

Energy Statement

Applicant: Mrs Clare Thomas

Agent: StudioExe Architects

Project: Proposed Garden Lodge at
Ty Hanner, Polbathic,
Torpoint, Cornwall, PL11 3EX

Version: P2402013/1.1

Date: 12 March 2024

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Revision	Date of issue	Description	Author
1.0	21/02/2024	Draft issue.	SJF
1.1	12/03/2024	Planning submission.	SJF

A INTRODUCTION

- A.01 This Energy Statement has been prepared by Stuart Foster to demonstrate compliance with Policy SEC1 – Sustainable Energy and Construction of the Cornwall Council Climate Emergency Development Plan Document.
- A.02 The proposed development is for a new garden lodge in the grounds of Ty Hanner, Polbathic, Torpoint, Cornwall, PL11 3EX with a floor area of 61.35 m².
- A.03 This Energy Statement provides an assessment of space heating demand, total energy consumption and on-site renewable energy generation arising from the development.
- A.04 This document is to be read in conjunction with the Architect's drawings and specifications, and the appendices to this document.

B POLICIES AND GUIDANCE

- B.01 The key national policies directly concerning this proposal are:
- Chapter 2 of the National Planning Policy Framework which outlines the national policies that aim to achieve sustainable development. It divides this objective into three parts: economic, social and environmental. One of the environmental objectives is to mitigate and adapt to climate change, including moving towards a low-carbon economy. This is an essential element of achieving sustainable development, which is a crucial goal of the planning system.
 - Paragraph 20 of the National Planning Policy Framework which sets out the strategic matters that should be addressed through strategic policies, including *"planning measures to address climate change mitigation and adaptation."*
- B.02 The key local policy directly concerning this proposal is:
- Objective 9 of the Cornwall Local Plan 2010–2030 which sets out to *"make best use of our resources by: ... reducing energy consumption while increasing renewable and low carbon energy production, ... and ... increasing resilience to climate change."*
 - Policy 12: Design of the Cornwall Local Plan 2010–2030, which requires designs to incorporate the fundamental principles of *"adaptability, inclusiveness, resilience and diversity"* to *"respond to climate change"*.
 - Policy 13: Development Standards of the Cornwall Local Plan 2010–2030, which requires designs to utilise *"opportunities for natural lighting, ventilation and heating by design, layout and orientation"* and to consider *"connection to an existing or planned heat network"*.

- Policy 14: Renewable and low carbon energy of the Cornwall Local Plan 2010–2030, which requires developments to “increase use and production of renewable and low carbon energy generation”.
- B.03 The key planning policy within the Climate Emergency DPD is Policy SEC1: Sustainable Energy and Construction:
- Clause 2b, which requires new dwellings to meet the following criteria:
 - space heating demand less than 30kWh/m²/annum;
 - total energy consumption less than 40kWh/m²/annum; and
 - on-site renewable energy generation to match the total energy consumption.
 - Clause 5, which requires all dwellings to “achieve an estimated water consumption of no more than 110 litres/person/day through the incorporation of water saving features”.
 - Clause 6, which requires development proposals to “minimise use of materials and creation of waste and promote opportunities for a circular economy”.

C DEVELOPMENT PROPOSAL

- C.01 The development proposal has been designed to include passive and operational energy efficiency measures to reduce heat loss, energy and water consumption.

C.1 Massing and thermal envelope

- C.1.01 The garden lodge is proposed to have the following U-values:

Element	U-value (W/m ² .K)	Construction
Ground floor	0.12	Ground-bearing concrete slab insulated below.
External walls	0.11	Timber frame w/ insulated service void and insulated outer layer and timber external cladding.
Roof (slope)	0.11	Timber rafters with insulation between.
Windows & Doors	0.80	Triple glazed windows, Rehau TOTAL70 or similar, assumed U _f =1.40, U _g =0.60.

- C.1.02 Internal partitions within the lodge are timber studwork with plasterboard lining and mineral fibre insulation between.
- C.1.03 Thermal bridging values have been calculated for each relevant bridge type using the default psi (ψ) values shown in Table K1 or junction-specific calculations.

C.2 Ventilation

C.2.01 The garden lodge will be ventilated by a Mechanical Ventilation with Heat Recovery system (MVHR) as per the following specification:

Manufacturer and model	Efficiency	No. of wetrooms
Zehnder ComfoAir Flex 250	94.0%	2

C.2.02 Design airtightness (AP50) value of 1.0 m³/h/m².

C.3 Orientation and site layout

C.3.01 The garden lodge is sited within the existing garden, which is constrained by the position of existing mature trees. There is a significant amount of overshadowing but the trees do provide significant shelter on three sides of the lodge.

C.3.02 Windows have been sized to provide appropriate levels of daylighting to reduce reliance on artificial lighting and face predominantly north-west to reduce the potential for overheating in summer.

C.4 Energy-efficient design

C.4.01 All fixed internal light fittings within each dwelling are 5W NVC Mercury LED downlights, energy-efficient at 130 lm/W, providing 765 luminaire lm at 4000K colour temperature.

C.4.02 Target levels of illuminance used to calculate numbers of downlights in each room are as follows:

Room	Target illuminance at floor level lm/m ²	Energy consumption W/m ²
Kitchen / Dining / Lounge	350	2.69
Bedroom	300	2.31
Bathroom	400	3.08

C.4.03 All external light fittings are to be low energy types, either:

- a) rated at no more than 100 lamp-watts per light fitting with automatic PIR and photocell control and manual override switching; or
- b) rated as having an efficacy of at least 45 lumens per circuit-watt with automatic PIR and photocell control and manual override switching.

C.4.04 All integrated whitegoods in kitchens and utilities are generally to be A-rated or better under the energy labelling scheme.

D ENERGY AND WATER CONSUMPTION

D.01 The proposal includes a number of design measures which are intended to reduce the use of energy and water.

D.1 Primary space heating and domestic hot water (DHW)

D.1.01 Space heating and domestic hot water shall be provided by an Air Source Heat Pump (ASHP) as per the following specification:

Manufacturer and model	Winter efficiency	Summer efficiency
Daikin Altherma 3 Monobloc EDLA04EV3	333.38%	165.12%

D.2 Secondary space heating

D.2.01 A solid fuel closed room heating is proposed in the living/dining area as per the following specification:

- Manufacturer and model: Stovax Vogue Small Eco (VG-SMW-E)
- Type: Wood Logs RWM Closed room heat
- Rated output: 5.0 kW
- Efficiency: 80.7%

D.3 Water consumption

D.3.01 Sanitaryware has been selected to meet the target of less than 110 l/person/day as per the following specification:

Appliance	Consumption	Manufacturer and model
WC	4 / 2.6 l flush	Armitage Shanks Profile 21 S3095 with Conceala cistern.
Shower	8 l/min	Ideal Standard shower outlet regulator.
Basin taps	5 l/min	Ideal Standard Connect Air Grande A7063AA single lever basin mixer with pop-up waste, chrome.
Sink taps	5 l/min	Ideal Standard Cerasprint B5344AA single lever monoblock mixer with flow regulator.
Dishwasher	1.25 l/place setting	To be confirmed.
Washing machine	8.17 l/kg	To be confirmed.

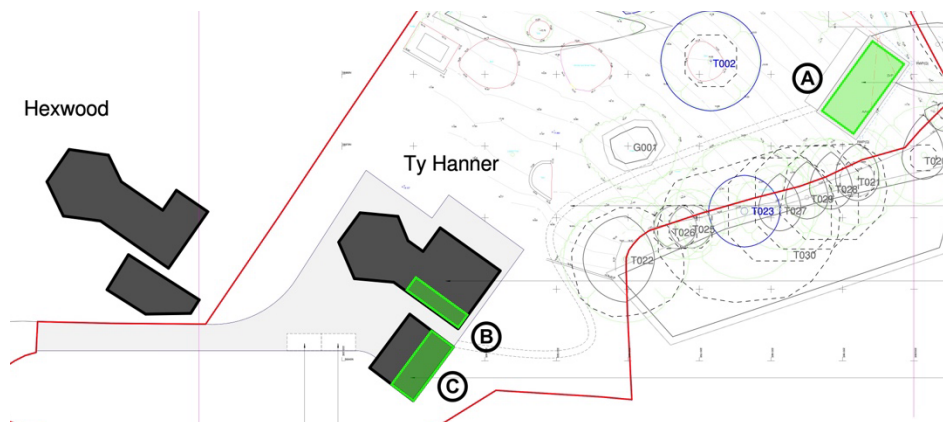
E RENEWABLE ENERGY GENERATION

E.01 The development will incorporate on-site renewable energy generation.

E.1 Proposed on-site installation

E.1.01 Photovoltaic (PV) arrays will be installed within the curtilage of the development site and allocated to the garden lodge. Subject to specialist survey the PV array may be located on the roof of the:

- A. garden lodge (facing South East at 5°, heavy overshading);
- B. main dwelling (facing South West at 22.5°, modest overshading); or
- C. garage/flat (facing South East at 22.5° pitch, little or no overshading).



E.1.02 As the worst case, Option A has been modelled for the Energy Summary Tool, comprising AIKO N-Type ABC White Hole Series (72 Cells) 610Wp panels as follows:

Location	No. off	Orientation	Pitch	Peak generation kWp
Garden Lodge roof	14	South East	5°	8.54
TOTAL	14			8.54

E.1.03 If either Options B or C were selected, then fewer and/or lower-rated PV panels would be required to meet the on-site renewable generation requirement.

F COMPLIANCE RESULTS

F.01 The design measures and technologies outlined above will ensure that the proposed development meets the requirements of the Climate Emergency DPD.

F.1 Clause 2b: Space heating & energy demand & energy generation

F.1.01 Compliance with the requirements has been calculated using the Climate Emergency DPD Policy SEC1 part 2b Energy Summary Tool (SAP V2.0).

F.1.02 The results of the calculation are as follows:

	Space heat demand kWh/m ² _{TFA} /yr	Total energy use kWh/m ² _{GIA} /yr	Renewable generation % total energy	Renewable deficit kWh/yr
Required	<30.0	<40.0	100%	0
Garden Lodge	24.5	39.6	115%	0

F.2 Clause 5: Water consumption

F.2.01 Compliance with the requirements has been calculated using the Water Efficiency Calculation for New Dwellings (<http://wrcpartgcalculator.co.uk>).

F.2.02 The results of the calculation are as follows:

	Total calculated use l/person/day	Contribution from greywater l/person/day	Contribution from rainwater l/person/day	Total normalised consumption l/person/day
Required				<110.00
Garden Lodge	102.04	0.00	0.00	97.90

F.3 Clause 6: Materials and waste

F.3.01 Refer to the Design & Access Statement for details of materials and waste.

G CONCLUSION

G.01 The thresholds of the Climate Emergency DPD for space heat demand and total energy use are shown to be met in the calculations presented above.

G.02 The applicant's proposals therefore meet policy requirements.

H APPENDICES

H.01 Detailed calculations are appended to this document in subsequent sections.

H.2 Water Efficiency Calculation for New Dwellings

Installation Type	Unit of Measure	Capacity/Flow rate (1)	Use Factor (2)	Fixed use (litres/person/day) (3)	Litres/person/day = [(1)x(2)] + (3) (4)
WC (single flush)	Flush Volume (litres)		4.42	0.00	0
WC (dual flush)	Full flush Volume (litres)	4	1.46	0.00	5.84
	Part flush Volume (litres)	2.6	2.96	0.00	7.70
WC (multiple fittings)	Average effective flushing Volume (litres)		4.42	0.00	0
Taps (excluding kitchen/utility room taps)	Flow rate (litres/min)	5.00	1.58	1.58	9.48
Bath (where shower also present)	Capacity to overflow(litres)		0.11	0.00	0
Shower (where bath also present)	Flow Rate(litres / minute)		4.37	0.00	0
Bath Only	Capacity to overflow(litres)		0.50	0.00	0
Shower Only	Flow Rate (litres/minute)	8.00	5.60	0.00	44.80
Kitchen/Utility room sink taps	Flow rate (litres/minute)	5.00	0.44	10.36	12.56
Washing Machine	(Litres/kg dry load)	8.17	2.1	0.00	17.157
Dishwasher	(Litres/place setting)	1.25	3.6	0.00	4.5
Waste disposal unit	(Litres/use)	<input type="checkbox"/> Present	3.08	0.00	0
Water Softener	(Litres/person/day)		1.00	0.00	0
(5)	Total Calculated use (litres/person/day) =SUM(column 4)				102.04
(6)	Contribution from greywater (litres/person/day)				0
(7)	Contribution from rainwater (litres/person/day)				0
(8)	Normalisation factor				0.91
(9)	Total internal water consumption = [(5)-(6)-(7)]x(8) (litres/person/day)				92.85
(10)	External water use				5.0
(11)	Total water consumption (Building Regulation 17.K) = (9)+(10)(litres/person/day)				97.9

Installation Type	Make/Model (mandatory)	Litres/Person/Day
WC (dual flush)	Armitage Shanks Profile 21 S3095 with Conceala cistern.	13.54
Taps	Ideal Standard Connect Air Grande A7063AA single lever basin mixer with pop-up waste, chrome.	9.48
Showers Only	Ideal Standard shower outlet regulator.	44.80
Kitchen Taps	Ideal Standard Cerasprint B5344AA single lever monoblock mixer with flow regulator.	12.56
Washing Machines		17.157
Dishwasher		4.5



