BASEENERGY
Building Assessments for a Sustainable Environment

Energy Statement

2 Verdun Road
London
SW13 9AY

Job number: 12444

Date: 05 November 2024

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0	15.10.2024	ROB	CT	First Issue
1	13.11.2024	ROB	CT	Second Issue

This document and any calculations herein have been produced based on information supplied by the client and their agents and design team. Any amendments to the technical specification on which this report is based may invalidate the results.

Contents

1 Executive Summary

This report has been produced by Base Energy on behalf of Jaspreet Narang and in support of the planning application for the development named as 2 Verdun Road, London, SW13 9AY comprising of the amalgamation of two dwellings into a single family 4-bedroom dwelling; alterations to existing rear dormers; addition of front porch; addition of side entrance door; and conversion of a single garage into a garden room falling under the requirements of London Borough of Richmond upon Thames Council.

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 London Plan
- Richmond Local Plan Policy LP 22 Sustainable Design and Construction

The above policies require:

- Policy LP22 requires developments to achieve the highest standards of sustainable design and construction in order to mitigate against climate change.
- Minor residential schemes must aim to achieve a 35% reduction in carbon dioxide emissions. This should be measured against the 2021 Building Regulations baseline.

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

- Thermal specification meeting and exceeding Part L 2021 notional U-values
- A design which limits air permeability
- A design which limits thermal bridging
- Energy saving building services including low energy lighting and heating controls.
- Low carbon Air Source Heat Pump

Table 1.1: Carbon emissions summary

	Total CO2 Emission (Tonnes CO2/year)	CO2 saving (Tonnes CO2/year)	Percentage savings (%)
Part L Baseline	1.7	NA	N/A
Be Lean Design	1.5	0.2	**11%**
Be Clean	1.5	0.0	**0%**
Be Green	0.9	0.6	**37%**
Cumulative saving	NA	0.9	**49%**

This results in an 49% saving in CO2 emissions over Part L building regulations.

2 Existing and Proposed Development

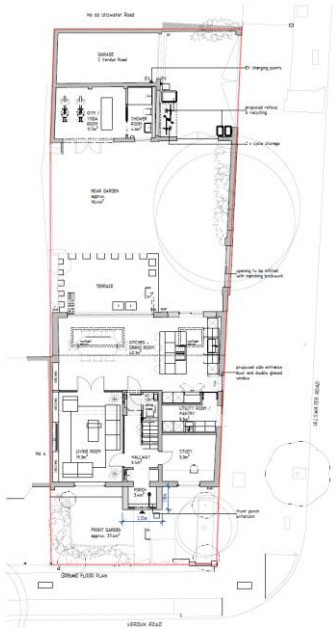
The development site is located at 2 Verdun Road, London, SW13 9AY (see figure 2.1 below).

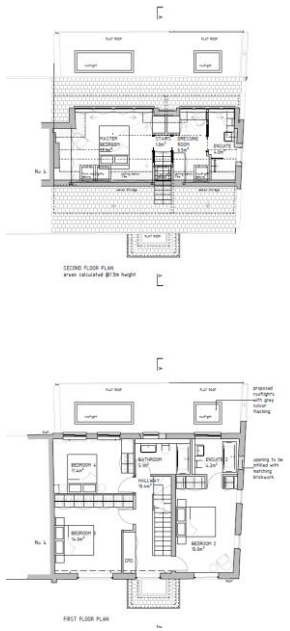
The development proposals are for the amalgamation of two dwellings into a single family 4-bedroom dwelling; alterations to existing rear dormers; addition of front porch; addition of side entrance door; and conversion of a single garage into a garden room.

The development proposals constitute a minor development and have been assessed in line with Part L 2021 under conversion and extension for existing dwellings.

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).

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 relevant Richmond Local Plan Policy LP 22 Sustainable Design and Construction requirements are as follows.

- Policy LP22 requires developments to achieve the highest standards of sustainable design and construction in order to mitigate against climate change.
- Minor residential schemes must aim to achieve a 35% reduction in carbon dioxide emissions. This should be measured against the 2021 Building Regulations baseline.

The dwelling will be assessed in line with the latest Part L 2021 guidance using SAP 10 software.

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-values[1] 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

SAP 10 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.

Table 5.1: Baseline CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)
Baseline	9.42	183	1,722

The **Total Baseline CO2 Emissions** for the development are shown to be 1,722 kg/year.

Table 5.2: Baseline Energy Demand

	Energy Demand (kWh/m2/year)	Floor Area (m2)	Total Baseline Energy Demand (kWhyear)
Baseline	96.63	183	17,683

The **Baseline Energy Demand** for the development is shown to be 17,683 kWh per 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)

	Part L 2021 Limiting Parameters	Proposed Development
Existing Walls	0.55	0.55
Dormer Walls	0.30	0.30
New external walls	0.18	0.17
Ground Floor	0.25	0.25
Existing Roofs	0.16	0.16
New Porch Roof	0.15	0.15
New Windows	1.6	1.2 Triple Glazed
Roof light	2.2	1.4 Double Glazed
Doors	1.6	1.4

- Insulation: The specified building envelope is designed to 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.

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 80 lumens per watt
- Space & Water Heating: SAP default Air Source Heat Pump
- Heating Controls: Programmer, thermostat, and TRVs

- Ventilation: Natural ventilation with localised extract fan

Table 6.1: Baseline vs Be Lean CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)	Reduction in CO2
Baseline	9.42	183	1,722	N/A
Be Lean	8.34	183	1,525	**11%**

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 197 kg/year.

7 Low Carbon Technology Review & Recommendations

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

- compliance 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

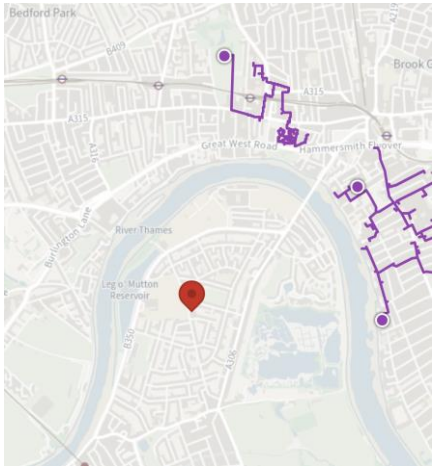
Biomass technology **is not recommended** for this development

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

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 0.25Watts to 0.35Watts 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. However, ASHPs are to be included and provide a greater emissions reduction

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 Carbon Technology Summary

The low carbon technology review indicates that ASHP and Solar PV would be potentially feasible. The following low carbon technology is recommended:

Air Source Heat Pump – Assumed model: Mitsubishi Ecodan 11.2kW (Heating efficiency 380%)

This technology is deemed optimal for meeting the needs of the development and achieving policy compliance. It has been incorporated into the energy model and the results are presented in the next section.

