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Energy Statement

Bellway Homes Ltd

Southern Gas Network Belvedere Holders Stations, Yarnton Way, DA17 6JP

Final

Rodrigo Guedes
BArch, MSc, CEng, MCIBSE

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ABOUT HODKINSON CONSULTANCY

Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project.

We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for quality and construction efficiency.

Executive Summary

The energy strategy for the proposed development at SGN Belvedere in the London Borough of Bexley has been formulated following the London Plan energy hierarchy: ***Be Lean, Be Clean, Be Green and Be Seen***. The overriding objective is the formulation of a strategy which effectively balances a number of key elements, including CO_2 emissions, affordability of heat, and the provision of high-quality buildings. These elements need to work with the regulatory and planning requirements for the development.

The proposed development will be built to the updated Part L 2021 Building Regulations. The new Part O of building regulations will also influence the energy strategy.

A range of Be Lean energy efficiency measures are proposed, including high performance fabric and efficient ventilation systems. They allow the development to achieve a **15%** reduction in site wide regulated CO_2 emissions, with a **15%** reduction for the residential portion of the development and a **18%** reduction for the non-residential development over a Part L 2021 baseline, meeting London Plan requirements.

In line with the London Plan, the feasibility of decentralised energy production has been considered at the Be Clean stage. A connection to an existing heat network is proposed, sourced by high grade waste heat. This delivers a further site wide CO_2 reduction of **82%**.

A range of Be Green renewable energy technologies has been considered. Suitable roof space will be utilised to provide approximately **388 kWp** of solar PV.

Table iii, below, summarises the anticipated site wide CO_2 emissions for the Proposed Development. The combination of the Be Lean, Be Clean and Be Green measures as outlined above result in an overall **98%** reduction over the Part L 2021 baseline. Compliance with both London Plan Policy SI2 (under the 2022 GLA Energy Guidance) is therefore achieved.

In line with the GLA guidance, the development will commit to offset the remaining CO_2 emissions through a payment to the London Borough of Bexley. The remaining CO_2 emissions to be offset are estimated as **186 Tonnes** CO_2 per annum, resulting in the estimated offset payment of **£22,241**, using the price of £95 per tonne of CO_2 for a period of 30 years.

Table *i*: Residential Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy		
Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	
	Regulated	**Unregulated**
Baseline: Part L 2021 Compliant Development	392.1	128.6
After *Be Lean* Measures	334.3	128.6
After *Be Clean* Measures	11.5	128.6
After *Be Green* Measures	6.2	128.6
Stage	**Regulated Carbon Dioxide Savings**	
	Tonnes CO_2 per Annum	**Percentage**
Savings from *Be Lean* Measures	57.8	15%
Savings from *Be Clean* Measures	322.8	82%
Savings from *Be Green* Measures	5.3	1%
Cumulative On-Site Savings	385.9	98%

Table *ii*: Non- Residential Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy		
Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	
	Regulated	**Unregulated**
Baseline: Part L 2021 Compliant Development	2.6	2.9
After *Be Lean* Measures	2.1	2.9
After *Be Clean* Measures	2.1	2.9
After *Be Green* Measures	1.6	2.9
Stage	**Regulated Carbon Dioxide Savings**	
	Tonnes CO_2 per Annum	**Percentage**
Savings from *Be Lean* Measures	0.5	18%
Savings from *Be Clean* Measures	0.0	0%
Savings from *Be Green* Measures	0.5	20%
Cumulative On-Site Savings	1.0	38%

Table *iii*: Site Wide Carbon Dioxide Emissions and Cumulative Savings			
Stage	**Regulated Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	**Regulated Carbon Dioxide Savings**	
		Tonnes CO_2 per Annum	**Percentage**
Baseline: Part L 2021 Compliant Development	394.7	-	-
After ***Be Lean*** Measures	336.4	58.3	15%
After ***Be Clean*** Measures	13.6	322.8	82%
After ***Be Green*** Measures	7.8	5.8	1%
Cumulative On-Site Savings	**-**	386.9	98%

CONTENTS

1. INTRODUCTION

1.1 This document has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, and is submitted in support of a full planning application made on behalf of Bellway Homes for the proposed development at SGN Belvedere, located in the London Borough of Bexley.

1.2 The energy strategy for the site has been formulated to address a number of key objectives:

> To provide comfortable high-quality homes that people aspire to live in;

> To address energy policy;

> To be low carbon from the outset,

> To adapt to climate change;

> To take account of specific site characteristics that link to the energy strategy, for instance acoustics and air quality;

> To provide a resilient supply of reasonably priced heat to residents.

1.3 A number of these objectives can compete with each other. This energy strategy and the development proposals seek to provide a sensible balance between all considerations.

1.4 This statement first establishes a baseline assessment of the energy demands and associated CO_2 emissions. The report will then follow The London Plan Energy Hierarchy approach of ***Be Lean***, ***Be Clean***, ***Be Green*** and ***Be Seen*** to demonstrate CO_2 reductions at each step.

2. DEVELOPMENT OVERVIEW

2.1 The site is located in the London Borough of Bexley, in a mixed commercial and residential area. In the north and south boundaries lie Yarnton Way and a railway line, respectively. There are residential dwellings to the east and commercial units to west of the site. The site was formerly known as Yarnton Way Gas Works.

2.2 Figure 1 shows the site location and the approximate site boundaries.

Figure 1: Site Location with approximate boundaries (please note that the eastern gas holder has already been removed from the site) - Map data 2022 Google

Proposed Development

2.3 The proposed development is described as follows:

2.4 *Redevelopment of the site to provide residential units including affordable housing (Use Class C3) and commercial floorspace (Class E) in new buildings ranging between 3 to 5 storeys in height, together with associated car parking and cycle storage, landscaping including new areas of public*

open space and a reptile retention zone, associated infrastructure including new junctions off Yarnton Way, drainage and land raising.

2.5 The development is comprised of 392 dwelling units, including:

> 295 flats

> 22 Duplexes

> 75 Houses

2.6 In addition, there is 298.19 m^2 of non-residential space proposed.

2.7 Figure 2, below, illustrates the proposed site layout.

Figure 2: Proposed Site Plan (Stockwool, 2023)

3. RELEVANT PLANNING POLICY

3.1 The following planning policies and requirements will inform the energy strategy for the proposed development.

National Policy: NPPF

3.2 The revised National Planning Policy Framework (NPPF) was published on the 20th July 2021 and sets out the Government's planning policies for England.

3.3 The NPPF provides a framework for achieving sustainable development, which has been summarised as "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*" (Resolution 42/187 of the United National General Assembly). At the heart of the framework is a **presumption in favour of sustainable development**.

3.4 The document states that the planning system has three overarching objectives which are interdependent and need to be pursued in mutually supportive ways:

a) **An economic objective** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;

b) **A social objective** – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed, beautiful and safe places, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and

c) **An environmental objective** – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

Regional Policy: London Plan (2021)

3.5 The London Plan sets out an integrated economic, environmental, transport and social framework for the development of London. The following policies are considered relevant to this energy strategy**:**

3.6 **Policy SI2 Minimising Greenhouse Gas Emissions, states:**

'Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation, and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) Be lean: use less energy and mange demand during operation;

2) Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly;

3) Be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site;

4) Be seen: monitor, verify and report on energy performance through the Mayor's post construction monitoring platform.

A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures.'

Any residual on-site emissions (Regulated CO_2) are to be offset up to a standard of Zero Carbon.

3.7 **Policy SI3 Energy Infrastructure, states:**

'Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system. The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

a) Connect to local existing or planned heat networks;

b) Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required);

c) Use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network);

d) Use ultra-low NOx gas boilers.'

3.8 **Policy SI4 Managing Heat Risk** seeks for energy strategies to demonstrate how they intend to reduce the risk of internal overheating, in line with the cooling hierarchy.

GLA Energy Assessment Guidance (2022)

3.9 In June 2022 the GLA released an updated Energy Assessment Guidance. This confirmed that the CO_2 reduction targets within the London Plan would still apply over the Part L 2021 baseline. It also sets a benchmark target of a 50% reduction in CO_2 for the residential part of the development.

3.10 Further guidance has been included in line with the update to Part L of Building Regulations, including guidance on requirements for connection to a CHP network (if applicable) and updated reporting templates to be included in the report.

Local Policy: London Borough of Bexley

Bexley Local Plan (2023)

3.11 The London Borough of Bexley's Core Planning Strategy was adopted in 2023. The following policies are considered relevant to this Statement:

3.12 **Policy SP14 Mitigating and adapting to climate change** indicates that the council will pursue the delivery of sustainable developments by:

> supporting developments that achieve zero-carbon and demonstrate a commitment to drive down greenhouse gas emissions to net zero;

> administering the borough's carbon offset fund, ring-fencing payments to implement projects that deliver greenhouse gas reductions;

> investigating opportunities for the funding and development of decentralised energy networks in the borough; and, supporting the provision of infrastructure, including safeguarding routes and land for such use, where necessary;

3.13 **Policy DP30 Mitigating Climate Change**

> Major development proposals must meet London Plan requirements and calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

3.14 **Policy DP31 Energy Infrastructure**

> Developments within heat network priority areas should be designed to facilitate cost-effective connections to the existing or proposed network in accordance with the London Plan.

> In designated heat network priority areas, proposals for the development of decentralised energy network infrastructure and related apparatus, including the use of low carbon technology, will be supported.

> Proposals for major developments that produce heat and/or energy should consider how they can contribute to the supply heat in a designated heat network priority area or demonstrate that this is not technically feasible or economically viable.

3.15 In addition, the Sustainable design and construction guide SPD (adopted 29 October 2007) highlights the importance of design and construction in creating a more environmentally friendly and sustainable development.

4. ASSESSMENT METHODOLOGY – BASELINE EMISSIONS

4.1 This statement first establishes a baseline assessment of the energy demands and associated CO_2 emissions for the development. The report will then follow the GLA hierarchy approach of ***Be Lean***, ***Be Clean***, ***Be Green*** and ***Be Seen***.

4.2 The development is expected to be built under Part L 2021 Building Regulations. All calculations have been undertaken using approved Part L 2021 software and associated CO_2 emission factors.

4.3 In line with the GLA's Energy Assessment Guidance (2022) the Target Emissions Rate (TER) from the final proposed building specification has been used.

4.4 The estimated annual energy demand for dwellings has been calculated using Standard Assessment Procedure (SAP) methodology. SAP calculates the Regulated energy demands associated with hot water, space heating and fixed electrical items. The unregulated energy demands for appliances and cooking are taken from BRE standard occupancy calculations.

4.5 Calculations have been performed on representative dwelling types. These encompass an array of flat and house types which differ in orientation and take account of the impact of ground floors, exposed floors, mid floors, and roofs. The selected dwellings therefore represent a fair aggregation of the proposed unit mix.

4.6 The estimated annual CO_2 emissions for the non-residential space have been calculated using Simplified Building Energy Model (SBEM) methodology.

Baseline Emissions

4.7 A baseline calculation has been carried out to establish the Regulated CO_2 emissions by which this energy strategy will be compared against. Table 1, below shows the Part L 2021 Regulated baseline CO_2 emissions rates. TER and BRUKL worksheets supporting these calculations are presented in Appendix A and B respectively.

Table 1: Carbon Dioxide Emissions Baseline (SAP 10 Carbon Emission Factors)

	Regulated [tCO_2/year]
Residential	392.1
Non-residential	2.6
Total	394.7

5. BE LEAN – ENERGY EFFICIENCY

5.1 The development will target a minimum of 10% and 15% reduction in regulated CO_2 emissions over a Part L 2021 baseline through energy efficiency measures for both the residential and non-residential parts respectively, in line with London Plan requirements.

5.2 This section sets out the potential measures to be implemented to enable theses targets to be achieved, thereby locking in significant CO_2 reductions through a reduction in energy demands.

5.3 All values stated within this section will be subject to review and potential changes at detailed design stage.

Residential

Insulation Standards

5.4 All dwellings will incorporate enhanced insulation in the building envelope (walls, roofs, floors and glazing) to achieve U-values which are likely to be similar to the following:

> Glazing with a U-value of 0.9 W/m^2.K (triple glazing);

> External wall U-value of 0.18 W/m^2.K for flats;

> External wall U-value of 0.24 W/m^2.K for houses;

> Corridors not to be actively heated. Corridor wall U-value of 0.18 W/m^2.K. Alternatively, corridors will be heated and treated as non-heat loss spaces.

> Party walls will be fully insulated and sealed (achieving an effective U-Value of 0.18 W/m^2.K);

> Exposed floor U-value of 0.10 W/m^2.K ;

> A main roof U-value of 0.10 W/m^2.K for flats;

> A main roof U-value of 0.11 W/m^2.K for houses;

Air Tightness & Ventilation

5.5 Air tightness standards will conform to, and exceed, Approved Document Part L requirements. By reducing air leakage loss and convective bypass of insulation, the following improvements of design air permeability will further reduce space heating requirements:

> 10m^3/h.m^2 to 3m^3/h.m^2 or less for apartments

> $10m^3/h.m^2$ to $4m^3/h.m^2$ or less for houses

5.6 Parts L & F compliant (System 4) Mechanical Ventilation with Heat Recovery (MVHR) will be installed in all units. These systems will remove stale air and odours from kitchens and wet rooms, whilst retaining the heat within the home, as shown in Figure 3, below. In this way substantial energy savings will be made.

5.7 MEV may replace MVHR in houses, subject to more detailed acoustic, ventilation and overheating analysis at detailed design stage.

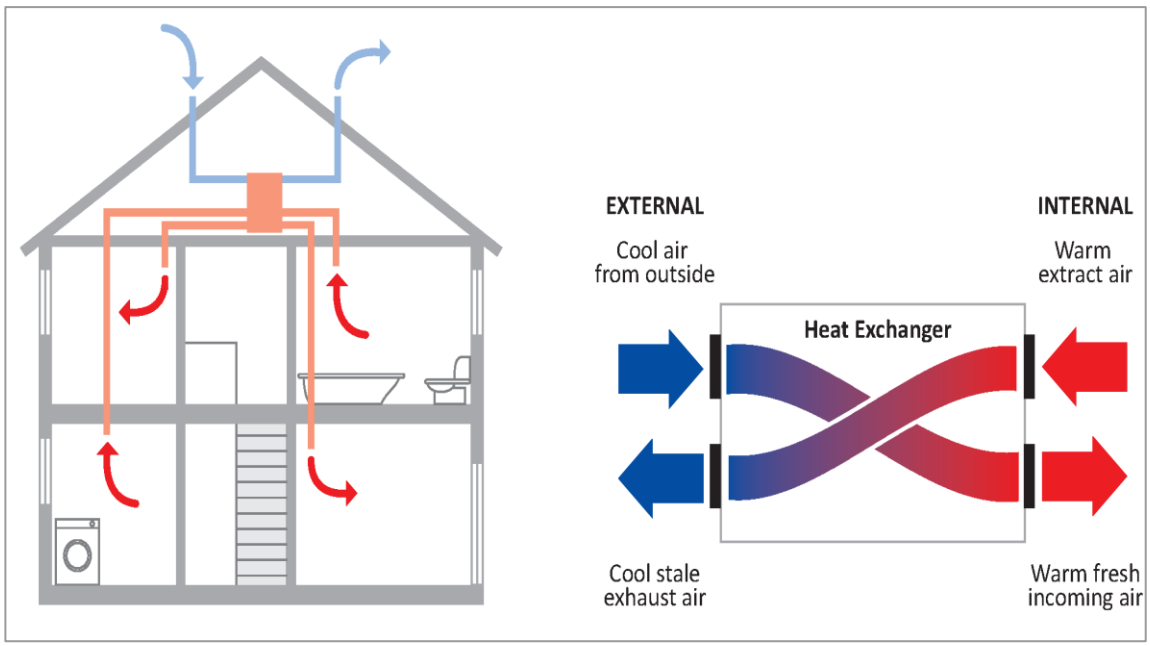

Figure 3: MVHR in operation.

5.8 The selected MVHR units have heat recovery efficiencies of at least 90%, with the Specific Fan Power (SFP) targeted as follows:

> ≤ 0.42 SFP for units with a kitchen and 1 wet rooms;

> ≤ 0.44 SFP for units with a kitchen and 2 wet rooms.

5.9 Additionally, high noise risk units will have peak lopping units installed, to prevent overheating.

5.10 The selected peak lopping units will have heat recovery efficiencies of at least 89%, and an SFP of 0.61.

Thermal Bridging

5.11 In well insulated buildings, as much as 30% of heat loss can occur through thermal bridges, which occur when highly conductive elements (e.g. metal studs) in the wall construction enable a low resistance escape route for heat. The Applicant is committed to delivering a development which prioritises the conservation of energy through lean design and has therefore placed particular importance on the development of construction details which minimise the effect of thermal bridges.

