elmhurst energy



SAP Report Submission for Building Regulations Compliance

Client: ABL Homes Ltd

Project: Plot 2, 2 Kiln Lane
Farnham, Surrey, GU10 3LR

Contact: Scott Spearing
Scott Spearing
scott@beatsolutions.co.uk

Report Issue Date: 04/05/2021

EXCELLENCE IN ENERGY ASSESSMENT

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Design SAP
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Property	Plot 2, 2 Kiln Lane, Farnham, Surrey, GU10 3LR		

SAP Rating	85 B	**DER**	15.93	**TER**	16.29
Environmental	86 B	**% DER<TER**	2.21		
CO_2 Emissions (t/year)	1.57	**DFEE**	47.21	**TFEE**	51.64
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.57		

Assessor Details	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk	**Assessor ID**	p775-0001
Client	ABL Homes Ltd, ABL HOMES		

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	16.29	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	15.93	$kgCO_2/m^2$	Pass
	-0.36 (-2.2%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	51.64	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	47.21	$kWh/m^2/yr$	
	-4.4 (-8.5%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	Pass
Roof	0.13 (max. 0.20)	0.17 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Ideal LOGIC COMBI ESP1 35 Combi boiler Efficiency: 89.6% SEDBUK2009 Minimum: 88.0%		Pass
Secondary heating system	None		

5 Cylinder insulation

Hot water storage	No cylinder		

6 Controls

Space heating controls	Time and temperature zone control		Pass
Hot water controls	No cylinder		
Boiler interlock	Yes		Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Slight	Pass

Based on:

Overshading	Average	
Windows facing North	3.24 m², No overhang	
Windows facing East	7.67 m², No overhang	
Windows facing West	8.87 m², No overhang	
Air change rate	5.00 ach	
Blinds/curtains	None	

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

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

10 Key features

Party wall U-value	0.00	W/m²K
Roof U-value	0.10	W/m²K
Floor U-value	0.12	W/m²K

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

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Orientation	East
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Semi-Detached
2.0 Number of Storeys	2
3.0 Date Built	2021
4.0 Sheltered Sides	1
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	23.79 m	58.24 m²	2.36 m
1st Storey:	23.79 m	58.24 m²	2.32 m

7.0 Living Area	17.00	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	164.64	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
External Walls	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.24	60.00	82.91	66.48
Dormer Walls & Cheeks	Timber Frame	Timber framed wall (one layer of plasterboard)	0.23	9.00	18.84	13.57

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Party Wall	Filled Cavity with Edge Sealing	Single plasterboard on dabs on both sides, dense blocks, cavity or cavity fill	0.00	70.00	33.06

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Wall - Masonry	Dense block, plasterboard on dabs	75.00	66.83
Internal Wall - Timber	Plasterboard on timber frame	9.00	74.62

10.0 External Roofs

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Description	Type	Construction	U-Value (W/m^2K)	Kappa (kJ/m^2K)	Gross Area (m^2)	Nett Area (m^2)
Pitched Cold Roof	External Plane Roof	Plasterboard, insulated at ceiling level	0.10	9.00	37.45	37.45
Sloping Roof	External Slope Roof	Plasterboard, insulated slope	0.17	9.00	31.04	29.64

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m^2K)	Area (m^2)
Internal Ceiling	Plasterboard ceiling, carpeted chipboard floor	9.00	58.24

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m^2K)	Kappa (kJ/m^2K)	Area (m^2)
Ground Floor	Ground Floor - Solid	Suspended concrete floor, carpeted	0.12	75.00	58.24

11.2 Internal Floors

Description	Construction	Kappa (kJ/m^2K)	Area (m^2)
Internal Floor	Plasterboard ceiling, carpeted chipboard floor	18.00	58.24

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m^2K)
Front Door	Manufacturer	Solid Door							1.40
Windows	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.40
Rooflights	Manufacturer	Roof Window	Double Low-E Soft 0.05			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 (m^2)	Curtain Closed
Front Door	Solid Door	[1] External Walls	East							1.92	
Front Elevation	Window	[1] External Walls	East	None	0.00					3.35	
Front Dormers	Window	[2] Dormer Walls & Cheeks	East	None	0.00					4.32	
Side Elevation	Window	[1] External Walls	North	None	0.00					3.24	
Rear Elevation	Window	[1] External Walls	West	None	0.00					7.92	
Rear Rooflights	Roof Window	[2] Sloping Roof	West	None						1.40	
Rear Dormer	Window	[2] Dormer Walls & Cheeks	West	None	0.00					0.95	

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

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported	Reference:
Independently assessed	E2 Other lintels (including other steel lintels)	14.34	0.230	Yes	Keystone Standard
Independently assessed	E3 Sill	13.42	0.034	Yes	CD0027
Independently assessed	E4 Jamb	34.80	0.040	No	CD0028
Table K1 - Approved	E5 Ground floor (normal)	23.79	0.160	Yes	
Independently assessed	E6 Intermediate floor within a dwelling	23.79	0.000	Yes	CD0029
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	9.15	0.060	No	
Independently assessed	E11 Eaves (insulation at rafter level)	13.00	0.034	No	CD0034
Independently assessed	E12 Gable (insulation at ceiling level)	7.00	0.073	No	CD0031
Table K1 - Approved	E13 Gable (insulation at rafter level)	7.44	0.040	No	
Independently assessed	E16 Corner (normal)	22.32	0.058	No	CD0035
Table K1 - Approved	E17 Corner (inverted – internal area greater than external area)	4.72	-0.090	No	
Table K1 - Default	E25 Staggered party wall between dwellings	7.21	0.120	No	
Table K1 - Default	P1 Party wall - Ground floor	7.51	0.160	No	
Table K1 - Default	P2 Party wall - Intermediate floor within a dwelling	7.51	0.000	No	
Table K1 - Default	P4 Party wall - Roof (insulation at ceiling level)	3.37	0.240	No	
Table K1 - Default	P5 Party wall - Roof (insulation at rafter level)	5.52	0.080	No	
Table K1 - Default	R1 Head of roof window	1.56	0.080	Yes	
Table K1 - Default	R2 Sill of roof window	1.56	0.060	Yes	
Table K1 - Default	R3 Jamb of roof window	3.60	0.080	Yes	
Table K1 - Default	R6 Flat ceiling	15.32	0.060	No	
Table K1 - Default	R7 Flat ceiling (inverted)	2.30	0.040	No	
Table K1 - Default	R9 Roof to wall (flat ceiling)	2.30	0.040	No	

Y-value	0.072	W/m²K

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

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	No
Night Ventilation	Yes
Air change rate	5.00

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	50	
Total number of L.E.L. fittings	50	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No	
23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Description	Gas Boiler	
Percentage of Heat	100	%
Database Ref. No.	17929	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.5	
In Summer	87.3	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	No	
Sap Code	2110	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	Yes	
SAP Code	901	
29.0 Hot Water Cylinder	None	

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	£30	B 86	
	Typical Cost	**Typical savings per year**	**Ratings after improvement SAP rating**	**Environmental Impact**
Solar photovoltaic panels, 2.5 kWp	£3,500 - £5,500	£357	A 94	

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

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Building Elements

Roof Pitched Cold Roof

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Mineral wool**				
	Main construction	200	0.0400	5.0000	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 2	**Mineral wool**				
	Main construction	200	0.0400	5.0000	91.67
	Main construction	200	0.1300	1.5385	8.33
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 4	**Plaster, standard**				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1000	

Total resistance: **Upper limit =** 9.788 m² K/W **Lower limit =** 9.418 m² K/W **Average =** 9.603 m² K/W

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

Unheated space: None

Total thickness: 416 mm **U-value: 0.10 W/m² K** **Kappa: n/a**

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Building Elements

Roof Sloping Roof

Roof Type: Pitched Roof, insulated sloping ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Celotex GA4000**				
	Main construction	100	0.0220	4.5455	91.67
	Main construction	100	0.1300	0.7692	8.33
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 2	**Celotex PL4050 [62.5mm]**				
	Main construction	62.5	0.0272	2.3000	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Plaster, standard**				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1000	

Total resistance: **Upper limit =** 6.370 m² K/W **Lower limit =** 5.673 m² K/W **Average =** 6.022 m² K/W

Total correction = 0.0043 m² K/W **U-value (unrounded) =** 0.17 W/m² K

Unheated space: None

Total thickness: 166 mm **U-value: 0.17 W/m² K** **Kappa: n/a**

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Building Elements

Wall External Walls

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Brick, outer leaf**				
	Main construction	102.5	0.7700	0.1331	82.81
	Main construction	102.5	0.9407	0.1090	17.19
Layer 2	**Earthwool Dritherm 32 Ultimate**				
	Main construction	100	0.0320	3.1250	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 3	**Thermalite Hi-Strength 7**				
	Main construction	100	0.1900	0.5263	93.43
	Main construction	100	0.8803	0.1136	6.57
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 4	**airspace/plaster dabs**				
	Main construction	15	0.0882	0.1700	80.00
	Main construction	15	0.0882	0.1700	20.00
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 5	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 6	**Plaster, standard**				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 4.157 m² K/W **Lower limit =** 4.085 m² K/W **Average =** 4.121 m² K/W

Total correction = 0.0001 m² K/W **U-value (unrounded) =** 0.24 W/m² K

Unheated space: None

Total thickness: 333 mm **U-value: 0.24 W/m² K** **Kappa: n/a**

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Building Elements

Wall Dormer Walls & Cheeks

Wall Type: Timber framed Wall with I-beams

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Tiling, clay**				
	Main construction	12	1.0000	0.0120	100.00
Layer 2	**airspace/timber battens**				
	Main construction	25	0.1389	0.1800	93.67
	Main construction	25	0.1300	0.1923	6.33
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 3	**Breather membrane**				
	Main construction	1	0.0000	0.0000	100.00
Layer 4	**Orientated Strand Board**				
	Main construction	12.5	0.1300	0.0962	100.00
Layer 5	**Timber Stud Void**				
	Main construction	30	0.1667	0.1800	87.50
	Main construction	30	0.1300	0.2308	12.50
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 6	**Celotex GA4000**				
	Main construction	70	0.0220	3.1818	87.50
	Main construction	70	0.1300	0.5385	12.50
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 7	**Celotex TB4000**				
	Main construction	30	0.0220	1.3636	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 8	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 9	**Plaster, standard**				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 4.668 m² K/W **Lower limit =** 4.046 m² K/W **Average =** 4.357 m² K/W

Total correction = 0.0030 m² K/W **U-value (unrounded) =** 0.23 W/m² K

U-VALUE CALCULATOR REPORT

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Unheated space: None

Total thickness: 196 mm **U-value: 0.23 W/m² K** **Kappa: n/a**

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Building Elements

Floor Ground Floor

Floor Type: Suspended Floor
Area = 58.24 m², Perimeter = 23.79 m, Wall thickness = 320.00 mm, Soil: Unknown
Depth of underfloor space below ground:0.200 m Floor wind shielding: Average (suburban)
Floor height above ground:h = 0.200 m
U-value of walls above ground:Uw = 1.500 m
Ventilation openings per perimeter length:e = 0.0015 %
Mean wind speed:v = 5.000 m/s
Resistance on solum:Rg = 0.000 m²K/W

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.1700	
Layer 1	**Blockwork, dense**				
	Main construction	100	1.5900	0.0629	82.95
	Main construction	100	2.3000	0.0435	17.05
Layer 2	**Celotex XR4000**				
	Main construction	150	0.0220	6.8182	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Screed**				
	Main construction	75	1.1500	0.0652	100.00
Int surface				0.1700	

Total resistance: **Upper limit =** 7.283 m² K/W **Lower limit =** 7.282 m² K/W **Average =** 7.282 m² K/W