8 Low Carbon Technology – Renewable Energy Generation - Be Green

The selected Low Carbon Technology has been incorporated into the calculation and the results are set out below.

Table 8.1: Baseline vs Be Green CO2 - SAP 10

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)	Reduction in CO2
Baseline	9.42	183	1,722	N/A
Be Green Design	4.84	183	885	**49%**

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 837 kg/year.

Table 8.2: Average 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	96.63	183	17,683	N/A
Be Lean & Green Design	50.02	183	9,153	**48%**

The **Energy Demand reduction** as a result of energy efficient fabric and services is shown to be 8,530 kWh per year

Table 8.3: Average Fabric Efficiency

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	83.28	77.56	**7%**

9 Conclusion

Proposals are for the development named as 2 Verdun Road, London, SW13 9AY comprising of the amalgamation of two dwellings into a single family 4-bedroom dwelling; alterations to existing rear dormers; addition of front porch; addition of side entrance door; and conversion of a single garage into a garden room falling under the requirements of London Borough of Richmond upon Thames Council.

Under the local planning policy for minor residential schemes, the development will aim to achieve a 35% reduction in carbon dioxide emissions. This should be measured against the 2021 Building Regulations baseline.

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.

Low carbon technology will be incorporated and is to comprise of an Air Source Heat Pump.

This results in a total 49% reduction in CO2 emissions Kg/year over Part L 2021.

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

10 Appendix 1 - Be Lean SAP Worksheets DER/TER

Full SAP Calculation Printout

Property Reference	12444	**Issued on Date**	18/11/2024
Assessment Reference	Be Lean V2	**Prop Type Ref**	End Terrace
Property	2, Verdun Road, London, SW13 9AY		

SAP Rating	58 D	**DER**	8.34	**TER**	8.67
Environmental	91 B	**% DER < TER**			3.81
CO_2 Emissions (t/year)	1.18	**DFEE**	77.24	**TFEE**	40.90
Compliance Check	See BREL	**% DFEE < TFEE**			-88.85
% DPER < TPER	-88.29	**DPER**	85.56	**TPER**	45.44

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	88.6900 (1b)	x	2.4000 (2b)	=	212.8560	(1b) - (3b)
First floor	62.9800 (1c)	x	2.6000 (2c)	=	163.7480	(1c) - (3c)
Second floor	31.1600 (1d)	x	2.3800 (2d)	=	74.1608	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	182.8300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	450.7648	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	5 * 10 =	50.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1109	(8)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8609	(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) =	0.7964	(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	1.0154	0.9954	0.9755	0.8760	0.8561	0.7565	0.7565	0.7366	0.7964	0.8561	0.8959	0.9357	(22b)
Effective ac	1.0154	0.9955	0.9758	0.8837	0.8664	0.7862	0.7862	0.7713	0.8171	0.8664	0.9013	0.9378	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
New Windows (Uw = 1.20)			42.7400	1.1450	48.9389			(27)
Door			3.7800	1.4000	5.2920			(26a)
RL1 - RL4			2.2500	1.3258	2.9830			(27a)
RL5			1.5400	1.3258	2.0417			(27a)
RL6			3.3000	1.3258	4.3750			(27a)
Heat Loss Floor 1			88.6900	0.2500	22.1725			(28a)
New external wall	17.1100	3.3600	13.7500	0.1700	2.3375			(29a)
Existing wall	136.3600	34.2100	102.1500	0.5500	56.1825			(29a)
Dormer upgrade	9.8900	8.9500	0.9400	0.3000	0.2820			(29a)
Stud wall	28.9600		28.9600	0.1100	3.1856			(29a)
Existing pitch roof	26.7600	2.2500	24.5100	0.1600	3.9216			(30)
Dormer pitch	10.9000		10.9000	0.1600	1.7440			(30)
Existing flat	25.0500	4.8400	20.2100	0.1600	3.2336			(30)
New porch roof	2.6100		2.6100	0.1500	0.3915			(30)
Ceiling to loft area	31.8300		31.8300	0.1100	3.5013			(30)
Total net area of external elements Aum(A, m2)			378.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		160.5827			(33)
Party Wall 1			39.9800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (Default value 0.200 * total exposed area) 75.6320 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 236.2147 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	151.0358	148.0759	145.1574	131.4492	128.8845	116.9451	116.9451	114.7341	121.5440	128.8845	134.0729	139.4972	(38)
Heat transfer coeff	387.2505	384.2905	381.3720	367.6639	365.0991	353.1598	353.1598	350.9488	357.7586	365.0991	370.2876	375.7119	(39)

Average = Sum(39)m / 12 = 367.6501

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1181	2.1019	2.0859	2.0110	1.9969	1.9316	1.9316	1.9195	1.9568	1.9969	2.0253	2.0550	(40)
HLP (average)												2.0109	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9795 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	92.7209	91.3275	89.2970	85.4120	82.5450	79.3478	77.5305	79.5456	81.7545	85.1874	89.1558	92.3656	(42a)
Hot water usage for baths	32.0216	31.5461	30.8764	29.6416	28.7170	27.6917	27.1379	27.8030	28.5270	29.6241	30.8843	31.9134	(42b)
Hot water usage for other uses	45.1433	43.5017	41.8602	40.2186	38.5770	36.9354	36.9354	38.5770	40.2186	41.8602	43.5017	45.1433	(42c)

Average daily hot water use (litres/day) 156.2140 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	169.8858	166.3753	162.0335	155.2722	149.8390	143.9750	141.6039	145.9256	150.5001	156.6716	163.5418	169.4223	(44)
Energy conte	269.0576	236.9162	249.0395	212.5599	201.7121	177.0340	171.2576	180.6863	185.5817	212.6019	232.9953	265.2744	(45)

Energy content (annual) Total = Sum(45)m = 2594.7167

Distribution loss (46)m = 0.15 x (45)m	40.3586	35.5374	37.3559	31.8840	30.2568	26.5551	25.6886	27.1029	27.8373	31.8903	34.9493	39.7912	(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

	323.9586	286.5042	303.9405	265.6899	256.6131	230.1640	226.1586	235.5873	238.7117	267.5029	286.1253	320.1754	(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

	323.9586	286.5042	303.9405	265.6899	256.6131	230.1640	226.1586	235.5873	238.7117	267.5029	286.1253	320.1754	(64)

Total per year (kWh/year) = Sum(64)m = 3241.1317 (64)
12Total per year (kWh/year) 3241 (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

