ENERGY STATEMENT

Compliance with Staffordshire Moorlands Core Strategy, Policies SD1 & SD3

PROJECT NAME

Broad Street

Leek

Staffordshire

ST13 5NS

ASSESSOR

Will Linley

Energy Statement

Project: Broad Street – 0811192EN

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1. Introduction

This energy statement has been prepared by Peak Acoustics to accompany a planning application relating to the proposed development of the land at the corner of Alsop Street & Broad Street, Leek, as requested by Staffordshire Moorlands District Council.

The proposed development of the previously developed land, as encouraged by Policy SD1 of the Council's Core Strategy Plan, will see the erection of 6no. two-bedroom dwellings and 1no. three-bedroom dwelling, situated in a Leek town centre, close to local amenities.

The energy statement is designed to look at the how the proposed development will incorporate measures to ensure a high level of energy efficiency, along with reduced CO_2 emissions, which go beyond the minimum requirements specified within Part L of the Building Regulations.

Using approved calculation methods (SAP2012), we can calculate the proposed carbon emissions of the development and compare them against the minimum required standards for a notionally compliant development, as per the parameters set out in Building Regulations Part L1A. The initial aim is to ensure the development surpasses the benchmark target and then how it can go beyond it by incorporating sustainable construction methods, with consideration given to renewable technologies and district heating installations.

2. Staffordshire Moorlands District Council

The Staffordshire Moorlands Core Strategy contains two policies within the sustainable development section which are relevant to the production of the energy statement.

Policy SD1 – Sustainable Use of Resources, states that '*The Council will require all development to make sustainable use of resources and adapt to climate change'.* The Council aims to achieve this by the following methods;

- Encouraging the use of previously developed land
- Design to minimise energy needs & maximise energy savings
- Assess energy efficiency, water conservation & sourcing of materials
- Feasibility of integrating renewables

Policy SD3 – Carbon-saving Measures in Development, states that *'The Council will promote further carbon-saving measures in both new and existing developments.* Again, this will be achieved by the following methods;

- Supporting developers who exceed thermal efficiency standards
- Supporting developers who contribute to district heating networks

The design specification focuses on a fabric first approach, which ensures a high level of energy efficiency along with reduced levels of energy consumption, which will ensure the development is satisfying the needs of The Council, as specified in the relevant policies above.

3. Baseline Target Emission Rates

The results were calculated using approved SAP2012 software (Elmhurst Design SAP) with notional values used to achieve Part L 2013 Building Regulations compliance and the inclusion of a high efficiency gas combi boiler, to provide heating and hot water to the dwellings.

The notional values in Table 4 of Building Regulations Part L1A set high standards for building energy efficiency and the developers will need to go above and beyond these values to guarantee the new development will achieve compliance.

Address	Target Carbon Emission Rates KG CO^2/m^2/year (TER)	Target Fabric Energy Efficiency kWh/m^2/year (TFEE)
Land on corner of Alsop Street & Broad Street (block compliance)	125.25	332.84

4. Dwelling Emission Rates

By focusing on a fabric first approach throughout the development, we can limit the amount of unnecessary heat loss through the building fabric in the first instance. Low U-values, which limit thermal transmittance through an element, have been applied to the external walls, roofs and floors as well as the glazing.

With the inclusion of accredited construction details (ACD) and good quality methods of construction, the heat loss through any thermal bridging details can also be limited. Providing ACDs are followed correctly, the development should also benefit from high levels of air tightness, which will reduce the impact on the primary heating system, due to reduced heat loss.

With the rear of the development also being south facing, the dwellings will benefit from solar gains which can help warm up the dwellings throughout the day and reduce the demand on the heating systems.

With a well-constructed airtight dwelling, it is also crucial to create a well ventilated, healthy environment with good air quality for the occupant. The development will include suitable ventilation to satisfy this requirement. This will also help avoid any overheating in the summer months, with purge ventilation being provided by the rear glazing units.

Energy Statement

Project: Broad Street – 0811192EN

Below is a table specifying the building elements incorporated into the design and how they compare against notional values. The notional values are well beyond the allowable limiting fabric parameters (Part L1A) which highlights how difficult it is to achieve a CO2 reduction beyond the minimum required benchmark.

Element or System	Land on corner of Alsop Street & Broad Street	Notional Values (Approved Document L1A)
External Walls	0.24 W/m²K	0.18 W/m²K
Floor	0.14 W/m²K	0.13 W/m²K
Roof	0.11 W/m²K	0.13 W/m²K
Openings	1.30 W/m²K	1.40 W/m²K
Airtightness	4.00 m³/h.m²	5.00 m³/h.m²
Ventilation	Natural (with extract fans)	Natural (with extract fans)
Heating System	Gas combi boiler 89.5% SEDBUK efficient	Gas combi boiler 89.5% SEDBUK efficient

The figures stated above were included within the SAP calculations (Appendix A) and the results are shown in the table below. Limiting heat loss through the fabric and ensuring a good level of airtightness has a real positive effect on the results.

Address	Dwelling Carbon Emission Rates KG CO²/m²/year (DER)	Dwelling Fabric Energy Efficiency kWh/m²/year (DFEE)	KG CO²/m²/year (DER) % reduction	kWh/m²/year (DFEE) % reduction
Land off 1-3 Barn Lane (block compliance)	123.64	240.78	+1.29%	+27.66%

5. Renewable & Low Carbon Technologies

Staffordshire Moorlands District Council have adopted a sensible approach to ensure that all future developments remain viable to developers and to encourage projects to be delivered. This is a positive step towards solving issues around housing availability, whilst also benefiting the local economy.

They appreciate that planning policy requirements should not overburden developer viability, which could have a negative impact, and understand that the Building Regulations will only become more stringent over time. In the first instance, if any developments meet the minimum requirements of Building Regulations Part L, by focusing on a fabric first approach, they will achieve The Council's target of creating a sustainable development.

Where the use of renewable technologies is viable for a specific development, they should be encouraged. The Council does state that they will give support for any developer wishing to incorporate technologies into their designs, with particular consideration given to any proposed district heating connections.

With the development allowing for a gas installation, the dwellings are potentially future proofed to benefit from a connection to a local district heating scheme, if any become available.

6. Results

The proposed sustainable design of the development ensures that the dwellings will benefit from a reduced energy demand, whilst also guaranteeing a reduction in CO_2 emissions beyond the minimum requirements.

The reduced energy demand will benefit the occupiers of the dwellings (reducing fuel poverty) and lessen the need to use high carbon fuels and grid supplied electricity (reducing the impact on the climate).

Due to the high levels of fabric efficiency, the building is also future proofed for future generations to enjoy and can be considered for a heating upgrade as the existing pipework could be used to compliment potential district heating or community heating schemes.

As we move closer to decarbonising the grid, there needs to be a bigger push towards the electrification of heating, so another consideration for this development would be to install heat pumps. The issue with this option would be finding a suitable location to store the units along with the additional costs involved, which could go against developer viability. With the implementation of the gas boilers, it provides the development with the potential to switch to hydrogen heating in the future, if this becomes an option.

7. Appendix

Appendix A

Example summary input report below, inclusive of full SAP calculations and U-Value calculations.

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

Design SAP
elmhurst energy

Property Reference	3 Broad Street	**Issued on Date**	12/12/2019
Assessment Reference	As Designed	**Prop Type Ref**	
Property	Broad Street, Leek, Staffordshire, ST13 5NS		

SAP Rating	84 B	**DER**	16.59	**TER**	16.99
Environmental	88 B	**% DER<TER**	2.36		
CO_2 Emissions (t/year)	1.12	**DFEE**	35.54	**TFEE**	43.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.43		

Assessor Details	Mr. William Linley, William Linley, Tel: 03300431764, will@acousticsurveys.co.uk	**Assessor ID**	P977-0001
Client			

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)	16.99	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	16.59	$kgCO_2/m^2$	Pass
	-0.40 (-2.4%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	43.04	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	35.54	$kWh/m^2/yr$	
	-7.5 (-17.4%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	Pass
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	Pass
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from manufacturer Combi boiler Efficiency: 90% Minimum: 88%		Pass
Secondary heating system	None		

5 Cylinder insulation

Hot water storage	No cylinder		

6 Controls

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

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Midlands)	Not significant		Pass

Based on:

Overshading	Average		
Windows facing North Windows facing South	7.04 m², No overhang 8.88 m², No overhang		
Air change rate	8.00 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	4.00 (design value)		
Maximum	10.0		Pass

10 Key features

Party wall U-value	0.00	W/m²K	
Roof U-value	0.11	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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Assessor Details	Mr. William Linley, William Linley, Tel: 03300431764, will@acousticsurveys.co.uk	**Assessor ID**	P977-0001
Client			

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

Orientation	North
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	House, Mid-Terrace
2.0 Number of Storeys	3
3.0 Date Built	2019
4.0 Sheltered Sides	3
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	7.24 m	23.99 m²	2.40 m
1st Storey:	7.24 m	23.99 m²	2.60 m
2nd Storey:	7.24 m	23.99 m²	2.60 m

7.0 Living Area	10.33	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	170.77	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
Main	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.24	60.00	55.02	37.21

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Party Wall 1	Filled Cavity with Edge Sealing	Plasterboard on dabs mounted on cement render on both sides, AAC blocks, cavity	0.00	45.00	92.16

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Wall 1	Plasterboard on timber frame	9.00	147.60

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Plane Roof	Plasterboard, insulated at ceiling level	0.11	9.00	23.99	23.99

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Ceiling 1	Plasterboard ceiling, carpeted chipboard floor	9.00	23.99
Internal Ceiling 2	Plasterboard ceiling, carpeted chipboard floor	9.00	23.99

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Heat Loss Floor 1	Ground Floor - Solid	Slab on ground, screed over insulation	0.14	110.00	23.99

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Plasterboard ceiling, carpeted chipboard floor	18.00	23.99
Internal Floor 2	Plasterboard ceiling, carpeted chipboard floor	18.00	23.99

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
HGD	Manufacturer	Half Glazed Door	Double Low-E Soft 0.05			0.63		0.70	1.30
Windows	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front	Half Glazed Door	[1] Main	North							1.89	
Front	Window	[1] Main	North	None	0.00					7.04	
Rear	Window	[1] Main	South	None	0.00					8.88	

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
Independently assessed	E2 Other lintels (including other steel lintels)	10.65	0.028	Yes
Independently assessed	E3 Sill	9.75	0.013	Yes
Independently assessed	E4 Jamb	28.00	0.009	Yes
Independently assessed	E5 Ground floor (normal)	7.24	0.097	No
Independently assessed	E6 Intermediate floor within a dwelling	14.48	0.000	No
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	7.24	0.060	No
Independently assessed	E18 Party wall between dwellings	30.40	0.044	Yes
Table K1 - Default	P1 Party wall - Ground floor	14.30	0.160	No
Table K1 - Default	P2 Party wall - Intermediate floor within a dwelling	28.60	0.000	No
Independently assessed	P4 Party wall - Roof (insulation at ceiling level)	14.30	0.041	No

Y-value	0.059	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	4.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open

Cross ventilation possible	Yes
Night Ventilation	Yes
Air change rate	8.00
Mechanical Ventilation	
Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				3
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System	No	
22.0 Lighting		
Internal		
Total number of light fittings	12	
Total number of L.E.L. fittings	12	
Percentage of L.E.L. fittings	100.00	%
External		
External lights fitted	Yes	
Light and motion sensor	Yes	
23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Manufacturer	
Percentage of Heat	100	%
Main Heating	BGW	
SAP Code	104	
Efficiency (Manufacturer)	89.5	%
Model Name		
Manufacturer		
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2106	
Burner Control	On/Off	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Unknown	
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	£27	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	£302	A 97	

