Energy Statement

Applicant: Mr Daniel Kemp

Agent: Stephens Scown LLP

Project: Proposed Dwelling at land adjacent to 11 Penvale View, Holywell Road, Cubert, Cornwall, TR8 5FW

Version: P2404018/1.0

Date: 23 April 2024

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Revision	Date of issue	Description	Author
1.0	23/04/2024	First Issue.	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 dwelling on land adjacent to 11 Penvale View, Cubert, Newquay, Cornwall, TR8 5FW with a floor area of 167.54 m².

A.03 This Energy Statement provides an assessment of space heating demand, total energy consumption, on-site renewable energy generation arising from the development and water consumption calculations.

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.

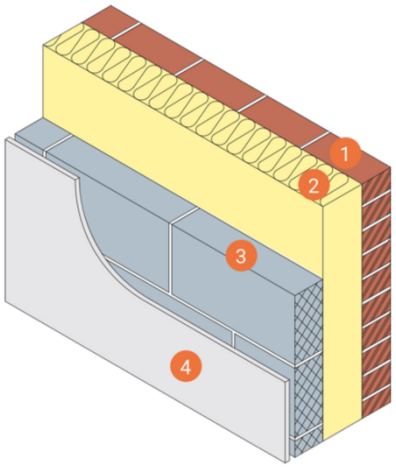
C.1 Massing and thermal envelope

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

Element	U-value (W/m².K)	Construction
Ground floor	0.11	Ground-bearing concrete slab, insulated above.
External walls	0.18	Full-fill masonry cavity wall with stone outer leaf, 0.190 W/mK inner leaf and plasterboard on dabs.
Roof (plane)	0.11	Timber rafters with insulation at ceiling joist level.
Roof (slope)	0.11	Timber rafters with insulation between.
Windows	1.20	Triple glazed windows.
Doors	1.00	Solid external doors.

C.1.02 Internal partitions within the dwelling are masonry blockwork at ground floor and timber studwork with plasterboard lining and mineral fibre insulation between at first floor.

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 the psi (ψ) values shown in the Recognised Construction Details for masonry full-fill cavity construction comprising: (1) brickwork/stonework outer leaf, (2) 150mm thick 0.032 W/mK cavity insulation, (3) 100mm thick 0.190 W/mK internal blockwork leaf, and (4) plasterboard on dabs.



Refer to **Appendix H.3 Thermal Bridging** for the thermal bridging report and relevant construction details.

C.2 Ventilation

C.2.01 The dwelling will be ventilated by a Mechanical Ventilation with Heat Recovery system (MVHR) with rigid ducting and Level 1 duct installation and installed by an approved installer as per the following specification:

Manufacturer and model	Efficiency	No. of wetrooms
Zehnder ComfoAir Flex 250	90.0%	5

C.2.02 Design airtightness (AP50) value of 1.0 $m^3/h/m^2$.

C.3 Orientation and site layout

C.3.01 The dwelling is sited within the existing garden with an orientation to match the existing dwellings. Trees are sufficiently distant to provide minimal overshading.

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 4000 K 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/m²	Energy consumption W/m²
Kitchen / Dining / Lounge	350	2.69
Bedroom	300	2.31
Bathroom	400	3.08
Circulation spaces	200	1.54

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) and installed by an MCS-certified installer as per the following specification:

Manufacturer and model	Winter efficiency	Summer efficiency
Daikin Altherma 3 Monobloc EDLA04EV3	340.19%	169.85%

D.2 Secondary space heating

There is no proposed secondary space heating.

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.
Bath	161 l to overflow	Cleargreen Baths ENVIRO R1.
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 by an MCS certified installer:

- on the main roof of the dwelling facing South West at 25° pitch, with little or no overshading (1no. horizontal row, 4no. panels per row); and
- on the garage roof of the dwelling facing South West at 25° pitch, with modest overshading (3no. horizontal rows, 2no. panels per row).

E.1.02 The following array sizes have been modelled for the Energy Summary Tool, comprising Marley M10 405Wp photo-voltaic panels:

Location	No. off	Orientation	Pitch	Peak generation kWp
Main roof	4	South West	25°	1.62
Garage roof	6	South West	25°	2.43
TOTAL	**10**			**4.05**

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/m²$_{TFA}$/yr	**Total energy use** kWh/m²$_{GIA}$/yr	**Renewable generation** % total energy	**Renewable deficit** kWh/yr
Required	*<30.0*	*<40.0*	*100%*	*0*
Dwelling	26.3	21.1	101%	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*
Dwelling	109.91	0.00	0.00	105.00

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.1 Climate Emergency DPD Policy Energy Summary Tool (SAP V2.0)

Information Classification: PUBLIC

3 - INPUT SAP (10.2) DATA

CORNWALL COUNCIL Etude

SAP Conversion Tool V2.0

Climate Zone: 4 South West England

↓ INSERT INFORMATION HERE ↓ (Inputs - general) ↓ INSERT INFORMATION HERE ↓ (Inputs - Space Heating Demand)

*excluding internal partition elements

Results				Inputs - general							Inputs - Space Heating Demand										
Space heat demand	Total energy use	Renewable generation	Renewable deficit	Quantity	Plot Name	Bedrooms	Number of storeys	SAP Floor Area	Volume	Site Exposure	Air permeability @50Pa	Total area external elements	Total area party elements*	Ventilation system	Heat recovery	Thermal mass	Fabric heat loss				
kWh/m²TFA/yr	kWh/m²GIA/yr	% total energy	kWh/year					m2	m3		m3/m2/hr	m2	m2		%	kJ/m2/K	W/K				
Required values:				Box numbers from SAP calculation printout --->				[4]	[5]		[17]	[31]	[32]+[32a]+[32b]		[23c]	[35]	[37]				
<30	<40	100%	0															Jan	Feb	Mar	Apr
30.0	33.4	107%	0	1	EXAMPLE - Semi Detached House	3	2	93.2	235	Normal	0.95	193	39	MVHR	79%	124	56.5	91	137	203	282
26.3	21.1	101%	0	1	House	4	2	167.54	441	Normal	1	381	0	MVHR	81%	282	92.9	181	293	465	706
		Total:	0																		

↓ INSERT INFORMATION HERE ↓

↓ INSERT INFO

Solar gains								Inputs - Total Energy Use										Inputs - Renewables	W			
W								Space heat source	Heating efficiency	Space heat source	Heating efficiency	Fraction of heat	Domestic hot water source	Water heating efficiency	Hot water storage losses	Pumps and fans energy	Lighting Efficacy	Renewable Generation (negative number)	Inputs only required for: waste wate			
[83]								(Primary)		(Secondary)					kWh/day	kWh/year	Lumen/Watt	kWh/year				
									[206]		[207]	[201]		[216]	[48]	[231]		[233]				
May	Jun	Jul	Aug	Sep	Oct	Nov	Dec												Jan	Feb	Mar	Apr
322	*353*	*311*	*287*	*235*	*158*	*107*	*74*	*Heat pump - air to water*	*311%*				*Heat pump - air to water*	*189%*	*1.4*	*180*	*100*	*-3142*				
835	940	804	726	565	352	214	150	Heat pump - air to water	340%				Heat pump - air to water	170%	1.6	57	130	-3352				

ORMATION HERE - WHERE APPLICABLE ↓

Water Heating Reductions - where applicable

r heat recovery, solar hot water and flue gas heat recovery (negative numbers)

kWh

Sum of [63 a, c and d]

May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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)	161.00	0.11	0.00	17.71
Shower (where bath also present)	Flow Rate(litres / minute)	8.00	4.37	0.00	34.96
Bath Only	Capacity to overflow(litres)		0.50	0.00	0
Shower Only	Flow Rate (litres/minute)		5.60	0.00	0
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)	☐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)			109.91
	(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)			100.02
	(10)	External water use			5.0
	(11)	Total water consumption (Building Regulation 17.K) =(9)+(10)(litres/person/day)			105.0

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
Baths (shower(s) present)	Cleargreen Baths ENVIRO R1.	17.71
Showers (bath(s) present)	Ideal Standard shower outlet regulator.	34.96
Kitchen Taps	Ideal Standard Cerasprint B5344AA single lever monoblock mixer with flow regulator.	12.56
Washing Machines		17.157
Dishwasher		4.5

H.3 Thermal Bridging

H.3.01 Thermal Bridging Report

Thermal Bridging

elmhurst energy

Property Reference	House	Issued on Date	23/04/2024
Assessment Reference	00_Initial Assessment	Prop Type Ref	Detached House
Property	12, Penhale View, Newquay, Cornwall, TR8 5FW		

SAP Rating	93 A	DER	0.90	TER	9.52
Environmental	99 A	% DER < TER			90.55
CO_2 Emissions (t/year)	0.04	DFEE	39.57	TFEE	44.67
Compliance Check	See BREL	% DFEE < TFEE			11.42
% DPER < TPER	67.02	DPER	16.62	TPER	50.39

Assessor Details	Mr. Stuart Foster	Assessor ID	CK03-0001
Client	CL2404024, Daniel Kemp		

	Junction details	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Non Gov Approved Schemes	0.019	14.73	0.28	RCD E2-01
External wall	E3 Sill	Non Gov Approved Schemes	0.022	12.84	0.28	RCD E3-01
External wall	E4 Jamb	Non Gov Approved Schemes	0.017	44.06	0.75	RCD E4-01
External wall	E5 Ground floor (normal)	Non Gov Approved Schemes	0.055	41.60	2.29	RCD E5-10
External wall	E6 Intermediate floor within a dwelling	Non Gov Approved Schemes	0.001	41.67	0.04	RCD E6-01
External wall	E16 Corner (normal)	Non Gov Approved Schemes	0.042	25.19	1.06	RCD E16-01
External roof	R1 Head of roof window	Table K1 - Default	0.240	3.75	0.90	
External roof	R2 Sill of roof window	Table K1 - Default	0.240	3.75	0.90	
External wall	E10 Eaves (insulation at ceiling level)	Non Gov Approved Schemes	0.057	9.80	0.56	RCD E10-01
External wall	E11 Eaves (insulation at rafter level)	Non Gov Approved Schemes	0.018	2.16	0.04	RCD E11-01
External wall	E13 Gable (insulation at rafter level)	Non Gov Approved Schemes	0.043	19.20	0.83	RCD E13-01
External wall	E17 Corner (inverted – internal area greater than external area)	Non Gov Approved Schemes	-0.085	10.08	-0.86	RCD E17-01
External roof	R3 Jamb of roof window	Table K1 - Default	0.240	11.05	2.65	
External roof	R4 Ridge (vaulted ceiling)	Table K1 - Default	0.120	9.31	1.12	
External roof	R8 Roof to wall (rafter)	Table K1 - Default	0.120	14.49	1.74	
External wall	E10 Eaves (insulation at ceiling level)	Table K1 - Default	0.120	4.16	0.50	Dormer
External wall	E12 Gable (insulation at ceiling level)	Table K1 - Default	0.250	1.97	0.49	Dormer

Total: 269.82 W/mK:

Y-Value: 0.04 W/m²K:

SAP 10 Online 2.13.5 Page 1 of 1

H.3.02 Junction E2

Calculated Ψ (Psi) value for use in SAP Calculation

Insulation thermal conductivity (W/mK)	Internal leaf block thermal conductivity (W/mK)					
	0.11	0.15	0.19	0.28	0.6	1.33
0.032	0.023	0.020	0.019	0.017	0.015	0.014
0.034	0.023	0.020	0.019	0.017	0.015	0.013
0.037	0.023	0.021	0.019	0.016	0.014	0.013

f-values: 0.954 - 0.958 (values above 0.75 indicate low risk of condensation and mould)

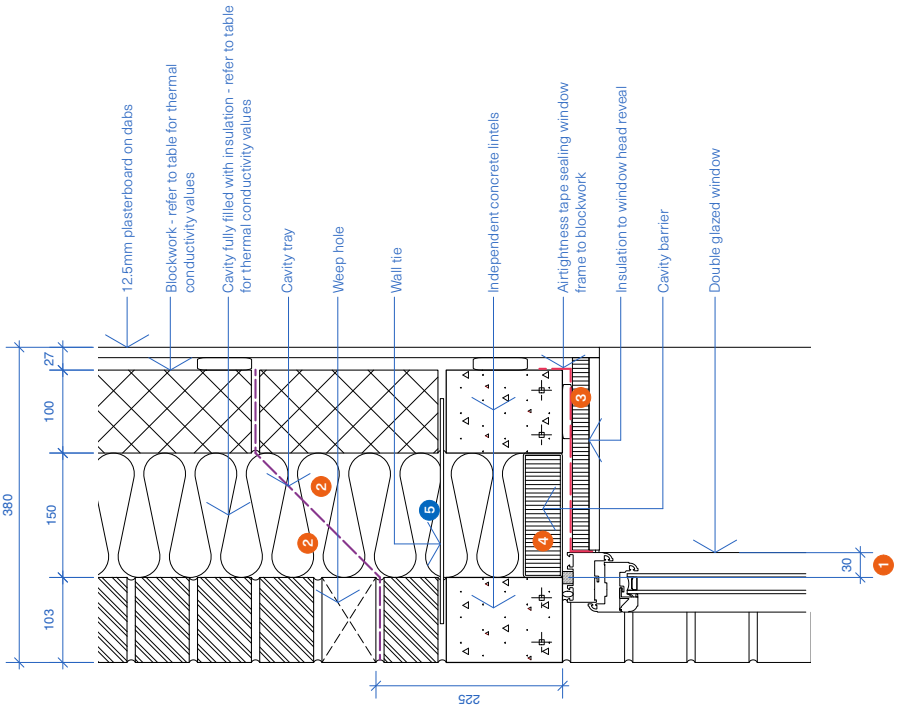
Ψ (Psi) value Thermal Compliance Notes

1. Minimum 30mm overlap of window frame and insulated wall cavity.
2. Ensure insulation is fitted around the angle of the cavity tray.
3. Minimum 15mm insulation with λ≤0.026W/mK to head reveal.
4. Insulated cavity barrier with λ≤0.026W/mK fixed in accordance with manufacturers guidelines. If fixing spikes are used, they should be installed at the required centres. For compression fit cavity barriers, use the correct size for a compressive fit in the cavity.