	133.3825	118.4450	126.7264	113.1802	110.9901	101.3678	100.8640	103.9990	104.2099	114.6109	119.9750	132.1245	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	178.7639	197.9172	178.7639	184.7227	178.7639	184.7227	178.7639	178.7639	184.7227	178.7639	184.7227	178.7639	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	354.4195	358.0973	348.8294	329.0993	304.1935	280.7856	265.1476	261.4699	270.7377	290.4679	315.3737	338.7816	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	(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)	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	(71)
Water heating gains (Table 5)	179.2775	176.2575	170.3312	157.1947	149.1802	140.7886	135.5698	139.7836	144.7360	154.0470	166.6319	177.5868	(72)
Total internal gains	783.1538	802.9649	768.6175	741.7096	702.8305	673.9898	647.1743	647.7103	667.8894	693.9717	737.4212	765.8252	(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	
East	28.6500	19.6403	0.5700	0.0000	0.7700	246.9662	(76)
South	3.2400	46.7521	0.5700	0.0000	0.7700	66.4831	(78)
West	10.8500	19.6403	0.5700	0.0000	0.7700	93.5282	(80)
West	2.2500	26.2379	0.6300	1.0000	1.0000	33.4731	(82)
Horizontal	4.8400	26.0000	0.6300	1.0000	1.0000	71.3513	(82)

Solar gains	511.8019	990.3427	1614.0846	2342.9110	2871.2793	2941.5399	2799.3777	2402.9395	1872.2656	1169.7822	635.9644	422.4167	(83)
Total gains	1294.9557	1793.3076	2382.7021	3084.6205	3574.1098	3615.5297	3446.5520	3050.6498	2540.1549	1863.7538	1373.3856	1188.2419	(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	32.7863	33.0389	33.2917	34.5330	34.7756	35.9512	35.9512	36.1777	35.4891	34.7756	34.2883	33.7933	
alpha	3.1858	3.2026	3.2194	3.3022	3.3184	3.3967	3.3967	3.4118	3.3659	3.3184	3.2859	3.2529	
util living area													
	0.9952	0.9865	0.9610	0.8846	0.7483	0.5707	0.4338	0.4990	0.7598	0.9497	0.9904	0.9964	(86)
MIT	18.9677	19.2483	19.6872	20.2530	20.6327	20.8336	20.8867	20.8742	20.7021	20.1350	19.4702	18.9696	(87)
Th 2	19.2558	19.2663	19.2767	19.3260	19.3354	19.3793	19.3793	19.3875	19.3623	19.3354	19.3165	19.2969	(88)
util rest of house													
	0.9934	0.9814	0.9463	0.8431	0.6656	0.4474	0.2819	0.3377	0.6452	0.9225	0.9861	0.9951	(89)
MIT 2	16.9708	17.3345	17.8920	18.6052	19.0166	19.2284	19.2581	19.2627	19.1251	18.4978	17.6539	17.0007	(90)
Living area fraction										fLA = Living area / (4) =		0.1056	(91)
MIT	17.1816	17.5365	18.0815	18.7792	19.1872	19.3978	19.4300	19.4328	19.2915	18.6706	17.8456	17.2085	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.1816	17.5365	18.0815	18.7792	19.1872	19.3978	19.4300	19.4328	19.2915	18.6706	17.8456	17.2085	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9899	0.9736	0.9318	0.8259	0.6571	0.4490	0.2869	0.3426	0.6392	0.9067	0.9799	0.9924	(94)
Useful gains	1281.8536	1746.0370	2220.2390	2547.6997	2348.5170	1623.2548	988.8224	1045.1125	1623.7367	1689.9038	1345.8122	1179.1816	(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													
	4988.4211	4856.0954	4416.8754	3632.2084	2733.5802	1694.3975	999.4578	1064.3745	1857.3201	2946.5677	3978.9725	4887.4644	(97)
Space heating kWh													
	2757.6862	2089.9592	1634.2975	780.8463	286.4871	0.0000	0.0000	0.0000	0.0000	934.9580	1895.8755	2758.9624	(98a)
Space heating requirement - total per year (kWh/year)												13139.0721	
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													
	2757.6862	2089.9592	1634.2975	780.8463	286.4871	0.0000	0.0000	0.0000	0.0000	934.9580	1895.8755	2758.9624	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13139.0721	
Space heating per m2											(98c) / (4) =	71.8650	(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 %)												170.0000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2757.6862	2089.9592	1634.2975	780.8463	286.4871	0.0000	0.0000	0.0000	0.0000	934.9580	1895.8755	2758.9624	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	1622.1683	1229.3878	961.3515	459.3214	168.5218	0.0000	0.0000	0.0000	0.0000	549.9753	1115.2209	1622.9191	(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													
	323.9586	286.5042	303.9405	265.6899	256.6131	230.1640	226.1586	235.5873	238.7117	267.5029	286.1253	320.1754	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	190.5639	168.5319	178.7885	156.2882	150.9489	135.3906	133.0345	138.5808	140.4187	157.3547	168.3090	188.3385	(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	44.9261	36.0413	32.4512	23.7752	18.3646	15.0041	16.7528	21.7760	28.2848	37.1112	41.9170	46.1747	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)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	(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	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)													
(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												7728.8660	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.0000	
Water heating fuel used												1906.5481	(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)												362.5790	(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)
Total delivered energy for all uses 9997.9930 (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	7728.8660	0.1558	1203.8609	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1906.5481	0.1410	268.8360	(264)
Space and water heating			1472.6969	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	362.5790	0.1443	52.3314	(268)
Total CO2, kg/year			1525.0283	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			8.3400	(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	7728.8660	1.5767	12185.7202	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1906.5481	1.5214	2900.6166	(278)
Space and water heating			15086.3368	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	362.5790	1.5338	556.1358	(282)
Total Primary energy kWh/year			15642.4725	(286)
Dwelling Primary energy Rate (DPER)			85.5600	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)			Volume (m3)	
Ground floor	88.6900	(1b)	x 2.4000	(2b)	=	212.8560	(1b) - (3b)
First floor	62.9800	(1c)	x 2.6000	(2c)	=	163.7480	(1c) - (3c)
Second floor	31.1600	(1d)	x 2.3800	(2d)	=	74.1608	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	182.8300						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	450.7648	(5)

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2. Ventilation rate
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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0887	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3387	(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) =	0.3133	(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	0.3995	0.3917	0.3838	0.3447	0.3368	0.2977	0.2977	0.2898	0.3133	0.3368	0.3525	0.3682	(22b)
Effective ac	0.5798	0.5767	0.5737	0.5594	0.5567	0.5443	0.5443	0.5420	0.5491	0.5567	0.5621	0.5678	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			3.7800	1.0000	3.7800			(26a)
TER Opening Type (Uw = 1.20)			35.9700	1.1450	41.1870			(27)
RL1 - RL4			1.8900	1.5038	2.8421			(27a)
RL5			1.3000	1.5918	2.0693			(27a)
RL6			2.7800	1.5918	4.4251			(27a)