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

Design SAP
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General Requirements Compliance	Pass	**% DFEE<TFEE**	17.43		

Assessor Details	Mr. William Linley, William Linley, Tel: 03300431764, will@acousticsurveys.co.uk	**Assessor ID**	P977-0001
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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-Terrace House, total floor area 72 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) 16.99 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.59 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)43.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)35.5 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer

Combi boiler
Efficiency: 90%
Minimum: 88% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: No cylinder

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Midlands): Not significant OK
Based on:
Overshading: Average
Windows facing North: 7.04 m², No overhang
Windows facing South: 8.88 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 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	23.9900 (1b)	x	2.4000 (2b)	=	57.5760	(1b) - (3b)
First floor	23.9900 (1c)	x	2.6000 (2c)	=	62.3740	(1c) - (3c)
Second floor	23.9900 (1d)	x	2.6000 (2d)	=	62.3740	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.3240	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1645	(8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.3645	(18)
Number of sides sheltered				3	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2825	(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	0.3602	0.3532	0.3461	0.3108	0.3037	0.2684	0.2684	0.2613	0.2825	0.3037	0.3178	0.3320	(22b)
Effective ac	0.5649	0.5624	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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	
HGD			1.8900	1.3000	2.4570			(26a)
Windows (Uw = 1.30)			15.9200	1.2357	19.6730			(27)
Heat Loss Floor 1			23.9900	0.1400	3.3586	110.0000	2638.9000	(28a)
Main	55.0200	17.8100	37.2100	0.2400	8.9304	60.0000	2232.6000	(29a)
External Roof 1	23.9900		23.9900	0.1100	2.6389	9.0000	215.9100	(30)
Total net area of external elements Aum(A, m2)			103.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.0579			(33)
Party Wall 1			92.1600	0.0000	0.0000	45.0000	4147.2000	(32)
Internal Wall 1			147.6000			9.0000	1328.4000	(32c)
Internal Floor 1			23.9900			18.0000	431.8200	(32d)
Internal Floor 2			23.9900			18.0000	431.8200	(32d)
Internal Ceiling 1			23.9900			18.0000	431.8200	(32e)
Internal Ceiling 2			23.9900			18.0000	431.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12290.2900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		170.7696	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.0255	(36)
Total fabric heat loss	(33) + (36) =	43.0834	(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	33.9869	33.8353	33.6867	32.9889	32.8583	32.2505	32.2505	32.1380	32.4847	32.8583	33.1225	33.3986	(38)
Heat transfer coeff	77.0703	76.9188	76.7702	76.0723	75.9418	75.3340	75.3340	75.2214	75.5681	75.9418	76.2059	76.4820	(39)
Average = Sum(39)m / 12 =												76.0717	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0709	1.0688	1.0667	1.0570	1.0552	1.0467	1.0467	1.0452	1.0500	1.0552	1.0589	1.0627	(40)
HLP (average)												1.0570	(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		2.2930 (42)
Average daily hot water use (litres/day)		88.6584 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.5243	93.9779	90.4316	86.8852	83.3389	79.7926	79.7926	83.3389	86.8852	90.4316	93.9779	97.5243	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	144.6257	126.4905	130.5269	113.7965	109.1905	94.2231	87.3115	100.1912	101.3878	118.1578	128.9784	140.0622	(45)
Energy content (annual)										Total = Sum(45)m =		1394.9421	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.6938	18.9736	19.5790	17.0695	16.3786	14.1335	13.0967	15.0287	15.2082	17.7237	19.3468	21.0093	(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	49.6973	43.2556	46.0829	42.8475	42.4686	39.3498	40.6614	42.4686	42.8475	46.0829	46.3453	49.6973	(61)
Total heat required for water heating calculated for each month													
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(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													
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(64)
									Total per year (kWh/year) = Sum(64)m =			1926.7468	(64)
Heat gains from water heating, kWh/month													
	60.5124	52.8720	54.9209	48.5492	46.9230	41.1666	39.1964	43.9307	44.4233	50.8082	54.4716	58.9950	(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	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.9984	15.9861	13.0007	9.8424	7.3573	6.2113	6.7116	8.7240	11.7093	14.8676	17.3527	18.4987	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	201.8505	203.9451	198.6668	187.4300	173.2456	159.9142	151.0080	148.9135	154.1917	165.4285	179.6130	192.9444	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	(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)													
	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	(71)
Water heating gains (Table 5)													
	81.3338	78.6786	73.8184	67.4295	63.0685	57.1758	52.6834	59.0467	61.6991	68.2906	75.6551	79.2944	(72)
Total internal gains													
	361.5776	359.0045	345.8808	325.0967	304.0662	283.6962	270.7978	277.0789	287.9949	308.9815	333.0155	351.1322	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.0400	10.6334	0.6300	0.7000	0.7700	22.8779	(74)
South	8.8800	46.7521	0.6300	0.7000	0.7700	126.8778	(78)

Solar gains	149.7557	251.5140	338.9840	418.4916	472.4941	472.0992	453.7952	412.1368	365.8252	276.1683	178.6163	128.7062	(83)
Total gains	511.3333	610.5185	684.8648	743.5883	776.5603	755.7954	724.5930	689.2157	653.8200	585.1499	511.6318	479.8384	(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	44.2968	44.3841	44.4700	44.8779	44.9551	45.3178	45.3178	45.3856	45.1774	44.9551	44.7993	44.6375	
alpha	3.9531	3.9589	3.9647	3.9919	3.9970	4.0212	4.0212	4.0257	4.0118	3.9970	3.9866	3.9758	
util living area													
	0.9842	0.9682	0.9384	0.8749	0.7603	0.5956	0.4466	0.4859	0.7014	0.8994	0.9708	0.9874	(86)
MIT	19.6084	19.8503	20.1639	20.5192	20.7935	20.9429	20.9859	20.9802	20.8879	20.5303	19.9983	19.5571	(87)
Th 2	20.0247	20.0264	20.0281	20.0361	20.0376	20.0446	20.0446	20.0459	20.0419	20.0376	20.0346	20.0314	(88)
util rest of house													
	0.9807	0.9614	0.9252	0.8482	0.7112	0.5204	0.3544	0.3920	0.6306	0.8719	0.9634	0.9846	(89)
MIT 2	18.7634	19.0024	19.3085	19.6505	19.8935	20.0145	20.0397	20.0386	19.9763	19.6695	19.1571	18.7179	(90)
Living area fraction										fLA = Living area / (4) =		0.1435	(91)
MIT	18.8847	19.1241	19.4313	19.7752	20.0227	20.1477	20.1756	20.1737	20.1072	19.7931	19.2778	18.8384	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7347	18.9741	19.2813	19.6252	19.8727	19.9977	20.0256	20.0237	19.9572	19.6431	19.1278	18.6884	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9744	0.9520	0.9128	0.8350	0.7020	0.5165	0.3525	0.3897	0.6237	0.8583	0.9543	0.9793	(94)
Useful gains	498.2656	581.2389	625.1230	620.8678	545.1263	390.3745	255.4303	268.6068	407.7964	502.2518	488.2382	469.9232	(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													
	1112.4866	1082.5598	981.2203	815.8889	620.6469	406.6331	258.0603	272.5807	442.6151	686.7476	916.5931	1108.1019	(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													
	456.9804	336.8876	264.9363	140.4152	56.1874	0.0000	0.0000	0.0000	0.0000	137.2649	308.4155	474.8050	(98)
Space heating												2175.8923	(98)
Space heating per m2											(98) / (4) =	30.2333	(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 %)												89.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2431.1646	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	456.9804	336.8876	264.9363	140.4152	56.1874	0.0000	0.0000	0.0000	0.0000	137.2649	308.4155	474.8050	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	510.5926	376.4108	296.0183	156.8885	62.7792	0.0000	0.0000	0.0000	0.0000	153.3686	344.5983	530.5084	(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	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month	217.1206	189.6605	197.3294	175.0213	169.4515	149.2434	142.9865	159.3965	161.1568	183.5092	195.8924	212.0218	(219)
Water heating fuel used												2152.7898	(219)
Annual totals kWh/year													
Space heating fuel - main system												2431.1646	(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)												317.8580	(232)
Total delivered energy for all uses												4976.8124	(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	2431.1646	0.2160	525.1316	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2152.7898	0.2160	465.0026	(264)
Space and water heating			990.1341	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	317.8580	0.5190	164.9683	(268)
Total CO2, kg/year			1194.0274	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.5900	(273)

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

DER		16.5900	ZC1
Total Floor Area	TFA	71.9700	
Assumed number of occupants	N	2.2930	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6198	ZC2
CO2 emissions from cooking, equation (L16)		2.4181	ZC3
Total CO2 emissions		35.6279	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		35.6279	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	23.9900 (1b)	x	2.4000 (2b)	=	57.5760	(1b) - (3b)
First floor	23.9900 (1c)	x	2.6000 (2c)	=	62.3740	(1c) - (3c)
Second floor	23.9900 (1d)	x	2.6000 (2d)	=	62.3740	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.3240	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1645	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4145	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3213	(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	0.4096	0.4016	0.3936	0.3534	0.3454	0.3052	0.3052	0.2972	0.3213	0.3454	0.3614	0.3775	(22b)
Effective ac	0.5839	0.5806	0.5774	0.5624	0.5596	0.5466	0.5466	0.5442	0.5516	0.5596	0.5653	0.5713	(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 Semi-glazed door			1.8900	1.2000	2.2680			(26a)
TER Opening Type (Uw = 1.40)			15.9200	1.3258	21.1061			(27)
Heat Loss Floor 1			23.9900	0.1300	3.1187			(28a)
Main	55.0200	17.8100	37.2100	0.1800	6.6978			(29a)
External Roof 1	23.9900		23.9900	0.1300	3.1187			(30)
Total net area of external elements Aum(A, m2)			103.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	36.3093			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6968	(36)
Total fabric heat loss (33) + (36) =	45.0061	(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	35.1311	34.9351	34.7430	33.8406	33.6717	32.8858	32.8858	32.7402	33.1885	33.6717	34.0133	34.3704	(38)
Heat transfer coeff	80.1372	79.9412	79.7490	78.8466	78.6778	77.8918	77.8918	77.7463	78.1946	78.6778	79.0194	79.3764	(39)
Average = Sum(39)m / 12 =												78.8458	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1135	1.1108	1.1081	1.0955	1.0932	1.0823	1.0823	1.0803	1.0865	1.0932	1.0979	1.1029	(40)
HLP (average)												1.0955	(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	2.2930 (42)
Average daily hot water use (litres/day)	88.6584 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.5243	93.9779	90.4316	86.8852	83.3389	79.7926	79.7926	83.3389	86.8852	90.4316	93.9779	97.5243	(44)
Energy conte	144.6257	126.4905	130.5269	113.7965	109.1905	94.2231	87.3115	100.1912	101.3878	118.1578	128.9784	140.0622	(45)
Energy content (annual)										Total = Sum(45)m =		1394.9421	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6938	18.9736	19.5790	17.0695	16.3786	14.1335	13.0967	15.0287	15.2082	17.7237	19.3468	21.0093	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	49.6973	43.2556	46.0829	42.8475	42.4686	39.3498	40.6614	42.4686	42.8475	46.0829	46.3453	49.6973 (61)
Total heat required for water heating calculated for each month												
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595 (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												
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595 (64)
								Total per year (kWh/year) = Sum(64)m =				1926.7468 (64)
Heat gains from water heating, kWh/month												
	60.5124	52.8720	54.9209	48.5492	46.9230	41.1666	39.1964	43.9307	44.4233	50.8082	54.4716	58.9950 (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	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.9984	15.9861	13.0007	9.8424	7.3573	6.2113	6.7116	8.7240	11.7093	14.8676	17.3527	18.4987	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	201.8505	203.9451	198.6668	187.4300	173.2456	159.9142	151.0080	148.9135	154.1917	165.4285	179.6130	192.9444	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	(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)													
	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	(71)
Water heating gains (Table 5)													
	81.3338	78.6786	73.8184	67.4295	63.0685	57.1758	52.6834	59.0467	61.6991	68.2906	75.6551	79.2944	(72)
Total internal gains													
	361.5776	359.0045	345.8808	325.0967	304.0662	283.6962	270.7978	277.0789	287.9949	308.9815	333.0155	351.1322	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.0400	10.6334	0.6300	0.7000	0.7700	22.8779	(74)
South	8.8800	46.7521	0.6300	0.7000	0.7700	126.8778	(78)

