BASEENERGY
Building Assessments for a Sustainable Environment

Energy Statement

31 The Green
Richmond
TW9 1LX

Job number: 11206

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0	21.11.2023	ROB	PK	First 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 Arminas Panavas and in support of the planning application for the development named as 31 The Green, Richmond comprising of the conversion of an existing Grade II listed building from an office space into one dwelling falling under the requirements of Richmond 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:

It is important to note that the building is Grade II listed; as part of the refurbishment, historic and original parts of the building will be maintained and preserved (including external windows and doors) and this limits what can be achieved, particularly in terms of fabric upgrades. SAP Appendix S has been referred to for this report.

- Thermal specification exceeding Part L 2021 notional U-values
- A design which limits air permeability
- A design which limits thermal bridging
- Energy saving building services including heating controls.

- Low carbon Air Source Heat Pumps and Solar PV Panels

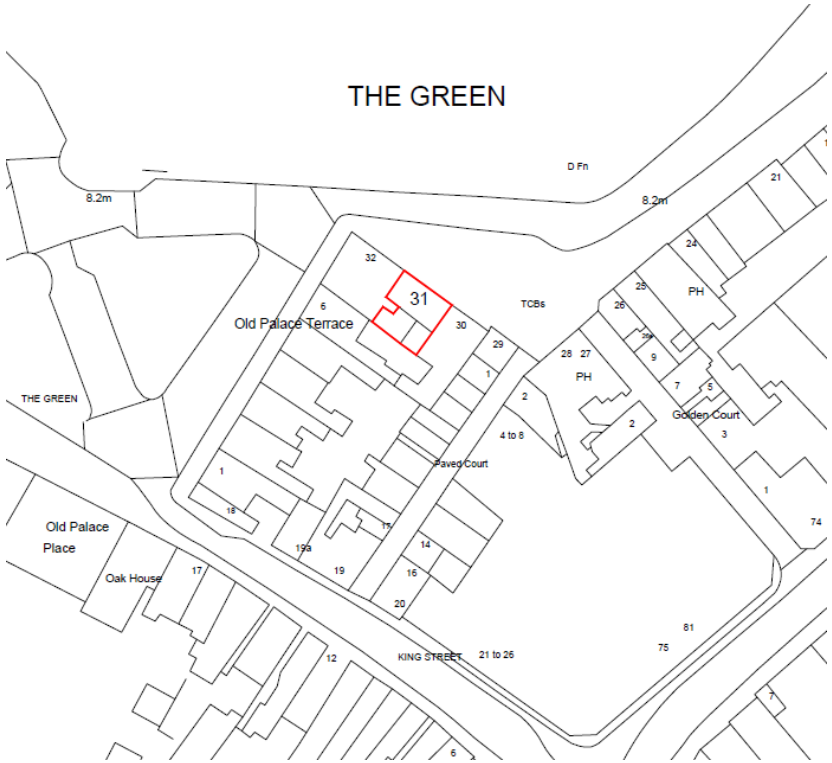
This results in a 54.46% reduction in CO2 over SAP Appendix S.

2 Existing and Proposed Development

The development site is located at 31 The Green, Richmond, TW9 1LX (see figure 1).

The development proposals are for the conversion of an existing Grade II listed building from an office space into one dwelling

The development proposals constitute a minor development.



Aspects of the site location, shape, and surroundings in particular the Grade II Listed status, along with any other requirements of planning, use type, and scale will 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).

Access and egress for the proposed dwelling will be provided from the South-East of Richmond's historic green

Figure 1: Site Location and proposals

3 Planning Policy

National Planning Policy Framework 2021

The NPPF was updated in July 2021 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.

The property is Grade II Listed and therefore under heritage restrictions, improvements to the fabric and low / zero carbon technologies are limited to the development.

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

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	4.19	145.52	609.73

The **Total Baseline CO2 Emissions** for the development are shown to be 609.73 kg/year.

We have carried out a further scenario to the dwelling based on SAP appendix S u-values to use as a baseline comparison due to heritage restrictions.

Table 6.1: SAP Appendix S Baseline CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)
Baseline	11.33	145.52	1,648.74

The **Total Baseline CO2 Emissions** for the development are shown to be 1,648.74 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.

It is important to note that the building is Grade II listed; as part of the refurbishment, historic and original parts of the building will be maintained and preserved (including external windows and doors), and this limits what can be achieved, particularly in terms of fabric upgrades. SAP 2012 Appendix S: Reduced Data SAP (RdSAP) has been referred to for this report.

Table 7.1: Building Fabric Standards (including u-values W/m²K)

	London Plan -Residential notional specifications	Part L1B Limiting Parameters	Proposed Development
Existing Wall – Front & Rear Extension	0.30	0.30	1.65
Existing Wall - Rear	0.30	0.30	0.81
Ground Floor	0.25	0.25	0.55
Roof	0.16	0.16	0.29
Windows	1.6	1.6	4.80
Doors	1.4	1.4	3.00

- Insulation: The specified building envelope is designed to meet the notional Part L targets were feasible. Due to heritage restrictions, Part L u-values cannot be met.
- 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 75 lumens per watt
- Space & Water Heating: Air Source Heat Pump
- Heating Controls: Comprising: Comprising time & temperature zone control

- Ventilation: Mechanical Ventilation – natural intermittent extract fans

Table 7.1: Baseline vs Be Lean CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)	Reduction in CO2
Part L Baseline	4.19	145.52	609.73	N/A
Be Lean	8.6	145.52	1,251	**-105.25%**

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 1,251 kg/year.

Table 7.2: SAP Appendix S vs Be Lean CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)	Reduction in CO2
SAP Appendix S Baseline	11.33	145.52	1,648.74	N/A
Be Lean	8.6	145.52	1,251	**24.12%**

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 1,251 kg/year.

8 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, however this will need to be checked with an installer

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.

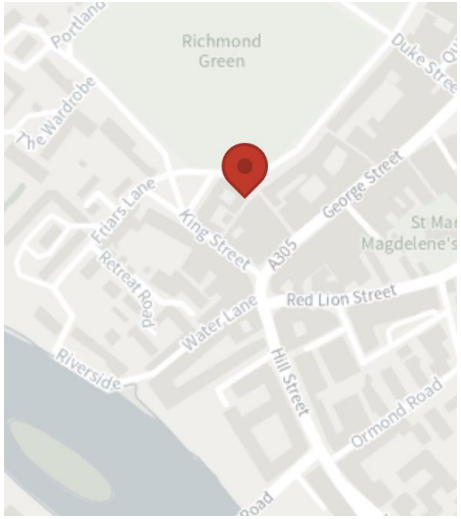
- Carbon emissions are cyclical unlike fossil fuel
- Requires fuel storage space and bulk delivery
- Carbon 'neutral' fuel in isolation but supply side emissions are still present so not neutral overall
- Harmful particulate emissions impact air quality and health

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 this will need to be checked with an installer.

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 PV would be potentially feasible. The following low carbon technology is recommended:

ASHP and solar PV

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. The location and feasibility of the systems should be further checked with planning, the heritage consultant and an installer.

Solar PV – 5.25kW with the orientation being horizontal, little or none overshading

9 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 9.1: 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
Part L Baseline	4.19	145.52	609.73	N/A
Be Green Design	5.16	145.52	750.88	**-23.15%**

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 750.88 kg/year.

Table 9.2: SAP Appendix S 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
SAP Appendix S Baseline	11.33	145.52	1,648.74	N/A
Be Green Design	5.16	145.52	750.88	**54.46%**

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 750.88 kg/year.

10 Conclusion

Proposals are for the development named as 31 The Green, Richmond, TW9 1LX comprising of the conversion of an existing Grade II listed building from an office space into one dwelling falling under the requirements of Richmond 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 energy efficient services. Low carbon technology will be incorporated and is to comprise of an air source heat pump and solar PV.

Solar PV – 5.25kW with the orientation being horizontal, little or none overshading

As previously advised, it is important to note that the building is Grade II listed; as part of the refurbishment, historic and original parts of the building will be maintained and preserved (including external windows and doors), and this limits what can be achieved, particularly in terms of fabric upgrades. This means there is no reduction in CO2 over the Baseline Notional Specifications, therefore we have used the SAP 2012 Appendix S: Reduced Data SAP (RdSAP) to compare the proposed dwelling due to he historic restrictions to the site.

This results in a 54.46% reduction in CO2 over SAP Appendix S.