Construction Notes

5. Wall tie: 225mm maximum distance from opening. No greater than 450mm vertical spacing. 450mm horizontal centres for first row of wall ties above and below opening.

Construction Detail

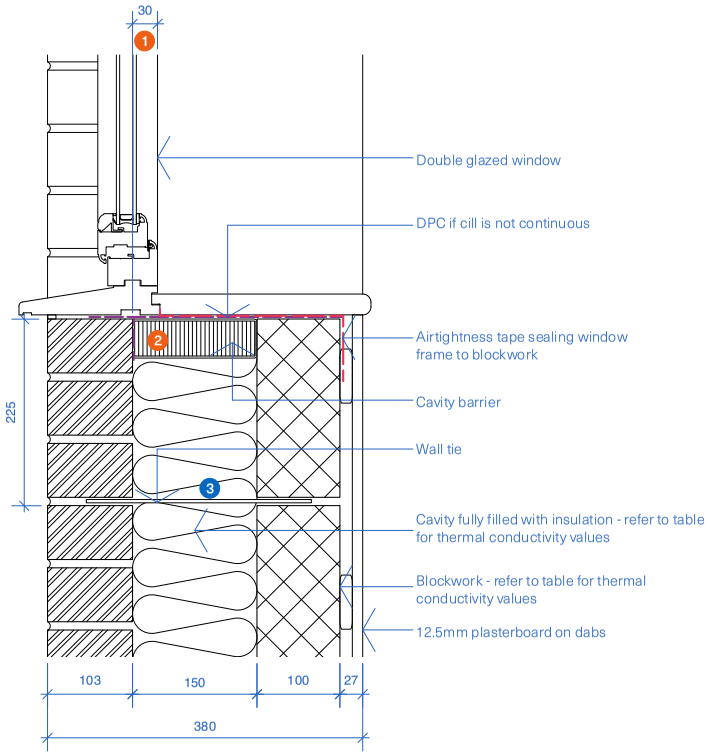


recognised construction details

Masonry Full Fill | 150mm Cavity | 150mm Insulation | MFF-150-E2-01 | Independent Concrete Lintels

Date: | Sign off:

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

	Internal leaf block thermal conductivity (W/mK)					
Insulation thermal conductivity (W/mK)	0.11	0.15	0.19	0.28	0.6	1.33
0.032	0.024	0.023	0.022	0.022	0.021	0.021
0.034	0.023	0.022	0.022	0.021	0.021	0.021
0.037	0.023	0.022	0.022	0.021	0.020	0.020

f-values: 0.881 - 0.893 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. Minimum 30mm overlap of window frame and insulated wall cavity.
2. Insulated cavity barrier with λ≤0.026W/mK fixed in accordance with manufacturers guidelines. If fixing spikes are used, they should be installed at the required centres. For compression fit cavity barriers, use the correct size for a compressive fit in the cavity.

Construction Notes

3. Wall tie: 225mm maximum distance from opening. No greater than 450mm vertical spacing. 450mm horizontal centres for first row of wall ties above and below opening.

recognised construction details

Masonry Full Fill | 150mm Cavity | 150mm Insulation | MFF-150-E3-01 | Cill, Proprietary insulated closer

Date: | Sign off:

H.3.04 Junction E4

Calculated Ψ (Psi) value for use in SAP Calculation

Insulation thermal conductivity (W/mK)	Internal leaf block thermal conductivity (W/mK)					
	0.11	0.15	0.19	0.28	0.6	1.33
0.032	0.019	0.018	0.017	0.017	0.016	0.016
0.034	0.019	0.017	0.017	0.016	0.016	0.016
0.037	0.018	0.017	0.017	0.016	0.015	0.015

f-values: 0.931 - 0.938 (values above 0.75 indicate low risk of condensation and mould)

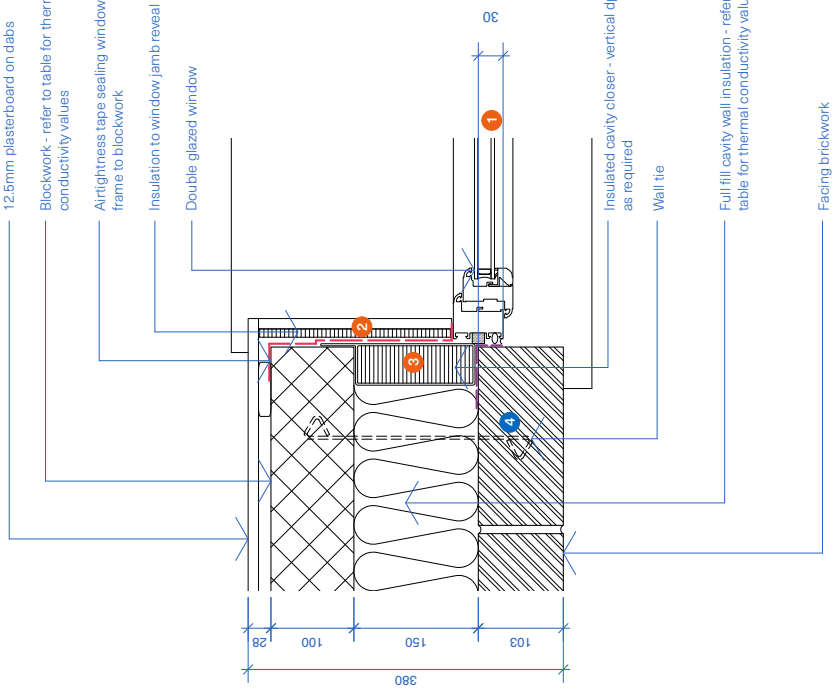
Ψ (Psi) value Thermal Compliance Notes

1. Minimum 30mm overlap of window frame and insulated wall cavity.
2. 10mm insulation with λ≤0.026W/mK to window jamb reveal.
3. Insulated cavity barrier with λ≤0.026W/mK fixed in accordance with maufacturers guidelines. If fixing spikes are used, they should be installed at the required centres. For compression fit cavity barriers, use the correct size for a compressive fit in the cavity.

Construction Notes

4. Wall tie: 225mm maximum distance from opening. No greater than 450mm vertical spacing. 450mm horizontal centres for first row of wall ties above and below opening.

Construction Detail



recognised construction details

Masonry Full Fill | 150mm Cavity | 150mm Insulation | MFF-150-E4-01 | Window jamb

Date: | Sign off:

H.3.05 Junction E5

Calculated Ψ (Psi) value for use in SAP Calculation

Insulation thermal conductivity (W/mK)	Internal leaf block thermal conductivity (W/mK)					
	0.11	0.15	0.19	0.28	0.6	1.33
0.032	0.038	0.047	0.055	0.059	0.095	0.155
0.034	0.039	0.047	0.055	0.060	0.096	0.154
0.037	0.039	0.048	0.055	0.060	0.096	0.154

f-values: 0.898 - 0.940 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. Minimum 20mm perimeter insulation with λ≤0.022W/mK.
2. Ensure the floor insulation is tightly butted against the external wall.
3. Continue full fill rigid cavity insulation at least 225mm below the top of slab. Insulation below DPC to provide thermal resistance equal to or better than main wall insulation.
4. 100mm Ground bearing slab.
5. 100mm insulation (0.022W/mK) above slab.
6. Ensure insulation is cut and fitted around the angle of the cavity tray.

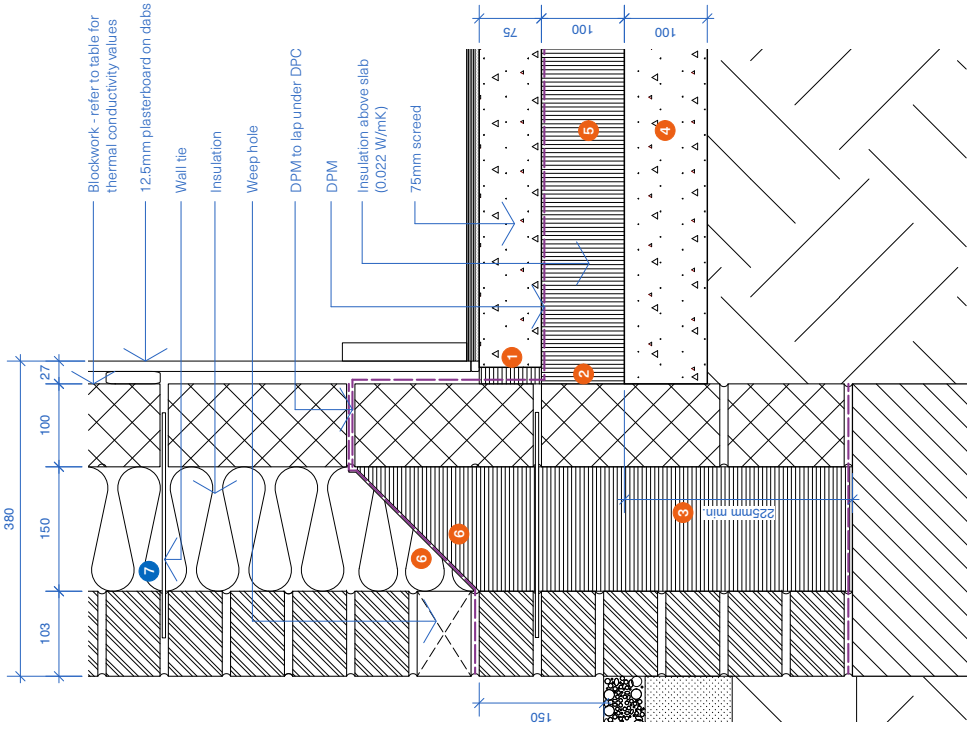
Construction Notes

7. Wall tie: No greater than 450mm vertical spacing.

General Notes

Rigid insulation below DPC to provide structural stability and stop water ingress.

Construction Detail

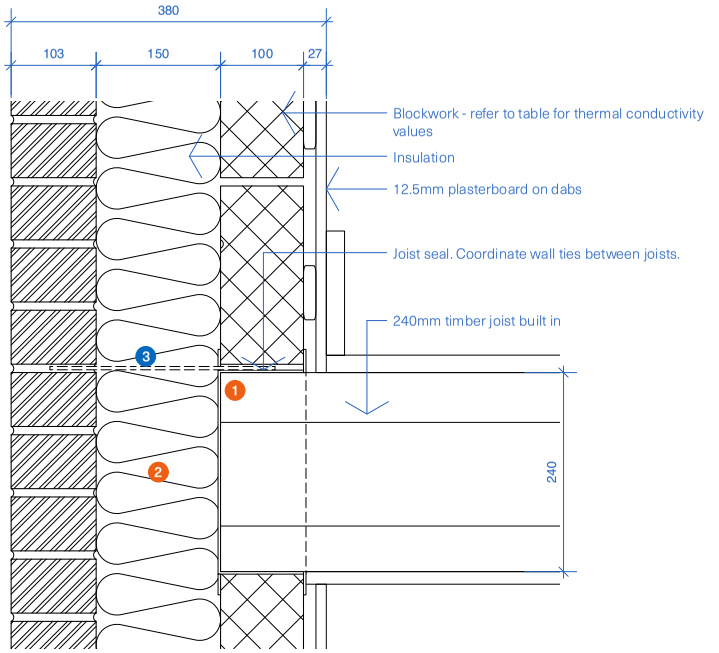


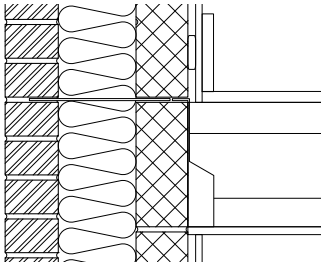
recognised construction details

Masonry Full Fill | 150mm Cavity | 150mm Insulation | MFF-150-E5-10 | Ground bearing slab, insulation above

Date: | Sign off:

Construction Detail





Joist hanger option

A joist hanger can be applied at this junction rather than building the timber joist into the wall. This does not affect the modelled Psi-values.