Total correction = 0.0088 m² K/W **U-value (unrounded) =** 0.12 W/m² K

Unheated space: None

Total thickness: 325 mm **U-value: 0.12 W/m² K** **Kappa: n/a**

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

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Environmental	86 B	**% DER<TER**	2.21		
CO_2 Emissions (t/year)	1.57	**DFEE**	47.21	**TFEE**	51.64
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.57		

Assessor Details	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk	**Assessor ID**	p775-0001
Client	ABL Homes Ltd, ABL HOMES		

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 116 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.29 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.93 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)51.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.2 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.17 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

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

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

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 3.24 m², No overhang
Windows facing East: 7.67 m², No overhang
Windows facing West: 8.87 m², No overhang
Air change rate: 5.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Floor U-value 0.12 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2400 (1b)	x	2.3600 (2b)	=	137.4464	(1b) - (3b)
First floor	58.2400 (1c)	x	2.3200 (2c)	=	135.1168	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	272.5632	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1468	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3968	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3670	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4679	0.4587	0.4496	0.4037	0.3945	0.3486	0.3486	0.3395	0.3670	0.3945	0.4129	0.4312	(22b)
Effective ac	0.6095	0.6052	0.6011	0.5815	0.5778	0.5608	0.5608	0.5576	0.5673	0.5778	0.5852	0.5930	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9200	1.4000	2.6880			(26)
Windows (Uw = 1.40)			19.7800	1.3258	26.2235			(27)
Rooflights (Uw = 1.40)			1.4000	1.3258	1.8561			(27a)
Ground Floor			58.2400	0.1200	6.9888	75.0000	4368.0000	(28a)
External Walls	82.9100	16.4300	66.4800	0.2400	15.9552	60.0000	3988.8000	(29a)
Dormer Walls & Cheeks	18.8400	5.2700	13.5700	0.2300	3.1211	9.0000	122.1300	(29a)
Pitched Cold Roof	37.4500		37.4500	0.1000	3.7450	9.0000	337.0500	(30)
Sloping Roof	31.0400	1.4000	29.6400	0.1700	5.0388	9.0000	266.7600	(30)
Total net area of external elements Aum(A, m2)			228.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.6164			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			66.8300			75.0000	5012.2500	(32c)
Internal Wall - Timber			74.6200			9.0000	671.5800	(32c)
Internal Floor			58.2400			18.0000	1048.3200	(32d)
Internal Ceiling			58.2400			18.0000	1048.3200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19177.4100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		164.6412 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		16.5490 (36)
Total fabric heat loss	(33) + (36) =	82.1655 (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	54.8198	54.4375	54.0627	52.3023	51.9729	50.4396	50.4396	50.1557	51.0302	51.9729	52.6392	53.3358	(38)
Heat transfer coeff	136.9853	136.6030	136.2282	134.4678	134.1384	132.6051	132.6051	132.3212	133.1957	134.1384	134.8047	135.5013	(39)
Average = Sum(39)m / 12 =												134.4662	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1760	1.1728	1.1695	1.1544	1.1516	1.1384	1.1384	1.1360	1.1435	1.1516	1.1573	1.1633	(40)
HLP (average)												1.1544	(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	2.8486 (42)
Average daily hot water use (litres/day)	101.8548 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	112.0403	107.9661	103.8919	99.8177	95.7435	91.6693	91.6693	95.7435	99.8177	103.8919	107.9661	112.0403	(44)
Energy conte	166.1525	145.3180	149.9552	130.7346	125.4429	108.2477	100.3074	115.1042	116.4789	135.7450	148.1763	160.9098	(45)
Energy content (annual)										Total = Sum(45)m =		1602.5726	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.9229	21.7977	22.4933	19.6102	18.8164	16.2372	15.0461	17.2656	17.4718	20.3617	22.2264	24.1365	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1553	12.7740	14.1165	13.6260	14.0448	13.5510	13.9772	14.0211	13.5918	14.0823	13.6684	14.1427	(61)
Total heat required for water heating calculated for each month													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(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													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(64)
									Total per year (kWh/year) = Sum(64)m =			1768.3239	(64)
Heat gains from water heating, kWh/month													
	58.7845	51.5118	53.3892	46.8757	45.2210	39.3801	36.8465	41.7774	42.1272	48.6558	52.6857	57.0382	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.4531	22.6072	18.3854	13.9189	10.4046	8.7840	9.4914	12.3373	16.5591	21.0255	24.5399	26.1605	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	280.5571	283.4684	276.1320	260.5137	240.7984	222.2688	209.8899	206.9786	214.3149	229.9333	249.6486	268.1782	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	(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)													
	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	(71)
Water heating gains (Table 5)													
	79.0115	76.6544	71.7597	65.1052	60.7809	54.6946	49.5249	56.1524	58.5100	65.3976	73.1746	76.6643	(72)
Total internal gains													
	453.7510	451.4594	435.0065	408.2672	380.7132	354.4767	337.6355	344.1976	358.1134	385.0857	416.0924	439.7323	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2400	10.6334	0.6300	0.7000	0.7700	10.5290	(74)
East	7.6700	19.6403	0.6300	0.7000	0.7700	46.0378	(76)
West	8.8700	19.6403	0.6300	0.7000	0.7700	53.2406	(80)
West	1.4000	25.9287	0.6300	0.7000	1.0000	14.4076	(82)

Solar gains	124.2150	243.1567	403.1370	595.6458	739.0533	761.0885	722.6887	614.3179	471.0611	289.0288	154.8560	102.1950	(83)
Total gains	577.9660	694.6161	838.1435	1003.9130	1119.7665	1115.5652	1060.3242	958.5155	829.1745	674.1146	570.9484	541.9273	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.8878	38.9967	39.1039	39.6159	39.7132	40.1723	40.1723	40.2585	39.9942	39.7132	39.5169	39.3137	
alpha	3.5925	3.5998	3.6069	3.6411	3.6475	3.6782	3.6782	3.6839	3.6663	3.6475	3.6345	3.6209	
util living area													
	0.9947	0.9891	0.9733	0.9261	0.8251	0.6685	0.5210	0.5856	0.8242	0.9623	0.9907	0.9958	(86)
MIT	19.1207	19.3394	19.7257	20.2308	20.6428	20.8860	20.9656	20.9475	20.7393	20.1761	19.5580	19.0883	(87)
Th 2	19.9392	19.9419	19.9444	19.9566	19.9589	19.9696	19.9696	19.9715	19.9655	19.9589	19.9543	19.9495	(88)
util rest of house													
	0.9934	0.9866	0.9667	0.9073	0.7806	0.5878	0.4111	0.4739	0.7617	0.9492	0.9881	0.9948	(89)
MIT 2	17.4190	17.7392	18.3006	19.0261	19.5810	19.8783	19.9518	19.9417	19.7230	18.9638	18.0674	17.3781	(90)
Living area fraction										fLA = Living area / (4) =		0.1459	(91)
MIT	17.6674	17.9727	18.5086	19.2019	19.7360	20.0253	20.0998	20.0885	19.8713	19.1407	18.2849	17.6277	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6674	17.9727	18.5086	19.2019	19.7360	20.0253	20.0998	20.0885	19.8713	19.1407	18.2849	17.6277	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9891	0.9793	0.9542	0.8901	0.7696	0.5926	0.4256	0.4875	0.7550	0.9350	0.9816	0.9912	(94)
Useful gains	571.6539	680.2518	799.7507	893.5847	861.8238	661.0392	451.3236	467.2536	626.0338	630.2907	560.4295	537.1699	(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													
	1831.1309	1785.7755	1635.9065	1385.2740	1077.9300	719.4290	464.0851	488.0686	768.7153	1145.6344	1507.7803	1819.4699	(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													
	937.0509	742.9119	622.0999	354.0163	160.7830	0.0000	0.0000	0.0000	0.0000	383.4157	682.0925	954.0312	(98)
Space heating												4836.4014	(98)
Space heating per m2											(98) / (4) =	41.5213	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5344.0899	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	937.0509	742.9119	622.0999	354.0163	160.7830	0.0000	0.0000	0.0000	0.0000	383.4157	682.0925	954.0312	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	1035.4153	820.8971	687.4032	391.1782	177.6607	0.0000	0.0000	0.0000	0.0000	423.6637	753.6934	1054.1781	(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													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9678	89.9217	89.8129	89.5492	88.9848	87.3000	87.3000	87.3000	87.3000	89.5774	89.8683	89.9886	(217)
Fuel for water heating, kWh/month													
	200.4137	175.8109	182.6815	161.2081	156.7546	139.5174	130.9103	147.9098	148.9929	167.2601	180.0910	194.5275	(219)
Water heating fuel used												1986.0778	(219)
Annual totals kWh/year													
Space heating fuel - main system												5344.0899	(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)												449.5095	(232)
Total delivered energy for all uses												7854.6772	(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	5344.0899	0.2160	1154.3234	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1986.0778	0.2160	428.9928	(264)
Space and water heating			1583.3162	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	449.5095	0.5190	233.2954	(268)
Total CO2, kg/year			1855.5366	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.9300	(273)

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

DER		15.9300	ZC1
Total Floor Area	TFA	116.4800	
Assumed number of occupants	N	2.8486	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.2730	ZC2
CO2 emissions from cooking, equation (L16)		1.6086	ZC3
Total CO2 emissions		31.8116	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		31.8116	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2400	(1b)	x 2.3600	(2b) =	137.4464	(1b) - (3b)
First floor	58.2400	(1c)	x 2.3200	(2c) =	135.1168	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		272.5632	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		40.0000 / (5) =	0.1468	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3968	(18)
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3670	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4679	0.4587	0.4496	0.4037	0.3945	0.3486	0.3486	0.3395	0.3670	0.3945	0.4129	0.4312	(22b)
Effective ac	0.6095	0.6052	0.6011	0.5815	0.5778	0.5608	0.5608	0.5576	0.5673	0.5778	0.5852	0.5930	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.9200	1.0000	1.9200			(26)
TER Opening Type (Uw = 1.40)			19.7800	1.3258	26.2235			(27)
TER Room Window (Uw = 1.70)			1.4000	1.5918	2.2285			(27a)
Ground Floor			58.2400	0.1300	7.5712			(28a)
External Walls	82.9100	16.4300	66.4800	0.1800	11.9664			(29a)
Dormer Walls & Cheeks	18.8400	5.2700	13.5700	0.1800	2.4426			(29a)
Pitched Cold Roof	37.4500		37.4500	0.1300	4.8685			(30)
Sloping Roof	31.0400	1.4000	29.6400	0.1300	3.8532			(30)
Total net area of external elements Aum(A, m2)			228.4800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.0738			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.0916	(36)
Total fabric heat loss					(33) + (36) =		75.1654	(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	54.8198	54.4375	54.0627	52.3023	51.9729	50.4396	50.4396	50.1557	51.0302	51.9729	52.6392	53.3358	(38)
Heat transfer coeff	129.9853	129.6029	129.2281	127.4677	127.1383	125.6051	125.6051	125.3212	126.1957	127.1383	127.8047	128.5012	(39)
Average = Sum(39)m / 12 =												127.4661	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1159	1.1127	1.1094	1.0943	1.0915	1.0783	1.0783	1.0759	1.0834	1.0915	1.0972	1.1032	(40)
HLP (average)												1.0943	(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	2.8486	(42)
Average daily hot water use (litres/day)	101.8548	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.0403	107.9661	103.8919	99.8177	95.7435	91.6693	91.6693	95.7435	99.8177	103.8919	107.9661	112.0403	(44)
Energy conte	166.1525	145.3180	149.9552	130.7346	125.4429	108.2477	100.3074	115.1042	116.4789	135.7450	148.1763	160.9098	(45)
Energy content (annual)										Total = Sum(45)m =		1602.5726	(45)
Distribution loss (46)m = 0.15 x (45)m	24.9229	21.7977	22.4933	19.6102	18.8164	16.2372	15.0461	17.2656	17.4718	20.3617	22.2264	24.1365	(46)

