19.6624	18.8666	16.2804	15.0862	17.3116	17.5184	20.4160	22.2857	24.2008 (46)
Water storage loss:												
Store volume												215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7300 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9342 (55)
Total storage loss												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 (56)												
If cylinder contains dedicated solar storage												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 (57)												
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624 (59)
Total heat required for water heating calculated for each month												
218.8178 192.8740 202.5773 181.6209 177.9998 159.0741 152.7973 167.6335 167.3273 188.3293 199.1091 213.5612 (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	218.8178	192.8740	202.5773	181.6209	177.9998	159.0741	152.7973	167.6335	167.3273	188.3293	199.1091	213.5612 (64)
Total per year (kWh/year) = Sum(64)m =												2221.7215 (64)
Heat gains from water heating, kWh/month												
97.1710 86.1820 91.7710 84.0155 83.5990 76.5187 75.2192 80.1522 79.2628 87.0335 89.8303 95.4231 (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	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
63.3257 56.2453 45.7418 34.6295 25.8859 21.8540 23.6140 30.6944 41.1979 52.3102 61.0538 65.0857 (67)												
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
424.0727 428.4732 417.3840 393.7763 363.9759 335.9676 317.2564 312.8559 323.9451 347.5528 377.3532 405.3615 (68)												
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 (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)												
-114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 (71)												
Water heating gains (Table 5)												
130.6062 128.2471 123.3482 116.6881 112.3642 106.2759 101.1010 107.7315 110.0873 116.9806 124.7643 128.2569 (72)												
Total internal gains	733.2259	728.1869	701.6952	660.3153	617.4474	579.3189	557.1928	566.5031	590.4517	632.0649	678.3926	713.9254 (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					0.6600	10.6334		0.6300	0.7000	0.7700	2.1448 (74)	
East					10.5400	19.6403		0.6300	0.7000	0.7700	63.2645 (76)	
South					3.2900	46.7521		0.6300	0.7000	0.7700	47.0076 (78)	
West					17.2500	19.6403		0.6300	0.7000	0.7700	103.5400 (80)	
East					1.5600	26.6725		0.6300	0.7000	1.0000	16.5147 (82)	
West					2.0700	26.6725		0.6300	0.7000	1.0000	21.9137 (82)	
Solar gains	254.3853	485.3852	777.8296	1114.1510	1356.1048	1386.1049	1320.3600	1138.9059	896.8563	569.4890	314.7745	210.8557 (83)
Total gains	987.6112	1213.5721	1479.5249	1774.4663	1973.5522	1965.4238	1877.5528	1705.4090	1487.3080	1201.5539	993.1671	924.7811 (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)												
tau	16.4605	16.4880	16.5151	16.6434	16.6676	16.7813	16.7813	16.8025	16.7373	16.6676	16.6187	16.5678
alpha	2.0974	2.0992	2.1010	2.1096	2.1112	2.1188	2.1188	2.1202	2.1158	2.1112	2.1079	2.1045
util living area	0.9446	0.9161	0.8645	0.7744	0.6558	0.5222	0.4090	0.4557	0.6494	0.8364	0.9229	0.9510 (86)
MIT	18.5738	18.8613	19.3281	19.8897	20.3466	20.6482	20.7785	20.7506	20.4929	19.8623	19.1097	18.5179 (87)
Th 2	19.5498	19.5518	19.5538	19.5631	19.5649	19.5730	19.5730	19.5746	19.5699	19.5649	19.5613	19.5576 (88)
util rest of house	0.9351	0.9021	0.8418	0.7366	0.5966	0.4344	0.2936	0.3378	0.5666	0.7992	0.9076	0.9426 (89)
MIT 2	16.4053	16.8145	17.4725	18.2485	18.8462	19.2120	19.3405	19.3223	19.0531	18.2406	17.1831	16.3292 (90)
Living area fraction												
MIT	16.9321	17.3117	17.9233	18.6472	19.2107	19.5609	19.6898	19.6692	19.4029	18.6346	17.6511	16.8609 (92)
Temperature adjustment												0.0000
adjusted MIT	16.9321	17.3117	17.9233	18.6472	19.2107	19.5609	19.6898	19.6692	19.4029	18.6346	17.6511	16.8609 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.9110 0.8731 0.8094 0.7079 0.5801 0.4335 0.3038 0.3463 0.5555 0.7685 0.8797 0.9202 (94)												
Useful gains	899.6798	1059.5191	1197.5943	1256.1459	1144.7784	852.0857	570.3689	590.6605	826.1585	923.4497	873.6452	850.9522 (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	2540.3633	2491.8820	2289.6843	1938.6755	1491.6666	978.5857	609.4928	644.0791	1048.7972	1595.7112	2101.6825	2529.6630 (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	1220.6685	962.5479	812.5150	491.4213	258.0848	0.0000	0.0000	0.0000	0.0000	500.1625	884.1868	1248.9609 (98)