Solar gains	149.7557	251.5140	338.9840	418.4916	472.4941	472.0992	453.7952	412.1368	365.8252	276.1683	178.6163	128.7062	(83)
Total gains	511.3333	610.5185	684.8648	743.5883	776.5603	755.7954	724.5930	689.2157	653.8200	585.1499	511.6318	479.8384	(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	62.3670	62.5199	62.6706	63.3878	63.5239	64.1648	64.1648	64.2850	63.9164	63.5239	63.2493	62.9647	
alpha	5.1578	5.1680	5.1780	5.2259	5.2349	5.2777	5.2777	5.2857	5.2611	5.2349	5.2166	5.1976	
util living area													
	0.9957	0.9887	0.9718	0.9239	0.8136	0.6326	0.4682	0.5110	0.7502	0.9438	0.9900	0.9968	(86)
MIT	19.9107	20.1018	20.3546	20.6480	20.8683	20.9731	20.9954	20.9928	20.9352	20.6493	20.2203	19.8744	(87)
Th 2	19.9898	19.9921	19.9942	20.0045	20.0064	20.0153	20.0153	20.0170	20.0119	20.0064	20.0025	19.9985	(88)
util rest of house													
	0.9943	0.9852	0.9627	0.8995	0.7595	0.5464	0.3660	0.4059	0.6693	0.9204	0.9862	0.9958	(89)
MIT 2	18.5488	18.8274	19.1914	19.6054	19.8834	19.9983	20.0137	20.0142	19.9642	19.6172	19.0088	18.5021	(90)
Living area fraction										fLA = Living area / (4) =		0.1435	(91)
MIT	18.7443	19.0103	19.3584	19.7551	20.0247	20.1382	20.1546	20.1546	20.1036	19.7654	19.1827	18.6991	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7443	19.0103	19.3584	19.7551	20.0247	20.1382	20.1546	20.1546	20.1036	19.7654	19.1827	18.6991	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9917	0.9803	0.9552	0.8922	0.7606	0.5577	0.3806	0.4209	0.6775	0.9133	0.9817	0.9938	(94)
Useful gains	507.0845	598.5120	654.2025	663.4023	590.6824	421.4888	275.8037	290.1055	442.9469	534.3982	502.2716	476.8602	(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													
	1157.5253	1127.9938	1025.4429	855.8850	654.9716	431.3803	276.8731	291.9079	469.4451	721.1096	954.7650	1150.8837	(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													
	483.9279	355.8117	276.2029	138.5876	47.8312	0.0000	0.0000	0.0000	0.0000	138.9133	325.7953	501.4735	(98)
Space heating												2268.5433	(98)
Space heating per m2											(98) / (4) =	31.5207	(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												2428.8473	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	483.9279	355.8117	276.2029	138.5876	47.8312	0.0000	0.0000	0.0000	0.0000	138.9133	325.7953	501.4735	(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)													
	518.1241	380.9547	295.7204	148.3807	51.2111	0.0000	0.0000	0.0000	0.0000	148.7294	348.8172	536.9095	(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													
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.2556	86.8709	86.1726	84.7445	82.5103	80.3000	80.3000	80.3000	80.3000	84.6328	86.5896	87.3828	(217)
Fuel for water heating, kWh/month													
	222.7053	195.4004	204.9489	184.8426	183.8062	166.3422	159.3685	177.6586	179.6206	194.0626	202.4766	217.1590	(219)
Water heating fuel used												2288.3917	(219)
Annual totals kWh/year													
Space heating fuel - main system												2428.8473	(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)												317.8580	(232)
Total delivered energy for all uses												5110.0969	(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	2428.8473	0.2160	524.6310	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2288.3917	0.2160	494.2926	(264)
Space and water heating			1018.9236	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	317.8580	0.5190	164.9683	(268)
Total CO2, kg/m2/year			1222.8169	(272)
Emissions per m2 for space and water heating			14.1576	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2922	(272b)
Emissions per m2 for pumps and fans			0.5409	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.1576 * 1.00) + 2.2922 + 0.5409, rounded to 2 d.p.			16.9900	(273)

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

Design SAP
elmhurst energy

Property Reference	3 Broad Street	**Issued on Date**	12/12/2019
Assessment Reference	As Designed	**Prop Type Ref**	
Property	Broad Street, Leek, Staffordshire, ST13 5NS		

SAP Rating	84 B	**DER**	16.59	**TER**	16.99
Environmental	88 B	**% DER<TER**	2.36		
CO_2 Emissions (t/year)	1.12	**DFEE**	35.54	**TFEE**	43.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.43		

Assessor Details	Mr. William Linley, William Linley, Tel: 03300431764, will@acousticsurveys.co.uk	**Assessor ID**	P977-0001
Client			

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	23.9900	(1b)	x 2.4000	(2b) =	57.5760	(1b) - (3b)
First floor	23.9900	(1c)	x 2.6000	(2c) =	62.3740	(1c) - (3c)
Second floor	23.9900	(1d)	x 2.6000	(2d) =	62.3740	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		182.3240	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1645	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.3645	(18)
Number of sides sheltered			3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2825	(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	0.3602	0.3532	0.3461	0.3108	0.3037	0.2684	0.2684	0.2613	0.2825	0.3037	0.3178	0.3320	(22b)
Effective ac	0.5649	0.5624	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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	
HGD			1.8900	1.3000	2.4570			(26a)
Windows (Uw = 1.30)			15.9200	1.2357	19.6730			(27)
Heat Loss Floor 1			23.9900	0.1400	3.3586	110.0000	2638.9000	(28a)
Main	55.0200	17.8100	37.2100	0.2400	8.9304	60.0000	2232.6000	(29a)
External Roof 1	23.9900		23.9900	0.1100	2.6389	9.0000	215.9100	(30)
Total net area of external elements Aum(A, m2)			103.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.0579			(33)
Party Wall 1			92.1600	0.0000	0.0000	45.0000	4147.2000	(32)
Internal Wall 1			147.6000			9.0000	1328.4000	(32c)
Internal Floor 1			23.9900			18.0000	431.8200	(32d)
Internal Floor 2			23.9900			18.0000	431.8200	(32d)
Internal Ceiling 1			23.9900			9.0000	215.9100	(32e)
Internal Ceiling 2			23.9900			9.0000	215.9100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 11858.4700	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	164.7696	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.0255	(36)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total fabric heat loss (33) + (36) = 43.0834 (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	33.9869	33.8353	33.6867	32.9889	32.8583	32.2505	32.2505	32.1380	32.4847	32.8583	33.1225	33.3986	(38)
Heat transfer coeff													
	77.0703	76.9188	76.7702	76.0723	75.9418	75.3340	75.3340	75.2214	75.5681	75.9418	76.2059	76.4820	(39)
Average = Sum(39)m / 12 =												76.0717	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0709	1.0688	1.0667	1.0570	1.0552	1.0467	1.0467	1.0452	1.0500	1.0552	1.0589	1.0627	(40)
HLP (average)												1.0570	(40)
Days in month													
	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.2930 (42)