Water storage loss:

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Total storage loss

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

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.2252	48.7898	45.2068	46.7137	48.7898	49.2252	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

	217.1114	191.3454	200.9141	179.9597	174.2328	153.4545	147.0211	163.8941	165.7041	186.7039	197.4913	211.8687	(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

	217.1114	191.3454	200.9141	179.9597	174.2328	153.4545	147.0211	163.8941	165.7041	186.7039	197.4913	211.8687	(64)
								Total per year (kWh/year) = Sum(64)m =				2189.7012	(64)

Heat gains from water heating, kWh/month

	67.9854	59.8251	62.5998	55.7755	53.9072	47.2941	45.0306	50.4696	51.0355	57.8749	61.5974	66.2422	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	(66)

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

	25.4531	22.6072	18.3854	13.9189	10.4046	8.7840	9.4914	12.3373	16.5591	21.0255	24.5399	26.1605	(67)

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

	280.5571	283.4684	276.1320	260.5137	240.7984	222.2688	209.8899	206.9786	214.3149	229.9333	249.6486	268.1782	(68)

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

	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	(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)

	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	(71)

Water heating gains (Table 5)

	91.3783	89.0254	84.1396	77.4660	72.4560	65.6862	60.5251	67.8355	70.8827	77.7889	85.5519	89.0353	(72)

Total internal gains

	466.1178	463.8304	447.3864	420.6280	392.3883	365.4683	348.6357	355.8807	370.4861	397.4770	428.4698	452.1033	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2400	10.6334	0.6300	0.7000	0.7700	10.5290	(74)
East	7.6700	19.6403	0.6300	0.7000	0.7700	46.0378	(76)
West	8.8700	19.6403	0.6300	0.7000	0.7700	53.2406	(80)
West	1.4000	25.9287	0.6300	0.7000	1.0000	14.4076	(82)

Solar gains	124.2150	243.1567	403.1370	595.6458	739.0533	761.0885	722.6887	614.3179	471.0611	289.0288	154.8560	102.1950	(83)
Total gains	590.3328	706.9871	850.5234	1016.2739	1131.4416	1126.5568	1071.3244	970.1986	841.5472	686.5059	583.3257	554.2983	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.2293	62.4129	62.5939	63.4583	63.6227	64.3994	64.3994	64.5453	64.0980	63.6227	63.2910	62.9479	
alpha	5.1486	5.1609	5.1729	5.2306	5.2415	5.2933	5.2933	5.3030	5.2732	5.2415	5.2194	5.1965	
util living area													
	0.9991	0.9975	0.9908	0.9584	0.8577	0.6747	0.5082	0.5783	0.8546	0.9843	0.9980	0.9994	(86)
MIT	19.7173	19.8786	20.1624	20.5371	20.8273	20.9642	20.9933	20.9874	20.8763	20.4731	20.0277	19.6949	(87)
Th 2	19.9878	19.9905	19.9931	20.0055	20.0078	20.0186	20.0186	20.0206	20.0144	20.0078	20.0031	19.9982	(88)
util rest of house													
	0.9988	0.9966	0.9874	0.9429	0.8096	0.5868	0.3989	0.4632	0.7862	0.9760	0.9971	0.9991	(89)
MIT 2	18.2653	18.5029	18.9177	19.4599	19.8404	19.9952	20.0161	20.0154	19.9131	19.3799	18.7303	18.2399	(90)
Living area fraction									fLA = Living area / (4) =			0.1459	(91)
MIT	18.4772	18.7037	19.0994	19.6171	19.9844	20.1366	20.1587	20.1572	20.0537	19.5394	18.9197	18.4522	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4772	18.7037	19.0994	19.6171	19.9844	20.1366	20.1587	20.1572	20.0537	19.5394	18.9197	18.4522	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9950	0.9831	0.9352	0.8083	0.5980	0.4148	0.4799	0.7894	0.9705	0.9957	0.9986	(94)
Useful gains	589.1890	703.4257	836.1398	950.4661	914.5116	673.6744	444.4362	465.5657	664.3111	666.2848	580.8238	553.5217	(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													
	1842.8333	1788.9938	1628.1947	1366.0826	1053.2637	695.4282	446.9957	470.8628	751.3283	1136.5455	1510.6098	1831.4295	(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													
	932.7114	729.5018	589.2888	299.2438	103.2315	0.0000	0.0000	0.0000	0.0000	349.8740	669.4459	950.7634	(98)
Space heating												4624.0606	(98)
Space heating per m2											(98) / (4) =	39.6983	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4950.8144	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	932.7114	729.5018	589.2888	299.2438	103.2315	0.0000	0.0000	0.0000	0.0000	349.8740	669.4459	950.7634	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	998.6204	781.0511	630.9302	320.3896	110.5263	0.0000	0.0000	0.0000	0.0000	374.5974	716.7515	1017.9480	(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													
	217.1114	191.3454	200.9141	179.9597	174.2328	153.4545	147.0211	163.8941	165.7041	186.7039	197.4913	211.8687	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3028	88.0975	87.5986	86.3226	83.7827	80.3000	80.3000	80.3000	80.3000	86.6095	87.8819	88.3744	(217)
Fuel for water heating, kWh/month													
	245.8714	217.1974	229.3577	208.4736	207.9580	191.1015	183.0898	204.1022	206.3563	215.5697	224.7234	239.7400	(219)
Water heating fuel used												2573.5409	(219)
Annual totals kWh/year													
Space heating fuel - main system												4950.8144	(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)												449.5095	(232)
Total delivered energy for all uses												8048.8647	(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	4950.8144	0.2160	1069.3759	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2573.5409	0.2160	555.8848	(264)
Space and water heating			1625.2607	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	449.5095	0.5190	233.2954	(268)
Total CO2, kg/m2/year			1897.4811	(272)
Emissions per m2 for space and water heating			13.9531	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0029	(272b)
Emissions per m2 for pumps and fans			0.3342	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.9531 * 1.00) + 2.0029 + 0.3342, rounded to 2 d.p.			16.2900	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2400 (1b)	x	2.3600 (2b)	=	137.4464 (1b) - (3b)	
First floor	58.2400 (1c)	x	2.3200 (2c)	=	135.1168 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	272.5632	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1468	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3968	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3670	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4679	0.4587	0.4496	0.4037	0.3945	0.3486	0.3486	0.3395	0.3670	0.3945	0.4129	0.4312	(22b)
Effective ac	0.6095	0.6052	0.6011	0.5815	0.5778	0.5608	0.5608	0.5576	0.5673	0.5778	0.5852	0.5930	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9200	1.4000	2.6880			(26)
Windows (Uw = 1.40)			19.7800	1.3258	26.2235			(27)
Rooflights (Uw = 1.40)			1.4000	1.3258	1.8561			(27a)
Ground Floor			58.2400	0.1200	6.9888	75.0000	4368.0000	(28a)
External Walls	82.9100	16.4300	66.4800	0.2400	15.9552	60.0000	3988.8000	(29a)
Dormer Walls & Cheeks	18.8400	5.2700	13.5700	0.2300	3.1211	9.0000	122.1300	(29a)
Pitched Cold Roof	37.4500		37.4500	0.1000	3.7450	9.0000	337.0500	(30)
Sloping Roof	31.0400	1.4000	29.6400	0.1700	5.0388	9.0000	266.7600	(30)
Total net area of external elements Aum(A, m2)			228.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.6164			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			66.8300			75.0000	5012.2500	(32c)
Internal Wall - Timber			74.6200			9.0000	671.5800	(32c)
Internal Floor			58.2400			18.0000	1048.3200	(32d)
Internal Ceiling			58.2400			9.0000	524.1600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	18653.2500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		160.1412 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		16.5490 (36)
Total fabric heat loss	(33) + (36) =	82.1655 (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	54.8198	54.4375	54.0627	52.3023	51.9729	50.4396	50.4396	50.1557	51.0302	51.9729	52.6392	53.3358	(38)
Heat transfer coeff	136.9853	136.6030	136.2282	134.4678	134.1384	132.6051	132.6051	132.3212	133.1957	134.1384	134.8047	135.5013	(39)
Average = Sum(39)m / 12 =												134.4662	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1760	1.1728	1.1695	1.1544	1.1516	1.1384	1.1384	1.1360	1.1435	1.1516	1.1573	1.1633	(40)
HLP (average)												1.1544	(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	2.8486 (42)
Average daily hot water use (litres/day)	101.8548 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	112.0403	107.9661	103.8919	99.8177	95.7435	91.6693	91.6693	95.7435	99.8177	103.8919	107.9661	112.0403	(44)
Energy conte	166.1525	145.3180	149.9552	130.7346	125.4429	108.2477	100.3074	115.1042	116.4789	135.7450	148.1763	160.9098	(45)
Energy content (annual)										Total = Sum(45)m =		1602.5726	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.3074	30.8801	31.8655	27.7811	26.6566	23.0026	21.3153	24.4596	24.7518	28.8458	31.4875	34.1933	(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	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.4531	22.6072	18.3854	13.9189	10.4046	8.7840	9.4914	12.3373	16.5591	21.0255	24.5399	26.1605	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	280.5571	283.4684	276.1320	260.5137	240.7984	222.2688	209.8899	206.9786	214.3149	229.9333	249.6486	268.1782	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	(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)													
	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	(71)
Water heating gains (Table 5)													
	47.4562	45.9525	42.8299	38.5849	35.8288	31.9481	28.6496	32.8759	34.3775	38.7712	43.7326	45.9588	(72)
Total internal gains													
	419.1958	417.7575	403.0767	378.7469	352.7611	328.7302	313.7602	317.9211	330.9808	355.4594	383.6504	406.0268	(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	3.2400	10.6334	0.6300	0.7000	0.7700	10.5290	(74)
East	7.6700	19.6403	0.6300	0.7000	0.7700	46.0378	(76)
West	8.8700	19.6403	0.6300	0.7000	0.7700	53.2406	(80)
West	1.4000	25.9287	0.6300	0.7000	1.0000	14.4076	(82)

Solar gains	124.2150	243.1567	403.1370	595.6458	739.0533	761.0885	722.6887	614.3179	471.0611	289.0288	154.8560	102.1950	(83)
Total gains	543.4107	660.9142	806.2138	974.3927	1091.8145	1089.8187	1036.4490	932.2390	802.0420	644.4882	538.5064	508.2218	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.8249	37.9308	38.0352	38.5331	38.6277	39.0743	39.0743	39.1582	38.9011	38.6277	38.4368	38.2392	
alpha	3.5217	3.5287	3.5357	3.5689	3.5752	3.6050	3.6050	3.6105	3.5934	3.5752	3.5625	3.5493	
util living area													
	0.9952	0.9899	0.9747	0.9288	0.8303	0.6765	0.5296	0.5964	0.8322	0.9650	0.9916	0.9962	(86)
MIT	19.0454	19.2698	19.6668	20.1877	20.6161	20.8741	20.9609	20.9404	20.7161	20.1295	19.4937	19.0130	(87)
Th 2	19.9392	19.9419	19.9444	19.9566	19.9589	19.9696	19.9696	19.9715	19.9655	19.9589	19.9543	19.9495	(88)
util rest of house													
	0.9940	0.9875	0.9685	0.9108	0.7871	0.5965	0.4190	0.4845	0.7719	0.9529	0.9892	0.9953	(89)
MIT 2	18.1465	18.3717	18.7668	19.2824	19.6792	19.8996	19.9554	19.9478	19.7825	19.2369	18.6051	18.1217	(90)
Living area fraction										fLA = Living area / (4) =		0.1459	(91)
MIT	18.2777	18.5028	18.8982	19.4145	19.8159	20.0418	20.1022	20.0927	19.9188	19.3672	18.7348	18.2518	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2777	18.5028	18.8982	19.4145	19.8159	20.0418	20.1022	20.0927	19.9188	19.3672	18.7348	18.2518	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9915	0.9831	0.9604	0.8993	0.7803	0.6026	0.4340	0.4986	0.7687	0.9438	0.9853	0.9932	(94)
Useful gains	538.7833	649.7173	774.2584	876.2643	851.9376	656.7432	449.8598	464.8452	616.5346	608.2528	530.6014	504.7837	(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													
	1914.7410	1858.1832	1688.9839	1413.8606	1088.6536	721.6141	464.4086	488.6235	775.0368	1176.0205	1568.4234	1904.0381	(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													
	1023.7125	812.0891	680.5558	387.0693	176.1167	0.0000	0.0000	0.0000	0.0000	422.4192	747.2319	1041.0453	(98)
Space heating												5290.2397	(98)
Space heating per m2											(98) / (4) =	45.4176	(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

