Designed SAP Calculation

Carbon Emissions Calculation - Part L Wales

Plot 9, Land opposite Bush Terrace, Jameston, Tenby, SA70 8EE

For

Evan Pritchard Contractors Ltd

15th May 2024

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Melin Consultants are accredited to provide a range of calculation, assessment, and testing services. They are members of the CIBSE Low Carbon Consultants.

Melin Consultants fully check all work prior to completion and a robust audit trail exists to demonstrate accountability.

All information within this document is based on evidence provided in the form of drawings and specifications.

CPD (Continual Professional Development) records are kept, and all technical staff are required to complete a minimum 20 hours per year in training activities.

Low Carbon Consultants have the expertise and necessary qualifications to offer advice in a professional capacity on matters relating to Part L of the Building Regulations and sustainability within the construction sector.

This document contains the following information:

1. U-values used
2. DER-TER & DPER-TPER Comparison
3. Construction, heating & ventilation overview
4. Explanation of SAP
5. Conclusion

Appendix: SAP Calculation outputs including PEA & BRWL Report

Project Ref: 710079

Report Date: 15/05/2024

Report Author: David Anslow

Function: Technical Consultant

Authorised By: Darren Baker

Function: Senior Consultant

1. U-Values

The table below outlines the Part L threshold or 'back-stop' U-values alongside the proposed dwelling U-values that have been used to run the calculation.

Building Element	Part L Threshold U-values	Proposed U-values*
Wall	0.18	0.15
Floor	0.15	0.10
Roof	0.13	0.11
Window	1.40	1.40
Glazed door	1.40	1.40
½ Glazed door	1.40	1.40

*Please note that these U-values are based on the element's component parts listed in section 3 of this report. If the element construction changes the U-value may also change.

2. DER-TER & DPER-TPER Comparison

The tables below highlight the proposed dwelling emission rate and primary energy rate against the target set out by a notional dwelling:

	Result ($kgCO_2/yr/m^2$)
DER (Dwelling Emission Rate)	9.03
TER (Target Emission Rate)	9.19
Overall Result	Pass

	Result ($kWh/m^2/yr$)
DPER (Dwelling Primary Energy Rate)	48.08
TPER (Target Primary Energy Rate)	48.17
Overall Result	Pass

	Result
Dwelling energy efficiency rating	98
Minimum energy efficiency rating	81
Overall Result	Pass

As outlined in the tables above Regulation 26, 26A, 26B & 26C have been met.

3. Construction, heating & ventilation overview

The table below lists all the construction, heating & ventilation details for the proposed dwelling:

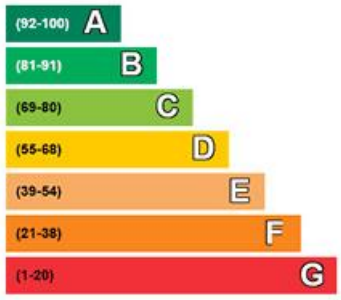
Building Element	Construction	U Value
Wall	**Cavity Wall – u-value calculated:** Dense block outer leaf, 50mm clear cavity, 100mm Kingspan K108 insulation, dense block inner leaf, 37.5mm Kingspan K118 insulated plasterboard on dabs.	0.15
Floor	**Solid concrete slab – u-value calculated:** 150mm Kingspan K103 above concrete slab below 75mm Screed	0.10
Roof	**Plane Roof – u-value calculated:** 400mm Rockwool between and over ceiling joists.	0.11
Opening	**Window:** Double glazed **Glazed door:** Double glazed **½ glazed door:** Double glazed	1.4 (g-value – 0.75) 1.4 (g-value – 0.75) 1.4 (g-value – 0.75)
System		Efficiency
Primary heating	**Gas combi boiler feeding radiators:** Ideal LOGIC+ COMBI2 C24 used in the calculations	
Secondary heating	None	
Water Heating	From combi boiler and WWHR System. Showersave, Blue QB1-21D used in calculation linked to both showers	
Heating controls	Programmer, Room Thermostat & TRVs	
Ventilation	Natural	
Renewables	6 kWp of Solar PV facing South	
Others		
Air permeability	A design air permeability of 5.01$m^3/(h.m^2)$ at 50Pa has been allowed for.	
Thermal Bridging	PSI values have been adopted from Table R2 under SAP10 conventions and are to be taken as reference values hence these will need to be calculated by As-built stage. ****Photographic evidence of the thermal bridging junction points, insulation & plant equipment will need to be provided by completion. ****	
Lighting	100% L.E.L fittings have been allowed for.	P = 10W, E = 75 lm/W

4. SAP Explanation

4.1 What is a SAP?

SAP stands for 'Standard Assessment Procedure' and is the only, official government approved system for assessing the energy and carbon emissions rating for new dwellings.

A SAP rating is a way of comparing energy performance of different dwellings – it results in a figure between 1 and 100+ (100 representing zero energy cost and anything over means you are exporting energy). The higher the SAP rating, the lower the fuel costs and the lower the associated emissions of carbon dioxide.



The SAP Calculations establish an energy cost based on the construction of the home, its heating system, internal lighting and any renewable technologies installed. It does **not** include energy used for cooking or appliances; this would be unregulated energy.

4.2 How is the SAP calculated?

The SAP Assessor will work from provided plans and construction details, together with a full HVAC (heating, ventilation and (where applicable) air conditioning) specification.

The assessor will scale off these plans either electronically or by hand to create a model of the dwelling(s) in SAP software. Once the site form is established, the heating, lighting and ventilation systems are added – specific products will be chosen from manufacturer databases where they are known.

All thermal elements (walls, floors, roofs and openings) are added in detail together with all calculations for thermal junctions. Any renewable technologies and cooling are also added.

Once complete, a SAP calculation is capable of producing a raft of detailed reporting outputs, from site form, heat losses and energy demand to seasonal variations, CO_2 emissions and renewables contributions amongst others.

4.3 Carbon Emissions

The headline emissions target is achieved using the DER/TER figures. CO_2 emissions are measured by comparing a Target Emission Rate (TER) against the predicted Dwelling Emission Rate (DER).

This target rate is set within the SAP calculations by reference to a notional dwelling of the same size and shape, using a set of baseline values.

4.4 Fabric Energy Efficiency

Fabric Energy Efficiency (FEE) is assessed using DFEE/TFEE figures. As with emissions the target is set within SAP using a set of baseline values depending on the size of the property.

It is a measure of the energy demand in units of kilowatt-hours per m^2 per year. How well a dwelling retains the heat it produces will have an impact on its CO_2 emissions as well as being assessed separately to gauge compliance.

4.5 Primary Energy Rating

The Primary Energy Rating is assessed using the DPER/TPER figures. It considers how much energy in kilowatt hours is required to provide heating and hot water to a newly built dwelling. It will also include energy used by lighting, ventilation, cooling systems and showers.

A notional specification will be used to set the target rate again using a set of baseline values as per the FEE and emissions.

5. Conclusion

The proposed development at Plot 9 on land opposite Bush Terrace in Jameston, Tenby achieves a SAP rating of **98A** and an Environmental Impact (EI) rating of **91B.**

Appendix:

SAP Calculation Outputs including PEA & BRWL.

Building Regulations Wales Part L (BRWL) Compliance Report

Approved Document L1 2021 Edition, Wales assessed by Array SAP 10 program, Array

Date: Wed 15 May 2024 15:08:21

Project Information			
Assessed By	David Anslow	Building Type	House, Detached
OCDEA Registration	EES/027282	Assessment Date	2024-05-15

Dwelling Details			
Assessment Type	As designed	Total Floor Area	166 m^2
Site Reference	710079	Plot Reference	710079
Address	Plot 9 17 Bush Park, Jameston, SA70 8EE		

Client Details	
Name	Evan Pritchard Contractors Ltd
Company	Evan Pritchard Contractors Ltd
Address	Unit 3A, Withybush East Business Park, Haverfordwest, SA62 4BW

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*9.19 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	9.03 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*48.17 kWh_{PE}/m^2*	
Dwelling primary energy	48.08 kWh_{PE}/m^2	OK
1c Minimum energy efficiency rating and dwelling energy efficiency rating		
Minimum energy efficiency rating	*81*	
Dwelling energy efficiency rating	98	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.18*	0.15	Walls (1) (0.15)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.4*	N/A	N/A	**N/A**
Floors	*0.15*	0.1	Ground Floor (0.1)	OK
Roofs	*0.13*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.4*	1.4	Front (1.4)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	170.31	0.15
Ground floor: Ground Floor, Ground Floor	82.96	0.1 **(!)**
Exposed roof: Roof (1)	82.96	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
Front, 1/2 Glazed Door	2.21	South	N/A	1.4
Front, Window	11.34	South	0.7	1.4
Side W, Window	3.18	West	0.7	1.4
Rear, Glazed Door	11.34	North	0.7	1.4
Rear, Window	5.47	North	0.7	1.4
Side E, 1/2 Glazed Door	1.89	East	N/A	1.4
Side E, Window	2.13	East	0.7	1.4

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1 - Main Dwelling**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	
External wall	E4: Jamb	Calculated by person with suitable expertise	0.05	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0 **(!)**	
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))		
Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5.01 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	89.0%
Emitter type	Radiators
Flow temperature	
System type	Combi boiler
Manufacturer	Ideal Boilers
Model	LOGIC+ COMBI2
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: N/A	
Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: Instantaneous	
Efficiency	69.7%
Manufacturer	Q-Blue B.V.
Model	Blue QB1-21D

6 Controls	
Main heating 1 - type: Programmer, room thermostat, and TRVs	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: N/A	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	75 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation		
System type: N/A		
Maximum permitted specific fan power	*N/A*	
Specific fan power	N/A	**N/A**
Minimum permitted heat recovery efficiency	*N/A*	
Heat recovery efficiency	N/A	**N/A**
Manufacturer/Model		
Commissioning		

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	6 kWp
Orientation	South
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BRWL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BRWL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