Average daily hot water use (litres/day) 88.6584 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	97.5243	93.9779	90.4316	86.8852	83.3389	79.7926	79.7926	83.3389	86.8852	90.4316	93.9779	97.5243	(44)
Energy conte	144.6257	126.4905	130.5269	113.7965	109.1905	94.2231	87.3115	100.1912	101.3878	118.1578	128.9784	140.0622	(45)
Energy content (annual)										Total = Sum(45)m =		1394.9421	(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													
	30.7330	26.8792	27.7370	24.1818	23.2030	20.0224	18.5537	21.2906	21.5449	25.1085	27.4079	29.7632	(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	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.9984	15.9861	13.0007	9.8424	7.3573	6.2113	6.7116	8.7240	11.7093	14.8676	17.3527	18.4987	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	201.8505	203.9451	198.6668	187.4300	173.2456	159.9142	151.0080	148.9135	154.1917	165.4285	179.6130	192.9444	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	(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)													
	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	(71)
Water heating gains (Table 5)													
	41.3077	39.9989	37.2809	33.5858	31.1868	27.8089	24.9378	28.6165	29.9235	33.7480	38.0666	40.0043	(72)
Total internal gains													
	318.5515	317.3248	306.3432	288.2530	269.1845	251.3292	240.0522	243.6487	253.2193	271.4390	292.4270	308.8421	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.0400	10.6334	0.6300	0.7000	0.7700	22.8779	(74)
South	8.8800	46.7521	0.6300	0.7000	0.7700	126.8778	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	149.7557	251.5140	338.9840	418.4916	472.4941	472.0992	453.7952	412.1368	365.8252	276.1683	178.6163	128.7062	(83)
Total gains	468.3072	568.8388	645.3272	706.7446	741.6786	723.4284	693.8474	655.7854	619.0444	547.6073	471.0433	437.5484	(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	42.7404	42.8247	42.9075	43.3011	43.3756	43.7256	43.7256	43.7910	43.5901	43.3756	43.2253	43.0692	
alpha	3.8494	3.8550	3.8605	3.8867	3.8917	3.9150	3.9150	3.9194	3.9060	3.8917	3.8817	3.8713	
util living area													
	0.9869	0.9724	0.9449	0.8853	0.7757	0.6139	0.4635	0.5064	0.7229	0.9115	0.9756	0.9898	(86)
MIT	19.4968	19.7506	20.0816	20.4609	20.7604	20.9303	20.9819	20.9744	20.8646	20.4682	19.9038	19.4444	(87)
Th 2	20.0247	20.0264	20.0281	20.0361	20.0376	20.0446	20.0446	20.0459	20.0419	20.0376	20.0346	20.0314	(88)
util rest of house													
	0.9841	0.9666	0.9331	0.8605	0.7284	0.5386	0.3690	0.4101	0.6537	0.8869	0.9695	0.9875	(89)
MIT 2	18.6560	18.9075	19.2320	19.5990	19.8676	20.0069	20.0382	20.0361	19.9606	19.6149	19.0675	18.6093	(90)
Living area fraction										fLA = Living area / (4) =		0.1435	(91)
MIT	18.7767	19.0285	19.3539	19.7228	19.9957	20.1395	20.1736	20.1708	20.0904	19.7374	19.1876	18.7292	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7767	19.0285	19.3539	19.7228	19.9957	20.1395	20.1736	20.1708	20.0904	19.7374	19.1876	18.7292	(93)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9792	0.9589	0.9231	0.8512	0.7262	0.5465	0.3821	0.4232	0.6575	0.8777	0.9624	0.9834	(94)
Useful gains	458.5495	545.4779	595.6928	601.5992	538.5901	395.3522	265.1302	277.5183	407.0234	480.6318	453.3342	430.2817	(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													
	1115.7218	1086.7466	986.7972	823.3119	629.9937	417.3102	269.2161	283.6446	452.6798	693.9071	921.1439	1111.2223	(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													
	488.9362	363.7326	290.9817	159.6331	68.0043	0.0000	0.0000	0.0000	0.0000	158.6769	336.8230	506.6199	(98)
Space heating												2373.4077	(98)
Space heating per m2											(98) / (4) =	32.9777	(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	708.1393	557.4714	571.6827	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8890	0.9344	0.9197	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	629.5443	520.8982	525.7772	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	930.7300	894.4225	851.3141	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	216.8537	277.9021	242.1995	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												736.9553	(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	54.2134	69.4755	60.5499	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												184.2388	(107)
Space cooling per m2												2.5599	(108)
Energy for space heating												32.9777	(99)
Energy for space cooling												2.5599	(108)
Total												35.5377	(109)
Dwelling Fabric Energy Efficiency (DFEE)												35.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	23.9900 (1b)	x	2.4000 (2b)	=	57.5760	(1b) - (3b)
First floor	23.9900 (1c)	x	2.6000 (2c)	=	62.3740	(1c) - (3c)
Second floor	23.9900 (1d)	x	2.6000 (2d)	=	62.3740	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.3240	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/	(5) =	0.1645	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.4145	(18)
Number of sides sheltered				3	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3213	(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	0.4096	0.4016	0.3936	0.3534	0.3454	0.3052	0.3052	0.2972	0.3213	0.3454	0.3614	0.3775	(22b)
Effective ac	0.5839	0.5806	0.5774	0.5624	0.5596	0.5466	0.5466	0.5442	0.5516	0.5596	0.5653	0.5713	(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 Semi-glazed door			1.8900	1.2000	2.2680			(26a)
TER Opening Type (Uw = 1.40)			15.9200	1.3258	21.1061			(27)
Heat Loss Floor 1			23.9900	0.1300	3.1187			(28a)
Main	55.0200	17.8100	37.2100	0.1800	6.6978			(29a)
External Roof 1	23.9900		23.9900	0.1300	3.1187			(30)
Total net area of external elements Aum(A, m2)			103.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	36.3093			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6968	(36)
Total fabric heat loss (33) + (36) =	45.0061	(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	35.1311	34.9351	34.7430	33.8406	33.6717	32.8858	32.8858	32.7402	33.1885	33.6717	34.0133	34.3704	(38)
Heat transfer coeff	80.1372	79.9412	79.7490	78.8466	78.6778	77.8918	77.8918	77.7463	78.1946	78.6778	79.0194	79.3764	(39)
Average = Sum(39)m / 12 =												78.8458	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1135	1.1108	1.1081	1.0955	1.0932	1.0823	1.0823	1.0803	1.0865	1.0932	1.0979	1.1029	(40)
HLP (average)												1.0955	(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	2.2930 (42)
Average daily hot water use (litres/day)	88.6584 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.5243	93.9779	90.4316	86.8852	83.3389	79.7926	79.7926	83.3389	86.8852	90.4316	93.9779	97.5243	(44)
Energy conte	144.6257	126.4905	130.5269	113.7965	109.1905	94.2231	87.3115	100.1912	101.3878	118.1578	128.9784	140.0622	(45)
Energy content (annual)										Total = Sum(45)m =		1394.9421	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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													
	30.7330	26.8792	27.7370	24.1818	23.2030	20.0224	18.5537	21.2906	21.5449	25.1085	27.4079	29.7632	(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	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	114.6493	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.9984	15.9861	13.0007	9.8424	7.3573	6.2113	6.7116	8.7240	11.7093	14.8676	17.3527	18.4987	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	201.8505	203.9451	198.6668	187.4300	173.2456	159.9142	151.0080	148.9135	154.1917	165.4285	179.6130	192.9444	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	34.4649	(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)													
	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	(71)
Water heating gains (Table 5)													
	41.3077	39.9989	37.2809	33.5858	31.1868	27.8089	24.9378	28.6165	29.9235	33.7480	38.0666	40.0043	(72)
Total internal gains													
	318.5515	317.3248	306.3432	288.2530	269.1845	251.3292	240.0522	243.6487	253.2193	271.4390	292.4270	308.8421	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.0400	10.6334	0.6300	0.7000	0.7700	22.8779	(74)
South	8.8800	46.7521	0.6300	0.7000	0.7700	126.8778	(78)

Solar gains	149.7557	251.5140	338.9840	418.4916	472.4941	472.0992	453.7952	412.1368	365.8252	276.1683	178.6163	128.7062	(83)
Total gains	468.3072	568.8388	645.3272	706.7446	741.6786	723.4284	693.8474	655.7854	619.0444	547.6073	471.0433	437.5484	(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	62.3670	62.5199	62.6706	63.3878	63.5239	64.1648	64.1648	64.2850	63.9164	63.5239	63.2493	62.9647	
alpha	5.1578	5.1680	5.1780	5.2259	5.2349	5.2777	5.2777	5.2857	5.2611	5.2349	5.2166	5.1976	
util living area													
	0.9971	0.9917	0.9778	0.9361	0.8339	0.6559	0.4878	0.5351	0.7775	0.9560	0.9931	0.9979	(86)
MIT	19.8553	20.0499	20.3092	20.6145	20.8507	20.9682	20.9944	20.9911	20.9231	20.6114	20.1692	19.8195	(87)
Th 2	19.9898	19.9921	19.9942	20.0045	20.0064	20.0153	20.0153	20.0170	20.0119	20.0064	20.0025	19.9985	(88)
util rest of house													
	0.9961	0.9890	0.9704	0.9145	0.7822	0.5685	0.3819	0.4260	0.6983	0.9366	0.9903	0.9973	(89)
MIT 2	18.9509	19.1458	19.4026	19.7024	19.9096	20.0014	20.0139	20.0146	19.9723	19.7068	19.2739	18.9222	(90)
Living area fraction									fLA = Living area / (4) =			0.1435	(91)
MIT	19.0807	19.2756	19.5327	19.8333	20.0447	20.1402	20.1547	20.1547	20.1087	19.8366	19.4024	19.0510	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0807	19.2756	19.5327	19.8333	20.0447	20.1402	20.1547	20.1547	20.1087	19.8366	19.4024	19.0510	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9949	0.9865	0.9661	0.9101	0.7844	0.5801	0.3972	0.4417	0.7068	0.9324	0.9881	0.9964	(94)
Useful gains	465.9365	561.1534	623.4362	643.2081	581.7782	419.6770	275.5714	289.6552	437.5669	510.5843	465.4379	435.9514	(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													
	1184.4874	1149.1991	1039.3470	862.0527	656.5412	431.5326	276.8801	291.9156	469.8504	726.7178	972.1286	1178.8199	(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													
	534.6019	395.1667	309.4377	157.5681	55.6237	0.0000	0.0000	0.0000	0.0000	160.8033	364.8173	552.6942	(98)
Space heating												2530.7129	(98)
Space heating per m2											(98) / (4) =	35.1634	(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	732.1832	576.3995	590.8717	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9227	0.9627	0.9506	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	675.6138	554.8713	561.7021	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	930.7300	894.4225	851.3141	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	183.6837	252.6261	215.4714	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												651.7812	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	45.9209	63.1565	53.8678	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												162.9453 (107)
Space cooling per m2												2.2641 (108)
Energy for space heating												35.1634 (99)
Energy for space cooling												2.2641 (108)
Total												37.4275 (109)
Target Fabric Energy Efficiency (TFEE)												43.0 (109)

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

Design SAP
elmhurst energy

Property Reference	3 Broad Street	**Issued on Date**	12/12/2019
Assessment Reference	As Designed	**Prop Type Ref**	
Property	Broad Street, Leek, Staffordshire, ST13 5NS		

SAP Rating	84 B	**DER**	16.59	**TER**	16.99
Environmental	88 B	**% DER<TER**	2.36		
CO_2 Emissions (t/year)	1.12	**DFEE**	35.54	**TFEE**	43.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.43		

Assessor Details	Mr. William Linley, William Linley, Tel: 03300431764, will@acousticsurveys.co.uk	**Assessor ID**	P977-0001
Client			