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Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1246.4882	981.2780	1005.6411	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8184	0.8790	0.8436	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1020.1640	862.4968	848.3481	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1370.8255	1306.7940	1189.5752	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	252.4763	330.5571	253.8729	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												836.9064	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	63.1191	82.6393	63.4682	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												209.2266	(107)
Space cooling per m2												1.7962	(108)
Energy for space heating												45.4176	(99)
Energy for space cooling												1.7962	(108)
Total												47.2138	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.2	(109)

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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2400	(1b)	x 2.3600	(2b) =	137.4464	(1b) - (3b)
First floor	58.2400	(1c)	x 2.3200	(2c) =	135.1168	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		272.5632	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		40.0000 / (5) =	0.1468	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3968	(18)
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3670	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4679	0.4587	0.4496	0.4037	0.3945	0.3486	0.3486	0.3395	0.3670	0.3945	0.4129	0.4312	(22b)
Effective ac	0.6095	0.6052	0.6011	0.5815	0.5778	0.5608	0.5608	0.5576	0.5673	0.5778	0.5852	0.5930	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.9200	1.0000	1.9200			(26)
TER Opening Type (Uw = 1.40)			19.7800	1.3258	26.2235			(27)
TER Room Window (Uw = 1.70)			1.4000	1.5918	2.2285			(27a)
Ground Floor			58.2400	0.1300	7.5712			(28a)
External Walls	82.9100	16.4300	66.4800	0.1800	11.9664			(29a)
Dormer Walls & Cheeks	18.8400	5.2700	13.5700	0.1800	2.4426			(29a)
Pitched Cold Roof	37.4500		37.4500	0.1300	4.8685			(30)
Sloping Roof	31.0400	1.4000	29.6400	0.1300	3.8532			(30)
Total net area of external elements Aum(A, m2)			228.4800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.0738			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0916	(36)
Total fabric heat loss (33) + (36) =	75.1654	(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	54.8198	54.4375	54.0627	52.3023	51.9729	50.4396	50.4396	50.1557	51.0302	51.9729	52.6392	53.3358	(38)
Heat transfer coeff	129.9853	129.6029	129.2281	127.4677	127.1383	125.6051	125.6051	125.3212	126.1957	127.1383	127.8047	128.5012	(39)
Average = Sum(39)m / 12 =												127.4661	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1159	1.1127	1.1094	1.0943	1.0915	1.0783	1.0783	1.0759	1.0834	1.0915	1.0972	1.1032	(40)
HLP (average)												1.0943	(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	2.8486	(42)
Average daily hot water use (litres/day)	101.8548	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.0403	107.9661	103.8919	99.8177	95.7435	91.6693	91.6693	95.7435	99.8177	103.8919	107.9661	112.0403	(44)
Energy conte	166.1525	145.3180	149.9552	130.7346	125.4429	108.2477	100.3074	115.1042	116.4789	135.7450	148.1763	160.9098	(45)
Energy content (annual)										Total = Sum(45)m =		1602.5726	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													

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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

35.3074	30.8801	31.8655	27.7811	26.6566	23.0026	21.3153	24.4596	24.7518	28.8458	31.4875	34.1933	(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	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	142.4312	(66)

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

25.4531	22.6072	18.3854	13.9189	10.4046	8.7840	9.4914	12.3373	16.5591	21.0255	24.5399	26.1605	(67)

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

280.5571	283.4684	276.1320	260.5137	240.7984	222.2688	209.8899	206.9786	214.3149	229.9333	249.6486	268.1782	(68)

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

37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	37.2431	(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)

-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	(71)

Water heating gains (Table 5)

47.4562	45.9525	42.8299	38.5849	35.8288	31.9481	28.6496	32.8759	34.3775	38.7712	43.7326	45.9588	(72)

Total internal gains

419.1958	417.7575	403.0767	378.7469	352.7611	328.7302	313.7602	317.9211	330.9808	355.4594	383.6504	406.0268	(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	3.2400	10.6334	0.6300	0.7000	0.7700	10.5290	(74)
East	7.6700	19.6403	0.6300	0.7000	0.7700	46.0378	(76)
West	8.8700	19.6403	0.6300	0.7000	0.7700	53.2406	(80)
West	1.4000	25.9287	0.6300	0.7000	1.0000	14.4076	(82)

Solar gains	124.2150	243.1567	403.1370	595.6458	739.0533	761.0885	722.6887	614.3179	471.0611	289.0288	154.8560	102.1950	(83)
Total gains	543.4107	660.9142	806.2138	974.3927	1091.8145	1089.8187	1036.4490	932.2390	802.0420	644.4882	538.5064	508.2218	(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	62.2293	62.4129	62.5939	63.4583	63.6227	64.3994	64.3994	64.5453	64.0980	63.6227	63.2910	62.9479	
alpha	5.1486	5.1609	5.1729	5.2306	5.2415	5.2933	5.2933	5.3030	5.2732	5.2415	5.2194	5.1965	
util living area	0.9994	0.9982	0.9927	0.9646	0.8713	0.6923	0.5241	0.5990	0.8730	0.9880	0.9986	0.9996	(86)
MIT	19.6794	19.8416	20.1280	20.5093	20.8117	20.9596	20.9923	20.9852	20.8608	20.4414	19.9915	19.6575	(87)
Th 2	19.9878	19.9905	19.9931	20.0055	20.0078	20.0186	20.0186	20.0206	20.0144	20.0078	20.0031	19.9982	(88)
util rest of house	0.9992	0.9975	0.9900	0.9510	0.8256	0.6040	0.4120	0.4812	0.8089	0.9816	0.9980	0.9994	(89)
MIT 2	18.7739	18.9380	19.2251	19.6072	19.8816	20.0003	20.0166	20.0163	19.9347	19.5486	19.0981	18.7604	(90)
Living area fraction									fLA = Living area / (4) =			0.1459	(91)
MIT	18.9061	19.0699	19.3568	19.7389	20.0173	20.1404	20.1590	20.1577	20.0699	19.6789	19.2285	18.8913	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9061	19.0699	19.3568	19.7389	20.0173	20.1404	20.1590	20.1577	20.0699	19.6789	19.2285	18.8913	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9989	0.9967	0.9876	0.9465	0.8261	0.6157	0.4284	0.4984	0.8132	0.9786	0.9974	0.9992	(94)
Useful gains	542.7918	658.7433	796.2466	922.2380	901.8996	671.0065	444.0503	464.6068	652.1870	630.7071	537.0942	507.8160	(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	1898.5761	1836.4601	1661.4663	1381.6080	1057.4474	695.8965	447.0305	470.9249	753.3745	1154.2716	1550.0801	1887.8523	(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	1008.7035	791.4257	643.7235	330.7465	115.7276	0.0000	0.0000	0.0000	0.0000	389.5320	729.3498	1026.7470	(98)
Space heating												5035.9556	(98)
Space heating per m2											(98) / (4) =	43.2345	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1180.6879	929.4777	952.4408	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8967	0.9461	0.9186	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1058.7410	879.4030	874.9589	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1370.8255	1306.7940	1189.5752	0.0000	0.0000	0.0000	0.0000	(103)

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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	224.7009	317.9789	234.0745	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												776.7543 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	56.1752	79.4947	58.5186	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												194.1886 (107)
Space cooling per m2												1.6671 (108)
Energy for space heating												43.2345 (99)
Energy for space cooling												1.6671 (108)
Total												44.9016 (109)
Target Fabric Energy Efficiency (TFEE)												51.6 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2400	(1b)	x 2.3600	(2b) =	137.4464	(1b) - (3b)
First floor	58.2400	(1c)	x 2.3200	(2c) =	135.1168	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.4800					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	272.5632	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1468	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3968	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3670	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.0000	3.9000	3.6000	3.7000	3.3000	3.3000	3.1000	3.1000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0750	1.0000	0.9750	0.9000	0.9250	0.8250	0.8250	0.7750	0.7750	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.3945	0.3670	0.3578	0.3303	0.3395	0.3028	0.3028	0.2844	0.2844	0.3119	0.3119	0.3486	(22b)
Effective ac	0.5778	0.5673	0.5640	0.5545	0.5576	0.5458	0.5458	0.5404	0.5404	0.5487	0.5487	0.5608	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9200	1.4000	2.6880			(26)
Windows (Uw = 1.40)			19.7800	1.3258	26.2235			(27)
Rooflights (Uw = 1.40)			1.4000	1.3258	1.8561			(27a)
Ground Floor			58.2400	0.1200	6.9888	75.0000	4368.0000	(28a)
External Walls	82.9100	16.4300	66.4800	0.2400	15.9552	60.0000	3988.8000	(29a)
Dormer Walls & Cheeks	18.8400	5.2700	13.5700	0.2300	3.1211	9.0000	122.1300	(29a)
Pitched Cold Roof	37.4500		37.4500	0.1000	3.7450	9.0000	337.0500	(30)
Sloping Roof	31.0400	1.4000	29.6400	0.1700	5.0388	9.0000	266.7600	(30)
Total net area of external elements Aum(A, m2)			228.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.6164			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			66.8300			75.0000	5012.2500	(32c)
Internal Wall - Timber			74.6200			9.0000	671.5800	(32c)
Internal Floor			58.2400			18.0000	1048.3200	(32d)
Internal Ceiling			58.2400			18.0000	1048.3200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19177.4100	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	164.6412	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	16.5490	(36)
Total fabric heat loss	(33) + (36) = 82.1655	(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	51.9729	51.0302	50.7312	49.8793	50.1557	49.0957	49.0957	48.6111	48.6111	49.3493	49.3493	50.4396	(38)
Heat transfer coeff	134.1384	133.1957	132.8966	132.0448	132.3212	131.2612	131.2612	130.7766	130.7766	131.5148	131.5148	132.6051	(39)
Average = Sum(39)m / 12 =												132.0256	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1516	1.1435	1.1409	1.1336	1.1360	1.1269	1.1269	1.1227	1.1227	1.1291	1.1291	1.1384	(40)
HLP (average)												1.1335	(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	2.8486 (42)
Average daily hot water use (litres/day)	101.8548 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF HEAT DEMAND 09 Jan 2014