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Space heating 6378.5477 (98)
Space heating per m2 (98) / (4) = 53.5248 (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 %) 170.0000 (206)
 Efficiency of secondary/supplementary heating system, % 0.0000 (208)
 Space heating requirement 3752.0869 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1220.6685	962.5479	812.5150	491.4213	258.0848	0.0000	0.0000	0.0000	0.0000	500.1625	884.1868	1248.9609 (98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)
Space heating fuel (main heating system)	718.0403	566.2046	477.9500	289.0714	151.8146	0.0000	0.0000	0.0000	0.0000	294.2133	520.1099	734.6829 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	218.8178	192.8740	202.5773	181.6209	177.9998	159.0741	152.7973	167.6335	167.3273	188.3293	199.1091	213.5612 (64)
Efficiency of water heater (217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000 (216)
Fuel for water heating, kWh/month	128.7164	113.4553	119.1631	106.8358	104.7057	93.5730	89.8808	98.6080	98.4278	110.7819	117.1230	125.6242 (219)
Water heating fuel used												1306.8950 (219)
Annual totals kWh/year												
Space heating fuel - main system												3752.0869 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
Total electricity for the above, kWh/year												30.0000 (231)
Electricity for lighting (calculated in Appendix L)												447.3406 (232)
Total delivered energy for all uses												5536.3226 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3752.0869	13.1900	494.9003 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1306.8950	13.1900	172.3795 (247)
Pumps and fans for heating	30.0000	13.1900	3.9570 (249)
Energy for lighting	447.3406	13.1900	59.0042 (250)
Additional standing charges			0.0000 (251)
Total energy cost			730.2409 (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] = 1.8682 (257)
 SAP value 73.9387
 SAP rating (Section 12) 74 (258)
 SAP band C

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	3752.0869	0.5190	1947.3331 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1306.8950	0.5190	678.2785 (264)
Space and water heating			2625.6116 (265)
Pumps and fans	30.0000	0.5190	15.5700 (267)
Energy for lighting	447.3406	0.5190	232.1698 (268)
Total kg/year			2873.3514 (272)
CO2 emissions per m2			24.1100 (273)
EI value			76.5469
EI rating			77 (274)
EI band			C

Calculation of stars for heating and DHW

Main heating energy efficiency $13.19 \times (1 + 0.29 \times 0.25) / 1.7000 = 8.321$, stars = 2
 Main heating environmental impact $0.519 \times (1 + 0.29 \times 0.25) / 1.7000 = 0.3274$, stars = 4
 Water heating energy efficiency $13.19 / 1.7000 = 7.759$, stars = 2

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Water heating environmental impact

$0.519 / 1.7000 = 0.3053$, stars = 4

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Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	119.1700 (1b)	x 2.6100 (2b)	= 311.0337 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.1700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 311.0337 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ 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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1286 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3786 (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) = 0.3218 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate	0.3862	0.3620	0.3540	0.3138	0.3138	0.2896	0.2977	0.2816	0.2977	0.3218	0.3299	0.3540 (22b)
Effective ac	0.5746	0.5655	0.5627	0.5492	0.5492	0.5419	0.5443	0.5396	0.5443	0.5518	0.5544	0.5627 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front Door			2.2100	1.6000	3.5360		(26)
Personnel Door			1.6600	1.8000	2.9880		(26)
Windows (Uw = 1.40)			31.7400	1.3258	42.0795		(27)
Roof Windows (Uw = 1.40)			3.6300	1.3258	4.8125		(27a)
Ground Floor			119.1700	0.1200	14.3004		(28a)
Brick	82.5500	30.3800	52.1700	0.2100	10.9557		(29a)
Stone Clad	30.2400	3.5700	26.6700	0.2100	5.6007		(29a)
Wall to Garage	14.4500	1.6600	12.7900	0.4500	5.7555		(29a)
Wall to voids	31.4700		31.4700	0.2979	9.3740		(29a)
Pitched Roof	82.4400		82.4400	0.1000	8.2440		(30)
Skeillins	44.1000	3.6300	40.4700	0.1900	7.6893		(30)
Skeillin at Roof	16.2700		16.2700	0.1900	3.0913		(30)
Total net area of external elements Aum(A, m ²)			420.6900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	118.4270		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.7162 (36)
Total fabric heat loss (33) + (36) = 141.1432 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	58.9741	58.0473	57.7516	56.3731	56.3731	55.6257	55.8682	55.3898	55.8682	56.6355	56.9046	57.7516 (38)
Average = Sum(39)m / 12 =	200.1173	199.1905	198.8948	197.5163	197.5163	196.7688	197.0113	196.5330	197.0113	197.7787	198.0478	198.8948 (39)
												197.9401 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.6793	1.6715	1.6690	1.6574	1.6574	1.6512	1.6532	1.6492	1.6532	1.6596	1.6619	1.6690 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8600 (42)
Average daily hot water use (litres/day)												102.1262 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	112.3388	108.2538	104.1687	100.0837	95.9986	91.9136	91.9136	95.9986	100.0837	104.1687	108.2538	112.3388 (44)
Energy content (annual)	166.5952	145.7052	150.3547	131.0829	125.7772	108.5361	100.5747	115.4109	116.7893	136.1067	148.5711	161.3386 (45)
										Total = Sum(45)m =		1606.8425 (45)

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Distribution loss (46)m = 0.15 x (45)m	24.9893	21.8558	22.5532	19.6624	18.8666	16.2804	15.0862	17.3116	17.5184	20.4160	22.2857	24.2008 (46)
Water storage loss:												
Store volume												215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7300 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9342 (55)
Total storage loss												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 (56)												
If cylinder contains dedicated solar storage												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 (57)												
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624 (59)
Total heat required for water heating calculated for each month												
218.8178 192.8740 202.5773 181.6209 177.9998 159.0741 152.7973 167.6335 167.3273 188.3293 199.1091 213.5612 (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	218.8178	192.8740	202.5773	181.6209	177.9998	159.0741	152.7973	167.6335	167.3273	188.3293	199.1091	213.5612 (64)
Total per year (kWh/year) = Sum(64)m =												2221.7215 (64)
Heat gains from water heating, kWh/month												
97.1710 86.1820 91.7710 84.0155 83.5990 76.5187 75.2192 80.1522 79.2628 87.0335 89.8303 95.4231 (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	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
63.3257 56.2453 45.7418 34.6295 25.8859 21.8540 23.6140 30.6944 41.1979 52.3102 61.0538 65.0857 (67)													
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
424.0727 428.4732 417.3840 393.7763 363.9759 335.9676 317.2564 312.8559 323.9451 347.5528 377.3532 405.3615 (68)													
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 (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)													
-114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 (71)													
Water heating gains (Table 5)													
130.6062 128.2471 123.3482 116.6881 112.3642 106.2759 101.1010 107.7315 110.0873 116.9806 124.7643 128.2569 (72)													
Total internal gains	733.2259	728.1869	701.6952	660.3153	617.4474	579.3189	557.1928	566.5031	590.4517	632.0649	678.3926	713.9254 (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	0.6600	12.7054	0.6300	0.7000	0.7700	2.5627 (74)
East	10.5400	23.7288	0.6300	0.7000	0.7700	76.4343 (76)
South	3.2900	53.5774	0.6300	0.7000	0.7700	53.8702 (78)
West	17.2500	23.7288	0.6300	0.7000	0.7700	125.0941 (80)
East	1.5600	32.5812	0.6300	0.7000	1.0000	20.1731 (82)
West	2.0700	32.5812	0.6300	0.7000	1.0000	26.7682 (82)

