

Energy Statement

Waterside, Kay Street, Summerseat, Bury

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Contents

1	Executive Summary	3
2	Existing and Proposed Development	4
3	Planning Policy	5
4	Methodology	6
5	Baseline Energy & CO2	7
6	Low Carbon Design – Fabric First – Be Lean	8
7	Low Carbon Technology Review & Recommendations	9
8	Low Carbon Technology – Renewable Energy Generation - Be Green	13
10	Conclusion	15
11	Appendix 1 – SAP Worksheet House Type 1 with Gas heating PV	16
12	Appendix 1 – SAP Worksheet House Type 1 with ASHP	17

1 Executive Summary

This report has been produced by Base Energy on behalf of Walbury Homes and in support of the planning application for the development named as Waterside Townhouses, Kay Street, Summerseat comprising 5 new build detached houses falling under the requirements of The Greater Manchester Combined Authority.

It sets out the design approach with regards to energy, carbon dioxide emissions, and sustainability in order to ensure the development complies with:

- National Planning Policy
- The Greater Manchester Combined Authority
- Places for everyone joint development plan, JP-S2 Carbon and Energy

The above policies require:

- Be Net Zero Carbon where feasible
- As an interim measure, development should be consistent with 2022 Part L building regulations (this would be Part L 2021)

The design of the development will incorporate energy efficient building fabric and services in addition to low carbon technology:

- Thermal specification exceeding Part L 2021 notional U-values
- A design which limits air permeability, targeting 4.0
- A design which limits thermal bridging by incorporating
- Energy saving building services including low energy lighting and controls
- Low carbon Air Source Heat Pumps and Solar PV Panels

The gas heating and solar PV option results in a 1% saving in CO2 emissions. Where the ASHP option results in a 67% saving in CO2 emissions.

2 Existing and Proposed Development

The development site is located on land at Kay Street, Summerseat, Bury.

The existing site is currently a car park and some trees. The development proposals are for 5 new build detached houses over three storeys with garage. There are 4 house types. This report has been revised due to the layout of the dwellings changing.

The development proposals constitute a minor development.



Aspects of the site location, shape, and surroundings (in particular the adjacent buildings), along with any other requirements of planning, use type, and scale will naturally constrain the development proposals in terms of the layout, positioning, and orientation of the proposed development. Subsequently, these constraints will impact on the feasibility of certain renewable technologies (as discussed in Section 4 of this report).

Due to the properties being in a conservation area there may be limitations to potential low or zero carbon technologies.

Figure 2.1: Site Location and proposals

3 Planning Policy

National Planning Policy Framework 2023

The NPPF was updated in December 2023 to place greater emphasis on beauty, place-making, the environment, and sustainable development. The strengthened environmental objectives aim to protect and enhance the natural, built, and historic environment, and encourage effective land use, greater biodiversity, prudent use of natural resources, minimisation of waste and pollution, and adaptation to climate change alongside a move to a low carbon economy.

Local Planning Policy, The Greater Manchester Combined Authority

The relevant Local Planning Policy requirements are as follows.

- Places for everyone joint development plan, JP-S2 Carbon and Energy

The development should target:

- Be Net Zero Carbon where feasible
 - From adoption to regulated operational carbon emissions
 - From 2028 to all emissions in construction
- As an interim measure, development should be consistent with 2022 Part L building regulations (this would be the current Part L 2021)
- From 2025 development should also calculate and minimise carbon emissions from unregulated emissions alongside regulated emissions. Development proposals should set out how this has been achieved in an energy statement in accordance with the energy hierarchy. This therefore is current not yet required
- Achieve energy demand reductions in terms of space heat demand; hot water energy demand and the delivery of on-site renewable energy generation, in accordance with Table 5.1.
- Solar PV is required where feasible to meet 20% of the ground floor area
- Include a detailed energy statement to demonstrate via site relevant evidence how the development has sought to maximize reductions in carbon emissions in line with relevant policy targets, including the minimisation of overheating risks and appropriate measures for post occupancy evaluation. Whole life cycle emissions should be considered where possible.

Based on the above the development will meet and go beyond the new Part L 2021 building regulations and where feasible aim to be net zero carbon. An overheating thermal model will be carried out to provide guidance on meeting Part O.

4 Methodology

The Standard Assessment Procedure (SAP) is the UK Government methodology for assessing and calculating the energy performance of dwellings.

The Simplified Building Energy Model (SBEM) is the UK Government methodology for assessing and calculating the energy performance of non-domestic buildings.

SAP and SBEM calculations take into account a range of factors that contribute to energy efficiency, including:

- Materials used for the construction and the thermal insulation of the building fabric (u-values¹ and thermal mass)
- Air permeability
- Efficiency, fuel source, and control of heating and cooling systems
- Ventilation system energy use and heat recovery
- Lighting energy
- Low carbon and energy saving or generating technologies

Approved Document Part L of current Building Regulations addresses the conservation of fuel and power. Part L is divided into two separate documents:

- Part L1 Newly constructed and extended or renovated existing dwellings
- Part L2 Newly constructed and extended or renovated existing non-domestic buildings

To comply with Part L, the calculations should demonstrate how the building will either meet or achieve a percentage reduction in the Building Emission Rate (BER) under the required Target Emission Rate (TER).

The calculation software has been used to calculate a baseline of energy demand and carbon dioxide emissions as appropriate from which any reductions or contributions have been measured.

¹ U-values (Thermal Transmittance) - the measure of the overall rate of heat transfer by all mechanisms under standard conditions, through a particular section of a construction. Lower u-values mean better thermal insulation

5 Baseline Energy & CO2

Energy modelling software has been used to calculate a baseline for the development. This forms the basis from which compliance with planning policy has been measured. House types A and B have been assessed.

Table 5.1: Baseline CO2 – Gas heating

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)
Baseline	10.31	859	8,856.29

The **Total Baseline CO2 Emissions** for the development are shown to be 8,856.29 kg/year.

Table 5.1: Baseline CO2 – ASHP heating

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)
Baseline	10.11	859	8,684.49

The **Total Baseline CO2 Emissions** for the development are shown to be 8,856.29 kg/year.

6 Low Carbon Design – Fabric First – Be Lean

Before considering low carbon energy generating technology the development has been designed to reduce energy demand through the first step of the energy hierarchy by considering 'fabric first'. A thermally efficient building envelope will follow the design standards as set out below.

Table 6.0: Building Fabric Standards (including u-values W/m²K)⁸

	Part L 2013 Limiting Parameters	Part L 2021 Limiting Parameters	Part L 2021 Notional Targets	Proposed Development
Walls	0.30	0.26	0.18	0.18
Ground Floor	0.25	0.18	0.13	0.11
Roof	0.20	0.16	0.11	0.11
Windows	2.00	1.6	1.2	1.2 (g-value 0.5)
Doors	2.00	1.6	1.0	1.2
Air permeability	10.00	8.00	5.00	4.0

- Insulation: The specified building envelope is designed to meet and exceed the notional Part L targets and will help to limit the energy demand of the dwelling for space heating
- Thermal bridging: The design will seek to limit heat loss through thermal bridging and targeting a global 'y-value' of 0.05

Once heat retention has been addressed the next step is to ensure energy consuming building services are efficient.

- Lighting: Low energy LED lighting throughout with a minimum efficacy of 85 lumens per watt
- Space & Water Heating: Condensing gas combi boiler
- Heating Controls: Comprising time & temperature zone control
- Ventilation: Natural ventilation with continuous extract fans
- Shower wastewater heat recovery systems with gas heating only option

7 Low Carbon Technology Review & Recommendations

Having set out an energy efficient design, the next step is to incorporate low carbon technology for energy generation. A number of technologies exist and should be specified where they:

- Comply with planning policy
- Are feasible for the site
- Are cost efficient
- Are appropriate for proposed development form and function
- Protect against fuel poverty
- Promote fuel security
- Reduce reliance on fossil fuels
- Reduce carbon emissions
- Reduce resource depletion
- Reduce pollution

Site location and development form and function will influence the suitability of different technologies through:

- Orientation
- Space (inside and outside of the buildings)
- Surrounding topography, structures, and natural features
- Wind speed
- Overshading
- Geology and ground conditions
- Building form, function, and density

In determining the most feasible renewable technologies for the dwelling, the following have been reviewed:

- Wind turbines
- Ground Source Heat Pumps
- Air Source Heat Pumps
- Biomass
- Combined Heat and Power
- Photovoltaic Panels
- Solar water heating

WIND TURBINES

Wind turbines are used to produce electricity. They can be either pole mounted (in a suitably exposed position) or building mounted; building mounted systems need a sufficient wind speed at the structural height and both a structural survey and planning permission.