Calculated Ψ (Psi) value for use in SAP Calculation

Insulation thermal conductivity (W/mK)	Internal leaf block thermal conductivity (W/mK)					
	0.11	0.15	0.19	0.28	0.6	1.33
0.032	0.000	0.001	0.001	0.001	0.002	0.002
0.034	0.001	0.001	0.001	0.001	0.002	0.003
0.037	0.001	0.001	0.001	0.002	0.002	0.002

f-values: 0.972 - 0.985 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. Joist seal to the end of the timber joist, built into the internal leaf blockwork. Airtightness seal.
2. Insulation to be continuous across floor abutment zone.

Construction Notes

3. Wall tie: No greater than 450mm vertical spacing.

General Notes

You can alternatively build this detail with a joist hanger rather than building the timber joist into the blockwork.

Maintain clear separation of components to prevent congestion within the cavity and mortar joints.

recognised construction details | Masonry Full Fill | 150mm Cavity | 150mm Insulation | MFF-150-E6-01 | Intermediate floor within a dwelling

Date: | Sign off:

H.3.07 Junction E10

Calculated Ψ (Psi) value for use in SAP Calculation

Insulation thermal conductivity (W/mK)	Internal leaf block thermal conductivity (W/mK)					
	0.11	0.15	0.19	0.28	0.6	1.33
0.032	0.051	0.055	0.057	0.060	0.065	0.068
0.034	0.050	0.053	0.055	0.058	0.063	0.066
0.037	0.047	0.050	0.052	0.055	0.059	0.062

f-values: 0.924 - 0.939 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. 400mm insulation quilt (0.044 W/mK), minimum roof pitch 40 degrees.
2. Ensure continuity of insulation between the loft and external wall.

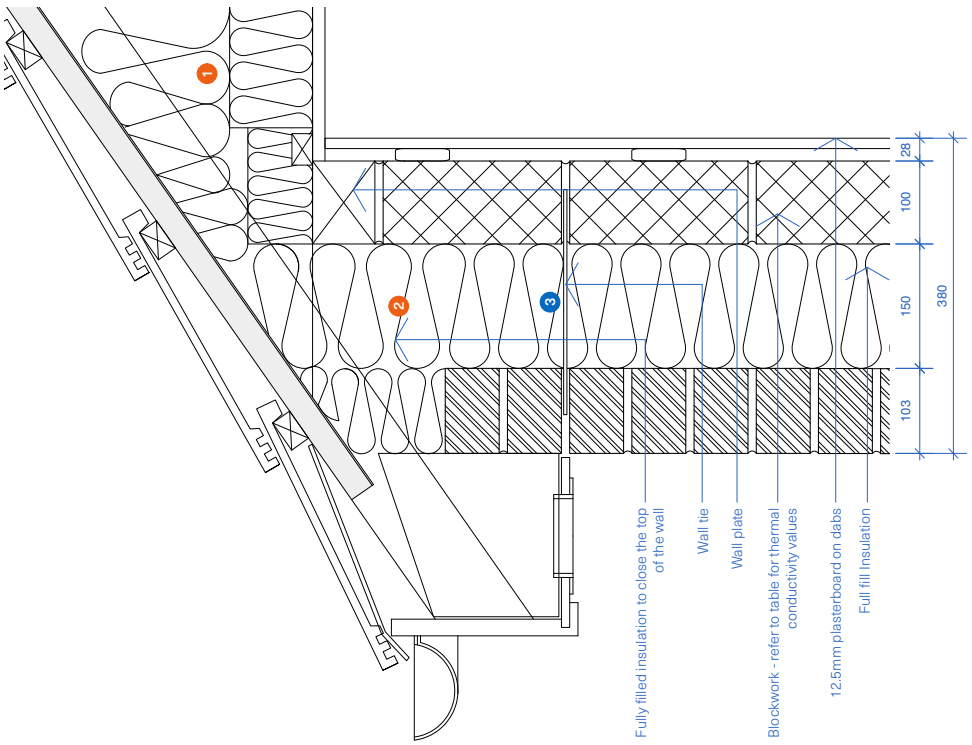
Construction Notes

3. Wall tie: 225mm maximum distance from opening. No greater than 450mm spacing.

General Notes

When the cavity is fully filled with insulation additional cavity closing is not required at the head of the wall. This meets the provisions of Diagram 5.3 ADBv1.

Construction Detail

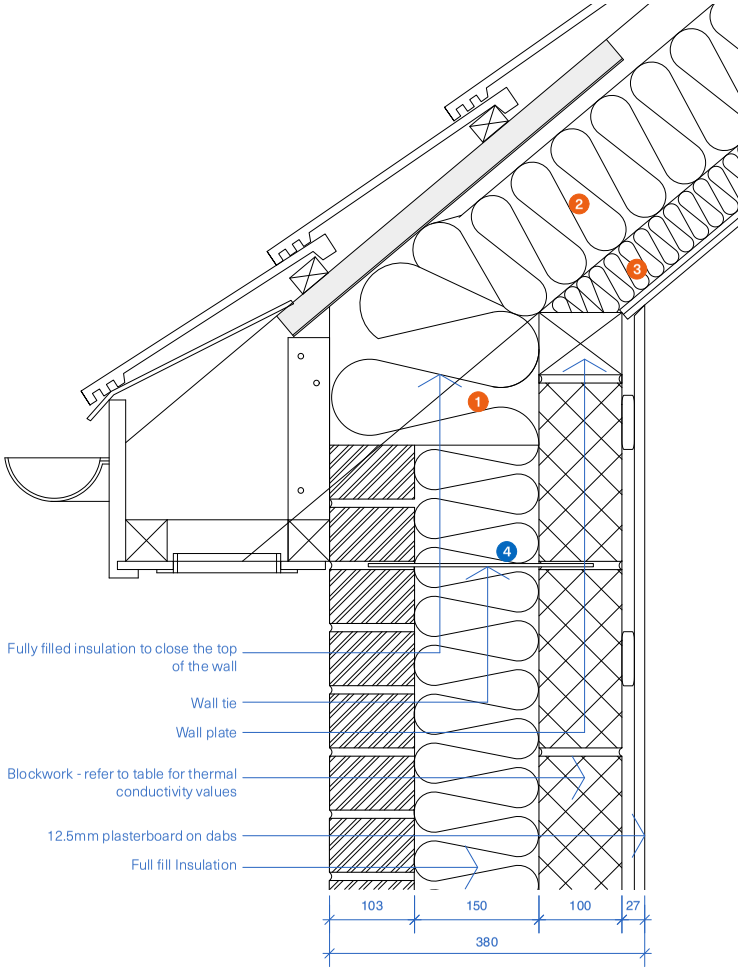


recognised construction details

Masonry Full Fill | 150mm Cavity | 150mm Insulation | MFF-150-E10-01 | Eaves (insulation at ceiling level)

Date: | Sign off:

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

	Internal leaf block thermal conductivity (W/mK)					
Insulation thermal conductivity (W/mK)	0.11	0.15	0.19	0.28	0.6	1.33
0.032	0.018	0.018	0.018	0.018	0.018	0.019
0.034	0.017	0.017	0.017	0.016	0.017	0.018
0.037	0.015	0.015	0.015	0.015	0.015	0.015

f-values: 0.950 - 0.962 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. Fully fill the void with insulation and ensure continuity of insulation between the roof and external wall.
2. 150mm insulation (0.022 W/mK) between rafters.
3. 60mm (0.022 W/mK) beneath rafters.

Construction Notes

4. Wall tie: 225mm maximum distance from opening. No greater than 450mm spacing.

General Notes

When the cavity is fully filled with insulation additional cavity closing is not required at the head of the wall. This meets the provisions of Diagram 5.3 ADBv1.

recognised construction details

Masonry Full Fill | 150mm Cavity | 150mm Insulation | MFF-150-E11-01 | Eaves (insulation at rafter level)

Date: | Sign off:

H.3.09 Junction E13

Calculated Ψ (Psi) value for use in SAP Calculation

Insulation thermal conductivity (W/mK)	Internal leaf block thermal conductivity (W/mK)					
	0.11	0.15	0.19	0.28	0.6	1.33
0.032	0.034	0.039	0.043	0.050	0.061	0.070
0.034	0.034	0.039	0.044	0.050	0.062	0.071
0.037	0.034	0.040	0.044	0.051	0.062	0.072

f-values: 0.921 - 0.941 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. Continue cavity insulation up to the wall head.
2. Minimum 100mm insulation λ≤0.044W/mK to void above the wall.
3. Pack insulation between the final rafter and the wall.
4. 150mm insulation (0.022 W/mK) between rafters.
5. 60mm (0.022 W/mK) beneath rafters.

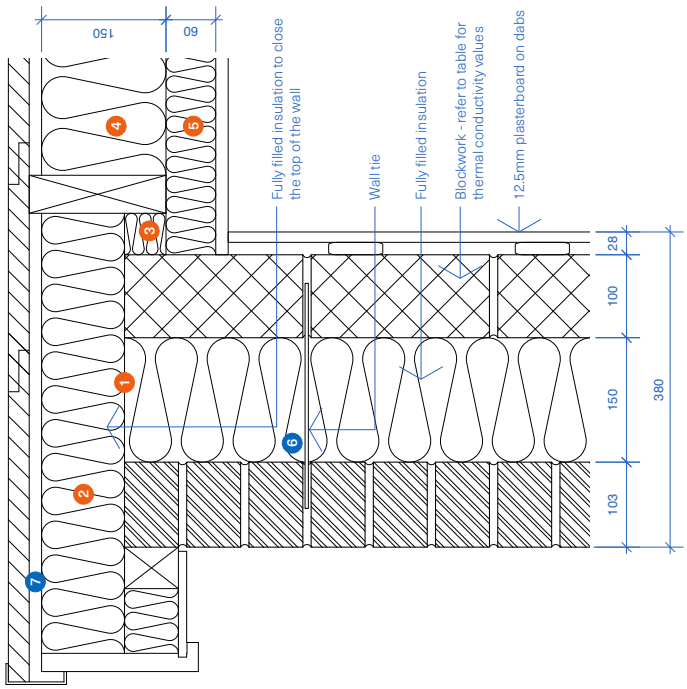
Construction Notes

6. Wall tie: 225mm maximum distance from opening. No greater than 450mm spacing.
7. Maintain air gap for ventilation.

General Notes

When the cavity is fully filled with insulation additional cavity closing is not required at the head of the wall.
This meets the provisions of Diagram 5.3 ADBv1.