	112.0403	107.9661	103.8919	99.8177	95.7435	91.6693	91.6693	95.7435	99.8177	103.8919	107.9661	112.0403	(44)
Energy conte	166.1525	145.3180	149.9552	130.7346	125.4429	108.2477	100.3074	115.1042	116.4789	135.7450	148.1763	160.9098	(45)
Energy content (annual)										Total = Sum(45)m =		1602.5726	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.9229	21.7977	22.4933	19.6102	18.8164	16.2372	15.0461	17.2656	17.4718	20.3617	22.2264	24.1365	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1553	12.7740	14.1165	13.6260	14.0448	13.5510	13.9772	14.0211	13.5918	14.0823	13.6684	14.1427	(61)
Total heat required for water heating calculated for each month													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(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													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(64)
									Total per year (kWh/year) = Sum(64)m =			1768.3239	(64)
RHI water heating demand												1768	(64)
Heat gains from water heating, kWh/month													
	58.7845	51.5118	53.3892	46.8757	45.2210	39.3801	36.8465	41.7774	42.1272	48.6558	52.6857	57.0382	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	63.6327	56.5180	45.9635	34.7974	26.0114	21.9599	23.7285	30.8432	41.3977	52.5639	61.3498	65.4013	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	418.7420	423.0872	412.1374	388.8265	359.4006	331.7445	313.2684	308.9232	319.8731	343.1840	372.6098	400.2660	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	(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)													
	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	(71)
Water heating gains (Table 5)													
	79.0115	76.6544	71.7597	65.1052	60.7809	54.6946	49.5249	56.1524	58.5100	65.3976	73.1746	76.6643	(72)
Total internal gains													
	676.2990	671.1725	644.7734	603.6418	561.1057	523.3118	501.4347	510.8317	534.6936	576.0582	622.0470	657.2443	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2400	13.1177	0.6300	0.7000	0.7700	12.9889	(74)
East	7.6700	24.4891	0.6300	0.7000	0.7700	57.4037	(76)
West	8.8700	24.4891	0.6300	0.7000	0.7700	66.3847	(80)
West	1.4000	32.5353	0.6300	0.7000	1.0000	18.0786	(82)

Solar gains	154.8560	261.4851	427.1378	641.5118	768.7764	847.9225	790.7724	683.3207	534.7456	332.2848	189.0827	124.2150	(83)
Total gains	831.1550	932.6576	1071.9112	1245.1536	1329.8822	1371.2343	1292.2071	1194.1524	1069.4392	908.3430	811.1297	781.4593	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.7132	39.9942	40.0842	40.3428	40.2585	40.5837	40.5837	40.7340	40.7340	40.5054	40.5054	40.1723	
alpha	3.6475	3.6663	3.6723	3.6895	3.6839	3.7056	3.7056	3.7156	3.7156	3.7004	3.7004	3.6782	
util living area													
	0.9819	0.9717	0.9394	0.8598	0.7214	0.5178	0.3695	0.4165	0.6898	0.9022	0.9693	0.9850	(86)
MIT	19.4725	19.6598	20.0552	20.4886	20.8022	20.9575	20.9909	20.9860	20.8751	20.4644	19.9018	19.4439	(87)
Th 2	19.9589	19.9655	19.9675	19.9735	19.9715	19.9789	19.9789	19.9823	19.9823	19.9772	19.9772	19.9696	(88)
util rest of house													
	0.9779	0.9655	0.9258	0.8293	0.6643	0.4350	0.2705	0.3127	0.6114	0.8734	0.9613	0.9816	(89)
MIT 2	17.9420	18.2165	18.7826	19.3830	19.7792	19.9501	19.9756	19.9765	19.8796	19.3688	18.5769	17.9078	(90)
Living area fraction									fLA = Living area / (4) =			0.1459	(91)
MIT	18.1654	18.4271	18.9683	19.5444	19.9285	20.0972	20.1238	20.1238	20.0249	19.5287	18.7702	18.1320	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1654	18.4271	18.9683	19.5444	19.9285	20.0972	20.1238	20.1238	20.0249	19.5287	18.7702	18.1320	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9680	0.9528	0.9091	0.8145	0.6616	0.4450	0.2848	0.3275	0.6150	0.8578	0.9483	0.9729	(94)
Useful gains	804.5519	888.6618	974.4378	1014.1882	879.9085	610.1392	368.0585	391.0661	657.7383	779.1968	769.2067	760.2912	(95)
Ext temp.	4.6000	5.1000	7.0000	9.4000	12.4000	15.3000	17.3000	17.1000	14.5000	11.1000	7.5000	4.6000	(96)
Heat loss rate W													
	1819.6354	1775.1139	1590.5469	1339.5124	996.1797	629.6826	370.6502	395.4454	722.5285	1108.5000	1482.2020	1794.4126	(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													
	755.2221	595.6958	458.3852	234.2334	86.5058	0.0000	0.0000	0.0000	0.0000	245.0015	513.3566	769.3864	(98)
Space heating												3657.7869	(98)
RHI space heating demand												3658	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2400	(1b)	x 2.3600	(2b) =	137.4464	(1b) - (3b)
First floor	58.2400	(1c)	x 2.3200	(2c) =	135.1168	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		272.5632	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1468	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3968	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3670	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4679	0.4587	0.4496	0.4037	0.3945	0.3486	0.3486	0.3395	0.3670	0.3945	0.4129	0.4312	(22b)
Effective ac	0.6095	0.6052	0.6011	0.5815	0.5778	0.5608	0.5608	0.5576	0.5673	0.5778	0.5852	0.5930	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9200	1.4000	2.6880			(26)
Windows (Uw = 1.40)			19.7800	1.3258	26.2235			(27)
Rooflights (Uw = 1.40)			1.4000	1.3258	1.8561			(27a)
Ground Floor			58.2400	0.1200	6.9888	75.0000	4368.0000	(28a)
External Walls	82.9100	16.4300	66.4800	0.2400	15.9552	60.0000	3988.8000	(29a)
Dormer Walls & Cheeks	18.8400	5.2700	13.5700	0.2300	3.1211	9.0000	122.1300	(29a)
Pitched Cold Roof	37.4500		37.4500	0.1000	3.7450	9.0000	337.0500	(30)
Sloping Roof	31.0400	1.4000	29.6400	0.1700	5.0388	9.0000	266.7600	(30)
Total net area of external elements Aum(A, m2)			228.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.6164			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			66.8300			75.0000	5012.2500	(32c)
Internal Wall - Timber			74.6200			9.0000	671.5800	(32c)
Internal Floor			58.2400			18.0000	1048.3200	(32d)
Internal Ceiling			58.2400			18.0000	1048.3200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19177.4100	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	164.6412	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	16.5490	(36)
Total fabric heat loss	(33) + (36) = 82.1655	(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	54.8198	54.4375	54.0627	52.3023	51.9729	50.4396	50.4396	50.1557	51.0302	51.9729	52.6392	53.3358	(38)
Heat transfer coeff	136.9853	136.6030	136.2282	134.4678	134.1384	132.6051	132.6051	132.3212	133.1957	134.1384	134.8047	135.5013	(39)
Average = Sum(39)m / 12 =												134.4662	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1760	1.1728	1.1695	1.1544	1.1516	1.1384	1.1384	1.1360	1.1435	1.1516	1.1573	1.1633	(40)
HLP (average)												1.1544	(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	2.8486 (42)
Average daily hot water use (litres/day)	101.8548 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	112.0403	107.9661	103.8919	99.8177	95.7435	91.6693	91.6693	95.7435	99.8177	103.8919	107.9661	112.0403	(44)
Energy conte	166.1525	145.3180	149.9552	130.7346	125.4429	108.2477	100.3074	115.1042	116.4789	135.7450	148.1763	160.9098	(45)
Energy content (annual)										Total = Sum(45)m =		1602.5726	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.9229	21.7977	22.4933	19.6102	18.8164	16.2372	15.0461	17.2656	17.4718	20.3617	22.2264	24.1365	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1553	12.7740	14.1165	13.6260	14.0448	13.5510	13.9772	14.0211	13.5918	14.0823	13.6684	14.1427	(61)
Total heat required for water heating calculated for each month													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(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													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(64)
									Total per year (kWh/year) = Sum(64)m =			1768.3239	(64)
Heat gains from water heating, kWh/month													
	58.7845	51.5118	53.3892	46.8757	45.2210	39.3801	36.8465	41.7774	42.1272	48.6558	52.6857	57.0382	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	63.6327	56.5180	45.9635	34.7974	26.0114	21.9599	23.7285	30.8432	41.3977	52.5639	61.3498	65.4013	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	418.7420	423.0872	412.1374	388.8265	359.4006	331.7445	313.2684	308.9232	319.8731	343.1840	372.6098	400.2660	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	(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)													
	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	(71)
Water heating gains (Table 5)													
	79.0115	76.6544	71.7597	65.1052	60.7809	54.6946	49.5249	56.1524	58.5100	65.3976	73.1746	76.6643	(72)
Total internal gains													
	676.2990	671.1725	644.7734	603.6418	561.1057	523.3118	501.4347	510.8317	534.6936	576.0582	622.0470	657.2443	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2400	10.6334	0.6300	0.7000	0.7700	10.5290	(74)
East	7.6700	19.6403	0.6300	0.7000	0.7700	46.0378	(76)
West	8.8700	19.6403	0.6300	0.7000	0.7700	53.2406	(80)
West	1.4000	25.9287	0.6300	0.7000	1.0000	14.4076	(82)