11 Appendix 1 - Notional SAP Worksheets DER/TER

Full SAP Calculation Printout

Property Reference	11206	**Issued on Date**	15/12/2023
Assessment Reference	Notional	**Prop Type Ref**	Grade 2 listed Mid Terrace
Property	31, The Green, Richmond, TW9 1LX		

SAP Rating	80 C	**DER**	4.19	**TER**	9.36
Environmental	96 A	**% DER < TER**			55.24
CO_2 Emissions (t/year)	0.5	**DFEE**	57.06	**TFEE**	36.71
Compliance Check	See BREL	**% DFEE < TFEE**			-55.42
% DPER < TPER	10.90	**DPER**	43.47	**TPER**	48.79

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	57.6400 (1b)	x	2.3000 (2b)	=	132.5720	(1b) - (3b)
First floor	43.9400 (1c)	x	2.7000 (2c)	=	118.6380	(1c) - (3c)
Second floor	43.9400 (1d)	x	2.7000 (2d)	=	118.6380	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	145.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	369.8480	(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	3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.0811	(8)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8311	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.7064	(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	0.9007	0.8831	0.8654	0.7771	0.7594	0.6711	0.6711	0.6535	0.7064	0.7594	0.7948	0.8301	(22b)
Effective ac	0.9056	0.8899	0.8745	0.8019	0.7884	0.7252	0.7252	0.7135	0.7495	0.7884	0.8158	0.8445	(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	
Door			1.8000	1.4000	2.5200			(26)
Windows (Uw = 1.60)			34.0700	1.5038	51.2331			(27)
Heat Loss Floor 1			57.6400	0.2500	14.4100			(28a)
Existing Solid Brick Front	73.3800	16.6800	56.7000	0.3000	17.0100			(29a)
Existing Solid Brick Rear	45.1200	11.5500	33.5700	0.3000	10.0710			(29a)
Existing Extension Wall	17.3200	7.6400	9.6800	0.3000	2.9040			(29a)
Flat Roof	57.6400		57.6400	0.1600	9.2224			(30)
Total net area of external elements Aum(A, m2)			251.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		107.3705			(33)
Party Wall 1			108.4100	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)	12.5550	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	119.9255	(37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m	110.5343	108.6117	106.7273	97.8762	96.2201	88.5111	88.5111	87.0835	91.4805	96.2201	99.5702	103.0726	(38)
Heat transfer coeff													
	230.4597	228.5372	226.6528	217.8016	216.1456	208.4366	208.4366	207.0089	211.4060	216.1456	219.4957	222.9981	(39)
Average = Sum(39)m / 12 =												217.7937	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5837	1.5705	1.5575	1.4967	1.4853	1.4324	1.4324	1.4225	1.4528	1.4853	1.5084	1.5324	(40)
HLP (average)												1.4967	
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												2.9269	(42)
Hot water usage for mixer showers													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths													
	84.5513	83.2956	81.5273	78.2669	75.8255	73.1184	71.6562	73.4121	75.3240	78.2207	81.5482	84.2654	(42b)
Hot water usage for other uses													
	44.6048	42.9828	41.3608	39.7388	38.1168	36.4948	36.4948	38.1168	39.7388	41.3608	42.9828	44.6048	(42c)
Average daily hot water use (litres/day)												118.9422	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	129.1561	126.2784	122.8881	118.0057	113.9423	109.6132	108.1510	111.5289	115.0628	119.5815	124.5310	128.8702	(44)
Energy conte	204.5517	179.8187	188.8744	161.5439	153.3883	134.7823	130.7993	138.0961	141.8839	162.2709	177.4173	201.7796	(45)
Energy content (annual)										Total = Sum(45)m =		1975.2064	
Distribution loss (46)m = 0.15 x (45)m													
	30.6827	26.9728	28.3312	24.2316	23.0082	20.2173	19.6199	20.7144	21.2826	24.3406	26.6126	30.2669	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8600	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0044	(55)
Total storage loss													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(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													
	258.9505	228.9531	243.2732	214.1879	207.7871	187.4263	185.1981	192.4949	194.5279	216.6697	230.0613	256.1784	(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													
	258.9505	228.9531	243.2732	214.1879	207.7871	187.4263	185.1981	192.4949	194.5279	216.6697	230.0613	256.1784	(64)
										Total per year (kWh/year) = Sum(64)m =		2615.7084	(64)
12Total per year (kWh/year)												2616	(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													
	111.5325	99.0972	106.3198	95.8285	94.5206	86.9303	87.0098	89.4360	89.2916	97.4741	101.1064	110.6108	(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	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	159.1868	176.2425	159.1868	164.4930	159.1868	164.4930	159.1868	159.1868	164.4930	159.1868	164.4930	159.1868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	315.6056	318.8806	310.6277	293.0583	270.8800	250.0356	236.1102	232.8352	241.0881	258.6576	280.8358	301.6802	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	(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)													
	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	(71)
Water heating gains (Table 5)													
	149.9092	147.4661	142.9029	133.0952	127.0439	120.7365	116.9487	120.2097	124.0161	131.0136	140.4256	148.6704	(72)
Total internal gains													
	691.6057	709.4933	679.6215	657.5505	624.0147	602.1692	579.1498	579.1358	596.5013	615.7620	652.6585	676.4415	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	14.8800	11.2829	0.7600	1.0000	0.7700	88.4244	(75)
Southwest	11.5500	36.7938	0.7600	1.0000	0.7700	223.8225	(79)
Northwest	7.6400	11.2829	0.7600	1.0000	0.7700	45.4007	(81)

Solar gains	357.6476	653.6575	1012.4333	1452.3583	1807.4002	1873.7866	1773.4640	1496.4393	1162.8643	754.2657	436.4744	300.8338	(83)
Total gains	1049.2533	1363.1508	1692.0548	2109.9088	2431.4150	2475.9558	2352.6138	2075.5751	1759.3656	1370.0277	1089.1329	977.2752	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	43.8495	44.2184	44.5861	46.3980	46.7535	48.4826	48.4826	48.8170	47.8017	46.7535	46.0399	45.3168	
alpha	3.9233	3.9479	3.9724	4.0932	4.1169	4.2322	4.2322	4.2545	4.1868	4.1169	4.0693	4.0211	
util living area													
	0.9956	0.9874	0.9640	0.8816	0.7216	0.5199	0.3854	0.4496	0.7251	0.9448	0.9902	0.9967	(86)

Living	19.0856	19.4034	19.8648	20.4628	20.8225	20.9672	20.9927	20.9866	20.8723	20.3380	19.6360	19.0907	
Non living	17.4449	17.8549	18.4396	19.1846	19.5661	19.7227	19.7367	19.7422	19.6461	19.0679	18.1839	17.4757	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	4	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	27	0	0	0	0	0	0	0	0	0	0	28	
MIT	20.0556	19.4034	19.8648	20.4628	20.8225	20.9672	20.9927	20.9866	20.8723	20.3380	19.6360	19.8385	(87)
Th 2	19.6253	19.6350	19.6446	19.6900	19.6985	19.7386	19.7386	19.7461	19.7231	19.6985	19.6812	19.6633	(88)
util rest of house	0.9940	0.9831	0.9514	0.8444	0.6499	0.4254	0.2772	0.3316	0.6268	0.9187	0.9861	0.9955	(89)
MIT 2	18.7871	17.8549	18.4396	19.1846	19.5661	19.7227	19.7367	19.7422	19.6461	19.0679	18.1839	18.5795	(90)
Living area fraction										fLA = Living area / (4) =		0.1440	(91)
MIT	18.9697	18.0778	18.6448	19.3686	19.7470	19.9018	19.9175	19.9213	19.8227	19.2507	18.3929	18.7607	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9697	18.0778	18.6448	19.3686	19.7470	19.9018	19.9175	19.9213	19.8227	19.2507	18.3929	18.7607	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9930	0.9756	0.9388	0.8335	0.6528	0.4381	0.2928	0.3485	0.6354	0.9067	0.9800	0.9944	(94)
Useful gains	1041.8861	1329.8527	1588.5037	1758.6560	1587.2546	1084.6631	688.7495	723.4128	1117.8363	1242.2249	1067.2982	971.7966	(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	3380.7794	3011.6273	2752.6547	2280.0777	1739.3138	1105.0977	691.4965	728.9486	1209.8034	1869.8149	2478.7475	3247.0184	(97)
Space heating kWh	1740.1366	1130.1525	866.1283	375.4236	113.1321	0.0000	0.0000	0.0000	0.0000	466.9270	1016.2435	1692.7650	(98a)
Space heating requirement - total per year (kWh/year)												7400.9087	
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	1740.1366	1130.1525	866.1283	375.4236	113.1321	0.0000	0.0000	0.0000	0.0000	466.9270	1016.2435	1692.7650	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7400.9087	
Space heating per m2											(98c) / (4) =	50.8584	(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 %)												319.5788	(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	1740.1366	1130.1525	866.1283	375.4236	113.1321	0.0000	0.0000	0.0000	0.0000	466.9270	1016.2435	1692.7650	(98)
Space heating efficiency (main heating system 1)	319.5788	319.5788	319.5788	319.5788	319.5788	0.0000	0.0000	0.0000	0.0000	319.5788	319.5788	319.5788	(210)
Space heating fuel (main heating system)	544.5093	353.6381	271.0218	117.4745	35.4004	0.0000	0.0000	0.0000	0.0000	146.1070	317.9946	529.6862	(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	258.9505	228.9531	243.2732	214.1879	207.7871	187.4263	185.1981	192.4949	194.5279	216.6697	230.0613	256.1784	(64)
Efficiency of water heater												186.6586	(216)
(217)m	186.6586	186.6586	186.6586	186.6586	186.6586	186.6586	186.6586	186.6586	186.6586	186.6586	186.6586	186.6586	(217)
Fuel for water heating, kWh/month	138.7295	122.6588	130.3306	114.7485	111.3193	100.4113	99.2176	103.1267	104.2159	116.0781	123.2525	137.2444	(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	43.3767	34.7984	31.3321	22.9552	17.7313	14.4866	16.1751	21.0250	27.3094	35.8314	40.4715	44.5823	(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	2315.8319	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	186.6586	
Water heating fuel used	1401.3331	(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)	350.0749	(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	4067.2399	(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	2315.8319	0.1565	362.5017	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1401.3331	0.1408	197.3777	(264)
Space and water heating			559.8794	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	350.0749	0.1443	50.5266	(268)
Total CO2, kg/year			610.4061	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.1900	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2315.8319	1.5795	3657.7852	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1401.3331	1.5208	2131.1605	(278)
Space and water heating			5788.9458	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	350.0749	1.5338	536.9566	(282)
Total Primary energy kWh/year			6325.9024	(286)
Dwelling Primary energy Rate (DPER)			43.4700	(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	57.6400	(1b)	x 2.3000	(2b) =	132.5720	(1b) - (3b)
First floor	43.9400	(1c)	x 2.7000	(2c) =	118.6380	(1c) - (3c)
Second floor	43.9400	(1d)	x 2.7000	(2d) =	118.6380	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	145.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		369.8480	(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) =	0.1082	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3582	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3044	(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	0.3881	0.3805	0.3729	0.3349	0.3273	0.2892	0.2892	0.2816	0.3044	0.3273	0.3425	0.3577	(22b)
Effective ac	0.5753	0.5724	0.5695	0.5561	0.5536	0.5418	0.5418	0.5396	0.5463	0.5536	0.5586	0.5640	(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			1.8000	1.0000	1.8000			(26)
TER Opening Type (Uw = 1.20)			34.0700	1.1450	39.0115			(27)
Heat Loss Floor 1			57.6400	0.1300	7.4932			(28a)
Existing Solid Brick Front	73.3800	16.6800	56.7000	0.1800	10.2060			(29a)
Existing Solid Brick Rear	45.1200	11.5500	33.5700	0.1800	6.0426			(29a)
Existing Extension Wall	17.3200	7.6400	9.6800	0.1800	1.7424			(29a)
Flat Roof	57.6400		57.6400	0.1100	6.3404			(30)
Total net area of external elements Aum(A, m2)			251.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.6361			(33)
Party Wall 1			108.4100	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	21.3200	0.0500	1.0660
E3 Sill	20.4200	0.0500	1.0210
E4 Jamb	65.2000	0.0500	3.2600
E5 Ground floor (normal)	20.7600	0.1600	3.3216
E6 Intermediate floor within a dwelling	29.5400	0.0000	0.0000
E18 Party wall between dwellings	30.8000	0.0600	1.8480