H.3 U-value calculations

H.3.01 Floor

U-VALUE CALCULATOR REPORT		Design SAP elmhurst energy			
Property Reference	P2402013	Issued on Date	20/02/2024		
Assessment Reference		Prop Type Ref	Garden Lodge		
Project	Ty Hanner, Polbathic, Torpoint, Cornwall, PL11 3EX				
Calculation Type	New Build (As Designed)				
SAP Rating		DER	TER		
Environmental		% DER<TER			
CO ₂ Emissions (t/year)		DFEE	TFEE		
General Requirements Compliance		% DFEE<TFEE			
Assessor Details	Mr. Stuart Foster, Stuart Foster, Tel: 01872 211 433, energy@stuartfoster.co.uk	Assessor ID	CK03-0001		
Client	Alex & Clare Thomas, CL2402018				
Building Elements					
Floor Floor - New ground floor slab					
Floor Type: Slab On Ground Floor Area = 71.29 m ² , Perimeter = 52.88 m, Wall thickness = 753.00 mm, Soil: Unknown Horizontal edge insulation: none Vertical edge insulation: Width D = 600.0 mm, Thickness dn = 200.0 mm, Lambda = 0.033					
Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	Liquid screed (including UFH) Main construction	60	1.6000	0.0375	100.00
Layer 2	Vapour control layer Main construction	1	0.1700	0.0059	100.00
Layer 3	Concrete, reinforced (2% steel) Main construction	175	2.5000	0.0700	100.00
Layer 4	Radon-proof DPM Main construction	1	0.1700	0.0059	100.00
Layer 5	Extruded polystyrene Main construction Corrections - Air Gap: Level 1, Fasteners: None or plastic	200	0.0330	6.0606	100.00
Layer 6	Sand blinding Main construction	50	1.4000	0.0357	100.00
Layer 7	Hardcore Main construction	150	2.0000	0.0750	100.00
Int surface				0.1700	
Total resistance:		Upper limit = 6.291 m ² K/W	Lower limit = 6.291 m ² K/W	Average = 6.291 m ² K/W	
		Total correction = 0.0093 m ² K/W	U-value (unrounded) = 0.12 W/m ² K		
Unheated space: None					
Total thickness: 637 mm		U-value: 0.12 W/m ² K		Kappa: n/a	

H.3.02 Wall

U-VALUE CALCULATOR REPORT		Design SAP elmhurst energy	
Property Reference	P2402013	Issued on Date	20/02/2024
Assessment Reference		Prop Type Ref	Garden Lodge
Project	Ty Hanner, Polbathic, Torpoint, Cornwall, PL11 3EX		
Calculation Type	New Build (As Designed)		
SAP Rating		DER	TER
Environmental		% DER<TER	
CO ₂ Emissions (t/year)		DFEE	TFEE
General Requirements Compliance		% DFEE<TFEE	
Assessor Details	Mr. Stuart Foster, Stuart Foster, Tel: 01872 211 433, energy@stuartfoster.co.uk	Assessor ID	CK03-0001
Client	Alex & Clare Thomas, CL2402018		
Building Elements			
Wall Ext wall - New external walls			
Wall Type: Timber framed Wall with I-beams			


U-VALUE CALCULATOR REPORT



Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)
Ext surface				0.1300	
Layer 1	Softwood, dry				
	Main construction	20	0.1300	0.0000	100.00
Layer 2	Horizontal battens				
	Main construction	38	0.0000	0.0000	87.50
	Main construction	38	0.1300	0.0000	12.50
	Corrections - Cavity Ventilated, Emissivity: Normal				
Layer 3	Counter battens				
	Main construction	25	0.0000	0.0000	91.67
	Main construction	25	0.1300	0.0000	8.33
	Corrections - Cavity Ventilated, Emissivity: Normal				
Layer 4	Breather membrane				
	Main construction	1	0.0000	0.0000	100.00
Layer 5	Celotex CW4000				
	Main construction	50	0.0220	2.2727	91.67
	Main construction	50	0.1300	0.3846	8.33
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 6	Steico Universal wood fibre sarking				
	Main construction	40	0.0480	0.8333	100.00
Layer 7	Celotex XR4000				
	Main construction	140	0.0220	6.3636	90.70
	Main construction	140	0.1300	1.0769	9.30
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 8	Smartply Airtight OSB				
	Main construction	12.5	0.1000	0.1250	100.00
Layer 9	Celotex TB4000				
	Main construction	25	0.0220	1.1364	90.70
	Main construction	25	0.1300	0.1923	9.30
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 10	Plasterboard, standard				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 11	Plaster, lightweight - Insulating				
	Main construction	3	0.1800	0.0167	100.00
Int surface				0.1300	
Total resistance:		Upper limit = 9.885 m ² K/W	Lower limit = 8.057 m ² K/W	Average = 8.971 m ² K/W	
		Total correction = 0.0028 m ² K/W	U-value (unrounded) = 0.11 W/m ² K		
Unheated space: None					
Total thickness: 367 mm		U-value: 0.11 W/m ² K		Kappa: n/a	

H.3.03 Roof

U-VALUE CALCULATOR REPORT



Property Reference	P2402013	Issued on Date	20/02/2024
Assessment Reference		Prop Type Ref	Garden Lodge
Project	Ty Hanner, Polbathic, Torpoint, Cornwall, PL11 3EX		
Calculation Type	New Build (As Designed)		

SAP Rating		DER		TER	
Environmental		% DER<TER			
CO ₂ Emissions (t/year)		DFEE		TFEE	
General Requirements Compliance		% DFEE<TFEE			

Assessor Details	Mr. Stuart Foster, Stuart Foster, Tel: 01872 211 433, energy@stuartfoster.co.uk	Assessor ID	CK03-0001
Client	Alex & Clare Thomas, CL2402018		


Building Elements

Roof Sloped Roof - New sloped roof

Roof Type: Pitched Roof, insulated sloping ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)
Ext surface				0.1000	
Layer 1	Roof tiles				
	Main construction	15	1.0000	0.0000	100.00
Layer 2	Air layer ventilated				
	Main construction	25	0.0000	0.0000	87.50
	Main construction	25	0.1300	0.0000	12.50
	Corrections - Cavity Ventilated, Emissivity: Normal				
Layer 3	Air layer ventilated				
	Main construction	25	0.0000	0.0000	87.50
	Main construction	25	0.1300	0.0000	12.50
	Corrections - Cavity Ventilated, Emissivity: Normal				
Layer 4	Breather membrane				
	Main construction	1	0.0000	0.0000	100.00
Layer 5	Steico Universal wood fibre sarking				
	Main construction	40	0.0480	0.8333	100.00
Layer 6	Celotex XR4000				
	Main construction	200	0.0220	9.0909	91.67
	Main construction	200	0.1300	1.5385	8.33
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 7	Smartply Airtight OSB				
	Main construction	12.5	0.1000	0.1250	100.00
Layer 8	Service void insulated w/ Celotex TB4000				
	Main construction	25	0.0220	1.1364	93.67
	Main construction	25	0.1300	0.1923	6.33
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 9	Plasterboard, standard				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 10	Plaster, lightweight - Insulating				
	Main construction	3	0.1800	0.0167	100.00
Int surface				0.1000	

Total resistance:	Upper limit = 9.787 m ² K/W	Lower limit = 8.553 m ² K/W	Average = 9.170 m ² K/W
	Total correction = 0.0050 m ² K/W	U-value (unrounded) = 0.11 W/m ² K	



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

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U-VALUE CALCULATOR REPORT



Unheated space: None

Total thickness: 359 mm

U-value: 0.11 W/m² K

Kappa: n/a

H.4 Psi-value calculations

H.4.01 Junction E2

Window Installation

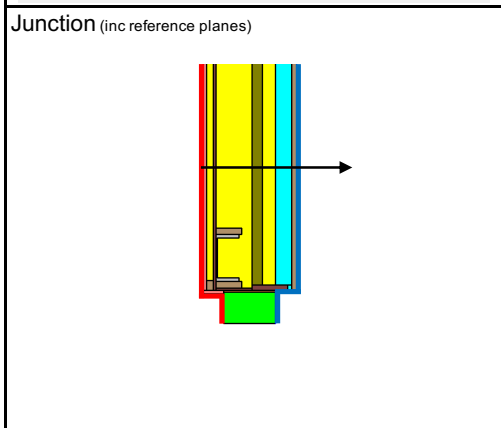
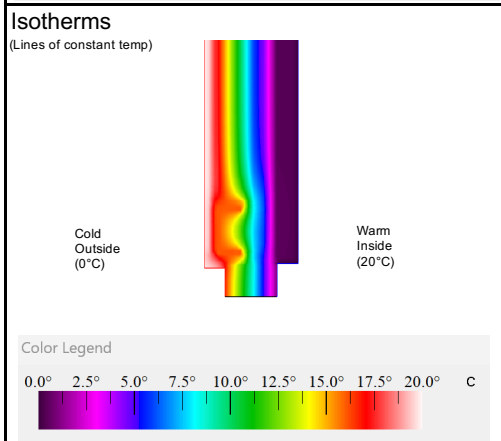
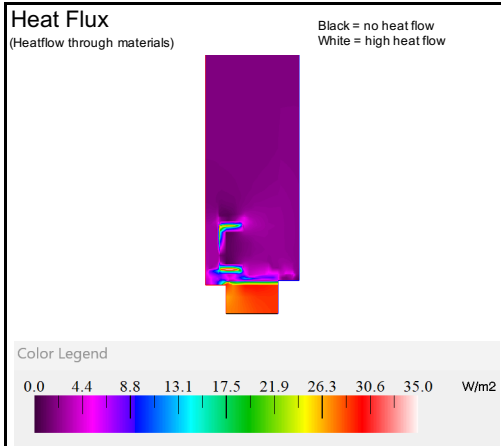
Calculation sheet provided by

WARM: Low Energy Building Practice
 3 Admirals Hard, Plymouth PL1 3RJ - 01752 542 546 - www.peterwarm.co.uk

Calculation carried out by

Stuart Foster 24 Kerley Vale, Chacewater, Truro, TR4 8JN
 01872 211 433 □ 07762 345 813
 Architect & Sustainability Consultant energy@stuartfoster.co.uk

V43



Window Installation

Software: Them 7.8	Date: 21/02/2024
Job Name: Garden Lodge, Ty Hanner, PL11 3EX	Job No: P2402013
Tab name: Window Installation	Completed by: SJF
Descrip: P2402013-E2	Checked by:

Data column	Row	Name	Ufactor name	Length mm	U factor	L2D W/Km
S	16	Wall	Internal	1100	0.1061	
T	16	Wall+Frame	External			0.2915

U - value calculation for data row Wall

Check surface resistances correct y

Check total length correct y

Modelling U Value (W/m2K) 0.106

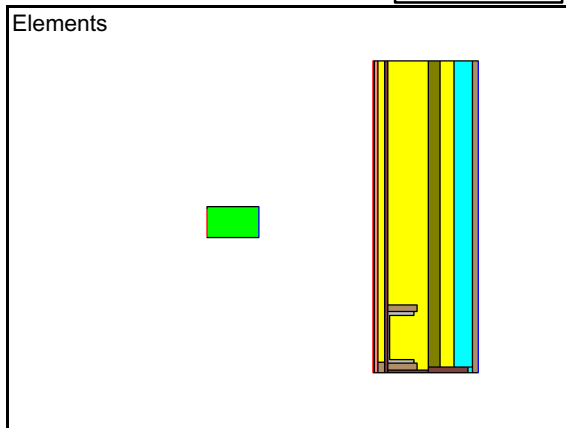
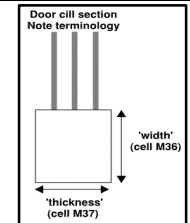
Data for window frame

	dimension mm	U-value W/m2K	conductivity W/mK
Frame width w	120		
thickness t	200		
Uf		1.40	
Homogenous frame?		y	
External Surface resistance		0.04	
Internal Surface resistance		0.13	
Draw frame as a rectangle 200 mm thick, 120 mm wide and with a conductivity of			
Frame Conductivity	0.367454	W/mK	

Psi Window Installation according to Passivhaus

	dimension mm	U-value W/m2K	heat flow W/mK
Wall and Frame			0.291
Wall	1000	0.106	0.106
Simplified Frame	120	1.400	0.168
			0.017
Installation Psi			0.02 W/mK