- Wind speed can be too low on low rise buildings
- Taller systems need sufficient space
- Wind resources very variable and unpredictable
- May need planning permission

Wind turbines technology is **not recommended** for this development

GROUND SOURCE HEAT PUMP (GSHP)

GSHPs use naturally occurring underground low-level heat in areas with appropriate geological features. Heat is transferred from the ground by either extracting and discharging (re-charging) water from/to the ground directly (open loop) or circulating water through pipes buried within the ground, (closed loop). The water is passed through a heat pump to transfer the heat from this water into a higher temperature water circuit to provide heating. The loop can be fitted horizontally (laid in a shallow trench) or vertically (in a borehole).

- Feasibility analysis is costly
- Suitable ground conditions required
- More capital intensive than air source heat pumps
- Can be more efficient and lower running costs than ASHPs
- Well suited to highly insulated buildings

Ground source heat pump technology is **not recommended** for this development

AIR SOURCE HEAT PUMP (ASHP)

ASHP systems absorb heat from outside air at a low temperature into a fluid which is then passed through an electrically driven compressor where its temperature is increased. There are two main types of ASHP systems: Air to Water systems distribute heat through wet central heating; Air to air produce warm air which is circulated by fans. For an ASHP system to be installed, there needs to be ample outdoor space for the external condensing unit; these units can also be noisy and blow out colder air to the neighbouring environment.

- Requires space for external plant and internal hot water tank for wet systems supplying DHW
- Can generate noise though quieter systems have been developed
- Least efficient when most needed
- Longer life than fossil fuel boilers
- High capital costs vs gas systems but lower than GSHPs
- Well suited to highly insulated buildings

Air source heat pump technology **is recommended** for this development

BIOMASS

Biomass systems burn wood pellets, chips, or logs to provide heat in a single room, or to power central heating and hot water boilers. There needs to be ample space available for both the boiler and the storage of fuel. There will also be regular deliveries of fuel and therefore adequate site access is required.

- Carbon emissions are cyclical unlike fossil fuel
- Requires fuel storage space and bulk delivery
- Carbon 'neutral' fuel in isolation but supply side emissions are still present so not neutral overall
- Harmful particulate emissions impact air quality and health

Biomass technology **is not recommended** for this development

COMBINED HEAT AND POWER (CHP)

CHP is effectively an on-site small power plant providing both electrical power and thermal heat energy. It is an energy efficiency and low carbon measure rather than a renewable energy technology. A CHP system operates by burning a primary fuel (normally natural gas) by use of either a reciprocating engine or turbine, which in turn drives an alternator to generate electrical power. The heat emitted by the engine and exhaust gases is recovered and used to heat the building or to provide hot water.

- Reduces consumption of and reliance on grid electricity
- Works best with high and consistent heat and hot water demand
- Recovers waste energy
- Can export to the grid
- Uses fossil fuel
- Emissions on site rather than upstream
- Efficiency is sensitive to sizing

CHP **is not recommended** for this development

DISTRICT HEATING

District Heating systems provide multiple buildings or dwellings with heat and hot water from a central boiler house, or 'energy centre'. The system can provide heating or cooling which is transferred from the energy centre through a network of highly insulated pipes carrying the heated water to each dwelling.

- Economies of scale
- Frees up space in habitable areas of development
- Variety of systems
- Can make use of waste heat from industry
- Can be fossil fuel based and dependent

Due to the location, there are no existing or proposed heat networks or energy centres within a suitable radius from the development and there are no existing networks local to the site.

District heating **is not recommended** for this development

SOLAR PHOTOVOLTAIC (PV)

Solar PV cells (which are mounted together in panels or tiles on the roof) convert sunlight into electricity. The cells are made from layers of semi-conducting material; when the light shines on the cell, an electric field is created across the layers. Although PV cells are most effective in bright sunlight, they can still generate electricity on a cloudy day. The power of a PV cell is measured in kilowatts peak (kWp). Each PV panel produces 250 Watts to 420 Watts depending on the manufacture.

- Passive technology, requires no energy input from grid
- Does not require sunny days to generate power
- Capital costs can be high although payback is effective
- Needs sufficient roof space and orientation
- Zero site or upstream emissions
- Can export to the grid

Solar PV technology **is recommended** for this development.

SOLAR HOT WATER

Solar hot water systems absorb energy from the sun and transfer this energy using heat exchangers to heat water which can then be stored. Systems should be roof mounted and oriented to face between a south-east and south-west direction.

- Mostly passive technology but requires pump energy
- Not suitable for combi boilers and developments without roof space
- Lower CO2 reductions than other technologies

Solar hot water technology **is not recommended** for this development

Low and Zero Carbon Technology Summary

The low carbon technology review indicates that solar PV panels and electric ASHP's would be potentially feasible to install. However due to the properties being located in a conservation area, solar PV panels and ASHP units may not be suitable and further approval with the local council maybe required. We have therefore carried out two scenarios one with gas boiler and PV and another with an ASHP only and not PV.

Solar PV with Gas heating or ASHP subject to further approval

Both these technologies have been reviewed further and are deemed optimal for meeting the needs of the development and achieving policy compliance. In the gas heating option solar PV at 3.5kWp has been incorporated into the models for house types A and B.

The above scenarios have been incorporated into the energy model and the results are presented in the next section. If there is an issue with installing solar PV panels due to aesthetic reasons, the electric ASHP option has been reviewed within the SAP model without PV panels. For guidance only a Mitsubishi Ecodan ASHP has been incorporated into the SAP calculations.

8 Low Carbon Technology – Renewable Energy Generation - Be Green

The below results show two scenarios on how to achieve compliance with Part L building regulations.

Option 1 – Gas and Solar PV option based on 3kWp solar PV south facing

Table 8.1: Baseline vs Be Green CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)	Reduction in CO2
Baseline	10.31	859	8,856	N/A
Be Green Design	10.11	859	8,685	1.9%

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 171 kg/year.

Table 8.2: Baseline vs Be Green Energy Demand

	Energy Demand (kWh/m2/year)	Floor Area (m2)	Total Baseline Energy Demand (kWh/year)	Reduction in Energy Demand
Baseline	54.00	859	46,386	N/A
Lean & Green Design	53.45	859	45,914	1.0%

The **Energy Demand reduction** as a result of energy efficient fabric and services is shown to be 472 kWh per year

Option 2 – Electric ASHP option with no solar PV

Table 8.3: Baseline vs Be Green CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)	Reduction in CO2
Baseline	10.11	859	8,684.49	N/A
Be Green Design	3.31	859	2,843.29	67%

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 5,841 kg/year.

Table 8.4: Baseline vs Be Green Energy Demand

	Energy Demand (kWh/m2/year)	Floor Area (m2)	Total Baseline Energy Demand (kWh/year)	Reduction in Energy Demand
Baseline	52.98	859	45,509.82	N/A
Be Green Design	34.74	859	29,841.67	35%

The **Energy Demand reduction** as a result of energy efficient fabric and services is shown to be 15,667 kWh per year.

10 Conclusion

Proposals are for the development named as Waterside Townhouses, Kay Street, Summerseat comprising 5 new build detached houses, falling under the requirements of The Greater Manchester Combined Authority.

Under the local planning policy Places for Everyone Joint Development Plan, JP-S2 Carbon and Energy the proposed development is required to be net zero carbon were feasible and meet Part L 2021 building regulations. Due to the properties being in a conservation area there may be limitations to potential low or zero carbon technologies.

Energy modelling software has been used to calculate a baseline against which compliance with the above can be measured.

The proposed development will be designed to limit energy demand through the inclusion of a thermally efficient building fabric and energy efficient services.