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.5166 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.1527 (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	70.2189	69.8618	69.5119	67.8682	67.5607	66.1291	66.1291	65.8640	66.6806	67.5607	68.1828	68.8332	(38)
Heat transfer coeff	153.3715	153.0145	152.6646	151.0209	150.7134	149.2818	149.2818	149.0167	149.8332	150.7134	151.3355	151.9859	(39)

Average = Sum(39)m / 12 = 151.0194

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0540	1.0515	1.0491	1.0378	1.0357	1.0259	1.0259	1.0240	1.0296	1.0357	1.0400	1.0444	(40)
HLP (average)												1.0378	
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 2.9269 (42)
Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

84.5513	83.2956	81.5273	78.2669	75.8255	73.1184	71.6562	73.4121	75.3240	78.2207	81.5482	84.2654	(42b)

Hot water usage for other uses

44.6048	42.9828	41.3608	39.7388	38.1168	36.4948	36.4948	38.1168	39.7388	41.3608	42.9828	44.6048	(42c)

Average daily hot water use (litres/day) 118.9422 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.1561	126.2784	122.8881	118.0057	113.9423	109.6132	108.1510	111.5289	115.0628	119.5815	124.5310	128.8702	(44)
Energy conte	204.5517	179.8187	188.8744	161.5439	153.3883	134.7823	130.7993	138.0961	141.8839	162.2709	177.4173	201.7796	(45)
Energy content (annual)											Total = Sum(45)m =	1975.2064	
Distribution loss (46)m = 0.15 x (45)m	30.6827	26.9728	28.3312	24.2316	23.0082	20.2173	19.6199	20.7144	21.2826	24.3406	26.6126	30.2669	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9188 (55)
Total storage loss

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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

256.2982	226.5576	240.6210	211.6212	205.1349	184.8596	182.5459	189.8427	191.9613	214.0175	227.4946	253.5262	(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	256.2982	226.5576	240.6210	211.6212	205.1349	184.8596	182.5459	189.8427	191.9613	214.0175	227.4946	253.5262	(64)

Total per year (kWh/year) = Sum(64)m = 2584.4807 (64)
12Total per year (kWh/year) 2584 (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

109.4107	97.1808	104.1980	93.7752	92.3989	84.8770	84.8880	87.3142	87.2383	95.3524	99.0531	108.4890	(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	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	159.1868	176.2425	159.1868	164.4930	159.1868	164.4930	159.1868	159.1868	164.4930	159.1868	164.4930	159.1868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	315.6056	318.8806	310.6277	293.0583	270.8800	250.0356	236.1102	232.8352	241.0881	258.6576	280.8358	301.6802	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	(69)
Pumps, fans 3.0000	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)	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	(71)
Water heating gains (Table 5)	147.0574	144.6143	140.0511	130.2434	124.1920	117.8847	114.0968	117.3578	121.1643	128.1618	137.5738	145.8186	(72)
Total internal gains	691.7538	709.6415	679.7696	657.6987	624.1629	599.3174	576.2979	576.2839	593.6495	615.9102	652.8067	676.5896	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	14.8800	11.2829	0.6300	0.7000	0.7700	51.3094	(75)
Southwest	11.5500	36.7938	0.6300	0.7000	0.7700	129.8760	(79)
Northwest	7.6400	11.2829	0.6300	0.7000	0.7700	26.3444	(81)

Solar gains	207.5297	379.2933	587.4778	842.7500	1048.7678	1087.2893	1029.0758	868.3286	674.7673	437.6726	253.2700	174.5627	(83)
Total gains	899.2836	1088.9348	1267.2474	1500.4487	1672.9307	1686.6067	1605.3738	1444.6126	1268.4168	1053.5828	906.0767	851.1524	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.8894	66.0431	66.1945	66.9150	67.0515	67.6945	67.6945	67.8149	67.4454	67.0515	66.7759	66.4901	
alpha	5.3926	5.4029	5.4130	5.4610	5.4701	5.5130	5.5130	5.5210	5.4964	5.4701	5.4517	5.4327	
util living area	0.9977	0.9932	0.9785	0.9153	0.7621	0.5555	0.4074	0.4704	0.7484	0.9596	0.9942	0.9983	(86)
MIT	19.7523	19.9633	20.2694	20.6586	20.9047	20.9861	20.9979	20.9955	20.9363	20.5814	20.0959	19.7204	(87)
Th 2	20.0386	20.0406	20.0426	20.0520	20.0537	20.0618	20.0618	20.0634	20.0587	20.0537	20.0502	20.0465	(88)
util rest of house	0.9969	0.9910	0.9714	0.8896	0.7058	0.4788	0.3215	0.3768	0.6702	0.9418	0.9919	0.9977	(89)
MIT 2	18.5788	18.8494	19.2371	19.7148	19.9782	20.0544	20.0612	20.0618	20.0174	19.6361	19.0267	18.5437	(90)
Living area fraction										fLA = Living area / (4) =		0.1440	(91)
MIT	18.7478	19.0097	19.3857	19.8507	20.1116	20.1885	20.1960	20.1963	20.1497	19.7722	19.1806	18.7131	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7478	19.0097	19.3857	19.8507	20.1116	20.1885	20.1960	20.1963	20.1497	19.7722	19.1806	18.7131	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9954	0.9876	0.9650	0.8832	0.7095	0.4894	0.3339	0.3902	0.6784	0.9349	0.9889	0.9965	(94)
Useful gains	895.1421	1075.3949	1222.8904	1325.2303	1186.9575	825.4719	535.9712	563.7559	860.4549	985.0394	896.0164	848.1841	(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	2215.8749	2158.9954	1967.1963	1653.7844	1267.7356	834.2618	536.8236	565.7049	906.4455	1382.3721	1828.2250	2205.7880	(97)
Space heating kWh	982.6252	728.1795	553.7636	236.5590	60.0989	0.0000	0.0000	0.0000	0.0000	295.6155	671.1902	1010.0573	(98a)
Space heating requirement - total per year (kWh/year)												4538.0893	
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	982.6252	728.1795	553.7636	236.5590	60.0989	0.0000	0.0000	0.0000	0.0000	295.6155	671.1902	1010.0573	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4538.0893	
Space heating per m2											(98c) / (4) =	31.1853	(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	982.6252	728.1795	553.7636	236.5590	60.0989	0.0000	0.0000	0.0000	0.0000	295.6155	671.1902	1010.0573	(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)	1064.5994	788.9269	599.9606	256.2936	65.1126	0.0000	0.0000	0.0000	0.0000	320.2768	727.1833	1094.3199	(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	256.2982	226.5576	240.6210	211.6212	205.1349	184.8596	182.5459	189.8427	191.9613	214.0175	227.4946	253.5262	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7754	86.4854	85.8666	84.3102	81.6757	79.8000	79.8000	79.8000	79.8000	84.7844	86.3351	86.8350	(217)
Fuel for water heating, kWh/month	295.3581	261.9605	280.2264	251.0031	251.1578	231.6536	228.7542	237.8981	240.5530	252.4255	263.5017	291.9631	(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	33.0759	26.5347	23.8915	17.5040	13.5206	11.0464	12.3339	16.0321	20.8241	27.3223	30.8605	33.9951	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-53.3701	-74.9622	-107.3290	-120.1358	-129.0055	-120.1111	-118.5046	-112.0618	-100.7270	-85.3317	-58.5258	-46.1642	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-31.0262	-65.1633	-129.3633	-194.1192	-256.5683	-257.8536	-254.9385	-216.0125	-158.4561	-93.2760	-41.4425	-24.5532	(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	4916.6731	(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	3086.4553	(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)	266.9412	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2849.0014	(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	5507.0681	(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	4916.6731	0.2100	1032.5013	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3086.4553	0.2100	648.1556	(264)
Space and water heating			1680.6570	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	266.9412	0.1443	38.5279	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1126.2287	0.1347	-151.6970	
PV Unit electricity exported	-1722.7727	0.1259	-216.9173	
Total			-368.6143	(269)
Total CO2, kg/year			1362.4998	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.3600	(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	4916.6731	1.1300	5555.8406	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3086.4553	1.1300	3487.6944	(278)
Space and water heating			9043.5350	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	266.9412	1.5338	409.4433	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1126.2287	1.4978	-1686.8822	
PV Unit electricity exported	-1722.7727	0.4622	-796.2353	
Total			-2483.1174	(283)
Total Primary energy kWh/year			7099.9617	(286)
Target Primary Energy Rate (TPER)			48.7900	(287)