Solar gains	304.9026	517.6387	825.9651	1244.0563	1453.0946	1586.2661	1494.0050	1303.0113	1018.7724	649.4500	381.0799	244.3286 (83)
Total gains	1038.1285	1245.8256	1527.6603	1904.3715	2070.5419	2165.5850	2051.1978	1869.5144	1609.2241	1281.5149	1059.4726	958.2540 (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)													
tau	16.5417	16.6187	16.6434	16.7595	16.7595	16.8232	16.8025	16.8434	16.8025	16.7373	16.7145	16.6434	
alpha	2.1028	2.1079	2.1096	2.1173	2.1173	2.1215	2.1202	2.1229	2.1202	2.1158	2.1143	2.1096	
util living area	0.9347	0.9073	0.8479	0.7368	0.6016	0.4410	0.3211	0.3388	0.5705	0.7910	0.9027	0.9418 (86)	
MIT	18.7530	18.9908	19.4734	20.0438	20.4786	20.7336	20.8257	20.8222	20.6215	20.0850	19.3474	18.7388 (87)	
Th 2	19.5557	19.5613	19.5631	19.5715	19.5715	19.5760	19.5746	19.5775	19.5746	19.5699	19.5683	19.5631 (88)	
util rest of house	0.9234	0.8917	0.8224	0.6939	0.5345	0.3478	0.2028	0.2116	0.4738	0.7423	0.8827	0.9314 (89)	
MIT 2	16.6654	17.0039	17.6808	18.4568	19.0111	19.2969	19.3740	19.3765	19.1975	18.5429	17.5243	16.6505 (90)	
Living area fraction													0.2429 (91)
MIT	17.1725	17.4866	18.1162	18.8423	19.3676	19.6459	19.7266	19.7277	19.5434	18.9175	17.9672	17.1578 (92)	
Temperature adjustment													0.0000
adjusted MIT	17.1725	17.4866	18.1162	18.8423	19.3676	19.6459	19.7266	19.7277	19.5434	18.9175	17.9672	17.1578 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.8972 0.8618 0.7901 0.6684 0.5239 0.3527 0.2162 0.2259 0.4715 0.7149 0.8526 0.9067 (94)													
Useful gains	931.4510	1073.6831	1207.0745	1272.9572	1084.7375	763.7767	443.3883	422.2667	758.6967	916.1191	903.3275	868.8853 (95)	
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000 (96)	
Heat loss rate W	2435.9358	2407.5296	2191.0731	1845.2555	1336.7161	835.4701	458.3737	437.8179	895.1102	1427.4715	1954.1753	2378.3478 (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	1119.3367	896.3448	732.0950	412.0548	187.4721	0.0000	0.0000	0.0000	0.0000	380.4462	756.6104	1123.0401 (98)	

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Space heating 5607.4000 (98)
Space heating per m2 (98) / (4) = 47.0538 (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 %) 170.0000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3298.4706 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1119.3367	896.3448	732.0950	412.0548	187.4721	0.0000	0.0000	0.0000	0.0000	380.4462	756.6104	1123.0401	(98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)	658.4333	527.2616	430.6441	242.3852	110.2777	0.0000	0.0000	0.0000	0.0000	223.7919	445.0649	660.6118	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	218.8178	192.8740	202.5773	181.6209	177.9998	159.0741	152.7973	167.6335	167.3273	188.3293	199.1091	213.5612	(64)
Efficiency of water heater (217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(216)
Fuel for water heating, kWh/month	128.7164	113.4553	119.1631	106.8358	104.7057	93.5730	89.8808	98.6080	98.4278	110.7819	117.1230	125.6242	(219)
Water heating fuel used												1306.8950	(219)
Annual totals kWh/year													
Space heating fuel - main system												3298.4706	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												447.3406	(232)
Total delivered energy for all uses												5082.7063	(238)

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3298.4706	19.4400	641.2227	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1306.8950	19.4400	254.0604	(247)
Pumps and fans for heating	30.0000	19.4400	5.8320	(249)
Energy for lighting	447.3406	19.4400	86.9630	(250)
Additional standing charges			0.0000	(251)
Total energy cost			988.0781	(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	3298.4706	0.5190	1711.9062	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1306.8950	0.5190	678.2785	(264)
Space and water heating			2390.1848	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	447.3406	0.5190	232.1698	(268)
Total kg/year			2637.9245	(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	3298.4706	3.0700	10126.3048	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1306.8950	3.0700	4012.1677	(264)
Space and water heating			14138.4724	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	447.3406	3.0700	1373.3358	(268)
Primary energy kWh/year			15603.9082	(272)
Primary energy kWh/m2/year			130.9382	(273)