Predicted Energy Assessment

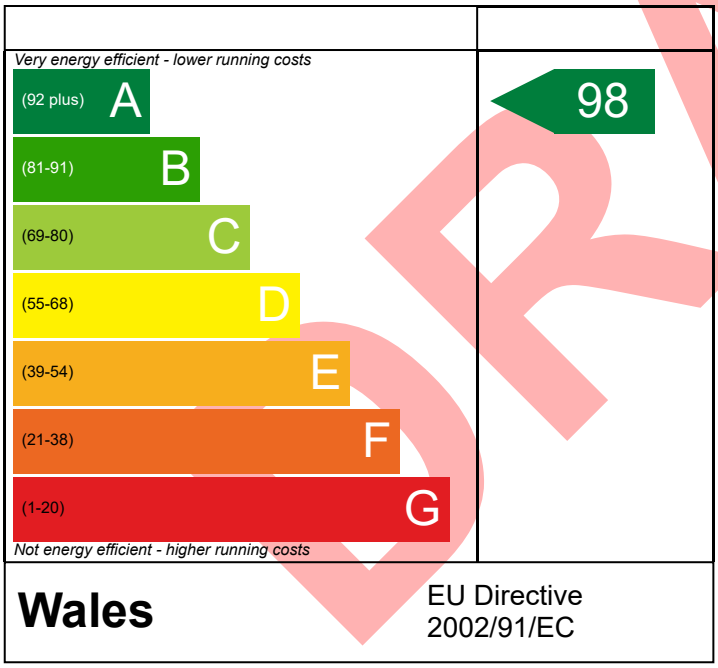
Plot 9, 17 Bush Park, Jameston, Pembrokeshire, SA70 8EE

Dwelling type:	House, Detached
Date of assessment:	15/05/2024
Produced by:	David Anslow
Total floor area:	165.92 m²
DRRN:	

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

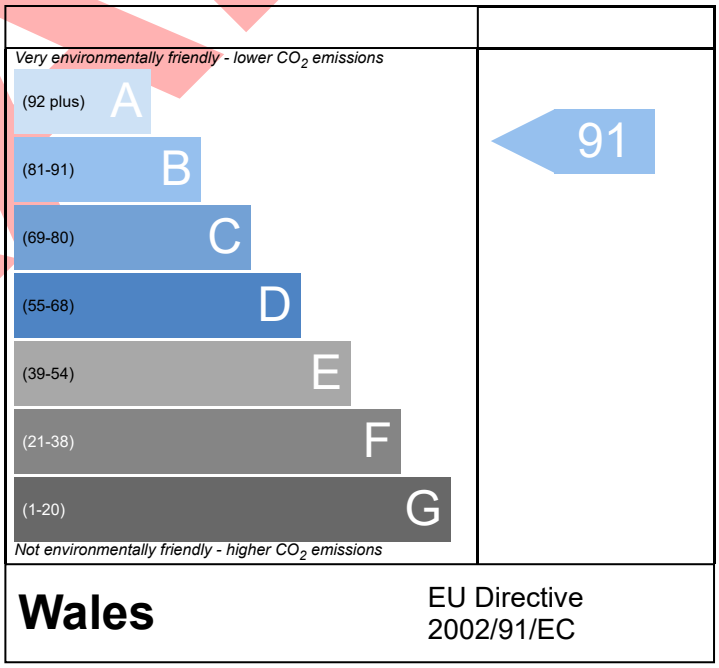
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



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

Environmental Impact (CO_2) Rating



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

Full SAP Calculation Printout

Property Reference	710079	**Issued on Date**	15/05/2024
Assessment Reference	710079	**Prop Type Ref**	
Property	Plot 9, 17 Bush Park, Jameston, Pembrokeshire, SA70 8EE		

SAP Rating	98 A	**DER**	9.03	**TER**	9.19
Environmental	91 B	**% DER < TER**			1.74
CO_2 Emissions (t/year)	1.31	**DPER**	48.08	**TPER**	48.17
Compliance Check	See BRWL	**% DPER < TPER**			0.18

Assessor Details	Mr. David Anslow	**Assessor ID**	AV54-0001
Client	Evan Pritchard Contractors Ltd, Evan Pritchard Contractors Ltd		

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	82.9600 (1b)	x	2.3700 (2b)	=	196.6152	(1b) - (3b)
First floor	82.9600 (1c)	x	2.7500 (2c)	=	228.1400	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 165.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	424.7552	(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	6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.1413	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0100	(17)
Infiltration rate		0.3918	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3918	(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	0.4995	0.4897	0.4799	0.4309	0.4211	0.3722	0.3722	0.3624	0.3918	0.4211	0.4407	0.4603	(22b)
Effective ac	0.6247	0.6199	0.6152	0.5929	0.5887	0.5693	0.5693	0.5657	0.5767	0.5887	0.5971	0.6059	(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	
1/2 Glazed Door			4.1000	1.4000	5.7400			(26a)
Glazed Door (Uw = 1.40)			11.3400	1.3258	15.0341			(27)
Window (Uw = 1.40)			22.1200	1.3258	29.3258			(27)
Ground Floor			82.9600	0.1000	8.2960	110.0000	9125.6000	(28a)
External Wall	207.8700	37.5600	170.3100	0.1500	25.5465	150.0000	25546.5000	(29a)
Plane Roof	82.9600		82.9600	0.1100	9.1256	9.0000	746.6400	(30)
Total net area of external elements Aum(A, m2)			373.7900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		93.0679			(33)
Internal Wall			286.2100			9.0000	2575.8900	(32c)
Internal Floor			82.9600			18.0000	1493.2800	(32d)
Internal Ceiling			82.9600			9.0000	746.6400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	40234.5500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		242.4937 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	24.0000	0.0500	1.2000
E3 Sill	16.6500	0.0500	0.8325
E4 Jamb	45.3000	0.0500	2.2650
E5 Ground floor (normal)	40.6000	0.1600	6.4960
E6 Intermediate floor within a dwelling	40.6000	0.0000	0.0000

E10 Eaves (insulation at ceiling level)	22.4500	0.0600	1.3470	
E12 Gable (insulation at ceiling level)	18.1500	0.0600	1.0890	
E16 Corner (normal)	25.6100	0.0900	2.3049	
E17 Corner (inverted - internal area greater than external area)	5.1200	-0.0900	-0.4608	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.0736 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 108.1415 (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	87.5701	86.8911	86.2256	83.0996	82.5147	79.7921	79.7921	79.2879	80.8408	82.5147	83.6979	84.9349	(38)
Heat transfer coeff	195.7117	195.0327	194.3671	191.2411	190.6563	187.9336	187.9336	187.4294	188.9823	190.6563	191.8394	193.0764	(39)
Average = Sum(39)m / 12 =												191.2383	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1796	1.1755	1.1715	1.1526	1.1491	1.1327	1.1327	1.1296	1.1390	1.1491	1.1562	1.1637	(40)
HLP (average)												1.1526	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9571 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	101.4753	99.9504	97.7282	93.4764	90.3387	86.8396	84.8507	87.0561	89.4736	93.2306	97.5736	101.0865	(42a)
Hot water usage for baths	31.8597	31.3866	30.7203	29.4917	28.5718	27.5517	27.0007	27.6624	28.3828	29.4743	30.7282	31.7520	(42b)
Hot water usage for other uses	44.9134	43.2802	41.6470	40.0137	38.3805	36.7473	36.7473	38.3805	40.0137	41.6470	43.2802	44.9134	(42c)
Average daily hot water use (litres/day)												163.9262	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	178.2485	174.6171	170.0954	162.9819	157.2910	151.1386	148.5987	153.0990	157.8701	164.3518	171.5820	177.7520	(44)
Energy conte	282.3020	248.6524	261.4303	223.1140	211.7439	185.8426	179.7173	189.5685	194.6696	223.0239	244.4500	278.3166	(45)
Energy content (annual)										Total = Sum(45)m =		2722.8311	
Distribution loss (46)m = 0.15 x (45)m	42.3453	37.2979	39.2145	33.4671	31.7616	27.8764	26.9576	28.4353	29.2004	33.4536	36.6675	41.7475	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	44.8258	40.5166	44.8782	43.4201	44.8644	43.4048	44.8258	44.8233	43.3742	44.8268	43.3867	44.8224	(61)
Total heat required for water heating calculated for each month	327.1278	289.1690	306.3085	266.5341	256.6084	229.2474	224.5431	234.3918	238.0438	267.8507	287.8366	323.1390	(62)
WWHRS	-86.7007	-76.6788	-80.2936	-66.4863	-61.9628	-53.0220	-49.6997	-52.8506	-54.8586	-64.6723	-73.2658	-85.0951	(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	240.4272	212.4902	226.0149	200.0478	194.6456	176.2254	174.8434	181.5412	183.1852	203.1784	214.5708	238.0439	(64)
										Total per year (kWh/year) = Sum(64)m =		2445.2140	(64)
12Total per year (kWh/year)												2445	(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	105.0719	92.8061	98.1451	85.0404	81.6210	72.6439	70.9625	74.2374	75.5712	85.3621	92.1263	103.7459	(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	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	171.2164	189.5610	171.2164	176.9236	171.2164	176.9236	171.2164	171.2164	176.9236	171.2164	176.9236	171.2164	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	337.3651	340.8659	332.0440	313.2632	289.5559	267.2743	252.3889	248.8881	257.7100	276.4907	300.1981	322.4796	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	(71)
Water heating gains (Table 5)	141.2256	138.1043	131.9155	118.1117	109.7056	100.8943	95.3796	99.7814	104.9600	114.7341	127.9532	139.4434	(72)
Total internal gains	720.1632	738.8872	705.5319	678.6546	640.8340	612.4483	586.3410	587.2420	606.9497	632.7973	675.4309	703.4955	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.3400	10.6334	0.7500	0.7000	0.7700	43.8710	(74)
North	5.4700	10.6334	0.7500	0.7000	0.7700	21.1618	(74)
East	2.1300	19.6403	0.7500	0.7000	0.7700	15.2202	(76)
South	11.3400	46.7521	0.7500	0.7000	0.7700	192.8885	(78)
West	3.1800	19.6403	0.7500	0.7000	0.7700	22.7231	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	295.8645	514.4076	735.8244	972.2944	1149.3710	1168.9362	1115.2791	978.0212	816.4362	576.7440	356.1757	252.0906	(83)
Total gains	1016.0277	1253.2948	1441.3563	1650.9490	1790.2050	1781.3844	1701.6201	1565.2631	1423.3859	1209.5413	1031.6066	955.5861	(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	57.1058	57.3046	57.5008	58.4407	58.6200	59.4692	59.4692	59.6292	59.1392	58.6200	58.2584	57.8852	
alpha	4.8071	4.8203	4.8334	4.8960	4.9080	4.9646	4.9646	4.9753	4.9426	4.9080	4.8839	4.8590	
util living area	0.9975	0.9928	0.9805	0.9365	0.8267	0.6407	0.4789	0.5377	0.7933	0.9636	0.9940	0.9981	(86)
MIT	19.5159	19.7513	20.0738	20.4920	20.8060	20.9592	20.9920	20.9864	20.8841	20.4590	19.9152	19.4884	(87)
Th 2	19.9364	19.9397	19.9429	19.9581	19.9609	19.9742	19.9742	19.9767	19.9691	19.9609	19.9552	19.9492	(88)
util rest of house	0.9967	0.9904	0.9739	0.9150	0.7735	0.5518	0.3709	0.4247	0.7144	0.9469	0.9917	0.9975	(89)
MIT 2	18.5888	18.8253	19.1459	19.5585	19.8350	19.9563	19.9723	19.9729	19.9079	19.5377	19.0013	18.5712	(90)
Living area fraction									fLA = Living area / (4) =			0.1506	(91)
MIT	18.7283	18.9647	19.2856	19.6990	19.9812	20.1073	20.1258	20.1255	20.0549	19.6764	19.1389	18.7093	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7283	18.9647	19.2856	19.6990	19.9812	20.1073	20.1258	20.1255	20.0549	19.6764	19.1389	18.7093	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9874	0.9685	0.9085	0.7747	0.5639	0.3872	0.4416	0.7217	0.9410	0.9891	0.9965	(94)
Useful gains	1011.2372	1237.5290	1395.9554	1499.9526	1386.8281	1004.5363	658.8569	691.2427	1027.3117	1138.1585	1020.3634	952.1960	(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	2823.7958	2743.0768	2485.1044	2065.2183	1578.8637	1034.9995	662.6160	698.2703	1125.3622	1730.4790	2309.5317	2801.3965	(97)
Space heating kWh	1348.5436	1011.7281	810.3268	406.9913	142.8745	0.0000	0.0000	0.0000	0.0000	440.6865	928.2011	1375.8052	(98a)
Space heating requirement - total per year (kWh/year)												6465.1571	
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	1348.5436	1011.7281	810.3268	406.9913	142.8745	0.0000	0.0000	0.0000	0.0000	440.6865	928.2011	1375.8052	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6465.1571	
Space heating per m2											(98c) / (4) =	38.9655	(99)
Energy for space heating												38.9655	(99)
Energy for space cooling												0.0000	(108)
Total												0.0000	(109)
Fabric Energy Efficiency (FEE)												48.1	(109)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 89.0000 (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	1348.5436	1011.7281	810.3268	406.9913	142.8745	0.0000	0.0000	0.0000	0.0000	440.6865	928.2011	1375.8052	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	1515.2175	1136.7732	910.4796	457.2936	160.5331	0.0000	0.0000	0.0000	0.0000	495.1533	1042.9226	1545.8485	(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	240.4272	212.4902	226.0149	200.0478	194.6456	176.2254	174.8434	181.5412	183.1852	203.1784	214.5708	238.0439	(64)
Efficiency of water heater												88.2000	(216)
(217)m	88.8780	88.8601	88.8243	88.7348	88.5369	88.2000	88.2000	88.2000	88.2000	88.7460	88.8487	88.8811	(217)
Fuel for water heating, kWh/month	270.5136	239.1289	254.4517	225.4447	219.8469	199.8020	198.2352	205.8290	207.6930	228.9438	241.5014	267.8229	(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	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	42.9720	34.4738	31.0398	22.7411	17.5659	14.3515	16.0242	20.8288	27.0546	35.4971	40.0939	44.1664	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-83.2338	-111.6323	-152.6552	-162.5795	-167.5605	-153.4671	-151.3941	-146.5910	-137.0179	-123.1704	-89.3661	-72.6122	(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	-67.0257	-139.1076	-274.3836	-409.7366	-539.4878	-541.6741	-534.5605	-452.7310	-332.3714	-197.3672	-88.8633	-53.1294	(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 7264.2214 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 88.2000
Water heating fuel used 2759.2131 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
central heating pump 41.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 86.0000 (231)
Electricity for lighting (calculated in Appendix L) 346.8090 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV generation	-5181.7182	(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	5274.5254	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7264.2214	0.2100	1525.4865	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2759.2131	0.2100	579.4348	(264)
Space and water heating			2104.9212	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	346.8090	0.1443	50.0553	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1551.2802	0.1358	-210.5878	
PV Unit electricity exported	-3630.4380	0.1261	-457.8511	
Total			-668.4389	(269)
Total CO2, kg/year			1498.4668	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.0300	(273)