Due to the properties being in a conservation area and possibly having limitations to the external appearance, this would affect the installation of solar PV and ASHP's. Therefore we have modelled two scenarios on reviewing solar PV with gas heating to meet Part L building requirements and a further scenario with an electric ASHP and no solar PV.

The gas heating and solar PV option results in a 1% saving in CO2 emissions and 1% in primary energy.

The ASHP option results in a 67% saving in CO2 emissions and 35% in primary energy.

This Energy Statement and the calculations on which it is based demonstrate that the proposed development complies with the local planning policy requirements.

11 Appendix 1 – SAP Worksheet House Type 1 with Gas heating PV

Full SAP Calculation Printout



Property Reference	Plot 1, Type 2				Issued on Date	30/04/2024	
Assessment Reference	v1 Gas			Prop Type Ref			
Property	Plot 4, Kay Street, Summerseat						
SAP Rating	97 A		DER	8.98	TER	9.60	
Environmental	91 B		% DER < TER				6.46
CO ₂ Emissions (t/year)	1.61		DFEE	35.90	TFEE	38.23	
Compliance Check	See BREL		% DFEE < TFEE				6.10
% DPER < TPER	14.62		DPER	42.88	TPER	50.22	
Assessor Details	Mr. Peter Kinsella				Assessor ID	L770-0002	
Client							

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	56.6000 (1b)	x 2.5000 (2b)	= 141.5000 (1b) - (3b)
First floor	78.4000 (1c)	x 2.7500 (2c)	= 215.6000 (1c) - (3c)
Second floor	37.0000 (1d)	x 2.4000 (2d)	= 88.8000 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.0000		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	445.9000 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	3 * 10 = 30.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.0673 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.2673 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2472 (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	0.3152	0.3090	0.3029	0.2720	0.2658	0.2349	0.2349	0.2287	0.2472	0.2658	0.2781	0.2905 (22b)
Effective ac	0.5497	0.5478	0.5459	0.5370	0.5353	0.5276	0.5276	0.5261	0.5306	0.5353	0.5387	0.5422 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front door			1.8900	1.0000	1.8900		(26)
Windows (U _w = 1.20)			26.1300	1.1450	29.9198		(27)
Heatloss Floor 1			56.6000	0.1200	6.7920		(28a)
Exposed floor			21.7000	0.1300	2.8210		(28b)
External Wall 1	205.0000	28.0200	176.9800	0.1800	31.8564		(29a)
Garage wall	23.5000		23.5000	0.1600	3.7600		(29a)
Flat roof	20.0000		20.0000	0.1100	2.2000		(30)
Pitched roof	35.0000		35.0000	0.1100	3.8500		(30)
Roof ceiling	33.7000		33.7000	0.1000	3.3700		(30)
Total net area of external elements A _{um} (A, m ²)			395.5000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	86.4592	(33)
Thermal mass parameter (TMP = C _m / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.030 * total exposed area)							11.8650 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	98.3242 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							

Full SAP Calculation Printout



(38)m	Jan 80.8842	Feb 80.6003	Mar 80.3220	Apr 79.0150	May 78.7705	Jun 77.6322	Jul 77.6322	Aug 77.4214	Sep 78.0706	Oct 78.7705	Nov 79.2652	Dec 79.7824	(38)
Heat transfer coeff	179.2084	178.9245	178.6463	177.3393	177.0948	175.9564	175.9564	175.7456	176.3949	177.0948	177.5894	178.1066	(39)
Average = Sum(39)m / 12 =												177.3381	
HLP	Jan 1.0419	Feb 1.0403	Mar 1.0386	Apr 1.0310	May 1.0296	Jun 1.0230	Jul 1.0230	Aug 1.0218	Sep 1.0256	Oct 1.0296	Nov 1.0325	Dec 1.0355	(40)
HLP (average)												1.0310	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)													

Assumed occupancy													2.9652 (42)
Hot water usage for mixer showers	101.6637	100.1359	97.9096	93.6499	90.5064	87.0008	85.0082	87.2177	89.6396	93.4036	97.7548	101.2742	(42a)
Hot water usage for baths	31.9187	31.4446	30.7771	29.5462	28.6246	27.6027	27.0507	27.7135	28.4353	29.5288	30.7850	31.8107	(42b)
Hot water usage for other uses	44.9971	43.3608	41.7245	40.0883	38.4520	36.8158	36.8158	38.4520	40.0883	41.7245	43.3608	44.9971	(42c)
Average daily hot water use (litres/day)												164.2306	(43)

Daily hot water use	Jan 178.5794	Feb 174.9413	Mar 170.4112	Apr 163.2845	May 157.5831	Jun 151.4192	Jul 148.8746	Aug 153.3832	Sep 158.1632	Oct 164.6570	Nov 171.9005	Dec 178.0820	(44)
Energy conte	282.8261	249.1141	261.9157	223.5283	212.1371	186.1876	180.0510	189.9205	195.0311	223.4380	244.9038	278.8334	(45)
Energy content (annual)										Total = Sum(45)m =		2727.8866	
Distribution loss (46)m = 0.15 x (45)m	42.4239	37.3671	39.2873	33.5292	31.8206	27.9281	27.0076	28.4881	29.2547	33.5157	36.7356	41.8250	(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	28.5011	25.7404	28.4927	27.5616	28.4728	27.5467	28.4600	28.4639	27.5502	28.4773	27.5702	28.4995	(61)
Total heat required for water heating calculated for each month	311.3272	274.8545	290.4084	251.0899	240.6099	213.7343	208.5109	218.3844	222.5813	251.9153	272.4740	307.3328	(62)
WWHRS	-64.3042	-56.8712	-59.5522	-49.3116	-45.9566	-39.3254	-36.8613	-39.1983	-40.6876	-47.9662	-54.3399	-63.1134	(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	247.0230	217.9833	230.8562	201.7783	194.6532	174.4089	171.6496	179.1861	181.8937	203.9491	218.1342	244.2194	(64)
12Total per year (kWh/year)								Total per year (kWh/year) = Sum(64)m =				2465.7350	(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	101.1650	89.2655	94.2101	81.2136	77.6538	68.7941	66.9819	70.2645	71.7354	81.4124	88.3231	99.8370	(65)

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

Metabolic gains (Table 5), Watts	Jan 148.2622	Feb 148.2622	Mar 148.2622	Apr 148.2622	May 148.2622	Jun 148.2622	Jul 148.2622	Aug 148.2622	Sep 148.2622	Oct 148.2622	Nov 148.2622	Dec 148.2622	(66)
(66)m	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	182.7084	202.2843	182.7084	188.7987	182.7084	188.7987	182.7084	182.7084	188.7987	182.7084	188.7987	182.7084	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	343.5839	347.1493	338.1647	319.0378	294.8935	272.2012	257.0413	253.4760	262.4605	281.5875	305.7318	328.4241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	(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)	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	(71)
Water heating gains (Table 5)	135.9744	132.8356	126.6265	112.7966	104.3734	95.5473	90.0295	94.4416	99.6325	109.4253	122.6709	134.1895	(72)
Total internal gains	732.7454	752.7478	717.9783	691.1117	652.4539	624.0258	597.2579	598.1047	618.3704	644.1999	687.6801	715.8006	(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			8.1600		10.6334		0.4500		0.0000		0.7700		30.0653 (74)
East			1.0200		19.6403		0.4500		0.0000		0.7700		6.9415 (76)
South			15.8700		46.7521		0.4500		0.0000		0.7700		257.0875 (78)
West			1.0800		19.6403		0.4500		0.0000		0.7700		7.3498 (80)

Solar gains	301.4440	506.4561	680.0072	830.1441	925.2170	918.2916	885.2965	813.2167	731.1972	555.7016	359.6452	258.9636	(83)
Total gains	1034.1894	1259.2039	1397.9855	1521.2559	1577.6709	1542.3174	1482.5544	1411.3213	1349.5676	1199.9015	1047.3253	974.7642	(84)