Construction Detail

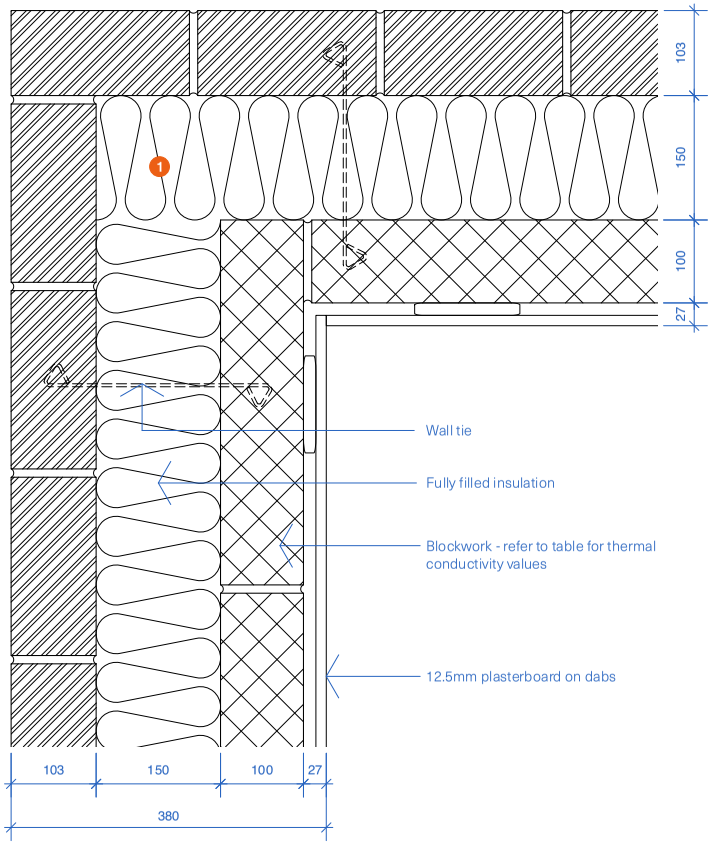


recognised construction details

Masonry Full Fill | 150mm Cavity | 150mm Insulation | MFF-150-E13-01 | Gable (insulation at rafter level)

Date: | Sign off:

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

	Internal leaf block thermal conductivity (W/mK)					
Insulation thermal conductivity (W/mK)	0.11	0.15	0.19	0.28	0.6	1.33
0.032	0.037	0.040	0.042	0.046	0.051	0.054
0.034	0.037	0.041	0.044	0.047	0.054	0.057
0.037	0.039	0.043	0.046	0.051	0.057	0.061

f-values: 0.924 - 0.966 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

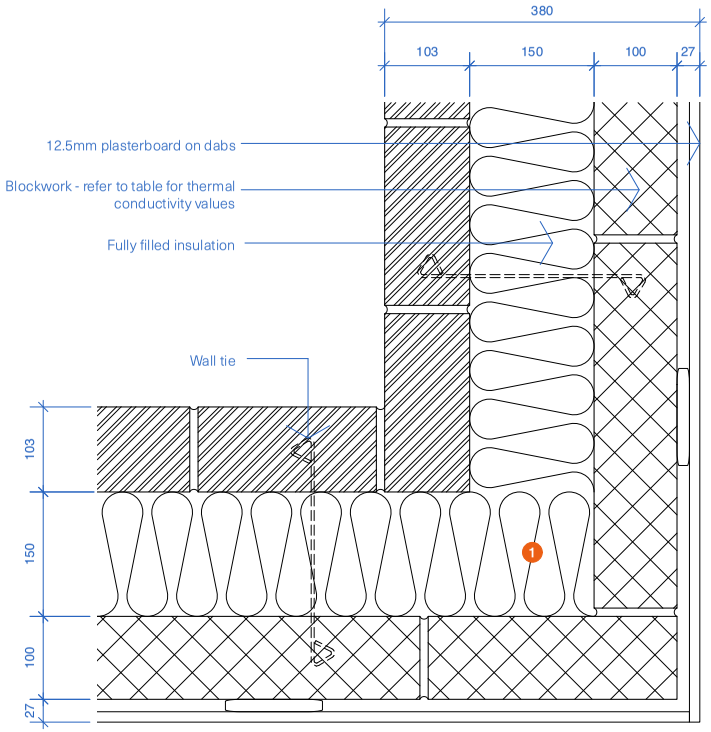
1 Ensure continuity of insulation at the corner.

recognised construction details

Masonry Full Fill | 150mm Cavity | 150mm Insulation | MFF-150-E16-01 | Corner (normal)

Date: | Sign off:

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

	Internal leaf block thermal conductivity (W/mK)					
Insulation thermal conductivity (W/mK)	0.11	0.15	0.19	0.28	0.6	1.33
0.032	-0.079	-0.082	-0.085	-0.088	-0.091	-0.093
0.034	-0.083	-0.086	-0.089	-0.094	-0.097	-0.098
0.037	-0.087	-0.092	-0.096	-0.099	-0.105	-0.107

f-values: 0.972 - 0.986 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1 Ensure continuity of insulation at the corner.

recognised construction details

Masonry Full Fill | 150mm Cavity | 150mm Insulation | MFF-150-E17-01 | Corner (inverted)

Date: | Sign off:

H.4 Full SAP Calculation Printout

The

Full SAP Calculation Printout

Property Reference	House	**Issued on Date**	23/04/2024
Assessment Reference	00_Initial Assessment	**Prop Type Ref**	
Property	12, Penhale View, Newquay, Cornwall, TR8 5FW		

SAP Rating	93 A	**DER**	0.90	**TER**	9.52
Environmental	99 A	**% DER < TER**			90.55
CO_2 Emissions (t/year)	0.04	**DFEE**	39.57	**TFEE**	44.67
Compliance Check	See BREL	**% DFEE < TFEE**			11.42
% DPER < TPER	67.02	**DPER**	16.62	**TPER**	50.39

Assessor Details	Mr. Stuart Foster	**Assessor ID**	CK03-0001
Client	CL2404024, Daniel Kemp		

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.4200 (1b)	x	2.4000 (2b)	=	236.2080	(1b) - (3b)
First floor	69.1200 (1c)	x	2.9700 (2c)	=	205.2864	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	167.5400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	441.4944	(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)

		Air changes per hour	
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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0463	(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	0.0590	0.0578	0.0567	0.0509	0.0497	0.0439	0.0439	0.0428	0.0463	0.0497	0.0520	0.0543	(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) =	81.0000	(23c)

Effective ac	0.1540	0.1528	0.1517	0.1459	0.1447	0.1389	0.1389	0.1378	0.1412	0.1447	0.1470	0.1493	(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 = 1.20)			17.8500	1.1450	20.4389			(27)
External Doors			3.9800	1.0000	3.9800			(26)
NE Roof Windows			2.1800	1.1450	2.4962			(27a)
SW Roof Windows			1.9500	1.1450	2.2328			(27a)
GF Floor			98.4200	0.1100	10.8262	110.0000	10826.2000	(28a)
External Wall (GF)	86.6700	15.4100	71.2600	0.1800	12.8268	150.0000	10689.0000	(29a)
Garage Wall (GF)	12.9800		12.9800	0.1600	2.0768	150.0000	1947.0000	(29a)
External Wall (FF)	45.1600	6.4200	38.7400	0.1800	6.9732	150.0000	5811.0000	(29a)
Knee Wall (FF)	28.1900		28.1900	0.1700	4.7923	9.0000	253.7100	(29a)
Dormer Wall (FF)	14.5600		14.5600	0.1800	2.6208	9.0000	131.0400	(29a)
GF Entrance Roof	9.9600		9.9600	0.1100	1.0956	9.0000	89.6400	(30)
FF Main Roof	80.3800	4.1300	76.2500	0.1100	8.3875	9.0000	686.2500	(30)
FF Dormer Roof	5.1000		5.1000	0.1100	0.5610	9.0000	45.9000	(30)
Total net area of external elements Aum(A, m2)			381.4200					(31)

Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	79.3081		(33)
Masonry (GF)	150.6300		100.0000	15063.0000 (32c)
Studwork (FF)	58.0900		9.0000	522.8100 (32c)
FF Intermediate Floor	69.1200		18.0000	1244.1600 (32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =			47309.7100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K				282.3786 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	14.7300	0.0190	0.2799
E3 Sill	12.8400	0.0220	0.2825
E4 Jamb	44.0600	0.0170	0.7490
E5 Ground floor (normal)	41.6040	0.0550	2.2882
E6 Intermediate floor within a dwelling	41.6750	0.0010	0.0417
E16 Corner (normal)	25.1890	0.0420	1.0579
R1 Head of roof window	3.7500	0.2400	0.9000
R2 Sill of roof window	3.7500	0.2400	0.9000
E10 Eaves (insulation at ceiling level)	9.8040	0.0570	0.5588
E11 Eaves (insulation at rafter level)	2.1590	0.0180	0.0389
E13 Gable (insulation at rafter level)	19.2000	0.0430	0.8256
E17 Corner (inverted - internal area greater than external area)	10.0790	-0.0850	-0.8567
R3 Jamb of roof window	11.0480	0.2400	2.6515
R4 Ridge (vaulted ceiling)	9.3100	0.1200	1.1172
R8 Roof to wall (rafter)	14.4920	0.1200	1.7390
E10 Eaves (insulation at ceiling level)	4.1640	0.1200	0.4997
E12 Gable (insulation at ceiling level)	1.9690	0.2500	0.4923

Thermal bridges (Sum(L x Psi) calculated using Appendix K)			13.5655 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =		92.8736 (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	22.4322	22.2637	22.0953	21.2530	21.0845	20.2422	20.2422	20.0738	20.5792	21.0845	21.4214	21.7584	(38)
Heat transfer coeff	115.3058	115.1373	114.9689	114.1266	113.9581	113.1158	113.1158	112.9474	113.4528	113.9581	114.2951	114.6320	(39)
Average = Sum(39)m / 12 =												114.0845	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6882	0.6872	0.6862	0.6812	0.6802	0.6752	0.6752	0.6742	0.6772	0.6802	0.6822	0.6842	(40)
HLP (average)												0.6809	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9593	(42)
Hot water usage for mixer showers	73.8370	72.7274	71.1105	68.0167	65.7336	63.1875	61.7403	63.3451	65.1041	67.8378	70.9980	73.5541	(42a)
Hot water usage for baths	31.8756	31.4022	30.7355	29.5064	28.5860	27.5654	27.0141	27.6761	28.3969	29.4889	30.7434	31.7678	(42b)
Hot water usage for other uses	44.9359	43.3018	41.6678	40.0338	38.3997	36.7657	36.7657	38.3997	40.0338	41.6678	43.3018	44.9359	(42c)
Average daily hot water use (litres/day)												138.4797	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.6484	147.4314	143.5138	137.5568	132.7193	127.5186	125.5202	129.4209	133.5348	138.9946	145.0432	150.2578	(44)
Energy conte	238.5903	209.9403	220.5753	188.3084	178.6657	156.7990	151.8058	160.2501	164.6617	188.6143	206.6407	235.2674	(45)
Energy content (annual)										Total = Sum(45)m =		2300.1191	
Distribution loss (46)m = 0.15 x (45)m	35.7885	31.4910	33.0863	28.2463	26.7999	23.5199	22.7709	24.0375	24.6993	28.2921	30.9961	35.2901	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2480	(55)
Total storage loss	38.6880	34.9440	38.6880	37.4400	38.6880	37.4400	38.6880	38.6880	37.4400	38.6880	37.4400	38.6880	(56)
If cylinder contains dedicated solar storage	38.6880	34.9440	38.6880	37.4400	38.6880	37.4400	38.6880	38.6880	37.4400	38.6880	37.4400	38.6880	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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	332.1359	294.4331	314.1209	278.8364	272.2113	216.7510	213.7562	222.2005	224.6137	282.1599	297.1687	328.8130	(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	332.1359	294.4331	314.1209	278.8364	272.2113	216.7510	213.7562	222.2005	224.6137	282.1599	297.1687	328.8130	(64)
										Total per year (kWh/year) = Sum(64)m =		3277.2007	(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	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	123.2174	109.4442	117.2274	105.0830	103.2924	70.1453	69.0853	71.8931	72.7596	106.6003	111.1784	122.1125	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.0925	34.7216	28.2375	21.3776	15.9800	13.4910	14.5775	18.9484	25.4325	32.2924	37.6900	40.1790	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	506.0184	511.2693	498.0372	469.8677	434.3088	400.8884	378.5615	373.3106	386.5427	414.7122	450.2712	483.6915	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	(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)	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	(71)
Water heating gains (Table 5)	165.6147	162.8634	157.5637	145.9485	138.8339	97.4240	92.8566	96.6305	101.0550	143.2800	154.4145	164.1297	(72)
Total internal gains	825.6258	823.7545	798.7386	752.0941	704.0229	626.7036	600.8959	603.7897	627.9304	705.1848	757.2758	802.9004	(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	4.9900	11.2829	0.5700	0.7000	0.7700	15.5679	(75)
Southeast	0.9200	36.7938	0.5700	0.7000	0.7700	9.3599	(77)
Southwest	4.8300	36.7938	0.5700	0.7000	0.7700	49.1392	(79)
Northwest	7.1100	11.2829	0.5700	0.7000	0.7700	22.1819	(81)
Northeast	2.1800	18.8604	0.5700	0.7000	1.0000	14.7646	(82)
Southwest	1.9500	35.6211	0.5700	0.7000	1.0000	24.9435	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	135.9569	255.5491	410.5057	606.0588	764.4472	795.6922	751.8941	628.6922	477.7393	299.1141	167.2770	113.4462	(83)
Total gains	961.5827	1079.3036	1209.2443	1358.1529	1468.4701	1422.3958	1352.7899	1232.4819	1105.6697	1004.2989	924.5529	916.3466	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	113.9716	114.1383	114.3056	115.1492	115.3194	116.1781	116.1781	116.3514	115.8331	115.3194	114.9795	114.6415	
alpha	8.5981	8.6092	8.6204	8.6766	8.6880	8.7452	8.7452	8.7568	8.7222	8.6880	8.6653	8.6428	
util living area	0.9987	0.9960	0.9819	0.9040	0.7094	0.5083	0.3679	0.4214	0.6975	0.9547	0.9961	0.9991	(86)
Living	20.3935	20.5106	20.6985	20.9036	20.9886	20.9994	21.0000	20.9999	20.9927	20.8576	20.5800	20.3648	
Non living	19.6329	19.7831	20.0202	20.2655	20.3499	20.3625	20.3628	20.3637	20.3567	20.2197	19.8758	19.5991	
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	20.6897	20.5106	20.6985	20.9036	20.9886	20.9994	21.0000	20.9999	20.9927	20.8576	20.5800	20.4536	(87)
Th 2	20.3512	20.3521	20.3530	20.3575	20.3584	20.3628	20.3628	20.3637	20.3610	20.3584	20.3566	20.3548	(88)
util rest of house	0.9983	0.9946	0.9759	0.8788	0.6648	0.4580	0.3146	0.3632	0.6375	0.9363	0.9946	0.9988	(89)
MIT 2	20.0649	19.7831	20.0202	20.2655	20.3499	20.3625	20.3628	20.3637	20.3567	20.2197	19.8758	19.7353	(90)
Living area fraction									fLA = Living area / (4) =			0.2955	(91)
MIT	20.2495	19.9981	20.2207	20.4540	20.5387	20.5507	20.5511	20.5517	20.5446	20.4082	20.0839	19.9476	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2495	19.9981	20.2207	20.4540	20.5387	20.5507	20.5511	20.5517	20.5446	20.4082	20.0839	19.9476	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9937	0.9744	0.8829	0.6775	0.4729	0.3304	0.3804	0.6551	0.9379	0.9937	0.9986	(94)
Useful gains	959.8403	1072.4749	1178.3029	1199.1458	994.9609	672.6099	446.9139	468.8620	724.3180	941.9698	918.7180	915.0582	(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	1839.0735	1738.3548	1577.4510	1318.6224	1007.2378	673.1209	446.9325	468.9234	731.1584	1117.7241	1483.9964	1805.1746	(97)
Space heating kWh	654.1495	447.4713	296.9662	86.0231	9.1340	0.0000	0.0000	0.0000	0.0000	130.7611	407.0005	662.2466	(98a)
Space heating requirement - total per year (kWh/year)												2693.7524	
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	654.1495	447.4713	296.9662	86.0231	9.1340	0.0000	0.0000	0.0000	0.0000	130.7611	407.0005	662.2466	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2693.7524	
Space heating per m2										(98c) / (4) =		16.0783	(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 %) 340.1878 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	654.1495	447.4713	296.9662	86.0231	9.1340	0.0000	0.0000	0.0000	0.0000	130.7611	407.0005	662.2466	(98)
Space heating efficiency (main heating system 1)	340.1878	340.1878	340.1878	340.1878	340.1878	0.0000	0.0000	0.0000	0.0000	340.1878	340.1878	340.1878	(210)
Space heating fuel (main heating system)	192.2907	131.5366	87.2948	25.2870	2.6850	0.0000	0.0000	0.0000	0.0000	38.4379	119.6400	194.6709	(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	332.1359	294.4331	314.1209	278.8364	272.2113	216.7510	213.7562	222.2005	224.6137	282.1599	297.1687	328.8130	(64)
Efficiency of water heater												169.8473	(216)
(217)m	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	(217)
Fuel for water heating, kWh/month	195.5498	173.3517	184.9432	164.1689	160.2683	127.6153	125.8520	130.8237	132.2445	166.1257	174.9623	193.5933	(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	49.7489	44.9345	49.7489	48.1441	49.7489	48.1441	49.7489	49.7489	48.1441	49.7489	48.1441	49.7489	(231)
Lighting	34.2174	27.4505	24.7161	18.1081	13.9872	11.4277	12.7596	16.5854	21.5428	28.2653	31.9256	35.1684	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-58.1285	-87.5381	-133.3956	-155.1700	-171.9299	-160.1313	-158.0496	-146.6638	-125.6967	-101.4787	-65.2935	-49.4705	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)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	(234a)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235a)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	(235a)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235c)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	(235c)