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	7264.2214	1.1300	8208.5702	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2759.2131	1.1300	3117.9108	(278)
Space and water heating			11326.4810	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	346.8090	1.5338	531.9473	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1551.2802	1.5018	-2329.6778	
PV Unit electricity exported	-3630.4380	0.4629	-1680.6569	
Total			-4010.3346	(283)
Total Primary energy kWh/year			7978.1944	(286)
Dwelling Primary energy Rate (DPER)			48.0800	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	82.9600 (1b)	x	2.3700 (2b)	=	196.6152	(1b) - (3b)
First floor	82.9600 (1c)	x	2.7500 (2c)	=	228.1400	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	424.7552	(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	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0942 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3442 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3442 (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	0.4388	0.4302	0.4216	0.3786	0.3700	0.3270	0.3270	0.3184	0.3442	0.3700	0.3872	0.4044	(22b)
Effective ac	0.5963	0.5925	0.5889	0.5717	0.5684	0.5535	0.5535	0.5507	0.5592	0.5684	0.5750	0.5818	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			4.1000	1.0000	4.1000			(26a)
TER Opening Type (Uw = 1.30)			33.4600	1.2357	41.3479			(27)
Ground Floor			82.9600	0.1100	9.1256			(28a)
External Wall	207.8700	37.5600	170.3100	0.1300	22.1403			(29a)
Plane Roof	82.9600		82.9600	0.1100	9.1256			(30)
Total net area of external elements Aum(A, m2)			373.7900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.8394			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 242.4937 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	24.0000	0.0500	1.2000
E3	Sill	16.6500	0.0500	0.8325
E4	Jamb	45.3000	0.0500	2.2650
E5	Ground floor (normal)	40.6000	0.1600	6.4960
E6	Intermediate floor within a dwelling	40.6000	0.0000	0.0000
E10	Eaves (insulation at ceiling level)	22.4500	0.0600	1.3470
E12	Gable (insulation at ceiling level)	18.1500	0.0600	1.0890
E16	Corner (normal)	25.6100	0.0900	2.3049
E17	Corner (inverted - internal area greater than external area)	5.1200	-0.0900	-0.4608

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.0736 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 100.9130 (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	83.5803	83.0562	82.5425	80.1298	79.6784	77.5770	77.5770	77.1879	78.3864	79.6784	80.5916	81.5463	(38)

Heat transfer coeff

	184.4933	183.9692	183.4555	181.0428	180.5914	178.4900	178.4900	178.1009	179.2994	180.5914	181.5046	182.4593	(39)

Average = Sum(39)m / 12 = 181.0407

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1119	1.1088	1.1057	1.0911	1.0884	1.0758	1.0758	1.0734	1.0806	1.0884	1.0939	1.0997	(40)
HLP (average)												1.0911	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9571 (42)

Hot water usage for mixer showers

	73.8002	72.6912	71.0750	67.9828	65.7009	63.1561	61.7096	63.3135	65.0717	67.8040	70.9626	73.5175	(42a)

Hot water usage for baths

	33.5366	33.0385	32.3371	31.0439	30.0756	29.0018	28.4218	29.1183	29.8766	31.0256	32.3454	33.4232	(42b)

Hot water usage for other uses

	47.2772	45.5581	43.8389	42.1197	40.4006	38.6814	38.6814	40.4006	42.1197	43.8389	45.5581	47.2772	(42c)

Average daily hot water use (litres/day) 142.1143 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	154.6141	151.2877	147.2511	141.1465	136.1770	130.8393	128.8128	132.8324	137.0680	142.6685	148.8662	154.2179	(44)
Energy conte	244.8709	215.4317	226.3194	193.2225	183.3204	160.8821	155.7879	164.4742	169.0186	193.5998	212.0871	241.4680	(45)

Energy content (annual) Total = Sum(45)m = 2360.4827

Distribution loss (46)m = 0.15 x (45)m

	36.7306	32.3148	33.9479	28.9834	27.4981	24.1323	23.3682	24.6711	25.3528	29.0400	31.8131	36.2202	(46)

Water storage loss:

Total storage loss

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

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

	295.8298	261.4591	277.2783	242.5375	234.2793	210.1972	206.7468	215.4331	218.3337	244.5587	261.4022	292.4269	(62)
WWHRS	-51.5448	-45.5866	-47.7357	-39.5270	-36.8378	-31.5223	-29.5472	-31.4204	-32.6142	-38.4486	-43.5576	-50.5902	(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

	244.2850	215.8725	229.5426	203.0105	197.4415	178.6749	177.1997	184.0127	185.7194	206.1102	217.8446	241.8367	(64)

Total per year (kWh/year) = Sum(64)m = 2481.5503 (64)

12Total per year (kWh/year) 2482 (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

	94.1593	83.1379	87.9909	76.5752	73.6938	65.8221	64.5392	67.4274	68.5275	77.1117	82.8477	93.0278	(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	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	147.8536	(66)

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

	171.2164	189.5610	171.2164	176.9236	171.2164	176.9236	171.2164	171.2164	176.9236	171.2164	176.9236	171.2164	(67)

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

	337.3651	340.8659	332.0440	313.2632	289.5559	267.2743	252.3889	248.8881	257.7100	276.4907	300.1981	322.4796	(68)

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

	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	37.7854	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	(71)

Water heating gains (Table 5)

	126.5582	123.7171	118.2674	106.3545	99.0508	91.4196	86.7463	90.6282	95.1770	103.6447	115.0663	125.0374	(72)

Total internal gains

	705.4957	724.5000	691.8838	666.8974	630.1791	602.9736	577.7076	578.0888	597.1667	621.7079	662.5440	689.0895	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	16.8100	10.6334	0.6300	0.7000	0.7700	54.6275	(74)
East	2.1300	19.6403	0.6300	0.7000	0.7700	12.7849	(76)
South	11.3400	46.7521	0.6300	0.7000	0.7700	162.0264	(78)
West	3.1800	19.6403	0.6300	0.7000	0.7700	19.0874	(80)