SAP 2012 EPC IMPROVEMENTS

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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Current energy efficiency rating: C 74
Current environmental impact rating: C 77

(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	Recommended
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	+ 2.4	-£ 102	-272 kg (10.3%)
U Solar photovoltaic panels	+ 8.1	-£ 375	-1000 kg (42.3%)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
Solar water heating	£102	2.28 kg/m²	C 76 C 79
Solar photovoltaic panels	£375	8.39 kg/m²	B 84 B 86
Total Savings	£477	10.68 kg/m²	

Potential energy efficiency rating: B 84
Potential environmental impact rating: B 86

Fuel prices for cost data on this page from database revision number 493 TEST (31 Mar 2022)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£988	£886	£102
Space heating	£647	£647	-£0
Water heating	£254	£152	£102
Lighting	£87	£87	£0
Generated (PV)	-£0	-£375	£375
Total cost of fuels	£988	£511	£477
Total cost of uses	£988	£511	£477
Delivered energy	43 kWh/m²	22 kWh/m²	21 kWh/m²
Carbon dioxide emissions	2.6 tonnes	1.4 tonnes	1.3 tonnes
CO2 emissions per m²	22 kg/m²	11 kg/m²	11 kg/m²
Primary energy	131 kWh/m²	68 kWh/m²	63 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	119.1700 (1b)	x 2.6100 (2b)	= 311.0337 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.1700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	311.0337 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ 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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour
Pressure test				40.0000 / (5) =	0.1286 (8)
Measured/design AP50				Yes	5.0000
Infiltration rate					0.3786 (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) =	0.3218 (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												
Effective ac	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front Door			2.2100	1.6000	3.5360		(26)
Personnel Door			1.6600	1.8000	2.9880		(26)
Windows (Uw = 1.40)			31.7400	1.3258	42.0795		(27)
Roof Windows (Uw = 1.40)			3.6300	1.3258	4.8125		(27a)
Ground Floor			119.1700	0.1200	14.3004		(28a)
Brick	82.5500	30.3800	52.1700	0.2100	10.9557		(29a)
Stone Clad	30.2400	3.5700	26.6700	0.2100	5.6007		(29a)
Wall to Garage	14.4500	1.6600	12.7900	0.4500	5.7555		(29a)
Wall to voids	31.4700		31.4700	0.2979	9.3740		(29a)
Pitched Roof	82.4400		82.4400	0.1000	8.2440		(30)
Skeillins	44.1000	3.6300	40.4700	0.1900	7.6893		(30)
Skeillin at Roof	16.2700		16.2700	0.1900	3.0913		(30)
Total net area of external elements Aum(A, m ²)			420.6900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	118.4270		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.7162 (36)
Total fabric heat loss (33) + (36) = 141.1432 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 59.9607	Feb 59.6252	Mar 59.2963	Apr 57.7516	May 57.4626	Jun 56.1173	Jul 56.1173	Aug 55.8682	Sep 56.6355	Oct 57.4626	Nov 58.0473	Dec 58.6585 (38)
Heat transfer coeff	201.1038	200.7683	200.4395	198.8948	198.6058	197.2605	197.2605	197.0113	197.7787	198.6058	199.1905	199.8017 (39)
Average = Sum(39)m / 12 =												198.8934 (39)
HLP	Jan 1.6875	Feb 1.6847	Mar 1.6820	Apr 1.6690	May 1.6666	Jun 1.6553	Jul 1.6553	Aug 1.6532	Sep 1.6596	Oct 1.6666	Nov 1.6715	Dec 1.6766 (40)
HLP (average)												1.6690 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8600 (42)
Average daily hot water use (litres/day)												102.1262 (43)
Daily hot water use	Jan 112.3388	Feb 108.2538	Mar 104.1687	Apr 100.0837	May 95.9986	Jun 91.9136	Jul 91.9136	Aug 95.9986	Sep 100.0837	Oct 104.1687	Nov 108.2538	Dec 112.3388 (44)
Energy conte	166.5952	145.7052	150.3547	131.0829	125.7772	108.5361	100.5747	115.4109	116.7893	136.1067	148.5711	161.3386 (45)
Energy content (annual)										Total = Sum(45)m =		1606.8425 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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Distribution loss (46)m = 0.15 x (45)m	24.9893	21.8558	22.5532	19.6624	18.8666	16.2804	15.0862	17.3116	17.5184	20.4160	22.2857	24.2008 (46)
Water storage loss:												
Store volume												215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7300 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9342 (55)
Total storage loss												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 (56)												
If cylinder contains dedicated solar storage												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.0260 28.9602 28.0260 28.9602 (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												
218.8178 192.8740 201.1816 174.8673 165.2054 146.4674 139.7703 155.5371 161.9244 186.9335 199.1091 213.5612 (62)												
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1079.5246 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1813.6014 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1287 (H8)
Utilisation factor												0.5877 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												102.1262 (H14)
Volume ratio Veff/V												0.7344 (H15)
Solar storage volume factor												0.9383 (H16)
Solar input												-879.3262 (H17)
Solar input	-25.4987	-42.5500	-72.4675	-97.1208	-119.9845	-117.9639	-116.4050	-101.7036	-79.6543	-54.3945	-30.2451	-21.3381 (63)
Solar input (sum of months) = Sum(63)m =												-879.3262 (63)
Output from w/h												
193.3191 150.3240 128.7141 77.7465 45.2209 28.5035 23.3654 53.8335 82.2701 132.5390 168.8639 192.2231 (64)												
Total per year (kWh/year) = Sum(64)m =												1276.9230 (64)
Heat gains from water heating, kWh/month												
97.1710 86.1820 90.6544 78.6126 73.3635 66.4333 64.7976 70.4751 74.9405 85.9169 89.8303 95.4231 (65)												