5.12 Figure 4 below illustrates the benefits of reducing thermal bridges.

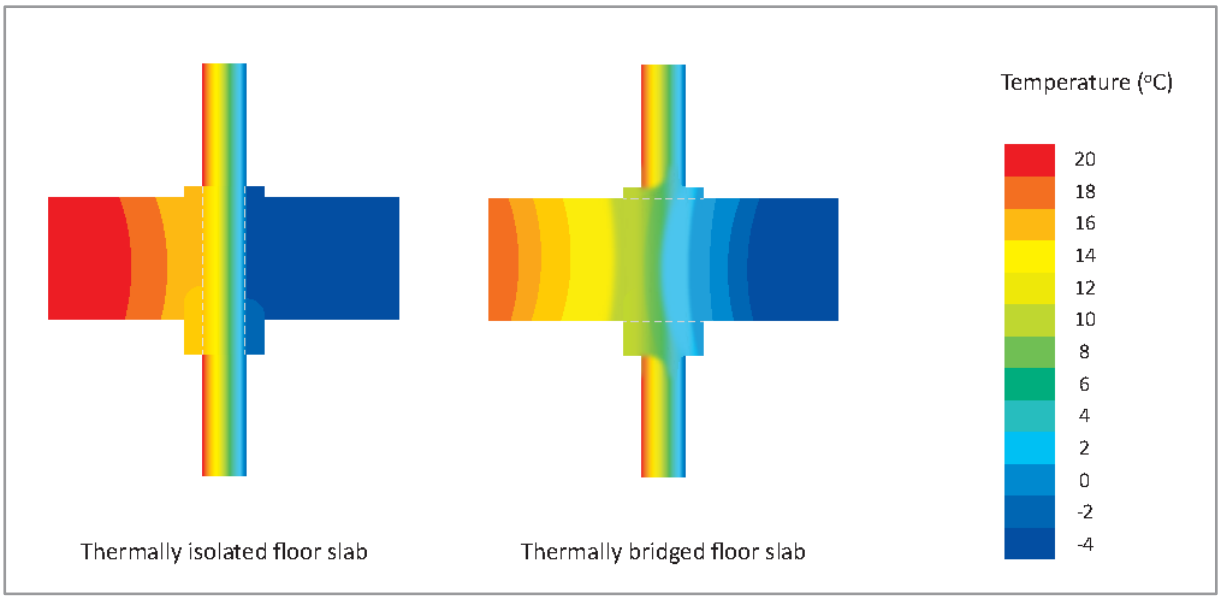

Figure 4: Thermal bridging.

5.13 Detailed modelling of all major junctions is likely to be undertaken at design stage. The results of initial assessments will be used to inform the design process and further modelling will take place to identify areas for further improvement.

5.14 The following psi values have been used in the initial modelling, based on calculated psi values achieved on similar schemes:

Proposed Psi-values **Element**	**Thermal bridge**	**Psi-Value (Ψ) (W/m.K) (Flats)**	**Psi-Value (Ψ) (W/m.K) (Houses)**
Lintel	E2	0.08	0.08
Sill	E3	Default	Default
Jamb	E4	0.05	0.05

Proposed Psi-values			
Element	**Thermal bridge**	**Psi-Value (Ψ) (W/m.K) (Flats)**	**Psi-Value (Ψ) (W/m.K) (Houses)**
Ground Floor (normal)	E5	0.12	0.12
Intermediate Floor (in houses)	E6	n.a.	0.02
Intermediate Floor (in blocks of flat)	E7	0.10 (0.05 per flat)	n.a.
Intermediate Floor (internal, corridors)	E7	0.20 (0.10 per flat)	n.a.
Corner (normal)	E16	0.10	0.10
Corner (inverted)	E17	0.00	0.00
Party wall between dwellings	E18	0.1 (0.05 per flat)	0.1 (0.05 per flat)
Balcony	E23	0.30 (0.15 per flat)	n.a.
Party wall - Roof (insulation at ceiling level)	P4	0.03	0.03
Party wall – Ground floor	P1	0.056	0.056

5.15 Further details will be determined during the detailed design stage when bespoke calculations are expected to be undertaken on the targeted junctions.

Space Heating & Hot Water

5.16 The space heating requirement will be reduced by the fabric, air tightness and ventilation measures detailed above.

5.17 In line with energy assessment guidance, a gas boiler baseline has been used in the Be Lean stage assessment. In line with the notional dwelling in SAP 10.2 methodology, an individual combi gas boiler has been assumed to provide heating and hot water, with an efficiency of 89.5%.

Lighting & Appliances

5.18 Energy efficient LED lighting will be installed in 100% of internal fittings in the homes.

5.19 It is very difficult to design and construct homes to reduce the unregulated electricity demands, because this is almost entirely dependent on the occupant of a home and can vary substantially. However, the Applicant is committed to ensuring that all efforts are made to enable the residents to minimise their unregulated electricity consumption.

Limiting the Risk of Summer Overheating

5.20 Minimising the risk of summer overheating is important so as to ensure that homes are adapted to climate change and remain comfortable to occupy in the future. Accordingly, dynamic thermal

modelling has been undertaken on a selection of unit types to ensure that the development does not cause an unacceptable risk of summer overheating within the dwellings.

5.21 The Applicant has adopted a holistic approach to the development of the energy strategy presented in this report. It is recognised that the varying implications of energy, overheating, daylighting, and noise cannot be considered only in isolation. It is a key aim to develop a strategy which ensures one of these elements does not get prioritised at the expense of another.

5.22 The following overheating measures are likely to be adopted for the development to assist in balancing these four central considerations:

> Solar control glazing to reduce uncomfortable solar heat gains whilst maximising energy efficiency. A g-value of 0.30 has been applied to all east facing facades, and 0.40 has been applied to all other apartments. These have been used in the dynamic overheating assessment.

> High performance MVHR systems to all units to assist in background ventilation, including peak lopping units in ground floor and high noise risk units;

> Shading in the form of balconies in the apartment units.

5.23 Full details of the residential overheating modelling and applied strategy are presented in the accompanying Dynamic Overheating Report.

5.24 At post planning stage, the overheating strategy may be revisited to investigate possibilities of including alternative strategies.

Non-Residential

5.25 In line with the London Plan Energy Hierarchy, the following ***Be Lean*** measures could be adopted for the non-residential area.

5.26 The non-residential spaces are unlikely to be fitted out fully by the Applicant. As such, certain services may differ from those set out in this section, but it will be ensured that the required CO_2 targets will still be achieved.

Insulation Standards

5.27 Enhanced insulation standards will be adopted to enable a fabric specification such as the following:

> External Wall U-value: 0.18 W/m^{2}K

> Commercial Unit wall to unheated spaces (e.g. lobbies, plant room, bin store): 0.22 W/m^{2}K

- Ground Floor U-value: 0. 12W/m^2K
- Glazing U-value: 1.2 W/m^2K
- Glazing G-value: 0.30
- Light transmittance: 0.60
- Louvre panel U-value: 0.25W/m^2K
- Air permeability: 5.0m^3/h.m^2

Services

5.28 The following specification is proposed for the services:

- Lighting: 120lm/W & LOR: 1
- Display lighting for retail & cafe: 120lm/W
- Lighting Controls: Daylight sensors (dimming) & parasitic power: 0.10
- Space Heating & Cooling: Heat pump - SCOP: 4.3, EER: 3.8, SEER: 6.5
- Hot Water: Heat pump; SCOP 3.0 and hot water storage losses: 207MJ/month
- Ventilation: MVHR - Specific fan power: 1.2W/l/s & heat recovery efficiency: 85%
- Ventilation: Variable speed control with CO_2 sensors and summer bypass
- Metering: Heating, lighting and cooling to be sub metered with provision for alarm out of range
- Power factor: >0.95
- PV: 4.0kWp

5.29 For the Be Lean stage, the efficiencies below were used.

- Space Heating Heat Pump COP: 2.86
- Hot Water COP: 2.64

Cooling Demand

5.30 The cooling demands of the non-residential areas are shown in Table 2, below.

Table 2: Cooling Demands for Non-Domestic Areas	
Scheme Component	**Area weighted average non-domestic cooling demand (MJ/m²)**
Actual	167
Notional	225.2

CO_2 Emissions at Be Lean Stage

5.31 Table 3, below, shows the site wide estimated Regulated CO_2 emissions following the ***Be Lean*** measures outlined above. As shown, these result in a CO_2 emissions reduction of **15%** over a Part L 2021 baseline for residential development, and **18%** for non-residential development. This exceeds London Plan requirements. DER and BRUKL worksheets supporting these calculations can be found in appendices A and B respectively.

Table 3: Regulated Carbon Dioxide Emissions at *Be Lean* Stage

Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**		
	Residential	**Non-residential**	**Cumulative**
Baseline: Part L 2021 Compliant Development	392.1	2.6	394.7
After *Be Lean* Measures	334.3	2.1	336.4
Total Emissions Reduction	**57.8**	**0.5**	**58.3**
Percentage Reduction	**15%**	**18%**	**15%**

5.32 Table 4, below, shows the expected Part L 2021 Fabric Energy Efficiency Standard (FEES) following the proposed ***Be Lean*** measures.

Table 4: Fabric Energy Efficiency

	Target Fabric Energy Efficiency (kWh/m²/year)	**Design Fabric Energy Efficiency (kWh/m²/year)**	**Improvement (%)**
Development Total	33.70	32.35	4%

6. *BE CLEAN*: DECENTRALISED ENERGY

6.1 In line with Policy SI3 of the London Plan, the application of decentralised heating networks as a *Be Clean* measure has been evaluated. This is the next step in the Energy Hierarchy after *Be Lean*.

Policy Context

6.2 Policy SI3 of the London Plan outlines the following order of preference for the selection of a heat source:

> Connect to local existing or planned heat networks;

> Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required);

> Use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network);

> Use ultra-low NOx gas boilers.

Area Wide Networks

6.3 Figure 5 below shows the location of the site (blue circle) on the London Heat Map.

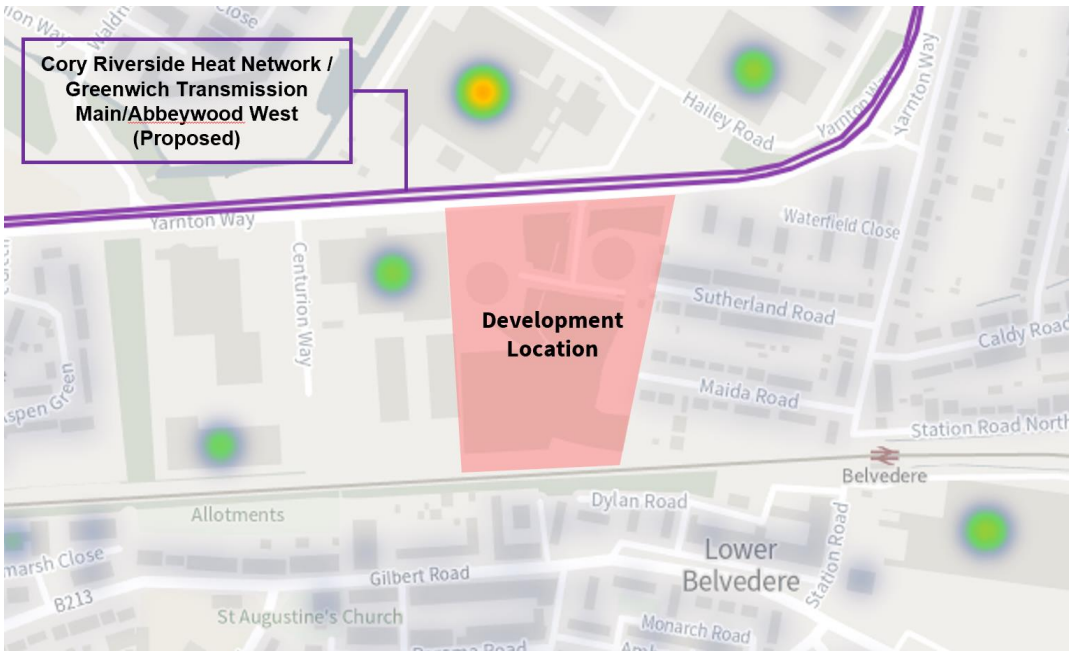

Figure 5: Site on London Heat Map (2023)

6.4 The site is located within a Heat Network Priority Area and there are two heat networks currently proposed directly to the north of the site:

> Cory Riverside Heat Network

> Greenwich Transmission Main / Abbeywood West

6.5 Although neither of these networks are currently operational, following correspondence with Vattenfall who are developing the Cory Riverside Heat Network, it has been decided to implement a strategy to connect to this network subject to detailed commercial negotiations.

6.6 Currently the following details have been confirmed with Vattenfall and, where appropriate, included within the Be Clean calculations:

Issue	Commentary
Heat availability date	Late 2025/early 2026 (in time for commissioning and first occupations, with temporary plant provided [offsite if necessary] where timelines do not align).
Carbon intensity of heat	0.045kgCO_2/kWh based on 100% recovered heat from waste to energy plant. For the purposes of the Be Clean calculations herein, the SAP default value for recovered heat has been used.
Operational temperatures	Primary flow/return 65°C/40°C, secondary flow/return 60°C/35°C.
Connection method	Heat exchanger substations for flats (see Appendix C) for location. Direct connections from branches to houses.
Distribution heat losses	10% primary distribution losses. A heat loss factor has been used in Be Clean calculations reflecting the intention bring the on site network forward in line with CIBSE CP1 requirements. A lower heat loss factor may be applied at detailed design stage.
Design requirements for connection	Currently only high-level information is available, but ongoing discussions with Vattenfall will ensure technical compatibility with the proposed network.

	At this stage sufficient space for substations and hydraulic interface units within each dwelling have been incorporated within the scheme design, and allowance for sufficient riser space to minimise heat losses in order to achieve CIBSE CP1 and London Heat Network Manual targets have been incorporated.

Table 5: Heat Network Connection Details

CO_2 Emissions at Be Clean Stage

6.7 Table below shows the Regulated and Total CO_2 reductions following the application of *Be Clean* measures. DER worksheets to support these calculations are in Appendix E.

Table 5: Regulated Carbon Dioxide Emissions at *Be Clean* Stage

Stage	Carbon Dioxide Emissions (Tonnes CO_2 per Annum)		
	Residential	Non-residential	Cumulative
After *Be Lean* Measures	334.3	2.1	336.4
After *Be Clean* Measures	11.5	2.1	13.6
Total Emissions Reduction	**322.8**	**0.0**	**322.8**
Percentage Reduction	**82%**	**0%**	**82%**

6.8 Table, below, shows the expected Energy Use Intensity (EUI) and space heating demand of the development.

Table 6: EUI and Space Heating Demand

Building Use	EUI (kWh/m²/year)	Space Heating Demand (kWh/m²/year)	Methodology Used	Explanatory Notes
Residential Total	53.20	12.15	SAP 10 Methodology	With unregulated energy demands included it is very hard to meet the target that has been set.
Non-residential	58.49	2.28	SBEM Methodology	

7. BE GREEN: RENEWABLE ENERGY TECHNOLOGIES

7.1 The final part of the Energy Hierarchy is ***Be Green*** which seeks for renewable energy technologies to be specified to provide, where feasible, a reduction in expected CO_2 emissions.

7.2 This section discusses the renewable technologies that are to be used for the proposed development. An analysis of other renewable technologies that are not considered feasible for the development can be found in Appendix F.

Photovoltaic (PV) Panels

7.3 PV panels will enable the development to generate its own electricity on site.

7.4 The apartment roof space that is available for PV installation is presented in Figure 6, as per mark-up provided by the architect. In total, this adds up to 4,902m^2 of useful area in the roofs of the apartment buildings.

7.5 The assumption is that 40% of this area will be covered by PV panels to take into account areas for circulation, maintenance and shading. Hence, 1,961 m^2 of PV panels are being assumed to be installed on site for the apartments.

Figure 6: Roof area available for PV installation (Stockwool, 2023)

7.6 In addition, each mid terrace house has capacity to accommodate 9.6 m^2 of PV, while end terrace houses have capacity to accommodate 12.8 m^2.

7.7 This adds up to an additional 755.2m^2 of PV panels to be installed in houses. This brings the total PV area on site to **2716.2m^2.**

7.8 By assuming that 7m^2 of PV area is equivalent to 1 kWp, the total installed PV anticipated for installation on site is **388 kWp**. This is equivalent to:

> Approximately 0.8 kWp per apartment.

> Approximately 2.4 kWp per mid-terrace house and 3.2 kWp per end terrace house.

7.9 Allocation of the solar PV between the residential and non-residential spaces will be confirmed at detailed design stage, but it is currently anticipated that approximately 4kWp will be allocated to the non-residential space.

CO_2 Emissions at *Be Green* Stage

7.10 Table 7 below shows the Regulated and Total CO_2 reductions following the application of *Be Green* measures. BRUKL worksheets supporting these calculations are shown in Appendix G and SAP Worksheets for the *Be Green* stage are in Appendix I. The proposed measures for the development meets the GLA's benchmark target of a 50% CO_2 reduction over a Part L 2021 baseline for residential areas.

7.11 The PV that is assumed in the notional dwelling under Part L 2021 has been accounted for at the ***Be Lean*** and ***Be Clean*** stages to show only the improvements from the proposed measures at each stage. This is then removed at the ***Be Green*** stage which has resulted in showing a reduction in performance despite, in reality, further CO_2 reduction being achieved from the proposed *Be Green* renewable technology measures at this stage.

Table 7: Regulated Carbon Dioxide Emissions at *Be Green* Stage

Stage	Carbon Dioxide Emissions (Tonnes CO_2 per Annum)		
	Residential	Non-residential	Cumulative
After *Be Clean* Measures	11.5	2.1	13.6
After *Be Green* Measures	6.2	1.6	7.8
Total Emissions Reduction	**5.3**	**0.5**	**5.8**
Percentage Reduction	**1%**	**20%**	**1%**

8. *BE SEEN*: ENERGY MONITORING

8.1 The London Plan introduces a fourth stage to the energy hierarchy; the *Be Seen* stage, which proposes monitoring and reporting of the actual operational energy performance of major developments for at least five years.

8.2 An effectively implemented post-construction monitoring regime can have several benefits including environmental (e.g. reduced grid infrastructure strain, carbon emissions reduction) and socio-economic (e.g. reduced occupants bills and raised awareness around energy use).