Solar gains	248.5262	432.1024	618.0925	816.7273	965.4717	981.9064	936.8345	821.5378	685.8064	484.4650	299.1876	211.7561	(83)
Total gains	954.0219	1156.6024	1309.9763	1483.6247	1595.6508	1584.8799	1514.5421	1399.6266	1282.9731	1106.1729	961.7316	900.8456	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.5782	60.7507	60.9208	61.7327	61.8870	62.6156	62.6156	62.7524	62.3330	61.8870	61.5756	61.2535	
alpha	5.0385	5.0500	5.0614	5.1155	5.1258	5.1744	5.1744	5.1835	5.1555	5.1258	5.1050	5.0836	
util living area													
	0.9981	0.9947	0.9857	0.9516	0.8574	0.6781	0.5100	0.5697	0.8219	0.9716	0.9955	0.9986	(86)
MIT	19.5811	19.7919	20.0866	20.4788	20.7915	20.9547	20.9914	20.9853	20.8776	20.4622	19.9530	19.5532	(87)
Th 2	19.9911	19.9937	19.9962	20.0081	20.0103	20.0207	20.0207	20.0226	20.0167	20.0103	20.0058	20.0011	(88)
util rest of house													
	0.9975	0.9930	0.9808	0.9345	0.8101	0.5911	0.4009	0.4564	0.7490	0.9584	0.9937	0.9981	(89)
MIT 2	18.3291	18.6002	18.9763	19.4717	19.8315	19.9942	20.0178	20.0171	19.9307	19.4611	18.8157	18.3004	(90)
Living area fraction										fLA = Living area / (4) =		0.1506	(91)
MIT	18.5176	18.7796	19.1434	19.6234	19.9760	20.1388	20.1644	20.1629	20.0733	19.6118	18.9869	18.4890	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5176	18.7796	19.1434	19.6234	19.9760	20.1388	20.1644	20.1629	20.0733	19.6118	18.9869	18.4890	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9899	0.9751	0.9262	0.8082	0.6022	0.4173	0.4733	0.7538	0.9511	0.9910	0.9970	(94)
Useful gains	950.2979	1144.9097	1277.3238	1374.0778	1289.6051	954.4097	632.0397	662.4141	967.0539	1052.1350	953.0516	898.1845	(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													
	2623.0484	2553.4237	2319.5102	1941.3884	1494.5753	988.6165	636.2078	670.1760	1071.0008	1627.4548	2157.5323	2607.1669	(97)
Space heating kWh													
	1244.5264	946.5214	775.3867	408.4636	152.4978	0.0000	0.0000	0.0000	0.0000	428.0380	867.2261	1271.4829	(98a)
Space heating requirement - total per year (kWh/year)												6094.1428	
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													
	1244.5264	946.5214	775.3867	408.4636	152.4978	0.0000	0.0000	0.0000	0.0000	428.0380	867.2261	1271.4829	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6094.1428	
Space heating per m2											(98c) / (4) =	36.7294	(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 %)												92.4000	(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													
	1244.5264	946.5214	775.3867	408.4636	152.4978	0.0000	0.0000	0.0000	0.0000	428.0380	867.2261	1271.4829	(98)
Space heating efficiency (main heating system 1)													
	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)													
	1346.8900	1024.3738	839.1631	442.0602	165.0409	0.0000	0.0000	0.0000	0.0000	463.2446	938.5564	1376.0637	(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													
	244.2850	215.8725	229.5426	203.0105	197.4415	178.6749	177.1997	184.0127	185.7194	206.1102	217.8446	241.8367	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.3648	87.1663	86.7772	85.8475	83.8342	80.3000	80.3000	80.3000	80.3000	85.9096	87.0287	87.4041	(217)
Fuel for water heating, kWh/month													
	279.6150	247.6560	264.5196	236.4780	235.5144	222.5092	220.6721	229.1565	231.2820	239.9152	250.3134	276.6881	(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	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	35.5754	28.5399	25.6970	18.8267	14.5423	11.8812	13.2660	17.2436	22.3978	29.3871	33.1926	36.5641	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-71.1806	-97.2348	-135.4308	-147.3158	-154.6747	-142.7388	-140.7751	-134.7771	-123.8109	-108.5882	-77.0532	-61.8944	(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	-50.2891	-104.4446	-205.2354	-304.9846	-400.2734	-401.2574	-396.7134	-337.4130	-249.2257	-148.4780	-66.8290	-39.8876	(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	(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	6595.3926	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	2934.3194	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	287.1137	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4100.5059	(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	5802.3199	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6595.3926	0.2100	1385.0325	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2934.3194	0.2100	616.2071	(264)
Space and water heating			2001.2395	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	287.1137	0.1443	41.4394	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1395.4745	0.1353	-188.8106	
PV Unit electricity exported	-2705.0314	0.1262	-341.3823	
Total			-530.1930	(269)
Total CO2, kg/year			1524.4152	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.1900	(273)

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	6595.3926	1.1300	7452.7937	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2934.3194	1.1300	3315.7810	(278)
Space and water heating			10768.5747	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	287.1137	1.5338	440.3846	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1395.4745	1.5001	-2093.3421	
PV Unit electricity exported	-2705.0314	0.4633	-1253.1432	
Total			-3346.4853	(283)
Total Primary energy kWh/year			7992.5747	(286)
Target Primary Energy Rate (TPER)			48.1700	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	82.9600 (1b)	x	2.3700 (2b)	=	196.6152	(1b) - (3b)
First floor	82.9600 (1c)	x	2.7500 (2c)	=	228.1400	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 165.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	424.7552	(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	6 * 10 =	60.0000 (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) =	60.0000 / (5) =	0.1413 (8)

Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0100	(17)
Infiltration rate	0.3918	(18)
Number of sides sheltered	0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3918	(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	0.4995	0.4897	0.4799	0.4309	0.4211	0.3722	0.3722	0.3624	0.3918	0.4211	0.4407	0.4603	(22b)
Effective ac	0.6247	0.6199	0.6152	0.5929	0.5887	0.5693	0.5693	0.5657	0.5767	0.5887	0.5971	0.6059	(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	
1/2 Glazed Door			4.1000	1.4000	5.7400			(26a)
Glazed Door (Uw = 1.40)			11.3400	1.3258	15.0341			(27)
Window (Uw = 1.40)			22.1200	1.3258	29.3258			(27)
Ground Floor			82.9600	0.1000	8.2960	110.0000	9125.6000	(28a)
External Wall	207.8700	37.5600	170.3100	0.1500	25.5465	150.0000	25546.5000	(29a)
Plane Roof	82.9600		82.9600	0.1100	9.1256	9.0000	746.6400	(30)
Total net area of external elements Aum(A, m2)			373.7900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		93.0679			(33)
Internal Wall			286.2100			9.0000	2575.8900	(32c)
Internal Floor			82.9600			18.0000	1493.2800	(32d)
Internal Ceiling			82.9600			9.0000	746.6400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 40234.5500	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	242.4937	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	24.0000	0.0500	1.2000
E3 Sill	16.6500	0.0500	0.8325
E4 Jamb	45.3000	0.0500	2.2650
E5 Ground floor (normal)	40.6000	0.1600	6.4960
E6 Intermediate floor within a dwelling	40.6000	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	22.4500	0.0600	1.3470
E12 Gable (insulation at ceiling level)	18.1500	0.0600	1.0890
E16 Corner (normal)	25.6100	0.0900	2.3049
E17 Corner (inverted - internal area greater than external area)	5.1200	-0.0900	-0.4608

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.0736	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 108.1415	(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	87.5701	86.8911	86.2256	83.0996	82.5147	79.7921	79.7921	79.2879	80.8408	82.5147	83.6979	84.9349	(38)
Heat transfer coeff	195.7117	195.0327	194.3671	191.2411	190.6563	187.9336	187.9336	187.4294	188.9823	190.6563	191.8394	193.0764	(39)
Average = Sum(39)m / 12 =												191.2383	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1796	1.1755	1.1715	1.1526	1.1491	1.1327	1.1327	1.1296	1.1390	1.1491	1.1562	1.1637	(40)
HLP (average)												1.1526	
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	2.9571	(42)

Hot water usage for mixer showers

	101.4753	99.9504	97.7282	93.4764	90.3387	86.8396	84.8507	87.0561	89.4736	93.2306	97.5736	101.0865	(42a)

Hot water usage for baths

	31.8597	31.3866	30.7203	29.4917	28.5718	27.5517	27.0007	27.6624	28.3828	29.4743	30.7282	31.7520	(42b)

Hot water usage for other uses

	44.9134	43.2802	41.6470	40.0137	38.3805	36.7473	36.7473	38.3805	40.0137	41.6470	43.2802	44.9134	(42c)
Average daily hot water use (litres/day)												163.9262	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	178.2485	174.6171	170.0954	162.9819	157.2910	151.1386	148.5987	153.0990	157.8701	164.3518	171.5820	177.7520	(44)
Energy conte	282.3020	248.6524	261.4303	223.1140	211.7439	185.8426	179.7173	189.5685	194.6696	223.0239	244.4500	278.3166	(45)
Energy content (annual)										Total = Sum(45)m =		2722.8311	
Distribution loss (46)m = 0.15 x (45)m	42.3453	37.2979	39.2145	33.4671	31.7616	27.8764	26.9576	28.4353	29.2004	33.4536	36.6675	41.7475	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	44.8258	40.5166	44.8782	43.4201	44.8644	43.4048	44.8258	44.8233	43.3742	44.8268	43.3867	44.8224	(61)
Total heat required for water heating calculated for each month	327.1278	289.1690	306.3085	266.5341	256.6084	229.2474	224.5431	234.3918	238.0438	267.8507	287.8366	323.1390	(62)
WWHRS	-86.7007	-76.6788	-80.2936	-66.4863	-61.9628	-53.0220	-49.6997	-52.8506	-54.8586	-64.6723	-73.2658	-85.0951	(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	240.4272	212.4902	226.0149	200.0478	194.6456	176.2254	174.8434	181.5412	183.1852	203.1784	214.5708	238.0439	(64)
										Total per year (kWh/year) = Sum(64)m =		2445.2140	(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	105.0719	92.8061	98.1451	85.0404	81.6210	72.6439	70.9625	74.2374	75.5712	85.3621	92.1263	103.7459	(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	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	(66)

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

	49.0944	43.6052	35.4621	26.8471	20.0685	16.9427	18.3072	23.7964	31.9395	40.5545	47.3331	50.4589	(67)

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

	503.5299	508.7550	495.5880	467.5570	432.1730	398.9169	376.6999	371.4748	384.6418	412.6728	448.0568	481.3129	(68)

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

	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	(71)

Water heating gains (Table 5)

	141.2256	138.1043	131.9155	118.1117	109.7056	100.8943	95.3796	99.7814	104.9600	114.7341	127.9532	139.4434	(72)

Total internal gains

	811.6910	808.3055	780.8066	730.3568	679.7881	631.5949	605.2277	609.8935	636.3822	685.8023	741.1840	789.0561	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.3400	10.6334	0.7500	0.7000	0.7700	43.8710	(74)
North	5.4700	10.6334	0.7500	0.7000	0.7700	21.1618	(74)
East	2.1300	19.6403	0.7500	0.7000	0.7700	15.2202	(76)
South	11.3400	46.7521	0.7500	0.7000	0.7700	192.8885	(78)
West	3.1800	19.6403	0.7500	0.7000	0.7700	22.7231	(80)