Solar gains	124.2150	243.1567	403.1370	595.6458	739.0533	761.0885	722.6887	614.3179	471.0611	289.0288	154.8560	102.1950	(83)
Total gains	800.5140	914.3291	1047.9105	1199.2877	1300.1591	1284.4003	1224.1234	1125.1496	1005.7547	865.0871	776.9030	759.4393	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.8878	38.9967	39.1039	39.6159	39.7132	40.1723	40.1723	40.2585	39.9942	39.7132	39.5169	39.3137	
alpha	3.5925	3.5998	3.6069	3.6411	3.6475	3.6782	3.6782	3.6839	3.6663	3.6475	3.6345	3.6209	
util living area													
	0.9849	0.9748	0.9496	0.8857	0.7683	0.6037	0.4598	0.5136	0.7490	0.9254	0.9757	0.9874	(86)
MIT	19.3550	19.5636	19.9227	20.3768	20.7256	20.9189	20.9771	20.9659	20.8166	20.3438	19.7700	19.3197	(87)
Th 2	19.9392	19.9419	19.9444	19.9566	19.9589	19.9696	19.9696	19.9715	19.9655	19.9589	19.9543	19.9495	(88)
util rest of house													
	0.9816	0.9692	0.9382	0.8599	0.7181	0.5243	0.3593	0.4099	0.6776	0.9029	0.9694	0.9846	(89)
MIT 2	17.7591	18.0623	18.5788	19.2206	19.6773	19.9068	19.9582	19.9530	19.8038	19.1920	18.3725	17.7145	(90)
Living area fraction										fLA = Living area / (4) =		0.1459	(91)
MIT	17.9920	18.2814	18.7750	19.3894	19.8303	20.0545	20.1069	20.1008	19.9516	19.3601	18.5765	17.9487	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9920	18.2814	18.7750	19.3894	19.8303	20.0545	20.1069	20.1008	19.9516	19.3601	18.5765	17.9487	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9725	0.9569	0.9217	0.8432	0.7112	0.5312	0.3731	0.4235	0.6765	0.8863	0.9575	0.9766	(94)
Useful gains	778.5329	874.9557	965.8825	1011.2140	924.7174	682.2739	456.7397	476.5226	680.4012	766.7058	743.9095	741.7024	(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													
	1875.6023	1827.9344	1672.1946	1410.4847	1090.5869	723.2974	465.0302	489.6987	779.4115	1175.0604	1547.0796	1862.9717	(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													
	816.2196	640.4017	525.4962	287.4749	123.4069	0.0000	0.0000	0.0000	0.0000	303.8158	578.2825	834.2244	(98)
Space heating												4109.3220	(98)
Space heating per m2											(98) / (4) =	35.2792	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4540.6873	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	816.2196	640.4017	525.4962	287.4749	123.4069	0.0000	0.0000	0.0000	0.0000	303.8158	578.2825	834.2244	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	901.9002	707.6262	580.6588	317.6518	136.3613	0.0000	0.0000	0.0000	0.0000	335.7081	638.9862	921.7949	(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													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9037	89.8479	89.7175	89.4045	88.7735	87.3000	87.3000	87.3000	87.3000	89.4175	89.7804	89.9283	(217)
Fuel for water heating, kWh/month													
	200.5565	175.9551	182.8758	161.4691	157.1277	139.5174	130.9103	147.9098	148.9929	167.5593	180.2673	194.6580	(219)
Water heating fuel used												1987.7993	(219)
Annual totals kWh/year													
Space heating fuel - main system												4540.6873	(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)												449.5095	(232)
Total delivered energy for all uses												7052.9961	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4540.6873	3.4800	158.0159	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1987.7993	3.4800	69.1754	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	449.5095	13.1900	59.2903	(250)
Additional standing charges			120.0000	(251)
Total energy cost			416.3741	(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] =	1.0830	(257)
SAP value		84.8926	
SAP rating (Section 12)		85	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4540.6873	0.2160	980.7885	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1987.7993	0.2160	429.3647	(264)
Space and water heating			1410.1531	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	449.5095	0.5190	233.2954	(268)
Total kg/year			1682.3735	(272)
CO2 emissions per m2			14.4400	(273)
EI value			86.0393	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8883 = 3.918, stars = 4
Water heating environmental impact	0.216 / 0.8883 = 0.2432, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2400	(1b)	x 2.3600	(2b) =	137.4464	(1b) - (3b)
First floor	58.2400	(1c)	x 2.3200	(2c) =	135.1168	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		272.5632	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1468	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3968	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3670	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.0000	3.9000	3.6000	3.7000	3.3000	3.3000	3.1000	3.1000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0750	1.0000	0.9750	0.9000	0.9250	0.8250	0.8250	0.7750	0.7750	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.3945	0.3670	0.3578	0.3303	0.3395	0.3028	0.3028	0.2844	0.2844	0.3119	0.3119	0.3486	(22b)
Effective ac	0.5778	0.5673	0.5640	0.5545	0.5576	0.5458	0.5458	0.5404	0.5404	0.5487	0.5487	0.5608	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9200	1.4000	2.6880			(26)
Windows (Uw = 1.40)			19.7800	1.3258	26.2235			(27)
Rooflights (Uw = 1.40)			1.4000	1.3258	1.8561			(27a)
Ground Floor			58.2400	0.1200	6.9888	75.0000	4368.0000	(28a)
External Walls	82.9100	16.4300	66.4800	0.2400	15.9552	60.0000	3988.8000	(29a)
Dormer Walls & Cheeks	18.8400	5.2700	13.5700	0.2300	3.1211	9.0000	122.1300	(29a)
Pitched Cold Roof	37.4500		37.4500	0.1000	3.7450	9.0000	337.0500	(30)
Sloping Roof	31.0400	1.4000	29.6400	0.1700	5.0388	9.0000	266.7600	(30)
Total net area of external elements Aum(A, m2)			228.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.6164			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			66.8300			75.0000	5012.2500	(32c)
Internal Wall - Timber			74.6200			9.0000	671.5800	(32c)
Internal Floor			58.2400			18.0000	1048.3200	(32d)
Internal Ceiling			58.2400			18.0000	1048.3200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19177.4100	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	164.6412	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	16.5490	(36)
Total fabric heat loss	(33) + (36) = 82.1655	(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	51.9729	51.0302	50.7312	49.8793	50.1557	49.0957	49.0957	48.6111	48.6111	49.3493	49.3493	50.4396	(38)
Heat transfer coeff	134.1384	133.1957	132.8966	132.0448	132.3212	131.2612	131.2612	130.7766	130.7766	131.5148	131.5148	132.6051	(39)
Average = Sum(39)m / 12 =												132.0256	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1516	1.1435	1.1409	1.1336	1.1360	1.1269	1.1269	1.1227	1.1227	1.1291	1.1291	1.1384	(40)
HLP (average)												1.1335	(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	2.8486 (42)
Average daily hot water use (litres/day)	101.8548 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	112.0403	107.9661	103.8919	99.8177	95.7435	91.6693	91.6693	95.7435	99.8177	103.8919	107.9661	112.0403	(44)
Energy conte	166.1525	145.3180	149.9552	130.7346	125.4429	108.2477	100.3074	115.1042	116.4789	135.7450	148.1763	160.9098	(45)
Energy content (annual)										Total = Sum(45)m =		1602.5726	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.9229	21.7977	22.4933	19.6102	18.8164	16.2372	15.0461	17.2656	17.4718	20.3617	22.2264	24.1365	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1553	12.7740	14.1165	13.6260	14.0448	13.5510	13.9772	14.0211	13.5918	14.0823	13.6684	14.1427	(61)
Total heat required for water heating calculated for each month													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(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													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(64)
									Total per year (kWh/year) = Sum(64)m =			1768.3239	(64)
Heat gains from water heating, kWh/month													
	58.7845	51.5118	53.3892	46.8757	45.2210	39.3801	36.8465	41.7774	42.1272	48.6558	52.6857	57.0382	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	63.6327	56.5180	45.9635	34.7974	26.0114	21.9599	23.7285	30.8432	41.3977	52.5639	61.3498	65.4013	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	418.7420	423.0872	412.1374	388.8265	359.4006	331.7445	313.2684	308.9232	319.8731	343.1840	372.6098	400.2660	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	(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)													
	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	(71)
Water heating gains (Table 5)													
	79.0115	76.6544	71.7597	65.1052	60.7809	54.6946	49.5249	56.1524	58.5100	65.3976	73.1746	76.6643	(72)
Total internal gains													
	676.2990	671.1725	644.7734	603.6418	561.1057	523.3118	501.4347	510.8317	534.6936	576.0582	622.0470	657.2443	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2400	13.1177	0.6300	0.7000	0.7700	12.9889	(74)
East	7.6700	24.4891	0.6300	0.7000	0.7700	57.4037	(76)
West	8.8700	24.4891	0.6300	0.7000	0.7700	66.3847	(80)
West	1.4000	32.5353	0.6300	0.7000	1.0000	18.0786	(82)

Solar gains	154.8560	261.4851	427.1378	641.5118	768.7764	847.9225	790.7724	683.3207	534.7456	332.2848	189.0827	124.2150	(83)
Total gains	831.1550	932.6576	1071.9112	1245.1536	1329.8822	1371.2343	1292.2071	1194.1524	1069.4392	908.3430	811.1297	781.4593	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.7132	39.9942	40.0842	40.3428	40.2585	40.5837	40.5837	40.7340	40.7340	40.5054	40.5054	40.1723	
alpha	3.6475	3.6663	3.6723	3.6895	3.6839	3.7056	3.7056	3.7156	3.7156	3.7004	3.7004	3.6782	
util living area													
	0.9819	0.9717	0.9394	0.8598	0.7214	0.5178	0.3695	0.4165	0.6898	0.9022	0.9693	0.9850	(86)
MIT	19.4725	19.6598	20.0552	20.4886	20.8022	20.9575	20.9909	20.9860	20.8751	20.4644	19.9018	19.4439	(87)
Th 2	19.9589	19.9655	19.9675	19.9735	19.9715	19.9789	19.9789	19.9823	19.9823	19.9772	19.9772	19.9696	(88)
util rest of house													
	0.9779	0.9655	0.9258	0.8293	0.6643	0.4350	0.2705	0.3127	0.6114	0.8734	0.9613	0.9816	(89)
MIT 2	17.9420	18.2165	18.7826	19.3830	19.7792	19.9501	19.9756	19.9765	19.8796	19.3688	18.5769	17.9078	(90)
Living area fraction									fLA = Living area / (4) =			0.1459	(91)
MIT	18.1654	18.4271	18.9683	19.5444	19.9285	20.0972	20.1238	20.1238	20.0249	19.5287	18.7702	18.1320	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1654	18.4271	18.9683	19.5444	19.9285	20.0972	20.1238	20.1238	20.0249	19.5287	18.7702	18.1320	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9680	0.9528	0.9091	0.8145	0.6616	0.4450	0.2848	0.3275	0.6150	0.8578	0.9483	0.9729	(94)
Useful gains	804.5519	888.6618	974.4378	1014.1882	879.9085	610.1392	368.0585	391.0661	657.7383	779.1968	769.2067	760.2912	(95)
Ext temp.	4.6000	5.1000	7.0000	9.4000	12.4000	15.3000	17.3000	17.1000	14.5000	11.1000	7.5000	4.6000	(96)
Heat loss rate W													
	1819.6354	1775.1139	1590.5469	1339.5124	996.1797	629.6826	370.6502	395.4454	722.5285	1108.5000	1482.2020	1794.4126	(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													
	755.2221	595.6958	458.3852	234.2334	86.5058	0.0000	0.0000	0.0000	0.0000	245.0015	513.3566	769.3864	(98)
Space heating												3657.7869	(98)
Space heating per m2											(98) / (4) =	31.4027	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4041.7535	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	755.2221	595.6958	458.3852	234.2334	86.5058	0.0000	0.0000	0.0000	0.0000	245.0015	513.3566	769.3864	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	834.4996	658.2274	506.5030	258.8215	95.5865	0.0000	0.0000	0.0000	0.0000	270.7199	567.2449	850.1507	(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													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8651	89.8096	89.6340	89.2525	88.4978	87.3000	87.3000	87.3000	87.3000	89.2584	89.7118	89.8893	(217)
Fuel for water heating, kWh/month													
	200.6427	176.0303	183.0463	161.7440	157.6172	139.5174	130.9103	147.9098	148.9929	167.8579	180.4052	194.7424	(219)
Water heating fuel used												1989.4163	(219)
Annual totals kWh/year													
Space heating fuel - main system												4041.7535	(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)												449.5095	(232)
Total delivered energy for all uses												6555.6792	(238)

10a. Fuel costs - using BEDF prices (476)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4041.7535	3.8700	156.4159	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1989.4163	3.8700	76.9904	(247)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Energy for lighting	449.5095	18.9000	84.9573	(250)
Additional standing charges			93.0000	(251)
Total energy cost			425.5386	(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	4041.7535	0.2160	873.0187	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1989.4163	0.2160	429.7139	(264)
Space and water heating			1302.7327	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	449.5095	0.5190	233.2954	(268)
Total kg/year			1574.9531	(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	4041.7535	1.2200	4930.9392	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1989.4163	1.2200	2427.0879	(264)
Space and water heating			7358.0271	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	449.5095	3.0700	1379.9940	(268)
Primary energy kWh/year			8968.2711	(272)
Primary energy kWh/m2/year			76.9941	(273)