12 Appendix 1 - SAP Appendix S SAP Worksheets DER/TER

Full SAP Calculation Printout

Property Reference	11206	**Issued on Date**	15/12/2023
Assessment Reference	SAP App S	**Prop Type Ref**	Grade 2 listed Mid Terrace
Property	31, The Green, Richmond, TW9 1LX		

SAP Rating	46 E	**DER**	11.33	**TER**	9.36
Environmental	89 B	**% DER < TER**			-21.05
CO_2 Emissions (t/year)	1.33	**DFEE**	145.69	**TFEE**	36.71
Compliance Check	See BREL	**% DFEE < TFEE**			-296.86
% DPER < TPER	-138.07	**DPER**	116.15	**TPER**	48.79

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	57.6400 (1b)	x	2.3000 (2b)	=	132.5720	(1b) - (3b)
First floor	43.9400 (1c)	x	2.7000 (2c)	=	118.6380	(1c) - (3c)
Second floor	43.9400 (1d)	x	2.7000 (2d)	=	118.6380	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	145.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	369.8480	(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	3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.0811	(8)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8311	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.7064	(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	0.9007	0.8831	0.8654	0.7771	0.7594	0.6711	0.6711	0.6535	0.7064	0.7594	0.7948	0.8301	(22b)
Effective ac	0.9056	0.8899	0.8745	0.8019	0.7884	0.7252	0.7252	0.7135	0.7495	0.7884	0.8158	0.8445	(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	
Door			1.8000	3.0000	5.4000			(26)
Windows (Uw = 4.80)			34.0700	4.0268	137.1946			(27)
Heat Loss Floor 1			57.6400	0.5500	31.7020			(28a)
Existing Solid Brick Front	73.3800	16.6800	56.7000	2.1000	119.0700			(29a)
Existing Solid Brick Rear	45.1200	11.5500	33.5700	2.1000	70.4970			(29a)
Existing Extension Wall	17.3200	7.6400	9.6800	0.6000	5.8080			(29a)
Flat Roof	57.6400		57.6400	0.6800	39.1952			(30)
Total net area of external elements Aum(A, m2)			251.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		408.8668			(33)
Party Wall 1			108.4100	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)							12.5550	(36)
Point Thermal bridges						(36a) =	0.0000	
Total fabric heat loss					(33) + (36) + (36a) =		421.4218	(37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m	110.5343	108.6117	106.7273	97.8762	96.2201	88.5111	88.5111	87.0835	91.4805	96.2201	99.5702	103.0726	(38)
Heat transfer coeff													
	531.9561	530.0336	528.1491	519.2980	517.6420	509.9329	509.9329	508.5053	512.9023	517.6420	520.9921	524.4945	(39)
Average = Sum(39)m / 12 =												519.2901	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.6556	3.6423	3.6294	3.5686	3.5572	3.5042	3.5042	3.4944	3.5246	3.5572	3.5802	3.6043	(40)
HLP (average)												3.5685	
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												2.9269	(42)
Hot water usage for mixer showers													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths													
	84.5513	83.2956	81.5273	78.2669	75.8255	73.1184	71.6562	73.4121	75.3240	78.2207	81.5482	84.2654	(42b)
Hot water usage for other uses													
	44.6048	42.9828	41.3608	39.7388	38.1168	36.4948	36.4948	38.1168	39.7388	41.3608	42.9828	44.6048	(42c)
Average daily hot water use (litres/day)												118.9422	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	129.1561	126.2784	122.8881	118.0057	113.9423	109.6132	108.1510	111.5289	115.0628	119.5815	124.5310	128.8702	(44)
Energy conte	204.5517	179.8187	188.8744	161.5439	153.3883	134.7823	130.7993	138.0961	141.8839	162.2709	177.4173	201.7796	(45)
Energy content (annual)										Total = Sum(45)m =		1975.2064	
Distribution loss (46)m = 0.15 x (45)m													
	30.6827	26.9728	28.3312	24.2316	23.0082	20.2173	19.6199	20.7144	21.2826	24.3406	26.6126	30.2669	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8600	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0044	(55)
Total storage loss													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(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													
	258.9505	228.9531	243.2732	214.1879	207.7871	187.4263	185.1981	192.4949	194.5279	216.6697	230.0613	256.1784	(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													
	258.9505	228.9531	243.2732	214.1879	207.7871	187.4263	185.1981	192.4949	194.5279	216.6697	230.0613	256.1784	(64)
										Total per year (kWh/year) = Sum(64)m =		2615.7084	(64)
12Total per year (kWh/year)												2616	(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													
	111.5325	99.0972	106.3198	95.8285	94.5206	86.9303	87.0098	89.4360	89.2916	97.4741	101.1064	110.6108	(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	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	159.1868	176.2425	159.1868	164.4930	159.1868	164.4930	159.1868	159.1868	164.4930	159.1868	164.4930	159.1868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	315.6056	318.8806	310.6277	293.0583	270.8800	250.0356	236.1102	232.8352	241.0881	258.6576	280.8358	301.6802	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	(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)													
	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	(71)
Water heating gains (Table 5)													
	149.9092	147.4661	142.9029	133.0952	127.0439	120.7365	116.9487	120.2097	124.0161	131.0136	140.4256	148.6704	(72)
Total internal gains													
	691.6057	709.4933	679.6215	657.5505	624.0147	602.1692	579.1498	579.1358	596.5013	615.7620	652.6585	676.4415	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	14.8800	11.2829	0.8500	0.7000	0.7700	69.2270	(75)
Southwest	11.5500	36.7938	0.8500	0.7000	0.7700	175.2295	(79)
Northwest	7.6400	11.2829	0.8500	0.7000	0.7700	35.5440	(81)

Solar gains	280.0005	511.7450	792.6287	1137.0437	1415.0041	1466.9777	1388.4357	1171.5545	910.4003	590.5106	341.7135	235.5212	(83)
Total gains	971.6061	1221.2383	1472.2502	1794.5942	2039.0189	2069.1469	1967.5854	1750.6903	1506.9017	1206.2726	994.3720	911.9627	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	18.9970	19.0659	19.1339	19.4600	19.5223	19.8174	19.8174	19.8731	19.7027	19.5223	19.3968	19.2672	
alpha	2.2665	2.2711	2.2756	2.2973	2.3015	2.3212	2.3212	2.3249	2.3135	2.3015	2.2931	2.2845	
util living area													
	0.9941	0.9896	0.9810	0.9592	0.9152	0.8370	0.7433	0.7926	0.9153	0.9750	0.9909	0.9950	(86)