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	23.9900	(1b)	x 2.4000	(2b) =	57.5760	(1b) - (3b)
First floor	23.9900	(1c)	x 2.6000	(2c) =	62.3740	(1c) - (3c)
Second floor	23.9900	(1d)	x 2.6000	(2d) =	62.3740	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		182.3240	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1645	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.3645	(18)
Number of sides sheltered			3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2825	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.1000	4.2000	4.1000	3.6000	3.7000	3.3000	3.1000	3.1000	3.2000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0250	1.0500	1.0250	0.9000	0.9250	0.8250	0.7750	0.7750	0.8000	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2896	0.2966	0.2896	0.2543	0.2613	0.2331	0.2190	0.2190	0.2260	0.2472	0.2613	0.2755	(22b)
Effective ac	0.5419	0.5440	0.5419	0.5323	0.5341	0.5272	0.5240	0.5240	0.5255	0.5306	0.5341	0.5379	(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	
HGD			1.8900	1.3000	2.4570			(26a)
Windows (Uw = 1.30)			15.9200	1.2357	19.6730			(27)
Heat Loss Floor 1			23.9900	0.1400	3.3586	110.0000	2638.9000	(28a)
Main	55.0200	17.8100	37.2100	0.2400	8.9304	60.0000	2232.6000	(29a)
External Roof 1	23.9900		23.9900	0.1100	2.6389	9.0000	215.9100	(30)
Total net area of external elements Aum(A, m2)			103.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.0579			(33)
Party Wall 1			92.1600	0.0000	0.0000	45.0000	4147.2000	(32)
Internal Wall 1			147.6000			9.0000	1328.4000	(32c)
Internal Floor 1			23.9900			18.0000	431.8200	(32d)
Internal Floor 2			23.9900			18.0000	431.8200	(32d)
Internal Ceiling 1			23.9900			18.0000	431.8200	(32e)
Internal Ceiling 2			23.9900			18.0000	431.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12290.2900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	170.7696	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.0255	(36)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Total fabric heat loss (33) + (36) = 43.0834 (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	32.6062	32.7308	32.6062	32.0284	32.1380	31.7178	31.5257	31.5257	31.6202	31.9219	32.1380	32.3661	(38)
Heat transfer coeff	75.6896	75.8142	75.6896	75.1119	75.2214	74.8012	74.6091	74.6091	74.7037	75.0053	75.2214	75.4495	(39)
Average = Sum(39)m / 12 =												75.1605	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0517	1.0534	1.0517	1.0437	1.0452	1.0393	1.0367	1.0367	1.0380	1.0422	1.0452	1.0483	(40)
HLP (average)												1.0443	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.2930 (42)
Average daily hot water use (litres/day) 88.6584 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.5243	93.9779	90.4316	86.8852	83.3389	79.7926	79.7926	83.3389	86.8852	90.4316	93.9779	97.5243	(44)
Energy conte	144.6257	126.4905	130.5269	113.7965	109.1905	94.2231	87.3115	100.1912	101.3878	118.1578	128.9784	140.0622	(45)
Energy content (annual)										Total = Sum(45)m =		1394.9421	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6938	18.9736	19.5790	17.0695	16.3786	14.1335	13.0967	15.0287	15.2082	17.7237	19.3468	21.0093	(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	49.6973	43.2556	46.0829	42.8475	42.4686	39.3498	40.6614	42.4686	42.8475	46.0829	46.3453	49.6973	(61)
Total heat required for water heating calculated for each month	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(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	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(64)
									Total per year (kWh/year) = Sum(64)m =			1926.7468	(64)
RHI water heating demand												1927	(64)
Heat gains from water heating, kWh/month	60.5124	52.8720	54.9209	48.5492	46.9230	41.1666	39.1964	43.9307	44.4233	50.8082	54.4716	58.9950	(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	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9961	39.9651	32.5018	24.6060	18.3933	15.5284	16.7789	21.8099	29.2732	37.1691	43.3818	46.2467	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	301.2695	304.3957	296.5177	279.7463	258.5755	238.6779	225.3851	222.2589	230.1369	246.9082	268.0791	287.9766	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	(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)	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	(71)
Water heating gains (Table 5)	81.3338	78.6786	73.8184	67.4295	63.0685	57.1758	52.6834	59.0467	61.6991	68.2906	75.6551	79.2944	(72)
Total internal gains	527.5100	522.9500	502.7486	471.6924	439.9479	411.2928	394.7581	403.0261	421.0198	452.2785	487.0265	513.4283	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.0400	10.1716	0.6300	0.7000	0.7700	21.8843	(74)
South	8.8800	44.4251	0.6300	0.7000	0.7700	120.5628	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	142.4471	244.2548	328.8524	424.0092	460.6404	475.2410	456.8752	412.4120	365.9325	277.4928	171.3424	127.3255	(83)
Total gains	669.9570	767.2048	831.6010	895.7016	900.5883	886.5338	851.6333	815.4381	786.9523	729.7713	658.3690	640.7539	(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	45.1048	45.0307	45.1048	45.4518	45.3856	45.6406	45.7581	45.7581	45.7002	45.5164	45.3856	45.2484	
alpha	4.0070	4.0020	4.0070	4.0301	4.0257	4.0427	4.0505	4.0505	4.0467	4.0344	4.0257	4.0166	
util living area	0.9667	0.9451	0.9076	0.8285	0.7233	0.5729	0.4685	0.5030	0.6735	0.8564	0.9458	0.9710	(86)
MIT	19.7925	19.9949	20.2806	20.6080	20.8198	20.9451	20.9797	20.9729	20.8924	20.6020	20.1369	19.7536	(87)
Th 2	20.0405	20.0391	20.0405	20.0471	20.0459	20.0507	20.0529	20.0529	20.0518	20.0483	20.0459	20.0432	(88)
util rest of house													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	0.9603	0.9351	0.8908	0.7986	0.6765	0.5079	0.3930	0.4263	0.6123	0.8253	0.9342	0.9654 (89)
MIT 2	18.9549	19.1501	19.4257	19.7351	19.9186	20.0197	20.0440	20.0404	19.9848	19.7374	19.2973	18.9192 (90)
Living area fraction									fLA = Living area / (4) =			0.1435 (91)
MIT	19.0751	19.2713	19.5484	19.8604	20.0480	20.1525	20.1783	20.1742	20.1150	19.8615	19.4178	19.0389 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.9251	19.1213	19.3984	19.7104	19.8980	20.0025	20.0283	20.0242	19.9650	19.7115	19.2678	18.8889 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9509	0.9234	0.8777	0.7868	0.6686	0.5044	0.3910	0.4239	0.6063	0.8126	0.9225	0.9566	(94)
Useful gains	637.0827	708.4674	729.8714	704.7173	602.1671	447.1787	332.9873	345.6775	477.1505	593.0431	607.3285	612.9743	(95)
Ext temp.	3.5000	4.0000	5.7000	8.2000	11.0000	13.8000	15.5000	15.3000	13.1000	9.7000	6.3000	3.5000	(96)
Heat loss rate W													
	1167.5236	1146.4117	1036.8302	864.5648	669.3165	463.9556	337.8507	352.4716	512.8438	750.9133	975.4585	1161.0889	(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													
	394.6480	294.2986	228.3774	115.0902	49.9592	0.0000	0.0000	0.0000	0.0000	117.4554	265.0536	407.7973	(98)
Space heating												1872.6797	(98)
RHI space heating demand												1873	(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	23.9900 (1b)	x	2.4000 (2b)	=	57.5760	(1b) - (3b)
First floor	23.9900 (1c)	x	2.6000 (2c)	=	62.3740	(1c) - (3c)
Second floor	23.9900 (1d)	x	2.6000 (2d)	=	62.3740	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.3240	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1645	(8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.3645	(18)
Number of sides sheltered				3	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2825	(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	0.3602	0.3532	0.3461	0.3108	0.3037	0.2684	0.2684	0.2613	0.2825	0.3037	0.3178	0.3320	(22b)
Effective ac	0.5649	0.5624	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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	
HGD			1.8900	1.3000	2.4570			(26a)
Windows (Uw = 1.30)			15.9200	1.2357	19.6730			(27)
Heat Loss Floor 1			23.9900	0.1400	3.3586	110.0000	2638.9000	(28a)
Main	55.0200	17.8100	37.2100	0.2400	8.9304	60.0000	2232.6000	(29a)
External Roof 1	23.9900		23.9900	0.1100	2.6389	9.0000	215.9100	(30)
Total net area of external elements Aum(A, m2)			103.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.0579			(33)
Party Wall 1			92.1600	0.0000	0.0000	45.0000	4147.2000	(32)
Internal Wall 1			147.6000			9.0000	1328.4000	(32c)
Internal Floor 1			23.9900			18.0000	431.8200	(32d)
Internal Floor 2			23.9900			18.0000	431.8200	(32d)
Internal Ceiling 1			23.9900			18.0000	431.8200	(32e)
Internal Ceiling 2			23.9900			18.0000	431.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12290.2900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		170.7696	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.0255	(36)
Total fabric heat loss	(33) + (36) =	43.0834	(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	33.9869	33.8353	33.6867	32.9889	32.8583	32.2505	32.2505	32.1380	32.4847	32.8583	33.1225	33.3986	(38)
Heat transfer coeff	77.0703	76.9188	76.7702	76.0723	75.9418	75.3340	75.3340	75.2214	75.5681	75.9418	76.2059	76.4820	(39)
Average = Sum(39)m / 12 =												76.0717	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0709	1.0688	1.0667	1.0570	1.0552	1.0467	1.0467	1.0452	1.0500	1.0552	1.0589	1.0627	(40)
HLP (average)												1.0570	(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		2.2930 (42)
Average daily hot water use (litres/day)		88.6584 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.5243	93.9779	90.4316	86.8852	83.3389	79.7926	79.7926	83.3389	86.8852	90.4316	93.9779	97.5243	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	144.6257	126.4905	130.5269	113.7965	109.1905	94.2231	87.3115	100.1912	101.3878	118.1578	128.9784	140.0622	(45)
Energy content (annual)										Total = Sum(45)m =		1394.9421	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.6938	18.9736	19.5790	17.0695	16.3786	14.1335	13.0967	15.0287	15.2082	17.7237	19.3468	21.0093	(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	49.6973	43.2556	46.0829	42.8475	42.4686	39.3498	40.6614	42.4686	42.8475	46.0829	46.3453	49.6973	(61)
Total heat required for water heating calculated for each month													
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(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													
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(64)
									Total per year (kWh/year) = Sum(64)m =			1926.7468	(64)
Heat gains from water heating, kWh/month													
	60.5124	52.8720	54.9209	48.5492	46.9230	41.1666	39.1964	43.9307	44.4233	50.8082	54.4716	58.9950	(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	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	44.9961	39.9651	32.5018	24.6060	18.3933	15.5284	16.7789	21.8099	29.2732	37.1691	43.3818	46.2467	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	301.2695	304.3957	296.5177	279.7463	258.5755	238.6779	225.3851	222.2589	230.1369	246.9082	268.0791	287.9766	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	(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)													
	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	(71)
Water heating gains (Table 5)													
	81.3338	78.6786	73.8184	67.4295	63.0685	57.1758	52.6834	59.0467	61.6991	68.2906	75.6551	79.2944	(72)
Total internal gains													
	527.5100	522.9500	502.7486	471.6924	439.9479	411.2928	394.7581	403.0261	421.0198	452.2785	487.0265	513.4283	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.0400	10.6334	0.6300	0.7000	0.7700	22.8779	(74)
South	8.8800	46.7521	0.6300	0.7000	0.7700	126.8778	(78)