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

Metabolic gains (Table 5), Watts												
(66)m	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030	171.6030 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
63.3257 56.2453 45.7418 34.6295 25.8859 21.8540 23.6140 30.6944 41.1979 52.3102 61.0538 65.0857 (67)												
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
424.0727 428.4732 417.3840 393.7763 363.9759 335.9676 317.2564 312.8559 323.9451 347.5528 377.3532 405.3615 (68)												
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 (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)												
-114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 (71)												
Water heating gains (Table 5)												
130.6062 128.2471 121.8474 109.1841 98.6069 92.2685 87.0936 94.7245 104.0841 115.4798 124.7643 128.2569 (72)												
Total internal gains												
733.2259 728.1869 700.1944 652.8113 603.6900 565.3114 543.1853 553.4961 584.4485 630.5641 678.3926 713.9254 (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	0.6600	10.6334	0.6300	0.7000	0.7700	2.1448 (74)
East	10.5400	19.6403	0.6300	0.7000	0.7700	63.2645 (76)
South	3.2900	46.7521	0.6300	0.7000	0.7700	47.0076 (78)
West	17.2500	19.6403	0.6300	0.7000	0.7700	103.5400 (80)
East	1.5600	26.6725	0.6300	0.7000	1.0000	16.5147 (82)
West	2.0700	26.6725	0.6300	0.7000	1.0000	21.9137 (82)

Solar gains	254.3853	485.3852	777.8296	1114.1510	1356.1048	1386.1049	1320.3600	1138.9059	896.8563	569.4890	314.7745	210.8557 (83)
Total gains	987.6112	1213.5721	1478.0241	1766.9623	1959.7948	1951.4163	1863.5453	1692.4020	1481.3048	1200.0531	993.1671	924.7811 (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)												
tau	16.4605	16.4880	16.5151	16.6434	16.6676	16.7813	16.7813	16.8025	16.7373	16.6676	16.6187	16.5678
alpha	2.0974	2.0992	2.1010	2.1096	2.1112	2.1188	2.1188	2.1202	2.1158	2.1112	2.1079	2.1045
util living area												
0.9446 0.9161 0.8647 0.7757 0.6583 0.5247 0.4114 0.4583 0.6508 0.8367 0.9229 0.9510 (86)												
MIT	18.5738	18.8613	19.3272	19.8862	20.3426	20.6460	20.7773	20.7492	20.4912	19.8615	19.1097	18.5179 (87)
Th 2	19.5498	19.5518	19.5538	19.5631	19.5649	19.5730	19.5730	19.5746	19.5699	19.5649	19.5613	19.5576 (88)
util rest of house												
0.9351 0.9021 0.8421 0.7379 0.5991 0.4368 0.2956 0.3400 0.5681 0.7995 0.9076 0.9426 (89)												
MIT 2	16.4053	16.8145	17.4713	18.2441	18.8416	19.2100	19.3398	19.3214	19.0514	18.2395	17.1831	16.3292 (90)
Living area fraction												FLA = Living area / (4) = 0.2429 (91)

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MIT	16.9321	17.3117	17.9221	18.6430	19.2062	19.5589	19.6890	19.6682	19.4012	18.6335	17.6511	16.8609 (92)
Temperature adjustment												0.0000
adjusted MIT	16.9321	17.3117	17.9221	18.6430	19.2062	19.5589	19.6890	19.6682	19.4012	18.6335	17.6511	16.8609 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9110	0.8731	0.8097	0.7091	0.5824	0.4358	0.3057	0.3485	0.5568	0.7689	0.8797	0.9202 (94)	
Useful gains	899.6798	1059.5191	1196.7265	1253.0291	1141.3065	850.4323	569.7339	589.8177	824.8064	922.6871	873.6452	850.9522 (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	2540.3633	2491.8820	2289.4448	1937.8380	1490.7807	978.1887	609.3420	643.8780	1048.4546	1595.5027	2101.6825	2529.6630 (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	1220.6685	962.5479	812.9824	493.0624	260.0088	0.0000	0.0000	0.0000	0.0000	500.5748	884.1868	1248.9609 (98)	
Space heating												6382.9924 (98)	
Space heating per m2												(98) / (4) =	53.5621 (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 %)													170.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3754.7014 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1220.6685	962.5479	812.9824	493.0624	260.0088	0.0000	0.0000	0.0000	0.0000	500.5748	884.1868	1248.9609 (98)	
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)	
Space heating fuel (main heating system)	718.0403	566.2046	478.2250	290.0367	152.9463	0.0000	0.0000	0.0000	0.0000	294.4557	520.1099	734.6829 (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	193.3191	150.3240	128.7141	77.7465	45.2209	28.5035	23.3654	53.8335	82.2701	132.5390	168.8639	192.2231 (64)	
Efficiency of water heater (217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000 (216)	
Fuel for water heating, kWh/month	113.7171	88.4259	75.7142	45.7332	26.6005	16.7668	13.7443	31.6667	48.3942	77.9641	99.3317	113.0724 (219)	
Water heating fuel used												751.1312 (219)	
Annual totals kWh/year													
Space heating fuel - main system													3754.7014 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													80.0000 (231)
Electricity for lighting (calculated in Appendix L)													447.3406 (232)
Energy saving/generation technologies (Appendices M,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =									-1727.2394				-1727.2394 (233)
Total delivered energy for all uses													3305.9338 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost f/year	
Space heating - main system 1	3754.7014	13.1900	495.2451 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	751.1312	13.1900	99.0742 (247)	
Pumps and fans for heating	30.0000	13.1900	3.9570 (249)	
Pump for solar water heating	50.0000	13.1900	6.5950 (249)	
Energy for lighting	447.3406	13.1900	59.0042 (250)	
Additional standing charges			0.0000 (251)	
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229 (252)	
Total energy cost			436.0527 (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] =	1.1156 (257)
SAP value			84.4379
SAP rating (Section 12)			84 (258)
SAP band			B