8.3 The *Be Seen* stage aims to monitor the actual energy and carbon performance of buildings and compare with the estimated figures put forward at both planning and as-built stages. This will assist with achieving a zero-carbon London and determining the effectiveness of the incumbent policies.

8.4 The figure below outlines the three stages for submission of information, and who is responsible for compiling all necessary outputs.

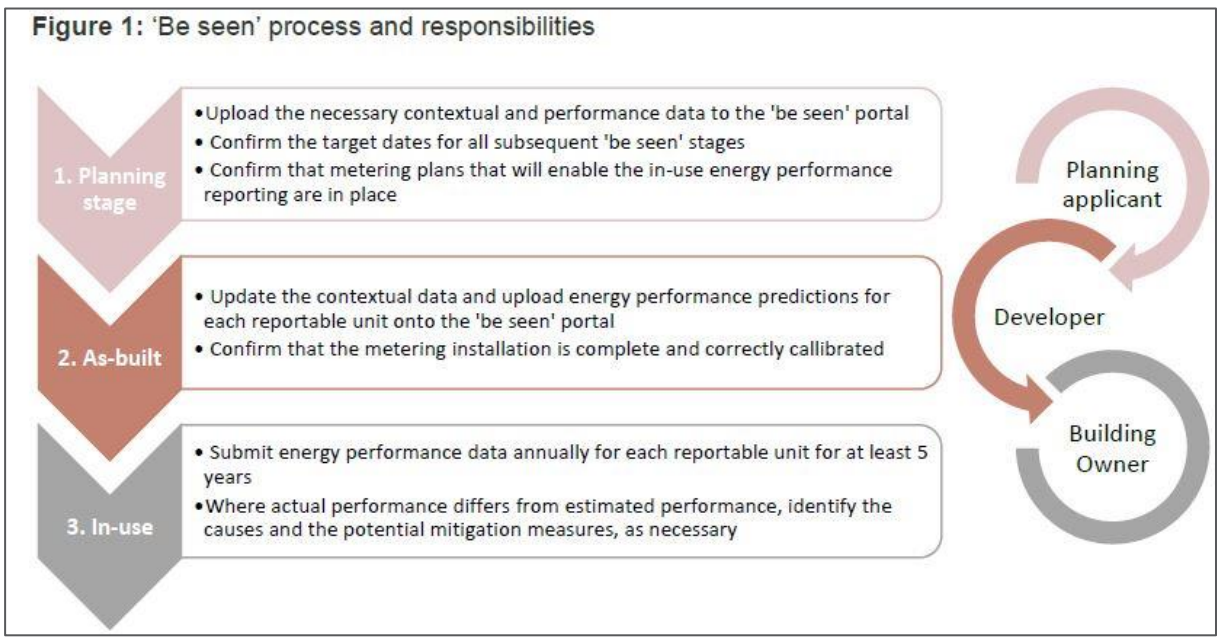

Figure 7: *Be Seen* Stages

8.5 In line with the GLA guidance document (October 2020), the following data points are to be monitored:

> Electricity consumption for dwellings (this encapsulates all energy used);

> Heat consumption from the communal heating network;

- Electricity consumption for non-residential units;
- Electricity consumption for common areas;
- Generation from PV panels.

8.6 The metering and controls strategy will be further developed during the detailed design process. Carbon emissions associated with these energy uses will also be accounted for.

8.7 A reduction in unregulated demands will also be encouraged. More information on e.g. supply of white goods can be found in the sustainability statement.

9. ZERO CARBON

9.1 The London Plan requires a minimum reduction in Regulated CO_2 emissions of 35% beyond the calculated baseline.

9.2 In addition to this, the development is also subject to an additional off-setting contribution to meet a total 100% in Regulated CO_2 emissions in order to achieve a standard of *Zero Carbon*.

9.3 Table 8 below shows the calculated carbon offsetting cost to the application, should the aforementioned ***Be Lean***, ***Be Clean***, *and* ***Be Green*** measures be adopted.

Table 8: Carbon Offset Payment

Stage	Residual CO_2 (Tonnes)	Offset Payment (£95/tonne/30yrs)
Residential	186	£17,696
Non-Residential	48	£4,545
Total	**234**	**£22,241**

9.4 The £95/tonne/year price as set out in the London Plan has been used, for a period of 30 years. It is suggested that a structure be adopted within the S106 document which enables part of this contribution to paid upon occupations in order to reflect any changes to the energy strategy made at as built stage.

10. SUMMARY

10.1 The energy strategy for the proposed development at SGN Belvedere in the London Borough of Bexley has been formulated following the London Plan energy hierarchy: ***Be Lean, Be Clean, Be Green and Be Seen***. The overriding objective is the formulation of a strategy which effectively balances a number of key elements, including CO_2 emissions, affordability of heat, and the provision of high-quality buildings. These elements need to work with the regulatory and planning requirements for the development.

10.2 The proposed development will be built to the updated Part L 2021 Building Regulations. The new Part O of building regulations will also influence the energy strategy.

10.3 A range of Be Lean energy efficiency measures are proposed, including high performance fabric and efficient ventilation systems. They allow the development to achieve a **15%** reduction in site wide regulated CO_2 emissions, with a **15%** reduction for the residential portion of the development and a **18%** reduction for the non-residential development over a Part L 2021 baseline, meeting London Plan requirements.

10.4 In line with the London Plan, the feasibility of decentralised energy production has been considered at the Be Clean stage. A connection to an existing heat network is proposed, sourced by high grade waste heat. This delivers a further site wide CO_2 reduction of **82%**.

10.5 A range of Be Green renewable energy technologies has been considered. Suitable roof space will be utilised to provide approximately **388 kWp** of solar PV.

10.6 Table 12, below, summarises the anticipated site wide CO_2 emissions for the Proposed Development. The combination of the Be Lean, Be Clean and Be Green measures as outlined above result in an overall **98%** reduction over the Part L 2021 baseline. Compliance with both London Plan Policy SI2 (under the 2022 GLA Energy Guidance) is therefore achieved.

10.7 In line with the GLA guidance, the development will commit to offset the remaining CO_2 emissions through a payment to the London Borough of Bexley. The remaining CO_2 emissions to be offset are estimated as **186 Tonnes CO_2** per annum, resulting in the estimated offset payment of **£22,241**, using the price of £95 per tonne of CO_2 for a period of 30 years.

Table 6: Residential Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy

Stage	Carbon Dioxide Emissions (Tonnes CO_2 per Annum)	
	Regulated	Unregulated
Baseline: Part L 2021 Compliant Development	392.1	128.6
After *Be Lean* Measures	334.3	128.6
After *Be Clean* Measures	11.5	128.6
After *Be Green* Measures	6.2	128.6
Stage	**Regulated Carbon Dioxide Savings**	
	Tonnes CO_2 per Annum	**Percentage**
Savings from *Be Lean* Measures	57.8	15%
Savings from *Be Clean* Measures	322.8	82%
Savings from *Be Green* Measures	5.3	1%
Cumulative On-Site Savings	385.9	98%

Table 7: Non- Residential Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy

Stage	Carbon Dioxide Emissions (Tonnes CO_2 per Annum)	
	Regulated	Unregulated
Baseline: Part L 2021 Compliant Development	2.6	2.9
After *Be Lean* Measures	2.1	2.9
After *Be Clean* Measures	2.1	2.9
After *Be Green* Measures	1.6	2.9
Stage	**Regulated Carbon Dioxide Savings**	
	Tonnes CO_2 per Annum	**Percentage**
Savings from *Be Lean* Measures	0.5	18%
Savings from *Be Clean* Measures	0.0	0%
Savings from *Be Green* Measures	0.5	20%
Cumulative On-Site Savings	1.0	38%

Table 8: Site Wide Carbon Dioxide Emissions and Cumulative Savings			
Stage	**Regulated Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	**Regulated Carbon Dioxide Savings**	
		Tonnes CO_2 per Annum	**Percentage**
Baseline: Part L 2021 Compliant Development	394.7	-	-
After ***Be Lean*** Measures	336.4	58.3	15%
After ***Be Clean*** Measures	13.6	322.8	82%
After ***Be Green*** Measures	7.8	5.8	1%
Cumulative On-Site Savings	-	386.9	98%

APPENDICES

Appendix A: SAP TER/DER Worksheets – *Be Lean*

Appendix B: SBEM BRUKL Worksheets – *Be Lean*

Appendix C: Indicative Heat Network Layout

Appendix D: Indicative Roof Plan

Appendix E: SAP TER/DER Worksheets – *Be Clean*

Appendix F: Analysis of renewable technology measures

Appendix G: SBEM BRUKL Worksheets – *Be Green*

Appendix H: Correspondence with Heat Network Operator

Appendix I: SAP TER/DER Worksheets – *Be Green*

Appendix A

SAP TER/DER Worksheets – *Be Lean*

Full SAP Calculation Printout

Property Reference	E1 03 06 (MF Flat) E_Be Lean	Issued on Date	30/08/2023
Assessment Reference	E1 03 06 (MF Flat) E_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	84 B	DER	14.29	TER	15.20
Environmental	90 B	% DER < TER			5.99
CO_2 Emissions (t/year)	0.66	DFEE	33.18	TFEE	32.25
Compliance Check	See BREL	% DFEE < TFEE			-2.87
% DPER < TPER	-1.04	DPER	82.37	TPER	81.52

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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	50.5400 (1b)	x	2.8000 (2b)	=	141.5120 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.5400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	141.5120	(5)

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1162	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.0000 (23c)

Effective ac	0.2432	0.2403	0.2374	0.2229	0.2200	0.2054	0.2054	0.2025	0.2112	0.2200	0.2258	0.2316	(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	
Opening Type 1 (Uw = 0.90)			8.3700	0.8687	7.2712			(27)
Door			4.0400	1.0000	4.0400			(26)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)

Wall to Corridor	40.8400	40.8400	0.1800	7.3512	(29a)
Total net area of external elements Aum(A, m2)		57.8400			(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		19.4886	(33)
Party Wall		22.4000	0.0000	0.0000	(32)
Party Floor 1		50.5400			(32d)
Party Ceiling 1		50.5400			(32b)

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)	4.9300	0.0800	0.3944
E3 Sill	3.9100	0.1000	0.3910
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0500	0.2880
E18 Party wall between dwellings	5.2000	0.0400	0.2080
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.1000	2.9060
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.1500	1.0980
E16 Corner (normal)	5.2000	0.1000	0.5200
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.1124 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 25.6010 (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	11.3581	11.2223	11.0866	10.4080	10.2723	9.5937	9.5937	9.4580	9.8652	10.2723	10.5437	10.8152	(38)
Heat transfer coeff	36.9591	36.8234	36.6877	36.0091	35.8733	35.1948	35.1948	35.0590	35.4662	35.8733	36.1448	36.4162	(39)

Average = Sum(39)m / 12 = 35.9751

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7313	0.7286	0.7259	0.7125	0.7098	0.6964	0.6964	0.6937	0.7017	0.7098	0.7152	0.7205	(40)
HLP (average)												0.7118	
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 1.7060 (42)

Hot water usage for mixer showers												
	59.4266	58.5335	57.2322	54.7422	52.9047	50.8555	49.6908	50.9823	52.3980	54.5982	57.1417	59.1989 (42a)
Hot water usage for baths												
	22.8391	22.4999	22.0223	21.1416	20.4821	19.7509	19.3559	19.8302	20.3466	21.1291	22.0279	22.7619 (42b)
Hot water usage for other uses												
	32.1012	30.9339	29.7666	28.5993	27.4320	26.2646	26.2646	27.4320	28.5993	29.7666	30.9339	32.1012 (42c)

Average daily hot water use (litres/day) 105.1477 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.3670	111.9674	109.0210	104.4831	100.8188	96.8710	95.3113	98.2445	101.3440	105.4939	110.1035	114.0621	(44)
Energy conte	181.1293	159.4401	167.5613	143.0321	135.7214	119.1142	115.2708	121.6472	124.9672	143.1543	156.8626	178.5936	(45)

Energy content (annual) Total = Sum(45)m = 1746.4941

Distribution loss (46)m = 0.15 x (45)m												
	27.1694	23.9160	25.1342	21.4548	20.3582	17.8671	17.2906	18.2471	18.7451	21.4731	23.5294	26.7890	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	41.6805	37.6107	41.5625	40.0554	41.2855	39.8149	41.0605	41.1445	39.8982	41.3501	40.1757	41.6585	(61)
Total heat required for water heating calculated for each month													
	222.8098	197.0508	209.1238	183.0875	177.0069	158.9291	156.3313	162.7916	164.8655	184.5044	197.0384	220.2521	(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													
	222.8098	197.0508	209.1238	183.0875	177.0069	158.9291	156.3313	162.7916	164.8655	184.5044	197.0384	220.2521	(64)

Total per year (kWh/year) = Sum(64)m = 2233.7911 (64)

12Total per year (kWh/year) 2234 (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												
	70.6456	62.4165	66.1047	57.5720	55.4487	49.5592	48.5927	50.7338	51.5262	57.9363	62.2008	69.7970	(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	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	77.6959	86.0205	77.6959	80.2858	77.6959	80.2858	77.6959	77.6959	80.2858	77.6959	80.2858	77.6959	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.6364	150.1787	146.2920	138.0176	127.5726	117.7558	111.1975	109.6552	113.5419	121.8163	132.2613	142.0781	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	(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)												
	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403 (71)
Water heating gains (Table 5)												
	94.9538	92.8817	88.8505	79.9611	74.5279	68.8322	65.3127	68.1906	71.5641	77.8714	86.3899	93.8132 (72)
Total internal gains												
	372.8762	380.6710	364.4285	349.8546	331.3865	315.4639	302.7963	304.1318	313.9819	328.9738	350.5272	365.1773 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	8.3700	19.6403	0.3000	0.8000	0.7700	27.3412 (76)

Solar gains	27.3412	53.4851	88.0824	128.4630	157.4362	161.1639	153.4346	131.7981	102.4435	63.4646	34.0912	22.4841 (83)
Total gains	400.2174	434.1562	452.5109	478.3176	488.8227	476.6279	456.2310	435.9299	416.4254	392.4384	384.6184	387.6614 (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	94.9623	95.3123	95.6649	97.4677	97.8365	99.7229	99.7229	100.1089	98.9597	97.8365	97.1018	96.3780	
alpha	7.3308	7.3542	7.3777	7.4978	7.5224	7.6482	7.6482	7.6739	7.5973	7.5224	7.4735	7.4252	
util living area													
	0.9849	0.9708	0.9390	0.8373	0.6698	0.4718	0.3394	0.3698	0.5833	0.8592	0.9645	0.9874 (86)	
MIT	20.4879	20.6062	20.7539	20.9188	20.9856	20.9991	20.9999	20.9999	20.9959	20.9172	20.6972	20.4730 (87)	
Th 2	20.3133	20.3156	20.3180	20.3298	20.3322	20.3440	20.3440	20.3464	20.3393	20.3322	20.3275	20.3227 (88)	
util rest of house													
	0.9809	0.9634	0.9243	0.8065	0.6258	0.4238	0.2888	0.3174	0.5293	0.8251	0.9543	0.9839 (89)	
MIT 2	19.8557	19.9724	20.1142	20.2703	20.3236	20.3437	20.3440	20.3464	20.3373	20.2738	20.0716	19.8494 (90)	
Living area fraction										fLA = Living area / (4) =		0.5006 (91)	
MIT	20.1722	20.2897	20.4344	20.5950	20.6550	20.6718	20.6724	20.6735	20.6670	20.5958	20.3848	20.1616 (92)	
Temperature adjustment												-0.1500	
adjusted MIT	20.0222	20.1397	20.2844	20.4450	20.5050	20.5218	20.5224	20.5235	20.5170	20.4458	20.2348	20.0116 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9788	0.9612	0.9235	0.8121	0.6374	0.4368	0.3026	0.3316	0.5440	0.8313	0.9527	0.9820 (94)	
Useful gains	391.7421	417.2943	417.9128	388.4280	311.5764	208.2054	138.0365	144.5464	226.5322	326.2190	366.4234	380.7007 (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													
	581.0771	561.1770	505.7178	415.7234	315.8648	208.4153	138.0468	144.5666	227.5857	353.2034	474.7538	575.7977 (97)	
Space heating kWh													
	140.8653	96.6892	65.3269	19.6527	3.1906	0.0000	0.0000	0.0000	0.0000	20.0764	77.9979	145.1522 (98a)	
Space heating requirement - total per year (kWh/year)												568.9511	
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													
	140.8653	96.6892	65.3269	19.6527	3.1906	0.0000	0.0000	0.0000	0.0000	20.0764	77.9979	145.1522 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												568.9511	
Space heating per m2											(98c) / (4) =	11.2574 (99)	

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													88.3000 (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													
	140.8653	96.6892	65.3269	19.6527	3.1906	0.0000	0.0000	0.0000	0.0000	20.0764	77.9979	145.1522 (98)	
Space heating efficiency (main heating system 1)													
	88.3000	88.3000	88.3000	88.3000	88.3000	0.0000	0.0000	0.0000	0.0000	88.3000	88.3000	88.3000 (210)	
Space heating fuel (main heating system)													
	159.5303	109.5008	73.9829	22.2567	3.6133	0.0000	0.0000	0.0000	0.0000	22.7366	88.3328	164.3853 (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