7. Mean internal temperature (heating season)													

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	26.6605	26.7028	26.7443	26.9415	26.9787	27.1532	27.1532	27.1858	27.0857	26.9787	26.9035	26.8254	
alpha	2.7774	2.7802	2.7830	2.7961	2.7986	2.8102	2.8102	2.8124	2.8057	2.7986	2.7936	2.7884	
util living area	0.9652	0.9410	0.9084	0.8474	0.7524	0.6136	0.4783	0.5148	0.6981	0.8693	0.9454	0.9700	(86)
MIT	18.5432	18.9101	19.3717	19.9407	20.4309	20.7770	20.9193	20.8985	20.6592	20.0118	19.1729	18.4733	(87)
Th 2	20.0486	20.0499	20.0513	20.0575	20.0587	20.0642	20.0642	20.0652	20.0621	20.0587	20.0563	20.0539	(88)

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util rest of house	0.9601	0.9328	0.8952	0.8244	0.7128	0.5489	0.3905	0.4276	0.6399	0.8448	0.9363	0.9657 (89)
MIT 2	17.1572	17.6205	18.2008	18.9080	19.4941	19.8813	20.0156	20.0006	19.7630	19.0086	17.9625	17.0718 (90)
Living area fraction									fLA = Living area / (4) =			0.1395 (91)
MIT	17.3506	17.8005	18.3642	19.0521	19.6248	20.0063	20.1417	20.1259	19.8881	19.1486	18.1314	17.2673 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.2006	17.6505	18.2142	18.9021	19.4748	19.8563	19.9917	19.9759	19.7381	18.9986	17.9814	17.1173 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9378	0.9040	0.8620	0.7902	0.6848	0.5331	0.3833	0.4187	0.6171	0.8100	0.9083	0.9453 (94)	
Useful gains	969.9126	1138.3102	1205.0270	1202.1611	1080.3591	822.2765	568.2551	590.8995	832.8204	971.9336	951.2585	921.4620 (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	2311.9016	2281.3731	2092.6960	1773.7609	1376.8814	924.8764	596.7866	628.4411	994.5235	1487.3516	1932.4265	2300.6653 (97)	
Space heating kWh	998.4398	768.1383	660.4257	411.5519	220.6126	0.0000	0.0000	0.0000	0.0000	383.4710	706.4410	1026.1272 (98a)	
Space heating requirement - total per year (kWh/year)												5175.2075	
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	998.4398	768.1383	660.4257	411.5519	220.6126	0.0000	0.0000	0.0000	0.0000	383.4710	706.4410	1026.1272 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												5175.2075	
Space heating per m2												30.0884 (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 %)													88.7000 (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	998.4398	768.1383	660.4257	411.5519	220.6126	0.0000	0.0000	0.0000	0.0000	383.4710	706.4410	1026.1272 (98)	
Space heating efficiency (main heating system 1)	88.7000	88.7000	88.7000	88.7000	88.7000	0.0000	0.0000	0.0000	0.0000	88.7000	88.7000	88.7000 (210)	
Space heating fuel (main heating system)	1125.6368	865.9958	744.5611	463.9818	248.7177	0.0000	0.0000	0.0000	0.0000	432.3236	796.4385	1156.8515 (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	247.0230	217.9833	230.8562	201.7783	194.6532	174.4089	171.6496	179.1861	181.8937	203.9491	218.1342	244.2194 (64)	
Efficiency of water heater (217)m	88.4796	88.4545	88.4124	88.3351	88.1810	87.6000	87.6000	87.6000	87.6000	88.3150	88.4380	88.4864 (217)	
Fuel for water heating, kWh/month	279.1863	246.4356	261.1128	228.4237	220.7429	199.0969	195.9471	204.5503	207.6412	230.9338	246.6521	275.9966 (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	47.4949	38.1022	34.3068	25.1346	19.4147	15.8620	17.7108	23.0211	29.9022	39.2332	44.3139	48.8150 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-69.2480	-108.3466	-170.0554	-205.5759	-231.2492	-218.5268	-215.6432	-199.4808	-170.9157	-131.3998	-79.9378	-58.5501 (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	-5.8818	-17.0233	-43.4640	-80.5822	-122.2750	-129.0437	-127.3341	-100.1801	-63.7789	-28.8690	-9.1769	-4.3206 (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													5834.5068 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													87.6000
Water heating fuel used													2796.7193 (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)													383.3114 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-2590.8591 (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													6509.6784 (238)

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

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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	5834.5068	0.2100	1225.2464 (261)
Total CO2 associated with community systems			0.0000 (273)
Water heating (other fuel)	2796.7193	0.2100	587.3111 (264)
Space and water heating			1812.5575 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	383.3114	0.1443	55.3237 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1858.9294	0.1331	-247.4014
PV Unit electricity exported	-731.9296	0.1205	-88.2078
Total			-335.6092 (269)
Total CO2, kg/year			1544.2012 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			8.9800 (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	5834.5068	1.1300	6592.9927 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2796.7193	1.1300	3160.2928 (278)
Space and water heating			9753.2855 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	383.3114	1.5338	587.9359 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1858.9294	1.4918	-2773.1372
PV Unit electricity exported	-731.9296	0.4421	-323.5810
Total			-3096.7182 (283)
Total Primary energy kWh/year			7374.6039 (286)
Dwelling Primary energy Rate (DPER)			42.8800 (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	56.6000 (1b)	x 2.5000 (2b)	= 141.5000 (1b) - (3b)
First floor	78.4000 (1c)	x 2.7500 (2c)	= 215.6000 (1c) - (3c)
Second floor	37.0000 (1d)	x 2.4000 (2d)	= 88.8000 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	445.9000 (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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0897 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3397 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3142 (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	0.4006	0.3928	0.3849	0.3457	0.3378	0.2985	0.2985	0.2907	0.3142	0.3378	0.3535	0.3692 (22b)
Effective ac	0.5803	0.5771	0.5741	0.5597	0.5571	0.5446	0.5446	0.5422	0.5494	0.5571	0.5625	0.5682 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			26.1300	1.1450	29.9198		(27)
Heatloss Floor 1			56.6000	0.1300	7.3580		(28a)
Exposed floor			21.7000	0.1300	2.8210		(28b)
External Wall 1	205.0000	28.0200	176.9800	0.1800	31.8564		(29a)

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Garage wall	23.5000	23.5000	0.1800	4.2300	(29a)
Flat roof	20.0000	20.0000	0.1100	2.2000	(30)
Pitched roof	35.0000	35.0000	0.1100	3.8500	(30)
Roof ceiling	33.7000	33.7000	0.1100	3.7070	(30)
Total net area of external elements Aum(A, m2)		395.5000			(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =	87.8322		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)

List of Thermal Bridges					
K1 Element		Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate		19.7500	0.0500	0.9875	
E3 Sill		17.9500	0.0500	0.8975	
E4 Jamb		56.0000	0.0500	2.8000	
E5 Ground floor (normal)		36.4000	0.1600	5.8240	
E6 Intermediate floor within a dwelling		66.0500	0.0000	0.0000	
E16 Corner (normal)		31.0000	0.0900	2.7900	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.2990 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 101.1312 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	85.3830	84.9244	84.4749	82.3637	81.9687	80.1298	80.1298	79.7893	80.8381	81.9687	82.7678	83.6032
Heat transfer coeff	186.5143	186.0557	185.6062	183.4949	183.0999	181.2611	181.2611	180.9205	181.9693	183.0999	183.8990	184.7344
Average = Sum(39)m / 12 =												183.4930
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0844	1.0817	1.0791	1.0668	1.0645	1.0538	1.0538	1.0519	1.0580	1.0645	1.0692	1.0740
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												
Assumed occupancy												2.9652 (42)
Hot water usage for mixer showers	73.9372	72.8261	71.2070	68.1090	65.8228	63.2733	61.8241	63.4310	65.1925	67.9299	71.0944	73.6540
Hot water usage for baths	31.9187	31.4446	30.7771	29.5462	28.6246	27.6027	27.0507	27.7135	28.4353	29.5288	30.7850	31.8107
Hot water usage for other uses	44.9971	43.3608	41.7245	40.0883	38.4520	36.8158	36.8158	38.4520	40.0883	41.7245	43.3608	44.9971
Average daily hot water use (litres/day)												138.6677 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	150.8530	147.6315	143.7086	137.7436	132.8995	127.6917	125.6906	129.5966	133.7160	139.1833	145.2402	150.4618
Energy conte	238.9142	210.2253	220.8747	188.5641	178.9083	157.0119	152.0119	160.4677	164.8853	188.8704	206.9212	235.5868
Energy content (annual)										Total = Sum(45)m =		2303.2416
Distribution loss (46)m = 0.15 x (45)m	35.8371	31.5338	33.1312	28.2846	26.8362	23.5518	22.8018	24.0701	24.7328	28.3306	31.0382	35.3380
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
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
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
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
Total heat required for water heating calculated for each month	289.8731	256.2527	271.8336	237.8791	229.8672	206.3270	202.9708	211.4266	214.2003	239.8293	256.2363	286.5457
WWHRS	-33.8010	-29.8939	-31.3032	-25.9203	-24.1568	-20.6711	-19.3759	-20.6043	-21.3871	-25.2131	-28.5633	-33.1751
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
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
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
Output from w/h	256.0721	226.3588	240.5305	211.9589	205.7104	185.6559	183.5949	190.8223	192.8132	214.6162	227.6730	253.3706
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2589.1767
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
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	92.1787	81.4068	86.1806	75.0263	72.2267	64.5352	63.2837	66.0952	67.1531	75.5391	81.1301	91.0723