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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	3754.7014	0.5190	1948.6900	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	751.1312	0.5190	389.8371	(264)
Space and water heating			2338.5271	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	447.3406	0.5190	232.1698	(268)
Energy saving/generation technologies				
FV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			1715.7797	(272)
CO2 emissions per m2			14.4000	(273)
EI value			85.9953	
EI rating			86	(274)
EI band			B	

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	119.1700 (1b)	x 2.6100 (2b)	= 311.0337 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.1700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 311.0337 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ 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)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				Air changes per hour
Pressure test					40.0000 / (5) =
Measured/design AP50					Yes
Infiltration rate					5.0000
Number of sides sheltered					0.3786 (18)
					2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3218 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate	0.3862	0.3620	0.3540	0.3138	0.3138	0.2896	0.2977	0.2816	0.2977	0.3218	0.3299	0.3540 (22b)
Effective ac	0.5746	0.5655	0.5627	0.5492	0.5492	0.5419	0.5443	0.5396	0.5443	0.5518	0.5544	0.5627 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front Door			2.2100	1.6000	3.5360		(26)
Personnel Door			1.6600	1.8000	2.9880		(26)
Windows (Uw = 1.40)			31.7400	1.3258	42.0795		(27)
Roof Windows (Uw = 1.40)			3.6300	1.3258	4.8125		(27a)
Ground Floor			119.1700	0.1200	14.3004		(28a)
Brick	82.5500	30.3800	52.1700	0.2100	10.9557		(29a)
Stone Clad	30.2400	3.5700	26.6700	0.2100	5.6007		(29a)
Wall to Garage	14.4500	1.6600	12.7900	0.4500	5.7555		(29a)
Wall to voids	31.4700		31.4700	0.2979	9.3740		(29a)
Pitched Roof	82.4400		82.4400	0.1000	8.2440		(30)
Skeillins	44.1000	3.6300	40.4700	0.1900	7.6893		(30)
Skeillin at Roof	16.2700		16.2700	0.1900	3.0913		(30)
Total net area of external elements Aum(A, m ²)			420.6900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	118.4270		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.7162 (36)
Total fabric heat loss						(33) + (36) =	141.1432 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	58.9741	58.0473	57.7516	56.3731	56.3731	55.6257	55.8682	55.3898	55.8682	56.6355	56.9046	57.7516 (38)
Heat transfer coeff	200.1173	199.1905	198.8948	197.5163	197.5163	196.7688	197.0113	196.5330	197.0113	197.7787	198.0478	198.8948 (39)
Average = Sum(39)m / 12 =												197.9401 (39)
HLP	1.6793	1.6715	1.6690	1.6574	1.6574	1.6512	1.6532	1.6492	1.6532	1.6596	1.6619	1.6690 (40)
HLP (average)												1.6610 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8600 (42)
Average daily hot water use (litres/day)												102.1262 (43)
Daily hot water use	112.3388	108.2538	104.1687	100.0837	95.9986	91.9136	91.9136	95.9986	100.0837	104.1687	108.2538	112.3388 (44)
Energy conte	166.5952	145.7052	150.3547	131.0829	125.7772	108.5361	100.5747	115.4109	116.7893	136.1067	148.5711	161.3386 (45)
Energy content (annual)										Total = Sum(45)m =		1606.8425 (45)

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Distribution loss (46)m = 0.15 x (45)m	24.9893	21.8558	22.5532	19.6624	18.8666	16.2804	15.0862	17.3116	17.5184	20.4160	22.2857	24.2008 (46)
Water storage loss:												
Store volume												215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7300 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9342 (55)
Total storage loss												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 (56)												
If cylinder contains dedicated solar storage												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.0260 28.9602 28.0260 28.9602 (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												
218.8178 192.8740 201.1816 174.8673 165.2054 146.4674 139.7703 155.5371 161.9244 186.9335 199.1091 213.5612 (62)												
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1204.7564 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2023.9908 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2596 (H8)
Utilisation factor												0.5479 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												102.1262 (H14)
Volume ratio Veff/V												0.7344 (H15)
Solar storage volume factor												0.9383 (H16)
Solar input												-914.9166 (H17)
Solar input	-28.2126	-41.9083	-71.1796	-100.5512	-119.4367	-125.5143	-122.4179	-107.9808	-83.7717	-57.3162	-33.8036	-22.8237 (63)
Solar input (sum of months) = Sum(63)m =												-914.9166 (63)
Output from w/h												
190.6052 150.9657 130.0020 74.3161 45.7687 20.9531 17.3524 47.5562 78.1528 129.6173 165.3055 190.7375 (64)												
Total per year (kWh/year) = Sum(64)m =												1241.3325 (64)
Heat gains from water heating, kWh/month												
97.1710 86.1820 90.6544 78.6126 73.3635 66.4333 64.7976 70.4751 74.9405 85.9169 89.8303 95.4231 (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 171.6030 171.6030 171.6030 171.6030 171.6030 171.6030 171.6030 171.6030 171.6030 171.6030 171.6030 171.6030 (66)												
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
63.3257 56.2453 45.7418 34.6295 25.8859 21.8540 23.6140 30.6944 41.1979 52.3102 61.0538 65.0857 (67)												
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
424.0727 428.4732 417.3840 393.7763 363.9759 335.9676 317.2564 312.8559 323.9451 347.5528 377.3532 405.3615 (68)												
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 55.0203 (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)												
-114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 -114.4020 (71)												
Water heating gains (Table 5)												
130.6062 128.2471 121.8474 109.1841 98.6069 92.2685 87.0936 94.7245 104.0841 115.4798 124.7643 128.2569 (72)												
Total internal gains												
733.2259 728.1869 700.1944 652.8113 603.6900 565.3114 543.1853 553.4961 584.4485 630.5641 678.3926 713.9254 (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		0.6600	12.7054	0.6300	0.7000	0.7700	2.5627 (74)
East		10.5400	23.7288	0.6300	0.7000	0.7700	76.4343 (76)
South		3.2900	53.5774	0.6300	0.7000	0.7700	53.8702 (78)
West		17.2500	23.7288	0.6300	0.7000	0.7700	125.0941 (80)
East		1.5600	32.5812	0.6300	0.7000	1.0000	20.1731 (82)
West		2.0700	32.5812	0.6300	0.7000	1.0000	26.7682 (82)