Living	16.9951	17.2888	17.8466	18.6670	19.4903	20.2103	20.5973	20.5088	19.8894	18.8454	17.8053	16.9762	
Non living	14.1969	14.5731	15.2850	16.3270	17.3329	18.1369	18.4477	18.4117	17.8369	16.5695	15.2435	14.1787	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	0	0	0	0	0	0	0	22	31	
16 / 9	0	0	0	30	0	0	0	0	0	8	8	0	
MIT	21.0000	21.0000	21.0000	19.6787	19.4903	20.2103	20.5973	20.5088	19.8894	19.0865	20.5175	21.0000	(87)
Th 2	18.4580	18.4632	18.4683	18.4927	18.4973	18.5191	18.5191	18.5232	18.5106	18.4973	18.4879	18.4783	(88)
util rest of house	0.9916	0.9851	0.9719	0.9365	0.8565	0.6867	0.4426	0.5206	0.8237	0.9567	0.9861	0.9928	(89)
MIT 2	18.4580	18.4632	18.4683	17.5367	17.3329	18.1369	18.4477	18.4117	17.8369	16.8474	18.1060	18.4783	(90)
Living area fraction										fLA = Living area / (4) =		0.1440	(91)
MIT	18.8240	18.8284	18.8328	17.8450	17.6435	18.4354	18.7572	18.7136	18.1324	17.1698	18.4532	18.8413	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8240	18.8284	18.8328	17.8450	17.6435	18.4354	18.7572	18.7136	18.1324	17.1698	18.4532	18.8413	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9920	0.9859	0.9736	0.9278	0.8238	0.6790	0.4843	0.5527	0.7992	0.9386	0.9860	0.9932	(94)
Useful gains	963.8663	1204.0648	1433.3110	1665.0796	1679.8373	1404.9160	952.9224	967.6360	1204.3524	1132.2020	980.4709	905.7748	(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	7726.1267	7382.5329	6513.5539	4645.1369	3076.5924	1955.8088	1100.0281	1176.4974	2068.2405	3400.7788	5914.9180	7679.2977	(97)
Space heating kWh	5031.1218	4151.9306	3779.7007	2145.6413	1039.1858	0.0000	0.0000	0.0000	0.0000	1687.8211	3552.8019	5039.5010	(98a)
Space heating requirement - total per year (kWh/year)												26427.7041	
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	5031.1218	4151.9306	3779.7007	2145.6413	1039.1858	0.0000	0.0000	0.0000	0.0000	1687.8211	3552.8019	5039.5010	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												26427.7041	
Space heating per m2											(98c) / (4) =	181.6087	(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 %)												291.8794	(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	5031.1218	4151.9306	3779.7007	2145.6413	1039.1858	0.0000	0.0000	0.0000	0.0000	1687.8211	3552.8019	5039.5010	(98)
Space heating efficiency (main heating system 1)	291.8794	291.8794	291.8794	291.8794	291.8794	0.0000	0.0000	0.0000	0.0000	291.8794	291.8794	291.8794	(210)
Space heating fuel (main heating system)	1723.6991	1422.4818	1294.9531	735.1124	356.0326	0.0000	0.0000	0.0000	0.0000	578.2598	1217.2159	1726.5699	(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	258.9505	228.9531	243.2732	214.1879	207.7871	187.4263	185.1981	192.4949	194.5279	216.6697	230.0613	256.1784	(64)
Efficiency of water heater												187.8219	(216)
(217)m	187.8219	187.8219	187.8219	187.8219	187.8219	187.8219	187.8219	187.8219	187.8219	187.8219	187.8219	187.8219	(217)
Fuel for water heating, kWh/month	137.8702	121.8991	129.5233	114.0378	110.6298	99.7894	98.6030	102.4880	103.5704	115.3591	122.4891	136.3943	(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	43.3767	34.7984	31.3321	22.9552	17.7313	14.4866	16.1751	21.0250	27.3094	35.8314	40.4715	44.5823	(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												9054.3245	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												187.8219	
Water heating fuel used												1392.6535	(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)												350.0749	(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												10797.0530	(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	9054.3245	0.1549	1402.6791	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1392.6535	0.1408	196.1552	(264)
Space and water heating			1598.8342	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	350.0749	0.1443	50.5266	(268)
Total CO2, kg/year			1649.3609	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.3300	(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	9054.3245	1.5736	14247.5515	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1392.6535	1.5208	2117.9606	(278)
Space and water heating			16365.5121	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	350.0749	1.5338	536.9566	(282)
Total Primary energy kWh/year			16902.4687	(286)
Dwelling Primary energy Rate (DPER)			116.1500	(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	57.6400	(1b)	x 2.3000	(2b) =	132.5720	(1b) - (3b)
First floor	43.9400	(1c)	x 2.7000	(2c) =	118.6380	(1c) - (3c)
Second floor	43.9400	(1d)	x 2.7000	(2d) =	118.6380	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	145.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		369.8480	(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) =	0.1082	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3582	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3044	(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	0.3881	0.3805	0.3729	0.3349	0.3273	0.2892	0.2892	0.2816	0.3044	0.3273	0.3425	0.3577	(22b)
Effective ac	0.5753	0.5724	0.5695	0.5561	0.5536	0.5418	0.5418	0.5396	0.5463	0.5536	0.5586	0.5640	(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			1.8000	1.0000	1.8000			(26)
TER Opening Type (Uw = 1.20)			34.0700	1.1450	39.0115			(27)
Heat Loss Floor 1			57.6400	0.1300	7.4932			(28a)
Existing Solid Brick Front	73.3800	16.6800	56.7000	0.1800	10.2060			(29a)
Existing Solid Brick Rear	45.1200	11.5500	33.5700	0.1800	6.0426			(29a)
Existing Extension Wall	17.3200	7.6400	9.6800	0.1800	1.7424			(29a)
Flat Roof	57.6400		57.6400	0.1100	6.3404			(30)
Total net area of external elements Aum(A, m2)			251.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.6361			(33)
Party Wall 1			108.4100	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	21.3200	0.0500	1.0660
E3 Sill	20.4200	0.0500	1.0210
E4 Jamb	65.2000	0.0500	3.2600
E5 Ground floor (normal)	20.7600	0.1600	3.3216
E6 Intermediate floor within a dwelling	29.5400	0.0000	0.0000
E18 Party wall between dwellings	30.8000	0.0600	1.8480

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.5166 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.1527 (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	70.2189	69.8618	69.5119	67.8682	67.5607	66.1291	66.1291	65.8640	66.6806	67.5607	68.1828	68.8332	(38)
Heat transfer coeff	153.3715	153.0145	152.6646	151.0209	150.7134	149.2818	149.2818	149.0167	149.8332	150.7134	151.3355	151.9859	(39)

Average = Sum(39)m / 12 = 151.0194

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0540	1.0515	1.0491	1.0378	1.0357	1.0259	1.0259	1.0240	1.0296	1.0357	1.0400	1.0444	(40)
HLP (average)												1.0378	
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 2.9269 (42)
Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

84.5513	83.2956	81.5273	78.2669	75.8255	73.1184	71.6562	73.4121	75.3240	78.2207	81.5482	84.2654	(42b)

Hot water usage for other uses

44.6048	42.9828	41.3608	39.7388	38.1168	36.4948	36.4948	38.1168	39.7388	41.3608	42.9828	44.6048	(42c)

Average daily hot water use (litres/day) 118.9422 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.1561	126.2784	122.8881	118.0057	113.9423	109.6132	108.1510	111.5289	115.0628	119.5815	124.5310	128.8702	(44)
Energy conte	204.5517	179.8187	188.8744	161.5439	153.3883	134.7823	130.7993	138.0961	141.8839	162.2709	177.4173	201.7796	(45)
Energy content (annual)											Total = Sum(45)m =	1975.2064	
Distribution loss (46)m = 0.15 x (45)m	30.6827	26.9728	28.3312	24.2316	23.0082	20.2173	19.6199	20.7144	21.2826	24.3406	26.6126	30.2669	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9188 (55)
Total storage loss

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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

256.2982	226.5576	240.6210	211.6212	205.1349	184.8596	182.5459	189.8427	191.9613	214.0175	227.4946	253.5262	(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	256.2982	226.5576	240.6210	211.6212	205.1349	184.8596	182.5459	189.8427	191.9613	214.0175	227.4946	253.5262	(64)

Total per year (kWh/year) = Sum(64)m = 2584.4807 (64)
12Total per year (kWh/year) 2584 (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

109.4107	97.1808	104.1980	93.7752	92.3989	84.8770	84.8880	87.3142	87.2383	95.3524	99.0531	108.4890	(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	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	159.1868	176.2425	159.1868	164.4930	159.1868	164.4930	159.1868	159.1868	164.4930	159.1868	164.4930	159.1868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	315.6056	318.8806	310.6277	293.0583	270.8800	250.0356	236.1102	232.8352	241.0881	258.6576	280.8358	301.6802	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	(69)
Pumps, fans 3.0000	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)	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	(71)
Water heating gains (Table 5)	147.0574	144.6143	140.0511	130.2434	124.1920	117.8847	114.0968	117.3578	121.1643	128.1618	137.5738	145.8186	(72)
Total internal gains	691.7538	709.6415	679.7696	657.6987	624.1629	599.3174	576.2979	576.2839	593.6495	615.9102	652.8067	676.5896	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	14.8800	11.2829	0.6300	0.7000	0.7700	51.3094	(75)
Southwest	11.5500	36.7938	0.6300	0.7000	0.7700	129.8760	(79)
Northwest	7.6400	11.2829	0.6300	0.7000	0.7700	26.3444	(81)