	222.8098	197.0508	209.1238	183.0875	177.0069	158.9291	156.3313	162.7916	164.8655	184.5044	197.0384	220.2521 (64)
Efficiency of water heater												87.3000 (216)
(217)m	87.6846	87.6267	87.5360	87.3959	87.3175	87.3000	87.3000	87.3000	87.3000	87.3971	87.5813	87.6945 (217)
Fuel for water heating, kWh/month												
	254.1036	224.8754	238.9004	209.4920	202.7164	182.0494	179.0736	186.4738	188.8493	211.1104	224.9777	251.1583 (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	18.8512	17.0269	18.8512	18.2431	18.8512	18.2431	18.8512	18.8512	18.2431	18.8512	18.2431	18.8512 (231)
Lighting	17.2321	13.8242	12.4472	9.1193	7.0440	5.7550	6.4258	8.3525	10.8491	14.2346	16.0779	17.7110 (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	644.3387 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	87.3000
Water heating fuel used	2553.7803 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)	
mechanical ventilation fans (SFP = 0.7875)	135.9577 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	221.9577 (231)
Electricity for lighting (calculated in Appendix L)	139.0728 (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	3559.1495 (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	644.3387	0.2100	135.3111	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2553.7803	0.2100	536.2939	(264)
Space and water heating			671.6050	(265)
Pumps, fans and electric keep-hot	221.9577	0.1387	30.7883	(267)
Energy for lighting	139.0728	0.1443	20.0725	(268)
Total CO2, kg/year			722.4658	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.2900	(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	644.3387	1.1300	728.1028	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2553.7803	1.1300	2885.7717	(278)
Space and water heating			3613.8745	(279)
Pumps, fans and electric keep-hot	221.9577	1.5128	335.7775	(281)
Energy for lighting	139.0728	1.5338	213.3144	(282)
Total Primary energy kWh/year			4162.9665	(286)
Dwelling Primary energy Rate (DPER)			82.3700	(287)

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		50.5400 (1b)	x	2.8000 (2b)	=	141.5120 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.5400						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	141.5120	(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		2 * 10 =	20.0000	(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) =		20.0000 / (5) =	0.1413	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3913	(18)
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3033	(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	0.3867	0.3791	0.3715	0.3336	0.3260	0.2881	0.2881	0.2805	0.3033	0.3260	0.3412	0.3564	(22b)
Effective ac	0.5748	0.5719	0.5690	0.5556	0.5531	0.5415	0.5415	0.5394	0.5460	0.5531	0.5582	0.5635	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			8.3700	1.1450	9.5840			(27)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)
Wall to Corridor	40.8400		40.8400	0.1800	7.3512			(29a)
Total net area of external elements Aum(A, m2)			57.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		21.8014			(33)
Party Wall			22.4000	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)	4.9300	0.0500	0.2465
E3 Sill	3.9100	0.0500	0.1955
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0700	0.4032
E18 Party wall between dwellings	5.2000	0.0600	0.3120
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.0700	2.0342
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.0200	0.1464
E16 Corner (normal)	5.2000	0.0900	0.4680
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.1128	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	25.9142	(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	26.8408	26.7052	26.5723	25.9482	25.8314	25.2878	25.2878	25.1871	25.4972	25.8314	26.0676	26.3146	(38)
Heat transfer coeff	52.7550	52.6194	52.4865	51.8623	51.7456	51.2019	51.2019	51.1013	51.4113	51.7456	51.9818	52.2288	(39)
Average = Sum(39)m / 12 =												51.8618	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0438	1.0411	1.0385	1.0262	1.0239	1.0131	1.0131	1.0111	1.0172	1.0239	1.0285	1.0334	(40)
HLP (average)												1.0262	
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 1.7060 (42)
Hot water usage for mixer showers
52.8236 52.0298 50.8730 48.6598 47.0264 45.2049 44.1696 45.3176 46.5760 48.5318 50.7926 52.6213 (42a)
Hot water usage for baths
22.8391 22.4999 22.0223 21.1416 20.4821 19.7509 19.3559 19.8302 20.3466 21.1291 22.0279 22.7619 (42b)
Hot water usage for other uses
32.1012 30.9339 29.7666 28.5993 27.4320 26.2646 26.2646 27.4320 28.5993 29.7666 30.9339 32.1012 (42c)
Average daily hot water use (litres/day) 99.0600 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.7640	105.4637	102.6619	98.4006	94.9405	91.2204	89.7901	92.5798	95.5220	99.4275	103.7544	107.4844	(44)
Energy conte	170.6718	150.1788	157.7875	134.7055	127.8081	112.1661	108.5933	114.6331	117.7881	134.9221	147.8172	168.2946	(45)
Energy content (annual)										Total = Sum(45)m =		1645.3665	
Distribution loss (46)m = 0.15 x (45)m													
	25.6008	22.5268	23.6681	20.2058	19.1712	16.8249	16.2890	17.1950	17.6682	20.2383	22.1726	25.2442	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	48.5263	48.3806	44.9854	45.7561	47.1776	47.1067	50.6671	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	221.6307	196.2062	208.7464	183.2318	176.1887	157.1516	154.3494	161.8107	164.8948	185.5893	197.1323	219.2535	(62)
WWHRS	-24.1488	-21.3574	-22.3642	-18.5184	-17.2585	-14.7682	-13.8429	-14.7205	-15.2798	-18.0132	-20.4068	-23.7016	(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													
	197.4820	174.8489	186.3822	164.7134	158.9302	142.3833	140.5065	147.0902	149.6151	167.5761	176.7255	195.5519	(64)
									Total per year (kWh/year) = Sum(64)m =			2001.8053	(64)
12Total per year (kWh/year)												2002	(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													
	69.4881	61.4413	65.2041	56.9212	54.5914	48.5416	47.5463	49.9099	50.9412	57.5284	61.4780	68.6977	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	77.6959	86.0205	77.6959	80.2858	77.6959	80.2858	77.6959	77.6959	80.2858	77.6959	80.2858	77.6959	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.6364	150.1787	146.2920	138.0176	127.5726	117.7558	111.1975	109.6552	113.5419	121.8163	132.2613	142.0781	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	(71)
Water heating gains (Table 5)													
	93.3980	91.4305	87.6399	79.0572	73.3755	67.4189	63.9063	67.0832	70.7517	77.3231	85.3861	92.3356	(72)
Total internal gains													
	371.3204	379.2199	363.2179	348.9506	330.2341	314.0506	301.3899	303.0244	313.1695	328.4255	349.5233	363.6998	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3700	19.6403	0.6300	0.7000	0.7700	50.2394	(76)

Solar gains	50.2394	98.2790	161.8514	236.0507	289.2890	296.1387	281.9362	242.1790	188.2399	116.6163	62.6426	41.3145	(83)
Total gains	421.5598	477.4988	525.0694	585.0013	619.5231	610.1893	583.3261	545.2034	501.4095	445.0418	412.1660	405.0142	(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	66.5288	66.7002	66.8690	67.6738	67.8265	68.5467	68.5467	68.6817	68.2675	67.8265	67.5183	67.1990	
alpha	5.4353	5.4467	5.4579	5.5116	5.5218	5.5698	5.5698	5.5788	5.5512	5.5218	5.5012	5.4799	
util living area													
	0.9904	0.9803	0.9550	0.8745	0.7235	0.5291	0.3850	0.4289	0.6737	0.9147	0.9799	0.9922	(86)
MIT	19.9975	20.1797	20.4380	20.7484	20.9284	20.9895	20.9985	20.9973	20.9631	20.7154	20.3088	19.9693	(87)

Th 2	20.0470	20.0492	20.0514	20.0616	20.0635	20.0724	20.0724	20.0741	20.0690	20.0635	20.0596	20.0556	(88)
util rest of house	0.9875	0.9745	0.9419	0.8419	0.6664	0.4559	0.3045	0.3438	0.5958	0.8841	0.9729	0.9898	(89)
MIT 2	18.8968	19.1278	19.4493	19.8212	20.0080	20.0669	20.0720	20.0732	20.0463	19.7954	19.3007	18.8675	(90)
Living area fraction										fLA = Living area / (4) =		0.5006	(91)
MIT	19.4478	19.6544	19.9442	20.2853	20.4688	20.5287	20.5358	20.5358	20.5053	20.2560	19.8053	19.4191	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4478	19.6544	19.9442	20.2853	20.4688	20.5287	20.5358	20.5358	20.5053	20.2560	19.8053	19.4191	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9851	0.9715	0.9401	0.8503	0.6920	0.4923	0.3449	0.3864	0.6334	0.8911	0.9705	0.9877	(94)
Useful gains	415.2978	463.8854	493.6385	497.4489	428.7083	300.4068	201.1651	210.6890	317.6052	396.5988	400.0192	400.0146	(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	799.1220	776.3651	705.6397	590.4704	453.7444	303.5617	201.5197	211.3449	329.3040	499.6532	660.4467	794.8740	(97)
Space heating kWh	285.5652	209.9864	157.7289	66.9755	18.6269	0.0000	0.0000	0.0000	0.0000	76.6725	187.5078	293.7754	(98a)
Space heating requirement - total per year (kWh/year)												1296.8386	
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	285.5652	209.9864	157.7289	66.9755	18.6269	0.0000	0.0000	0.0000	0.0000	76.6725	187.5078	293.7754	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1296.8386	
Space heating per m2											(98c) / (4) =	25.6596	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.4000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	285.5652	209.9864	157.7289	66.9755	18.6269	0.0000	0.0000	0.0000	0.0000	76.6725	187.5078	293.7754	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	309.0533	227.2580	170.7023	72.4843	20.1590	0.0000	0.0000	0.0000	0.0000	82.9789	202.9305	317.9388	(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	197.4820	174.8489	186.3822	164.7134	158.9302	142.3833	140.5065	147.0902	149.6151	167.5761	176.7255	195.5519	(64)
Efficiency of water heater												80.3000	(216)
(217)m	85.1708	84.7749	84.0258	82.6102	81.1233	80.3000	80.3000	80.3000	80.3000	82.8149	84.5086	85.2512	(217)
Fuel for water heating, kWh/month	231.8657	206.2508	221.8154	199.3864	195.9120	177.3142	174.9770	183.1758	186.3201	202.3503	209.1214	229.3831	(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	16.1437	12.9511	11.6610	8.5433	6.5991	5.3915	6.0199	7.8249	10.1638	13.3355	15.0624	16.5924	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-11.3138	-17.0291	-26.1177	-31.4068	-35.6997	-34.0167	-33.6213	-30.8312	-26.2323	-20.3627	-12.8211	-9.6609	(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	-3.4863	-7.5439	-15.3897	-23.7023	-31.9162	-32.2648	-31.8673	-26.7013	-19.2192	-10.9587	-4.7098	-2.7404	(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												1403.5050	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												80.3000	
Water heating fuel used												2417.8723	(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)												130.2887	(232)

Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-499.6132 (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	3538.0527 (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	1403.5050	0.2100	294.7360	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2417.8723	0.2100	507.7532	(264)
Space and water heating			802.4892	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	130.2887	0.1443	18.8047	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	0.1332	-38.5158	
PV Unit electricity exported	-210.4999	0.1252	-26.3508	
Total			-64.8666	(269)
Total CO2, kg/year			768.3566	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.2000	(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	1403.5050	1.1300	1585.9606	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2417.8723	1.1300	2732.1957	(278)
Space and water heating			4318.1563	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	130.2887	1.5338	199.8412	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	1.4923	-431.4386	
PV Unit electricity exported	-210.4999	0.4595	-96.7185	
Total			-528.1571	(283)
Total Primary energy kWh/year			4119.9411	(286)
Target Primary Energy Rate (TPER)			81.5200	(287)

Full SAP Calculation Printout

Property Reference	E1 03 06 (MF Flat)_Be Lean	Issued on Date	30/08/2023
Assessment Reference	E1 03 06 (MF Flat)_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	84 B	DER	14.08	TER	15.20
Environmental	90 B	% DER < TER			7.37
CO_2 Emissions (t/year)	0.65	DFEE	31.94	TFEE	32.25
Compliance Check	See BREL	% DFEE < TFEE			0.97
% DPER < TPER	0.40	DPER	81.19	TPER	81.52

Assessor Details	Mr. Michael Wride	Assessor ID	U300-0001
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		50.5400 (1b)	x	2.8000 (2b)	=	141.5120 (1b)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.5400						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	141.5120	(5)

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2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1162	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.0000 (23c)

Effective ac	0.2432	0.2403	0.2374	0.2229	0.2200	0.2054	0.2054	0.2025	0.2112	0.2200	0.2258	0.2316	(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	
Opening Type 1 (Uw = 0.90)			8.3700	0.8687	7.2712			(27)
Door			4.0400	1.0000	4.0400			(26)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)

Wall to Corridor	40.8400	40.8400	0.1800	7.3512	(29a)
Total net area of external elements Aum(A, m2)		57.8400			(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		19.4886	(33)
Party Wall		22.4000	0.0000	0.0000	(32)
Party Floor 1		50.5400			(32d)
Party Ceiling 1		50.5400			(32b)

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)	4.9300	0.0800	0.3944
E3 Sill	3.9100	0.1000	0.3910
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0500	0.2880
E18 Party wall between dwellings	5.2000	0.0400	0.2080
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.1000	2.9060
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.1500	1.0980
E16 Corner (normal)	5.2000	0.1000	0.5200
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.1124 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 25.6010 (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	11.3581	11.2223	11.0866	10.4080	10.2723	9.5937	9.5937	9.4580	9.8652	10.2723	10.5437	10.8152	(38)
Heat transfer coeff	36.9591	36.8234	36.6877	36.0091	35.8733	35.1948	35.1948	35.0590	35.4662	35.8733	36.1448	36.4162	(39)

Average = Sum(39)m / 12 = 35.9751

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7313	0.7286	0.7259	0.7125	0.7098	0.6964	0.6964	0.6937	0.7017	0.7098	0.7152	0.7205	(40)
HLP (average)												0.7118	
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 1.7060 (42)

Hot water usage for mixer showers												
	59.4266	58.5335	57.2322	54.7422	52.9047	50.8555	49.6908	50.9823	52.3980	54.5982	57.1417	59.1989 (42a)
Hot water usage for baths												
	22.8391	22.4999	22.0223	21.1416	20.4821	19.7509	19.3559	19.8302	20.3466	21.1291	22.0279	22.7619 (42b)
Hot water usage for other uses												
	32.1012	30.9339	29.7666	28.5993	27.4320	26.2646	26.2646	27.4320	28.5993	29.7666	30.9339	32.1012 (42c)

Average daily hot water use (litres/day) 105.1477 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.3670	111.9674	109.0210	104.4831	100.8188	96.8710	95.3113	98.2445	101.3440	105.4939	110.1035	114.0621	(44)
Energy conte	181.1293	159.4401	167.5613	143.0321	135.7214	119.1142	115.2708	121.6472	124.9672	143.1543	156.8626	178.5936	(45)

Energy content (annual) Total = Sum(45)m = 1746.4941

Distribution loss (46)m = 0.15 x (45)m												
	27.1694	23.9160	25.1342	21.4548	20.3582	17.8671	17.2906	18.2471	18.7451	21.4731	23.5294	26.7890	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	41.6805	37.6107	41.5625	40.0554	41.2855	39.8149	41.0605	41.1445	39.8982	41.3501	40.1757	41.6585	(61)
Total heat required for water heating calculated for each month													
	222.8098	197.0508	209.1238	183.0875	177.0069	158.9291	156.3313	162.7916	164.8655	184.5044	197.0384	220.2521	(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													
	222.8098	197.0508	209.1238	183.0875	177.0069	158.9291	156.3313	162.7916	164.8655	184.5044	197.0384	220.2521	(64)

Total per year (kWh/year) = Sum(64)m = 2233.7911 (64)

12Total per year (kWh/year) 2234 (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												
	70.6456	62.4165	66.1047	57.5720	55.4487	49.5592	48.5927	50.7338	51.5262	57.9363	62.2008	69.7970	(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	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	77.6959	86.0205	77.6959	80.2858	77.6959	80.2858	77.6959	77.6959	80.2858	77.6959	80.2858	77.6959	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.6364	150.1787	146.2920	138.0176	127.5726	117.7558	111.1975	109.6552	113.5419	121.8163	132.2613	142.0781	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	(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)												
	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403 (71)
Water heating gains (Table 5)												
	94.9538	92.8817	88.8505	79.9611	74.5279	68.8322	65.3127	68.1906	71.5641	77.8714	86.3899	93.8132 (72)
Total internal gains												
	372.8762	380.6710	364.4285	349.8546	331.3865	315.4639	302.7963	304.1318	313.9819	328.9738	350.5272	365.1773 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
West	8.3700	19.6403	0.4000	0.8000	0.7700	36.4549 (80)