Solar gains	304.9026	517.6387	825.9651	1244.0563	1453.0946	1586.2661	1494.0050	1303.0113	1018.7724	649.4500	381.0799	244.3286 (83)
Total gains	1038.1285	1245.8256	1526.1595	1896.8675	2056.7846	2151.5775	2037.1903	1856.5074	1603.2209	1280.0141	1059.4726	958.2540 (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 16.5417 16.6187 16.6434 16.7595 16.7595 16.8232 16.8025 16.8434 16.8025 16.7373 16.7145 16.6434												
alpha 2.1028 2.1079 2.1096 2.1173 2.1173 2.1215 2.1202 2.1229 2.1202 2.1158 2.1143 2.1096												
util living area												
0.9347 0.9073 0.8482 0.7380 0.6040 0.4432 0.3230 0.3408 0.5719 0.7914 0.9027 0.9418 (86)												
MIT 18.7530 18.9908 19.4725 20.0407 20.4754 20.7322 20.8252 20.8216 20.6203 20.0843 19.3474 18.7388 (87)												
Th 2 19.5557 19.5613 19.5631 19.5715 19.5715 19.5760 19.5746 19.5775 19.5746 19.5699 19.5683 19.5631 (88)												
util rest of house												
0.9234 0.8917 0.8226 0.6952 0.5369 0.3497 0.2042 0.2130 0.4751 0.7426 0.8827 0.9314 (89)												
MIT 2 16.6654 17.0039 17.6796 18.4530 19.0077 19.2959 19.3737 19.3763 19.1965 18.5420 17.5243 16.6505 (90)												
Living area fraction												
FLA = Living area / (4) =												0.2429 (91)

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

MIT	17.1725	17.4866	18.1151	18.8387	19.3643	19.6448	19.7263	19.7274	19.5423	18.9167	17.9672	17.1578 (92)
Temperature adjustment												0.0000
adjusted MIT	17.1725	17.4866	18.1151	18.8387	19.3643	19.6448	19.7263	19.7274	19.5423	18.9167	17.9672	17.1578 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8972	0.8618	0.7904	0.6697	0.5261	0.3545	0.2175	0.2273	0.4727	0.7152	0.8526	0.9067 (94)
Useful gains	931.4510	1073.6831	1206.2579	1270.2605	1082.0714	762.8295	443.1411	422.0069	757.8150	915.4822	903.3275	868.8853 (95)
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000 (96)
Heat loss rate W	2435.9358	2407.5296	2190.8492	1844.5440	1336.0545	835.2483	458.3130	437.7536	894.8945	1427.3001	1954.1753	2378.3478 (97)
Month fractl	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	1119.3367	896.3448	732.5359	413.4841	188.9634	0.0000	0.0000	0.0000	0.0000	380.7925	756.6104	1123.0401 (98)
Space heating												5611.1080 (98)
Space heating per m2												(98) / (4) = 47.0849 (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 %)	170.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3300.6518	(211)

[illegible][illegible]

Electricity for pumps and fans:	
central heating pump	30.0000 (230c)
pump for solar water heating	50.0000 (230g)
Total electricity for the above, kWh/year	80.0000 (231)
Electricity for lighting (calculated in Appendix L)	447.3406 (232)

Energy saving/generation technologies (Appendices M, N and Q)			
PV Unit 0 (0.80 * 2.50 * 1205 * 0.80) =	-1927.6103	-1927.6103	(233)
Total delivered energy for all uses	2630.5777	2630.5777	(238)

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3300.6518	19.4400	641.6467 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	730.1956	19.4400	141.9500 (247)
Pumps and fans for heating	30.0000	19.4400	5.8320 (249)
Pump for solar water heating	50.0000	19.4400	9.7200 (249)
Energy for lighting	447.3406	19.4400	86.9630 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-1927.6103	19.4400	-374.7274 (252)
Total energy cost			511.3843 (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	3300.6518	0.5190	1713.0383 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	730.1956	0.5190	378.9715 (264)
Space and water heating			2092.0098 (265)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

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

Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	447.3406	0.5190	232.1698 (268)
Energy saving/generation technologies			
PV Unit	-1927.6103	0.5190	-1000.4297 (269)
Total kg/year			1365.2698 (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	3300.6518	3.0700	10133.0009 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	730.1956	3.0700	2241.7005 (264)
Space and water heating			12374.7015 (265)
Pumps and fans	80.0000	3.0700	245.6000 (267)
Energy for lighting	447.3406	3.0700	1373.3358 (268)
Energy saving/generation technologies			
PV Unit	-1927.6103	3.0700	-5917.7636 (269)
Primary energy kWh/year			8075.8737 (272)
Primary energy kWh/m2/year			67.7677 (273)