SAP 2012 EPC IMPROVEMENTS

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

Current energy efficiency rating: B 85
Current environmental impact rating: B 86

(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	+ 1.0	-£ 30	-195 kg (12.4%)
U Solar photovoltaic panels	+ 8.3	-£ 357	-980 kg (71.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£30	1.67 kg/m²	B 86	B 88
Solar photovoltaic panels	£357	8.41 kg/m²	A 94	A 95
Total Savings	£387	10.08 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 476 TEST (01 Apr 2021)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£99	£109	-£9
Mains gas	£326	£287	£40
Space heating	£264	£264	£0
Water heating	£77	£47	£30
Lighting	£85	£85	£0
Generated (PV)	-£0	-£357	£357
Total cost of fuels	£425	£39	£388
Total cost of uses	£426	£39	£387
Delivered energy	56 kWh/m²	32 kWh/m²	25 kWh/m²
Carbon dioxide emissions	1.6 tonnes	0.4 tonnes	1.2 tonnes
CO2 emissions per m²	14 kg/m²	3 kg/m²	10 kg/m²
Primary energy	77 kWh/m²	18 kWh/m²	59 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2400	(1b)	x 2.3600	(2b) =	137.4464	(1b) - (3b)
First floor	58.2400	(1c)	x 2.3200	(2c) =	135.1168	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		272.5632	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1468	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3968	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3670	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4679	0.4587	0.4496	0.4037	0.3945	0.3486	0.3486	0.3395	0.3670	0.3945	0.4129	0.4312	(22b)
Effective ac	0.6095	0.6052	0.6011	0.5815	0.5778	0.5608	0.5608	0.5576	0.5673	0.5778	0.5852	0.5930	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9200	1.4000	2.6880			(26)
Windows (Uw = 1.40)			19.7800	1.3258	26.2235			(27)
Rooflights (Uw = 1.40)			1.4000	1.3258	1.8561			(27a)
Ground Floor			58.2400	0.1200	6.9888	75.0000	4368.0000	(28a)
External Walls	82.9100	16.4300	66.4800	0.2400	15.9552	60.0000	3988.8000	(29a)
Dormer Walls & Cheeks	18.8400	5.2700	13.5700	0.2300	3.1211	9.0000	122.1300	(29a)
Pitched Cold Roof	37.4500		37.4500	0.1000	3.7450	9.0000	337.0500	(30)
Sloping Roof	31.0400	1.4000	29.6400	0.1700	5.0388	9.0000	266.7600	(30)
Total net area of external elements Aum(A, m2)			228.4800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.6164			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			66.8300			75.0000	5012.2500	(32c)
Internal Wall - Timber			74.6200			9.0000	671.5800	(32c)
Internal Floor			58.2400			18.0000	1048.3200	(32d)
Internal Ceiling			58.2400			18.0000	1048.3200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19177.4100	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	164.6412	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	16.5490	(36)
Total fabric heat loss	(33) + (36) = 82.1655	(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	54.8198	54.4375	54.0627	52.3023	51.9729	50.4396	50.4396	50.1557	51.0302	51.9729	52.6392	53.3358	(38)
Heat transfer coeff	136.9853	136.6030	136.2282	134.4678	134.1384	132.6051	132.6051	132.3212	133.1957	134.1384	134.8047	135.5013	(39)
Average = Sum(39)m / 12 =												134.4662	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1760	1.1728	1.1695	1.1544	1.1516	1.1384	1.1384	1.1360	1.1435	1.1516	1.1573	1.1633	(40)
HLP (average)												1.1544	(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	2.8486 (42)
Average daily hot water use (litres/day)	101.8548 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	112.0403	107.9661	103.8919	99.8177	95.7435	91.6693	91.6693	95.7435	99.8177	103.8919	107.9661	112.0403	(44)
Energy conte	166.1525	145.3180	149.9552	130.7346	125.4429	108.2477	100.3074	115.1042	116.4789	135.7450	148.1763	160.9098	(45)
Energy content (annual)										Total = Sum(45)m =		1602.5726	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.9229	21.7977	22.4933	19.6102	18.8164	16.2372	15.0461	17.2656	17.4718	20.3617	22.2264	24.1365	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1553	12.7740	14.1165	13.6260	14.0448	13.5510	13.9772	14.0211	13.5918	14.0823	13.6684	14.1427	(61)
Total heat required for water heating calculated for each month													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(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												1.1317	(H8)
Utilisation factor												0.5867	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.8548	(H14)
Volume ratio Veff/V												0.7363	(H15)
Solar storage volume factor												0.9388	(H16)
Solar input												-878.3700	(H17)
Solar input	-25.4710	-42.5037	-72.3887	-97.0152	-119.8541	-117.8356	-116.2784	-101.5930	-79.5677	-54.3354	-30.2122	-21.3149	(63)
								Solar input (sum of months) = Sum(63)m =				-878.3700	(63)
Output from w/h													
	154.8368	115.5883	91.6829	47.3454	19.6337	3.9630	0.0000	27.5323	50.5031	95.4919	131.6324	153.7377	(64)
								Total per year (kWh/year) = Sum(64)m =				891.9476	(64)
Heat gains from water heating, kWh/month													
	58.7845	51.5118	53.3892	46.8757	45.2210	39.3801	36.8465	41.7774	42.1272	48.6558	52.6857	57.0382	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	63.6327	56.5180	45.9635	34.7974	26.0114	21.9599	23.7285	30.8432	41.3977	52.5639	61.3498	65.4013	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	418.7420	423.0872	412.1374	388.8265	359.4006	331.7445	313.2684	308.9232	319.8731	343.1840	372.6098	400.2660	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	(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)													
	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	(71)
Water heating gains (Table 5)													
	79.0115	76.6544	71.7597	65.1052	60.7809	54.6946	49.5249	56.1524	58.5100	65.3976	73.1746	76.6643	(72)
Total internal gains													
	676.2990	671.1725	644.7734	603.6418	561.1057	523.3118	501.4347	510.8317	534.6936	576.0582	622.0470	657.2443	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2400	10.6334	0.6300	0.7000	0.7700	10.5290	(74)
East	7.6700	19.6403	0.6300	0.7000	0.7700	46.0378	(76)
West	8.8700	19.6403	0.6300	0.7000	0.7700	53.2406	(80)
West	1.4000	25.9287	0.6300	0.7000	1.0000	14.4076	(82)

Solar gains	124.2150	243.1567	403.1370	595.6458	739.0533	761.0885	722.6887	614.3179	471.0611	289.0288	154.8560	102.1950	(83)
Total gains	800.5140	914.3291	1047.9105	1199.2877	1300.1591	1284.4003	1224.1234	1125.1496	1005.7547	865.0871	776.9030	759.4393	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.8878	38.9967	39.1039	39.6159	39.7132	40.1723	40.1723	40.2585	39.9942	39.7132	39.5169	39.3137	
alpha	3.5925	3.5998	3.6069	3.6411	3.6475	3.6782	3.6782	3.6839	3.6663	3.6475	3.6345	3.6209	
util living area													
	0.9849	0.9748	0.9496	0.8857	0.7683	0.6037	0.4598	0.5136	0.7490	0.9254	0.9757	0.9874	(86)
MIT	19.3550	19.5636	19.9227	20.3768	20.7256	20.9189	20.9771	20.9659	20.8166	20.3438	19.7700	19.3197	(87)
Th 2	19.9392	19.9419	19.9444	19.9566	19.9589	19.9696	19.9696	19.9715	19.9655	19.9589	19.9543	19.9495	(88)
util rest of house													
	0.9816	0.9692	0.9382	0.8599	0.7181	0.5243	0.3593	0.4099	0.6776	0.9029	0.9694	0.9846	(89)
MIT 2	17.7591	18.0623	18.5788	19.2206	19.6773	19.9068	19.9582	19.9530	19.8038	19.1920	18.3725	17.7145	(90)
Living area fraction									fLA = Living area / (4) =			0.1459	(91)
MIT	17.9920	18.2814	18.7750	19.3894	19.8303	20.0545	20.1069	20.1008	19.9516	19.3601	18.5765	17.9487	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9920	18.2814	18.7750	19.3894	19.8303	20.0545	20.1069	20.1008	19.9516	19.3601	18.5765	17.9487	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9725	0.9569	0.9217	0.8432	0.7112	0.5312	0.3731	0.4235	0.6765	0.8863	0.9575	0.9766	(94)
Useful gains	778.5329	874.9557	965.8825	1011.2140	924.7174	682.2739	456.7397	476.5226	680.4012	766.7058	743.9095	741.7024	(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	1875.6023	1827.9344	1672.1946	1410.4847	1090.5869	723.2974	465.0302	489.6987	779.4115	1175.0604	1547.0796	1862.9717	(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	816.2196	640.4017	525.4962	287.4749	123.4069	0.0000	0.0000	0.0000	0.0000	303.8158	578.2825	834.2244	(98)
Space heating												4109.3220	(98)
Space heating per m2											(98) / (4) =	35.2792	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4540.6873	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	816.2196	640.4017	525.4962	287.4749	123.4069	0.0000	0.0000	0.0000	0.0000	303.8158	578.2825	834.2244	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	901.9002	707.6262	580.6588	317.6518	136.3613	0.0000	0.0000	0.0000	0.0000	335.7081	638.9862	921.7949	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.8368	115.5883	91.6829	47.3454	19.6337	3.9630	0.0000	27.5323	50.5031	95.4919	131.6324	153.7377	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9741	89.9956	90.0099	90.0333	90.0469	87.3000	87.3000	87.3000	87.3000	89.7136	89.8891	89.9867	(217)
Fuel for water heating, kWh/month	172.0904	128.4377	101.8587	52.5865	21.8038	4.5395	0.0000	31.5375	57.8500	106.4409	146.4388	170.8449	(219)
Water heating fuel used												994.4289	(219)
Annual totals kWh/year													
Space heating fuel - main system												4540.6873	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												449.5095	(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												4382.3863	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4540.6873	3.4800	158.0159	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	994.4289	3.4800	34.6061	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	449.5095	13.1900	59.2903	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			160.5770	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4177	(257)
SAP value	94.1738	
SAP rating (Section 12)	94	(258)
SAP band	A	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4540.6873	0.2160	980.7885	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	994.4289	0.2160	214.7966	(264)
Space and water heating			1195.5851	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	449.5095	0.5190	233.2954	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			597.3183	(272)
CO2 emissions per m2			5.1300	(273)
EI value			95.0433	
EI rating			95	(274)
EI band			A	