Solar gains	149.7557	251.5140	338.9840	418.4916	472.4941	472.0992	453.7952	412.1368	365.8252	276.1683	178.6163	128.7062	(83)
Total gains	677.2657	774.4640	841.7326	890.1840	912.4420	883.3919	848.5533	815.1629	786.8450	728.4468	665.6428	642.1345	(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	44.2968	44.3841	44.4700	44.8779	44.9551	45.3178	45.3178	45.3856	45.1774	44.9551	44.7993	44.6375	
alpha	3.9531	3.9589	3.9647	3.9919	3.9970	4.0212	4.0212	4.0257	4.0118	3.9970	3.9866	3.9758	
util living area													
	0.9609	0.9353	0.8927	0.8128	0.6870	0.5230	0.3851	0.4166	0.6135	0.8308	0.9353	0.9672	(86)
MIT	19.8704	20.0869	20.3571	20.6492	20.8585	20.9640	20.9917	20.9885	20.9310	20.6711	20.2225	19.8192	(87)
Th 2	20.0247	20.0264	20.0281	20.0361	20.0376	20.0446	20.0446	20.0459	20.0419	20.0376	20.0346	20.0314	(88)
util rest of house													
	0.9532	0.9230	0.8728	0.7794	0.6352	0.4527	0.3040	0.3336	0.5432	0.7933	0.9210	0.9606	(89)
MIT 2	19.0192	19.2295	19.4881	19.7629	19.9420	20.0262	20.0418	20.0418	20.0033	19.7902	19.3710	18.9748	(90)
Living area fraction									fLA = Living area / (4) =			0.1435	(91)
MIT	19.1414	19.3526	19.6128	19.8901	20.0736	20.1608	20.1782	20.1777	20.1365	19.9166	19.4932	19.0960	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9914	19.2026	19.4628	19.7401	19.9236	20.0108	20.0282	20.0277	19.9865	19.7666	19.3432	18.9460	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9428	0.9106	0.8594	0.7680	0.6286	0.4501	0.3026	0.3320	0.5389	0.7813	0.9084	0.9512	(94)
Useful gains	638.5402	705.1898	723.3716	683.6509	573.5522	397.6238	256.7493	270.6536	424.0184	569.1601	604.6823	610.7734	(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													
	1132.2712	1100.1366	995.1565	824.6343	624.5122	407.6196	258.2562	272.8791	444.8293	696.1309	933.0057	1127.8015	(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													
	367.3358	265.4042	202.2079	101.5081	37.9143	0.0000	0.0000	0.0000	0.0000	94.4663	236.3929	384.6689	(98)
Space heating												1689.8984	(98)
Space heating per m2											(98) / (4) =	23.4806	(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 %)												89.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1888.1546	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	367.3358	265.4042	202.2079	101.5081	37.9143	0.0000	0.0000	0.0000	0.0000	94.4663	236.3929	384.6689	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	410.4311	296.5410	225.9307	113.4169	42.3623	0.0000	0.0000	0.0000	0.0000	105.5489	264.1261	429.7976	(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	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month	217.1206	189.6605	197.3294	175.0213	169.4515	149.2434	142.9865	159.3965	161.1568	183.5092	195.8924	212.0218	(219)
Water heating fuel used												2152.7898	(219)
Annual totals kWh/year													
Space heating fuel - main system												1888.1546	(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)												317.8580	(232)
Total delivered energy for all uses												4433.8024	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1888.1546	3.4800	65.7078	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2152.7898	3.4800	74.9171	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	317.8580	13.1900	41.9255	(250)
Additional standing charges			120.0000	(251)
Total energy cost			312.4428	(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] =	1.1219	(257)
SAP value		84.3498	
SAP rating (Section 12)		84	(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	1888.1546	0.2160	407.8414	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2152.7898	0.2160	465.0026	(264)
Space and water heating			872.8440	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	317.8580	0.5190	164.9683	(268)
Total kg/year			1076.7373	(272)
CO2 emissions per m2			14.9600	(273)
EI value			87.6650	
EI rating			88	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.8950 = 3.888, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.8950 = 0.2413, stars = 4
Water heating energy efficiency	3.48 / 0.8950 = 3.888, stars = 4
Water heating environmental impact	0.216 / 0.8950 = 0.2413, 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	23.9900 (1b)	x	2.4000 (2b)	=	57.5760	(1b) - (3b)
First floor	23.9900 (1c)	x	2.6000 (2c)	=	62.3740	(1c) - (3c)
Second floor	23.9900 (1d)	x	2.6000 (2d)	=	62.3740	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.3240	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1645	(8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.3645	(18)
Number of sides sheltered				3	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2825	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.1000	4.2000	4.1000	3.6000	3.7000	3.3000	3.1000	3.1000	3.2000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0250	1.0500	1.0250	0.9000	0.9250	0.8250	0.7750	0.7750	0.8000	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2896	0.2966	0.2896	0.2543	0.2613	0.2331	0.2190	0.2190	0.2260	0.2472	0.2613	0.2755	(22b)
Effective ac	0.5419	0.5440	0.5419	0.5323	0.5341	0.5272	0.5240	0.5240	0.5255	0.5306	0.5341	0.5379	(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	
HGD			1.8900	1.3000	2.4570			(26a)
Windows (Uw = 1.30)			15.9200	1.2357	19.6730			(27)
Heat Loss Floor 1			23.9900	0.1400	3.3586	110.0000	2638.9000	(28a)
Main	55.0200	17.8100	37.2100	0.2400	8.9304	60.0000	2232.6000	(29a)
External Roof 1	23.9900		23.9900	0.1100	2.6389	9.0000	215.9100	(30)
Total net area of external elements Aum(A, m2)			103.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.0579			(33)
Party Wall 1			92.1600	0.0000	0.0000	45.0000	4147.2000	(32)
Internal Wall 1			147.6000			9.0000	1328.4000	(32c)
Internal Floor 1			23.9900			18.0000	431.8200	(32d)
Internal Floor 2			23.9900			18.0000	431.8200	(32d)
Internal Ceiling 1			23.9900			18.0000	431.8200	(32e)
Internal Ceiling 2			23.9900			18.0000	431.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12290.2900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		170.7696	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.0255	(36)
Total fabric heat loss	(33) + (36) =	43.0834	(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	32.6062	32.7308	32.6062	32.0284	32.1380	31.7178	31.5257	31.5257	31.6202	31.9219	32.1380	32.3661	(38)
Heat transfer coeff	75.6896	75.8142	75.6896	75.1119	75.2214	74.8012	74.6091	74.6091	74.7037	75.0053	75.2214	75.4495	(39)
Average = Sum(39)m / 12 =												75.1605	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0517	1.0534	1.0517	1.0437	1.0452	1.0393	1.0367	1.0367	1.0380	1.0422	1.0452	1.0483	(40)
HLP (average)												1.0443	(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		2.2930 (42)
Average daily hot water use (litres/day)		88.6584 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.5243	93.9779	90.4316	86.8852	83.3389	79.7926	79.7926	83.3389	86.8852	90.4316	93.9779	97.5243	(44)

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

Energy conte	144.6257	126.4905	130.5269	113.7965	109.1905	94.2231	87.3115	100.1912	101.3878	118.1578	128.9784	140.0622	(45)
Energy content (annual)										Total = Sum(45)m =		1394.9421	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.6938	18.9736	19.5790	17.0695	16.3786	14.1335	13.0967	15.0287	15.2082	17.7237	19.3468	21.0093	(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	49.6973	43.2556	46.0829	42.8475	42.4686	39.3498	40.6614	42.4686	42.8475	46.0829	46.3453	49.6973	(61)
Total heat required for water heating calculated for each month													
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(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													
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(64)
									Total per year (kWh/year) = Sum(64)m =			1926.7468	(64)
Heat gains from water heating, kWh/month													
	60.5124	52.8720	54.9209	48.5492	46.9230	41.1666	39.1964	43.9307	44.4233	50.8082	54.4716	58.9950	(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	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	44.9961	39.9651	32.5018	24.6060	18.3933	15.5284	16.7789	21.8099	29.2732	37.1691	43.3818	46.2467	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	301.2695	304.3957	296.5177	279.7463	258.5755	238.6779	225.3851	222.2589	230.1369	246.9082	268.0791	287.9766	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	(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)													
	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	(71)
Water heating gains (Table 5)													
	81.3338	78.6786	73.8184	67.4295	63.0685	57.1758	52.6834	59.0467	61.6991	68.2906	75.6551	79.2944	(72)
Total internal gains													
	527.5100	522.9500	502.7486	471.6924	439.9479	411.2928	394.7581	403.0261	421.0198	452.2785	487.0265	513.4283	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.0400	10.1716	0.6300	0.7000	0.7700	21.8843	(74)
South	8.8800	44.4251	0.6300	0.7000	0.7700	120.5628	(78)

Solar gains	142.4471	244.2548	328.8524	424.0092	460.6404	475.2410	456.8752	412.4120	365.9325	277.4928	171.3424	127.3255	(83)
Total gains	669.9570	767.2048	831.6010	895.7016	900.5883	886.5338	851.6333	815.4381	786.9523	729.7713	658.3690	640.7539	(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	45.1048	45.0307	45.1048	45.4518	45.3856	45.6406	45.7581	45.7581	45.7002	45.5164	45.3856	45.2484	
alpha	4.0070	4.0020	4.0070	4.0301	4.0257	4.0427	4.0505	4.0505	4.0467	4.0344	4.0257	4.0166	
util living area													
	0.9667	0.9451	0.9076	0.8285	0.7233	0.5729	0.4685	0.5030	0.6735	0.8564	0.9458	0.9710	(86)
MIT	19.7925	19.9949	20.2806	20.6080	20.8198	20.9451	20.9797	20.9729	20.8924	20.6020	20.1369	19.7536	(87)
Th 2	20.0405	20.0391	20.0405	20.0471	20.0459	20.0507	20.0529	20.0529	20.0518	20.0483	20.0459	20.0432	(88)
util rest of house													
	0.9603	0.9351	0.8908	0.7986	0.6765	0.5079	0.3930	0.4263	0.6123	0.8253	0.9342	0.9654	(89)
MIT 2	18.9549	19.1501	19.4257	19.7351	19.9186	20.0197	20.0440	20.0404	19.9848	19.7374	19.2973	18.9192	(90)
Living area fraction									fLA = Living area / (4) =			0.1435	(91)
MIT	19.0751	19.2713	19.5484	19.8604	20.0480	20.1525	20.1783	20.1742	20.1150	19.8615	19.4178	19.0389	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9251	19.1213	19.3984	19.7104	19.8980	20.0025	20.0283	20.0242	19.9650	19.7115	19.2678	18.8889	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9509	0.9234	0.8777	0.7868	0.6686	0.5044	0.3910	0.4239	0.6063	0.8126	0.9225	0.9566	(94)
Useful gains	637.0827	708.4674	729.8714	704.7173	602.1671	447.1787	332.9873	345.6775	477.1505	593.0431	607.3285	612.9743	(95)
Ext temp.	3.5000	4.0000	5.7000	8.2000	11.0000	13.8000	15.5000	15.3000	13.1000	9.7000	6.3000	3.5000	(96)
Heat loss rate W													
	1167.5236	1146.4117	1036.8302	864.5648	669.3165	463.9556	337.8507	352.4716	512.8438	750.9133	975.4585	1161.0889	(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													
	394.6480	294.2986	228.3774	115.0902	49.9592	0.0000	0.0000	0.0000	0.0000	117.4554	265.0536	407.7973	(98)
Space heating												1872.6797	(98)
Space heating per m2											(98) / (4) =	26.0203	(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 %)												89.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2092.3796	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	394.6480	294.2986	228.3774	115.0902	49.9592	0.0000	0.0000	0.0000	0.0000	117.4554	265.0536	407.7973	(98)
Space heating efficiency (main heating system 1)													
	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)													
	440.9475	328.8253	255.1702	128.5924	55.8203	0.0000	0.0000	0.0000	0.0000	131.2351	296.1493	455.6394	(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													
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month													
	217.1206	189.6605	197.3294	175.0213	169.4515	149.2434	142.9865	159.3965	161.1568	183.5092	195.8924	212.0218	(219)
Water heating fuel used												2152.7898	(219)
Annual totals kWh/year													
Space heating fuel - main system												2092.3796	(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)												317.8580	(232)
Total delivered energy for all uses												4638.0273	(238)

10a. Fuel costs - using BEDF prices (453)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2092.3796	3.9300	82.2305	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2152.7898	3.9300	84.6046	(247)
Pumps and fans for heating	75.0000	17.5600	13.1700	(249)
Energy for lighting	317.8580	17.5600	55.8159	(250)
Additional standing charges			88.0000	(251)
Total energy cost			323.8210	(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	2092.3796	0.2160	451.9540	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2152.7898	0.2160	465.0026	(264)
Space and water heating			916.9566	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	317.8580	0.5190	164.9683	(268)
Total kg/year			1120.8499	(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	2092.3796	1.2200	2552.7031	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2152.7898	1.2200	2626.4035	(264)
Space and water heating			5179.1066	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	317.8580	3.0700	975.8240	(268)
Primary energy kWh/year			6385.1806	(272)
Primary energy kWh/m2/year			88.7200	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 88

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

(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	+ 1.3	-£ 27	-173 kg (15.5%)
U Solar photovoltaic panels	+ 11.4	-£ 302	-893 kg (94.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£27	2.41 kg/m²	B 86	B 90
Solar photovoltaic panels	£302	12.41 kg/m²	A 97	A 100
Total Savings	£330	14.82 kg/m²		

Potential energy efficiency rating: A 97
Potential environmental impact rating: A 100