Solar gains	36.4549	71.3135	117.4432	171.2839	209.9149	214.8853	204.5795	175.7308	136.5913	84.6195	45.4550	29.9787 (83)
Total gains	409.3311	451.9846	481.8717	521.1386	541.3014	530.3492	507.3758	479.8626	450.5733	413.5933	395.9822	395.1561 (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	94.9623	95.3123	95.6649	97.4677	97.8365	99.7229	99.7229	100.1089	98.9597	97.8365	97.1018	96.3780	
alpha	7.3308	7.3542	7.3777	7.4978	7.5224	7.6482	7.6482	7.6739	7.5973	7.5224	7.4735	7.4252	
util living area													
	0.9829	0.9640	0.9194	0.7903	0.6100	0.4244	0.3052	0.3360	0.5407	0.8325	0.9588	0.9859	(86)
MIT	20.5065	20.6389	20.7956	20.9450	20.9921	20.9996	21.0000	20.9999	20.9975	20.9336	20.7172	20.4887	(87)
Th 2	20.3133	20.3156	20.3180	20.3298	20.3322	20.3440	20.3440	20.3464	20.3393	20.3322	20.3275	20.3227	(88)
util rest of house													
	0.9783	0.9552	0.9017	0.7571	0.5684	0.3810	0.2597	0.2883	0.4900	0.7960	0.9473	0.9821	(89)
MIT 2	19.8739	20.0034	20.1515	20.2906	20.3276	20.3439	20.3440	20.3464	20.3381	20.2863	20.0902	19.8647	(90)
Living area fraction										fLA = Living area / (4) =		0.5006	(91)
MIT	20.1906	20.3215	20.4739	20.6182	20.6602	20.6721	20.6724	20.6736	20.6682	20.6103	20.4041	20.1770	(92)
Temperature adjustment												-0.1500	
adjusted MIT	20.0406	20.1715	20.3239	20.4682	20.5102	20.5221	20.5224	20.5236	20.5182	20.4603	20.2541	20.0270	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9762	0.9531	0.9019	0.7642	0.5796	0.3928	0.2721	0.3012	0.5038	0.8034	0.9459	0.9801	(94)
Useful gains	399.5896	430.7764	434.6035	398.2396	313.7323	208.3269	138.0428	144.5578	226.9979	332.2723	374.5639	387.2946	(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													
	581.7575	562.3492	507.1678	416.5586	316.0529	208.4269	138.0475	144.5679	227.6289	353.7232	475.4523	576.3611	(97)
Space heating kWh													
	135.5329	88.4169	53.9879	13.1897	1.7265	0.0000	0.0000	0.0000	0.0000	15.9594	72.6397	140.6655	(98a)
Space heating requirement - total per year (kWh/year)												522.1185	
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													
	135.5329	88.4169	53.9879	13.1897	1.7265	0.0000	0.0000	0.0000	0.0000	15.9594	72.6397	140.6655	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												522.1185	
Space heating per m2											(98c) / (4) =	10.3308	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													88.3000 (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													
	135.5329	88.4169	53.9879	13.1897	1.7265	0.0000	0.0000	0.0000	0.0000	15.9594	72.6397	140.6655	(98)
Space heating efficiency (main heating system 1)													
	88.3000	88.3000	88.3000	88.3000	88.3000	0.0000	0.0000	0.0000	0.0000	88.3000	88.3000	88.3000	(210)
Space heating fuel (main heating system)													
	153.4914	100.1324	61.1414	14.9374	1.9553	0.0000	0.0000	0.0000	0.0000	18.0741	82.2646	159.3041	(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

	222.8098	197.0508	209.1238	183.0875	177.0069	158.9291	156.3313	162.7916	164.8655	184.5044	197.0384	220.2521 (64)
Efficiency of water heater												87.3000 (216)
(217)m	87.6755	87.6073	87.5033	87.3665	87.3096	87.3000	87.3000	87.3000	87.3000	87.3788	87.5671	87.6870 (217)
Fuel for water heating, kWh/month												
	254.1300	224.9251	238.9895	209.5626	202.7349	182.0494	179.0736	186.4738	188.8493	211.1547	225.0141	251.1798 (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	18.8512	17.0269	18.8512	18.2431	18.8512	18.2431	18.8512	18.8512	18.2431	18.8512	18.2431	18.8512 (231)
Lighting	17.2321	13.8242	12.4472	9.1193	7.0440	5.7550	6.4258	8.3525	10.8491	14.2346	16.0779	17.7110 (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	591.3007 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	87.3000
Water heating fuel used	2554.1367 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)	
mechanical ventilation fans (SFP = 0.7875)	135.9577 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	221.9577 (231)
Electricity for lighting (calculated in Appendix L)	139.0728 (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	3506.4678 (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	591.3007	0.2100	124.1731	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2554.1367	0.2100	536.3687	(264)
Space and water heating			660.5418	(265)
Pumps, fans and electric keep-hot	221.9577	0.1387	30.7883	(267)
Energy for lighting	139.0728	0.1443	20.0725	(268)
Total CO2, kg/year			711.4026	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.0800	(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	591.3007	1.1300	668.1698	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2554.1367	1.1300	2886.1744	(278)
Space and water heating			3554.3442	(279)
Pumps, fans and electric keep-hot	221.9577	1.5128	335.7775	(281)
Energy for lighting	139.0728	1.5338	213.3144	(282)
Total Primary energy kWh/year			4103.4362	(286)
Dwelling Primary energy Rate (DPER)			81.1900	(287)

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		50.5400 (1b)	x	2.8000 (2b)	=	141.5120 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.5400						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	141.5120	(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		2 * 10 =	20.0000	(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) =		20.0000 / (5) =	0.1413	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3913	(18)
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3033	(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	0.3867	0.3791	0.3715	0.3336	0.3260	0.2881	0.2881	0.2805	0.3033	0.3260	0.3412	0.3564	(22b)
Effective ac	0.5748	0.5719	0.5690	0.5556	0.5531	0.5415	0.5415	0.5394	0.5460	0.5531	0.5582	0.5635	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			8.3700	1.1450	9.5840			(27)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)
Wall to Corridor	40.8400		40.8400	0.1800	7.3512			(29a)
Total net area of external elements Aum(A, m2)			57.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		21.8014			(33)
Party Wall			22.4000	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)	4.9300	0.0500	0.2465
E3 Sill	3.9100	0.0500	0.1955
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0700	0.4032
E18 Party wall between dwellings	5.2000	0.0600	0.3120
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.0700	2.0342
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.0200	0.1464
E16 Corner (normal)	5.2000	0.0900	0.4680
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.1128	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	25.9142	(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	26.8408	26.7052	26.5723	25.9482	25.8314	25.2878	25.2878	25.1871	25.4972	25.8314	26.0676	26.3146	(38)
Heat transfer coeff	52.7550	52.6194	52.4865	51.8623	51.7456	51.2019	51.2019	51.1013	51.4113	51.7456	51.9818	52.2288	(39)
Average = Sum(39)m / 12 =												51.8618	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0438	1.0411	1.0385	1.0262	1.0239	1.0131	1.0131	1.0111	1.0172	1.0239	1.0285	1.0334	(40)
HLP (average)												1.0262	
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 1.7060 (42)

Hot water usage for mixer showers

	52.8236	52.0298	50.8730	48.6598	47.0264	45.2049	44.1696	45.3176	46.5760	48.5318	50.7926	52.6213 (42a)

Hot water usage for baths

	22.8391	22.4999	22.0223	21.1416	20.4821	19.7509	19.3559	19.8302	20.3466	21.1291	22.0279	22.7619 (42b)

Hot water usage for other uses

	32.1012	30.9339	29.7666	28.5993	27.4320	26.2646	26.2646	27.4320	28.5993	29.7666	30.9339	32.1012 (42c)

Average daily hot water use (litres/day) 99.0600 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.7640	105.4637	102.6619	98.4006	94.9405	91.2204	89.7901	92.5798	95.5220	99.4275	103.7544	107.4844	(44)
Energy conte	170.6718	150.1788	157.7875	134.7055	127.8081	112.1661	108.5933	114.6331	117.7881	134.9221	147.8172	168.2946	(45)
Energy content (annual)										Total = Sum(45)m =		1645.3665	
Distribution loss (46)m = 0.15 x (45)m													
	25.6008	22.5268	23.6681	20.2058	19.1712	16.8249	16.2890	17.1950	17.6682	20.2383	22.1726	25.2442	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	48.5263	48.3806	44.9854	45.7561	47.1776	47.1067	50.6671	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	221.6307	196.2062	208.7464	183.2318	176.1887	157.1516	154.3494	161.8107	164.8948	185.5893	197.1323	219.2535	(62)
WWHRS	-24.1488	-21.3574	-22.3642	-18.5184	-17.2585	-14.7682	-13.8429	-14.7205	-15.2798	-18.0132	-20.4068	-23.7016	(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													
	197.4820	174.8489	186.3822	164.7134	158.9302	142.3833	140.5065	147.0902	149.6151	167.5761	176.7255	195.5519	(64)
										Total per year (kWh/year) = Sum(64)m =		2001.8053	(64)
12Total per year (kWh/year)												2002	(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													
	69.4881	61.4413	65.2041	56.9212	54.5914	48.5416	47.5463	49.9099	50.9412	57.5284	61.4780	68.6977	(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	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	77.6959	86.0205	77.6959	80.2858	77.6959	80.2858	77.6959	77.6959	80.2858	77.6959	80.2858	77.6959	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.6364	150.1787	146.2920	138.0176	127.5726	117.7558	111.1975	109.6552	113.5419	121.8163	132.2613	142.0781	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	(71)
Water heating gains (Table 5)													
	93.3980	91.4305	87.6399	79.0572	73.3755	67.4189	63.9063	67.0832	70.7517	77.3231	85.3861	92.3356	(72)
Total internal gains													
	371.3204	379.2199	363.2179	348.9506	330.2341	314.0506	301.3899	303.0244	313.1695	328.4255	349.5233	363.6998	(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	
West	8.3700	19.6403	0.6300	0.7000	0.7700	50.2394	(80)

Solar gains	50.2394	98.2790	161.8514	236.0507	289.2890	296.1387	281.9362	242.1790	188.2399	116.6163	62.6426	41.3145	(83)
Total gains	421.5598	477.4988	525.0694	585.0013	619.5231	610.1893	583.3261	545.2034	501.4095	445.0418	412.1660	405.0142	(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	66.5288	66.7002	66.8690	67.6738	67.8265	68.5467	68.5467	68.6817	68.2675	67.8265	67.5183	67.1990	
alpha	5.4353	5.4467	5.4579	5.5116	5.5218	5.5698	5.5698	5.5788	5.5512	5.5218	5.5012	5.4799	
util living area													
	0.9904	0.9803	0.9550	0.8745	0.7235	0.5291	0.3850	0.4289	0.6737	0.9147	0.9799	0.9922	(86)
MIT	19.9975	20.1797	20.4380	20.7484	20.9284	20.9895	20.9985	20.9973	20.9631	20.7154	20.3088	19.9693	(87)

Th 2	20.0470	20.0492	20.0514	20.0616	20.0635	20.0724	20.0724	20.0741	20.0690	20.0635	20.0596	20.0556	(88)
util rest of house	0.9875	0.9745	0.9419	0.8419	0.6664	0.4559	0.3045	0.3438	0.5958	0.8841	0.9729	0.9898	(89)
MIT 2	18.8968	19.1278	19.4493	19.8212	20.0080	20.0669	20.0720	20.0732	20.0463	19.7954	19.3007	18.8675	(90)
Living area fraction										fLA = Living area / (4) =		0.5006	(91)
MIT	19.4478	19.6544	19.9442	20.2853	20.4688	20.5287	20.5358	20.5358	20.5053	20.2560	19.8053	19.4191	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4478	19.6544	19.9442	20.2853	20.4688	20.5287	20.5358	20.5358	20.5053	20.2560	19.8053	19.4191	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9851	0.9715	0.9401	0.8503	0.6920	0.4923	0.3449	0.3864	0.6334	0.8911	0.9705	0.9877	(94)
Useful gains	415.2978	463.8854	493.6385	497.4489	428.7083	300.4068	201.1651	210.6890	317.6052	396.5988	400.0192	400.0146	(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	799.1220	776.3651	705.6397	590.4704	453.7444	303.5617	201.5197	211.3449	329.3040	499.6532	660.4467	794.8740	(97)
Space heating kWh	285.5652	209.9864	157.7289	66.9755	18.6269	0.0000	0.0000	0.0000	0.0000	76.6725	187.5078	293.7754	(98a)
Space heating requirement - total per year (kWh/year)												1296.8386	
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	285.5652	209.9864	157.7289	66.9755	18.6269	0.0000	0.0000	0.0000	0.0000	76.6725	187.5078	293.7754	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1296.8386	
Space heating per m2											(98c) / (4) =	25.6596	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.4000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	285.5652	209.9864	157.7289	66.9755	18.6269	0.0000	0.0000	0.0000	0.0000	76.6725	187.5078	293.7754	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	309.0533	227.2580	170.7023	72.4843	20.1590	0.0000	0.0000	0.0000	0.0000	82.9789	202.9305	317.9388	(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	197.4820	174.8489	186.3822	164.7134	158.9302	142.3833	140.5065	147.0902	149.6151	167.5761	176.7255	195.5519	(64)
Efficiency of water heater												80.3000	(216)
(217)m	85.1708	84.7749	84.0258	82.6102	81.1233	80.3000	80.3000	80.3000	80.3000	82.8149	84.5086	85.2512	(217)
Fuel for water heating, kWh/month	231.8657	206.2508	221.8154	199.3864	195.9120	177.3142	174.9770	183.1758	186.3201	202.3503	209.1214	229.3831	(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	16.1437	12.9511	11.6610	8.5433	6.5991	5.3915	6.0199	7.8249	10.1638	13.3355	15.0624	16.5924	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-11.3138	-17.0291	-26.1177	-31.4068	-35.6997	-34.0167	-33.6213	-30.8312	-26.2323	-20.3627	-12.8211	-9.6609	(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	-3.4863	-7.5439	-15.3897	-23.7023	-31.9162	-32.2648	-31.8673	-26.7013	-19.2192	-10.9587	-4.7098	-2.7404	(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												1403.5050	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												80.3000	
Water heating fuel used												2417.8723	(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)												130.2887	(232)

Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-499.6132 (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	3538.0527 (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	1403.5050	0.2100	294.7360	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2417.8723	0.2100	507.7532	(264)
Space and water heating			802.4892	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	130.2887	0.1443	18.8047	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	0.1332	-38.5158	
PV Unit electricity exported	-210.4999	0.1252	-26.3508	
Total			-64.8666	(269)
Total CO2, kg/year			768.3566	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.2000	(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	1403.5050	1.1300	1585.9606	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2417.8723	1.1300	2732.1957	(278)
Space and water heating			4318.1563	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	130.2887	1.5338	199.8412	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	1.4923	-431.4386	
PV Unit electricity exported	-210.4999	0.4595	-96.7185	
Total			-528.1571	(283)
Total Primary energy kWh/year			4119.9411	(286)
Target Primary Energy Rate (TPER)			81.5200	(287)

Full SAP Calculation Printout

Property Reference	E2 00 04 (GF Flat)_Be Lean	Issued on Date	30/08/2023
Assessment Reference	E2 00 04 (GF Flat)_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	84 B	DER	14.51	TER	15.65
Environmental	89 B	% DER < TER			7.28
CO_2 Emissions (t/year)	0.84	DFEE	39.13	TFEE	40.59
Compliance Check	See BREL	% DFEE < TFEE			3.60
% DPER < TPER	0.61	DPER	83.09	TPER	83.60

Assessor Details	Mr. Michael Wride	Assessor ID	U300-0001
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	64.9200 (1b)	x	2.8000 (2b)	=	181.7760 (1b)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 64.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.7760	(5)

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2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493	(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	
Opening Type 1 (Uw = 0.90)			16.1800	0.8687	14.0560			(27)
Door			4.0400	1.0000	4.0400			(26)
Ground Floor			64.9200	0.1000	6.4920			(28a)

External Wall	44.9400	20.2200	24.7200	0.1800	4.4496	(29a)
Wall to Corridor	6.7200		6.7200	0.2000	1.3440	(29a)
Wall to Cycle Store	22.4200		22.4200	0.2000	4.4840	(29a)
Total net area of external elements Aum(A, m2)			139.0000			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.8656	(33)
Party Wall			20.0000	0.0000	0.0000	(32)
Party Ceiling 1			64.9200			(32b)

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

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.9400	0.0800	0.6352
E3 Sill	6.9200	0.1000	0.6920
E4 Jamb	11.3000	0.0500	0.5650
E5 Ground floor (normal)	16.0500	0.1200	1.9260
E7 Party floor between dwellings (in blocks of flats)	11.3700	0.0500	0.5685
E18 Party wall between dwellings	8.4000	0.0500	0.4200
P1 Party wall - Ground floor	7.7200	0.0560	0.4323
E5 Ground floor (normal)	2.4000	0.1200	0.2880
E7 Party floor between dwellings (in blocks of flats)	2.4000	0.1200	0.2880
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.1500	0.7020
E16 Corner (normal)	8.4000	0.1000	0.8400
E17 Corner (inverted – internal area greater than external area)	5.6000	0.0000	0.0000
E5 Ground floor (normal)	8.0100	0.3200	2.5632
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	7.7200	0.0000	0.0000
P7 Party Wall - Exposed floor (normal)	8.0100	0.1200	0.9612

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.8814 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 45.7470 (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	15.7201	15.5289	15.3377	14.3817	14.1905	13.2344	13.2344	13.0432	13.6168	14.1905	14.5729	14.9553	(38)
Heat transfer coeff	61.4671	61.2759	61.0847	60.1287	59.9375	58.9814	58.9814	58.7902	59.3638	59.9375	60.3199	60.7023	(39)

Average = Sum(39)m / 12 = 60.0809

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9468	0.9439	0.9409	0.9262	0.9233	0.9085	0.9085	0.9056	0.9144	0.9233	0.9291	0.9350	(40)
HLP (average)												0.9255	
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 2.1168 (42)

Hot water usage for mixer showers

67.1752	66.1657	64.6946	61.8800	59.8029	57.4865	56.1699	57.6298	59.2302	61.7172	64.5923	66.9178	(42a)

Hot water usage for baths

25.8010	25.4178	24.8782	23.8833	23.1383	22.3123	21.8661	22.4019	22.9853	23.8692	24.8846	25.7138	(42b)