Heat Loss Floor 1			88.6900	0.1300	11.5297	(28a)
New external wall	17.1100	3.1300	13.9800	0.1800	2.5164	(29a)
Existing wall	136.3600	29.0900	107.2700	0.1800	19.3086	(29a)
Dormer upgrade	9.8900	7.5300	2.3600	0.1800	0.4248	(29a)
Stud wall	28.9600		28.9600	0.1800	5.2128	(29a)
Existing pitch roof	26.7600	1.8900	24.8700	0.1100	2.7357	(30)
Dormer pitch	10.9000		10.9000	0.1100	1.1990	(30)
Existing flat	25.0500	4.0800	20.9700	0.1100	2.3067	(30)
New porch roof	2.6100		2.6100	0.1100	0.2871	(30)
Ceiling to loft area	31.8300		31.8300	0.1100	3.5013	(30)
Total net area of external elements Aum(A, m2)			378.1600			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.3256	(33)
Party Wall 1			39.9800	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		18.9080 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	122.2336 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	86.2466	85.7857	85.3338	83.2117	82.8146	80.9663	80.9663	80.6240	81.6783	82.8146	83.6179	84.4576	(38)
Heat transfer coeff	208.4802	208.0193	207.5675	205.4453	205.0482	203.1999	203.1999	202.8576	203.9119	205.0482	205.8515	206.6912	(39)
Average = Sum(39)m / 12 =												205.4434	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1403	1.1378	1.1353	1.1237	1.1215	1.1114	1.1114	1.1095	1.1153	1.1215	1.1259	1.1305	(40)
HLP (average)												1.1237	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9795	(42)
Hot water usage for mixer showers													
	74.1767	73.0620	71.4376	68.3296	66.0360	63.4782	62.0244	63.6365	65.4036	68.1499	71.3246	73.8925	(42a)
Hot water usage for baths													
	32.0216	31.5461	30.8764	29.6416	28.7170	27.6917	27.1379	27.8030	28.5270	29.6241	30.8843	31.9134	(42b)
Hot water usage for other uses													
	45.1433	43.5017	41.8602	40.2186	38.5770	36.9354	36.9354	38.5770	40.2186	41.8602	43.5017	45.1433	(42c)
Average daily hot water use (litres/day)												139.1169	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	151.3417	148.1098	144.1741	138.1898	133.3300	128.1054	126.0978	130.0164	134.1492	139.6342	145.7107	150.9492	(44)
Energy conte	239.6882	210.9064	221.5903	189.1749	179.4878	157.5205	152.5043	160.9875	165.4194	189.4822	207.5916	236.3500	(45)
Energy content (annual)										Total = Sum(45)m =		2310.7032	
Distribution loss (46)m = 0.15 x (45)m													
	35.9532	31.6360	33.2385	28.3762	26.9232	23.6281	22.8756	24.1481	24.8129	28.4223	31.1387	35.4525	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(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													
	286.2831	252.9921	268.1852	234.2668	226.0827	202.6124	199.0992	207.5824	210.5113	236.0771	252.6834	282.9449	(62)
WWHRS	-33.9105	-29.9907	-31.4046	-26.0042	-24.2350	-20.7381	-19.4386	-20.6710	-21.4564	-25.2947	-28.6558	-33.2825	(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													
	252.3726	223.0014	236.7806	208.2626	201.8477	181.8743	179.6606	186.9114	189.0549	210.7824	224.0276	249.6624	(64)
									Total per year (kWh/year) = Sum(64)m =			2544.2385	(64)
12Total per year (kWh/year)												2544	(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													
	116.9722	103.7949	110.9547	98.9741	96.9556	88.4491	87.9836	90.8043	91.0754	100.2788	105.0977	115.8623	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	178.7639	197.9172	178.7639	184.7227	178.7639	184.7227	178.7639	178.7639	184.7227	178.7639	184.7227	178.7639	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	354.4195	358.0973	348.8294	329.0993	304.1935	280.7856	265.1476	261.4699	270.7377	290.4679	315.3737	338.7816	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	(71)
Water heating gains (Table 5)													
	157.2208	154.4568	149.1326	137.4641	130.3167	122.8459	118.2575	122.0488	126.4937	134.7833	145.9690	155.7289	(72)
Total internal gains													
	761.0971	781.1641	747.4189	721.9790	683.9670	656.0471	629.8620	629.9754	649.6470	674.7080	716.7583	743.9673	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W