Solar gains	207.5297	379.2933	587.4778	842.7500	1048.7678	1087.2893	1029.0758	868.3286	674.7673	437.6726	253.2700	174.5627	(83)
Total gains	899.2836	1088.9348	1267.2474	1500.4487	1672.9307	1686.6067	1605.3738	1444.6126	1268.4168	1053.5828	906.0767	851.1524	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.8894	66.0431	66.1945	66.9150	67.0515	67.6945	67.6945	67.8149	67.4454	67.0515	66.7759	66.4901	
alpha	5.3926	5.4029	5.4130	5.4610	5.4701	5.5130	5.5130	5.5210	5.4964	5.4701	5.4517	5.4327	
util living area	0.9977	0.9932	0.9785	0.9153	0.7621	0.5555	0.4074	0.4704	0.7484	0.9596	0.9942	0.9983	(86)
MIT	19.7523	19.9633	20.2694	20.6586	20.9047	20.9861	20.9979	20.9955	20.9363	20.5814	20.0959	19.7204	(87)
Th 2	20.0386	20.0406	20.0426	20.0520	20.0537	20.0618	20.0618	20.0634	20.0587	20.0537	20.0502	20.0465	(88)
util rest of house	0.9969	0.9910	0.9714	0.8896	0.7058	0.4788	0.3215	0.3768	0.6702	0.9418	0.9919	0.9977	(89)
MIT 2	18.5788	18.8494	19.2371	19.7148	19.9782	20.0544	20.0612	20.0618	20.0174	19.6361	19.0267	18.5437	(90)
Living area fraction										fLA = Living area / (4) =		0.1440	(91)
MIT	18.7478	19.0097	19.3857	19.8507	20.1116	20.1885	20.1960	20.1963	20.1497	19.7722	19.1806	18.7131	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7478	19.0097	19.3857	19.8507	20.1116	20.1885	20.1960	20.1963	20.1497	19.7722	19.1806	18.7131	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9954	0.9876	0.9650	0.8832	0.7095	0.4894	0.3339	0.3902	0.6784	0.9349	0.9889	0.9965	(94)
Useful gains	895.1421	1075.3949	1222.8904	1325.2303	1186.9575	825.4719	535.9712	563.7559	860.4549	985.0394	896.0164	848.1841	(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	2215.8749	2158.9954	1967.1963	1653.7844	1267.7356	834.2618	536.8236	565.7049	906.4455	1382.3721	1828.2250	2205.7880	(97)
Space heating kWh	982.6252	728.1795	553.7636	236.5590	60.0989	0.0000	0.0000	0.0000	0.0000	295.6155	671.1902	1010.0573	(98a)
Space heating requirement - total per year (kWh/year)												4538.0893	
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	982.6252	728.1795	553.7636	236.5590	60.0989	0.0000	0.0000	0.0000	0.0000	295.6155	671.1902	1010.0573	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4538.0893	
Space heating per m2											(98c) / (4) =	31.1853	(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	982.6252	728.1795	553.7636	236.5590	60.0989	0.0000	0.0000	0.0000	0.0000	295.6155	671.1902	1010.0573	(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)	1064.5994	788.9269	599.9606	256.2936	65.1126	0.0000	0.0000	0.0000	0.0000	320.2768	727.1833	1094.3199	(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	256.2982	226.5576	240.6210	211.6212	205.1349	184.8596	182.5459	189.8427	191.9613	214.0175	227.4946	253.5262	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7754	86.4854	85.8666	84.3102	81.6757	79.8000	79.8000	79.8000	79.8000	84.7844	86.3351	86.8350	(217)
Fuel for water heating, kWh/month	295.3581	261.9605	280.2264	251.0031	251.1578	231.6536	228.7542	237.8981	240.5530	252.4255	263.5017	291.9631	(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	33.0759	26.5347	23.8915	17.5040	13.5206	11.0464	12.3339	16.0321	20.8241	27.3223	30.8605	33.9951	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-53.3701	-74.9622	-107.3290	-120.1358	-129.0055	-120.1111	-118.5046	-112.0618	-100.7270	-85.3317	-58.5258	-46.1642	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-31.0262	-65.1633	-129.3633	-194.1192	-256.5683	-257.8536	-254.9385	-216.0125	-158.4561	-93.2760	-41.4425	-24.5532	(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	4916.6731	(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	3086.4553	(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)	266.9412	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2849.0014	(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	5507.0681	(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	4916.6731	0.2100	1032.5013	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3086.4553	0.2100	648.1556	(264)
Space and water heating			1680.6570	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	266.9412	0.1443	38.5279	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1126.2287	0.1347	-151.6970	
PV Unit electricity exported	-1722.7727	0.1259	-216.9173	
Total			-368.6143	(269)
Total CO2, kg/year			1362.4998	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.3600	(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	4916.6731	1.1300	5555.8406	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3086.4553	1.1300	3487.6944	(278)
Space and water heating			9043.5350	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	266.9412	1.5338	409.4433	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1126.2287	1.4978	-1686.8822	
PV Unit electricity exported	-1722.7727	0.4622	-796.2353	
Total			-2483.1174	(283)
Total Primary energy kWh/year			7099.9617	(286)
Target Primary Energy Rate (TPER)			48.7900	(287)

13 Appendix 1 - Be Green SAP Worksheets DER/TER

Full SAP Calculation Printout

Property Reference	11206	**Issued on Date**	15/12/2023
Assessment Reference	Be Green	**Prop Type Ref**	Grade 2 listed Mid Terrace
Property	31, The Green, Richmond, TW9 1LX		

SAP Rating	72 C	**DER**	5.16	**TER**	9.36
Environmental	95 A	**% DER < TER**			44.87
CO_2 Emissions (t/year)	0.52	**DFEE**	125.01	**TFEE**	36.71
Compliance Check	See BREL	**% DFEE < TFEE**			-240.53
% DPER < TPER	-30.90	**DPER**	63.87	**TPER**	48.79

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	57.6400 (1b)	x	2.3000 (2b)	=	132.5720	(1b) - (3b)
First floor	43.9400 (1c)	x	2.7000 (2c)	=	118.6380	(1c) - (3c)
Second floor	43.9400 (1d)	x	2.7000 (2d)	=	118.6380	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	145.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	369.8480	(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	3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.0811	(8)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8311	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.7064	(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	0.9007	0.8831	0.8654	0.7771	0.7594	0.6711	0.6711	0.6535	0.7064	0.7594	0.7948	0.8301	(22b)
Effective ac	0.9056	0.8899	0.8745	0.8019	0.7884	0.7252	0.7252	0.7135	0.7495	0.7884	0.8158	0.8445	(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	
Door			1.8000	3.0000	5.4000			(26)
Windows (Uw = 4.80)			34.0700	4.0268	137.1946			(27)
Heat Loss Floor 1			57.6400	0.5500	31.7020			(28a)
Existing Extension Wall	17.3200	16.6800	0.6400	1.6500	1.0560			(29a)
Existing Solid Brick Rear	45.1200	11.5500	33.5700	0.8100	27.1917			(29a)
Existing Solid Brick Front	73.3800	7.6400	65.7400	1.6500	108.4710			(29a)
Flat Roof	57.6400		57.6400	0.2900	16.7156			(30)
Total net area of external elements Aum(A, m2)			251.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		327.7309			(33)
Party Wall 1			108.4100	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)	12.5550	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	340.2859	(37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m	110.5343	108.6117	106.7273	97.8762	96.2201	88.5111	88.5111	87.0835	91.4805	96.2201	99.5702	103.0726	(38)
Heat transfer coeff													
	450.8202	448.8977	447.0132	438.1621	436.5061	428.7970	428.7970	427.3694	431.7664	436.5061	439.8562	443.3586	(39)
Average = Sum(39)m / 12 =												438.1542	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.0980	3.0848	3.0718	3.0110	2.9996	2.9467	2.9467	2.9368	2.9671	2.9996	3.0227	3.0467	(40)
HLP (average)												3.0110	
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												2.9269	(42)
Hot water usage for mixer showers													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths													
	84.5513	83.2956	81.5273	78.2669	75.8255	73.1184	71.6562	73.4121	75.3240	78.2207	81.5482	84.2654	(42b)
Hot water usage for other uses													
	44.6048	42.9828	41.3608	39.7388	38.1168	36.4948	36.4948	38.1168	39.7388	41.3608	42.9828	44.6048	(42c)
Average daily hot water use (litres/day)												118.9422	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	129.1561	126.2784	122.8881	118.0057	113.9423	109.6132	108.1510	111.5289	115.0628	119.5815	124.5310	128.8702	(44)
Energy conte	204.5517	179.8187	188.8744	161.5439	153.3883	134.7823	130.7993	138.0961	141.8839	162.2709	177.4173	201.7796	(45)
Energy content (annual)										Total = Sum(45)m =		1975.2064	
Distribution loss (46)m = 0.15 x (45)m													
	30.6827	26.9728	28.3312	24.2316	23.0082	20.2173	19.6199	20.7144	21.2826	24.3406	26.6126	30.2669	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8600	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0044	(55)
Total storage loss													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(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													
	258.9505	228.9531	243.2732	214.1879	207.7871	187.4263	185.1981	192.4949	194.5279	216.6697	230.0613	256.1784	(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													
	258.9505	228.9531	243.2732	214.1879	207.7871	187.4263	185.1981	192.4949	194.5279	216.6697	230.0613	256.1784	(64)
										Total per year (kWh/year) = Sum(64)m =		2615.7084	(64)
12Total per year (kWh/year)												2616	(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													
	111.5325	99.0972	106.3198	95.8285	94.5206	86.9303	87.0098	89.4360	89.2916	97.4741	101.1064	110.6108	(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	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	159.1868	176.2425	159.1868	164.4930	159.1868	164.4930	159.1868	159.1868	164.4930	159.1868	164.4930	159.1868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	315.6056	318.8806	310.6277	293.0583	270.8800	250.0356	236.1102	232.8352	241.0881	258.6576	280.8358	301.6802	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	(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)													
	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	(71)
Water heating gains (Table 5)													
	149.9092	147.4661	142.9029	133.0952	127.0439	120.7365	116.9487	120.2097	124.0161	131.0136	140.4256	148.6704	(72)
Total internal gains													
	691.6057	709.4933	679.6215	657.5505	624.0147	602.1692	579.1498	579.1358	596.5013	615.7620	652.6585	676.4415	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	14.8800	11.2829	0.8500	0.7000	0.7700	69.2270	(75)
Southwest	11.5500	36.7938	0.8500	0.7000	0.7700	175.2295	(79)
Northwest	7.6400	11.2829	0.8500	0.7000	0.7700	35.5440	(81)