Fuel prices for cost data on this page from database revision number 453 TEST (27 Nov 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£69	£78	-£9
Mains gas	£255	£219	£36
Space heating	£183	£183	£0
Water heating	£85	£57	£27
Lighting	£56	£56	£0
Generated (PV)	-£0	-£302	£302
Total cost of fuels	£324	-£5	£329
Total cost of uses	£324	-£6	£329
Delivered energy	64 kWh/m²	28 kWh/m²	36 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.1 tonnes	1.1 tonnes
CO2 emissions per m²	16 kg/m²	1 kg/m²	15 kg/m²
Primary energy	89 kWh/m²	2 kWh/m²	87 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	23.9900 (1b)	x	2.4000 (2b)	=	57.5760	(1b) - (3b)
First floor	23.9900 (1c)	x	2.6000 (2c)	=	62.3740	(1c) - (3c)
Second floor	23.9900 (1d)	x	2.6000 (2d)	=	62.3740	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.3240	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1645	(8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.3645	(18)
Number of sides sheltered				3	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2825	(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	0.3602	0.3532	0.3461	0.3108	0.3037	0.2684	0.2684	0.2613	0.2825	0.3037	0.3178	0.3320	(22b)
Effective ac	0.5649	0.5624	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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	
HGD			1.8900	1.3000	2.4570			(26a)
Windows (Uw = 1.30)			15.9200	1.2357	19.6730			(27)
Heat Loss Floor 1			23.9900	0.1400	3.3586	110.0000	2638.9000	(28a)
Main	55.0200	17.8100	37.2100	0.2400	8.9304	60.0000	2232.6000	(29a)
External Roof 1	23.9900		23.9900	0.1100	2.6389	9.0000	215.9100	(30)
Total net area of external elements Aum(A, m2)			103.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.0579			(33)
Party Wall 1			92.1600	0.0000	0.0000	45.0000	4147.2000	(32)
Internal Wall 1			147.6000			9.0000	1328.4000	(32c)
Internal Floor 1			23.9900			18.0000	431.8200	(32d)
Internal Floor 2			23.9900			18.0000	431.8200	(32d)
Internal Ceiling 1			23.9900			18.0000	431.8200	(32e)
Internal Ceiling 2			23.9900			18.0000	431.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12290.2900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		170.7696	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.0255	(36)
Total fabric heat loss	(33) + (36) =	43.0834	(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	33.9869	33.8353	33.6867	32.9889	32.8583	32.2505	32.2505	32.1380	32.4847	32.8583	33.1225	33.3986	(38)
Heat transfer coeff	77.0703	76.9188	76.7702	76.0723	75.9418	75.3340	75.3340	75.2214	75.5681	75.9418	76.2059	76.4820	(39)
Average = Sum(39)m / 12 =												76.0717	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0709	1.0688	1.0667	1.0570	1.0552	1.0467	1.0467	1.0452	1.0500	1.0552	1.0589	1.0627	(40)
HLP (average)												1.0570	(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		2.2930 (42)
Average daily hot water use (litres/day)		88.6584 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.5243	93.9779	90.4316	86.8852	83.3389	79.7926	79.7926	83.3389	86.8852	90.4316	93.9779	97.5243	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	144.6257	126.4905	130.5269	113.7965	109.1905	94.2231	87.3115	100.1912	101.3878	118.1578	128.9784	140.0622	(45)
Energy content (annual)										Total = Sum(45)m =		1394.9421	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.6938	18.9736	19.5790	17.0695	16.3786	14.1335	13.0967	15.0287	15.2082	17.7237	19.3468	21.0093	(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	49.6973	43.2556	46.0829	42.8475	42.4686	39.3498	40.6614	42.4686	42.8475	46.0829	46.3453	49.6973	(61)
Total heat required for water heating calculated for each month													
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(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												1.3001	(H8)
Utilisation factor												0.5366	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												88.6584	(H14)
Volume ratio Veff/V												0.8459	(H15)
Solar storage volume factor												0.9665	(H16)
Solar input												-827.0706	(H17)
Solar input	-23.9834	-40.0214	-68.1610	-91.3492	-112.8542	-110.9537	-109.4874	-95.6597	-74.9207	-51.1620	-28.4478	-20.0700	(63)
								Solar input (sum of months) = Sum(63)m =				-827.0706	(63)
Output from w/h													
	170.3395	129.7247	108.4488	65.2948	38.8048	22.6191	18.4855	47.0001	69.3146	113.0787	146.8759	169.6895	(64)
									Total per year (kWh/year) = Sum(64)m =			1099.6762	(64)
Heat gains from water heating, kWh/month													
	60.5124	52.8720	54.9209	48.5492	46.9230	41.1666	39.1964	43.9307	44.4233	50.8082	54.4716	58.9950	(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	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	44.9961	39.9651	32.5018	24.6060	18.3933	15.5284	16.7789	21.8099	29.2732	37.1691	43.3818	46.2467	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	301.2695	304.3957	296.5177	279.7463	258.5755	238.6779	225.3851	222.2589	230.1369	246.9082	268.0791	287.9766	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	(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)													
	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	(71)
Water heating gains (Table 5)													
	81.3338	78.6786	73.8184	67.4295	63.0685	57.1758	52.6834	59.0467	61.6991	68.2906	75.6551	79.2944	(72)
Total internal gains													
	527.5100	522.9500	502.7486	471.6924	439.9479	411.2928	394.7581	403.0261	421.0198	452.2785	487.0265	513.4283	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.0400	10.6334	0.6300	0.7000	0.7700	22.8779	(74)
South	8.8800	46.7521	0.6300	0.7000	0.7700	126.8778	(78)

Solar gains	149.7557	251.5140	338.9840	418.4916	472.4941	472.0992	453.7952	412.1368	365.8252	276.1683	178.6163	128.7062	(83)
Total gains	677.2657	774.4640	841.7326	890.1840	912.4420	883.3919	848.5533	815.1629	786.8450	728.4468	665.6428	642.1345	(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	44.2968	44.3841	44.4700	44.8779	44.9551	45.3178	45.3178	45.3856	45.1774	44.9551	44.7993	44.6375	
alpha	3.9531	3.9589	3.9647	3.9919	3.9970	4.0212	4.0212	4.0257	4.0118	3.9970	3.9866	3.9758	
util living area													
	0.9609	0.9353	0.8927	0.8128	0.6870	0.5230	0.3851	0.4166	0.6135	0.8308	0.9353	0.9672	(86)
MIT	19.8704	20.0869	20.3571	20.6492	20.8585	20.9640	20.9917	20.9885	20.9310	20.6711	20.2225	19.8192	(87)
Th 2	20.0247	20.0264	20.0281	20.0361	20.0376	20.0446	20.0446	20.0459	20.0419	20.0376	20.0346	20.0314	(88)
util rest of house													
	0.9532	0.9230	0.8728	0.7794	0.6352	0.4527	0.3040	0.3336	0.5432	0.7933	0.9210	0.9606	(89)
MIT 2	19.0192	19.2295	19.4881	19.7629	19.9420	20.0262	20.0418	20.0418	20.0033	19.7902	19.3710	18.9748	(90)
Living area fraction									fLA = Living area / (4) =			0.1435	(91)
MIT	19.1414	19.3526	19.6128	19.8901	20.0736	20.1608	20.1782	20.1777	20.1365	19.9166	19.4932	19.0960	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9914	19.2026	19.4628	19.7401	19.9236	20.0108	20.0282	20.0277	19.9865	19.7666	19.3432	18.9460	(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	0.9428	0.9106	0.8594	0.7680	0.6286	0.4501	0.3026	0.3320	0.5389	0.7813	0.9084	0.9512	(94)
Useful gains	638.5402	705.1898	723.3716	683.6509	573.5522	397.6238	256.7493	270.6536	424.0184	569.1601	604.6823	610.7734	(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	1132.2712	1100.1366	995.1565	824.6343	624.5122	407.6196	258.2562	272.8791	444.8293	696.1309	933.0057	1127.8015	(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	367.3358	265.4042	202.2079	101.5081	37.9143	0.0000	0.0000	0.0000	0.0000	94.4663	236.3929	384.6689	(98)

Space heating 1689.8984 (98)
Space heating per m2 (98) / (4) = 23.4806 (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 %) 89.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 1888.1546 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	367.3358	265.4042	202.2079	101.5081	37.9143	0.0000	0.0000	0.0000	0.0000	94.4663	236.3929	384.6689	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	410.4311	296.5410	225.9307	113.4169	42.3623	0.0000	0.0000	0.0000	0.0000	105.5489	264.1261	429.7976	(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

	170.3395	129.7247	108.4488	65.2948	38.8048	22.6191	18.4855	47.0001	69.3146	113.0787	146.8759	169.6895	(64)

Efficiency of water heater 89.5000 (216)

(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)

Fuel for water heating, kWh/month

	190.3235	144.9438	121.1718	72.9551	43.3573	25.2728	20.6542	52.5141	77.4465	126.3449	164.1072	189.5972	(219)

Water heating fuel used 1228.6885 (219)
Annual totals kWh/year
Space heating fuel - main system 1888.1546 (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) 317.8580 (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 1832.4617 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1888.1546	3.4800	65.7078	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1228.6885	3.4800	42.7584	(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	317.8580	13.1900	41.9255	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			59.0562	(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] = 0.2121 (257)
SAP value 97.0419
SAP rating (Section 12) 97 (258)
SAP band A

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1888.1546	0.2160	407.8414	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1228.6885	0.2160	265.3967	(264)
Space and water heating			673.2381	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	317.8580	0.5190	164.9683	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			6.6442	(272)
CO2 emissions per m2			0.0900	(273)
EI value			99.9239	
EI rating			100	(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	23.9900 (1b)	x	2.4000 (2b)	=	57.5760	(1b) - (3b)
First floor	23.9900 (1c)	x	2.6000 (2c)	=	62.3740	(1c) - (3c)
Second floor	23.9900 (1d)	x	2.6000 (2d)	=	62.3740	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.3240	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1645	(8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.3645	(18)
Number of sides sheltered				3	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2825	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.1000	4.2000	4.1000	3.6000	3.7000	3.3000	3.1000	3.1000	3.2000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0250	1.0500	1.0250	0.9000	0.9250	0.8250	0.7750	0.7750	0.8000	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2896	0.2966	0.2896	0.2543	0.2613	0.2331	0.2190	0.2190	0.2260	0.2472	0.2613	0.2755	(22b)
Effective ac	0.5419	0.5440	0.5419	0.5323	0.5341	0.5272	0.5240	0.5240	0.5255	0.5306	0.5341	0.5379	(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	
HGD			1.8900	1.3000	2.4570			(26a)
Windows (Uw = 1.30)			15.9200	1.2357	19.6730			(27)
Heat Loss Floor 1			23.9900	0.1400	3.3586	110.0000	2638.9000	(28a)
Main	55.0200	17.8100	37.2100	0.2400	8.9304	60.0000	2232.6000	(29a)
External Roof 1	23.9900		23.9900	0.1100	2.6389	9.0000	215.9100	(30)
Total net area of external elements Aum(A, m2)			103.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.0579			(33)
Party Wall 1			92.1600	0.0000	0.0000	45.0000	4147.2000	(32)
Internal Wall 1			147.6000			9.0000	1328.4000	(32c)
Internal Floor 1			23.9900			18.0000	431.8200	(32d)
Internal Floor 2			23.9900			18.0000	431.8200	(32d)
Internal Ceiling 1			23.9900			18.0000	431.8200	(32e)
Internal Ceiling 2			23.9900			18.0000	431.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12290.2900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		170.7696	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.0255	(36)
Total fabric heat loss	(33) + (36) =	43.0834	(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	32.6062	32.7308	32.6062	32.0284	32.1380	31.7178	31.5257	31.5257	31.6202	31.9219	32.1380	32.3661	(38)
Heat transfer coeff	75.6896	75.8142	75.6896	75.1119	75.2214	74.8012	74.6091	74.6091	74.7037	75.0053	75.2214	75.4495	(39)
Average = Sum(39)m / 12 =												75.1605	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0517	1.0534	1.0517	1.0437	1.0452	1.0393	1.0367	1.0367	1.0380	1.0422	1.0452	1.0483	(40)
HLP (average)												1.0443	(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	2.2930 (42)
Average daily hot water use (litres/day)	88.6584 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.5243	93.9779	90.4316	86.8852	83.3389	79.7926	79.7926	83.3389	86.8852	90.4316	93.9779	97.5243	(44)