East				24.1100	19.6403	0.6300	0.7000	0.7700				144.7159	(76)
South				2.7200	46.7521	0.6300	0.7000	0.7700				38.8635	(78)
West				9.1400	19.6403	0.6300	0.7000	0.7700				54.8612	(80)
West				1.8900	26.2379	0.6300	0.7000	1.0000				19.6822	(82)
Horizontal				4.0800	26.0000	0.6300	0.7000	1.0000				42.1032	(82)
Solar gains	300.2259	581.0163	947.1124	1374.9731	1685.1996	1726.4933	1643.0306	1410.2586	1098.6773	686.3346	373.0747	247.7825	(83)
Total gains	1061.3230	1362.1805	1694.5312	2096.9520	2369.1666	2382.5404	2272.8926	2040.2341	1748.3243	1361.0426	1089.8330	991.7498	(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	60.9004	61.0353	61.1682	61.8000	61.9197	62.4829	62.4829	62.5884	62.2648	61.9197	61.6781	61.4275	
alpha	5.0600	5.0690	5.0779	5.1200	5.1280	5.1655	5.1655	5.1726	5.1510	5.1280	5.1119	5.0952	
util living area	0.9983	0.9938	0.9756	0.8988	0.7347	0.5347	0.3914	0.4530	0.7351	0.9614	0.9955	0.9988	(86)
MIT	19.5774	19.8274	20.2025	20.6458	20.9020	20.9843	20.9974	20.9947	20.9282	20.5143	19.9539	19.5397	(87)
Th 2	19.9681	19.9701	19.9721	19.9815	19.9833	19.9915	19.9915	19.9930	19.9884	19.9833	19.9797	19.9760	(88)
util rest of house	0.9977	0.9917	0.9675	0.8690	0.6746	0.4553	0.3028	0.3561	0.6523	0.9437	0.9937	0.9984	(89)
MIT 2	18.3042	18.6249	19.0993	19.6380	19.9074	19.9833	19.9908	19.9913	19.9427	19.4995	18.7946	18.2616	(90)
Living area fraction									fLA = Living area / (4) =			0.1056	(91)
MIT	18.4386	18.7518	19.2158	19.7444	20.0124	20.0890	20.0970	20.0972	20.0467	19.6067	18.9170	18.3965	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4386	18.7518	19.2158	19.7444	20.0124	20.0890	20.0970	20.0972	20.0467	19.6067	18.9170	18.3965	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9881	0.9595	0.8609	0.6764	0.4632	0.3121	0.3663	0.6575	0.9350	0.9908	0.9974	(94)
Useful gains	1057.4493	1345.9044	1625.9698	1805.1681	1602.5398	1103.4937	709.3900	747.3281	1149.5336	1272.5638	1079.8331	989.1345	(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	2947.6222	2881.4461	2639.3853	2227.9213	1704.4483	1115.3676	710.5944	750.0129	1212.6124	1846.7983	2432.5387	2934.2931	(97)
Space heating kWh	1406.2886	1031.8840	753.9811	304.3823	75.8200	0.0000	0.0000	0.0000	0.0000	427.2305	973.9480	1447.1980	(98a)
Space heating requirement - total per year (kWh/year)												6420.7325	
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	1406.2886	1031.8840	753.9811	304.3823	75.8200	0.0000	0.0000	0.0000	0.0000	427.2305	973.9480	1447.1980	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6420.7325	
Space heating per m2											(98c) / (4) =	35.1186	(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	1406.2886	1031.8840	753.9811	304.3823	75.8200	0.0000	0.0000	0.0000	0.0000	427.2305	973.9480	1447.1980	(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)	1523.6063	1117.9675	816.8810	329.7750	82.1452	0.0000	0.0000	0.0000	0.0000	462.8716	1055.1983	1567.9285	(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	252.3726	223.0014	236.7806	208.2626	201.8477	181.8743	179.6606	186.9114	189.0549	210.7824	224.0276	249.6624	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.3019	87.0552	86.4693	84.9096	82.0713	79.8000	79.8000	79.8000	79.8000	85.6102	86.9658	87.3505	(217)
Fuel for water heating, kWh/month	289.0804	256.1608	273.8319	245.2755	245.9419	227.9127	225.1386	234.2248	236.9109	246.2119	257.6042	285.8167	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	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	37.1436	29.7980	26.8298	19.6566	15.1834	12.4049	13.8508	18.0038	23.3851	30.6825	34.6558	38.1760	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-75.6650	-103.1482	-143.3705	-155.6106	-163.0892	-150.3801	-148.2873	-142.0971	-130.7601	-114.9987	-81.8202	-65.8174	(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	-54.1946	-112.4612	-220.8252	-327.9300	-430.1888	-431.1896	-426.3253	-362.7069	-268.0420	-159.8229	-71.9999	-42.9946	(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												6956.3733	(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	3024.1103	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	299.7703	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4383.7255	(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	5982.5283	(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	6956.3733	0.2100	1460.8384	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3024.1103	0.2100	635.0632	(264)
Space and water heating			2095.9015	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	299.7703	0.1443	43.2661	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1475.0444	0.1354	-199.6489	
PV Unit electricity exported	-2908.6811	0.1262	-367.1397	
Total			-566.7886	(269)
Total CO2, kg/year			1584.3083	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.6700	(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	6956.3733	1.1300	7860.7018	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3024.1103	1.1300	3417.2446	(278)
Space and water heating			11277.9464	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	299.7703	1.5338	459.7976	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1475.0444	1.5003	-2212.9756	
PV Unit electricity exported	-2908.6811	0.4633	-1347.6953	
Total			-3560.6709	(283)
Total Primary energy kWh/year			8307.1739	(286)
Target Primary Energy Rate (TPER)			45.4400	(287)

11 Appendix 1 - Be Green SAP Worksheets DER/TER

Full SAP Calculation Printout

Property Reference	12444	**Issued on Date**	18/11/2024
Assessment Reference	Be Green V2	**Prop Type Ref**	End Terrace
Property	2, Verdun Road, London, SW13 9AY		

SAP Rating	76 C	**DER**	4.84	**TER**	8.80
Environmental	95 A	**% DER < TER**			45.00
CO_2 Emissions (t/year)	0.72	**DFEE**	77.56	**TFEE**	40.90
Compliance Check	See BREL	**% DFEE < TFEE**			-89.62
% DPER < TPER	-8.34	**DPER**	50.02	**TPER**	46.17

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	88.6900 (1b)	x	2.4000 (2b)	=	212.8560	(1b) - (3b)
First floor	62.9800 (1c)	x	2.6000 (2c)	=	163.7480	(1c) - (3c)
Second floor	31.1600 (1d)	x	2.3800 (2d)	=	74.1608	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	182.8300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	450.7648	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	5 * 10 =	50.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1109	(8)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8609	(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) =	0.7964	(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	1.0154	0.9954	0.9755	0.8760	0.8561	0.7565	0.7565	0.7366	0.7964	0.8561	0.8959	0.9357	(22b)
Effective ac	1.0154	0.9955	0.9758	0.8837	0.8664	0.7862	0.7862	0.7713	0.8171	0.8664	0.9013	0.9378	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
New Windows (Uw = 1.20)			42.7400	1.1450	48.9389			(27)
Door			3.7800	1.4000	5.2920			(26a)
RL1 - RL4			2.2500	1.3258	2.9830			(27a)
RL5			1.5400	1.3258	2.0417			(27a)
RL6			3.3000	1.3258	4.3750			(27a)
Heat Loss Floor 1			88.6900	0.2500	22.1725			(28a)
New external wall	17.1100	3.3600	13.7500	0.1700	2.3375			(29a)
Existing wall	136.3600	34.2100	102.1500	0.5500	56.1825			(29a)
Dormer upgrade	9.8900	8.9500	0.9400	0.3000	0.2820			(29a)
Stud wall	28.9600		28.9600	0.1100	3.1856			(29a)
Existing pitch roof	26.7600	2.2500	24.5100	0.1600	3.9216			(30)
Dormer pitch	10.9000		10.9000	0.1600	1.7440			(30)
Existing flat	25.0500	4.8400	20.2100	0.1600	3.2336			(30)
New porch roof	2.6100		2.6100	0.1500	0.3915			(30)
Ceiling to loft area	31.8300		31.8300	0.1100	3.5013			(30)
Total net area of external elements Aum(A, m2)			378.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		160.5827			(33)
Party Wall 1			39.9800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (Default value 0.200 * total exposed area) 75.6320 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 236.2147 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	151.0358	148.0759	145.1574	131.4492	128.8845	116.9451	116.9451	114.7341	121.5440	128.8845	134.0729	139.4972	(38)
Heat transfer coeff	387.2505	384.2905	381.3720	367.6639	365.0991	353.1598	353.1598	350.9488	357.7586	365.0991	370.2876	375.7119	(39)