5. Internal gains (see Table 5 and 5a)												
Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	182.7084	202.2843	182.7084	188.7987	182.7084	188.7987	182.7084	182.7084	188.7987	182.7084	188.7987	182.7084
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	343.5839	347.1493	338.1647	319.0378	294.8935	272.2012	257.0413	253.4760	262.4605	281.5875	305.7318	328.4241
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
Losses e.g. evaporation (negative values) (Table 5)	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097
Water heating gains (Table 5)	123.8961	121.1410	115.8341	104.2032	97.0789	89.6323	85.0587	88.8377	93.2682	101.5311	112.6807	122.4090
Total internal gains	720.6671	741.0532	707.1859	682.5184	645.1594	618.1108	592.2871	592.5008	612.0061	636.3056	677.6898	704.0202

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	8.1600	10.6334	0.6300	0.7000	0.7700	26.5176	(74)
East	1.0200	19.6403	0.6300	0.7000	0.7700	6.1224	(76)
South	15.8700	46.7521	0.6300	0.7000	0.7700	226.7512	(78)

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West	1.0800		19.6403		0.6300		0.7000		0.7700		6.4825 (80)	
Solar gains	265.8736	446.6942	599.7663	732.1871	816.0414	809.9332	780.8315	717.2571	644.9160	490.1288	317.2071	228.4059 (83)
Total gains	986.5407	1187.7475	1306.9522	1414.7055	1461.2008	1428.0440	1373.1186	1309.7578	1256.9221	1126.4345	994.8969	932.4261 (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	25.6162	25.6793	25.7415	26.0377	26.0938	26.3585	26.3585	26.4082	26.2559	26.0938	25.9804	25.8630
alpha	2.7077	2.7120	2.7161	2.7358	2.7396	2.7572	2.7572	2.7605	2.7504	2.7396	2.7320	2.7242
util living area	0.9692	0.9493	0.9224	0.8702	0.7859	0.6538	0.5183	0.5545	0.7330	0.8872	0.9522	0.9733 (86)
MIT	18.3812	18.7316	19.1941	19.7923	20.3225	20.7223	20.8946	20.8699	20.5906	19.8945	19.0376	18.3260 (87)
Th 2	20.0136	20.0158	20.0179	20.0280	20.0299	20.0387	20.0387	20.0403	20.0353	20.0299	20.0261	20.0221 (88)
util rest of house	0.9646	0.9419	0.9106	0.8492	0.7481	0.5879	0.4243	0.4623	0.6756	0.8647	0.9440	0.9693 (89)
MIT 2	16.9325	17.3767	17.9609	18.7112	19.3525	19.8086	19.9747	19.9567	19.6725	18.8501	17.7755	16.8673 (90)
Living area fraction	17.1347	17.5657	18.1330	18.8620	19.4878	19.9361	20.1031	20.0841	19.8006	18.9958	17.9516	17.0708 (92)
Temperature adjustment	17.1347	17.5657	18.1330	18.8620	19.4878	19.9361	20.1031	20.0841	19.8006	18.9958	17.9516	0.0000
adjusted MIT	17.1347	17.5657	18.1330	18.8620	19.4878	19.9361	20.1031	20.0841	19.8006	18.9958	17.9516	17.0708 (93)
8. Space heating requirement												
Utilisation	0.9446	0.9160	0.8806	0.8180	0.7236	0.5802	0.4311	0.4669	0.6597	0.8341	0.9191	0.9510 (94)
Useful gains	931.8997	1088.0222	1150.8563	1157.2259	1057.3023	828.5450	591.8924	611.4813	829.1329	939.6044	914.4098	886.7788 (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	2393.8484	2356.5314	2159.1502	1827.9838	1425.9529	967.2232	634.9728	666.5382	1037.3382	1537.2751	1995.6004	2377.6881 (97)
Space heating kWh	1087.6898	852.4382	750.1707	482.9457	274.2760	0.0000	0.0000	0.0000	0.0000	444.6670	778.4572	1109.2365 (98a)
Space heating requirement - total per year (kWh/year)												5779.8812
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	1087.6898	852.4382	750.1707	482.9457	274.2760	0.0000	0.0000	0.0000	0.0000	444.6670	778.4572	1109.2365 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5779.8812
Space heating per m2										(98c) / (4) =		33.6040 (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	1087.6898	852.4382	750.1707	482.9457	274.2760	0.0000	0.0000	0.0000	0.0000	444.6670	778.4572	1109.2365 (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)	1177.1535	922.5522	811.8730	522.6685	296.8356	0.0000	0.0000	0.0000	0.0000	481.2414	842.4862	1200.4724 (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	256.0721	226.3588	240.5305	211.9589	205.7104	185.6559	183.5949	190.8223	192.8132	214.6162	227.6730	253.3706 (64)
Efficiency of water heater (217)m	87.1219	86.9462	86.6470	86.0878	84.9986	80.3000	80.3000	80.3000	80.3000	85.9050	86.7965	80.3000 (216)
Fuel for water heating, kWh/month	293.9238	260.3437	277.5982	246.2125	242.0163	231.2028	228.6363	237.6367	240.1161	249.8296	262.3066	290.6820 (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	37.9632	30.4555	27.4218	20.0904	15.5184	12.6787	14.1564	18.4010	23.9011	31.3595	35.4205	39.0183 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-53.6479	-75.9876	-109.6816	-123.7740	-133.7311	-124.7819	-123.1181	-116.0447	-103.6970	-86.9806	-59.0589	-46.3303 (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	-29.2256	-61.6096	-122.7401	-184.8109	-244.8858	-246.3631	-243.5869	-206.1101	-150.8097	-88.4045	-39.1056	-23.1111 (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												6255.2826 (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												3060.5046 (219)
Space cooling fuel												0.0000 (221)

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Electricity for pumps and fans:	86.0000 (231)
Total electricity for the above, kWh/year	
Electricity for lighting (calculated in Appendix L)	306.3848 (232)

Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2797.5968 (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	6910.5752 (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	6255.2826	0.2100	1313.6094 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3060.5046	0.2100	642.7060 (264)
Space and water heating			1956.3153 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	306.3848	0.1443	44.2208 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1156.8336	0.1345	-155.6232
PV Unit electricity exported	-1640.7632	0.1258	-206.4233
Total			-362.0464 (269)
Total CO2, kg/year			1650.4190 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.6000 (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	6255.2826	1.1300	7068.4694 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3060.5046	1.1300	3458.3702 (278)
Space and water heating			10526.8396 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	306.3848	1.5338	469.9432 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1156.8336	1.4972	-1731.9869
PV Unit electricity exported	-1640.7632	0.4618	-757.7068
Total			-2489.6937 (283)
Total Primary energy kWh/year			8637.1899 (286)
Target Primary Energy Rate (TPER)			50.2200 (287)