Electricity generated by PVs (Appendix M) (negative quantity)

(233b)m	-20.4246	-47.1258	-103.9150	-171.9029	-238.1150	-244.9918	-240.9157	-198.2913	-138.4334	-72.9869	-28.6251	-15.7433	(233b)

Electricity generated by wind turbines (Appendix M) (negative quantity)

(234b)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	(234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)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	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)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	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	791.8428	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	169.8473	
Water heating fuel used	1929.4988	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.0875)		
mechanical ventilation fans (SFP = 1.0875)	585.7527	(230a)
Total electricity for the above, kWh/year	585.7527	(231)
Electricity for lighting (calculated in Appendix L)	276.1542	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2934.4172	(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	648.8314	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	791.8428	16.4900	130.5749	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1929.4988	16.4900	318.1744	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	585.7527	16.4900	96.5906	(249)
Energy for lighting	276.1542	16.4900	45.5378	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1412.9464	16.4900	-232.9949	
PV Unit electricity exported	-1521.4708	5.5900	-85.0502	
Total			-318.0451	(252)
Total energy cost			272.8326	(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] =	0.4621 (257)
SAP value		92.5090
SAP rating (Section 12)		93 (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	791.8428	0.1575	124.7403	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1929.4988	0.1416	273.1764	(264)
Space and water heating			397.9167	(265)
Pumps, fans and electric keep-hot	585.7527	0.1387	81.2511	(267)
Energy for lighting	276.1542	0.1443	39.8576	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1412.9464	0.1338	-189.0194	
PV Unit electricity exported	-1521.4708	0.1235	-187.9736	
Total			-376.9930	(269)
Total CO2, kg/year			142.0324	(272)
CO2 emissions per m2			0.8500	(273)
EI value			99.1045	
EI rating			99	(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

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1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)

Ground floor	98.4200 (1b)	x 2.4000 (2b)	= 236.2080	(1b) - (3b)
First floor	69.1200 (1c)	x 2.9700 (2c)	= 205.2864	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 167.5400				(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	441.4944	(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)

	Air changes per hour	
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		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0463 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.3000	6.0000	5.8000	5.1000	5.1000	4.6000	4.6000	4.5000	4.9000	5.7000	5.9000	6.3000	(22)
Wind factor	1.5750	1.5000	1.4500	1.2750	1.2750	1.1500	1.1500	1.1250	1.2250	1.4250	1.4750	1.5750	(22a)
Adj infilt rate	0.0728	0.0694	0.0671	0.0590	0.0590	0.0532	0.0532	0.0520	0.0567	0.0659	0.0682	0.0728	(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) =	81.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.1678	0.1644	0.1621	0.1540	0.1540	0.1482	0.1482	0.1470	0.1517	0.1609	0.1632	0.1678	(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 = 1.20)			17.8500	1.1450	20.4389			(27)
External Doors			3.9800	1.0000	3.9800			(26)
NE Roof Windows			2.1800	1.1450	2.4962			(27a)
SW Roof Windows			1.9500	1.1450	2.2328			(27a)
GF Floor			98.4200	0.1100	10.8262	110.0000	10826.2000	(28a)
External Wall (GF)	86.6700	15.4100	71.2600	0.1800	12.8268	150.0000	10689.0000	(29a)
Garage Wall (GF)	12.9800		12.9800	0.1600	2.0768	150.0000	1947.0000	(29a)
External Wall (FF)	45.1600	6.4200	38.7400	0.1800	6.9732	150.0000	5811.0000	(29a)
Knee Wall (FF)	28.1900		28.1900	0.1700	4.7923	9.0000	253.7100	(29a)
Dormer Wall (FF)	14.5600		14.5600	0.1800	2.6208	9.0000	131.0400	(29a)
GF Entrance Roof	9.9600		9.9600	0.1100	1.0956	9.0000	89.6400	(30)
FF Main Roof	80.3800	4.1300	76.2500	0.1100	8.3875	9.0000	686.2500	(30)
FF Dormer Roof	5.1000		5.1000	0.1100	0.5610	9.0000	45.9000	(30)
Total net area of external elements Aum(A, m2)			381.4200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		79.3081			(33)
Masonry (GF)			150.6300			100.0000	15063.0000	(32c)
Studwork (FF)			58.0900			9.0000	522.8100	(32c)
FF Intermediate Floor			69.1200			18.0000	1244.1600	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 47309.7100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	282.3786 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	14.7300	0.0190	0.2799
E3 Sill	12.8400	0.0220	0.2825
E4 Jamb	44.0600	0.0170	0.7490
E5 Ground floor (normal)	41.6040	0.0550	2.2882
E6 Intermediate floor within a dwelling	41.6750	0.0010	0.0417
E16 Corner (normal)	25.1890	0.0420	1.0579
R1 Head of roof window	3.7500	0.2400	0.9000
R2 Sill of roof window	3.7500	0.2400	0.9000
E10 Eaves (insulation at ceiling level)	9.8040	0.0570	0.5588
E11 Eaves (insulation at rafter level)	2.1590	0.0180	0.0389
E13 Gable (insulation at rafter level)	19.2000	0.0430	0.8256
E17 Corner (inverted - internal area greater than external area)	10.0790	-0.0850	-0.8567
R3 Jamb of roof window	11.0480	0.2400	2.6515
R4 Ridge (vaulted ceiling)	9.3100	0.1200	1.1172
R8 Roof to wall (rafter)	14.4920	0.1200	1.7390
E10 Eaves (insulation at ceiling level)	4.1640	0.1200	0.4997
E12 Gable (insulation at ceiling level)	1.9690	0.2500	0.4923

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.5655 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	92.8736 (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	24.4537	23.9483	23.6114	22.4322	22.4322	21.5899	21.5899	21.4214	22.0953	23.4429	23.7799	24.4537	(38)
Heat transfer coeff	117.3273	116.8219	116.4850	115.3058	115.3058	114.4635	114.4635	114.2951	114.9689	116.3165	116.6535	117.3273	(39)

Average = Sum(39)m / 12 = 115.8112

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7003	0.6973	0.6953	0.6882	0.6882	0.6832	0.6832	0.6822	0.6862	0.6943	0.6963	0.7003	(40)
HLP (average)												0.6912	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9593	(42)
Hot water usage for mixer showers													
	73.8370	72.7274	71.1105	68.0167	65.7336	63.1875	61.7403	63.3451	65.1041	67.8378	70.9980	73.5541	(42a)
Hot water usage for baths													
	31.8756	31.4022	30.7355	29.5064	28.5860	27.5654	27.0141	27.6761	28.3969	29.4889	30.7434	31.7678	(42b)
Hot water usage for other uses													
	44.9359	43.3018	41.6678	40.0338	38.3997	36.7657	36.7657	38.3997	40.0338	41.6678	43.3018	44.9359	(42c)
Average daily hot water use (litres/day)												138.4797	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	150.6484	147.4314	143.5138	137.5568	132.7193	127.5186	125.5202	129.4209	133.5348	138.9946	145.0432	150.2578	(44)
Energy conte	238.5903	209.9403	220.5753	188.3084	178.6657	156.7990	151.8058	160.2501	164.6617	188.6143	206.6407	235.2674	(45)
Energy content (annual)											Total = Sum(45)m =	2300.1191	
Distribution loss (46)m = 0.15 x (45)m													
	35.7885	31.4910	33.0863	28.2463	26.7999	23.5199	22.7709	24.0375	24.6993	28.2921	30.9961	35.2901	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2480	(55)
Total storage loss													
	38.6880	34.9440	38.6880	37.4400	38.6880	37.4400	38.6880	38.6880	37.4400	38.6880	37.4400	38.6880	(56)
If cylinder contains dedicated solar storage													
	38.6880	34.9440	38.6880	37.4400	38.6880	37.4400	38.6880	38.6880	37.4400	38.6880	37.4400	38.6880	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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													
	332.1359	294.4331	314.1209	278.8364	272.2113	216.7510	213.7562	222.2005	224.6137	282.1599	297.1687	328.8130	(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													
	332.1359	294.4331	314.1209	278.8364	272.2113	216.7510	213.7562	222.2005	224.6137	282.1599	297.1687	328.8130	(64)
										Total per year (kWh/year) = Sum(64)m =		3277.2007	(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	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	123.2174	109.4442	117.2274	105.0830	103.2924	70.1453	69.0853	71.8931	72.7596	106.6003	111.1784	122.1125	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	39.0925	34.7216	28.2375	21.3776	15.9800	13.4910	14.5775	18.9484	25.4325	32.2924	37.6900	40.1790	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	506.0184	511.2693	498.0372	469.8677	434.3088	400.8884	378.5615	373.3106	386.5427	414.7122	450.2712	483.6915	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	(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)													
	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	(71)
Water heating gains (Table 5)													
	165.6147	162.8634	157.5637	145.9485	138.8339	97.4240	92.8566	96.6305	101.0550	143.2800	154.4145	164.1297	(72)
Total internal gains													
	825.6258	823.7545	798.7386	752.0941	704.0229	626.7036	600.8959	603.7897	627.9304	705.1848	757.2758	802.9004	(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	4.9900	15.4493	0.5700	0.7000	0.7700	21.3164	(75)
Southeast	0.9200	47.1180	0.5700	0.7000	0.7700	11.9862	(77)
Southwest	4.8300	47.1180	0.5700	0.7000	0.7700	62.9275	(79)
Northwest	7.1100	15.4493	0.5700	0.7000	0.7700	30.3727	(81)
Northeast	2.1800	26.2076	0.5700	0.7000	1.0000	20.5163	(82)
Southwest	1.9500	47.7956	0.5700	0.7000	1.0000	33.4686	(82)