Solar gains	280.0005	511.7450	792.6287	1137.0437	1415.0041	1466.9777	1388.4357	1171.5545	910.4003	590.5106	341.7135	235.5212	(83)
Total gains	971.6061	1221.2383	1472.2502	1794.5942	2039.0189	2069.1469	1967.5854	1750.6903	1506.9017	1206.2726	994.3720	911.9627	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	22.4159	22.5119	22.6068	23.0635	23.1510	23.5672	23.5672	23.6460	23.4051	23.1510	22.9747	22.7932	
alpha	2.4944	2.5008	2.5071	2.5376	2.5434	2.5711	2.5711	2.5764	2.5603	2.5434	2.5316	2.5195	
util living area													
	0.9947	0.9902	0.9811	0.9567	0.9054	0.8126	0.7047	0.7608	0.9053	0.9745	0.9916	0.9956	(86)

Living	17.4319	17.7221	18.2514	19.0278	19.7804	20.4101	20.7224	20.6476	20.1062	19.1463	18.1832	17.4191	
Non living	14.8447	15.2176	15.8939	16.8826	17.7935	18.4832	18.7217	18.6941	18.2068	17.0509	15.8223	14.8387	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	22	0	0	0	0	0	0	0	0	31	
16 / 9	0	0	9	26	0	0	0	0	0	0	30	0	
MIT	21.0000	21.0000	20.5480	19.7690	19.7804	20.4101	20.7224	20.6476	20.1062	19.1463	19.4047	21.0000	(87)
Th 2	18.7018	18.7082	18.7145	18.7445	18.7502	18.7769	18.7769	18.7819	18.7666	18.7502	18.7387	18.7268	(88)
util rest of house													
	0.9925	0.9861	0.9724	0.9339	0.8457	0.6663	0.4350	0.5112	0.8141	0.9568	0.9872	0.9938	(89)
MIT 2	18.7018	18.7082	18.3531	17.7840	17.7935	18.4832	18.7217	18.6941	18.2068	17.0509	17.4515	18.7268	(90)
Living area fraction										fLA = Living area / (4) =		0.1440	(91)
MIT	19.0327	19.0381	18.6691	18.0698	18.0795	18.7606	19.0097	18.9754	18.4803	17.3525	17.7327	19.0541	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0327	19.0381	18.6691	18.0698	18.0795	18.7606	19.0097	18.9754	18.4803	17.3525	17.7327	19.0541	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9929	0.9869	0.9722	0.9240	0.8187	0.6648	0.4722	0.5415	0.7952	0.9364	0.9843	0.9941	(94)
Useful gains	964.7351	1205.1902	1431.2915	1658.2645	1669.3819	1375.5802	929.1803	947.9930	1198.2674	1129.5900	978.7663	906.5636	(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													
	6641.7833	6346.5820	5439.7399	4017.8475	2784.6919	1784.0623	1033.2843	1100.6334	1891.2521	2947.5226	4676.8421	6585.6853	(97)
Space heating kWh													
	4223.7238	3455.0153	2982.2856	1698.8997	829.7906	0.0000	0.0000	0.0000	0.0000	1352.5418	2662.6146	4225.2665	(98a)
Space heating requirement - total per year (kWh/year)												21430.1380	
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													
	4223.7238	3455.0153	2982.2856	1698.8997	829.7906	0.0000	0.0000	0.0000	0.0000	1352.5418	2662.6146	4225.2665	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												21430.1380	
Space heating per m2											(98c) / (4) =	147.2659	(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 %)												331.2069	(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													
	4223.7238	3455.0153	2982.2856	1698.8997	829.7906	0.0000	0.0000	0.0000	0.0000	1352.5418	2662.6146	4225.2665	(98)
Space heating efficiency (main heating system 1)													
	331.2069	331.2069	331.2069	331.2069	331.2069	0.0000	0.0000	0.0000	0.0000	331.2069	331.2069	331.2069	(210)
Space heating fuel (main heating system)													
	1275.2525	1043.1593	900.4299	512.9422	250.5355	0.0000	0.0000	0.0000	0.0000	408.3677	803.9128	1275.7182	(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													
	258.9505	228.9531	243.2732	214.1879	207.7871	187.4263	185.1981	192.4949	194.5279	216.6697	230.0613	256.1784	(64)
Efficiency of water heater												187.4949	(216)
(217)m	187.4949	187.4949	187.4949	187.4949	187.4949	187.4949	187.4949	187.4949	187.4949	187.4949	187.4949	187.4949	(217)
Fuel for water heating, kWh/month													
	138.1107	122.1116	129.7492	114.2366	110.8228	99.9634	98.7750	102.6667	103.7510	115.5603	122.7027	136.6322	(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	43.3767	34.7984	31.3321	22.9552	17.7313	14.4866	16.1751	21.0250	27.3094	35.8314	40.4715	44.5823	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-65.8964	-111.1865	-188.7568	-227.1053	-231.9511	-170.3846	-167.4820	-157.0916	-134.9777	-125.9023	-75.5647	-54.3449	(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	-15.3484	-41.2231	-111.2240	-226.4947	-368.0105	-434.4154	-423.1052	-333.5020	-212.7823	-80.3345	-24.2273	-11.2759	(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												6470.3181	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												187.4949	
Water heating fuel used												1395.0823	(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)												350.0749	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3992.5872	(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												4222.8881	(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	6470.3181	0.1551	1003.8297	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1395.0823	0.1408	196.4973	(264)
Space and water heating			1200.3270	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	350.0749	0.1443	50.5266	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1710.6439	0.1350	-230.9937	
PV Unit electricity exported	-2281.9433	0.1180	-269.2293	
Total			-500.2230	(269)
Total CO2, kg/year			750.6306	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.1600	(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	6470.3181	1.5744	10186.8623	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1395.0823	1.5208	2121.6543	(278)
Space and water heating			12308.5166	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	350.0749	1.5338	536.9566	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1710.6439	1.4992	-2564.5223	
PV Unit electricity exported	-2281.9433	0.4325	-987.0247	
Total			-3551.5470	(283)
Total Primary energy kWh/year			9293.9263	(286)
Dwelling Primary energy Rate (DPER)			63.8700	(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	57.6400 (1b)	x	2.3000 (2b)	=	132.5720	(1b) - (3b)
First floor	43.9400 (1c)	x	2.7000 (2c)	=	118.6380	(1c) - (3c)
Second floor	43.9400 (1d)	x	2.7000 (2d)	=	118.6380	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	145.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	369.8480	(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) =	0.1082	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3582	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3044	(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	0.3881	0.3805	0.3729	0.3349	0.3273	0.2892	0.2892	0.2816	0.3044	0.3273	0.3425	0.3577	(22b)
Effective ac	0.5753	0.5724	0.5695	0.5561	0.5536	0.5418	0.5418	0.5396	0.5463	0.5536	0.5586	0.5640	(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			1.8000	1.0000	1.8000	(26)
TER Opening Type (Uw = 1.20)			34.0700	1.1450	39.0115	(27)
Heat Loss Floor 1			57.6400	0.1300	7.4932	(28a)
Existing Extension Wall	17.3200	16.6800	0.6400	0.1800	0.1152	(29a)
Existing Solid Brick Rear	45.1200	11.5500	33.5700	0.1800	6.0426	(29a)
Existing Solid Brick Front	73.3800	7.6400	65.7400	0.1800	11.8332	(29a)
Flat Roof	57.6400		57.6400	0.1100	6.3404	(30)
Total net area of external elements Aum(A, m2)			251.1000			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.6361	(33)
Party Wall 1			108.4100	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	21.3200	0.0500	1.0660
E3 Sill	20.4200	0.0500	1.0210
E4 Jamb	65.2000	0.0500	3.2600
E5 Ground floor (normal)	20.7600	0.1600	3.3216
E6 Intermediate floor within a dwelling	29.5400	0.0000	0.0000
E18 Party wall between dwellings	30.8000	0.0600	1.8480