12 Appendix 1 – SAP Worksheet House Type 1 with ASHP

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Property Reference	Plot 1, Type 2				Issued on Date	30/04/2024		
Assessment Reference	v0 ASHP			Prop Type Ref				
Property	Plot 4, Kay Street, Summerseat							
SAP Rating	84 B		DER	3.11		TER	9.42	
Environmental	97 A		% DER < TER				66.99	
CO ₂ Emissions (t/year)	0.55		DFEE	35.90		TFEE	38.23	
Compliance Check	See BREL		% DFEE < TFEE				6.10	
% DPER < TPER	33.65		DPER	32.70		TPER	49.28	
Assessor Details	Mr. Peter Kinsella					Assessor ID	L770-0002	
Client								

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	56.6000 (1b)	x 2.5000 (2b)	= 141.5000 (1b) - (3b)
First floor	78.4000 (1c)	x 2.7500 (2c)	= 215.6000 (1c) - (3c)
Second floor	37.0000 (1d)	x 2.4000 (2d)	= 88.8000 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.0000		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	445.9000 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	3 * 10 = 30.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.0673 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.2673 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2472 (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	0.3152	0.3090	0.3029	0.2720	0.2658	0.2349	0.2349	0.2287	0.2472	0.2658	0.2781	0.2905 (22b)
Effective ac	0.5497	0.5478	0.5459	0.5370	0.5353	0.5276	0.5276	0.5261	0.5306	0.5353	0.5387	0.5422 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front door			1.8900	1.0000	1.8900		(26)
Windows (U _w = 1.20)			26.1300	1.1450	29.9198		(27)
Heatloss Floor 1			56.6000	0.1200	6.7920		(28a)
Exposed floor			21.7000	0.1300	2.8210		(28b)
External Wall 1	205.0000	28.0200	176.9800	0.1800	31.8564		(29a)
Garage wall	23.5000		23.5000	0.1600	3.7600		(29a)
Flat roof	20.0000		20.0000	0.1100	2.2000		(30)
Pitched roof	35.0000		35.0000	0.1100	3.8500		(30)
Roof ceiling	33.7000		33.7000	0.1000	3.3700		(30)
Total net area of external elements A _{um} (A, m ²)			395.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.4592		(33)
Thermal mass parameter (TMP = C _m / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.030 * total exposed area)							11.8650 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	98.3242 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							

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(38)m	Jan 80.8842	Feb 80.6003	Mar 80.3220	Apr 79.0150	May 78.7705	Jun 77.6322	Jul 77.6322	Aug 77.4214	Sep 78.0706	Oct 78.7705	Nov 79.2652	Dec 79.7824	(38)	
Heat transfer coeff	179.2084	178.9245	178.6463	177.3393	177.0948	175.9564	175.9564	175.7456	176.3949	177.0948	177.5894	178.1066	(39)	
Average = Sum(39)m / 12 =												177.3381		
HLP	Jan 1.0419	Feb 1.0403	Mar 1.0386	Apr 1.0310	May 1.0296	Jun 1.0230	Jul 1.0230	Aug 1.0218	Sep 1.0256	Oct 1.0296	Nov 1.0325	Dec 1.0355	(40)	
HLP (average)												1.0310		
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31		

4. Water heating energy requirements (kWh/year)														

Assumed occupancy												2.9652	(42)	
Hot water usage for mixer showers	101.6637	100.1359	97.9096	93.6499	90.5064	87.0008	85.0082	87.2177	89.6396	93.4036	97.7548	101.2742	(42a)	
Hot water usage for baths	31.9187	31.4446	30.7771	29.5462	28.6246	27.6027	27.0507	27.7135	28.4353	29.5288	30.7850	31.8107	(42b)	
Hot water usage for other uses	44.9971	43.3608	41.7245	40.0883	38.4520	36.8158	36.8158	38.4520	40.0883	41.7245	43.3608	44.9971	(42c)	
Average daily hot water use (litres/day)												164.2306	(43)	

Daily hot water use	Jan 178.5794	Feb 174.9413	Mar 170.4112	Apr 163.2845	May 157.5831	Jun 151.4192	Jul 148.8746	Aug 153.3832	Sep 158.1632	Oct 164.6570	Nov 171.9005	Dec 178.0820	(44)	
Energy conte	282.8261	249.1141	261.9157	223.5283	212.1371	186.1876	180.0510	189.9205	195.0311	223.4380	244.9038	278.8334	(45)	
Energy content (annual)										Total = Sum(45)m =		2727.8866		
Distribution loss (46)m = 0.15 x (45)m	42.4239	37.3671	39.2873	33.5292	31.8206	27.9281	27.0076	28.4881	29.2547	33.5157	36.7356	41.8250	(46)	
Water storage loss:														
Store volume												150.0000	(47)	
a) If manufacturer declared loss factor is known (kWh/day):												1.8900	(48)	
Temperature factor from Table 2b												0.5400	(49)	
Enter (49) or (54) in (55)												1.0206	(55)	
Total storage loss	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(56)	
If cylinder contains dedicated solar storage	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)	
Total heat required for water heating calculated for each month	337.7271	298.7021	316.8167	276.6583	267.0381	239.3176	234.9520	244.8215	248.1611	278.3390	298.0338	333.7344	(62)	
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)	
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)	
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)	
Output from w/h	337.7271	298.7021	316.8167	276.6583	267.0381	239.3176	234.9520	244.8215	248.1611	278.3390	298.0338	333.7344	(64)	
										Total per year (kWh/year) = Sum(64)m =		3374.3016	(64)	
													3374	(64)
12Total per year (kWh/year)														
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	137.9605	122.5008	131.0078	116.8271	114.4564	104.4114	103.7877	107.0694	107.3518	118.2139	123.9345	136.6329	(65)	

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

Metabolic gains (Table 5), Watts	Jan 148.2622	Feb 148.2622	Mar 148.2622	Apr 148.2622	May 148.2622	Jun 148.2622	Jul 148.2622	Aug 148.2622	Sep 148.2622	Oct 148.2622	Nov 148.2622	Dec 148.2622	(66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	182.7084	202.2843	182.7084	188.7987	182.7084	188.7987	182.7084	182.7084	188.7987	182.7084	188.7987	182.7084	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	343.5839	347.1493	338.1647	319.0378	294.8935	272.2012	257.0413	253.4760	262.4605	281.5875	305.7318	328.4241	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	(69)	
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	(71)	
Water heating gains (Table 5)	185.4308	182.2929	176.0857	162.2599	153.8392	145.0158	139.4997	143.9104	149.0998	158.8897	172.1313	183.6464	(72)	
Total internal gains	779.2018	799.2051	764.4375	737.5751	698.9197	673.4943	646.7281	647.5735	667.8376	690.6642	734.1405	762.2575	(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				8.1600	10.6334	0.4500		0.0000		0.7700			30.0653	(74)
East				1.0200	19.6403	0.4500		0.0000		0.7700			6.9415	(76)
South				15.8700	46.7521	0.4500		0.0000		0.7700			257.0875	(78)
West				1.0800	19.6403	0.4500		0.0000		0.7700			7.3498	(80)

Solar gains	301.4440	506.4561	680.0072	830.1441	925.2170	918.2916	885.2965	813.2167	731.1972	555.7016	359.6452	258.9636	(83)	
Total gains	1080.6458	1305.6612	1444.4447	1567.7192	1624.1367	1591.7859	1532.0246	1460.7902	1399.0349	1246.3659	1093.7857	1021.2211	(84)	

7. Mean internal temperature (heating season)														

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)														
tau	Jan 26.6605	Feb 26.7028	Mar 26.7443	Apr 26.9415	May 26.9787	Jun 27.1532	Jul 27.1532	Aug 27.1858	Sep 27.0857	Oct 26.9787	Nov 26.9035	Dec 26.8254		
alpha	2.7774	2.7802	2.7830	2.7961	2.7986	2.8102	2.8102	2.8124	2.8057	2.7986	2.7936	2.7884		
util living area														