Solar gains	180.5878	292.9557	465.2391	705.8214	835.3980	939.9756	803.8878	725.7478	565.0180	352.3978	214.4326	149.9867	(83)
Total gains	1006.2136	1116.7102	1263.9777	1457.9155	1539.4209	1566.6792	1404.7837	1329.5376	1192.9484	1057.5826	971.7084	952.8871	(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	112.0079	112.4925	112.8178	113.9716	113.9716	114.8103	114.8103	114.9795	114.3056	112.9812	112.6549	112.0079	
alpha	8.4672	8.4995	8.5212	8.5981	8.5981	8.6540	8.6540	8.6653	8.6204	8.5321	8.5103	8.4672	
util living area													
	0.9949	0.9884	0.9568	0.8389	0.6597	0.4672	0.3910	0.3868	0.5947	0.8799	0.9814	0.9958	(86)
Living	20.5684	20.6518	20.8087	20.9498	20.9933	20.9997	20.9999	20.9999	20.9979	20.9416	20.7566	20.5651	
Non living	19.8474	19.9544	20.1468	20.3070	20.3465	20.3555	20.3557	20.3566	20.3519	20.2980	20.0871	19.8434	
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	20.7792	20.6518	20.8087	20.9498	20.9933	20.9997	20.9999	20.9999	20.9979	20.9416	20.7566	20.6259	(87)
Th 2	20.3406	20.3432	20.3450	20.3512	20.3512	20.3557	20.3557	20.3566	20.3530	20.3459	20.3441	20.3406	(88)
util rest of house													
	0.9930	0.9842	0.9430	0.8048	0.6142	0.4204	0.3386	0.3315	0.5340	0.8397	0.9733	0.9941	(89)

MIT 2	20.1440	19.9544	20.1468	20.3070	20.3465	20.3555	20.3557	20.3566	20.3519	20.2980	20.0871	19.9330	(90)
Living area fraction									fLA = Living area / (4) =			0.2955	(91)
MIT	20.3317	20.1605	20.3424	20.4970	20.5376	20.5459	20.5461	20.5467	20.5428	20.4882	20.2849	20.1378	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3317	20.1605	20.3424	20.4970	20.5376	20.5459	20.5461	20.5467	20.5428	20.4882	20.2849	20.1378	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9929	0.9828	0.9429	0.8128	0.6274	0.4342	0.3541	0.3479	0.5519	0.8492	0.9724	0.9934	(94)
Useful gains	999.1123	1097.4516	1191.8379	1185.0017	965.8983	680.3025	497.4252	462.4852	658.4398	898.0591	944.8533	946.6228	(95)
Ext temp.	6.6000	6.8000	8.0000	9.7000	12.1000	14.6000	16.2000	16.5000	14.8000	12.2000	9.5000	7.0000	(96)
Heat loss rate W	1611.1007	1560.7943	1437.7067	1244.9516	972.9095	680.5856	497.4655	462.5173	660.2442	964.0545	1258.0997	1541.4169	(97)
Space heating kWh	455.3194	311.3663	182.9263	43.1639	5.2163	0.0000	0.0000	0.0000	0.0000	49.1006	225.5374	442.5268	(98a)
Space heating requirement - total per year (kWh/year)												1715.1572	
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	455.3194	311.3663	182.9263	43.1639	5.2163	0.0000	0.0000	0.0000	0.0000	49.1006	225.5374	442.5268	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1715.1572	
Space heating per m2											(98c) / (4) =	10.2373	(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 %)												339.8620	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	455.3194	311.3663	182.9263	43.1639	5.2163	0.0000	0.0000	0.0000	0.0000	49.1006	225.5374	442.5268	(98)
Space heating efficiency (main heating system 1)	339.8620	339.8620	339.8620	339.8620	339.8620	0.0000	0.0000	0.0000	0.0000	339.8620	339.8620	339.8620	(210)
Space heating fuel (main heating system)	133.9719	91.6155	53.8237	12.7004	1.5348	0.0000	0.0000	0.0000	0.0000	14.4472	66.3615	130.2078	(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	332.1359	294.4331	314.1209	278.8364	272.2113	216.7510	213.7562	222.2005	224.6137	282.1599	297.1687	328.8130	(64)
Efficiency of water heater												169.7606	(216)
(217)m	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	(217)
Fuel for water heating, kWh/month	195.6495	173.4402	185.0375	164.2527	160.3501	127.6804	125.9162	130.8905	132.3120	166.2104	175.0516	193.6921	(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	49.7489	44.9345	49.7489	48.1441	49.7489	48.1441	49.7489	49.7489	48.1441	49.7489	48.1441	49.7489	(231)
Lighting	34.2174	27.4505	24.7161	18.1081	13.9872	11.4277	12.7596	16.5854	21.5428	28.2653	31.9256	35.1684	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-73.0601	-96.0028	-142.6979	-167.4182	-178.9558	-173.0573	-162.4834	-157.4971	-138.2928	-112.4376	-78.6114	-62.2205	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)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	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)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	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)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	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-31.8370	-58.3978	-124.2942	-208.6532	-262.9250	-299.0839	-258.2167	-235.3079	-170.9873	-92.5520	-42.2544	-24.5732	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)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	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)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	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)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	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												504.6628	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												169.7606	
Water heating fuel used												1930.4833	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.0875)													
mechanical ventilation fans (SFP = 1.0875)												585.7527	(230a)
Total electricity for the above, kWh/year												585.7527	(231)
Electricity for lighting (calculated in Appendix L)												276.1542	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3351.8175	(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												-54.7645	(238)

10a. Fuel costs - using BEDF prices (540)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year

Space heating - main system 1	504.6628	25.1600	126.9732	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1930.4833	25.1600	485.7096	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	585.7527	25.1600	147.3754	(249)
Energy for lighting	276.1542	25.1600	69.4804	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1542.7348	25.1600	-388.1521	
PV Unit electricity exported	-1809.0827	5.8100	-105.1077	
Total			-493.2598	(252)
Total energy cost			336.2788	(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	504.6628	0.1584	79.9590	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1930.4833	0.1416	273.3158	(264)
Space and water heating			353.2747	(265)
Pumps, fans and electric keep-hot	585.7527	0.1387	81.2511	(267)
Energy for lighting	276.1542	0.1443	39.8576	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1542.7348	0.1344	-207.2827	
PV Unit electricity exported	-1809.0827	0.1248	-225.8335	
Total			-433.1162	(269)
Total CO2, kg/year			41.2672	(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	504.6628	1.5865	800.6491	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1930.4833	1.5236	2941.1975	(278)
Space and water heating			3741.8465	(279)
Pumps, fans and electric keep-hot	585.7527	1.5128	886.1267	(281)
Energy for lighting	276.1542	1.5338	423.5746	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1542.7348	1.4965	-2308.7733	
PV Unit electricity exported	-1809.0827	0.4582	-828.9367	
Total			-3137.7100	(283)
Total Primary energy kWh/year			1913.8379	(286)

SAP 10 EPC IMPROVEMENTS

00_Initial Assessment

Current energy efficiency rating: A 93
Current environmental impact rating: A 99

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	+ 1.2	-£ 86	-48 kg (117.0%)
V2 Wind turbine	+ 13.0	-£ 692	-496 kg (7069.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£86	0.29 kg/m²	A 94	A 99
Wind turbine	£692	2.96 kg/m²	A 107	A 102
Total Savings	£778	3.25 kg/m²		

Potential energy efficiency rating: A 107
Potential environmental impact rating: A 102

Fuel prices for cost data on this page from database revision number 540 TEST (28 Mar 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	£830	£733	£97
Space heating	£274	£294	-£20
Water heating	£486	£369	£117
Lighting	£69	£69	£0
Generated (PV)	-£493	-£483	-£11
Generated (wind)	-£0	-£692	£692
Total cost of fuels	£337	-£442	£778
Total cost of uses	£336	-£443	£778
Delivered energy	-0 kWh/m²	-24 kWh/m²	24 kWh/m²
Carbon dioxide emissions	0.0 tonnes	-0.5 tonnes	0.5 tonnes
CO2 emissions per m²	0 kg/m²	-3 kg/m²	3 kg/m²
Primary energy	11 kWh/m²	-17 kWh/m²	29 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.4200	(1b)	x 2.4000	(2b) =	236.2080	(1b) - (3b)
First floor	69.1200	(1c)	x 2.9700	(2c) =	205.2864	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	167.5400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		441.4944	(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)
	Air changes per hour		
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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0463	(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	0.0590	0.0578	0.0567	0.0509	0.0497	0.0439	0.0439	0.0428	0.0463	0.0497	0.0520	0.0543	(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) =	81.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.1540	0.1528	0.1517	0.1459	0.1447	0.1389	0.1389	0.1378	0.1412	0.1447	0.1470	0.1493	(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 = 1.20)			17.8500	1.1450	20.4389			(27)
External Doors			3.9800	1.0000	3.9800			(26)
NE Roof Windows			2.1800	1.1450	2.4962			(27a)
SW Roof Windows			1.9500	1.1450	2.2328			(27a)
GF Floor			98.4200	0.1100	10.8262	110.0000	10826.2000	(28a)
External Wall (GF)	86.6700	15.4100	71.2600	0.1800	12.8268	150.0000	10689.0000	(29a)
Garage Wall (GF)	12.9800		12.9800	0.1600	2.0768	150.0000	1947.0000	(29a)
External Wall (FF)	45.1600	6.4200	38.7400	0.1800	6.9732	150.0000	5811.0000	(29a)
Knee Wall (FF)	28.1900		28.1900	0.1700	4.7923	9.0000	253.7100	(29a)
Dormer Wall (FF)	14.5600		14.5600	0.1800	2.6208	9.0000	131.0400	(29a)
GF Entrance Roof	9.9600		9.9600	0.1100	1.0956	9.0000	89.6400	(30)
FF Main Roof	80.3800	4.1300	76.2500	0.1100	8.3875	9.0000	686.2500	(30)
FF Dormer Roof	5.1000		5.1000	0.1100	0.5610	9.0000	45.9000	(30)
Total net area of external elements Aum(A, m2)			381.4200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		79.3081			(33)
Masonry (GF)			150.6300			100.0000	15063.0000	(32c)
Studwork (FF)			58.0900			9.0000	522.8100	(32c)
FF Intermediate Floor			69.1200			18.0000	1244.1600	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 47309.7100	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	282.3786	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	14.7300	0.0190	0.2799
E3 Sill	12.8400	0.0220	0.2825
E4 Jamb	44.0600	0.0170	0.7490
E5 Ground floor (normal)	41.6040	0.0550	2.2882
E6 Intermediate floor within a dwelling	41.6750	0.0010	0.0417
E16 Corner (normal)	25.1890	0.0420	1.0579
R1 Head of roof window	3.7500	0.2400	0.9000
R2 Sill of roof window	3.7500	0.2400	0.9000
E10 Eaves (insulation at ceiling level)	9.8040	0.0570	0.5588
E11 Eaves (insulation at rafter level)	2.1590	0.0180	0.0389
E13 Gable (insulation at rafter level)	19.2000	0.0430	0.8256
E17 Corner (inverted - internal area greater than external area)	10.0790	-0.0850	-0.8567
R3 Jamb of roof window	11.0480	0.2400	2.6515
R4 Ridge (vaulted ceiling)	9.3100	0.1200	1.1172
R8 Roof to wall (rafter)	14.4920	0.1200	1.7390
E10 Eaves (insulation at ceiling level)	4.1640	0.1200	0.4997
E12 Gable (insulation at ceiling level)	1.9690	0.2500	0.4923
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			13.5655 (36)

Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 92.8736 (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	22.4322	22.2637	22.0953	21.2530	21.0845	20.2422	20.2422	20.0738	20.5792	21.0845	21.4214	21.7584	(38)
Heat transfer coeff	115.3058	115.1373	114.9689	114.1266	113.9581	113.1158	113.1158	112.9474	113.4528	113.9581	114.2951	114.6320	(39)