Error in calculation: From them report - worst cell **9.8 %**



H.4.02 Junction E3

Window Installation

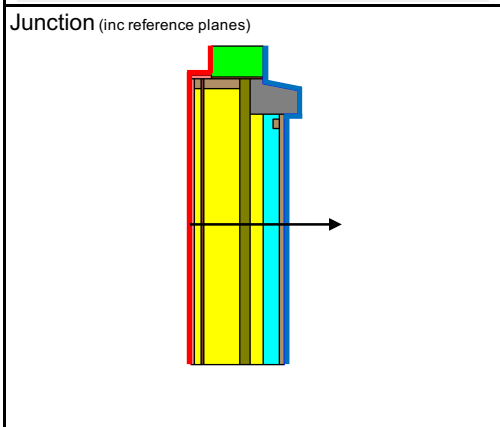
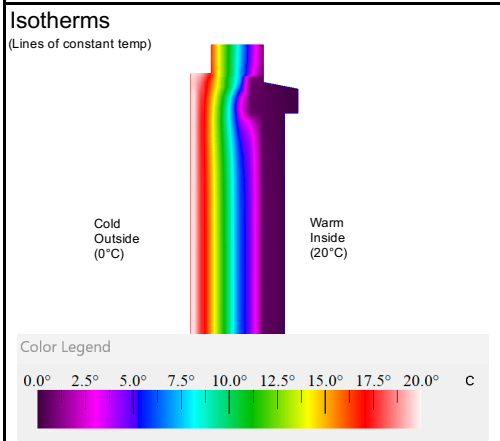
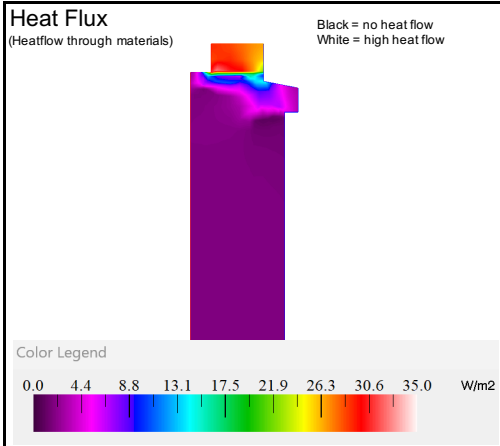
Calculation sheet provided by

WARM: Low Energy Building Practice
 3 Admirals Hard, Plymouth PL1 3RJ - 01752 542 546 - www.peterwarm.co.uk

Calculation carried out by

Stuart Foster 24 Kerley Vale, Chacewater, Truro, TR4 8JN
 01872 211 433 □ 07762 345 813
 Architect & Sustainability Consultant energy@stuartfoster.co.uk

V43



Window Installation

Software: Them 7.8	Date: 21/02/2024
Job Name: Garden Lodge, Ty Hanner, PL11 3EX	Job No: P2402013
Tab name: Window Installation	Completed by: SJF
Descrip: P2402013-E3	Checked by:

Data column	Row	Name	Ufactor name	Length mm	U factor	L2D W/Km
S	16	Wall	External	1264.3	0.0916	
T	16	Wall+Frame	External			0.2962

U - value calculation for data row Wall

Check surface resistances correct y

Check total length correct y

Modelling U Value (W/m2K) 0.092

Data for window frame

Frame	width w mm	thickness t mm	Uf W/m2K	conductivity W/mK
	120	200	1.40	
Homogenous frame?			y	
External Surface resistance			0.04	
Internal Surface resistance			0.13	

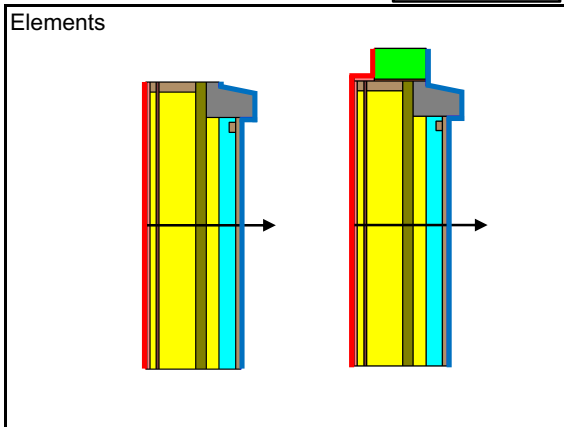
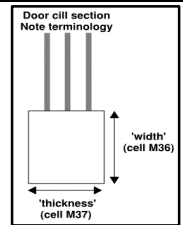
Draw frame as a rectangle 200 mm thick, 120 mm wide and with a conductivity of **Frame Conductivity 0.367454 W/mK**

Psi Window Installation according to Passivhaus

Wall and Frame	dimension mm	U-value W/m2K	heat flow W/mK
Wall	1000	0.092	0.296
Simplified Frame	120	1.400	0.092
			0.168
			0.037

Installation Psi 0.04 W/mK

Error in calculation: From them report - worst cell **9.8 %**



H.4.03 Junction E4

Window Installation

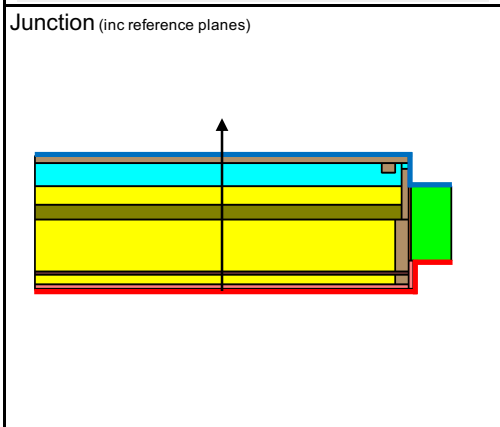
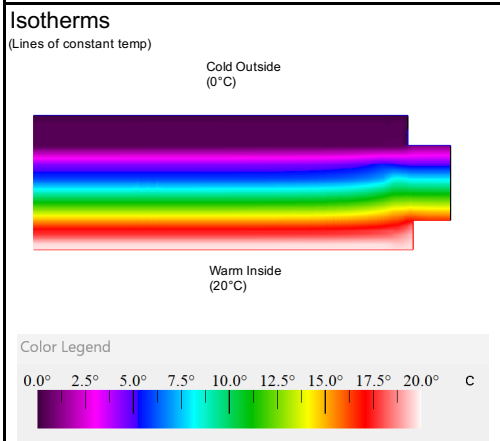
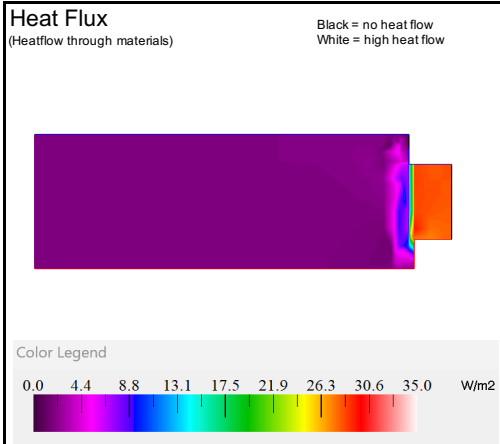
Calculation sheet provided by

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Calculation carried out by

Stuart Foster 24 Kerley Vale, Chacewater, Truro, TR4 8JN
 01872 211 433 □ 07762 345 813
 Architect & Sustainability Consultant energy@stuartfoster.co.uk

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Window Installation

Software: Them 7.8 Date: 21/02/2024
 Job Name: Garden Lodge, Ty Hanner, PL11 3EX Job No: P2402013
 Tab name: Window Installation Completed by: SJF
 Descr: P2402013-E4 Checked by:

Data column	Row	Name	Ufactor name	Length mm	U factor	L2D W/Km
S	16	Wall	Internal	1100	0.0983	
T	16	Wall+Frame	External			0.2832

U - value calculation for data row Wall

Check surface resistances correct y
 Check total length correct y

Modelling U Value (W/m2K) 0.098

Data for window frame

Frame	width w	thickness t	Uf	U-value mm W/m2K	conductivity W/mK
	120	200		1.40	
			Homogenous frame?	y	
			External Surface resistance	0.04	
			Internal Surface resistance	0.13	

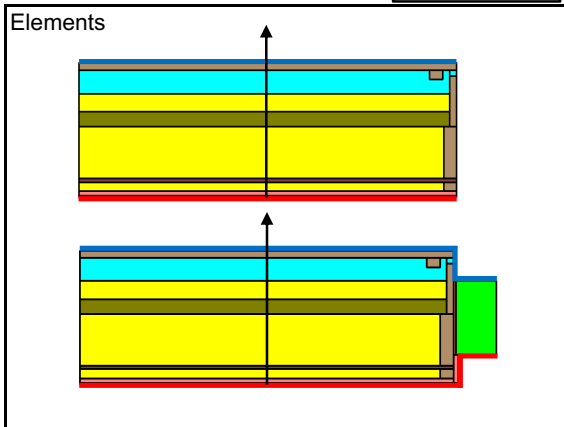
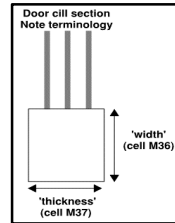
Draw frame as a rectangle 200 mm thick, 120 mm wide and with a conductivity of
Frame Conductivity 0.367454 W/mK

Psi Window Installation according to Passivhaus

Wall and Frame	dimension mm	U-value W/m2K	heat flow W/mK
Wall	1000	0.098	0.283
Simplified Frame	120	1.400	0.098
			0.168
			0.017

Installation Psi 0.02 W/mK

Error in calculation: From them report - worst cell **9.8 %**



H.4.04 Junction E5

GroundFloor - Wall

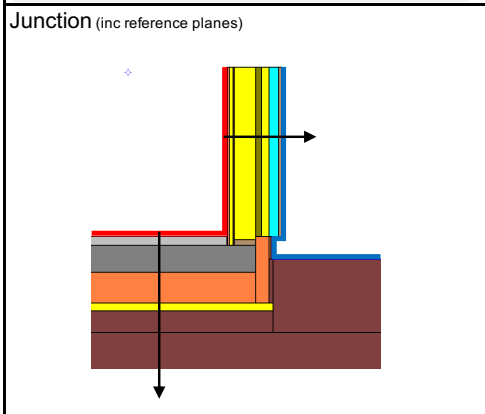
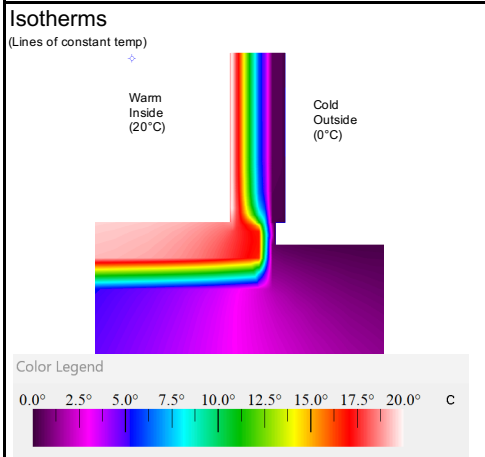
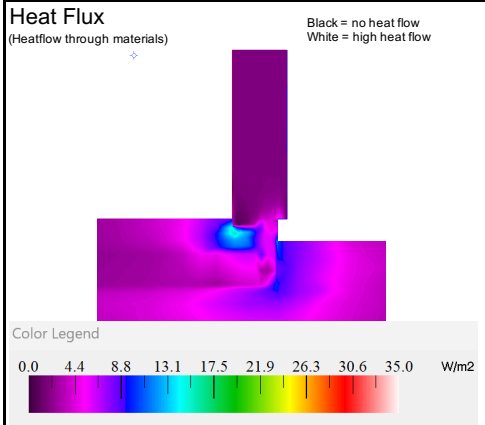
Calculation sheet provided by

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Calculation carried out by

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 Architect & Sustainability Consultant

V43



GroundFloor - Wall

Software: Therm 7.8 Date: 20/02/2024
 Job Name: Garden Lodge, Ty Hanner, PL11 3EX Job No: P2402013
 Tab name: GroundFloor - Wall Completed by: Stuart Foster
 Description: E5 Floor to Wall Junction Checked by:

Data column	Row	Name	Ufactor name	Length mm	U factor	L2D W/mK
S	16	Wall	Internal	1100	0.089	
T	16	Floor	Internal	4000	0.1556	
U	16	L2D	Internal			0.6457

U - value calculation for data row **Wall**
 Check surface resistances correct y
 Check total length correct y
Modelling U Value (W/m2K) 0.089

U - value calculation for data row **Floor**
 Check surface resistance correct (zero under) y
 Check total length correct y
Floor Cassette Modelling U Value (W/m2K) 0.156
 GROUND BEARING Ground Floor Calculation using ISO 13770, check values below
 areas m2 61.35 m2 perim m 34.002 m
 wall thick 0.365 m ground k 2.0 W/m2K
 dg 13.30 B* 3.6086113
FLOOR Modelling U Value (W/m2K) 0.134

psi calculation

	length mm	U-value/L2D1heat flow W/m2K	W/mK	psi value W/mK
L2D				0.646
Wall	1100	0.0890	0.098	
Floor	4000	0.1338	0.535	
				0.013