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2400	(1b)	x 2.3600	(2b) =	137.4464	(1b) - (3b)
First floor	58.2400	(1c)	x 2.3200	(2c) =	135.1168	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		272.5632	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1468	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3968	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3670	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.0000	3.9000	3.6000	3.7000	3.3000	3.3000	3.1000	3.1000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0750	1.0000	0.9750	0.9000	0.9250	0.8250	0.8250	0.7750	0.7750	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.3945	0.3670	0.3578	0.3303	0.3395	0.3028	0.3028	0.2844	0.2844	0.3119	0.3119	0.3486	(22b)
Effective ac	0.5778	0.5673	0.5640	0.5545	0.5576	0.5458	0.5458	0.5404	0.5404	0.5487	0.5487	0.5608	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9200	1.4000	2.6880			(26)
Windows (Uw = 1.40)			19.7800	1.3258	26.2235			(27)
Rooflights (Uw = 1.40)			1.4000	1.3258	1.8561			(27a)
Ground Floor			58.2400	0.1200	6.9888	75.0000	4368.0000	(28a)
External Walls	82.9100	16.4300	66.4800	0.2400	15.9552	60.0000	3988.8000	(29a)
Dormer Walls & Cheeks	18.8400	5.2700	13.5700	0.2300	3.1211	9.0000	122.1300	(29a)
Pitched Cold Roof	37.4500		37.4500	0.1000	3.7450	9.0000	337.0500	(30)
Sloping Roof	31.0400	1.4000	29.6400	0.1700	5.0388	9.0000	266.7600	(30)
Total net area of external elements Aum(A, m2)			228.4800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.6164			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			66.8300			75.0000	5012.2500	(32c)
Internal Wall - Timber			74.6200			9.0000	671.5800	(32c)
Internal Floor			58.2400			18.0000	1048.3200	(32d)
Internal Ceiling			58.2400			18.0000	1048.3200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19177.4100	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	164.6412	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	16.5490	(36)
Total fabric heat loss	(33) + (36) = 82.1655	(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	51.9729	51.0302	50.7312	49.8793	50.1557	49.0957	49.0957	48.6111	48.6111	49.3493	49.3493	50.4396	(38)
Heat transfer coeff	134.1384	133.1957	132.8966	132.0448	132.3212	131.2612	131.2612	130.7766	130.7766	131.5148	131.5148	132.6051	(39)
Average = Sum(39)m / 12 =												132.0256	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1516	1.1435	1.1409	1.1336	1.1360	1.1269	1.1269	1.1227	1.1227	1.1291	1.1291	1.1384	(40)
HLP (average)												1.1335	(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	2.8486 (42)
Average daily hot water use (litres/day)	101.8548 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	112.0403	107.9661	103.8919	99.8177	95.7435	91.6693	91.6693	95.7435	99.8177	103.8919	107.9661	112.0403	(44)
Energy conte	166.1525	145.3180	149.9552	130.7346	125.4429	108.2477	100.3074	115.1042	116.4789	135.7450	148.1763	160.9098	(45)
Energy content (annual)										Total = Sum(45)m =		1602.5726	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.9229	21.7977	22.4933	19.6102	18.8164	16.2372	15.0461	17.2656	17.4718	20.3617	22.2264	24.1365	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1553	12.7740	14.1165	13.6260	14.0448	13.5510	13.9772	14.0211	13.5918	14.0823	13.6684	14.1427	(61)
Total heat required for water heating calculated for each month													
	180.3078	158.0921	164.0717	144.3606	139.4877	121.7987	114.2847	129.1253	130.0708	149.8273	161.8447	175.0526	(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												1179.9840	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1982.3731	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2370	(H8)
Utilisation factor												0.5544	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.8548	(H14)
Volume ratio Veff/V												0.7363	(H15)
Solar storage volume factor												0.9388	(H16)
Solar input												-907.2711	(H17)
Solar input	-29.5012	-42.4892	-71.4546	-97.6921	-116.9229	-123.2858	-119.4147	-105.7974	-84.2628	-58.1058	-34.2753	-24.0692	(63)
									Solar input (sum of months) = Sum(63)m =			-907.2711	(63)
Output from w/h													
	150.8066	115.6029	92.6171	46.6684	22.5648	0.0000	0.0000	23.3279	45.8080	91.7215	127.5693	150.9834	(64)
									Total per year (kWh/year) = Sum(64)m =			867.6699	(64)
Heat gains from water heating, kWh/month													
	58.7845	51.5118	53.3892	46.8757	45.2210	39.3801	36.8465	41.7774	42.1272	48.6558	52.6857	57.0382	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	170.9174	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	63.6327	56.5180	45.9635	34.7974	26.0114	21.9599	23.7285	30.8432	41.3977	52.5639	61.3498	65.4013	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	418.7420	423.0872	412.1374	388.8265	359.4006	331.7445	313.2684	308.9232	319.8731	343.1840	372.6098	400.2660	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	54.9404	(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)													
	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	-113.9449	(71)
Water heating gains (Table 5)													
	79.0115	76.6544	71.7597	65.1052	60.7809	54.6946	49.5249	56.1524	58.5100	65.3976	73.1746	76.6643	(72)
Total internal gains													
	676.2990	671.1725	644.7734	603.6418	561.1057	523.3118	501.4347	510.8317	534.6936	576.0582	622.0470	657.2443	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2400	13.1177	0.6300	0.7000	0.7700	12.9889	(74)
East	7.6700	24.4891	0.6300	0.7000	0.7700	57.4037	(76)
West	8.8700	24.4891	0.6300	0.7000	0.7700	66.3847	(80)
West	1.4000	32.5353	0.6300	0.7000	1.0000	18.0786	(82)

Solar gains	154.8560	261.4851	427.1378	641.5118	768.7764	847.9225	790.7724	683.3207	534.7456	332.2848	189.0827	124.2150	(83)
Total gains	831.1550	932.6576	1071.9112	1245.1536	1329.8822	1371.2343	1292.2071	1194.1524	1069.4392	908.3430	811.1297	781.4593	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.7132	39.9942	40.0842	40.3428	40.2585	40.5837	40.5837	40.7340	40.7340	40.5054	40.5054	40.1723	
alpha	3.6475	3.6663	3.6723	3.6895	3.6839	3.7056	3.7056	3.7156	3.7156	3.7004	3.7004	3.6782	
util living area													
	0.9819	0.9717	0.9394	0.8598	0.7214	0.5178	0.3695	0.4165	0.6898	0.9022	0.9693	0.9850	(86)
MIT	19.4725	19.6598	20.0552	20.4886	20.8022	20.9575	20.9909	20.9860	20.8751	20.4644	19.9018	19.4439	(87)
Th 2	19.9589	19.9655	19.9675	19.9735	19.9715	19.9789	19.9789	19.9823	19.9823	19.9772	19.9772	19.9696	(88)
util rest of house													
	0.9779	0.9655	0.9258	0.8293	0.6643	0.4350	0.2705	0.3127	0.6114	0.8734	0.9613	0.9816	(89)
MIT 2	17.9420	18.2165	18.7826	19.3830	19.7792	19.9501	19.9756	19.9765	19.8796	19.3688	18.5769	17.9078	(90)
Living area fraction									fLA = Living area / (4) =			0.1459	(91)
MIT	18.1654	18.4271	18.9683	19.5444	19.9285	20.0972	20.1238	20.1238	20.0249	19.5287	18.7702	18.1320	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1654	18.4271	18.9683	19.5444	19.9285	20.0972	20.1238	20.1238	20.0249	19.5287	18.7702	18.1320	(93)

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9680	0.9528	0.9091	0.8145	0.6616	0.4450	0.2848	0.3275	0.6150	0.8578	0.9483	0.9729	(94)
Useful gains	804.5519	888.6618	974.4378	1014.1882	879.9085	610.1392	368.0585	391.0661	657.7383	779.1968	769.2067	760.2912	(95)
Ext temp.	4.6000	5.1000	7.0000	9.4000	12.4000	15.3000	17.3000	17.1000	14.5000	11.1000	7.5000	4.6000	(96)
Heat loss rate W	1819.6354	1775.1139	1590.5469	1339.5124	996.1797	629.6826	370.6502	395.4454	722.5285	1108.5000	1482.2020	1794.4126	(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	755.2221	595.6958	458.3852	234.2334	86.5058	0.0000	0.0000	0.0000	0.0000	245.0015	513.3566	769.3864	(98)
Space heating												3657.7869	(98)
Space heating per m2											(98) / (4) =	31.4027	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4041.7535	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	755.2221	595.6958	458.3852	234.2334	86.5058	0.0000	0.0000	0.0000	0.0000	245.0015	513.3566	769.3864	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	834.4996	658.2274	506.5030	258.8215	95.5865	0.0000	0.0000	0.0000	0.0000	270.7199	567.2449	850.1507	(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	150.8066	115.6029	92.6171	46.6684	22.5648	0.0000	0.0000	23.3279	45.8080	91.7215	127.5693	150.9834	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9512	89.9641	89.9458	89.9522	89.8189	87.3000	87.3000	87.3000	87.3000	89.6053	89.8445	89.9591	(217)
Fuel for water heating, kWh/month	167.6539	128.4989	102.9698	51.8814	25.1226	0.0000	0.0000	26.7215	52.4719	102.3617	141.9890	167.8356	(219)
Water heating fuel used												967.5064	(219)
Annual totals kWh/year													
Space heating fuel - main system												4041.7535	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												449.5095	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1180 * 0.80) =										-1887.9744		-1887.9744	(233)
Total delivered energy for all uses												3695.7949	(238)

10a. Fuel costs - using BEDF prices (476)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4041.7535	3.8700	156.4159	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	967.5064	3.8700	37.4425	(247)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Pump for solar water heating	50.0000	18.9000	9.4500	(249)
Energy for lighting	449.5095	18.9000	84.9573	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-1887.9744	18.9000	-356.8272	(252)
Total energy cost			38.6135	(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	4041.7535	0.2160	873.0187	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	967.5064	0.2160	208.9814	(264)
Space and water heating			1082.0001	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	449.5095	0.5190	233.2954	(268)

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

Energy saving/generation technologies			
PV Unit	-1887.9744	0.5190	-979.8587 (269)
Total kg/year			400.3118 (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	4041.7535	1.2200	4930.9392	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	967.5064	1.2200	1180.3578	(264)
Space and water heating			6111.2970	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	449.5095	3.0700	1379.9940	(268)
Energy saving/generation technologies				
PV Unit	-1887.9744	3.0700	-5796.0815	(269)
Primary energy kWh/year			2078.9595	(272)
Primary energy kWh/m2/year			17.8482	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	No
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	164.6 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	5.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	449.73 (P1)
Transmission heat loss coefficient	82.17 (37)
Summer heat loss coefficient	531.89 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)
West	1.000	1.00	1.000	1.000	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	3.2400	81.1852	0.6300	0.7000	0.9000	93.9605
East	7.6700	117.5071	0.6300	0.7000	0.9000	321.9459
West	8.8700	117.5071	0.6300	0.7000	0.9000	372.3156
West	1.4000	176.6135	0.6300	0.7000	1.0000	98.1371
total:						886.3591

	Jun	Jul	Aug	
Solar gains	943	886	772	(P3)
Internal gains	520	498	508	
Total summer gains	1464	1385	1280	(P5)
Summer gain/loss ratio	2.75	2.60	2.41	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 164.6)	0.85	0.85	0.85	
Threshold temperature	19.60	21.35	21.05	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

PREDICTED ENERGY ASSESSMENT

Design SAP
elmhurst energy

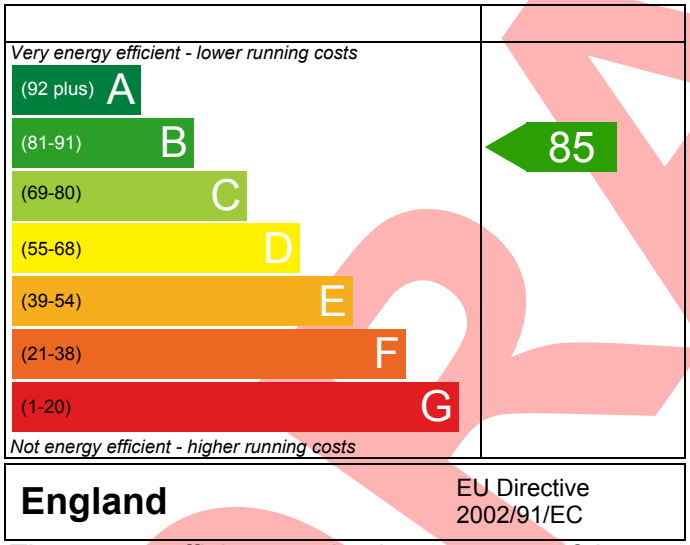
Plot 2, 2 Kiln Lane,
Farnham,
Surrey,
GU10 3LR

Dwelling type:	House, Semi-Detached
Date of assessment:	04/05/2021
Produced by:	Scott Spearing
Total floor area:	116.48 m²

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

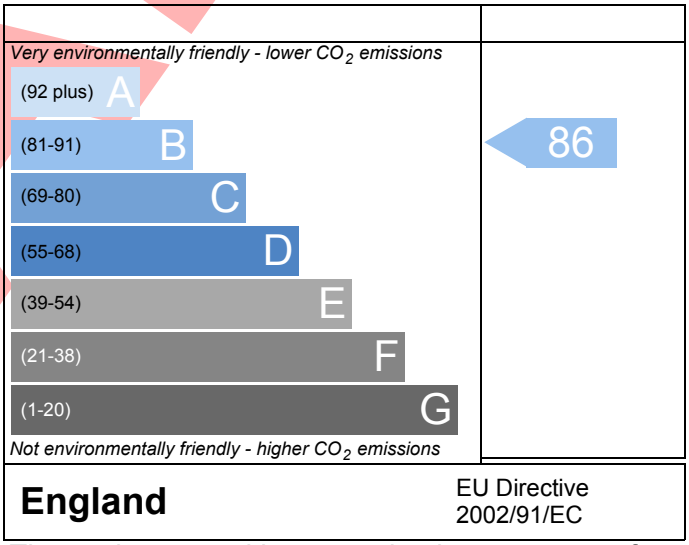
The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO_2) emissions.

Energy Efficiency Rating



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

Environmental Impact (CO_2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

DRAFT

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