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.5166 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.1527 (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	70.2189	69.8618	69.5119	67.8682	67.5607	66.1291	66.1291	65.8640	66.6806	67.5607	68.1828	68.8332	(38)
Heat transfer coeff	153.3715	153.0145	152.6646	151.0209	150.7134	149.2818	149.2818	149.0167	149.8332	150.7134	151.3355	151.9859	(39)

Average = Sum(39)m / 12 = 151.0194

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0540	1.0515	1.0491	1.0378	1.0357	1.0259	1.0259	1.0240	1.0296	1.0357	1.0400	1.0444	(40)
HLP (average)												1.0378	
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 2.9269 (42)

Hot water usage for mixer showers

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

	84.5513	83.2956	81.5273	78.2669	75.8255	73.1184	71.6562	73.4121	75.3240	78.2207	81.5482	84.2654	(42b)

Hot water usage for other uses

	44.6048	42.9828	41.3608	39.7388	38.1168	36.4948	36.4948	38.1168	39.7388	41.3608	42.9828	44.6048	(42c)

Average daily hot water use (litres/day) 118.9422 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.1561	126.2784	122.8881	118.0057	113.9423	109.6132	108.1510	111.5289	115.0628	119.5815	124.5310	128.8702	(44)
Energy conte	204.5517	179.8187	188.8744	161.5439	153.3883	134.7823	130.7993	138.0961	141.8839	162.2709	177.4173	201.7796	(45)

Energy content (annual) Total = Sum(45)m = 1975.2064

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

	30.6827	26.9728	28.3312	24.2316	23.0082	20.2173	19.6199	20.7144	21.2826	24.3406	26.6126	30.2669	(46)

Water storage loss:

Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss

	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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

	256.2982	226.5576	240.6210	211.6212	205.1349	184.8596	182.5459	189.8427	191.9613	214.0175	227.4946	253.5262	(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	256.2982	226.5576	240.6210	211.6212	205.1349	184.8596	182.5459	189.8427	191.9613	214.0175	227.4946	253.5262	(64)

Total per year (kWh/year) = Sum(64)m = 2584.4807 (64)

12Total per year (kWh/year) 2584 (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

	109.4107	97.1808	104.1980	93.7752	92.3989	84.8770	84.8880	87.3142	87.2383	95.3524	99.0531	108.4890	(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	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	146.3470	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	159.1868	176.2425	159.1868	164.4930	159.1868	164.4930	159.1868	159.1868	164.4930	159.1868	164.4930	159.1868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	315.6056	318.8806	310.6277	293.0583	270.8800	250.0356	236.1102	232.8352	241.0881	258.6576	280.8358	301.6802	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	37.6347	(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)	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	-117.0776	(71)
Water heating gains (Table 5)	147.0574	144.6143	140.0511	130.2434	124.1920	117.8847	114.0968	117.3578	121.1643	128.1618	137.5738	145.8186	(72)
Total internal gains	691.7538	709.6415	679.7696	657.6987	624.1629	599.3174	576.2979	576.2839	593.6495	615.9102	652.8067	676.5896	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	14.8800	11.2829	0.6300	0.7000	0.7700	51.3094	(75)
Southwest	11.5500	36.7938	0.6300	0.7000	0.7700	129.8760	(79)
Northwest	7.6400	11.2829	0.6300	0.7000	0.7700	26.3444	(81)

Solar gains	207.5297	379.2933	587.4778	842.7500	1048.7678	1087.2893	1029.0758	868.3286	674.7673	437.6726	253.2700	174.5627 (83)
Total gains	899.2836	1088.9348	1267.2474	1500.4487	1672.9307	1686.6067	1605.3738	1444.6126	1268.4168	1053.5828	906.0767	851.1524 (84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.8894	66.0431	66.1945	66.9150	67.0515	67.6945	67.6945	67.8149	67.4454	67.0515	66.7759	66.4901	
alpha	5.3926	5.4029	5.4130	5.4610	5.4701	5.5130	5.5130	5.5210	5.4964	5.4701	5.4517	5.4327	
util living area	0.9977	0.9932	0.9785	0.9153	0.7621	0.5555	0.4074	0.4704	0.7484	0.9596	0.9942	0.9983	(86)
MIT	19.7523	19.9633	20.2694	20.6586	20.9047	20.9861	20.9979	20.9955	20.9363	20.5814	20.0959	19.7204	(87)
Th 2	20.0386	20.0406	20.0426	20.0520	20.0537	20.0618	20.0618	20.0634	20.0587	20.0537	20.0502	20.0465	(88)
util rest of house	0.9969	0.9910	0.9714	0.8896	0.7058	0.4788	0.3215	0.3768	0.6702	0.9418	0.9919	0.9977	(89)
MIT 2	18.5788	18.8494	19.2371	19.7148	19.9782	20.0544	20.0612	20.0618	20.0174	19.6361	19.0267	18.5437	(90)
Living area fraction									fLA = Living area / (4) =			0.1440	(91)
MIT	18.7478	19.0097	19.3857	19.8507	20.1116	20.1885	20.1960	20.1963	20.1497	19.7722	19.1806	18.7131	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7478	19.0097	19.3857	19.8507	20.1116	20.1885	20.1960	20.1963	20.1497	19.7722	19.1806	18.7131	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9954	0.9876	0.9650	0.8832	0.7095	0.4894	0.3339	0.3902	0.6784	0.9349	0.9889	0.9965	(94)
Useful gains	895.1421	1075.3949	1222.8904	1325.2303	1186.9575	825.4719	535.9712	563.7559	860.4549	985.0394	896.0164	848.1841	(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	2215.8749	2158.9954	1967.1963	1653.7844	1267.7356	834.2618	536.8236	565.7049	906.4455	1382.3721	1828.2250	2205.7880	(97)
Space heating kWh	982.6252	728.1795	553.7636	236.5590	60.0989	0.0000	0.0000	0.0000	0.0000	295.6155	671.1902	1010.0573	(98a)
Space heating requirement - total per year (kWh/year)												4538.0893	
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	982.6252	728.1795	553.7636	236.5590	60.0989	0.0000	0.0000	0.0000	0.0000	295.6155	671.1902	1010.0573	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4538.0893	
Space heating per m2											(98c) / (4) =	31.1853	(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	982.6252	728.1795	553.7636	236.5590	60.0989	0.0000	0.0000	0.0000	0.0000	295.6155	671.1902	1010.0573	(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)	1064.5994	788.9269	599.9606	256.2936	65.1126	0.0000	0.0000	0.0000	0.0000	320.2768	727.1833	1094.3199	(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	256.2982	226.5576	240.6210	211.6212	205.1349	184.8596	182.5459	189.8427	191.9613	214.0175	227.4946	253.5262	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7754	86.4854	85.8666	84.3102	81.6757	79.8000	79.8000	79.8000	79.8000	84.7844	86.3351	86.8350	(217)
Fuel for water heating, kWh/month	295.3581	261.9605	280.2264	251.0031	251.1578	231.6536	228.7542	237.8981	240.5530	252.4255	263.5017	291.9631	(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	33.0759	26.5347	23.8915	17.5040	13.5206	11.0464	12.3339	16.0321	20.8241	27.3223	30.8605	33.9951	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-53.3701	-74.9622	-107.3290	-120.1358	-129.0055	-120.1111	-118.5046	-112.0618	-100.7270	-85.3317	-58.5258	-46.1642	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-31.0262	-65.1633	-129.3633	-194.1192	-256.5683	-257.8536	-254.9385	-216.0125	-158.4561	-93.2760	-41.4425	-24.5532	(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	4916.6731	(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	3086.4553	(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)	266.9412	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2849.0014	(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	5507.0681	(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	4916.6731	0.2100	1032.5013	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3086.4553	0.2100	648.1556	(264)
Space and water heating			1680.6570	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	266.9412	0.1443	38.5279	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1126.2287	0.1347	-151.6970	
PV Unit electricity exported	-1722.7727	0.1259	-216.9173	
Total			-368.6143	(269)
Total CO2, kg/year			1362.4998	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.3600	(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	4916.6731	1.1300	5555.8406	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3086.4553	1.1300	3487.6944	(278)
Space and water heating			9043.5350	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	266.9412	1.5338	409.4433	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1126.2287	1.4978	-1686.8822	
PV Unit electricity exported	-1722.7727	0.4622	-796.2353	
Total			-2483.1174	(283)
Total Primary energy kWh/year			7099.9617	(286)
Target Primary Energy Rate (TPER)			48.7900	(287)