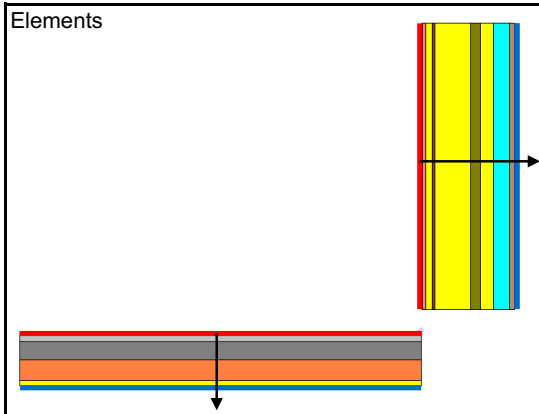
psi Internal 0.01 W/mK

psi calculation

	length mm	U-value/L2D1heat flow W/m2K	W/mK	psi value W/mK
L2D				0.646
Wall	1585	0.0890	0.141	
Floor	4370	0.1338	0.585	
				0.080

psi External -0.08 W/mK

Error in calculation: From them report - worst cell **8 %**



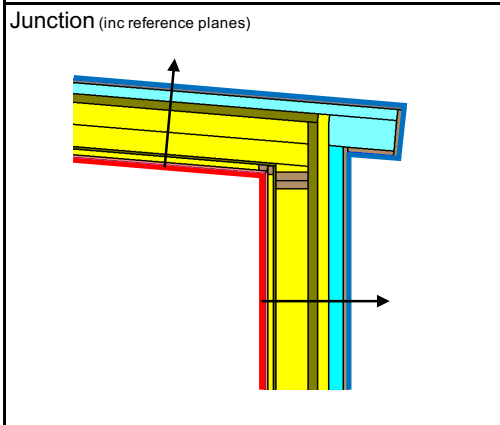
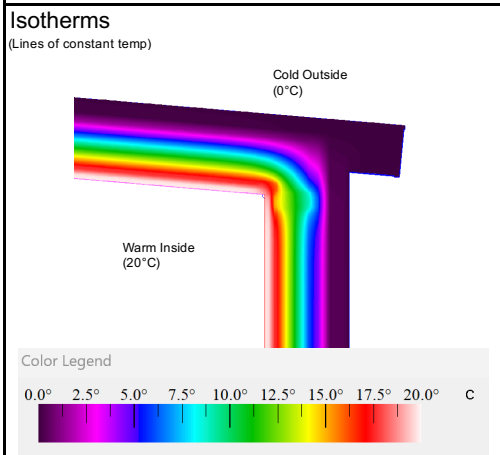
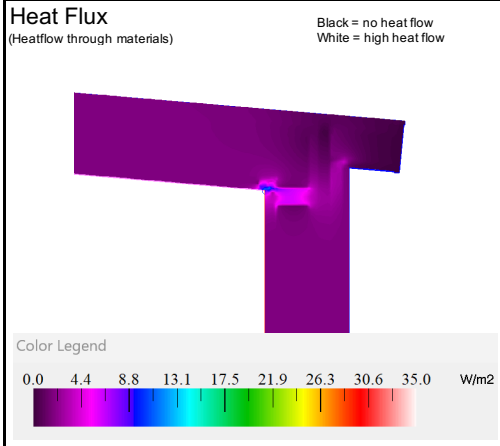
H.4.05 Junction II

Ambient Junction

Calculation sheet provided by

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Calculation carried out by

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01872 211 433 □ 07762 345 813
energy@stuartfoster.co.uk
Architect & Sustainability Consultant

Software: Them 7.8 Date: 20/02/2024
Job Name: Garden Lodge, Ty Hanner, PL11 3EX Job No: P2402013
Tab name: Ambient Junction Completed by: SJF
Descrip: E11 Eaves (insulated rafters) Checked by:

Data colum	Row	Name	Ufactor name	Length mm	U factor	L2D W/Km
S	17	Roof	Internal	1000	0.0866	
T	16	Wall	Internal	1100	0.089	
U	16	L2D	External			0.2159

U - value calculation for data row Roof
Check surface resistances correct y
Check total length correct y
Modelling U Value (W/m2K) 0.087

U - value calculation for data row Wall
Check surface resistance correct y
Check total length correct y
Modelling U Value (W/m2K) 0.089

psi calculation

	length mm	U-value/Wm2K	L2D1 heat flow W/mK	psi value W/mK
L2D				0.216
Roof	Length time U value: 1000	0.087		0.087
Wall	Length time U value: 1100	0.089		0.098
				0.031

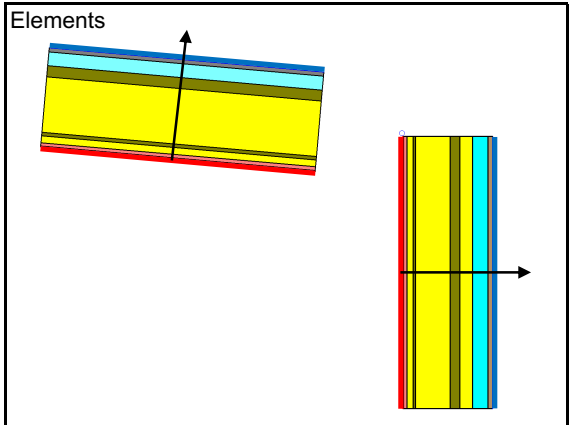
psi Internal 0.03 W/mK

psi calculation

	length mm	U-value/Wm2K	L2D1 heat flow W/mK	psi value W/mK
L2D				0.216
Roof	Length time U value: 1580	0.087		0.137
Wall	Length time U value: 1407	0.089		0.125
				-0.046

psi External -0.046 W/mK

Error in calculation: From them report - worst cell 2.4 %



H.4.06 Junction 13

Ambient Junction

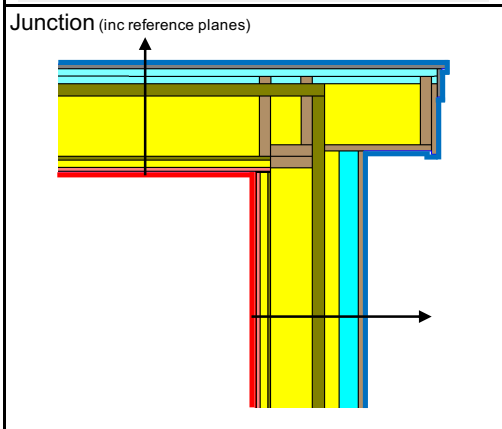
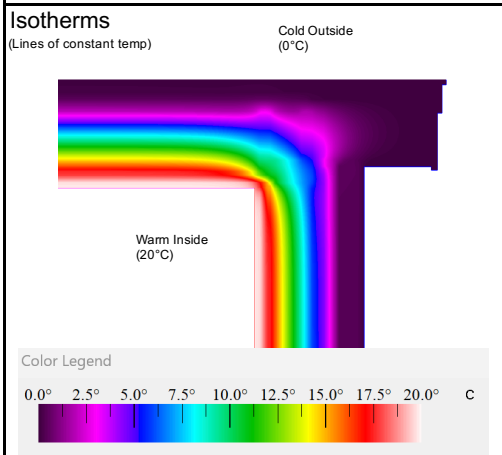
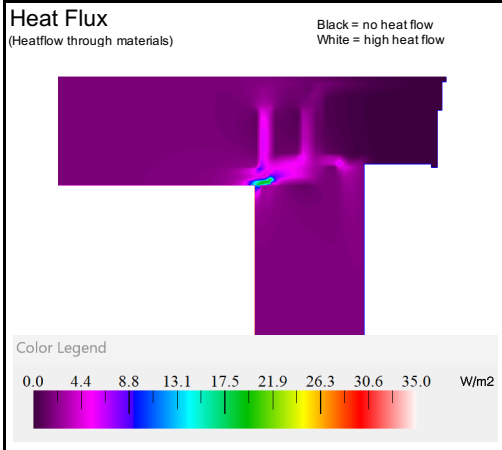
Calculation sheet provided by

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Calculation carried out by

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 Architect & Sustainability Consultant

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Software: Them 7.8 Date: 21/02/2024
 Job Name: Garden Lodge, Ty Hanner, PL11 3EX Job No: P2402013
 Tab name: Ambient Junction Completed by: SJF
 Descr: E13 Gable (insulated rafters) Checked by:

Data colum	Row	Name	Ufactor name	Length mm	U factor	L2D W/Km
S	17	Roof	Internal	1000	0.086	
T	16	Wall	Internal	1100	0.089	
U	16	L2D	External			0.2193

U - value calculation for data row **Roof**

Check surface resistances correct **y**
 Check total length correct **y**

Modelling U Value (W/m2K) 0.086

U - value calculation for data row **Wall**

Check surface resistance correct **y**
 Check total length correct **y**

Modelling U Value (W/m2K) 0.089

Psi calculation

	length mm	U-value/Wm2K	L2D1 heat flow W/mK	psi value W/mK
L2D			0.219	
Roof	Length time U value: 1000	0.086	0.086	
Wall	Length time U value: 1100	0.089	0.098	0.035

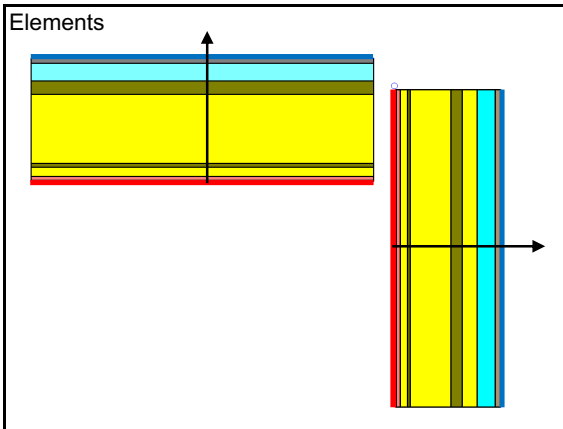
psi Internal 0.04 W/mK

Psi calculation

	length mm	U-value/Wm2K	L2D1 heat flow W/mK	psi value W/mK
L2D			0.219	
Roof	Length time U value: 1640	0.086	0.141	
Wall	Length time U value: 1460	0.089	0.130	-0.052

psi External -0.052 W/mK

Error in calculation: From them report - worst cell **4.8 %**



H.4.07 Junction 16

Ambient Junction

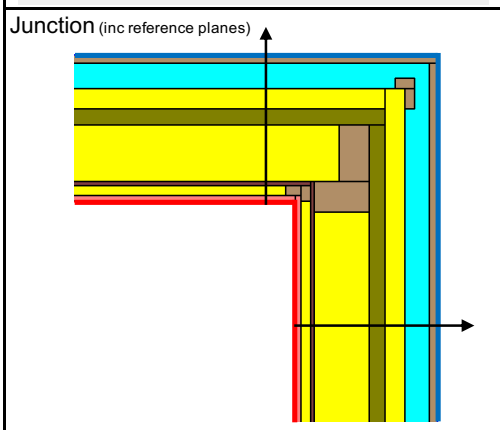
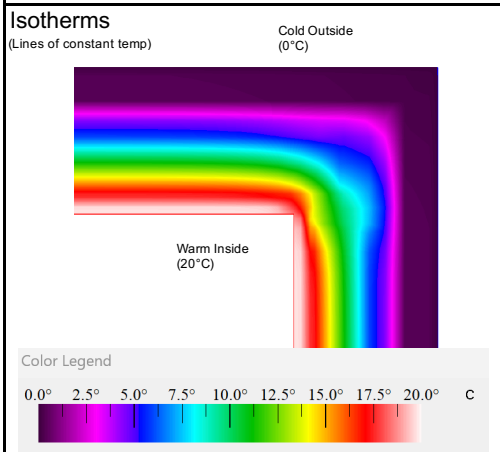
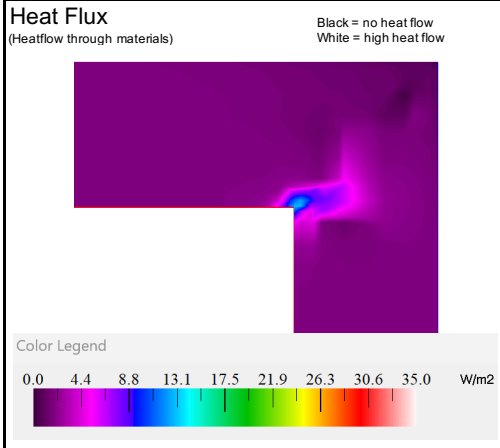
Calculation sheet provided by

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Calculation carried out by

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Architect & Sustainability Consultant

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Software: Them 7.8 Date: 16/02/2024
Job Name: Garden Lodge, Ty Hanner, PL11 3EX Job No: P2402013
Tab name: Ambient Junction Completed by: SJF
Descrip: E16 Corner normal Checked by:

Data colum	Row	Name	Ufactor name	Length mm	U factor	L2D W/Km
S	16	Wall 1	Internal	1100	0.0899	
T	16	Wall 2	Internal	1100	0.0899	
U	16	L2D	Internal			0.2330

U - value calculation for data row Wall 1
Check surface resistances correct y
Check total length correct y
Modelling U Value (W/m2K) 0.090

U - value calculation for data row Wall 2
Check surface resistance correct y
Check total length correct y
Modelling U Value (W/m2K) 0.090

Psi calculation

	length mm	U-value/L2D1 heat flow W/m2K	psi value W/mK
L2D			0.233
Wall 1	Length time U value: 1100	0.090	0.099
Wall 2	Length time U value: 1100	0.090	0.099
			0.035