Average = Sum(39)m / 12 = 114.0845

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6882	0.6872	0.6862	0.6812	0.6802	0.6752	0.6752	0.6742	0.6772	0.6802	0.6822	0.6842	(40)
HLP (average)												0.6809	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9593 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	73.8370	72.7274	71.1105	68.0167	65.7336	63.1875	61.7403	63.3451	65.1041	67.8378	70.9980	73.5541	(42a)
Hot water usage for baths	31.8756	31.4022	30.7355	29.5064	28.5860	27.5654	27.0141	27.6761	28.3969	29.4889	30.7434	31.7678	(42b)
Hot water usage for other uses	44.9359	43.3018	41.6678	40.0338	38.3997	36.7657	36.7657	38.3997	40.0338	41.6678	43.3018	44.9359	(42c)

Average daily hot water use (litres/day) 138.4797 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.6484	147.4314	143.5138	137.5568	132.7193	127.5186	125.5202	129.4209	133.5348	138.9946	145.0432	150.2578	(44)
Energy conte	238.5903	209.9403	220.5753	188.3084	178.6657	156.7990	151.8058	160.2501	164.6617	188.6143	206.6407	235.2674	(45)
Energy content (annual)										Total = Sum(45)m =		2300.1191	
Distribution loss (46)m = 0.15 x (45)m	35.7885	31.4910	33.0863	28.2463	26.7999	23.5199	22.7709	24.0375	24.6993	28.2921	30.9961	35.2901	(46)

Water storage loss:

Store volume	150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.6000	(48)
Temperature factor from Table 2b	0.7800	(49)
Enter (49) or (54) in (55)	1.2480	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	38.6880	34.9440	38.6880	37.4400	38.6880	37.4400	38.6880	38.6880	37.4400	38.6880	37.4400	38.6880	(56)
If cylinder contains dedicated solar storage	38.6880	34.9440	38.6880	37.4400	38.6880	37.4400	38.6880	38.6880	37.4400	38.6880	37.4400	38.6880	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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	332.1359	294.4331	314.1209	278.8364	272.2113	216.7510	213.7562	222.2005	224.6137	282.1599	297.1687	328.8130	(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	649.0238	(H24)
Heat delivered to space heating	0.0000	(H29)
Solar input	649.0238	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar input	-0.0000	-16.1698	-59.7592	-83.8370	-112.3148	-101.1925	-100.7235	-87.1237	-59.0013	-28.9021	-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	332.1359	278.2633	254.3617	194.9994	159.8965	115.5586	113.0327	135.0768	165.6124	253.2578	297.1687	328.8130	(64)

Total per year (kWh/year) = Sum(64)m = 2628.1769 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	123.2174	109.4442	117.2274	105.0830	103.2924	70.1453	69.0853	71.8931	72.7596	106.6003	111.1784	122.1125	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.0925	34.7216	28.2375	21.3776	15.9800	13.4910	14.5775	18.9484	25.4325	32.2924	37.6900	40.1790	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	506.0184	511.2693	498.0372	469.8677	434.3088	400.8884	378.5615	373.3106	386.5427	414.7122	450.2712	483.6915	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	(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)	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	(71)
Water heating gains (Table 5)	165.6147	162.8634	157.5637	145.9485	138.8339	97.4240	92.8566	96.6305	101.0550	143.2800	154.4145	164.1297	(72)
Total internal gains	825.6258	823.7545	798.7386	752.0941	704.0229	626.7036	600.8959	603.7897	627.9304	705.1848	757.2758	802.9004	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.9900	11.2829	0.5700	0.7000	0.7700	15.5679	(75)

Southeast	0.9200	36.7938	0.5700	0.7000	0.7700	9.3599 (77)
Southwest	4.8300	36.7938	0.5700	0.7000	0.7700	49.1392 (79)
Northwest	7.1100	11.2829	0.5700	0.7000	0.7700	22.1819 (81)
Northeast	2.1800	18.8604	0.5700	0.7000	1.0000	14.7646 (82)
Southwest	1.9500	35.6211	0.5700	0.7000	1.0000	24.9435 (82)

Solar gains	135.9569	255.5491	410.5057	606.0588	764.4472	795.6922	751.8941	628.6922	477.7393	299.1141	167.2770	113.4462 (83)
Total gains	961.5827	1079.3036	1209.2443	1358.1529	1468.4701	1422.3958	1352.7899	1232.4819	1105.6697	1004.2989	924.5529	916.3466 (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	113.9716	114.1383	114.3056	115.1492	115.3194	116.1781	116.1781	116.3514	115.8331	115.3194	114.9795	114.6415	
alpha	8.5981	8.6092	8.6204	8.6766	8.6880	8.7452	8.7452	8.7568	8.7222	8.6880	8.6653	8.6428	
util living area													
	0.9987	0.9960	0.9819	0.9040	0.7094	0.5083	0.3679	0.4214	0.6975	0.9547	0.9961	0.9991	(86)
Living	20.3935	20.5106	20.6985	20.9036	20.9886	20.9994	21.0000	20.9999	20.9927	20.8576	20.5800	20.3648	
Non living	19.6329	19.7831	20.0202	20.2655	20.3499	20.3625	20.3628	20.3637	20.3567	20.2197	19.8758	19.5991	
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	20.6897	20.5106	20.6985	20.9036	20.9886	20.9994	21.0000	20.9999	20.9927	20.8576	20.5800	20.4536	(87)
Th 2	20.3512	20.3521	20.3530	20.3575	20.3584	20.3628	20.3628	20.3637	20.3610	20.3584	20.3566	20.3548	(88)
util rest of house													
	0.9983	0.9946	0.9759	0.8788	0.6648	0.4580	0.3146	0.3632	0.6375	0.9363	0.9946	0.9988	(89)
MIT 2	20.0649	19.7831	20.0202	20.2655	20.3499	20.3625	20.3628	20.3637	20.3567	20.2197	19.8758	19.7353	(90)
Living area fraction										fLA = Living area / (4) =		0.2955	(91)
MIT	20.2495	19.9981	20.2207	20.4540	20.5387	20.5507	20.5511	20.5517	20.5446	20.4082	20.0839	19.9476	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2495	19.9981	20.2207	20.4540	20.5387	20.5507	20.5511	20.5517	20.5446	20.4082	20.0839	19.9476	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9937	0.9744	0.8829	0.6775	0.4729	0.3304	0.3804	0.6551	0.9379	0.9937	0.9986	(94)
Useful gains	959.8403	1072.4749	1178.3029	1199.1458	994.9609	672.6099	446.9139	468.8620	724.3180	941.9698	918.7180	915.0582	(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													
	1839.0735	1738.3548	1577.4510	1318.6224	1007.2378	673.1209	446.9325	468.9234	731.1584	1117.7241	1483.9964	1805.1746	(97)
Space heating kWh													
	654.1495	447.4713	296.9662	86.0231	9.1340	0.0000	0.0000	0.0000	0.0000	130.7611	407.0005	662.2466	(98a)
Space heating requirement - total per year (kWh/year)												2693.7524	
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													
	654.1495	447.4713	296.9662	86.0231	9.1340	0.0000	0.0000	0.0000	0.0000	130.7611	407.0005	662.2466	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2693.7524	
Space heating per m2											(98c) / (4) =	16.0783	(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 %)	340.1878 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	654.1495	447.4713	296.9662	86.0231	9.1340	0.0000	0.0000	0.0000	0.0000	130.7611	407.0005	662.2466	(98)
Space heating efficiency (main heating system 1)													
	340.1878	340.1878	340.1878	340.1878	0.0000	0.0000	0.0000	0.0000	340.1878	340.1878	340.1878	340.1878	(210)
Space heating fuel (main heating system)													
	192.2907	131.5366	87.2948	25.2870	2.6850	0.0000	0.0000	0.0000	0.0000	38.4379	119.6400	194.6709	(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													
	332.1359	278.2633	254.3617	194.9994	159.8965	115.5586	113.0327	135.0768	165.6124	253.2578	297.1687	328.8130	(64)
Efficiency of water heater												169.8473	(216)
(217)m	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	169.8473	(217)
Fuel for water heating, kWh/month													
	195.5498	163.8315	149.7591	114.8087	94.1414	68.0368	66.5496	79.5284	97.5067	149.1092	174.9623	193.5933	(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	56.5434	51.0714	56.5434	54.7194	56.5434	54.7194	56.5434	56.5434	54.7194	56.5434	54.7194	56.5434	(231)
Lighting	34.2174	27.4505	24.7161	18.1081	13.9872	11.4277	12.7596	16.5854	21.5428	28.2653	31.9256	35.1684	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-58.1983	-87.4495	-131.8444	-150.8667	-163.4869	-151.4971	-149.5367	-140.5893	-122.9121	-101.0029	-65.4040	-49.5259	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	-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)													
(235a)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	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)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	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-20.3549	-47.2144	-105.4662	-176.2062	-246.5580	-253.6260	-249.4286	-204.3658	-141.2180	-73.4627	-28.5146	-15.6879	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	-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)													
(235b)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	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													

(235d)m	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	791.8428	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	169.8473	
Water heating fuel used	1547.3767	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.0875)		
mechanical ventilation fans (SFP = 1.0875)	585.7527	(230a)
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	665.7527	(231)
Electricity for lighting (calculated in Appendix L)	276.1542	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2934.4172	(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	-3228.8314	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	791.8428	16.4900	130.5749	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1547.3767	16.4900	255.1624	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	585.7527	16.4900	96.5906	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	276.1542	16.4900	45.5378	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1372.3139	16.4900	-226.2946	
PV Unit electricity exported	-1562.1033	5.5900	-87.3216	
Total			-313.6161	(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			-245.2449	(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] =	-0.4154	(257)
SAP value	106.7336	
SAP rating (Section 12)	107	(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	791.8428	0.1575	124.7403	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1547.3767	0.1451	224.4534	(264)
Space and water heating			349.1937	(265)
Pumps, fans and electric keep-hot	665.7527	0.1387	92.3481	(267)
Energy for lighting	276.1542	0.1443	39.8576	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1372.3139	0.1341	-184.0093	
PV Unit electricity exported	-1562.1033	0.1233	-192.6015	
Total			-376.6108	(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			-391.1830	(272)
CO2 emissions per m2			-2.3300	(273)
EI value			102.4663	
EI rating			102	(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	98.4200	(1b)	x 2.4000	(2b) =	236.2080	(1b) - (3b)
First floor	69.1200	(1c)	x 2.9700	(2c) =	205.2864	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	167.5400					(4)

Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 441.4944 (5)

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2. Ventilation rate

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		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)
		Air changes per hour	
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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0463	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.3000	6.0000	5.8000	5.1000	5.1000	4.6000	4.6000	4.5000	4.9000	5.7000	5.9000	6.3000	(22)
Wind factor	1.5750	1.5000	1.4500	1.2750	1.2750	1.1500	1.1500	1.1250	1.2250	1.4250	1.4750	1.5750	(22a)
Adj infilt rate	0.0728	0.0694	0.0671	0.0590	0.0590	0.0532	0.0532	0.0520	0.0567	0.0659	0.0682	0.0728	(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) =	81.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.1678	0.1644	0.1621	0.1540	0.1540	0.1482	0.1482	0.1470	0.1517	0.1609	0.1632	0.1678	(25)