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	SAP 0873 Plot 2	Issued on Date	07/04/2022
Assessment Reference	Rev A	Prop Type Ref	
Property			
SAP Rating	74 C	DER	25.53
Environmental	77 C	% DER-TER	11.06
CO ₂ Emissions (t/year)	2.64	DEREE	65.14
General Requirements Compliance	Pass	% DEREE-TEEE	6.94
Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com		Assessor ID
Client	K & J Contracts, K&JC		

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

Orientation	East
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	Bungalow, Detached
2.0 Number of Storeys	1
3.0 Date Built	2022
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
	Ground Floor: 50.82 m	119.17 m ²	2.61 m

7.0 Living Area	28.95	m ²
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8.0 Thermal Mass Parameter		Simple calculation - Low
Thermal Mass	100.00	kJ/m²K

9.0 External Walls		U-Value (W/m ² K)	Gross Area (m ²)	Nett Area (m ²)
Description	Type			
Brick	Timber Frame	0.21	82.55	52.17
Stone Clad	Timber Frame	0.21	30.24	26.67
Wall to Garage	Timber Frame	0.45	14.45	12.79
Wall to voids	Timber Frame	0.35	31.47	31.47

10.0 External Roofs		U-Value (W/m ² K)	Gross Area (m ²)	Nett Area (m ²)
Description	Type			
Pitched Roof	External Plane Roof	0.10	82.44	82.44
Skeillins	External Slope Roof	0.19	44.10	40.47
Skeillin at Roof	External Slope Roof	0.19	16.27	16.27

11.0 Heat Loss Floors		U-Value (W/m ² K)	Area (m ²)
Description	Type		
Ground Floor	Ground Floor - Solid	0.12	119.17

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)
Front Door	Manufacturer	Solid Door							1.60
Personnel Door	Manufacturer	Solid Door							1.80
Windows	Manufacturer	Window	Double Low-E Soft 0.1			0.63		0.70	1.40
Roof Windows	Manufacturer	Roof Window	Double Low-E Soft 0.1			0.63		0.70	1.40

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front Door	Solid Door	[1] Brick	East							2.21	
Front Elevation	Window	[1] Brick	East	None	0.00					6.97	
Front Elevation	Window	[2] Stone Clad	East	None	0.00					3.57	
North	Solid Door	[3] Wall to Garage	North							1.66	
North Elevation	Window	[1] Brick	North	None	0.00					0.66	
West Elevation	Window	[1] Brick	West	None	0.00					17.25	
South Elevation	Window	[1] Brick	South	None	0.00					3.29	
East Roof Window	Roof Window	[2] Skeillins	East	None						1.56	
West Roof Windows	Roof Window	[2] Skeillins	West	None						2.07	

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
Table K1 - Approved	E2 Other lintels (including other steel lintels)	17.47	0.300	No
Table K1 - Approved	E3 Sill	3.00	0.040	No
Table K1 - Approved	E4 Jamb	43.12	0.050	No
Table K1 - Approved	E5 Ground floor (normal)	50.82	0.160	No
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	26.82	0.060	No
Table K1 - Approved	E11 Eaves (insulation at rafter level)	13.58	0.040	No
Table K1 - Approved	E12 Gable (insulation at ceiling level)	6.07	0.240	No
Table K1 - Approved	E13 Gable (insulation at rafter level)	5.14	0.040	No
Table K1 - Approved	E16 Corner (normal)	23.80	0.090	No
Table K1 - Approved	E17 Corner (inverted -- internal area greater than external area)	14.28	-0.090	No
Table K1 - Default	R1 Head of roof window	2.46	0.080	No
Table K1 - Default	R2 Sill of roof window	2.46	0.060	No
Table K1 - Default	R3 Jamb of roof window	8.51	0.080	No
Table K1 - Default	R4 Ridge (vaulted ceiling)	11.49	0.080	No
Table K1 - Default	R5 Ridge (inverted)	8.15	0.040	No
Table K1 - Default	R6 Flat ceiling	2.10	0.060	No

Y-value 0.054 W/m²K

18.0 Pressure Testing

Yes

Designed AP₅₀ 5.00 m³/(h.m²) @ 50 Pa

Property Tested ?

As Built AP₅₀ m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather Windows fully open

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Cross ventilation possible	Yes
Night Ventilation	Yes
Air change rate	6.00
Mechanical Ventilation	
Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System

No

22.0 Lighting

Internal

Total number of light fittings	12	
Total number of L.E.L. fittings	12	
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

Description	SAP table	
Percentage of Heat	PET	%
Main Heating	100	
SAP Code	PET	
Efficiency (SAP Table)	224	%
Controls	170.0	
PCDF Controls	CHD Time and temperature zone control	
Sap Code	0	
Is MHS Pumped	2207	
Heat Emitter	Pump in heated space	
Underfloor Heating	Underfloor	
Flow Temperature	Yes - Pipes in thin screed	
	Unknown	

25.0 Main Heating 2

None

Community Heating	None
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28.0 Water Heating

Water Heating	HWP From main heating 1
Flue Gas Heat Recovery System	Main Heating 1
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	Yes
SAP Code	901
Immersion Heater	Single
Supplementary Immersion	Yes
Immersion Only Heating Hot Water	Yes
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	215.00 L
Loss	1.73 kWh/day
Pipes insulation	Fully insulated primary pipework
31.0 Thermal Store	None

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	£102	C 76	
	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental impact
Solar photovoltaic panels, 2.5 kWp	£3,500 - £5,500	£375	B 84	