Average = Sum(39)m / 12 = 367.6501

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1181	2.1019	2.0859	2.0110	1.9969	1.9316	1.9316	1.9195	1.9568	1.9969	2.0253	2.0550	(40)
HLP (average)												2.0109	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9795 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	83.4488	82.1947	80.3673	76.8708	74.2905	71.4130	69.7774	71.5910	73.5791	76.6687	80.2402	83.1291	(42a)
Hot water usage for baths	32.0216	31.5461	30.8764	29.6416	28.7170	27.6917	27.1379	27.8030	28.5270	29.6241	30.8843	31.9134	(42b)
Hot water usage for other uses	45.1433	43.5017	41.8602	40.2186	38.5770	36.9354	36.9354	38.5770	40.2186	41.8602	43.5017	45.1433	(42c)

Average daily hot water use (litres/day) 147.6655 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	160.6138	157.2425	153.1038	146.7310	141.5845	136.0402	133.8508	137.9710	142.3247	148.1529	154.6263	160.1858	(44)
Energy conte	254.3729	223.9113	235.3149	200.8674	190.6000	167.2773	161.8810	170.8369	175.5006	201.0421	220.2935	250.8122	(45)

Energy content (annual) Total = Sum(45)m = 2452.7100

Distribution loss (46)m = 0.15 x (45)m	38.1559	33.5867	35.2972	30.1301	28.5900	25.0916	24.2821	25.6255	26.3251	30.1563	33.0440	37.6218	(46)

Water storage loss:
Store volume 300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.0900 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1286 (55)

Total storage loss	34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(56)
If cylinder contains dedicated solar storage	34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(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	312.6219	276.5233	293.5639	257.2374	248.8490	223.6473	220.1300	229.0859	231.8706	259.2911	276.6635	309.0612	(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	312.6219	276.5233	293.5639	257.2374	248.8490	223.6473	220.1300	229.0859	231.8706	259.2911	276.6635	309.0612	(64)

Total per year (kWh/year) = Sum(64)m = 3138.5450 (64)

12Total per year (kWh/year) 3139 (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	131.1782	116.5401	124.8414	111.8844	109.9737	100.7157	100.4246	103.4025	103.4499	113.4457	118.3436	129.9943	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	178.7639	197.9172	178.7639	184.7227	178.7639	184.7227	178.7639	178.7639	184.7227	178.7639	184.7227	178.7639	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	354.4195	358.0973	348.8294	329.0993	304.1935	280.7856	265.1476	261.4699	270.7377	290.4679	315.3737	338.7816	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	(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)	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	(71)
Water heating gains (Table 5)	176.3148	173.4228	167.7976	155.3950	147.8141	139.8829	134.9793	138.9818	143.6805	152.4808	164.3661	174.7235	(72)
Total internal gains	777.1911	797.1301	763.0838	736.9099	698.4644	673.0841	646.5838	646.9085	666.8338	689.4055	732.1554	759.9619	(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	
East	28.6500	19.6403	0.5700	0.0000	0.7700	246.9662	(76)
South	3.2400	46.7521	0.5700	0.0000	0.7700	66.4831	(78)
West	10.8500	19.6403	0.5700	0.0000	0.7700	93.5282	(80)
West	2.2500	26.2379	0.5700	1.0000	1.0000	30.2852	(82)
Horizontal	4.8400	26.0000	0.5700	1.0000	1.0000	64.5559	(82)

Solar gains	501.8186	969.8302	1578.0417	2287.0695	2800.1087	2867.5136	2729.3800	2344.6135	1829.2564	1144.8314	623.3356	414.3250	(83)
Total gains	1279.0097	1766.9604	2341.1255	3023.9794	3498.5731	3540.5977	3375.9637	2991.5220	2496.0902	1834.2368	1355.4909	1174.2869	(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	32.7863	33.0389	33.2917	34.5330	34.7756	35.9512	35.9512	36.1777	35.4891	34.7756	34.2883	33.7933	
alpha	3.1858	3.2026	3.2194	3.3022	3.3184	3.3967	3.3967	3.4118	3.3659	3.3184	3.2859	3.2529	
util living area	0.9954	0.9870	0.9628	0.8895	0.7568	0.5800	0.4419	0.5072	0.7667	0.9517	0.9908	0.9966	(86)
Living	18.9619	19.2389	19.6737	20.2382	20.6224	20.8298	20.8854	20.8724	20.6958	20.1257	19.4636	18.9644	
Non living	16.9634	17.3227	17.8757	18.5892	19.0079	19.2264	19.2578	19.2622	19.1206	18.4871	17.6457	16.9941	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	7	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	24	18	0	0	0	0	0	0	0	0	0	31	
MIT	20.1063	19.7298	19.6737	20.2382	20.6224	20.8298	20.8854	20.8724	20.6958	20.1257	19.4636	19.8471	(87)
Th 2	19.2558	19.2663	19.2767	19.3260	19.3354	19.3793	19.3793	19.3875	19.3623	19.3354	19.3165	19.2969	(88)
util rest of house	0.9936	0.9822	0.9486	0.8491	0.6749	0.4558	0.2876	0.3441	0.6529	0.9254	0.9866	0.9953	(89)
MIT 2	18.4724	18.0207	17.8757	18.5892	19.0079	19.2264	19.2578	19.2622	19.1206	18.4871	17.6457	18.2805	(90)
Living area fraction									fLA = Living area / (4) =			0.1056	(91)
MIT	18.6449	18.2011	18.0655	18.7633	19.1783	19.3956	19.4296	19.4322	19.2869	18.6600	17.8376	18.4459	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6449	18.2011	18.0655	18.7633	19.1783	19.3956	19.4296	19.4322	19.2869	18.6600	17.8376	18.4459	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9928	0.9780	0.9344	0.8319	0.6659	0.4571	0.2927	0.3489	0.6466	0.9098	0.9806	0.9944	(94)
Useful gains	1269.8426	1727.9998	2187.5733	2515.5516	2329.6460	1618.5196	987.9996	1043.7663	1613.8799	1668.8096	1329.2054	1167.6801	(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	5555.0730	5111.4798	4410.7482	3626.3637	2730.3334	1693.6251	999.3100	1064.1407	1855.6407	2942.7144	3975.9858	5352.3431	(97)
Space heating kWh	3188.2114	2273.6985	1654.0421	799.7847	298.1114	0.0000	0.0000	0.0000	0.0000	947.7851	1905.6819	3113.3893	(98a)
Space heating requirement - total per year (kWh/year)												14180.7044	
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	3188.2114	2273.6985	1654.0421	799.7847	298.1114	0.0000	0.0000	0.0000	0.0000	947.7851	1905.6819	3113.3893	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												14180.7044	
Space heating per m2										(98c) / (4) =		77.5622	(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 %) 380.7867 (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	3188.2114	2273.6985	1654.0421	799.7847	298.1114	0.0000	0.0000	0.0000	0.0000	947.7851	1905.6819	3113.3893	(98)
Space heating efficiency (main heating system 1)	380.7867	380.7867	380.7867	380.7867	380.7867	0.0000	0.0000	0.0000	0.0000	380.7867	380.7867	380.7867	(210)
Space heating fuel (main heating system)	837.2697	597.1056	434.3750	210.0349	78.2883	0.0000	0.0000	0.0000	0.0000	248.9019	500.4592	817.6204	(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	312.6219	276.5233	293.5639	257.2374	248.8490	223.6473	220.1300	229.0859	231.8706	259.2911	276.6635	309.0612	(64)
Efficiency of water heater												176.0062	(216)
(217)m	176.0062	176.0062	176.0062	176.0062	176.0062	176.0062	176.0062	176.0062	176.0062	176.0062	176.0062	176.0062	(217)
Fuel for water heating, kWh/month	177.6198	157.1100	166.7918	146.1525	141.3865	127.0678	125.0694	130.1579	131.7400	147.3193	157.1896	175.5968	(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	44.9261	36.0413	32.4512	23.7752	18.3646	15.0041	16.7528	21.7760	28.2848	37.1112	41.9170	46.1747	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)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	(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	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)													
(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 3724.0550 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 176.0062
Water heating fuel used 1783.2013 (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) 362.5790 (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)
Total delivered energy for all uses	5869.8353	(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	3724.0550	0.1562	581.5324	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1783.2013	0.1410	251.3457	(264)
Space and water heating			832.8781	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	362.5790	0.1443	52.3314	(268)
Total CO2, kg/year			885.2095	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.8400	(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	3724.0550	1.5781	5876.8904	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1783.2013	1.5212	2712.5914	(278)
Space and water heating			8589.4819	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	362.5790	1.5338	556.1358	(282)
Total Primary energy kWh/year			9145.6176	(286)
Dwelling Primary energy Rate (DPER)			50.0200	(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	88.6900 (1b)	x	2.4000 (2b)	=	212.8560	(1b) - (3b)
First floor	62.9800 (1c)	x	2.6000 (2c)	=	163.7480	(1c) - (3c)
Second floor	31.1600 (1d)	x	2.3800 (2d)	=	74.1608	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 182.8300						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	450.7648	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0887	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3387	(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) =	0.3133	(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	0.3995	0.3917	0.3838	0.3447	0.3368	0.2977	0.2977	0.2898	0.3133	0.3368	0.3525	0.3682	(22b)
Effective ac	0.5798	0.5767	0.5737	0.5594	0.5567	0.5443	0.5443	0.5420	0.5491	0.5567	0.5621	0.5678	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K