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	0.9614	0.9362	0.9022	0.8391	0.7419	0.6006	0.4657	0.5011	0.6840	0.8598	0.9399	0.9666 (86)
Living	18.5935	18.9562	19.4127	19.9733	20.4531	20.7891	20.9246	20.9052	20.6776	20.0472	19.2198	18.5245
Non living	17.2206	17.6780	18.2509	18.9462	19.5180	19.8921	20.0190	20.0053	19.7807	19.0499	18.0208	17.1365
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	19.7689	18.9562	19.4127	19.9733	20.4531	20.7891	20.9246	20.9052	20.6776	20.0472	19.2198	18.8708 (87)
Th 2	20.0486	20.0499	20.0513	20.0575	20.0587	20.0642	20.0642	20.0652	20.0621	20.0587	20.0563	20.0539 (88)
util rest of house												
	0.9559	0.9274	0.8883	0.8154	0.7017	0.5361	0.3793	0.4152	0.6252	0.8341	0.9301	0.9617 (89)
MIT 2	18.9211	17.6780	18.2509	18.9462	19.5180	19.8921	20.0190	20.0053	19.7807	19.0499	18.0208	17.6622 (90)
Living area fraction									fLA = Living area / (4) =			0.1395 (91)
MIT	19.0394	17.8563	18.4130	19.0896	19.6484	20.0172	20.1454	20.1308	19.9059	19.1891	18.1881	17.8309 (92)
Temperature adjustment												0.0000
adjusted MIT	19.0394	17.8563	18.4130	19.0896	19.6484	20.0172	20.1454	20.1308	19.9059	19.1891	18.1881	17.8309 (93)

8. Space heating requirement												

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9489	0.9001	0.8579	0.7864	0.6820	0.5326	0.3872	0.4216	0.6144	0.8051	0.9036	0.9462 (94)
Useful gains	1025.4073	1175.1711	1239.2553	1232.9092	1107.7378	847.7463	593.2278	615.8198	859.5320	1003.4907	988.3694	966.2601 (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	2641.4308	2318.2085	2128.2164	1807.0092	1407.6268	953.1989	623.8365	655.6787	1024.1263	1521.0823	1969.1242	2427.7485 (97)
Space heating kWh	1202.3215	768.1211	661.3871	413.3520	223.1174	0.0000	0.0000	0.0000	0.0000	385.0881	706.1435	1087.3473 (98a)
Space heating requirement - total per year (kWh/year)												5446.8781
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	1202.3215	768.1211	661.3871	413.3520	223.1174	0.0000	0.0000	0.0000	0.0000	385.0881	706.1435	1087.3473 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5446.8781
Space heating per m2										(98c) / (4) =		31.6679 (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 %)												398.5751 (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	1202.3215	768.1211	661.3871	413.3520	223.1174	0.0000	0.0000	0.0000	0.0000	385.0881	706.1435	1087.3473 (98)
Space heating efficiency (main heating system 1)	398.5751	398.5751	398.5751	398.5751	398.5751	0.0000	0.0000	0.0000	0.0000	398.5751	398.5751	398.5751 (210)
Space heating fuel (main heating system)	301.6550	192.7168	165.9379	103.7074	55.9788	0.0000	0.0000	0.0000	0.0000	96.6162	177.1670	272.8087 (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	337.7271	298.7021	316.8167	276.6583	267.0381	239.3176	234.9520	244.8215	248.1611	278.3390	298.0338	333.7344 (64)
Efficiency of water heater (217)m	177.9808	177.9808	177.9808	177.9808	177.9808	177.9808	177.9808	177.9808	177.9808	177.9808	177.9808	177.9808 (216)
Fuel for water heating, kWh/month	189.7549	167.8283	178.0061	155.4428	150.0376	134.4626	132.0098	137.5550	139.4314	156.3871	167.4529	187.5115 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	47.4949	38.1022	34.3068	25.1346	19.4147	15.8620	17.7108	23.0211	29.9022	39.2332	44.3139	48.8150 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1366.5877 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												177.9808
Water heating fuel used												1895.8801 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												383.3114 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (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)

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Total delivered energy for all uses 3645.7792 (238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	1366.5877	0.1551	211.9721 (261)
Total CO ₂ associated with community systems			0.0000 (373)
Water heating (other fuel)	1895.8801	0.1410	267.3746 (264)
Space and water heating			479.3467 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	383.3114	0.1443	55.3237 (268)
Total CO ₂ , kg/year			534.6704 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.1100 (273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	1366.5877	1.5742	2151.2745 (275)
Total CO ₂ associated with community systems			0.0000 (473)
Water heating (other fuel)	1895.8801	1.5215	2884.5469 (278)
Space and water heating			5035.8214 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	383.3114	1.5338	587.9359 (282)
Total Primary energy kWh/year			5623.7573 (286)
Dwelling Primary energy Rate (DPER)			32.7000 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	56.6000 (1b)	x 2.5000 (2b)	= 141.5000 (1b) - (3b)
First floor	78.4000 (1c)	x 2.7500 (2c)	= 215.6000 (1c) - (3c)
Second floor	37.0000 (1d)	x 2.4000 (2d)	= 88.8000 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.0000		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	445.9000 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0897 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3397 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3142 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	3.8000	3.8000	3.7000	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	0.4006	0.3928	0.3849	0.3457	0.3378	0.2985	0.2985	0.2907	0.3142	0.3378	0.3535	0.3692 (22b)
Effective ac	0.5803	0.5771	0.5741	0.5597	0.5571	0.5446	0.5446	0.5422	0.5494	0.5571	0.5625	0.5682 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			26.1300	1.1450	29.9198		(27)
Heatloss Floor 1			56.6000	0.1300	7.3580		(28a)
Exposed floor			21.7000	0.1300	2.8210		(28b)
External Wall 1	205.0000	28.0200	176.9800	0.1800	31.8564		(29a)
Garage wall	23.5000		23.5000	0.1800	4.2300		(29a)
Flat roof	20.0000		20.0000	0.1100	2.2000		(30)
Pitched roof	35.0000		35.0000	0.1100	3.8500		(30)

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Roof ceiling	33.7000					33.7000	0.1100	3.7070	(30)			
Total net area of external elements Aum(A, m2)	395.5000					395.5000			(31)			
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =							87.8322	(33)			
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K									100.0000 (35)			
List of Thermal Bridges												
K1 Element						Length	Psi-value	Total				
E1 Steel lintel with perforated steel base plate						19.7500	0.0500	0.9875				
E3 Sill						17.9500	0.0500	0.8975				
E4 Jamb						56.0000	0.0500	2.8000				
E5 Ground floor (normal)						36.4000	0.1600	5.8240				
E6 Intermediate floor within a dwelling						66.0500	0.0000	0.0000				
E16 Corner (normal)						31.0000	0.0900	2.7900				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)									13.2990 (36)			
Point Thermal bridges									(36a) = 0.0000			
Total fabric heat loss									(33) + (36) + (36a) = 101.1312 (37)			
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	85.3830	84.9244	84.4749	82.3637	81.9687	80.1298	80.1298	79.7893	80.8381	81.9687	82.7678	83.6032 (38)
Average = Sum(39)m / 12 =	186.5143	186.0557	185.6062	183.4949	183.0999	181.2611	181.2611	180.9205	181.9693	183.0999	183.8990	184.7344 (39)
												183.4930
HLP	1.0844	1.0817	1.0791	1.0668	1.0645	1.0538	1.0538	1.0519	1.0580	1.0645	1.0692	1.0740 (40)
HLP (average)												1.0668
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												