Solar gains	295.8645	514.4076	735.8244	972.2944	1149.3710	1168.9362	1115.2791	978.0212	816.4362	576.7440	356.1757	252.0906	(83)
Total gains	1107.5555	1322.7131	1516.6310	1702.6512	1829.1591	1800.5310	1720.5068	1587.9147	1452.8184	1262.5463	1097.3597	1041.1467	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.1058	57.3046	57.5008	58.4407	58.6200	59.4692	59.4692	59.6292	59.1392	58.6200	58.2584	57.8852	
alpha	4.8071	4.8203	4.8334	4.8960	4.9080	4.9646	4.9646	4.9753	4.9426	4.9080	4.8839	4.8590	
util living area													
	0.9964	0.9910	0.9763	0.9296	0.8176	0.6351	0.4740	0.5308	0.7838	0.9574	0.9923	0.9973	(86)
MIT	19.5752	19.7952	20.1183	20.5164	20.8162	20.9607	20.9924	20.9871	20.8904	20.4877	19.9571	19.5442	(87)
Th 2	19.9364	19.9397	19.9429	19.9581	19.9609	19.9742	19.9742	19.9767	19.9691	19.9609	19.9552	19.9492	(88)
util rest of house													
	0.9952	0.9881	0.9684	0.9065	0.7632	0.5465	0.3669	0.4188	0.7039	0.9385	0.9893	0.9964	(89)
MIT 2	18.6477	18.8685	19.1888	19.5802	19.8425	19.9570	19.9724	19.9732	19.9117	19.5640	19.0426	18.6267	(90)
Living area fraction									fLA = Living area / (4) =			0.1506	(91)
MIT	18.7873	19.0080	19.3287	19.7212	19.9891	20.1081	20.1259	20.1258	20.0591	19.7030	19.1803	18.7649	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7873	19.0080	19.3287	19.7212	19.9891	20.1081	20.1259	20.1258	20.0591	19.7030	19.1803	18.7649	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9933	0.9846	0.9625	0.9002	0.7649	0.5587	0.3831	0.4356	0.7117	0.9325	0.9862	0.9949	(94)
Useful gains	1100.1650	1302.3123	1459.7690	1532.7693	1399.0352	1005.8961	659.0575	691.7108	1033.9575	1177.3627	1082.1728	1035.8841	(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													
	2835.3419	2751.5253	2493.4763	2069.4529	1580.3670	1035.1586	662.6408	698.3272	1126.1630	1735.5481	2317.4783	2812.1308	(97)
Space heating kWh													
	1290.9716	973.8711	769.0782	386.4122	134.9108	0.0000	0.0000	0.0000	0.0000	415.2900	889.4200	1321.5275	(98a)
Space heating requirement - total per year (kWh/year)												6181.4815	
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													
	1290.9716	973.8711	769.0782	386.4122	134.9108	0.0000	0.0000	0.0000	0.0000	415.2900	889.4200	1321.5275	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6181.4815	
Space heating per m2											(98c) / (4) =	37.2558	(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 %)	89.0000	(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													
	1290.9716	973.8711	769.0782	386.4122	134.9108	0.0000	0.0000	0.0000	0.0000	415.2900	889.4200	1321.5275	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	1450.5299	1094.2372	864.1328	434.1710	151.5852	0.0000	0.0000	0.0000	0.0000	466.6179	999.3483	1484.8624	(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													
	240.4272	212.4902	226.0149	200.0478	194.6456	176.2254	174.8434	181.5412	183.1852	203.1784	214.5708	238.0439	(64)
Efficiency of water heater												88.2000	(216)
(217)m	88.8734	88.8556	88.8170	88.7255	88.5258	88.2000	88.2000	88.2000	88.2000	88.7356	88.8434	88.8770	(217)
Fuel for water heating, kWh/month													
	270.5276	239.1409	254.4725	225.4683	219.8745	199.8020	198.2352	205.8290	207.6930	228.9706	241.5158	267.8354	(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	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	42.9720	34.4738	31.0398	22.7411	17.5659	14.3515	16.0242	20.8288	27.0546	35.4971	40.0939	44.1664	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-83.2338	-111.6323	-152.6552	-162.5795	-167.5605	-153.4671	-151.3941	-146.5910	-137.0179	-123.1704	-89.3661	-72.6122	(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	-67.0257	-139.1076	-274.3836	-409.7366	-539.4878	-541.6741	-534.5605	-452.7310	-332.3714	-197.3672	-88.8633	-53.1294	(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	6945.4848	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	88.2000	
Water heating fuel used	2759.3648	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	346.8090	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-5181.7182	(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	4955.9404	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6945.4848	3.6400	252.8156	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2759.3648	3.6400	100.4409	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	346.8090	16.4900	57.1888	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1551.2802	16.4900	-255.8061	
PV Unit electricity exported	-3630.4380	5.5900	-202.9415	
Total			-458.7476	(252)
Total energy cost			57.8791	(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] =	0.0988 (257)
SAP value		98.3986
SAP rating (Section 12)		98 (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	6945.4848	0.2100	1458.5518	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2759.3648	0.2100	579.4666	(264)
Space and water heating			2038.0184	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	346.8090	0.1443	50.0553	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1551.2802	0.1358	-210.5878	
PV Unit electricity exported	-3630.4380	0.1261	-457.8511	
Total			-668.4389	(269)
Total CO2, kg/year			1431.5640	(272)
CO2 emissions per m2			8.6300	(273)
EI value			90.9051	
EI rating			91	(274)
EI band			B	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	82.9600 (1b)	x	2.3700 (2b)	=	196.6152	(1b) - (3b)
First floor	82.9600 (1c)	x	2.7500 (2c)	=	228.1400	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	424.7552	(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	6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.1413	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0100	(17)
Infiltration rate		0.3918	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3918	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	7.8000	7.4000	6.9000	6.1000	6.1000	5.6000	5.6000	5.7000	6.4000	7.3000	7.7000	7.8000	(22)
Wind factor	1.9500	1.8500	1.7250	1.5250	1.5250	1.4000	1.4000	1.4250	1.6000	1.8250	1.9250	1.9500	(22a)
Adj infilt rate	0.7639	0.7248	0.6758	0.5974	0.5974	0.5485	0.5485	0.5583	0.6268	0.7150	0.7541	0.7639	(22b)
Effective ac	0.7918	0.7626	0.7283	0.6785	0.6785	0.6504	0.6504	0.6558	0.6964	0.7556	0.7844	0.7918	(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	
1/2 Glazed Door			4.1000	1.4000	5.7400			(26a)
Glazed Door (Uw = 1.40)			11.3400	1.3258	15.0341			(27)
Window (Uw = 1.40)			22.1200	1.3258	29.3258			(27)
Ground Floor			82.9600	0.1000	8.2960	110.0000	9125.6000	(28a)
External Wall	207.8700	37.5600	170.3100	0.1500	25.5465	150.0000	25546.5000	(29a)
Plane Roof	82.9600		82.9600	0.1100	9.1256	9.0000	746.6400	(30)
Total net area of external elements Aum(A, m2)			373.7900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		93.0679			(33)
Internal Wall			286.2100			9.0000	2575.8900	(32c)
Internal Floor			82.9600			18.0000	1493.2800	(32d)
Internal Ceiling			82.9600			9.0000	746.6400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	40234.5500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		242.4937 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	24.0000	0.0500	1.2000
E3 Sill	16.6500	0.0500	0.8325
E4 Jamb	45.3000	0.0500	2.2650
E5 Ground floor (normal)	40.6000	0.1600	6.4960
E6 Intermediate floor within a dwelling	40.6000	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	22.4500	0.0600	1.3470
E12 Gable (insulation at ceiling level)	18.1500	0.0600	1.0890
E16 Corner (normal)	25.6100	0.0900	2.3049
E17 Corner (inverted - internal area greater than external area)	5.1200	-0.0900	-0.4608

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		15.0736 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	108.1415 (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	110.9850	106.8976	102.0910	95.0994	95.0994	91.1667	91.1667	91.9264	97.6204	105.9094	109.9430	110.9850	(38)
Heat transfer coeff	219.1265	215.0392	210.2325	203.2410	203.2410	199.3083	199.3083	200.0679	205.7620	214.0510	218.0845	219.1265	(39)
Average = Sum(39)m / 12 =												208.8824	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3207	1.2960	1.2671	1.2249	1.2249	1.2012	1.2012	1.2058	1.2401	1.2901	1.3144	1.3207	(40)
HLP (average)												1.2589	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.9571 (42)

Hot water usage for mixer showers
101.4753 99.9504 97.7282 93.4764 90.3387 86.8396 84.8507 87.0561 89.4736 93.2306 97.5736 101.0865 (42a)
Hot water usage for baths
31.8597 31.3866 30.7203 29.4917 28.5718 27.5517 27.0007 27.6624 28.3828 29.4743 30.7282 31.7520 (42b)
Hot water usage for other uses
44.9134 43.2802 41.6470 40.0137 38.3805 36.7473 36.7473 38.3805 40.0137 41.6470 43.2802 44.9134 (42c)
Average daily hot water use (litres/day) 163.9262 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	178.2485	174.6171	170.0954	162.9819	157.2910	151.1386	148.5987	153.0990	157.8701	164.3518	171.5820	177.7520	(44)
Energy conte	282.3020	248.6524	261.4303	223.1140	211.7439	185.8426	179.7173	189.5685	194.6696	223.0239	244.4500	278.3166	(45)

Energy content (annual) Total = Sum(45)m = 2722.8311
Distribution loss (46)m = 0.15 x (45)m
42.3453 37.2979 39.2145 33.4671 31.7616 27.8764 26.9576 28.4353 29.2004 33.4536 36.6675 41.7475 (46)
Water storage loss:
Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	44.8258	40.5166	44.8782	43.4201	44.8644	43.4048	44.8258	44.8233	43.3742	44.8268	43.3867	44.8224	(61)

Total heat required for water heating calculated for each month
327.1278 289.1690 306.3085 266.5341 256.6084 229.2474 224.5431 234.3918 238.0438 267.8507 287.8366 323.1390 (62)

WWHRS	-86.7007	-76.6788	-80.2936	-66.4863	-61.9628	-53.0220	-49.6997	-52.8506	-54.8586	-64.6723	-73.2658	-85.0951	(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
240.4272 212.4902 226.0149 200.0478 194.6456 176.2254 174.8434 181.5412 183.1852 203.1784 214.5708 238.0439 (64)
Total per year (kWh/year) = Sum(64)m = 2445.2140 (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
105.0719 92.8061 98.1451 85.0404 81.6210 72.6439 70.9625 74.2374 75.5712 85.3621 92.1263 103.7459 (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	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
49.0944 43.6052 35.4621 26.8471 20.0685 16.9427 18.3072 23.7964 31.9395 40.5545 47.3331 50.4589 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
503.5299 508.7550 495.5880 467.5570 432.1730 398.9169 376.6999 371.4748 384.6418 412.6728 448.0568 481.3129 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
55.6995 55.6995 55.6995 55.6995 55.6995 55.6995 55.6995 55.6995 55.6995 55.6995 55.6995 55.6995 (69)

Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)
-118.2829 -118.2829 -118.2829 -118.2829 -118.2829 -118.2829 -118.2829 -118.2829 -118.2829 -118.2829 -118.2829 -118.2829 (71)
Water heating gains (Table 5)
141.2256 138.1043 131.9155 118.1117 109.7056 100.8943 95.3796 99.7814 104.9600 114.7341 127.9532 139.4434 (72)
Total internal gains
811.6910 808.3055 780.8066 730.3568 679.7881 631.5949 605.2277 609.8935 636.3822 685.8023 741.1840 789.0561 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.3400	12.7955	0.7500	0.7000	0.7700	52.7912	(74)
North	5.4700	12.7955	0.7500	0.7000	0.7700	25.4645	(74)
East	2.1300	23.8384	0.7500	0.7000	0.7700	18.4735	(76)
South	11.3400	54.5463	0.7500	0.7000	0.7700	225.0459	(78)
West	3.1800	23.8384	0.7500	0.7000	0.7700	27.5802	(80)

Solar gains	349.3553	549.9631	817.6635	1112.5727	1272.9564	1362.9131	1216.2615	1085.5761	892.0792	615.3056	393.7298	287.7989	(83)
Total gains	1161.0462	1358.2686	1598.4701	1842.9295	1952.7445	1994.5080	1821.4892	1695.4697	1528.4614	1301.1079	1134.9138	1076.8551	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.0037	51.9732	53.1614	54.9902	54.9902	56.0753	56.0753	55.8623	54.3165	52.2131	51.2474	51.0037	
alpha	4.4002	4.4649	4.5441	4.6660	4.6660	4.7384	4.7384	4.7242	4.6211	4.4809	4.4165	4.4002	
util living area	0.9935	0.9877	0.9697	0.9169	0.8188	0.6624	0.5699	0.5980	0.7905	0.9467	0.9861	0.9946	(86)
MIT	19.6177	19.7863	20.1113	20.5111	20.7834	20.9384	20.9749	20.9696	20.8623	20.4829	20.0242	19.6210	(87)
Th 2	19.8247	19.8439	19.8667	19.9001	19.9001	19.9190	19.9190	19.9154	19.8880	19.8486	19.8296	19.8247	(88)
util rest of house	0.9911	0.9834	0.9593	0.8900	0.7641	0.5787	0.4653	0.4880	0.7072	0.9204	0.9799	0.9926	(89)
MIT 2	18.6058	18.7866	19.1216	19.5247	19.7597	19.8892	19.9104	19.9049	19.8164	19.4685	19.0132	18.6094	(90)
Living area fraction									fLA = Living area / (4) =			0.1506	(91)
MIT	18.7581	18.9371	19.2706	19.6732	19.9138	20.0472	20.0706	20.0652	19.9738	19.6212	19.1654	18.7617	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7581	18.9371	19.2706	19.6732	19.9138	20.0472	20.0706	20.0652	19.9738	19.6212	19.1654	18.7617	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9880	0.9787	0.9522	0.8834	0.7649	0.5892	0.4806	0.5040	0.7144	0.9137	0.9748	0.9898	(94)
Useful gains	1147.1271	1329.3916	1522.1057	1628.0443	1493.5684	1175.1779	875.4036	854.4745	1091.9893	1188.8086	1106.3428	1065.9147	(95)
Ext temp.	5.9000	6.0000	7.1000	9.0000	11.5000	13.9000	15.6000	15.7000	14.1000	11.5000	8.9000	6.3000	(96)

Heat loss rate W

2817.5511	2781.9822	2558.6557	2169.2411	1710.0296	1225.1845	891.0347	873.3379	1208.6141	1738.3476	2238.7203	2730.6977	(97)

Space heating kWh

1242.7954	976.1409	771.1932	389.6617	161.0471	0.0000	0.0000	0.0000	0.0000	408.8570	815.3118	1238.5985	(98a)

Space heating requirement - total per year (kWh/year) 6003.6057

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

1242.7954	976.1409	771.1932	389.6617	161.0471	0.0000	0.0000	0.0000	0.0000	408.8570	815.3118	1238.5985	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 6003.6057

Space heating per m2 (98c) / (4) = 36.1837 (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 %) 89.0000 (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													
	1242.7954	976.1409	771.1932	389.6617	161.0471	0.0000	0.0000	0.0000	0.0000	408.8570	815.3118	1238.5985	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	1396.3994	1096.7875	866.5092	437.8222	180.9518	0.0000	0.0000	0.0000	0.0000	459.3899	916.0807	1391.6837	(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													
	240.4272	212.4902	226.0149	200.0478	194.6456	176.2254	174.8434	181.5412	183.1852	203.1784	214.5708	238.0439	(64)
Efficiency of water heater												88.2000	(216)
(217)m	88.8693	88.8559	88.8174	88.7270	88.5604	88.2000	88.2000	88.2000	88.2000	88.7328	88.8321	88.8701	(217)
Fuel for water heating, kWh/month													
	270.5401	239.1402	254.4714	225.4644	219.7884	199.8020	198.2352	205.8290	207.6930	228.9778	241.5464	267.8562	(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	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	42.9720	34.4738	31.0398	22.7411	17.5659	14.3515	16.0242	20.8288	27.0546	35.4971	40.0939	44.1664	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-94.1530	-116.9154	-160.9271	-170.2790	-171.8005	-158.1432	-154.1577	-150.7116	-141.7709	-128.0122	-96.1061	-80.5600	(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	-85.7881	-154.7107	-318.1916	-487.2005	-611.2512	-651.2381	-593.2827	-515.9037	-374.9291	-218.1391	-103.6832	-65.0317	(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 6745.6244 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 88.2000

Water heating fuel used 2759.3440 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

central heating pump 41.0000 (230c)

main heating flue fan 45.0000 (230e)

Total electricity for the above, kWh/year 86.0000 (231)

Electricity for lighting (calculated in Appendix L) 346.8090 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV generation -5802.8865 (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 4134.8910 (238)

10a. Fuel costs - using BEDF prices (542)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6745.6244	6.1900	417.5541	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2759.3440	6.1900	170.8034	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	25.1600	21.6376	(249)
Energy for lighting	346.8090	25.1600	87.2571	(250)
Additional standing charges			102.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1623.5368	25.1600	-408.4819	
PV Unit electricity exported	-4179.3497	5.8100	-242.8202	
Total			-651.3021	(252)
Total energy cost			147.9502	(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	6745.6244	0.2100	1416.5811	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2759.3440	0.2100	579.4622	(264)
Space and water heating			1996.0434	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	346.8090	0.1443	50.0553	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1623.5368	0.1361	-221.0202	
PV Unit electricity exported	-4179.3497	0.1265	-528.5575	
Total			-749.5777	(269)
Total CO2, kg/year			1308.4502	(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	6745.6244	1.1300	7622.5555	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2759.3440	1.1300	3118.0588	(278)
Space and water heating			10740.6143	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	346.8090	1.5338	531.9473	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1623.5368	1.5032	-2440.5175	
PV Unit electricity exported	-4179.3497	0.4643	-1940.3238	
Total			-4380.8413	(283)
Total Primary energy kWh/year			7021.8211	(286)

SAP 10 EPC IMPROVEMENTS

710079

Current energy efficiency rating: A 98
Current environmental impact rating: B 91

N	Solar water heating	SAP increase too small
U	Solar photovoltaic panels	Already installed
V2	Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
(none)			

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.4	-£ 34	-159 kg (12.2%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: A 98
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 542 TEST (30 Apr 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£109	£109	£0
Mains gas	£690	£690	£0
Space heating	£541	£541	£0
Water heating	£171	£171	£0
Lighting	£87	£87	£0
Generated (PV)	-£651	-£651	£0
Total cost of fuels	£148	£148	£0
Total cost of uses	£148	£148	£0
Delivered energy	25 kWh/m²	25 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.3 tonnes	1.3 tonnes	0.0 tonnes
CO2 emissions per m²	8 kg/m²	8 kg/m²	0 kg/m²
Primary energy	42 kWh/m²	42 kWh/m²	0 kWh/m²

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

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1. Overall dwelling characteristics

	Area	Storey height	Volume

	(m2)		(m)		(m3)	
Ground floor	82.9600 (1b)	x	2.3700 (2b)	=	196.6152	(1b) - (3b)
First floor	82.9600 (1c)	x	2.7500 (2c)	=	228.1400	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	424.7552	(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	6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.1413	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0100	(17)
Infiltration rate		0.3918	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3918	(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	0.4995	0.4897	0.4799	0.4309	0.4211	0.3722	0.3722	0.3624	0.3918	0.4211	0.4407	0.4603	(22b)
Effective ac	0.6247	0.6199	0.6152	0.5929	0.5887	0.5693	0.5693	0.5657	0.5767	0.5887	0.5971	0.6059	(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	
1/2 Glazed Door			4.1000	1.4000	5.7400			(26a)
Glazed Door (Uw = 1.40)			11.3400	1.3258	15.0341			(27)
Window (Uw = 1.40)			22.1200	1.3258	29.3258			(27)
Ground Floor			82.9600	0.1000	8.2960	110.0000	9125.6000	(28a)
External Wall	207.8700	37.5600	170.3100	0.1500	25.5465	150.0000	25546.5000	(29a)
Plane Roof	82.9600		82.9600	0.1100	9.1256	9.0000	746.6400	(30)
Total net area of external elements Aum(A, m2)			373.7900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		93.0679			(33)
Internal Wall			286.2100			9.0000	2575.8900	(32c)
Internal Floor			82.9600			18.0000	1493.2800	(32d)
Internal Ceiling			82.9600			9.0000	746.6400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	40234.5500	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		242.4937	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	24.0000	0.0500	1.2000
E3 Sill	16.6500	0.0500	0.8325
E4 Jamb	45.3000	0.0500	2.2650
E5 Ground floor (normal)	40.6000	0.1600	6.4960
E6 Intermediate floor within a dwelling	40.6000	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	22.4500	0.0600	1.3470
E12 Gable (insulation at ceiling level)	18.1500	0.0600	1.0890
E16 Corner (normal)	25.6100	0.0900	2.3049
E17 Corner (inverted - internal area greater than external area)	5.1200	-0.0900	-0.4608