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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 = 1.20)			17.8500	1.1450	20.4389			(27)
External Doors			3.9800	1.0000	3.9800			(26)
NE Roof Windows			2.1800	1.1450	2.4962			(27a)
SW Roof Windows			1.9500	1.1450	2.2328			(27a)
GF Floor			98.4200	0.1100	10.8262	110.0000	10826.2000	(28a)
External Wall (GF)	86.6700	15.4100	71.2600	0.1800	12.8268	150.0000	10689.0000	(29a)
Garage Wall (GF)	12.9800		12.9800	0.1600	2.0768	150.0000	1947.0000	(29a)
External Wall (FF)	45.1600	6.4200	38.7400	0.1800	6.9732	150.0000	5811.0000	(29a)
Knee Wall (FF)	28.1900		28.1900	0.1700	4.7923	9.0000	253.7100	(29a)
Dormer Wall (FF)	14.5600		14.5600	0.1800	2.6208	9.0000	131.0400	(29a)
GF Entrance Roof	9.9600		9.9600	0.1100	1.0956	9.0000	89.6400	(30)
FF Main Roof	80.3800	4.1300	76.2500	0.1100	8.3875	9.0000	686.2500	(30)
FF Dormer Roof	5.1000		5.1000	0.1100	0.5610	9.0000	45.9000	(30)
Total net area of external elements Aum(A, m2)			381.4200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		79.3081			(33)
Masonry (GF)			150.6300			100.0000	15063.0000	(32c)
Studwork (FF)			58.0900			9.0000	522.8100	(32c)
FF Intermediate Floor			69.1200			18.0000	1244.1600	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	47309.7100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		282.3786 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	14.7300	0.0190	0.2799
E3 Sill	12.8400	0.0220	0.2825
E4 Jamb	44.0600	0.0170	0.7490
E5 Ground floor (normal)	41.6040	0.0550	2.2882
E6 Intermediate floor within a dwelling	41.6750	0.0010	0.0417
E16 Corner (normal)	25.1890	0.0420	1.0579
R1 Head of roof window	3.7500	0.2400	0.9000
R2 Sill of roof window	3.7500	0.2400	0.9000
E10 Eaves (insulation at ceiling level)	9.8040	0.0570	0.5588
E11 Eaves (insulation at rafter level)	2.1590	0.0180	0.0389
E13 Gable (insulation at rafter level)	19.2000	0.0430	0.8256
E17 Corner (inverted - internal area greater than external area)	10.0790	-0.0850	-0.8567
R3 Jamb of roof window	11.0480	0.2400	2.6515
R4 Ridge (vaulted ceiling)	9.3100	0.1200	1.1172
R8 Roof to wall (rafter)	14.4920	0.1200	1.7390
E10 Eaves (insulation at ceiling level)	4.1640	0.1200	0.4997
E12 Gable (insulation at ceiling level)	1.9690	0.2500	0.4923

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.5655 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	92.8736 (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	24.4537	23.9483	23.6114	22.4322	22.4322	21.5899	21.5899	21.4214	22.0953	23.4429	23.7799	24.4537	(38)
Heat transfer coeff	117.3273	116.8219	116.4850	115.3058	115.3058	114.4635	114.4635	114.2951	114.9689	116.3165	116.6535	117.3273	(39)
Average = Sum(39)m / 12 =												115.8112	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7003	0.6973	0.6953	0.6882	0.6882	0.6832	0.6832	0.6822	0.6862	0.6943	0.6963	0.7003	(40)
HLP (average)												0.6912	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9593	(42)
Hot water usage for mixer showers													
	73.8370	72.7274	71.1105	68.0167	65.7336	63.1875	61.7403	63.3451	65.1041	67.8378	70.9980	73.5541	(42a)
Hot water usage for baths													
	31.8756	31.4022	30.7355	29.5064	28.5860	27.5654	27.0141	27.6761	28.3969	29.4889	30.7434	31.7678	(42b)
Hot water usage for other uses													
	44.9359	43.3018	41.6678	40.0338	38.3997	36.7657	36.7657	38.3997	40.0338	41.6678	43.3018	44.9359	(42c)
Average daily hot water use (litres/day)												138.4797	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	150.6484	147.4314	143.5138	137.5568	132.7193	127.5186	125.5202	129.4209	133.5348	138.9946	145.0432	150.2578	(44)
Energy conte	238.5903	209.9403	220.5753	188.3084	178.6657	156.7990	151.8058	160.2501	164.6617	188.6143	206.6407	235.2674	(45)
Energy content (annual)										Total = Sum(45)m =		2300.1191	
Distribution loss (46)m = 0.15 x (45)m													
	35.7885	31.4910	33.0863	28.2463	26.7999	23.5199	22.7709	24.0375	24.6993	28.2921	30.9961	35.2901	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2480	(55)
Total storage loss													
	38.6880	34.9440	38.6880	37.4400	38.6880	37.4400	38.6880	38.6880	37.4400	38.6880	37.4400	38.6880	(56)
If cylinder contains dedicated solar storage													
	38.6880	34.9440	38.6880	37.4400	38.6880	37.4400	38.6880	38.6880	37.4400	38.6880	37.4400	38.6880	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(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													
	332.1359	294.4331	314.1209	278.8364	272.2113	216.7510	213.7562	222.2005	224.6137	282.1599	297.1687	328.8130	(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												788.3984	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												788.3984	
Solar input	-7.5223	-26.0983	-73.0469	-101.2293	-122.7312	-119.9185	-106.3239	-101.9992	-74.9338	-43.2883	-11.3067	-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													
	324.6135	268.3348	241.0740	177.6071	149.4801	96.8326	107.4323	120.2013	149.6799	238.8716	285.8620	328.8130	(64)
										Total per year (kWh/year) = Sum(64)m =		2488.8023	(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	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	123.2174	109.4442	117.2274	105.0830	103.2924	70.1453	69.0853	71.8931	72.7596	106.6003	111.1784	122.1125	(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	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	177.5560	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	39.0925	34.7216	28.2375	21.3776	15.9800	13.4910	14.5775	18.9484	25.4325	32.2924	37.6900	40.1790	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	506.0184	511.2693	498.0372	469.8677	434.3088	400.8884	378.5615	373.3106	386.5427	414.7122	450.2712	483.6915	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	55.7149	(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)													
	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	-118.3707	(71)
Water heating gains (Table 5)													
	165.6147	162.8634	157.5637	145.9485	138.8339	97.4240	92.8566	96.6305	101.0550	143.2800	154.4145	164.1297	(72)
Total internal gains													
	825.6258	823.7545	798.7386	752.0941	704.0229	626.7036	600.8959	603.7897	627.9304	705.1848	757.2758	802.9004	(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	4.9900	15.4493	0.5700	0.7000	0.7700	21.3164	(75)
Southeast	0.9200	47.1180	0.5700	0.7000	0.7700	11.9862	(77)
Southwest	4.8300	47.1180	0.5700	0.7000	0.7700	62.9275	(79)
Northwest	7.1100	15.4493	0.5700	0.7000	0.7700	30.3727	(81)
Northeast	2.1800	26.2076	0.5700	0.7000	1.0000	20.5163	(82)
Southwest	1.9500	47.7956	0.5700	0.7000	1.0000	33.4686	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	180.5878	292.9557	465.2391	705.8214	835.3980	939.9756	803.8878	725.7478	565.0180	352.3978	214.4326	149.9867	(83)
Total gains	1006.2136	1116.7102	1263.9777	1457.9155	1539.4209	1566.6792	1404.7837	1329.5376	1192.9484	1057.5826	971.7084	952.8871	(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	112.0079	112.4925	112.8178	113.9716	113.9716	114.8103	114.8103	114.9795	114.3056	112.9812	112.6549	112.0079	

alpha	8.4672	8.4995	8.5212	8.5981	8.5981	8.6540	8.6540	8.6653	8.6204	8.5321	8.5103	8.4672	
util living area													
	0.9949	0.9884	0.9568	0.8389	0.6597	0.4672	0.3910	0.3868	0.5947	0.8799	0.9814	0.9958	(86)
Living	20.5684	20.6518	20.8087	20.9498	20.9933	20.9997	20.9999	20.9999	20.9979	20.9416	20.7566	20.5651	
Non living	19.8474	19.9544	20.1468	20.3070	20.3465	20.3555	20.3557	20.3566	20.3519	20.2980	20.0871	19.8434	
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	20.7792	20.6518	20.8087	20.9498	20.9933	20.9997	20.9999	20.9999	20.9979	20.9416	20.7566	20.6259	(87)
Th 2	20.3406	20.3432	20.3450	20.3512	20.3512	20.3557	20.3557	20.3566	20.3530	20.3459	20.3441	20.3406	(88)
util rest of house													
	0.9930	0.9842	0.9430	0.8048	0.6142	0.4204	0.3386	0.3315	0.5340	0.8397	0.9733	0.9941	(89)
MIT 2	20.1440	19.9544	20.1468	20.3070	20.3465	20.3555	20.3557	20.3566	20.3519	20.2980	20.0871	19.9330	(90)
Living area fraction										fLA = Living area / (4) =		0.2955	(91)
MIT	20.3317	20.1605	20.3424	20.4970	20.5376	20.5459	20.5461	20.5467	20.5428	20.4882	20.2849	20.1378	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3317	20.1605	20.3424	20.4970	20.5376	20.5459	20.5461	20.5467	20.5428	20.4882	20.2849	20.1378	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9929	0.9828	0.9429	0.8128	0.6274	0.4342	0.3541	0.3479	0.5519	0.8492	0.9724	0.9934	(94)
Useful gains	999.1123	1097.4516	1191.8379	1185.0017	965.8983	680.3025	497.4252	462.4852	658.4398	898.0591	944.8533	946.6228	(95)
Ext temp.	6.6000	6.8000	8.0000	9.7000	12.1000	14.6000	16.2000	16.5000	14.8000	12.2000	9.5000	7.0000	(96)
Heat loss rate W													
	1611.1007	1560.7943	1437.7067	1244.9516	972.9095	680.5856	497.4655	462.5173	660.2442	964.0545	1258.0997	1541.4169	(97)
Space heating kWh													
	455.3194	311.3663	182.9263	43.1639	5.2163	0.0000	0.0000	0.0000	0.0000	49.1006	225.5374	442.5268	(98a)
Space heating requirement - total per year (kWh/year)												1715.1572	
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													
	455.3194	311.3663	182.9263	43.1639	5.2163	0.0000	0.0000	0.0000	0.0000	49.1006	225.5374	442.5268	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1715.1572	
Space heating per m2											(98c) / (4) =	10.2373	(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 %)												339.8620	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	455.3194	311.3663	182.9263	43.1639	5.2163	0.0000	0.0000	0.0000	0.0000	49.1006	225.5374	442.5268	(98)
Space heating efficiency (main heating system 1)													
	339.8620	339.8620	339.8620	339.8620	339.8620	0.0000	0.0000	0.0000	0.0000	339.8620	339.8620	339.8620	(210)
Space heating fuel (main heating system)													
	133.9719	91.6155	53.8237	12.7004	1.5348	0.0000	0.0000	0.0000	0.0000	14.4472	66.3615	130.2078	(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													
	324.6135	268.3348	241.0740	177.6071	149.4801	96.8326	107.4323	120.2013	149.6799	238.8716	285.8620	328.8130	(64)
Efficiency of water heater												169.7606	(216)
(217)m	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	169.7606	(217)
Fuel for water heating, kWh/month													
	191.2184	158.0666	142.0082	104.6221	88.0534	57.0407	63.2846	70.8064	88.1712	140.7108	168.3912	193.6921	(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	56.5434	51.0714	56.5434	54.7194	56.5434	54.7194	56.5434	56.5434	54.7194	56.5434	54.7194	56.5434	(231)
Lighting	34.2174	27.4505	24.7161	18.1081	13.9872	11.4277	12.7596	16.5854	21.5428	28.2653	31.9256	35.1684	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-73.0995	-95.6917	-140.2670	-160.9775	-168.7938	-160.7425	-152.8941	-149.0797	-133.8196	-111.3145	-78.6091	-62.3113	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	-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)													
(235a)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	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)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	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-31.7976	-58.7089	-126.7251	-215.0939	-273.0871	-311.3987	-267.8061	-243.7254	-175.4605	-93.6751	-42.2566	-24.4824	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	-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)													
(235b)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	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)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	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												504.6628	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												169.7606	
Water heating fuel used												1466.0656	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.0875)													
mechanical ventilation fans (SFP = 1.0875)												585.7527	(230a)
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												665.7527	(231)
Electricity for lighting (calculated in Appendix L)												276.1542	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3351.8175	(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	-4014.7229	(238)

10a. Fuel costs - using BEDF prices (540)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	504.6628	25.1600	126.9732	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1466.0656	25.1600	368.8621	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	585.7527	25.1600	147.3754	(249)
Pump for solar water heating	80.0000	25.1600	20.1280	(249)
Energy for lighting	276.1542	25.1600	69.4804	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1487.6002	25.1600	-374.2802	
PV Unit electricity exported	-1864.2173	5.8100	-108.3110	
Total			-482.5912	(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			-441.8181	(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	504.6628	0.1584	79.9590	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1466.0656	0.1456	213.4627	(264)
Space and water heating			293.4217	(265)
Pumps, fans and electric keep-hot	665.7527	0.1387	92.3481	(267)
Energy for lighting	276.1542	0.1443	39.8576	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1487.6002	0.1347	-200.4360	
PV Unit electricity exported	-1864.2173	0.1246	-232.2066	
Total			-432.6427	(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			-502.9868	(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	504.6628	1.5865	800.6491	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1466.0656	1.5386	2255.7090	(278)
Space and water heating			3056.3581	(279)
Pumps, fans and electric keep-hot	665.7527	1.5128	1007.1507	(281)
Energy for lighting	276.1542	1.5338	423.5746	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1487.6002	1.4980	-2228.3749	
PV Unit electricity exported	-1864.2173	0.4572	-852.3098	
Total			-3080.6847	(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			-2930.0172	(286)