Assumed occupancy												2.9652 (42)
Hot water usage for mixer showers	73.9372	72.8261	71.2070	68.1090	65.8228	63.2733	61.8241	63.4310	65.1925	67.9299	71.0944	73.6540 (42a)
Hot water usage for baths	31.9187	31.4446	30.7771	29.5462	28.6246	27.6027	27.0507	27.7135	28.4353	29.5288	30.7850	31.8107 (42b)
Hot water usage for other uses	44.9971	43.3608	41.7245	40.0883	38.4520	36.8158	36.8158	38.4520	40.0883	41.7245	43.3608	44.9971 (42c)
Average daily hot water use (litres/day)												138.6677 (43)
Daily hot water use	150.8530	147.6315	143.7086	137.7436	132.8995	127.6917	125.6906	129.5966	133.7160	139.1833	145.2402	150.4618 (44)
Energy conte	238.9142	210.2253	220.8747	188.5641	178.9083	157.0119	152.0119	160.4677	164.8853	188.8704	206.9212	235.5868 (45)
Energy content (annual)										Total = Sum(45)m =		2303.2416
Distribution loss (46)m = 0.15 x (45)m	35.8371	31.5338	33.1312	28.2846	26.8362	23.5518	22.8018	24.0701	24.7328	28.3306	31.0382	35.3380 (46)
Water storage loss:												150.0000 (47)
Store volume												1.3938 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.7527 (55)
Enter (49) or (54) in (55)												
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	285.5091	252.3110	267.4696	233.6559	225.5032	202.1037	198.6068	207.0626	209.9771	235.4653	252.0131	282.1817 (62)
WWHRS	-33.8010	-29.8939	-31.3032	-25.9203	-24.1568	-20.6711	-19.3759	-20.6043	-21.3871	-25.2131	-28.5633	-33.1751 (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	251.7081	222.4171	236.1665	207.7356	201.3464	181.4326	179.2309	186.4583	188.5900	210.2522	223.4497	249.0066 (64)
12Total per year (kWh/year)												2537.7941 (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	116.7149	103.5685	110.7168	98.7710	96.7629	88.2799	87.8199	90.6314	90.8978	100.0753	104.8748	115.6085 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622	148.2622 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	182.7084	202.2843	182.7084	188.7987	182.7084	188.7987	182.7084	182.7084	188.7987	182.7084	188.7987	182.7084 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	343.5839	347.1493	338.1647	319.0378	294.8935	272.2012	257.0413	253.4760	262.4605	281.5875	305.7318	328.4241 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262	37.8262 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097	-118.6097 (71)
Water heating gains (Table 5)	156.8749	154.1198	148.8129	137.1820	130.0577	122.6110	118.0375	121.8164	126.2470	134.5098	145.6594	155.3878 (72)
Total internal gains	753.6459	774.0320	740.1647	715.4971	678.1382	651.0895	625.2659	625.4795	644.9848	669.2844	710.6686	736.9990 (73)

6. Solar gains												

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
North	8.1600	10.6334	0.6300	0.7000	0.7700	26.5176 (74)						
East	1.0200	19.6403	0.6300	0.7000	0.7700	6.1224 (76)						

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South	15.8700				46.7521				0.6300				0.7000				0.7700				226.7512 (78)			
West	1.0800				19.6403				0.6300				0.7000				0.7700				6.4825 (80)			
Solar gains	265.8736	446.6942	599.7663	732.1871	816.0414	809.9332	780.8315	717.2571	644.9160	490.1288	317.2071	228.4059 (83)												
Total gains	1019.5195	1220.7263	1339.9310	1447.6843	1494.1796	1461.0227	1406.0974	1342.7366	1289.9008	1159.4132	1027.8757	965.4048 (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	25.6162	25.6793	25.7415	26.0377	26.0938	26.3585	26.3585	26.4082	26.2559	26.0938	25.9804	25.8630												
alpha	2.7077	2.7120	2.7161	2.7358	2.7396	2.7572	2.7572	2.7605	2.7504	2.7396	2.7320	2.7242												
util living area	0.9668	0.9461	0.9183	0.8646	0.7785	0.6446	0.5089	0.5444	0.7234	0.8809	0.9487	0.9710 (86)												
MIT	18.4170	18.7650	19.2245	19.8175	20.3407	20.7323	20.8994	20.8758	20.6051	19.9213	19.0715	18.3624 (87)												
Th 2	20.0136	20.0158	20.0179	20.0280	20.0299	20.0387	20.0387	20.0403	20.0353	20.0299	20.0261	20.0221 (88)												
util rest of house	0.9619	0.9384	0.9061	0.8430	0.7401	0.5787	0.4158	0.4529	0.6654	0.8575	0.9399	0.9667 (89)												
MIT 2	16.9777	17.4184	17.9983	18.7411	19.3724	19.8178	19.9779	19.9609	19.6868	18.8817	17.8177	16.9134 (90)												
Living area fraction									fLA = Living area / (4) =			0.1395 (91)												
MIT	17.1785	17.6063	18.1694	18.8913	19.5075	19.9454	20.1065	20.0886	19.8149	19.0268	17.9926	17.1156 (92)												
Temperature adjustment												0.0000												
adjusted MIT	17.1785	17.6063	18.1694	18.8913	19.5075	19.9454	20.1065	20.0886	19.8149	19.0268	17.9926	17.1156 (93)												
8. Space heating requirement																								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec												
Utilisation	0.9410	0.9119	0.8756	0.8119	0.7162	0.5716	0.4228	0.4579	0.6503	0.8269	0.9142	0.9476 (94)												
Useful gains	959.3740	1113.1440	1173.2993	1175.4212	1070.1228	835.1613	594.5008	614.8331	838.8589	958.7762	939.7155	914.7959 (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	2402.0324	2364.0837	2165.9080	1833.3455	1429.5509	968.9081	635.5866	667.3386	1039.9457	1542.9406	2003.1429	2385.9527 (97)												
Space heating kWh	1073.3378	840.6315	738.5009	473.7055	267.4146	0.0000	0.0000	0.0000	0.0000	434.6184	765.6677	1094.5407 (98a)												
Space heating requirement - total per year (kWh/year)												5688.4170												
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	1073.3378	840.6315	738.5009	473.7055	267.4146	0.0000	0.0000	0.0000	0.0000	434.6184	765.6677	1094.5407 (98c)												
Space heating requirement after solar contribution - total per year (kWh/year)												5688.4170												
Space heating per m2												(98c) / (4) =	33.0722 (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 %)													92.3000 (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	1073.3378	840.6315	738.5009	473.7055	267.4146	0.0000	0.0000	0.0000	0.0000	434.6184	765.6677	1094.5407 (98)												
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)												
Space heating fuel (main heating system)	1162.8796	910.7600	800.1093	513.2237	289.7233	0.0000	0.0000	0.0000	0.0000	470.8758	829.5425	1185.8512 (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	251.7081	222.4171	236.1665	207.7356	201.3464	181.4326	179.2309	186.4583	188.5900	210.2522	223.4497	249.0066 (64)												
Efficiency of water heater (217)m	86.9374	86.7529	86.4379	85.8484	84.6970	79.8000	79.8000	79.8000	79.8000	85.6505	86.5937	79.8000 (216)												
Fuel for water heating, kWh/month	289.5279	256.3801	273.2211	241.9796	237.7255	227.3592	224.6001	233.6570	236.3283	245.4768	258.0438	286.2741 (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	37.9632	30.4555	27.4218	20.0904	15.5184	12.6787	14.1564	18.4010	23.9011	31.3595	35.4205	39.0183 (232)												
Electricity generated by PVs (Appendix M) (negative quantity)																								
(233a)m	-53.6479	-75.9876	-109.6816	-123.7740	-133.7311	-124.7819	-123.1181	-116.0447	-103.6970	-86.9806	-59.0589	-46.3303 (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	-29.2256	-61.6096	-122.7401	-184.8109	-244.8858	-246.3631	-243.5869	-206.1101	-150.8097	-88.4045	-39.1056	-23.1111 (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												6162.9653 (211)												
Space heating fuel - main system 2												0.0000 (213)												
Space heating fuel - secondary												0.0000 (215)												
Efficiency of water heater												79.8000												
Water heating fuel used												3010.5735 (219)												
Space cooling fuel												0.0000 (221)												

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Electricity for pumps and fans:	
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	306.3848 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2797.5968 (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	6768.3268 (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	6162.9653	0.2100	1294.2227 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3010.5735	0.2100	632.2204 (264)
Space and water heating			1926.4432 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	306.3848	0.1443	44.2208 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1156.8336	0.1345	-155.6232
PV Unit electricity exported	-1640.7632	0.1258	-206.4233
Total			-362.0464 (269)
Total CO2, kg/year			1620.5468 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.4200 (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	6162.9653	1.1300	6964.1508 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3010.5735	1.1300	3401.9481 (278)
Space and water heating			10366.0989 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	306.3848	1.5338	469.9432 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1156.8336	1.4972	-1731.9869
PV Unit electricity exported	-1640.7632	0.4618	-757.7068
Total			-2489.6937 (283)
Total Primary energy kWh/year			8476.4492 (286)
Target Primary Energy Rate (TPER)			49.2800 (287)