Hot water usage for other uses

36.3081	34.9878	33.6675	32.3472	31.0269	29.7066	29.7066	31.0269	32.3472	33.6675	34.9878	36.3081	(42c)

Average daily hot water use (litres/day) 118.8622 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.2843	126.5713	123.2403	118.1105	113.9681	109.5054	107.7425	111.0586	114.5626	119.2539	124.4647	128.9397	(44)
Energy conte	204.7547	180.2358	189.4158	161.6874	153.4230	134.6496	130.3053	137.5137	141.2672	161.8265	177.3228	201.8883	(45)

Energy content (annual) Total = Sum(45)m = 1974.2900

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

30.7132	27.0354	28.4124	24.2531	23.0134	20.1974	19.5458	20.6271	21.1901	24.2740	26.5984	30.2833	(46)

Water storage loss:

Total storage loss

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

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
41.8861	37.7917	41.7526	40.2177	41.4395	39.9825	41.2384	41.3011	40.0400	41.5126	40.3537	41.8611	(61)

Primary loss
Combi loss

Total heat required for water heating calculated for each month

246.6407	218.0274	231.1684	201.9050	194.8625	174.6321	171.5436	178.8148	181.3072	203.3391	217.6765	243.7495	(62)
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)
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)
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)
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)

WWHRS
PV diverter
Solar input
FGHRS

Output from w/h

246.6407	218.0274	231.1684	201.9050	194.8625	174.6321	171.5436	178.8148	181.3072	203.3391	217.6765	243.7495	(64)

Total per year (kWh/year) = Sum(64)m = 2463.6668 (64)

12Total per year (kWh/year) 2464 (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

78.5524	69.3763	73.4189	63.8155	61.3730	54.7666	53.6361	56.0486	56.9813	64.1854	69.0483	77.5932	(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	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
93.3937 103.4002 93.3937 96.5069 93.3937 96.5069 93.3937 93.3937 96.5069 93.3937 96.5069 93.3937 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
185.1635 187.0849 182.2430 171.9352 158.9234 146.6941 138.5242 136.6028 141.4447 151.7525 164.7643 176.9936 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
33.5840 33.5840 33.5840 33.5840 33.5840 33.5840 33.5840 33.5840 33.5840 33.5840 33.5840 33.5840 (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)
-84.6717 -84.6717 -84.6717 -84.6717 -84.6717 -84.6717 -84.6717 -84.6717 -84.6717 -84.6717 -84.6717 -84.6717 (71)
Water heating gains (Table 5)
105.5812 103.2386 98.6813 88.6326 82.4906 76.0647 72.0915 75.3341 79.1408 86.2708 95.9004 104.2919 (72)
Total internal gains
441.8904 451.4756 432.0700 414.8265 392.5596 374.0176 358.7613 360.0825 371.8442 389.1689 414.9234 432.4311 (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	
South	6.0300	46.7521	0.4000	0.8000	0.7700	62.5175	(78)
West	10.1500	19.6403	0.4000	0.8000	0.7700	44.2076	(80)

Solar gains 106.7250 188.8669 272.8427 355.1168 408.1634 408.4096 392.5212 353.3688 301.8822 213.0496 129.2261 90.3750 (83)
Total gains 548.6154 640.3424 704.9127 769.9433 800.7230 782.4271 751.2825 713.4512 673.7263 602.2185 544.1496 522.8061 (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	73.3455	73.5743	73.8046	74.9781	75.2173	76.4365	76.4365	76.6851	75.9441	75.2173	74.7404	74.2696	
alpha	5.8897	5.9050	5.9203	5.9985	6.0145	6.0958	6.0958	6.1123	6.0629	6.0145	5.9827	5.9513	
util living area	0.9882	0.9712	0.9335	0.8317	0.6701	0.4795	0.3451	0.3784	0.5960	0.8718	0.9722	0.9908	(86)
MIT	20.1695	20.3744	20.6091	20.8500	20.9641	20.9960	20.9995	20.9992	20.9860	20.8306	20.4677	20.1376	(87)
Th 2	20.1279	20.1304	20.1329	20.1453	20.1478	20.1603	20.1603	20.1628	20.1553	20.1478	20.1428	20.1378	(88)
util rest of house	0.9848	0.9633	0.9164	0.7960	0.6170	0.4179	0.2794	0.3099	0.5280	0.8347	0.9632	0.9880	(89)
MIT 2	19.3861	19.5876	19.8122	20.0363	20.1266	20.1586	20.1601	20.1626	20.1488	20.0279	19.6910	19.3629	(90)

Living area fraction fLA = Living area / (4) = 0.3880 (91)

MIT	19.6900	19.8929	20.1214	20.3520	20.4516	20.4835	20.4859	20.4872	20.4736	20.3394	19.9924	19.6635	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.5400	19.7429	19.9714	20.2020	20.3016	20.3335	20.3359	20.3372	20.3236	20.1894	19.8424	19.5135	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9818	0.9591	0.9127	0.7985	0.6269	0.4307	0.2932	0.3242	0.5418	0.8367	0.9594	0.9855	(94)
Useful gains	538.6356	614.1571	643.4051	614.8380	501.9367	337.0142	220.2577	231.3080	365.0262	503.8612	522.0387	515.2211	(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	936.7617	909.5104	822.8979	679.5768	515.5557	338.1723	220.3458	231.4687	369.4592	574.7615	768.6182	929.5661	(97)
Space heating kWh	296.2058	198.4775	133.5427	46.6119	10.1325	0.0000	0.0000	0.0000	0.0000	52.7498	177.5372	308.2727	(98a)

Space heating requirement - total per year (kWh/year) 1223.5300

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	296.2058	198.4775	133.5427	46.6119	10.1325	0.0000	0.0000	0.0000	0.0000	52.7498	177.5372	308.2727	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 1223.5300
Space heating per m2 (98c) / (4) = 18.8467 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 88.3000 (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	296.2058	198.4775	133.5427	46.6119	10.1325	0.0000	0.0000	0.0000	0.0000	52.7498	177.5372	308.2727	(98)
Space heating efficiency (main heating system 1)	88.3000	88.3000	88.3000	88.3000	88.3000	0.0000	0.0000	0.0000	0.0000	88.3000	88.3000	88.3000	(210)
Space heating fuel (main heating system)	335.4539	224.7763	151.2374	52.7881	11.4751	0.0000	0.0000	0.0000	0.0000	59.7393	201.0614	349.1197	(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

246.6407	218.0274	231.1684	201.9050	194.8625	174.6321	171.5436	178.8148	181.3072	203.3391	217.6765	243.7495 (64)

Efficiency of water heater

											87.3000 (216)
(217)m	87.8428	87.7737	87.6635	87.4858	87.3489	87.3000	87.3000	87.3000	87.3000	87.5041	87.7464	87.8556 (217)

Fuel for water heating, kWh/month

280.7750	248.3973	263.6996	230.7860	223.0852	200.0368	196.4990	204.8279	207.6830	232.3765	248.0746	277.4432 (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	21.6658	19.5691	21.6658	20.9669	21.6658	20.9669	21.6658	21.6658	20.9669	21.6658	20.9669	21.6658 (231)
Lighting	21.2352	17.0357	15.3387	11.2378	8.6804	7.0920	7.9186	10.2929	13.3694	17.5414	19.8129	21.8254 (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	1385.6512 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	87.3000
Water heating fuel used	2813.6841 (219)
Space cooling fuel	0.0000 (221)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7625)

mechanical ventilation fans (SFP = 0.7625)	169.0971 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	255.0971 (231)
Electricity for lighting (calculated in Appendix L)	171.3805 (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	4625.8129 (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	1385.6512	0.2100	290.9868	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2813.6841	0.2100	590.8737	(264)
Space and water heating			881.8604	(265)
Pumps, fans and electric keep-hot	255.0971	0.1387	35.3851	(267)
Energy for lighting	171.3805	0.1443	24.7355	(268)
Total CO2, kg/year			941.9810	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.5100	(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	1385.6512	1.1300	1565.7859	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2813.6841	1.1300	3179.4630	(278)
Space and water heating			4745.2489	(279)
Pumps, fans and electric keep-hot	255.0971	1.5128	385.9109	(281)
Energy for lighting	171.3805	1.5338	262.8691	(282)
Total Primary energy kWh/year			5394.0289	(286)
Dwelling Primary energy Rate (DPER)			83.0900	(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	64.9200 (1b)	x	2.8000 (2b)	=	181.7760 (1b)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.7760	(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	2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1100	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3600	(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) =	0.3060	(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	0.3902	0.3825	0.3749	0.3366	0.3290	0.2907	0.2907	0.2831	0.3060	0.3290	0.3443	0.3596	(22b)
Effective ac	0.5761	0.5732	0.5703	0.5567	0.5541	0.5423	0.5423	0.5401	0.5468	0.5541	0.5593	0.5646	(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			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			12.2000	1.1450	13.9695			(27)
Ground Floor			64.9200	0.1300	8.4396			(28a)
External Wall	44.9400	16.2400	28.7000	0.1800	5.1660			(29a)
Wall to Corridor	6.7200		6.7200	0.1800	1.2096			(29a)
Wall to Cycle Store	22.4200		22.4200	0.1800	4.0356			(29a)
Total net area of external elements Aum(A, m2)			139.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		36.8603			(33)
Party Wall			20.0000	0.0000	0.0000			(32)

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

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	7.9400	0.0500	0.3970
E3	Sill	6.9200	0.0500	0.3460
E4	Jamb	11.3000	0.0500	0.5650
E5	Ground floor (normal)	16.0500	0.1600	2.5680
E7	Party floor between dwellings (in blocks of flats)	11.3700	0.0700	0.7959
E18	Party wall between dwellings	8.4000	0.0600	0.5040
P1	Party wall - Ground floor	7.7200	0.0800	0.6176
E5	Ground floor (normal)	2.4000	0.1600	0.3840
E7	Party floor between dwellings (in blocks of flats)	2.4000	0.0700	0.1680
E23	Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.0200	0.0936
E16	Corner (normal)	8.4000	0.0900	0.7560
E17	Corner (inverted – internal area greater than external area)	5.6000	-0.0900	-0.5040
E5	Ground floor (normal)	8.0100	0.1600	1.2816
P3	Party wall - Intermediate floor between dwellings (in blocks of flats)	7.7200	0.0000	0.0000
P7	Party Wall - Exposed floor (normal)	8.0100	0.1600	1.2816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.2543 (36)
Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 46.1146 (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	34.5591	34.3818	34.2080	33.3917	33.2390	32.5280	32.5280	32.3963	32.8019	33.2390	33.5480	33.8710	(38)
Heat transfer coeff	80.6737	80.4964	80.3226	79.5063	79.3536	78.6426	78.6426	78.5109	78.9164	79.3536	79.6625	79.9855	(39)

Average = Sum(39)m / 12 = 79.5056

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2427	1.2399	1.2373	1.2247	1.2223	1.2114	1.2114	1.2093	1.2156	1.2223	1.2271	1.2321	(40)
HLP (average)												1.2247	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.1168 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	59.7113	58.8139	57.5063	55.0044	53.1581	51.0991	49.9288	51.2265	52.6490	54.8598	57.4154	59.4825	(42a)
Hot water usage for baths	25.8010	25.4178	24.8782	23.8833	23.1383	22.3123	21.8661	22.4019	22.9853	23.8692	24.8846	25.7138	(42b)
Hot water usage for other uses	36.3081	34.9878	33.6675	32.3472	31.0269	29.7066	29.7066	31.0269	32.3472	33.6675	34.9878	36.3081	(42c)

Average daily hot water use (litres/day) 111.9807 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	121.8203	119.2195	116.0520	111.2349	107.3233	103.1180	101.5014	104.6553	107.9815	112.3965	117.2878	121.5043	(44)
Energy conte	192.9337	169.7670	178.3676	152.2751	144.4778	126.7956	122.7572	129.5851	133.1520	152.5209	167.0980	190.2464	(45)

Energy content (annual) Total = Sum(45)m = 1859.9765

Distribution loss (46)m = 0.15 x (45)m	28.9400	25.4651	26.7551	22.8413	21.6717	19.0193	18.4136	19.4378	19.9728	22.8781	25.0647	28.5370	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	243.8926	215.7944	229.3265	201.5901	195.4368	176.1107	173.7161	180.5440	182.4671	203.4799	216.4130	241.2053	(62)
WWHRS	-27.2975	-24.1421	-25.2802	-20.9330	-19.5088	-16.6939	-15.6478	-16.6399	-17.2721	-20.3619	-23.0676	-26.7920	(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	216.5951	191.6523	204.0463	180.6571	175.9279	159.4168	158.0683	163.9041	165.1950	183.1179	193.3455	214.4134	(64)

Total per year (kWh/year) = Sum(64)m = 2206.3396 (64)

12Total per year (kWh/year) 2206 (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	76.8902	67.9544	72.0470	62.9602	60.7786	54.4883	53.5565	55.8268	56.6018	63.4529	67.8888	75.9967	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	94.7737	104.9280	94.7737	97.9328	94.7737	97.9328	94.7737	94.7737	97.9328	94.7737	97.9328	94.7737	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	185.1635	187.0849	182.2430	171.9352	158.9234	146.6941	138.5242	136.6028	141.4447	151.7525	164.7643	176.9936	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	(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)	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	(71)
Water heating gains (Table 5)	103.3470	101.1226	96.8373	87.4448	81.6917	75.6782	71.9845	75.0360	78.6136	85.2862	94.2901	102.1461	(72)
Total internal gains	441.0361	450.8874	431.6059	415.0646	393.1406	375.0569	360.0343	361.1643	372.7430	389.5643	414.7391	431.6652	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	4.5500	46.7521	0.6300	0.7000	0.7700	65.0106	(78)
West	7.6500	19.6403	0.6300	0.7000	0.7700	45.9177	(80)

Solar gains	110.9283	196.2954	283.5534	369.0305	424.1366	424.3855	407.8784	367.2063	313.7232	221.4233	134.3137	93.9356	(83)
Total gains	551.9644	647.1828	715.1593	784.0951	817.2772	799.4424	767.9126	728.3706	686.4661	610.9875	549.0528	525.6009	(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	55.8836	56.0066	56.1278	56.7041	56.8132	57.3269	57.3269	57.4230	57.1279	56.8132	56.5929	56.3644	
alpha	4.7256	4.7338	4.7419	4.7803	4.7875	4.8218	4.8218	4.8282	4.8085	4.7875	4.7729	4.7576	
util living area	0.9912	0.9809	0.9593	0.8996	0.7825	0.6027	0.4453	0.4872	0.7204	0.9253	0.9820	0.9930	(86)
MIT	19.7008	19.9259	20.2221	20.5820	20.8395	20.9649	20.9933	20.9898	20.9185	20.5764	20.0748	19.6629	(87)
Th 2	19.8860	19.8882	19.8903	19.9003	19.9022	19.9109	19.9109	19.9125	19.9075	19.9022	19.8984	19.8944	(88)
util rest of house	0.9884	0.9750	0.9465	0.8689	0.7219	0.5113	0.3379	0.3764	0.6325	0.8953	0.9752	0.9907	(89)
MIT 2	18.4029	18.6885	19.0588	19.4962	19.7749	19.8922	19.9089	19.9092	19.8570	19.5024	18.8869	18.3608	(90)
Living area fraction										fLA = Living area / (4) =		0.3880	(91)
MIT	18.9065	19.1686	19.5102	19.9175	20.1880	20.3084	20.3297	20.3285	20.2689	19.9191	19.3478	18.8661	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9065	19.1686	19.5102	19.9175	20.1880	20.3084	20.3297	20.3285	20.2689	19.9191	19.3478	18.8661	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9850	0.9700	0.9411	0.8694	0.7389	0.5458	0.3797	0.4196	0.6635	0.8958	0.9708	0.9878	(94)
Useful gains	543.7093	627.7644	673.0137	681.7084	603.8835	436.3069	291.5562	305.6041	455.4364	547.3284	533.0355	519.1739	(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	1178.3582	1148.5719	1045.0113	875.9600	673.5524	448.9270	293.3123	308.4292	486.8244	739.5061	975.6936	1173.0738	(97)
Space heating kWh	472.1788	349.9826	276.7662	139.8612	51.8337	0.0000	0.0000	0.0000	0.0000	142.9802	318.7138	486.5015	(98a)
Space heating requirement - total per year (kWh/year)												2238.8180	
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	472.1788	349.9826	276.7662	139.8612	51.8337	0.0000	0.0000	0.0000	0.0000	142.9802	318.7138	486.5015	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2238.8180	
Space heating per m2										(98c) / (4) =		34.4858	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.4000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	472.1788	349.9826	276.7662	139.8612	51.8337	0.0000	0.0000	0.0000	0.0000	142.9802	318.7138	486.5015	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000		(210)
Space heating fuel (main heating system)	511.0160	378.7691	299.5305	151.3649	56.0971	0.0000	0.0000	0.0000	0.0000	154.7404	344.9283	526.5168	(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	216.5951	191.6523	204.0463	180.6571	175.9279	159.4168	158.0683	163.9041	165.1950	183.1179	193.3455	214.4134	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.0035	85.6541	85.0351	83.8391	82.1076	80.3000	80.3000	80.3000	80.3000	83.8568	85.4447	86.0799	(217)
Fuel for water heating, kWh/month	251.8444	223.7515	239.9553	215.4808	214.2650	198.5265	196.8472	204.1147	205.7223	218.3698	226.2813	249.0866	(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	19.6921	15.7977	14.2241	10.4212	8.0496	6.5766	7.3431	9.5449	12.3979	16.2667	18.3732	20.2394	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-14.4302	-21.6645	-33.1394	-39.7339	-45.0493	-42.8675	-42.3521	-38.8832	-33.1632	-25.8402	-16.3283	-12.3270	(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	-4.5809	-9.9002	-20.1780	-31.0552	-41.8051	-42.2729	-41.7698	-35.0188	-25.2205	-14.3930	-6.1906	-3.6028	(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	(234b)