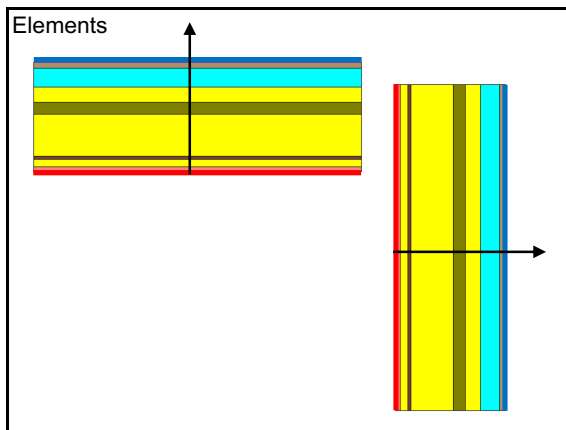
psi Internal 0.04 W/mK

Psi calculation

	length mm	U-value/L2D1 heat flow W/m2K	psi value W/mK
L2D			0.233
Wall 1	Length time U value: 1465	0.090	0.132
Wall 2	Length time U value: 1465	0.090	0.132
			-0.030

psi External -0.030 W/mK

Error in calculation: From them report - worst cell 4.9 %



H.5 Full SAP Calculation Printout

Full SAP Calculation Printout



Property Reference	Garden Lodge		Issued on Date	12/03/2024	
Assessment Reference	03_Energy Statement	Prop Type Ref			
Property	Ty Hanner, Polbathic, Torpoint, Cornwall, PL11 3EX				
SAP Rating	96 A	DER	-0.38	TER	11.93
Environmental	100 A	% DER < TER			103.19
CO ₂ Emissions (t/year)	-0.08	DFEE	35.63	TFEE	49.85
Compliance Check	See BREL	% DFEE < TFEE			28.53
% DPER < TPER	78.54	DPER	13.70	TPER	63.83
Assessor Details	Mr. Stuart Foster			Assessor ID	CK03-0001
Client	CL2402018, Clare Thomas				

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	61.3500 (1b)	2.6800 (2b)	164.4180 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	61.3500		164.4180 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 164.4180 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		1.0000 (17)
Infiltration rate		0.0500 (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) =	0.0388 (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	0.0494	0.0484	0.0475	0.0426	0.0417	0.0368	0.0368	0.0358	0.0388	0.0417	0.0436	0.0455 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												84.6000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.1264	0.1254	0.1245	0.1196	0.1187	0.1138	0.1138	0.1128	0.1157	0.1187	0.1206	0.1225 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Windows (U _w = 0.80)			18.0800	0.7752	14.0155		(27)
Ground Floor			61.3500	0.1200	7.3620	110.0000	6748.5000 (28a)
External Walls	44.7400	18.0800	26.6600	0.1100	2.9326	9.0000	239.9400 (29a)
External Roof	61.6100		61.6100	0.1100	6.7771	9.0000	554.4900 (30)
Total net area of external elements A _{um} (A, m ²)			167.7000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	31.0872	(33)
Internal Partitions			87.5700			9.0000	788.1300 (32c)
Heat capacity C _m = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =	8331.0600	(34)
Thermal mass parameter (TMP = C _m / TFA) in kJ/m ² K							135.7956 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				8.3100	0.0200	0.1662	
E3 Sill				8.3100	0.0400	0.3324	
E4 Jamb				29.0100	0.0200	0.5802	

Full SAP Calculation Printout



Temperature during heating periods in the living area from Table 9, Th1 (C)												
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	56.5541	56.6269	56.6998	57.0673	57.1413	57.5146	57.5146	57.5898	57.3647	57.1413	56.9934	56.8462
alpha	4.7703	4.7751	4.7800	4.8045	4.8094	4.8343	4.8343	4.8393	4.8243	4.8094	4.7996	4.7897
util living area	0.9138	0.8890	0.8333	0.7235	0.5694	0.4070	0.2947	0.3281	0.5166	0.7493	0.8751	0.9229 (86)
Living	20.4589	20.5437	20.6824	20.8260	20.9052	20.9310	20.9351	20.9346	20.9210	20.8262	20.6287	20.4310
Non living	19.7374	19.8417	20.0095	20.1794	20.2655	20.2941	20.2974	20.2979	20.2842	20.1836	19.9510	19.7059
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.7232	20.5437	20.6824	20.8260	20.9052	20.9310	20.9351	20.9346	20.9210	20.8262	20.6287	20.5106 (87)
Th 2	20.3701	20.3708	20.3716	20.3754	20.3762	20.3800	20.3800	20.3808	20.3785	20.3762	20.3747	20.3731 (88)
util rest of house	0.9033	0.8760	0.8149	0.6968	0.5354	0.3686	0.2535	0.2844	0.4734	0.7187	0.8587	0.9133 (89)
MIT 2	20.1178	19.8417	20.0095	20.1794	20.2655	20.2941	20.2974	20.2979	20.2842	20.1836	19.9510	19.8261 (90)
Living area fraction									FLA = Living area / (4) =			0.5487 (91)
MIT	20.4500	20.2269	20.3787	20.5341	20.6165	20.6436	20.6473	20.6472	20.6336	20.5362	20.3228	20.2016 (92)
Temperature adjustment												0.0000
adjusted MIT	20.4500	20.2269	20.3787	20.5341	20.6165	20.6436	20.6473	20.6472	20.6336	20.5362	20.3228	20.2016 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9047	0.8728	0.8151	0.7038	0.5487	0.3850	0.2713	0.3032	0.4913	0.7268	0.8573	0.9104 (94)
Useful gains	478.3336	484.4299	474.9511	432.5721	350.6437	241.6440	162.6302	170.2973	258.8268	364.0425	426.7916	465.7267 (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	660.8532	626.3666	566.4544	471.7863	361.1104	243.1717	162.8481	170.6705	263.5755	402.4076	536.9052	651.4191 (97)
Space heating kWh	135.7946	95.3815	68.0785	28.2342	7.7873	0.0000	0.0000	0.0000	0.0000	28.5436	79.2818	138.1551 (98a)
Space heating requirement - total per year (kWh/year)												581.2566
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh	135.7946	95.3815	68.0785	28.2342	7.7873	0.0000	0.0000	0.0000	0.0000	28.5436	79.2818	138.1551 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												581.2566
Space heating per m2										(98c) / (4) =		9.4744 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												
Fraction of space heat from main system(s)												
Efficiency of main space heating system 1 (in %)												
Efficiency of main space heating system 2 (in %)												
Efficiency of secondary/supplementary heating system, %												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	135.7946	95.3815	68.0785	28.2342	7.7873	0.0000	0.0000	0.0000	0.0000	28.5436	79.2818	138.1551 (98)
Space heating efficiency (main heating system 1)	333.0197	333.0197	333.0197	333.0197	333.0197	0.0000	0.0000	0.0000	0.0000	333.0197	333.0197	333.0197 (210)
Space heating fuel (main heating system)	40.7768	28.6414	20.4428	8.4782	2.3384	0.0000	0.0000	0.0000	0.0000	8.5711	23.8070	41.4856 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	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	221.5611	195.9809	208.2400	183.1042	177.5258	159.9950	157.8878	164.1119	165.8715	184.9372	196.6343	219.1362 (64)
Efficiency of water heater												165.1200 (216)
(217)m	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200 (217)
Fuel for water heating, kWh/month	134.1818	118.6900	126.1144	110.8916	107.5132	96.8962	95.6200	99.3895	100.4551	112.0017	119.0857	132.7133 (219)
Space cooling fuel requirement												
(221)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 (221)
Pumps and Fa	13.4162	12.1178	13.4162	12.9834	13.4162	12.9834	13.4162	13.4162	12.9834	13.4162	12.9834	13.4162 (231)
Lighting	16.5001	13.2370	11.9185	8.7320	6.7448	5.5106	6.1529	7.9977	10.3883	13.6300	15.3950	16.9587 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-33.1265	-53.0484	-86.3902	-104.7863	-117.0133	-110.2833	-108.4423	-100.4604	-84.3390	-63.7418	-37.9998	-27.6035 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-13.1289	-33.7234	-84.3988	-153.4633	-224.5649	-234.0495	-227.7987	-178.8509	-113.6524	-53.6757	-18.8151	-9.7566 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												174.5412 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												165.1200
Water heating fuel used												1353.5525 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)												
mechanical ventilation fans (SFP = 0.7875)												157.9646 (230a)
Total electricity for the above, kWh/year												157.9646 (231)
Electricity for lighting (calculated in Appendix L)												133.1656 (232)

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Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-2273.1130 (233)
Wind generation		0.0000 (234)
Hydro-electric generation (Appendix N)		0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)		0.0000 (235)
Appendix Q - special features		
Energy saved or generated		-0.0000 (236)
Energy used		0.0000 (237)
Total delivered energy for all uses		-453.8890 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	174.5412	16.4900	28.7818 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1353.5525	16.4900	223.2008 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	157.9646	16.4900	26.0484 (249)
Energy for lighting	133.1656	16.4900	21.9590 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-927.2350	16.4900	-152.9010
PV Unit electricity exported	-1345.8780	5.5900	-75.2346
Total			-228.1356 (252)
Total energy cost			71.8544 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.2432 (257)
SAP value		96.0572
SAP rating (Section 12)		96 (258)
SAP band		A

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	174.5412	0.1570	27.4007 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1353.5525	0.1409	190.6817 (264)
Space and water heating			218.0824 (265)
Pumps, fans and electric keep-hot	157.9646	0.1387	21.9116 (267)
Energy for lighting	133.1656	0.1443	19.2199 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-927.2350	0.1329	-123.2535
PV Unit electricity exported	-1345.8780	0.1216	-163.6099
Total			-286.8634 (269)
Total CO2, kg/year			-27.6494 (272)
CO2 emissions per m2			-0.4500 (273)
EI value			100.3484
EI rating			100 (274)
EI band			A

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	61.3500 (1b)	x 2.6800 (2b)	= 164.4180 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	61.3500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	164.4180 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes

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Pressure Test Method													Blower Door
Measured/design AP50													1.0000 (17)
Infiltration rate													0.0500 (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) = 0.0388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.3000	5.7000	5.6000	5.1000	5.1000	4.5000	4.6000	4.5000	4.8000	5.7000	5.8000	6.2000	(22)
Wind factor	1.5750	1.4250	1.4000	1.2750	1.2750	1.1250	1.1500	1.1250	1.2000	1.4250	1.4500	1.5500	(22a)
Adj infiltr rate	0.0610	0.0552	0.0543	0.0494	0.0494	0.0436	0.0446	0.0436	0.0465	0.0552	0.0562	0.0601	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation													0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													84.6000 (23c)
Effective ac	0.1380	0.1322	0.1312	0.1264	0.1264	0.1206	0.1216	0.1206	0.1235	0.1322	0.1332	0.1371	(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						
Windows (Uw = 0.80)			18.0800	0.7752	14.0155			(27)					
Ground Floor			61.3500	0.1200	7.3620	110.0000	6748.5000	(28a)					
External Walls	44.7400	18.0800	26.6600	0.1100	2.9326	9.0000	239.9400	(29a)					
External Roof	61.6100		61.6100	0.1100	6.7771	9.0000	554.4900	(30)					
Total net area of external elements Aum (A, m2)			167.7000					(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 31.0872			(33)					
Internal Partitions			87.5700			9.0000	788.1300	(32c)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 8331.0600	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							135.7956	(35)					
List of Thermal Bridges													
K1 Element				Length	Psi-value	Total							
E2 Other lintels (including other steel lintels)				8.3100	0.0200	0.1662							
E3 Sill				8.3100	0.0400	0.3324							
E4 Jamb				29.0100	0.0200	0.5802							
E5 Ground floor (normal)				34.0020	0.0100	0.3400							
E11 Eaves (insulation at rafter level)				23.6060	0.0300	0.7082							
E13 Gable (insulation at rafter level)				10.4400	0.0400	0.4176							
E16 Corner (normal)				10.7360	0.0400	0.4294							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							2.9740	(36)					
Point Thermal bridges							0.0000	(36a) =					
Total fabric heat loss							(33) + (36) + (36a) = 34.0612	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	7.4893	7.1739	7.1214	6.8585	6.8585	6.5432	6.5957	6.5432	6.7009	7.1739	7.2265	7.4367	(38)
Heat transfer coeff	41.5505	41.2352	41.1826	40.9198	40.9198	40.6044	40.6570	40.6044	40.7621	41.2352	41.2877	41.4980	(39)
Average = Sum(39)m / 12 =												41.0381	
HLP	0.6773	0.6721	0.6713	0.6670	0.6670	0.6618	0.6627	0.6618	0.6644	0.6721	0.6730	0.6764	(40)
HLP (average)												0.6689	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.0195 (42)
Hot water usage for mixer showers													
74.5696	73.4489	71.8160	68.6915	66.3858	63.8144	62.3529	63.9735	65.7500	68.5109	71.7024	74.2839	74.2839	(42a)
Hot water usage for baths													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses													
35.3121	34.0280	32.7439	31.4598	30.1758	28.8917	28.8917	30.1758	31.4598	32.7439	34.0280	35.3121	35.3121	(42c)
Average daily hot water use (litres/day)													100.8525 (43)
Daily hot water use													
109.8816	107.4769	104.5599	100.1514	96.5616	92.7061	91.2446	94.1493	97.2099	101.2548	105.7304	109.5959	109.5959	(44)
Energy conte	174.0257	153.0457	160.7046	137.1022	129.9904	113.9930	110.3524	116.5765	119.8695	137.4018	150.6323	171.6008	(45)
Energy content (annual)													Total = Sum(45)m = 1675.2949
Distribution loss (46)m = 0.15 x (45)m													
26.1039	22.9569	24.1057	20.5653	19.4986	17.0990	16.5529	17.4865	17.9804	20.6103	22.5948	25.7401	25.7401	(46)
Water storage loss:													
Store volume													229.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.4500 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.7830 (55)
Total storage loss													
24.2730	21.9240	24.2730	23.4900	24.2730	23.4900	24.2730	24.2730	23.4900	24.2730	23.4900	24.2730	24.2730	(56)
If cylinder contains dedicated solar storage													
24.2730	21.9240	24.2730	23.4900	24.2730	23.4900	24.2730	24.2730	23.4900	24.2730	23.4900	24.2730	24.2730	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi 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	(61)
Total heat required for water heating calculated for each month													
221.5611	195.9809	208.2400	183.1042	177.5258	159.9950	157.8878	164.1119	165.8715	184.9372	196.6343	219.1362	219.1362	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
221.5611	195.9809	208.2400	183.1042	177.5258	159.9950	157.8878	164.1119	165.8715	184.9372	196.6343	219.1362	219.1362	(64)
Total per year (kWh/year) = Sum(64)m =													2234.9859 (64)
Electric shower(s)													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000 (64a)
Heat gains from water heating, kWh/month													
95.8919	85.2359	91.4626	82.3881	81.2501	74.7043	74.7205	76.7900	76.6582	83.7144	86.8869	95.0856	95.0856	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.8510	16.7433	13.6165	10.3086	7.7058	6.5056	7.0295	9.1372	12.2639	15.5719	18.1747	19.3749	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	263.1916	265.9227	259.0404	244.3888	225.8938	208.5111	196.8984	194.1673	201.0496	215.7012	234.1962	251.5789	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	(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)	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	(71)
Water heating gains (Table 5)	128.8869	126.8391	122.9336	114.4279	109.2072	103.7559	100.4308	103.2124	106.4697	112.5194	120.6762	127.8032	(72)
Total internal gains	500.4569	499.0325	485.1180	458.6528	432.3342	408.3001	393.8861	396.0443	409.3107	433.3199	462.5745	488.2844	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
Northeast	1.0000	15.4493	0.5700	0.8000	0.3000	0.8000	1.9021	(75)					
Southwest	1.0000	47.1180	0.5700	0.8000	0.3000	0.8000	5.8012	(79)					
Northwest	16.0800	15.4493	0.5700	0.8000	0.3000	0.8000	30.5860	(81)					
Solar gains	38.2893	64.6476	112.0794	182.9486	229.1282	258.8725	219.3504	193.2759	140.8761	81.4367	47.2301	32.4099	(83)
Total gains	538.7462	563.6801	597.1975	641.6013	661.4624	667.1726	613.2365	589.3202	550.1868	514.7566	509.8046	520.6944	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
alpha	4.7130	4.7414	4.7462	4.7703	4.7703	4.7996	4.7946	4.7996	4.7849	4.7414	4.7367	4.7177	
util living area	0.8653	0.8412	0.7815	0.6755	0.5357	0.3810	0.3043	0.3025	0.4463	0.6533	0.7989	0.8695	(86)
Living	20.6210	20.6702	20.7619	20.8564	20.9118	20.9317	20.9344	20.9345	20.9280	20.8814	20.7646	20.6205	
Non living	19.9280	19.9902	20.0980	20.2075	20.2657	20.2891	20.2904	20.2913	20.2839	20.2325	20.1028	19.9289	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.8061	20.6702	20.7619	20.8564	20.9118	20.9317	20.9344	20.9345	20.9280	20.8814	20.7646	20.6736	(87)
Th 2	20.3610	20.3655	20.3663	20.3701	20.3701	20.3747	20.3739	20.3747	20.3724	20.3655	20.3648	20.3617	(88)
util rest of house	0.8486	0.8226	0.7583	0.6464	0.5012	0.3440	0.2631	0.2598	0.4022	0.6147	0.7733	0.8528	(89)
MIT 2	20.1884	19.9902	20.0980	20.2075	20.2657	20.2891	20.2904	20.2913	20.2839	20.2325	20.1028	20.0069	(90)
Living area fraction													
MIT	20.5273	20.3633	20.4623	20.5635	20.6202	20.6417	20.6437	20.6442	20.6373	20.5885	20.4659	20.3727	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.5273	20.3633	20.4623	20.5635	20.6202	20.6417	20.6437	20.6442	20.6373	20.5885	20.4659	20.3727	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	459.6052	463.6715	455.0311	420.5813	340.6759	240.0867	172.2539	163.9564	231.6050	323.5693	396.4195	444.2094	(95)
Ext temp.	6.6000	6.8000	7.9000	9.6000	12.1000	14.7000	16.4000	16.6000	14.9000	12.3000	9.4000	6.9000	(96)
Heat loss rate W	578.6863	559.2841	517.3478	448.6250	348.6443	241.2576	172.5377	164.2137	233.8638	341.7792	456.8854	559.0883	(97)
Space heating kWh	88.5964	64.2517	46.3636	20.1915	5.9285	0.0000	0.0000	0.0000	0.0000	13.5482	43.5354	85.4699	(98a)
Space heating requirement - total per year (kWh/year)												367.8852	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	88.5964	64.2517	46.3636	20.1915	5.9285	0.0000	0.0000	0.0000	0.0000	13.5482	43.5354	85.4699	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												367.8852	
Space heating per m ²										(98c) / (4) =		5.9965	(99)

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 %)												333.6915	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												80.7000	(208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating efficiency (main heating system 1)	333.6915	333.6915	333.6915	333.6915	333.6915	0.0000	0.0000	0.0000	0.0000	333.6915	333.6915	333.6915	(210)
Space heating fuel (main heating system)	26.5504	19.2548	13.8942	6.0509	1.7766	0.0000	0.0000	0.0000	0.0000	4.0601	13.0466	25.6134	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													

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Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)	
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating requirement	221.5611	195.9809	208.2400	183.1042	177.5258	159.9950	157.8878	164.1119	165.8715	184.9372	196.6343	219.1362	165.1200	(64)	
Efficiency of water heater (217)m	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	(216)	
Fuel for water heating, kWh/month	134.1818	118.6900	126.1144	110.8916	107.5132	96.8962	95.6200	99.3895	100.4551	112.0017	119.0857	132.7133	165.1200	(217)	
Space cooling fuel 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	0.0000	(221)	
(221)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	0.0000	(221)	
Pumps and Fa	13.4162	12.1178	13.4162	12.9834	13.4162	12.9834	13.4162	13.4162	12.9834	13.4162	12.9834	13.4162	12.9834	(231)	
Lighting	16.5001	13.2370	11.9185	8.7320	6.7448	5.5106	6.1529	7.9977	10.3883	13.6300	15.3950	16.9587	16.9587	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)	-42.8758	-59.0224	-93.6353	-112.8013	-121.5929	-117.1390	-110.7822	-107.2236	-92.7623	-72.1879	-48.0003	-36.8434	0.0000	(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)	
Electricity generated by PVs (Appendix M) (negative quantity)	-21.1701	-42.2114	-102.0605	-186.7683	-252.0082	-284.0087	-243.2493	-214.7850	-143.1057	-70.1363	-29.4746	-16.5282	0.0000	(233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)	
Annual totals kWh/year															
Space heating fuel - main system 1														110.2471	(211)
Space heating fuel - main system 2														0.0000	(213)
Space heating fuel - secondary														0.0000	(215)
Efficiency of water heater														165.1200	
Water heating fuel used														1353.5525	(219)
Space cooling fuel														0.0000	(221)
Electricity for pumps and fans:															
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)															
mechanical ventilation fans (SFP = 0.7875)														157.9646	(230a)
Total electricity for the above, kWh/year														157.9646	(231)
Electricity for lighting (calculated in Appendix L)														133.1656	(232)
Energy saving/generation technologies (Appendices M ,N and Q)															
PV generation														-2620.3726	(233)
Wind generation														0.0000	(234)
Hydro-electric generation (Appendix N)														0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)														0.0000	(235)
Appendix Q - special features															
Energy saved or generated														-0.0000	(236)
Energy used														0.0000	(237)
Total delivered energy for all uses														-865.4428	(238)

10a. Fuel costs - using BEDF prices (538)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	110.2471	25.1600	27.7382	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1353.5525	25.1600	340.5538	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	157.9646	25.1600	39.7439	(249)
Energy for lighting	133.1656	25.1600	33.5045	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1014.8664	25.1600	-255.3404	
PV Unit electricity exported	-1605.5062	5.8100	-93.2799	
Total			-348.6203	(252)
Total energy cost			92.9200	(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	110.2471	0.1572	17.3313	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1353.5525	0.1409	190.6817	(264)
Space and water heating			208.0130	(265)
Pumps, fans and electric keep-hot	157.9646	0.1387	21.9116	(267)
Energy for lighting	133.1656	0.1443	19.2199	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1014.8664	0.1337	-135.6900	
PV Unit electricity exported	-1605.5062	0.1228	-197.2313	
Total			-332.9213	(269)
Total CO2, kg/year			-83.7767	(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	110.2471	1.5820	174.4094	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1353.5525	1.5209	2058.6227	(278)
Space and water heating			2233.0322	(279)
Pumps, fans and electric keep-hot	157.9646	1.5128	238.9688	(281)
Energy for lighting	133.1656	1.5338	204.2539	(282)
Energy saving/generation technologies				

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PV Unit electricity used in dwelling	-1014.8664	1.4941	-1516.2961
PV Unit electricity exported	-1605.5062	0.4508	-723.8316
Total			-2240.1277 (283)
Total Primary energy kWh/year			436.1272 (286)

 SAP 10 EPC IMPROVEMENTS

03_Energy Statement

Current energy efficiency rating: A 96
 Current environmental impact rating: A 100

N Solar water heating			Recommended
U Solar photovoltaic panels			Already installed
V2 Wind turbine			Recommended
Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 2.5	-£ 81	-48 kg (57.7%)
V2 Wind turbine	+ 25.9	-£ 692	-496 kg (375.5%)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
Solar water heating	£81	0.79 kg/m ²	A 99 A 101
Wind turbine	£692	8.08 kg/m ²	A 124 A 107
Total Savings	£773	8.87 kg/m ²	

Potential energy efficiency rating: A 124
 Potential environmental impact rating: A 107

Fuel prices for cost data on this page from database revision number 538 TEST (29 Feb 2024)
 Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£442	£344	£97
Space heating	£67	£88	-£20
Water heating	£341	£223	£118
Lighting	£34	£34	£0
Generated (PV)	-£349	-£332	-£16
Generated (wind)	-£0	-£692	£692
Total cost of fuels	£93	-£680	£773
Total cost of uses	£93	-£679	£774
Delivered energy	-14 kWh/m ²	-79 kWh/m ²	65 kWh/m ²
Carbon dioxide emissions	-0.1 tonnes	-0.6 tonnes	0.5 tonnes
CO2 emissions per m ²	-1 kg/m ²	-10 kg/m ²	9 kg/m ²
Primary energy	7 kWh/m ²	-71 kWh/m ²	79 kWh/m ²

 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
 CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	61.3500	2.6800 (2b)	164.4180 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	61.3500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	164.4180 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	1.0000 (17)
Infiltration rate	0.0500 (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) = 0.0388 (21)

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	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													
Balanced mechanical ventilation with heat recovery	0.0494	0.0484	0.0475	0.0426	0.0417	0.0368	0.0368	0.0358	0.0388	0.0417	0.0436	0.0455	(22b)
If mechanical ventilation													0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													84.6000 (23c)
Effective ac	0.1264	0.1254	0.1245	0.1196	0.1187	0.1138	0.1138	0.1128	0.1157	0.1187	0.1206	0.1225	(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	
Windows (Uw = 0.80)			18.0800	0.7752	14.0155			(27)
Ground Floor			61.3500	0.1200	7.3620	110.0000	6748.5000	(28a)
External Walls	44.7400	18.0800	26.6600	0.1100	2.9326	9.0000	239.9400	(29a)
External Roof	61.6100		61.6100	0.1100	6.7771	9.0000	554.4900	(30)
Total net area of external elements Aum(A, m2)			167.7000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...	(30) + (32) =	31.0872		(33)
Internal Partitions			87.5700				788.1300	(32c)
Heat capacity Cm = Sum(A x k)							(28)...	(30) + (32) + (32a)...
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								8331.0600 (34)
List of Thermal Bridges								135.7956 (35)