TER Semi-glazed door			3.7800	1.0000	3.7800		(26a)
TER Opening Type (Uw = 1.20)			35.9700	1.1450	41.1870		(27)
RL1 - RL4			1.8900	1.5038	2.8421		(27a)
RL5			1.3000	1.5918	2.0693		(27a)
RL6			2.7800	1.5918	4.4251		(27a)
Heat Loss Floor 1			88.6900	0.1300	11.5297		(28a)
New external wall	17.1100	3.1300	13.9800	0.1800	2.5164		(29a)
Existing wall	136.3600	29.0900	107.2700	0.1800	19.3086		(29a)
Dormer upgrade	9.8900	7.5300	2.3600	0.1800	0.4248		(29a)
Stud wall	28.9600		28.9600	0.1800	5.2128		(29a)
Existing pitch roof	26.7600	1.8900	24.8700	0.1100	2.7357		(30)
Dormer pitch	10.9000		10.9000	0.1100	1.1990		(30)
Existing flat	25.0500	4.0800	20.9700	0.1100	2.3067		(30)
New porch roof	2.6100		2.6100	0.1100	0.2871		(30)
Ceiling to loft area	31.8300		31.8300	0.1100	3.5013		(30)
Total net area of external elements Aum(A, m2)			378.1600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.3256		(33)
Party Wall 1			39.9800	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		18.9080 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	122.2336 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	86.2466	85.7857	85.3338	83.2117	82.8146	80.9663	80.9663	80.6240	81.6783	82.8146	83.6179	84.4576	(38)
Heat transfer coeff	208.4802	208.0193	207.5675	205.4453	205.0482	203.1999	203.1999	202.8576	203.9119	205.0482	205.8515	206.6912	(39)
Average = Sum(39)m / 12 =												205.4434	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1403	1.1378	1.1353	1.1237	1.1215	1.1114	1.1114	1.1095	1.1153	1.1215	1.1259	1.1305	(40)
HLP (average)												1.1237	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9795	(42)
Hot water usage for mixer showers													
	74.1767	73.0620	71.4376	68.3296	66.0360	63.4782	62.0244	63.6365	65.4036	68.1499	71.3246	73.8925	(42a)
Hot water usage for baths													
	32.0216	31.5461	30.8764	29.6416	28.7170	27.6917	27.1379	27.8030	28.5270	29.6241	30.8843	31.9134	(42b)
Hot water usage for other uses													
	45.1433	43.5017	41.8602	40.2186	38.5770	36.9354	36.9354	38.5770	40.2186	41.8602	43.5017	45.1433	(42c)
Average daily hot water use (litres/day)												139.1169	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.3417	148.1098	144.1741	138.1898	133.3300	128.1054	126.0978	130.0164	134.1492	139.6342	145.7107	150.9492	(44)
Energy conte	239.6882	210.9064	221.5903	189.1749	179.4878	157.5205	152.5043	160.9875	165.4194	189.4822	207.5916	236.3500	(45)
Energy content (annual)										Total = Sum(45)m =		2310.7032	
Distribution loss (46)m = 0.15 x (45)m													
	35.9532	31.6360	33.2385	28.3762	26.9232	23.6281	22.8756	24.1481	24.8129	28.4223	31.1387	35.4525	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1127	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1409	(55)
Total storage loss													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(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													
	298.3170	263.8614	280.2191	245.9125	238.1166	214.2581	211.1331	219.6163	222.1570	248.1111	264.3291	294.9788	(62)
WWHRS	-33.9105	-29.9907	-31.4046	-26.0042	-24.2350	-20.7381	-19.4386	-20.6710	-21.4564	-25.2947	-28.6558	-33.2825	(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	264.4065	233.8707	248.8145	219.9083	213.8817	193.5200	191.6945	198.9453	200.7006	222.8163	235.6733	261.6963	(64)
									Total per year (kWh/year) = Sum(64)m =			2685.9281	(64)
12Total per year (kWh/year)												2686	(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	126.5994	112.4904	120.5818	108.2907	106.5828	97.7656	97.6107	100.4314	100.3920	109.9059	114.4143	125.4894	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	148.9763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	178.7639	197.9172	178.7639	184.7227	178.7639	184.7227	178.7639	178.7639	184.7227	178.7639	184.7227	178.7639	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	354.4195	358.0973	348.8294	329.0993	304.1935	280.7856	265.1476	261.4699	270.7377	290.4679	315.3737	338.7816	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	37.8976	(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)	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	-119.1810	(71)
Water heating gains (Table 5)	170.1605	167.3964	162.0723	150.4038	143.2564	135.7856	131.1972	134.9884	139.4333	147.7230	158.9087	168.6686	(72)
Total internal gains	774.0368	794.1038	760.3586	734.9187	696.9067	668.9868	642.8017	642.9151	662.5867	687.6477	729.6980	756.9070	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	24.1100	19.6403	0.6300	0.7000	0.7700	144.7159	(76)
South	2.7200	46.7521	0.6300	0.7000	0.7700	38.8635	(78)
West	9.1400	19.6403	0.6300	0.7000	0.7700	54.8612	(80)
West	1.8900	26.2379	0.6300	0.7000	1.0000	19.6822	(82)
Horizontal	4.0800	26.0000	0.6300	0.7000	1.0000	42.1032	(82)