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

(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

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

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year	
Space heating fuel - main system 1	2422.9632 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	80.3000
Water heating fuel used	2644.2453 (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)	158.9265 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-641.7667 (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	4670.3682 (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	2422.9632	0.2100	508.8223	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2644.2453	0.2100	555.2915	(264)
Space and water heating			1064.1138	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	158.9265	0.1443	22.9380	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-365.7789	0.1333	-48.7524	
PV Unit electricity exported	-275.9878	0.1252	-34.5513	
Total			-83.3037	(269)
Total CO2, kg/year			1015.6774	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.6500	(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	2422.9632	1.1300	2737.9484	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2644.2453	1.1300	2987.9972	(278)
Space and water heating			5725.9456	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	158.9265	1.5338	243.7667	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-365.7789	1.4925	-545.9323	
PV Unit electricity exported	-275.9878	0.4595	-126.8177	
Total			-672.7500	(283)
Total Primary energy kWh/year			5427.0631	(286)
Target Primary Energy Rate (TPER)			83.6000	(287)

Full SAP Calculation Printout

Property Reference	E6 04 04 (TF Flat)_Be Lean	Issued on Date	30/08/2023
Assessment Reference	E6 04 04 (TF Flat)_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	85 B	DER	12.74	TER	15.00
Environmental	90 B	% DER < TER			15.07
CO_2 Emissions (t/year)	0.81	DFEE	33.79	TFEE	39.74
Compliance Check	See BREL	% DFEE < TFEE			14.97
% DPER < TPER	8.15	DPER	73.53	TPER	80.05

Assessor Details	Mr. Michael Wride	Assessor ID	U300-0001
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	70.6700 (1b)	x	2.8000 (2b)	=	197.8760 (1b)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 70.6700						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.8760	(5)

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2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493	(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	
Opening Type 1 (Uw = 0.90)			13.5100	0.8687	11.7365			(27)
Door			4.0400	1.0000	4.0400			(26)
External Wall	44.9000	17.5500	27.3500	0.1800	4.9230			(29a)

External Wall 2	4.0300	4.0300	0.2000	0.8060	(29a)
External Roof 1	70.6700	70.6700	0.1000	7.0670	(30)
Total net area of external elements Aum(A, m2)		119.6000			(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		28.5725	(33)
Party Wall		40.8700	0.0000	0.0000	(32)
Party Floor 1		70.6700			(32d)

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)	7.9300	0.0800	0.6344
E3 Sill	6.9100	0.1000	0.6910
E4 Jamb	9.5800	0.0500	0.4790
E7 Party floor between dwellings (in blocks of flats)	12.5900	0.0500	0.6295
E18 Party wall between dwellings	14.0000	0.0500	0.7000
E7 Party floor between dwellings (in blocks of flats)	1.5500	0.1000	0.1550
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.1500	0.7020
E16 Corner (normal)	2.8000	0.1000	0.2800
E17 Corner (inverted – internal area greater than external area)	2.8000	0.0000	0.0000
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	15.7200	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	15.7200	0.0500	0.7860
E15 Flat roof with parapet	17.2700	0.3000	5.1810
E14 Flat roof	1.5500	0.1600	0.2480

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.4859 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	39.0584 (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	17.1124	16.9043	16.6962	15.6555	15.4473	14.4066	14.4066	14.1985	14.8229	15.4473	15.8636	16.2799	(38)
Heat transfer coeff	56.1708	55.9627	55.7545	54.7138	54.5057	53.4650	53.4650	53.2569	53.8813	54.5057	54.9220	55.3383	(39)

Average = Sum(39)m / 12 = 54.6618

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7948	0.7919	0.7889	0.7742	0.7713	0.7565	0.7565	0.7536	0.7624	0.7713	0.7772	0.7831	(40)
HLP (average)												0.7735	
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 2.2623 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	69.9195	68.8687	67.3376	64.4080	62.2460	59.8350	58.4646	59.9842	61.6499	64.2386	67.2311	69.6516	(42a)
Hot water usage for baths	26.8500	26.4513	25.8897	24.8544	24.0791	23.2194	22.7551	23.3127	23.9198	24.8397	25.8964	26.7593	(42b)
Hot water usage for other uses	37.7980	36.4235	35.0491	33.6746	32.3001	30.9256	30.9256	32.3001	33.6746	35.0491	36.4235	37.7980	(42c)

Average daily hot water use (litres/day) 123.7195 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	134.5675	131.7436	128.2764	122.9370	118.6252	113.9801	112.1453	115.5970	119.2443	124.1274	129.5510	134.2089	(44)
Energy conte	213.1221	187.6011	197.1560	168.2945	159.6924	140.1518	135.6301	143.1332	147.0402	168.4396	184.5692	210.1387	(45)

Energy content (annual) Total = Sum(45)m = 2054.9690

Distribution loss (46)m = 0.15 x (45)m	31.9683	28.1402	29.5734	25.2442	23.9539	21.0228	20.3445	21.4700	22.0560	25.2659	27.6854	31.5208	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	41.9589	37.8557	41.8200	40.2752	41.4940	40.0303	41.2847	41.3500	40.0902	41.5701	40.4168	41.9329	(61)
Total heat required for water heating calculated for each month	255.0810	225.4568	238.9760	208.5697	201.1864	180.1822	176.9148	184.4832	187.1304	210.0098	224.9860	252.0716	(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	255.0810	225.4568	238.9760	208.5697	201.1864	180.1822	176.9148	184.4832	187.1304	210.0098	224.9860	252.0716	(64)

Total per year (kWh/year) = Sum(64)m = 2545.0477 (64)

12Total per year (kWh/year) 2545 (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	81.3528	71.8413	76.0094	66.0267	63.4712	56.6081	55.4182	57.9293	58.9134	66.3987	71.4734	80.3543	(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	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	101.5460	112.4259	101.5460	104.9309	101.5460	104.9309	101.5460	101.5460	104.9309	101.5460	104.9309	101.5460	(67)

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

	198.8557	200.9192	195.7193	184.6492	170.6752	157.5416	148.7676	146.7041	151.9040	162.9741	176.9481	190.0817 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114 (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)												
	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912 (71)
Water heating gains (Table 5)												
	109.3452	106.9067	102.1631	91.7038	85.3108	78.6223	74.4868	77.8619	81.8242	89.2456	99.2687	108.0031 (72)
Total internal gains												
	469.6811	480.1860	459.3626	441.2181	417.4662	398.0290	381.7346	383.0462	395.5933	413.6999	441.0819	459.5650 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	8.3500	19.6403	0.4000	0.8000	0.7700	36.3678 (76)
South	5.1600	46.7521	0.4000	0.8000	0.7700	53.4975 (78)

Solar gains	89.8653	158.7583	228.7688	297.0139	340.8582	340.8696	327.6867	295.3398	252.8508	178.9185	108.7592	76.1339 (83)
Total gains	559.5464	638.9443	688.1314	738.2319	758.3244	738.8986	709.4213	678.3860	648.4441	592.6184	549.8410	535.6989 (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	87.3699	87.6948	88.0222	89.6965	90.0390	91.7916	91.7916	92.1504	91.0825	90.0390	89.3566	88.6844	
alpha	6.8247	6.8463	6.8681	6.9798	7.0026	7.1194	7.1194	7.1434	7.0722	7.0026	6.9571	6.9123	
util living area													
	0.9879	0.9703	0.9315	0.8223	0.6547	0.4621	0.3315	0.3610	0.5685	0.8548	0.9692	0.9905	(86)
MIT	20.3752	20.5440	20.7281	20.9104	20.9830	20.9987	20.9999	20.9998	20.9949	20.9017	20.6249	20.3513	(87)
Th 2	20.2578	20.2604	20.2629	20.2757	20.2783	20.2912	20.2912	20.2937	20.2860	20.2783	20.2732	20.2680	(88)
util rest of house													
	0.9845	0.9627	0.9152	0.7891	0.6084	0.4114	0.2782	0.3056	0.5117	0.8187	0.9599	0.9878	(89)
MIT 2	19.6975	19.8636	20.0395	20.2108	20.2682	20.2906	20.2911	20.2937	20.2836	20.2093	19.9547	19.6828	(90)
Living area fraction									fLA = Living area / (4) =			0.3835	(91)
MIT	19.9574	20.1245	20.3036	20.4791	20.5423	20.5622	20.5629	20.5645	20.5564	20.4748	20.2117	19.9392	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.8074	19.9745	20.1536	20.3291	20.3923	20.4122	20.4129	20.4145	20.4064	20.3248	20.0617	19.7892	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9820	0.9592	0.9124	0.7917	0.6159	0.4200	0.2873	0.3151	0.5214	0.8212	0.9567	0.9856	(94)
Useful gains	549.4701	612.8684	627.8732	584.4254	467.0264	310.3695	203.8376	213.7594	338.1108	486.6733	526.0405	527.9832	(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													
	871.0633	843.6107	761.2495	625.3286	473.7807	310.7476	203.8579	213.7978	339.7947	530.0593	711.8824	862.6781	(97)
Space heating kWh													
	239.2653	155.0589	99.2319	29.4503	5.0253	0.0000	0.0000	0.0000	0.0000	32.2792	133.8062	249.0129	(98a)
Space heating requirement - total per year (kWh/year)												943.1299	
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													
	239.2653	155.0589	99.2319	29.4503	5.0253	0.0000	0.0000	0.0000	0.0000	32.2792	133.8062	249.0129	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												943.1299	
Space heating per m2										(98c) / (4) =		13.3455	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 88.3000 (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													
	239.2653	155.0589	99.2319	29.4503	5.0253	0.0000	0.0000	0.0000	0.0000	32.2792	133.8062	249.0129	(98)
Space heating efficiency (main heating system 1)													
	88.3000	88.3000	88.3000	88.3000	88.3000	0.0000	0.0000	0.0000	0.0000	88.3000	88.3000	88.3000	(210)
Space heating fuel (main heating system)													
	270.9686	175.6046	112.3804	33.3525	5.6911	0.0000	0.0000	0.0000	0.0000	36.5562	151.5359	282.0079	(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

255.0810	225.4568	238.9760	208.5697	201.1864	180.1822	176.9148	184.4832	187.1304	210.0098	224.9860	252.0716 (64)
Efficiency of water heater											87.3000 (216)
(217)m 87.7812	87.7047	87.5910	87.4225	87.3241	87.3000	87.3000	87.3000	87.3000	87.4319	87.6703	87.7941 (217)
Fuel for water heating, kWh/month											
290.5874	257.0634	272.8315	238.5767	230.3905	206.3942	202.6515	211.3209	214.3533	240.1981	256.6274	287.1168 (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 22.9378	20.7180	22.9378	22.1979	22.9378	22.1979	22.9378	22.9378	22.1979	22.9378	22.1979	22.9378 (231)
Lighting 23.7895	19.0848	17.1838	12.5896	9.7245	7.9450	8.8711	11.5309	14.9775	19.6513	22.1961	24.4507 (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	1068.0973 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	87.3000
Water heating fuel used	2908.1116 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7625)	
mechanical ventilation fans (SFP = 0.7625)	184.0741 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	270.0741 (231)
Electricity for lighting (calculated in Appendix L)	191.9949 (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	4438.2780 (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	1068.0973	0.2100	224.3004	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2908.1116	0.2100	610.7034	(264)
Space and water heating			835.0039	(265)
Pumps, fans and electric keep-hot	270.0741	0.1387	37.4626	(267)
Energy for lighting	191.9949	0.1443	27.7108	(268)
Total CO2, kg/year			900.1773	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.7400	(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	1068.0973	1.1300	1206.9499	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2908.1116	1.1300	3286.1662	(278)
Space and water heating			4493.1161	(279)
Pumps, fans and electric keep-hot	270.0741	1.5128	408.5682	(281)
Energy for lighting	191.9949	1.5338	294.4882	(282)
Total Primary energy kWh/year			5196.1725	(286)
Dwelling Primary energy Rate (DPER)			73.5300	(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		70.6700 (1b)	x	2.8000 (2b)	=	197.8760 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6700						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.8760	(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) =	0.1516 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.4016 (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) =	0.3414 (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	0.4352	0.4267	0.4182	0.3755	0.3670	0.3243	0.3243	0.3158	0.3414	0.3670	0.3840	0.4011	(22b)
Effective ac	0.5947	0.5910	0.5874	0.5705	0.5673	0.5526	0.5526	0.5499	0.5583	0.5673	0.5737	0.5804	(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			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			13.5100	1.1450	15.4695			(27)
External Wall	44.9000	17.5500	27.3500	0.1800	4.9230			(29a)
External Wall 2	4.0300		4.0300	0.1800	0.7254			(29a)
External Roof 1	70.6700		70.6700	0.1100	7.7737			(30)
Total net area of external elements Aum(A, m2)			119.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.9316			(33)
Party Wall			40.8700	0.0000	0.0000			(32)

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

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	7.9300	0.0500	0.3965
E3	Sill	6.9100	0.0500	0.3455
E4	Jamb	9.5800	0.0500	0.4790
E7	Party floor between dwellings (in blocks of flats)	12.5900	0.0700	0.8813
E18	Party wall between dwellings	14.0000	0.0600	0.8400
E7	Party floor between dwellings (in blocks of flats)	1.5500	0.0700	0.1085
E23	Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.0200	0.0936
E16	Corner (normal)	2.8000	0.0900	0.2520
E17	Corner (inverted – internal area greater than external area)	2.8000	-0.0900	-0.2520
P3	Party wall - Intermediate floor between dwellings (in blocks of flats)	15.7200	0.0000	0.0000
P4	Party wall - Roof (insulation at ceiling level)	15.7200	0.1200	1.8864
E15	Flat roof with parapet	17.2700	0.5600	9.6712
E14	Flat roof	1.5500	0.0800	0.1240

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.8260 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 47.7576 (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	38.8346	38.5944	38.3590	37.2533	37.0464	36.0833	36.0833	35.9050	36.4543	37.0464	37.4649	37.9024	(38)

Heat transfer coeff

	86.5922	86.3520	86.1166	85.0108	84.8040	83.8409	83.8409	83.6625	84.2118	84.8040	85.2225	85.6600 (39)
Average = Sum(39)m / 12 =												85.0098
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2253	1.2219	1.2186	1.2029	1.2000	1.1864	1.1864	1.1838	1.1916	1.2000	1.2059	1.2121 (40)
HLP (average)												1.2029
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												2.2623 (42)
Hot water usage for mixer showers												
	62.1507	61.2167	59.8556	57.2515	55.3298	53.1867	51.9685	53.3193	54.7999	57.1010	59.7610	61.9125 (42a)
Hot water usage for baths												
	26.8500	26.4513	25.8897	24.8544	24.0791	23.2194	22.7551	23.3127	23.9198	24.8397	25.8964	26.7593 (42b)
Hot water usage for other uses												
	37.7980	36.4235	35.0491	33.6746	32.3001	30.9256	30.9256	32.3001	33.6746	35.0491	36.4235	37.7980 (42c)
Average daily hot water use (litres/day)												116.5569 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
	126.7987	124.0915	120.7944	115.7805	111.7090	107.3318	105.6493	108.9321	112.3943	116.9897	122.0809	126.4698 (44)
Energy conte	200.8182	176.7046	185.6565	158.4977	150.3818	131.9769	127.7736	134.8807	138.5935	158.7540	173.9266	198.0212 (45)
Energy content (annual)										Total = Sum(45)m =		1935.9854
Distribution loss (46)m = 0.15 x (45)m												
	30.1227	26.5057	27.8485	23.7747	22.5573	19.7965	19.1660	20.2321	20.7890	23.8131	26.0890	29.7032 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	251.7771	222.7320	236.6155	207.8128	201.3407	181.2920	178.7326	185.8396	187.9085	209.7129	223.2417	248.9801 (62)
WWHRS	-28.4127	-25.1284	-26.3130	-21.7882	-20.3058	-17.3759	-16.2871	-17.3197	-17.9777	-21.1938	-24.0100	-27.8865 (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												
	223.3644	197.6036	210.3024	186.0246	181.0349	163.9161	162.4455	168.5199	169.9308	188.5191	199.2318	221.0935 (64)
										Total per year (kWh/year) = Sum(64)m =		2271.9866 (64)
12Total per year (kWh/year)												2272 (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												
	79.5118	70.2611	74.4705	65.0293	62.7417	56.2111	55.2245	57.5876	58.4111	65.5254	70.1594	78.5818 (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	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	101.5460	112.4259	101.5460	104.9309	101.5460	104.9309	101.5460	101.5460	104.9309	101.5460	104.9309	101.5460 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	198.8557	200.9192	195.7193	184.6492	170.6752	157.5416	148.7676	146.7041	151.9040	162.9741	176.9481	190.0817 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912 (71)
Water heating gains (Table 5)												
	106.8707	104.5553	100.0948	90.3184	84.3302	78.0710	74.2264	77.4026	81.1265	88.0718	97.4436	105.6207 (72)
Total internal gains												
	467.2066	477.8346	457.2943	439.8327	416.4856	397.4777	381.4742	382.5869	394.8956	412.5261	439.2568	457.1826 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3500	19.6403	0.6300	0.7000	0.7700	50.1194	(76)
South	5.1600	46.7521	0.6300	0.7000	0.7700	73.7263	(78)