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		15.0736	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	108.1415	(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	87.5701	86.8911	86.2256	83.0996	82.5147	79.7921	79.7921	79.2879	80.8408	82.5147	83.6979	84.9349	(38)
Heat transfer coeff	195.7117	195.0327	194.3671	191.2411	190.6563	187.9336	187.9336	187.4294	188.9823	190.6563	191.8394	193.0764	(39)
Average = Sum(39)m / 12 =												191.2383	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1796	1.1755	1.1715	1.1526	1.1491	1.1327	1.1327	1.1296	1.1390	1.1491	1.1562	1.1637	(40)
HLP (average)												1.1526	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.9571	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
101.4753	99.9504	97.7282	93.4764	90.3387	86.8396	84.8507	87.0561	89.4736	93.2306	97.5736	101.0865	(42a)

Hot water usage for baths

31.8597	31.3866	30.7203	29.4917	28.5718	27.5517	27.0007	27.6624	28.3828	29.4743	30.7282	31.7520	(42b)

Hot water usage for other uses

44.9134	43.2802	41.6470	40.0137	38.3805	36.7473	36.7473	38.3805	40.0137	41.6470	43.2802	44.9134	(42c)

Average daily hot water use (litres/day)	163.9262	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	178.2485	174.6171	170.0954	162.9819	157.2910	151.1386	148.5987	153.0990	157.8701	164.3518	171.5820	177.7520	(44)
Energy conte	282.3020	248.6524	261.4303	223.1140	211.7439	185.8426	179.7173	189.5685	194.6696	223.0239	244.4500	278.3166	(45)
Energy content (annual)										Total = Sum(45)m =		2722.8311	

Distribution loss (46)m = 0.15 x (45)m

	42.3453	37.2979	39.2145	33.4671	31.7616	27.8764	26.9576	28.4353	29.2004	33.4536	36.6675	41.7475 (46)

Water storage loss:

Total storage loss

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

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	44.8258	40.5166	44.8782	43.4201	44.8644	43.4048	44.8258	44.8233	43.3742	44.8268	43.3867	44.8224 (61)

Total heat required for water heating calculated for each month

	327.1278	289.1690	306.3085	266.5341	256.6084	229.2474	224.5431	234.3918	238.0438	267.8507	287.8366	323.1390 (62)
WWHRS	-86.7007	-76.6788	-80.2936	-66.4863	-61.9628	-53.0220	-49.6997	-52.8506	-54.8586	-64.6723	-73.2658	-85.0951 (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

	240.4272	212.4902	226.0149	200.0478	194.6456	176.2254	174.8434	181.5412	183.1852	203.1784	214.5708	238.0439 (64)

Total per year (kWh/year) = Sum(64)m = 2445.2140 (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

	105.0719	92.8061	98.1451	85.0404	81.6210	72.6439	70.9625	74.2374	75.5712	85.3621	92.1263	103.7459 (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	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	(66)

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

	49.0944	43.6052	35.4621	26.8471	20.0685	16.9427	18.3072	23.7964	31.9395	40.5545	47.3331	50.4589 (67)

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

	503.5299	508.7550	495.5880	467.5570	432.1730	398.9169	376.6999	371.4748	384.6418	412.6728	448.0568	481.3129 (68)

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

	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829 (71)

Water heating gains (Table 5)

	141.2256	138.1043	131.9155	118.1117	109.7056	100.8943	95.3796	99.7814	104.9600	114.7341	127.9532	139.4434 (72)

Total internal gains

	811.6910	808.3055	780.8066	730.3568	679.7881	631.5949	605.2277	609.8935	636.3822	685.8023	741.1840	789.0561 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.3400	10.6334	0.7500	0.7000	0.7700	43.8710	(74)
North	5.4700	10.6334	0.7500	0.7000	0.7700	21.1618	(74)
East	2.1300	19.6403	0.7500	0.7000	0.7700	15.2202	(76)
South	11.3400	46.7521	0.7500	0.7000	0.7700	192.8885	(78)
West	3.1800	19.6403	0.7500	0.7000	0.7700	22.7231	(80)

Solar gains	295.8645	514.4076	735.8244	972.2944	1149.3710	1168.9362	1115.2791	978.0212	816.4362	576.7440	356.1757	252.0906	(83)
Total gains	1107.5555	1322.7131	1516.6310	1702.6512	1829.1591	1800.5310	1720.5068	1587.9147	1452.8184	1262.5463	1097.3597	1041.1467	(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	57.1058	57.3046	57.5008	58.4407	58.6200	59.4692	59.4692	59.6292	59.1392	58.6200	58.2584	57.8852	
alpha	4.8071	4.8203	4.8334	4.8960	4.9080	4.9646	4.9646	4.9753	4.9426	4.9080	4.8839	4.8590	
util living area													
	0.9964	0.9910	0.9763	0.9296	0.8176	0.6351	0.4740	0.5308	0.7838	0.9574	0.9923	0.9973	(86)
MIT	19.5752	19.7952	20.1183	20.5164	20.8162	20.9607	20.9924	20.9871	20.8904	20.4877	19.9571	19.5442	(87)
Th 2	19.9364	19.9397	19.9429	19.9581	19.9609	19.9742	19.9742	19.9767	19.9691	19.9609	19.9552	19.9492	(88)
util rest of house													
	0.9952	0.9881	0.9684	0.9065	0.7632	0.5465	0.3669	0.4188	0.7039	0.9385	0.9893	0.9964	(89)
MIT 2	18.6477	18.8685	19.1888	19.5802	19.8425	19.9570	19.9724	19.9732	19.9117	19.5640	19.0426	18.6267	(90)
Living area fraction									fLA = Living area / (4) =			0.1506	(91)
MIT	18.7873	19.0080	19.3287	19.7212	19.9891	20.1081	20.1259	20.1258	20.0591	19.7030	19.1803	18.7649	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7873	19.0080	19.3287	19.7212	19.9891	20.1081	20.1259	20.1258	20.0591	19.7030	19.1803	18.7649	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9933	0.9846	0.9625	0.9002	0.7649	0.5587	0.3831	0.4356	0.7117	0.9325	0.9862	0.9949	(94)
Useful gains	1100.1650	1302.3123	1459.7690	1532.7693	1399.0352	1005.8961	659.0575	691.7108	1033.9575	1177.3627	1082.1728	1035.8841	(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													
	2835.3419	2751.5253	2493.4763	2069.4529	1580.3670	1035.1586	662.6408	698.3272	1126.1630	1735.5481	2317.4783	2812.1308	(97)
Space heating kWh													
	1290.9716	973.8711	769.0782	386.4122	134.9108	0.0000	0.0000	0.0000	0.0000	415.2900	889.4200	1321.5275	(98a)
Space heating requirement - total per year (kWh/year)												6181.4815	
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													
	1290.9716	973.8711	769.0782	386.4122	134.9108	0.0000	0.0000	0.0000	0.0000	415.2900	889.4200	1321.5275	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6181.4815	
Space heating per m2											(98c) / (4) =	37.2558	(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 %)												89.0000	(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													
	1290.9716	973.8711	769.0782	386.4122	134.9108	0.0000	0.0000	0.0000	0.0000	415.2900	889.4200	1321.5275	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	1450.5299	1094.2372	864.1328	434.1710	151.5852	0.0000	0.0000	0.0000	0.0000	466.6179	999.3483	1484.8624	(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													
	240.4272	212.4902	226.0149	200.0478	194.6456	176.2254	174.8434	181.5412	183.1852	203.1784	214.5708	238.0439	(64)
Efficiency of water heater												88.2000	(216)
(217)m	88.8734	88.8556	88.8170	88.7255	88.5258	88.2000	88.2000	88.2000	88.2000	88.7356	88.8434	88.8770	(217)
Fuel for water heating, kWh/month													
	270.5276	239.1409	254.4725	225.4683	219.8745	199.8020	198.2352	205.8290	207.6930	228.9706	241.5158	267.8354	(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	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	42.9720	34.4738	31.0398	22.7411	17.5659	14.3515	16.0242	20.8288	27.0546	35.4971	40.0939	44.1664	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-83.2338	-111.6323	-152.6552	-162.5795	-167.5605	-153.4671	-151.3941	-146.5910	-137.0179	-123.1704	-89.3661	-72.6122	(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	-67.0257	-139.1076	-274.3836	-409.7366	-539.4878	-541.6741	-534.5605	-452.7310	-332.3714	-197.3672	-88.8633	-53.1294	(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												6945.4848	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												88.2000	
Water heating fuel used												2759.3648	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												346.8090	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-5181.7182	(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												4955.9404	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6945.4848	3.6400	252.8156	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2759.3648	3.6400	100.4409	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	346.8090	16.4900	57.1888	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1551.2802	16.4900	-255.8061	
PV Unit electricity exported	-3630.4380	5.5900	-202.9415	
Total			-458.7476	(252)
Total energy cost			57.8791	(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] =	0.0988	(257)
SAP value		98.3986	
SAP rating (Section 12)		98	(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	6945.4848	0.2100	1458.5518	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2759.3648	0.2100	579.4666	(264)
Space and water heating			2038.0184	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	346.8090	0.1443	50.0553	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1551.2802	0.1358	-210.5878	
PV Unit electricity exported	-3630.4380	0.1261	-457.8511	
Total			-668.4389	(269)
Total CO2, kg/year			1431.5640	(272)
CO2 emissions per m2			8.6300	(273)
EI value			90.9051	
EI rating			91	(274)
EI band			B	

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	82.9600 (1b)	x	2.3700 (2b)	=	196.6152	(1b) - (3b)
First floor	82.9600 (1c)	x	2.7500 (2c)	=	228.1400	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	424.7552	(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	6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.1413	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0100	(17)
Infiltration rate		0.3918	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3918	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	7.8000	7.4000	6.9000	6.1000	6.1000	5.6000	5.6000	5.7000	6.4000	7.3000	7.7000	7.8000	(22)
Wind factor	1.9500	1.8500	1.7250	1.5250	1.5250	1.4000	1.4000	1.4250	1.6000	1.8250	1.9250	1.9500	(22a)
Adj infilt rate	0.7639	0.7248	0.6758	0.5974	0.5974	0.5485	0.5485	0.5583	0.6268	0.7150	0.7541	0.7639	(22b)
Effective ac	0.7918	0.7626	0.7283	0.6785	0.6785	0.6504	0.6504	0.6558	0.6964	0.7556	0.7844	0.7918	(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	
1/2 Glazed Door			4.1000	1.4000	5.7400			(26a)
Glazed Door (Uw = 1.40)			11.3400	1.3258	15.0341			(27)
Window (Uw = 1.40)			22.1200	1.3258	29.3258			(27)
Ground Floor			82.9600	0.1000	8.2960	110.0000	9125.6000	(28a)
External Wall	207.8700	37.5600	170.3100	0.1500	25.5465	150.0000	25546.5000	(29a)
Plane Roof	82.9600		82.9600	0.1100	9.1256	9.0000	746.6400	(30)
Total net area of external elements Aum(A, m2)			373.7900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		93.0679			(33)
Internal Wall			286.2100			9.0000	2575.8900	(32c)
Internal Floor			82.9600			18.0000	1493.2800	(32d)
Internal Ceiling			82.9600			9.0000	746.6400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	40234.5500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		242.4937 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	24.0000	0.0500	1.2000
E3 Sill	16.6500	0.0500	0.8325
E4 Jamb	45.3000	0.0500	2.2650
E5 Ground floor (normal)	40.6000	0.1600	6.4960
E6 Intermediate floor within a dwelling	40.6000	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	22.4500	0.0600	1.3470