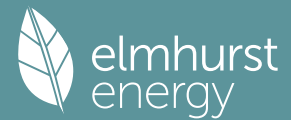
K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	8.3100	0.0200	0.1662	
E3 Sill	8.3100	0.0400	0.3324	
E4 Jamb	29.0100	0.0200	0.5802	
E5 Ground floor (normal)	34.0020	0.0100	0.3400	
E11 Eaves (insulation at rafter level)	23.6060	0.0300	0.7082	
E13 Gable (insulation at rafter level)	10.4400	0.0400	0.4176	
E16 Corner (normal)	10.7360	0.0400	0.4294	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				2.9740 (36)
Point Thermal bridges				(36a) = 0.0000
Total fabric heat loss				(33) + (36) + (36a) = 34.0612 (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	6.8585	6.8060	6.7534	6.4906	6.4380	6.1752	6.1752	6.1227	6.2804	6.4380	6.5432	6.6483	(38)
Heat transfer coeff	40.9198	40.8672	40.8147	40.5518	40.4993	40.2365	40.2365	40.1839	40.3416	40.4993	40.6044	40.7095	(39)
Average = Sum(39)m / 12 =													40.5387
HLP	0.6670	0.6661	0.6653	0.6610	0.6601	0.6559	0.6559	0.6550	0.6576	0.6601	0.6618	0.6636	(40)
HLP (average)													0.6608
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.0195 (42)
Hot water usage for mixer showers	74.5696	73.4489	71.8160	68.6915	66.3858	63.8144	62.3529	63.9735	65.7500	68.5109	71.7024	74.2839	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	35.3121	34.0280	32.7439	31.4598	30.1758	28.8917	28.8917	30.1758	31.4598	32.7439	34.0280	35.3121	(42c)
Average daily hot water use (litres/day)													100.8525 (43)
Daily hot water use	109.8816	107.4769	104.5599	100.1514	96.5616	92.7061	91.2446	94.1493	97.2099	101.2548	105.7304	109.5959	(44)
Energy conte	174.0257	153.0457	160.7046	137.1022	129.9904	113.9930	110.3524	116.5765	119.8695	137.4018	150.6323	171.6008	(45)
Energy content (annual)													Total = Sum(45)m = 1675.2949
Distribution loss (46)m = 0.15 x (45)m	26.1039	22.9569	24.1057	20.5653	19.4986	17.0990	16.5529	17.4865	17.9804	20.6103	22.5948	25.7401	(46)
Water storage loss:													229.0000 (47)
Store volume													1.4500 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.7830 (55)
Enter (49) or (54) in (55)													
Total storage loss	24.2730	21.9240	24.2730	23.4900	24.2730	23.4900	24.2730	24.2730	23.4900	24.2730	23.4900	24.2730	(56)
If cylinder contains dedicated solar storage													
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(57)
Combi 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	(61)
Total heat required for water heating calculated for each month	221.5611	195.9809	206.8443	176.3506	164.7315	147.3883	144.8609	152.0154	160.4686	183.5414	196.6343	219.1362	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector													3.0000 (H1)
Zero-loss collector efficiency													0.8000 (H2)
Collector linear heat loss coefficient													1.8000 (H3)
Collector 2nd order heat loss coefficient													0.0000 (H4)
Collector loop efficiency													0.9000 (H5)
Incidence angle modifier													1.0000 (H6)
Overshading factor													0.8000 (H8)
Overall heat loss coefficient of system													6.5000 (H10)
Heat loss coefficient of collector loop													3.9667 (H11)
Dedicated solar storage volume													75.0000 (H12)
Effective solar volume													75.0000 (H14)
Reference volume													225.0000 (H15)
Storage tank correction coefficient													1.3161 (H16)
Heat delivered to hot water													590.0407 (H24)
Heat delivered to space heating													0.0000 (H29)
Solar input													590.0407
Solar input	-0.0000	-16.2629	-56.7719	-76.6401	-98.0298	-89.9839	-89.1319	-79.0173	-55.7442	-28.4587	-0.0000	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	221.5611	179.7180	150.0724	99.7105	66.7017	57.4043	55.7290	72.9981	104.7244	155.0827	196.6343	219.1362	(64)

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Electric shower(s)	Total per year (kWh/year) = Sum(64)m = 1579.4728 (64)											
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Heat gains from water heating, kWh/month	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)											
	95.8919	85.2359	90.3460	76.9852	71.0147	64.6189	64.2989	67.1128	72.3359	82.5978	86.8869	95.0856 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	18.8510	16.7433	13.6165	10.3086	7.7058	6.5056	7.0295	9.1372	12.2639	15.5719	18.1747	19.3749 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	263.1916	265.9227	259.0404	244.3888	225.8938	208.5111	196.8984	194.1673	201.0496	215.7012	234.1962	251.5789 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368 (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)												
	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814 (71)
Water heating gains (Table 5)												
	128.8869	126.8391	121.4328	106.9239	95.4498	89.7485	86.4233	90.2054	100.4665	111.0186	120.6762	127.8032 (72)
Total internal gains												
	500.4569	499.0325	483.6172	451.1488	418.5769	394.2926	379.8787	383.0374	403.3075	431.8191	462.5745	488.2844 (73)

6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
Northeast	1.0000	11.2829	0.5700	0.8000	0.3000	1.3892 (75)						
Southwest	1.0000	36.7938	0.5700	0.8000	0.3000	4.5301 (79)						
Northwest	16.0800	11.2829	0.5700	0.8000	0.3000	22.3376 (81)						
Solar gains	28.2568	56.0129	97.5729	155.9854	206.7431	219.3355	205.6003	165.5790	117.4611	67.5504	35.2804	23.2533 (83)
Total gains	528.7138	555.0454	581.1901	607.1341	625.3201	613.6281	585.4789	548.6164	520.7686	499.3695	497.8549	511.5377 (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	56.5541	56.6269	56.6998	57.0673	57.1413	57.5146	57.5146	57.5898	57.3647	57.1413	56.9934	56.8462
alpha	4.7703	4.7751	4.7800	4.8045	4.8094	4.8343	4.8343	4.8393	4.8243	4.8094	4.7996	4.7897
util living area	0.9138	0.8890	0.8344	0.7296	0.5802	0.4160	0.3017	0.3358	0.5221	0.7507	0.8751	0.9229 (86)
Living	20.4589	20.5437	20.6809	20.8219	20.9027	20.9306	20.9350	20.9345	20.9204	20.8253	20.6287	20.4310
Non living	19.7374	19.8417	20.0077	20.1750	20.2631	20.2937	20.2973	20.2978	20.2836	20.1826	19.9510	19.7059
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.7232	20.5437	20.6809	20.8219	20.9027	20.9306	20.9350	20.9345	20.9204	20.8253	20.6287	20.5106 (87)
Th 2	20.3701	20.3708	20.3716	20.3754	20.3762	20.3800	20.3800	20.3808	20.3785	20.3762	20.3747	20.3731 (88)
util rest of house	0.9033	0.8760	0.8160	0.7030	0.5460	0.3768	0.2595	0.2910	0.4785	0.7202	0.8587	0.9133 (89)
MIT 2	20.1178	19.8417	20.0077	20.1750	20.2631	20.2937	20.2973	20.2978	20.2836	20.1826	19.9510	19.8261 (90)
Living area fraction	fLA = Living area / (4) =											0.5487 (91)
MIT	20.4500	20.2269	20.3771	20.5299	20.6140	20.6431	20.6472	20.6471	20.6330	20.5352	20.3228	20.2016 (92)
Temperature adjustment												0.0000
adjusted MIT	20.4500	20.2269	20.3771	20.5299	20.6140	20.6431	20.6472	20.6471	20.6330	20.5352	20.3228	20.2016 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9047	0.8728	0.8162	0.7098	0.5592	0.3935	0.2777	0.3103	0.4965	0.7283	0.8573	0.9104 (94)
Useful gains	478.3336	484.4299	474.3387	430.9482	349.6786	241.4747	162.6031	170.2520	258.5860	363.6734	426.7916	465.7267 (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												
	660.8532	626.3666	566.3873	471.6144	361.0110	243.1542	162.8451	170.6657	263.5506	402.3682	536.9052	651.4191 (97)
Space heating kWh												
	135.7946	95.3815	68.4842	29.2796	8.4313	0.0000	0.0000	0.0000	0.0000	28.7890	79.2818	138.1551 (98a)
Space heating requirement - total per year (kWh/year)												
												583.5971
Solar heating kWh												
	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												
												0.0000
Space heating kWh												
	135.7946	95.3815	68.4842	29.2796	8.4313	0.0000	0.0000	0.0000	0.0000	28.7890	79.2818	138.1551 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												
												583.5971
Space heating per m2												(98c) / (4) = 9.5126 (99)

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 %)												333.0197 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												80.7000 (208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	135.7946	95.3815	68.4842	29.2796	8.4313	0.0000	0.0000	0.0000	0.0000	28.7890	79.2818	138.1551 (98)

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Space heating efficiency (main heating system 1)	333.0197	333.0197	333.0197	333.0197	0.0000	0.0000	0.0000	0.0000	333.0197	333.0197	333.0197	(210)
Space heating fuel (main heating system)	40.7768	28.6414	20.5646	8.7922	2.5318	0.0000	0.0000	0.0000	8.6448	23.8070	41.4856	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	221.5611	179.7180	150.0724	99.7105	66.7017	57.4043	55.7290	72.9981	104.7244	155.0827	196.6343	219.1362 (64)
Efficiency of water heater	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200 (216)
Fuel for water heating, kWh/month	134.1818	108.8409	90.8869	60.3867	40.3959	34.7652	33.7506	44.2091	63.4232	93.9212	119.0857	132.7133 (219)
Space cooling fuel 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 (221)
Pumps and Fa	20.2107	18.2548	20.2107	19.5587	20.2107	19.5587	20.2107	20.2107	19.5587	20.2107	19.5587	20.2107 (231)
Lighting	16.5001	13.2370	11.9185	8.7320	6.7448	5.5106	6.1529	7.9977	10.3883	13.6300	15.3950	16.9587 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-33.2175	-52.9124	-84.0537	-97.9881	-103.5073	-96.3214	-94.7447	-90.5977	-80.1601	-63.0400	-38.1424	-27.6738 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-13.0378	-33.8595	-86.7353	-160.2615	-238.0708	-248.0114	-241.4963	-188.7136	-117.8312	-54.3775	-18.6725	-9.6863 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	-91.1028	-82.2864	-91.1028	-88.1640	-91.1028	-88.1640	-91.1028	-88.1640	-91.1028	-88.1640	-91.1028	-88.1640 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												175.2441 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												165.1200
Water heating fuel used												956.5606 (219)
Space cooling fuel												0.0000 (221)

Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)												
mechanical ventilation fans (SFP = 0.7875)												157.9646 (230a)
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												237.9646 (231)
Electricity for lighting (calculated in Appendix L)												133.1656 (232)

Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2273.1130 (233)
Wind generation												-3575.5408 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												-4345.7189 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	175.2441	16.4900	28.8977 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	956.5606	16.4900	157.7368 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	157.9646	16.4900	26.0484 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	133.1656	16.4900	21.9590 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-862.3592	16.4900	-142.2030
PV Unit electricity exported	-1410.7538	5.5900	-78.8611
Total			-221.0642 (252)
Wind Turbine electricity used in dwelling	-2502.8785	16.4900	-412.7247
Wind Turbine electricity exported	-1072.6622	5.5900	-59.9618
Total			-472.6865 (252)
Total energy cost			-445.9167 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	-1.5095 (257)
SAP value		124.4682
SAP rating (Section 12)		124 (258)
SAP band		A

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	175.2441	0.1569	27.4998 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	956.5606	0.1465	140.1541 (264)
Space and water heating			167.6539 (265)
Pumps, fans and electric keep-hot	237.9646	0.1387	33.0086 (267)

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Energy for lighting	133.1656	0.1443	19.2199 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-862.3592	0.1337	-115.2614
PV Unit electricity exported	-1410.7538	0.1212	-170.9852
Total			-286.2466 (269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801
Wind Turbine electricity exported	-1072.6622	0.1387	-148.7915
Total			-495.9716 (269)
Total CO2, kg/year			-562.3357 (272)
CO2 emissions per m2			-9.1700 (273)
EI value			107.0854
EI rating			107 (274)
EI band			A