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

Energy conte	144.6257	126.4905	130.5269	113.7965	109.1905	94.2231	87.3115	100.1912	101.3878	118.1578	128.9784	140.0622	(45)
Energy content (annual)										Total = Sum(45)m =		1394.9421	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.6938	18.9736	19.5790	17.0695	16.3786	14.1335	13.0967	15.0287	15.2082	17.7237	19.3468	21.0093	(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	49.6973	43.2556	46.0829	42.8475	42.4686	39.3498	40.6614	42.4686	42.8475	46.0829	46.3453	49.6973	(61)
Total heat required for water heating calculated for each month													
	194.3229	169.7461	176.6098	156.6440	151.6591	133.5728	127.9729	142.6598	144.2354	164.2407	175.3237	189.7595	(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												1075.4508	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1806.7574	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2952	(H8)
Utilisation factor												0.5379	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												88.6584	(H14)
Volume ratio Veff/V												0.8459	(H15)
Solar storage volume factor												0.9665	(H16)
Solar input												-826.0197	(H17)
Solar input	-22.9780	-39.1558	-66.5916	-93.0833	-110.5012	-112.1100	-110.6713	-96.2146	-75.4397	-51.7886	-27.4893	-19.9962	(63)
								Solar input (sum of months) = Sum(63)m =				-826.0197	(63)
Output from w/h													
	171.3449	130.5903	110.0182	63.5607	41.1578	21.4629	17.3016	46.4452	68.7957	112.4521	147.8344	169.7634	(64)
									Total per year (kWh/year) = Sum(64)m =			1100.7272	(64)
Heat gains from water heating, kWh/month													
	60.5124	52.8720	54.9209	48.5492	46.9230	41.1666	39.1964	43.9307	44.4233	50.8082	54.4716	58.9950	(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	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	137.5792	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	44.9961	39.9651	32.5018	24.6060	18.3933	15.5284	16.7789	21.8099	29.2732	37.1691	43.3818	46.2467	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	301.2695	304.3957	296.5177	279.7463	258.5755	238.6779	225.3851	222.2589	230.1369	246.9082	268.0791	287.9766	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	51.0509	(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)													
	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	-91.7194	(71)
Water heating gains (Table 5)													
	81.3338	78.6786	73.8184	67.4295	63.0685	57.1758	52.6834	59.0467	61.6991	68.2906	75.6551	79.2944	(72)
Total internal gains													
	527.5100	522.9500	502.7486	471.6924	439.9479	411.2928	394.7581	403.0261	421.0198	452.2785	487.0265	513.4283	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.0400	10.1716	0.6300	0.7000	0.7700	21.8843	(74)
South	8.8800	44.4251	0.6300	0.7000	0.7700	120.5628	(78)

Solar gains	142.4471	244.2548	328.8524	424.0092	460.6404	475.2410	456.8752	412.4120	365.9325	277.4928	171.3424	127.3255	(83)
Total gains	669.9570	767.2048	831.6010	895.7016	900.5883	886.5338	851.6333	815.4381	786.9523	729.7713	658.3690	640.7539	(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	45.1048	45.0307	45.1048	45.4518	45.3856	45.6406	45.7581	45.7581	45.7002	45.5164	45.3856	45.2484	
alpha	4.0070	4.0020	4.0070	4.0301	4.0257	4.0427	4.0505	4.0505	4.0467	4.0344	4.0257	4.0166	
util living area													
	0.9667	0.9451	0.9076	0.8285	0.7233	0.5729	0.4685	0.5030	0.6735	0.8564	0.9458	0.9710	(86)
MIT	19.7925	19.9949	20.2806	20.6080	20.8198	20.9451	20.9797	20.9729	20.8924	20.6020	20.1369	19.7536	(87)
Th 2	20.0405	20.0391	20.0405	20.0471	20.0459	20.0507	20.0529	20.0529	20.0518	20.0483	20.0459	20.0432	(88)
util rest of house													
	0.9603	0.9351	0.8908	0.7986	0.6765	0.5079	0.3930	0.4263	0.6123	0.8253	0.9342	0.9654	(89)
MIT 2	18.9549	19.1501	19.4257	19.7351	19.9186	20.0197	20.0440	20.0404	19.9848	19.7374	19.2973	18.9192	(90)
Living area fraction									fLA = Living area / (4) =			0.1435	(91)
MIT	19.0751	19.2713	19.5484	19.8604	20.0480	20.1525	20.1783	20.1742	20.1150	19.8615	19.4178	19.0389	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9251	19.1213	19.3984	19.7104	19.8980	20.0025	20.0283	20.0242	19.9650	19.7115	19.2678	18.8889	(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	0.9509	0.9234	0.8777	0.7868	0.6686	0.5044	0.3910	0.4239	0.6063	0.8126	0.9225	0.9566	(94)
Useful gains	637.0827	708.4674	729.8714	704.7173	602.1671	447.1787	332.9873	345.6775	477.1505	593.0431	607.3285	612.9743	(95)
Ext temp.	3.5000	4.0000	5.7000	8.2000	11.0000	13.8000	15.5000	15.3000	13.1000	9.7000	6.3000	3.5000	(96)
Heat loss rate W	1167.5236	1146.4117	1036.8302	864.5648	669.3165	463.9556	337.8507	352.4716	512.8438	750.9133	975.4585	1161.0889	(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	394.6480	294.2986	228.3774	115.0902	49.9592	0.0000	0.0000	0.0000	0.0000	117.4554	265.0536	407.7973	(98)
Space heating												1872.6797	(98)
Space heating per m2											(98) / (4) =	26.0203	(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 %)	89.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2092.3796	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	394.6480	294.2986	228.3774	115.0902	49.9592	0.0000	0.0000	0.0000	0.0000	117.4554	265.0536	407.7973	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	440.9475	328.8253	255.1702	128.5924	55.8203	0.0000	0.0000	0.0000	0.0000	131.2351	296.1493	455.6394	(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	171.3449	130.5903	110.0182	63.5607	41.1578	21.4629	17.3016	46.4452	68.7957	112.4521	147.8344	169.7634	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month	191.4469	145.9109	122.9254	71.0175	45.9864	23.9808	19.3314	51.8941	76.8667	125.6448	165.1781	189.6797	(219)
Water heating fuel used												1229.8627	(219)
Annual totals kWh/year													
Space heating fuel - main system												2092.3796	(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)												317.8580	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1075 * 0.80) =											-1720.7214	-1720.7214	(233)
Total delivered energy for all uses												2044.3789	(238)

10a. Fuel costs - using BEDF prices (453)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2092.3796	3.9300	82.2305	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1229.8627	3.9300	48.3336	(247)
Pumps and fans for heating	75.0000	17.5600	13.1700	(249)
Pump for solar water heating	50.0000	17.5600	8.7800	(249)
Energy for lighting	317.8580	17.5600	55.8159	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-1720.7214	17.5600	-302.1587	(252)
Total energy cost			-5.8287	(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	2092.3796	0.2160	451.9540	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1229.8627	0.2160	265.6504	(264)
Space and water heating			717.6043	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	317.8580	0.5190	164.9683	(268)
Energy saving/generation technologies				
PV Unit	-1720.7214	0.5190	-893.0544	(269)

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

Total kg/year 54.3933 (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	2092.3796	1.2200	2552.7031	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1229.8627	1.2200	1500.4325	(264)
Space and water heating			4053.1356	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	317.8580	3.0700	975.8240	(268)
Energy saving/generation technologies				
PV Unit	-1720.7214	3.0700	-5282.6146	(269)
Primary energy kWh/year			130.0951	(272)
Primary energy kWh/m2/year			1.8076	(273)

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	3 Broad Street	**Issued on Date**	12/12/2019
Assessment Reference	As Designed	**Prop Type Ref**	
Project	Broad Street, Leek, Staffordshire, ST13 5NS		
Calculation Type	New Build (As Designed)		

SAP Rating	84 B	**DER**	16.59	**TER**	16.99
Environmental	88 B	**% DER<TER**	2.36		
CO_2 Emissions (t/year)	1.12	**DFEE**	35.54	**TFEE**	43.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.43		

Assessor Details	Mr. William Linley, William Linley, Tel: 03300431764, will@acousticsurveys.co.uk	**Assessor ID**	P977-0001
Client			

Building Elements

Roof 000002

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	250	0.0400	6.2500	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 2	**Mineral wool**				
	Main construction	150	0.0400	3.7500	87.50
	Main construction	150	0.1300	1.1538	12.50
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Gyproc Wallboard (12.5mm)**				
	Main construction	12.5	0.1900	0.0658	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Int surface				0.1000	

Total resistance: **Upper limit =** 9.788 m² K/W **Lower limit =** 9.383 m² K/W **Average =** 9.585 m² K/W

Total correction = 0.0052 m² K/W **U-value (unrounded) =** 0.11 W/m² K

Unheated space: None

Total thickness: 413 mm **U-value: 0.11 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	3 Broad Street	**Issued on Date**	12/12/2019
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Calculation Type	New Build (As Designed)		

SAP Rating	84 B	**DER**	16.59	**TER**	16.99
Environmental	88 B	**% DER<TER**	2.36		
CO_2 Emissions (t/year)	1.12	**DFEE**	35.54	**TFEE**	43.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.43		

Assessor Details	Mr. William Linley, William Linley, Tel: 03300431764, will@acousticsurveys.co.uk	**Assessor ID**	P977-0001
Client			

Building Elements

Wall 000001

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	100	0.7700	0.1299	82.81
	Main construction	100	0.9407	0.1063	17.19
Layer 2	**Earthwool Dritherm 32 Ultimate**				
	Main construction	100	0.0320	3.1250	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Blockwork, light**				
	Main construction	100	0.1800	0.5556	93.43
	Main construction	100	0.8803	0.1136	6.57
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	**Gyproc Wallboard (12.5mm)**				
	Main construction	12.5	0.1900	0.0658	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Int surface				0.1300	

Total resistance: **Upper limit =** 4.180 m² K/W **Lower limit =** 4.098 m² K/W **Average =** 4.139 m² K/W

Total correction = 0.0057 m² K/W **U-value (unrounded) =** 0.24 W/m² K

Unheated space: None

Total thickness: 328 mm **U-value: 0.24 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	3 Broad Street	**Issued on Date**	12/12/2019
Assessment Reference	As Designed	**Prop Type Ref**	
Project	Broad Street, Leek, Staffordshire, ST13 5NS		
Calculation Type	New Build (As Designed)		

SAP Rating	84 B	**DER**	16.59	**TER**	16.99
Environmental	88 B	**% DER<TER**	2.36		
CO_2 Emissions (t/year)	1.12	**DFEE**	35.54	**TFEE**	43.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.43		

Assessor Details	Mr. William Linley, William Linley, Tel: 03300431764, will@acousticsurveys.co.uk	**Assessor ID**	P977-0001
Client			

Building Elements

Floor 000003

Floor Type: Slab On Ground Floor
Area = 23.99 m², Perimeter = 7.24 m, Wall thickness = 275.00 mm, Soil: Unknown
Horizontal edge insulation: none
Vertical edge insulation: none

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Concrete, medium density**				
	Main construction	150	1.3500	0.1111	100.00
Layer 2	**Kooltherm K3 Floorboard (45mm +)**				
	Main construction	100	0.0200	5.0000	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Screed**				
	Main construction	65	1.1500	0.0565	100.00
Int surface				0.1700	

Total resistance: **Upper limit =** 5.168 m² K/W **Lower limit =** 5.168 m² K/W **Average =** 5.168 m² K/W

Total correction = 0.0094 m² K/W **U-value (unrounded) =** 0.14 W/m² K

Unheated space: None

Total thickness: 315 mm **U-value: 0.14 W/m² K** **Kappa: n/a**