E12 Gable (insulation at ceiling level)	18.1500	0.0600	1.0890	
E16 Corner (normal)	25.6100	0.0900	2.3049	
E17 Corner (inverted - internal area greater than external area)	5.1200	-0.0900	-0.4608	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				15.0736 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	108.1415 (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	110.9850	106.8976	102.0910	95.0994	95.0994	91.1667	91.1667	91.9264	97.6204	105.9094	109.9430	110.9850	(38)
Heat transfer coeff	219.1265	215.0392	210.2325	203.2410	203.2410	199.3083	199.3083	200.0679	205.7620	214.0510	218.0845	219.1265	(39)
Average = Sum(39)m / 12 =												208.8824	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3207	1.2960	1.2671	1.2249	1.2249	1.2012	1.2012	1.2058	1.2401	1.2901	1.3144	1.3207	(40)
HLP (average)												1.2589	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9571	(42)
Hot water usage for mixer showers	101.4753	99.9504	97.7282	93.4764	90.3387	86.8396	84.8507	87.0561	89.4736	93.2306	97.5736	101.0865	(42a)
Hot water usage for baths	31.8597	31.3866	30.7203	29.4917	28.5718	27.5517	27.0007	27.6624	28.3828	29.4743	30.7282	31.7520	(42b)
Hot water usage for other uses	44.9134	43.2802	41.6470	40.0137	38.3805	36.7473	36.7473	38.3805	40.0137	41.6470	43.2802	44.9134	(42c)
Average daily hot water use (litres/day)												163.9262	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	178.2485	174.6171	170.0954	162.9819	157.2910	151.1386	148.5987	153.0990	157.8701	164.3518	171.5820	177.7520	(44)
Energy conte	282.3020	248.6524	261.4303	223.1140	211.7439	185.8426	179.7173	189.5685	194.6696	223.0239	244.4500	278.3166	(45)
Energy content (annual)										Total = Sum(45)m =		2722.8311	
Distribution loss (46)m = 0.15 x (45)m	42.3453	37.2979	39.2145	33.4671	31.7616	27.8764	26.9576	28.4353	29.2004	33.4536	36.6675	41.7475	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	44.8258	40.5166	44.8782	43.4201	44.8644	43.4048	44.8258	44.8233	43.3742	44.8268	43.3867	44.8224	(61)
Total heat required for water heating calculated for each month	327.1278	289.1690	306.3085	266.5341	256.6084	229.2474	224.5431	234.3918	238.0438	267.8507	287.8366	323.1390	(62)
WWHRS	-86.7007	-76.6788	-80.2936	-66.4863	-61.9628	-53.0220	-49.6997	-52.8506	-54.8586	-64.6723	-73.2658	-85.0951	(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	240.4272	212.4902	226.0149	200.0478	194.6456	176.2254	174.8434	181.5412	183.1852	203.1784	214.5708	238.0439	(64)
										Total per year (kWh/year) = Sum(64)m =		2445.2140	(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	105.0719	92.8061	98.1451	85.0404	81.6210	72.6439	70.9625	74.2374	75.5712	85.3621	92.1263	103.7459	(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	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	177.4244	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.0944	43.6052	35.4621	26.8471	20.0685	16.9427	18.3072	23.7964	31.9395	40.5545	47.3331	50.4589	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	503.5299	508.7550	495.5880	467.5570	432.1730	398.9169	376.6999	371.4748	384.6418	412.6728	448.0568	481.3129	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	55.6995	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	-118.2829	(71)
Water heating gains (Table 5)	141.2256	138.1043	131.9155	118.1117	109.7056	100.8943	95.3796	99.7814	104.9600	114.7341	127.9532	139.4434	(72)
Total internal gains	811.6910	808.3055	780.8066	730.3568	679.7881	631.5949	605.2277	609.8935	636.3822	685.8023	741.1840	789.0561	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.3400	12.7955	0.7500	0.7000	0.7700	52.7912	(74)
North	5.4700	12.7955	0.7500	0.7000	0.7700	25.4645	(74)
East	2.1300	23.8384	0.7500	0.7000	0.7700	18.4735	(76)
South	11.3400	54.5463	0.7500	0.7000	0.7700	225.0459	(78)
West	3.1800	23.8384	0.7500	0.7000	0.7700	27.5802	(80)

Solar gains	349.3553	549.9631	817.6635	1112.5727	1272.9564	1362.9131	1216.2615	1085.5761	892.0792	615.3056	393.7298	287.7989	(83)
Total gains	1161.0462	1358.2686	1598.4701	1842.9295	1952.7445	1994.5080	1821.4892	1695.4697	1528.4614	1301.1079	1134.9138	1076.8551	(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	51.0037	51.9732	53.1614	54.9902	54.9902	56.0753	56.0753	55.8623	54.3165	52.2131	51.2474	51.0037	
alpha	4.4002	4.4649	4.5441	4.6660	4.6660	4.7384	4.7384	4.7242	4.6211	4.4809	4.4165	4.4002	
util living area													
	0.9935	0.9877	0.9697	0.9169	0.8188	0.6624	0.5699	0.5980	0.7905	0.9467	0.9861	0.9946	(86)
MIT	19.6177	19.7863	20.1113	20.5111	20.7834	20.9384	20.9749	20.9696	20.8623	20.4829	20.0242	19.6210	(87)
Th 2	19.8247	19.8439	19.8667	19.9001	19.9001	19.9190	19.9190	19.9154	19.8880	19.8486	19.8296	19.8247	(88)
util rest of house													
	0.9911	0.9834	0.9593	0.8900	0.7641	0.5787	0.4653	0.4880	0.7072	0.9204	0.9799	0.9926	(89)
MIT 2	18.6058	18.7866	19.1216	19.5247	19.7597	19.8892	19.9104	19.9049	19.8164	19.4685	19.0132	18.6094	(90)
Living area fraction										fLA = Living area / (4) =		0.1506	(91)
MIT	18.7581	18.9371	19.2706	19.6732	19.9138	20.0472	20.0706	20.0652	19.9738	19.6212	19.1654	18.7617	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7581	18.9371	19.2706	19.6732	19.9138	20.0472	20.0706	20.0652	19.9738	19.6212	19.1654	18.7617	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9880	0.9787	0.9522	0.8834	0.7649	0.5892	0.4806	0.5040	0.7144	0.9137	0.9748	0.9898	(94)
Useful gains	1147.1271	1329.3916	1522.1057	1628.0443	1493.5684	1175.1779	875.4036	854.4745	1091.9893	1188.8086	1106.3428	1065.9147	(95)
Ext temp.	5.9000	6.0000	7.1000	9.0000	11.5000	13.9000	15.6000	15.7000	14.1000	11.5000	8.9000	6.3000	(96)
Heat loss rate W													
	2817.5511	2781.9822	2558.6557	2169.2411	1710.0296	1225.1845	891.0347	873.3379	1208.6141	1738.3476	2238.7203	2730.6977	(97)
Space heating kWh													
	1242.7954	976.1409	771.1932	389.6617	161.0471	0.0000	0.0000	0.0000	0.0000	408.8570	815.3118	1238.5985	(98a)
Space heating requirement - total per year (kWh/year)												6003.6057	
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													
	1242.7954	976.1409	771.1932	389.6617	161.0471	0.0000	0.0000	0.0000	0.0000	408.8570	815.3118	1238.5985	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6003.6057	
Space heating per m2											(98c) / (4) =	36.1837	(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 %)	89.0000	(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													
	1242.7954	976.1409	771.1932	389.6617	161.0471	0.0000	0.0000	0.0000	0.0000	408.8570	815.3118	1238.5985	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	1396.3994	1096.7875	866.5092	437.8222	180.9518	0.0000	0.0000	0.0000	0.0000	459.3899	916.0807	1391.6837	(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													
	240.4272	212.4902	226.0149	200.0478	194.6456	176.2254	174.8434	181.5412	183.1852	203.1784	214.5708	238.0439	(64)
Efficiency of water heater												88.2000	(216)
(217)m	88.8693	88.8559	88.8174	88.7270	88.5604	88.2000	88.2000	88.2000	88.2000	88.7328	88.8321	88.8701	(217)
Fuel for water heating, kWh/month													
	270.5401	239.1402	254.4714	225.4644	219.7884	199.8020	198.2352	205.8290	207.6930	228.9778	241.5464	267.8562	(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	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	42.9720	34.4738	31.0398	22.7411	17.5659	14.3515	16.0242	20.8288	27.0546	35.4971	40.0939	44.1664	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-94.1530	-116.9154	-160.9271	-170.2790	-171.8005	-158.1432	-154.1577	-150.7116	-141.7709	-128.0122	-96.1061	-80.5600	(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	-85.7881	-154.7107	-318.1916	-487.2005	-611.2512	-651.2381	-593.2827	-515.9037	-374.9291	-218.1391	-103.6832	-65.0317	(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	6745.6244	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	88.2000	
Water heating fuel used	2759.3440	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	346.8090	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-5802.8865	(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			4134.8910 (238)

10a. Fuel costs - using BEDF prices (542)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6745.6244	6.1900	417.5541	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2759.3440	6.1900	170.8034	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	25.1600	21.6376	(249)
Energy for lighting	346.8090	25.1600	87.2571	(250)
Additional standing charges			102.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1623.5368	25.1600	-408.4819	
PV Unit electricity exported	-4179.3497	5.8100	-242.8202	
Total			-651.3021	(252)
Total energy cost			147.9502	(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	6745.6244	0.2100	1416.5811	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2759.3440	0.2100	579.4622	(264)
Space and water heating			1996.0434	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	346.8090	0.1443	50.0553	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1623.5368	0.1361	-221.0202	
PV Unit electricity exported	-4179.3497	0.1265	-528.5575	
Total			-749.5777	(269)
Total CO2, kg/year			1308.4502	(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	6745.6244	1.1300	7622.5555	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2759.3440	1.1300	3118.0588	(278)
Space and water heating			10740.6143	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	346.8090	1.5338	531.9473	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1623.5368	1.5032	-2440.5175	
PV Unit electricity exported	-4179.3497	0.4643	-1940.3238	
Total			-4380.8413	(283)
Total Primary energy kWh/year			7021.8211	(286)