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	61.3500 (1b)	x 2.6800 (2b)	= 164.4180 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	61.3500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 164.4180 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		1.0000	(17)
Infiltration rate		0.0500	(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) =		0.0388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.3000	5.7000	5.6000	5.1000	5.1000	4.5000	4.6000	4.5000	4.8000	5.7000	5.8000	6.2000 (22)
Wind factor	1.5750	1.4250	1.4000	1.2750	1.2750	1.1250	1.1500	1.1250	1.2000	1.4250	1.4500	1.5500 (22a)
Adj infilt rate	0.0610	0.0552	0.0543	0.0494	0.0494	0.0436	0.0446	0.0436	0.0465	0.0552	0.0562	0.0601 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												84.6000 (23c)
Effective ac	0.1380	0.1322	0.1312	0.1264	0.1264	0.1206	0.1216	0.1206	0.1235	0.1322	0.1332	0.1371 (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
Windows (Uw = 0.80)			18.0800	0.7752	14.0155		(27)
Ground Floor			61.3500	0.1200	7.3620	110.0000	6748.5000 (28a)
External Walls	44.7400	18.0800	26.6600	0.1100	2.9326	9.0000	239.9400 (29a)
External Roof	61.6100		61.6100	0.1100	6.7771	9.0000	554.4900 (30)
Total net area of external elements Aum(A, m2)			167.7000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	31.0872	(33)
Internal Partitions			87.5700			9.0000	788.1300 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							8331.0600 (34)
List of Thermal Bridges							135.7956 (35)
K1 Element				Length	Psi-value		Total
E2 Other lintels (including other steel lintels)				8.3100	0.0200		0.1662
E3 Sill				8.3100	0.0400		0.3324
E4 Jamb				29.0100	0.0200		0.5802
E5 Ground floor (normal)				34.0020	0.0100		0.3400
E11 Eaves (insulation at rafter level)				23.6060	0.0300		0.7082
E13 Gable (insulation at rafter level)				10.4400	0.0400		0.4176
E16 Corner (normal)				10.7360	0.0400		0.4294
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							2.9740 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	34.0612 (37)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	7.4893	7.1739	7.1214	6.8585	6.8585	6.5432	6.5957	6.5432	6.7009	7.1739	7.2265	7.4367	(38)
Heat transfer coeff	41.5505	41.2352	41.1826	40.9198	40.9198	40.6044	40.6570	40.6044	40.7621	41.2352	41.2877	41.4980	(39)
Average = Sum(39)m / 12 =												41.0381	
HLP	0.6773	0.6721	0.6713	0.6670	0.6670	0.6618	0.6627	0.6618	0.6644	0.6721	0.6730	0.6764	(40)
HLP (average)												0.6689	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.0195	(42)
Hot water usage for mixer showers	74.5696	73.4489	71.8160	68.6915	66.3858	63.8144	62.3529	63.9735	65.7500	68.5109	71.7024	74.2839	74.2839	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	35.3121	34.0280	32.7439	31.4598	30.1758	28.8917	28.8917	30.1758	31.4598	32.7439	34.0280	35.3121	35.3121	(42c)
Average daily hot water use (litres/day)													100.8525	(43)
Daily hot water use	109.8816	107.4769	104.5599	100.1514	96.5616	92.7061	91.2446	94.1493	97.2099	101.2548	105.7304	109.5959	109.5959	(44)
Energy conte	174.0257	153.0457	160.7046	137.1022	129.9904	113.9930	110.3524	116.5765	119.8695	137.4018	150.6323	171.6008	171.6008	(45)
Energy content (annual)													1675.2949	
Distribution loss (46)m = 0.15 x (45)m	26.1039	22.9569	24.1057	20.5653	19.4986	17.0990	16.5529	17.4865	17.9804	20.6103	22.5948	25.7401	25.7401	(46)
Water storage loss:													229.0000	(47)
Store volume													1.4500	(48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400	(49)
Temperature factor from Table 2b													0.7830	(55)
Enter (49) or (54) in (55)														
Total storage loss	24.2730	21.9240	24.2730	23.4900	24.2730	23.4900	24.2730	24.2730	23.4900	24.2730	23.4900	24.2730	24.2730	(56)
If cylinder contains dedicated solar storage	24.2730	21.9240	24.2730	23.4900	24.2730	23.4900	24.2730	24.2730	23.4900	24.2730	23.4900	24.2730	24.2730	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	23.2624	(59)
Combi 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	0.0000	(61)
Total heat required for water heating calculated for each month	221.5611	195.9809	206.8443	176.3506	164.7315	147.3883	144.8609	152.0154	160.4686	183.5414	196.6343	219.1362	219.1362	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector													3.0000	(H1)
Zero-loss collector efficiency													0.8000	(H2)
Collector linear heat loss coefficient													1.8000	(H3)
Collector 2nd order heat loss coefficient													0.0000	(H4)
Collector loop efficiency													0.9000	(H5)
Incidence angle modifier													1.0000	(H6)
Overshading factor													0.8000	(H8)
Overall heat loss coefficient of system													6.5000	(H10)
Heat loss coefficient of collector loop													3.9667	(H11)
Dedicated solar storage volume													75.0000	(H12)
Effective solar volume													75.0000	(H14)
Reference volume													225.0000	(H15)
Storage tank correction coefficient													1.3161	(H16)
Heat delivered to hot water													706.6387	(H24)
Heat delivered to space heating													0.0000	(H29)
Solar input	-7.9993	-24.6712	-67.7710	-89.8273	-105.9649	-103.2906	-92.2173	-90.6517	-69.1829	-41.6441	-12.8102	-0.6083	-0.6083	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	213.5617	171.3097	139.0733	86.5233	58.7666	44.0976	52.6436	61.3638	91.2857	141.8974	183.8242	218.5279	218.5279	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower (s) (kWh/year) = Sum(64a)m =													0.0000	(64a)
Heat gains from water heating, kWh/month	95.8919	85.2359	90.3460	76.9852	71.0147	64.6189	64.2989	67.1128	72.3359	82.5978	86.8869	95.0856	95.0856	(65)

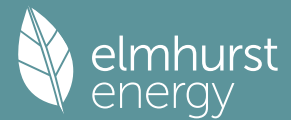
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	121.1721	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.8510	16.7433	13.6165	10.3086	7.7058	6.5056	7.0295	9.1372	12.2639	15.5719	18.1747	19.3749	19.3749	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	263.1916	265.9227	259.0404	244.3888	225.8938	208.5111	196.8984	194.1673	201.0496	215.7012	234.1962	251.5789	251.5789	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	49.1368	(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	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	-80.7814	(71)
Water heating gains (Table 5)	128.8869	126.8391	121.4328	106.9239	95.4498	89.7485	86.4233	90.2054	100.4665	111.0186	120.6762	127.8032	127.8032	(72)
Total internal gains	500.4569	499.0325	483.6172	451.1488	418.5769	394.2926	379.8787	383.0374	403.3075	431.8191	462.5745	488.2844	488.2844	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	1.0000	15.4493	0.5700	0.8000	0.3000	1.9021 (75)
Southwest	1.0000	47.1180	0.5700	0.8000	0.3000	5.8012 (79)
Northwest	16.0800	15.4493	0.5700	0.8000	0.3000	30.5860 (81)

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Solar gains	38.2893	64.6476	112.0794	182.9486	229.1282	258.8725	219.3504	193.2759	140.8761	81.4367	47.2301	32.4099 (83)
Total gains	538.7462	563.6801	595.6967	634.0973	647.7051	653.1651	599.2290	576.3133	544.1836	513.2558	509.8046	520.6944 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												
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	55.6956	56.1216	56.1932	56.5541	56.5541	56.9934	56.9197	56.9934	56.7729	56.1216	56.0502	55.7662
alpha	4.7130	4.7414	4.7462	4.7703	4.7703	4.7996	4.7946	4.7996	4.7849	4.7414	4.7367	4.7177
util living area	0.8653	0.8412	0.7827	0.6815	0.5459	0.3890	0.3113	0.3092	0.4510	0.6548	0.7989	0.8695 (86)
Living	20.6210	20.6702	20.7608	20.8534	20.9099	20.9314	20.9343	20.9344	20.9276	20.8809	20.7646	20.6205
Non living	19.9280	19.9902	20.0968	20.2044	20.2640	20.2888	20.2904	20.2913	20.2837	20.2320	20.1028	19.9289
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.8061	20.6702	20.7608	20.8534	20.9099	20.9314	20.9343	20.9344	20.9276	20.8809	20.7646	20.6736 (87)
Th 2	20.3610	20.3655	20.3663	20.3701	20.3701	20.3747	20.3739	20.3747	20.3724	20.3655	20.3648	20.3617 (88)
util rest of house	0.8486	0.8226	0.7595	0.6524	0.5109	0.3512	0.2693	0.2656	0.4065	0.6162	0.7733	0.8528 (89)
MIT 2	20.1884	19.9902	20.0968	20.2044	20.2640	20.2888	20.2904	20.2913	20.2837	20.2320	20.1028	20.0069 (90)
Living area fraction	20.5273	20.3633	20.4611	20.5605	20.6184	20.6413	20.6437	20.6442	20.6370	20.5880	20.4659	20.3727 (92)
MIT	20.5273	20.3633	20.4611	20.5605	20.6184	20.6413	20.6437	20.6442	20.6370	20.5880	20.4659	20.3727 (92)
Temperature adjustment												0.0000
adjusted MIT	20.5273	20.3633	20.4611	20.5605	20.6184	20.6413	20.6437	20.6442	20.6370	20.5880	20.4659	20.3727 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8531	0.8226	0.7631	0.6614	0.5249	0.3674	0.2874	0.2844	0.4254	0.6300	0.7776	0.8531 (94)
Useful gains	459.6052	463.6715	454.5714	419.3902	339.9494	239.9640	172.2199	163.9266	231.4902	323.3735	396.4195	444.2094 (95)
Ext temp.	6.6000	6.8000	7.9000	9.6000	12.1000	14.7000	16.4000	16.6000	14.9000	12.3000	9.4000	6.9000 (96)
Heat loss rate W	578.6863	559.2841	517.2978	448.4994	348.5691	241.2448	172.5340	164.2104	233.8518	341.7584	456.8854	559.0883 (97)
Space heating kWh	88.5964	64.2517	46.6685	20.9587	6.4130	0.0000	0.0000	0.0000	0.0000	13.6784	43.5354	85.4699 (98a)
Space heating requirement - total per year (kWh/year)												369.5720
Solar heating kWh	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh	88.5964	64.2517	46.6685	20.9587	6.4130	0.0000	0.0000	0.0000	0.0000	13.6784	43.5354	85.4699 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												369.5720
Space heating per m2										(98c) / (4) =		6.0240 (99)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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 %)												333.6915 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												80.7000 (208)
Space heating requirement	88.5964	64.2517	46.6685	20.9587	6.4130	0.0000	0.0000	0.0000	0.0000	13.6784	43.5354	85.4699 (98)
Space heating efficiency (main heating system 1)	333.6915	333.6915	333.6915	333.6915	333.6915	0.0000	0.0000	0.0000	0.0000	333.6915	333.6915	333.6915 (210)
Space heating fuel (main heating system)	26.5504	19.2548	13.9855	6.2809	1.9218	0.0000	0.0000	0.0000	0.0000	4.0991	13.0466	25.6134 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	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	213.5617	171.3097	139.0733	86.5233	58.7666	44.0976	52.6436	61.3638	91.2857	141.8974	183.8242	218.5279 (64)
Efficiency of water heater	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200	165.1200 (216)
Fuel for water heating, kWh/month	129.3373	103.7486	84.2256	52.4003	35.5902	26.7064	31.8820	37.1631	55.2845	85.9359	111.3276	132.3449 (219)
Space cooling fuel 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 (221)
Pumps and Fa	20.2107	18.2548	20.2107	19.5587	20.2107	19.5587	20.2107	20.2107	19.5587	20.2107	19.5587	20.2107 (231)
Lighting	16.5001	13.2370	11.9185	8.7320	6.7448	5.5106	6.1529	7.9977	10.3883	13.6300	15.3950	16.9587 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-42.9182	-58.6148	-90.1534	-103.2326	-105.5829	-98.6140	-95.9021	-94.1299	-86.3045	-70.6287	-47.9600	-36.9564 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-212.5732	-212.5732	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-21.1277	-42.6190	-105.5424	-196.3369	-268.0182	-302.5337	-258.1294	-227.8787	-149.5635	-71.6956	-29.5149	-16.4152 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	-91.1028	-82.2864	-91.1028	-88.1640	-91.1028	-88.1640	-91.1028	-91.1028	-88.1640	-91.1028	-88.1640	-91.1028 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												110.7526 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												165.1200
Water heating fuel used												885.9464 (219)

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Space cooling fuel		0.0000 (221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)		
mechanical ventilation fans (SFP = 0.7875)		157.9646 (230a)
pump for solar water heating		80.0000 (230g)
Total electricity for the above, kWh/year		237.9646 (231)
Electricity for lighting (calculated in Appendix L)		133.1656 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-2620.3726 (233)
Wind generation		-3575.5408 (234)
Hydro-electric generation (Appendix N)		0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)		0.0000 (235)
Appendix Q - special features		
Energy saved or generated		-0.0000 (236)
Energy used		0.0000 (237)
Total delivered energy for all uses		-4828.0841 (238)

10a. Fuel costs - using BEDF prices (538)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	110.7526	25.1600	27.8654 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	885.9464	25.1600	222.9041 (247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (247a)
Pumps, fans and electric keep-hot	157.9646	25.1600	39.7439 (249)
Pump for solar water heating	80.0000	25.1600	20.1280 (249)
Energy for lighting	133.1656	25.1600	33.5045 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-930.9974	25.1600	-234.2389
PV Unit electricity exported	-1689.3752	5.8100	-98.1527
Total			-332.3916 (252)
Wind Turbine electricity used in dwelling	-2502.8785	25.1600	-629.7242
Wind Turbine electricity exported	-1072.6622	5.8100	-62.3217
Total			-692.0459 (252)
Total energy cost			-680.2917 (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	110.7526	0.1571	17.4026 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	885.9464	0.1473	130.4800 (264)
Space and water heating			147.8827 (265)
Pumps, fans and electric keep-hot	237.9646	0.1387	33.0086 (267)
Energy for lighting	133.1656	0.1443	19.2199 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-930.9974	0.1346	-125.2886
PV Unit electricity exported	-1689.3752	0.1225	-206.8994
Total			-332.1880 (269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801
Wind Turbine electricity exported	-1072.6622	0.1387	-148.7915
Total			-495.9716 (269)
Total CO2, kg/year			-628.0484 (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	110.7526	1.5817	175.1791 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	885.9464	1.5449	1368.6642 (278)
Space and water heating			1543.8433 (279)
Pumps, fans and electric keep-hot	237.9646	1.5128	359.9928 (281)
Energy for lighting	133.1656	1.5338	204.2539 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-930.9974	1.4974	-1394.0472
PV Unit electricity exported	-1689.3752	0.4494	-759.2848
Total			-2153.3320 (283)
Wind Turbine electricity used in dwelling	-2502.8785	1.5128	-3786.3546
Wind Turbine electricity exported	-1072.6622	0.5128	-550.0612
Total			-4336.4158 (283)
Total Primary energy kWh/year			-4381.6578 (286)