Solar gains	300.2259	581.0163	947.1124	1374.9731	1685.1996	1726.4933	1643.0306	1410.2586	1098.6773	686.3346	373.0747	247.7825	(83)
Total gains	1074.2627	1375.1201	1707.4709	2109.8917	2382.1063	2395.4801	2285.8323	2053.1738	1761.2640	1373.9823	1102.7727	1004.6895	(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	60.9004	61.0353	61.1682	61.8000	61.9197	62.4829	62.4829	62.5884	62.2648	61.9197	61.6781	61.4275	
alpha	5.0600	5.0690	5.0779	5.1200	5.1280	5.1655	5.1655	5.1726	5.1510	5.1280	5.1119	5.0952	
util living area	0.9982	0.9935	0.9749	0.8969	0.7320	0.5321	0.3893	0.4503	0.7314	0.9600	0.9953	0.9987	(86)
MIT	19.5849	19.8348	20.2092	20.6503	20.9037	20.9847	20.9975	20.9949	20.9299	20.5205	19.9613	19.5472	(87)
Th 2	19.9681	19.9701	19.9721	19.9815	19.9833	19.9915	19.9915	19.9930	19.9884	19.9833	19.9797	19.9760	(88)
util rest of house	0.9976	0.9913	0.9665	0.8667	0.6717	0.4529	0.3011	0.3539	0.6484	0.9417	0.9934	0.9983	(89)
MIT 2	18.3138	18.6342	19.1075	19.6428	19.9089	19.9835	19.9908	19.9914	19.9439	19.5068	18.8040	18.2713	(90)
Living area fraction									fLA = Living area / (4) =			0.1056	(91)
MIT	18.4480	18.7609	19.2238	19.7492	20.0139	20.0892	20.0970	20.0973	20.0480	19.6138	18.9262	18.4060	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4480	18.7609	19.2238	19.7492	20.0139	20.0892	20.0970	20.0973	20.0480	19.6138	18.9262	18.4060	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9876	0.9585	0.8587	0.6736	0.4608	0.3104	0.3640	0.6537	0.9330	0.9904	0.9972	(94)
Useful gains	1070.1341	1358.0663	1636.5709	1811.6890	1604.6908	1103.8098	709.4269	747.4171	1151.3922	1281.9652	1092.1583	1001.8863	(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	2949.5825	2883.3404	2641.0546	2228.9129	1704.7493	1115.4097	710.5995	750.0250	1212.8695	1848.2611	2434.4373	2936.2472	(97)
Space heating kWh	1398.3096	1024.9842	747.3358	300.4012	74.4435	0.0000	0.0000	0.0000	0.0000	421.3241	966.4409	1439.1645	(98a)
Space heating requirement - total per year (kWh/year)												6372.4038	
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	1398.3096	1024.9842	747.3358	300.4012	74.4435	0.0000	0.0000	0.0000	0.0000	421.3241	966.4409	1439.1645	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6372.4038	
Space heating per m2										(98c) / (4) =		34.8543	(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	1398.3096	1024.9842	747.3358	300.4012	74.4435	0.0000	0.0000	0.0000	0.0000	421.3241	966.4409	1439.1645	(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)	1514.9616	1110.4921	809.6813	325.4617	80.6538	0.0000	0.0000	0.0000	0.0000	456.4725	1047.0649	1559.2248	(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	264.4065	233.8707	248.8145	219.9083	213.8817	193.5200	191.6945	198.9453	200.7006	222.8163	235.6733	261.6963	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.2355	86.9776	86.3670	84.7597	81.9443	79.8000	79.8000	79.8000	79.8000	85.4657	86.8790	87.2854	(217)
Fuel for water heating, kWh/month	303.0952	268.8862	288.0898	259.4490	261.0085	242.5063	240.2187	249.3049	251.5045	260.7083	271.2660	299.8169	(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	37.1436	29.7980	26.8298	19.6566	15.1834	12.4049	13.8508	18.0038	23.3851	30.6825	34.6558	38.1760	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-75.6650	-103.1482	-143.3705	-155.6106	-163.0892	-150.3801	-148.2873	-142.0971	-130.7601	-114.9987	-81.8202	-65.8174	(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	-54.1946	-112.4612	-220.8252	-327.9300	-430.1888	-431.1896	-426.3253	-362.7069	-268.0420	-159.8229	-71.9999	-42.9946	(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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	6904.0128	(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	3195.8543	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	299.7703	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4383.7255	(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	6101.9119	(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	6904.0128	0.2100	1449.8427	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3195.8543	0.2100	671.1294	(264)
Space and water heating			2120.9721	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	299.7703	0.1443	43.2661	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1475.0444	0.1354	-199.6489	
PV Unit electricity exported	-2908.6811	0.1262	-367.1397	
Total			-566.7886	(269)
Total CO2, kg/year			1609.3789	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.8000	(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	6904.0128	1.1300	7801.5345	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3195.8543	1.1300	3611.3154	(278)
Space and water heating			11412.8498	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	299.7703	1.5338	459.7976	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1475.0444	1.5003	-2212.9756	
PV Unit electricity exported	-2908.6811	0.4633	-1347.6953	
Total			-3560.6709	(283)
Total Primary energy kWh/year			8442.0774	(286)
Target Primary Energy Rate (TPER)			46.1700	(287)