Solar gains	123.8457	218.7888	315.2720	409.3222	469.7452	469.7609	451.5933	407.0151	348.4600	246.5720	149.8837	104.9220 (83)
Total gains	591.0522	696.6234	772.5663	849.1549	886.2308	867.2386	833.0675	789.6020	743.3556	659.0982	589.1405	562.1046 (84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)													
tau	56.6753	56.8329	56.9883	57.7296	57.8704	58.5352	58.5352	58.6599	58.2773	57.8704	57.5862	57.2921	
alpha	4.7784	4.7889	4.7992	4.8486	4.8580	4.9023	4.9023	4.9107	4.8852	4.8580	4.8391	4.8195	
util living area	0.9917	0.9814	0.9594	0.8979	0.7776	0.5949	0.4382	0.4800	0.7147	0.9250	0.9826	0.9934	(86)
MIT	19.7133	19.9421	20.2397	20.6000	20.8504	20.9689	20.9942	20.9912	20.9251	20.5907	20.0905	19.6791	(87)
Th 2	19.8998	19.9025	19.9052	19.9177	19.9200	19.9309	19.9309	19.9329	19.9267	19.9200	19.9153	19.9103	(88)
util rest of house	0.9891	0.9756	0.9467	0.8670	0.7173	0.5055	0.3342	0.3724	0.6278	0.8951	0.9761	0.9913	(89)
MIT 2	18.4286	18.7193	19.0919	19.5313	19.8016	19.9143	19.9292	19.9301	19.8803	19.5334	18.9190	18.3927	(90)
Living area fraction										fLA = Living area / (4) =		0.3835	(91)
MIT	18.9212	19.1882	19.5321	19.9411	20.2038	20.3187	20.3376	20.3370	20.2810	19.9388	19.3682	18.8860	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9212	19.1882	19.5321	19.9411	20.2038	20.3187	20.3376	20.3370	20.2810	19.9388	19.3682	18.8860	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9858	0.9707	0.9414	0.8677	0.7343	0.5389	0.3742	0.4138	0.6583	0.8957	0.9718	0.9885	(94)
Useful gains	582.6772	676.2434	727.2564	736.8333	650.7601	467.3637	311.7413	326.7394	489.3167	590.3393	572.5354	555.6400	(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	1266.0834	1233.8151	1122.2776	938.6139	721.1533	479.4630	313.3662	329.3762	520.5109	791.9696	1045.5269	1257.9988	(97)
Space heating kWh	508.4542	374.6882	293.8957	145.2820	52.3726	0.0000	0.0000	0.0000	0.0000	150.0130	340.5539	522.5550	(98a)
Space heating requirement - total per year (kWh/year)												2387.8146	
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	508.4542	374.6882	293.8957	145.2820	52.3726	0.0000	0.0000	0.0000	0.0000	150.0130	340.5539	522.5550	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2387.8146	
Space heating per m2										(98c) / (4) =		33.7882	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	508.4542	374.6882	293.8957	145.2820	52.3726	0.0000	0.0000	0.0000	0.0000	150.0130	340.5539	522.5550	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	550.2751	405.5067	318.0690	157.2316	56.6803	0.0000	0.0000	0.0000	0.0000	162.3517	368.5649	565.5357	(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	223.3644	197.6036	210.3024	186.0246	181.0349	163.9161	162.4455	168.5199	169.9308	188.5191	199.2318	221.0935	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.0860	85.7298	85.0986	83.8573	82.0817	80.3000	80.3000	80.3000	80.3000	83.8964	85.5195	86.1567	(217)
Fuel for water heating, kWh/month	259.4666	230.4959	247.1281	221.8347	220.5545	204.1297	202.2982	209.8629	211.6199	224.7046	232.9666	256.6181	(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	21.0993	16.9266	15.2405	11.1659	8.6248	7.0466	7.8679	10.2269	13.2838	17.4291	19.6861	21.6857	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-15.6659	-23.4967	-35.9056	-43.0029	-48.7093	-46.3280	-45.7656	-42.0367	-35.8852	-28.0005	-17.7169	-13.3848	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.0290	-10.8637	-22.1341	-34.0561	-45.8379	-46.3534	-45.8070	-38.4110	-27.6695	-15.7962	-6.7965	-3.9559	(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	2584.2149 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	80.3000
Water heating fuel used	2721.6798 (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)	170.2831 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-698.6084 (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	4863.5694 (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	2584.2149	0.2100	542.6851	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2721.6798	0.2100	571.5527	(264)
Space and water heating			1114.2379	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	170.2831	0.1443	24.5771	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-395.8982	0.1333	-52.7761	
PV Unit electricity exported	-302.7101	0.1252	-37.8983	
Total			-90.6744	(269)
Total CO2, kg/year			1060.0699	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.0000	(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	2584.2149	1.1300	2920.1628	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2721.6798	1.1300	3075.4981	(278)
Space and water heating			5995.6610	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	170.2831	1.5338	261.1859	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-395.8982	1.4926	-590.9209	
PV Unit electricity exported	-302.7101	0.4595	-139.1025	
Total			-730.0234	(283)
Total Primary energy kWh/year			5656.9242	(286)
Target Primary Energy Rate (TPER)			80.0500	(287)

Full SAP Calculation Printout

Property Reference	Harper End Terrace_Be Lean	Issued on Date	30/08/2023
Assessment Reference	Harper (End Terrace)_Copy	Prop Type Ref	Harper (End Terrace)
Property	Harper ET, Harper (End Terrace)		

SAP Rating	85 B	DER	10.78	TER	10.06
Environmental	89 B	% DER < TER			-7.16
CO_2 Emissions (t/year)	1.31	DFEE	36.88	TFEE	36.60
Compliance Check	See BREL	% DFEE < TFEE			-0.76
% DPER < TPER	-18.85	DPER	62.53	TPER	52.61

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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	47.8100 (1b)	x	2.5000 (2b)	=	119.5250 (1b)	-
First floor	47.8100 (1c)	x	2.7800 (2c)	=	132.9118 (1c)	-
Second floor	47.8100 (1d)	x	2.7800 (2d)	=	132.9118 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.4300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	385.3486	(5)

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

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5)	=	0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			4.0000 (17)
Infiltration rate			0.2000 (18)
Number of sides sheltered			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1850 (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	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3399	0.3353	0.3306	0.3075	0.3029	0.2797	0.2797	0.2751	0.2890	0.3029	0.3121	0.3214	(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	
Opening Type 1 (Uw = 0.90)			22.3600	0.8687	19.4247			(27)

Door			1.5800	0.9500	1.5010	(26)
Heat Loss Floor 1			47.8100	0.1000	4.7810	(28a)
External Wall	137.3600	23.9400	113.4200	0.2400	27.2208	(29a)
External Roof	47.8100		47.8100	0.1100	5.2591	(30)
Total net area of external elements Aum(A, m2)			232.9800			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.1866	(33)
Party Wall			52.2200	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)	15.7690	0.0800	1.2615
E3 Sill	14.7550	0.0500	0.7378
E4 Jamb	42.9260	0.0500	2.1463
E5 Ground floor (normal)	19.5600	0.1200	2.3472
E6 Intermediate floor within a dwelling	26.0148	0.0200	0.5203
E10 Eaves (insulation at ceiling level)	9.8900	0.0500	0.4945
E12 Gable (insulation at ceiling level)	9.7000	0.0500	0.4850
E16 Corner (normal)	14.0448	0.1000	1.4045
E18 Party wall between dwellings	14.0448	0.0500	0.7022
P1 Party wall - Ground floor	9.8900	0.0560	0.5538
P2 Party wall - Intermediate floor within a dwelling	9.8900	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	9.8900	0.0300	0.2967

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.9498 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 69.1364 (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	43.2202	42.6321	42.0439	39.1032	38.5151	35.5744	35.5744	34.9863	36.7507	38.5151	39.6914	40.8677	(38)
Heat transfer coeff	112.3567	111.7685	111.1804	108.2397	107.6515	104.7109	104.7109	104.1227	105.8871	107.6515	108.8278	110.0041	(39)

Average = Sum(39)m / 12 = 108.0927

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7834	0.7793	0.7752	0.7547	0.7506	0.7300	0.7300	0.7259	0.7382	0.7506	0.7588	0.7670	(40)
HLP (average)												0.7536	
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 2.9233 (42)

Hot water usage for mixer showers

82.3891	81.1510	79.3468	75.8947	73.3472	70.5062	68.8914	70.6819	72.6447	75.6951	79.2213	82.0735	(42a)

Hot water usage for baths

31.6166	31.1470	30.4858	29.2666	28.3537	27.3414	26.7947	27.4513	28.1662	29.2493	30.4936	31.5097	(42b)

Hot water usage for other uses

44.5680	42.9474	41.3267	39.7060	38.0854	36.4647	36.4647	38.0854	39.7060	41.3267	42.9474	44.5680	(42c)

Average daily hot water use (litres/day) 145.7899 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	158.5737	155.2454	151.1592	144.8674	139.7863	134.3124	132.1508	136.2186	140.5170	146.2711	152.6623	158.1512	(44)
Energy conte	251.1420	221.0673	232.3261	198.3162	188.1792	165.1527	159.8249	168.6671	173.2715	198.4885	217.4954	247.6265	(45)

Energy content (annual) Total = Sum(45)m = 2421.5573

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

37.6713	33.1601	34.8489	29.7474	28.2269	24.7729	23.9737	25.3001	25.9907	29.7733	32.6243	37.1440	(46)

Water storage loss:

Total storage loss

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

If cylinder contains dedicated solar storage

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

Total heat required for water heating calculated for each month

302.1009	267.0947	283.2850	247.6312	239.1381	214.4678	210.7838	219.6260	222.5865	249.4474	266.8105	298.5854	(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

302.1009	267.0947	283.2850	247.6312	239.1381	214.4678	210.7838	219.6260	222.5865	249.4474	266.8105	298.5854	(64)

Total per year (kWh/year) = Sum(64)m = 3021.5573 (64)

12Total per year (kWh/year) 3022 (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

96.2444	85.0117	89.9882	78.2689	75.3093	67.2420	65.8815	68.8215	69.9415	78.7372	84.6460	95.0755	(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	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	165.7121	183.4669	165.7121	171.2358	165.7121	171.2358	165.7121	165.7121	171.2358	165.7121	171.2358	165.7121	(67)

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

	313.2793	316.5301	308.3381	290.8982	268.8834	248.1926	234.3699	231.1190	239.3111	256.7510	278.7658	299.4566 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167 (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)												
	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339 (71)
Water heating gains (Table 5)												
	129.3608	126.5056	120.9518	108.7068	101.2222	93.3917	88.5504	92.5020	97.1410	105.8295	117.5639	127.7897 (72)
Total internal gains												
	678.2024	696.3528	664.8522	640.6910	605.6679	579.6704	555.4826	556.1834	574.5381	598.1428	637.4157	662.8086 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	10.6100	19.6403	0.4000	0.8000	0.7700	46.2111 (76)
West	11.7500	19.6403	0.4000	0.8000	0.7700	51.1762 (80)

Solar gains	97.3873	190.5102	313.7432	457.5757	560.7763	574.0543	546.5231	469.4552	364.8963	226.0564	121.4305	80.0866 (83)
Total gains	775.5897	886.8631	978.5954	1098.2667	1166.4441	1153.7246	1102.0057	1025.6386	939.4344	824.1993	758.8462	742.8951 (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	88.6500	89.1165	89.5879	92.0219	92.5246	95.1231	95.1231	95.6604	94.0664	92.5246	91.5245	90.5459	
alpha	6.9100	6.9411	6.9725	7.1348	7.1683	7.3415	7.3415	7.3774	7.2711	7.1683	7.1016	7.0364	
util living area													
	0.9987	0.9963	0.9877	0.9396	0.8013	0.5763	0.4177	0.4661	0.7460	0.9680	0.9963	0.9990	(86)
MIT	20.1176	20.2659	20.4821	20.7763	20.9464	20.9957	20.9996	20.9992	20.9759	20.7407	20.3911	20.1115	(87)
Th 2	20.2678	20.2713	20.2749	20.2928	20.2964	20.3144	20.3144	20.3180	20.3072	20.2964	20.2892	20.2821	(88)
util rest of house													
	0.9983	0.9951	0.9836	0.9216	0.7566	0.5166	0.3528	0.3975	0.6831	0.9547	0.9949	0.9987	(89)
MIT 2	19.4510	19.6016	19.8186	20.1148	20.2619	20.3125	20.3143	20.3177	20.2946	20.0893	19.7417	19.4568	(90)
Living area fraction										fLA = Living area / (4) =		0.1162	(91)
MIT	19.5285	19.6788	19.8956	20.1916	20.3414	20.3918	20.3939	20.3969	20.3738	20.1650	19.8171	19.5328	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.3785	19.5288	19.7456	20.0416	20.1914	20.2418	20.2439	20.2469	20.2238	20.0150	19.6671	19.3828	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9934	0.9798	0.9140	0.7495	0.5102	0.3461	0.3903	0.6751	0.9480	0.9932	0.9981	(94)
Useful gains	773.6844	881.0062	958.8394	1003.8269	874.2068	588.6373	381.4499	400.3130	634.2067	781.3107	753.6511	741.5135	(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													
	1694.1649	1635.0395	1472.6557	1205.9673	914.1080	590.7621	381.5535	400.5503	648.4280	1013.5344	1367.6517	1670.1757	(97)
Space heating kWh													
	684.8375	506.7104	382.2793	145.5411	29.6865	0.0000	0.0000	0.0000	0.0000	172.7744	442.0804	690.9246	(98a)
Space heating requirement - total per year (kWh/year)												3054.8344	
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													
	684.8375	506.7104	382.2793	145.5411	29.6865	0.0000	0.0000	0.0000	0.0000	172.7744	442.0804	690.9246	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3054.8344	
Space heating per m2											(98c) / (4) =	21.2984	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	89.5000 (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													
	684.8375	506.7104	382.2793	145.5411	29.6865	0.0000	0.0000	0.0000	0.0000	172.7744	442.0804	690.9246	(98)
Space heating efficiency (main heating system 1)													
	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)													
	765.1816	566.1569	427.1278	162.6158	33.1693	0.0000	0.0000	0.0000	0.0000	193.0441	493.9446	771.9828	(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												
	302.1009	267.0947	283.2850	247.6312	239.1381	214.4678	210.7838	219.6260	222.5865	249.4474	266.8105	298.5854 (64)
Efficiency of water heater												89.5000 (216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000 (217)
Fuel for water heating, kWh/month												
	337.5429	298.4299	316.5196	276.6829	267.1934	239.6288	235.5126	245.3921	248.7000	278.7122	298.1123	333.6150 (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	41.2433	37.2520	41.2433	39.9129	41.2433	39.9129	41.2433	41.2433	39.9129	41.2433	39.9129	41.2433 (231)
Lighting	45.3708	36.3981	32.7725	24.0105	18.5464	15.1526	16.9187	21.9915	28.5648	37.4786	42.3319	46.6318 (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	3413.2228 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.5000
Water heating fuel used	3376.0417 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8500)	
mechanical ventilation fans (SFP = 0.8500)	399.6065 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	485.6065 (231)
Electricity for lighting (calculated in Appendix L)	366.1680 (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	7641.0390 (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	3413.2228	0.2100	716.7768	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3376.0417	0.2100	708.9688	(264)
Space and water heating			1425.7455	(265)
Pumps, fans and electric keep-hot	485.6065	0.1387	67.3596	(267)
Energy for lighting	366.1680	0.1443	52.8494	(268)
Total CO2, kg/year			1545.9545	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.7800	(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	3413.2228	1.1300	3856.9417	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3376.0417	1.1300	3814.9272	(278)
Space and water heating			7671.8689	(279)
Pumps, fans and electric keep-hot	485.6065	1.5128	734.6255	(281)
Energy for lighting	366.1680	1.5338	561.6407	(282)
Total Primary energy kWh/year			8968.1351	(286)
Dwelling Primary energy Rate (DPER)			62.5300	(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	47.8100 (1b)	x	2.5000 (2b)	=	119.5250 (1b)	-
First floor	47.8100 (1c)	x	2.7800 (2c)	=	132.9118 (1c)	-
Second floor	47.8100 (1d)	x	2.7800 (2d)	=	132.9118 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.4300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	385.3486	(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) =	0.1038	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3538	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3273	(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	0.4173	0.4091	0.4009	0.3600	0.3518	0.3109	0.3109	0.3027	0.3273	0.3518	0.3682	0.3845	(22b)
Effective ac	0.5871	0.5837	0.5804	0.5648	0.5619	0.5483	0.5483	0.5458	0.5536	0.5619	0.5678	0.5739	(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			1.5800	1.0000	1.5800			(26)
TER Opening Type (Uw = 1.20)			22.3600	1.1450	25.6031			(27)
Heat Loss Floor 1			47.8100	0.1300	6.2153			(28a)
External Wall	137.3600	23.9400	113.4200	0.1800	20.4156			(29a)
External Roof	47.8100		47.8100	0.1100	5.2591			(30)
Total net area of external elements Aum(A, m2)			232.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.0731			(33)
Party Wall			52.2200	0.0000	0.0000			(32)

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

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	15.7690	0.0500	0.7885
E3	Sill	14.7550	0.0500	0.7378
E4	Jamb	42.9260	0.0500	2.1463
E5	Ground floor (normal)	19.5600	0.1600	3.1296
E6	Intermediate floor within a dwelling	26.0148	0.0000	0.0000
E10	Eaves (insulation at ceiling level)	9.8900	0.0600	0.5934
E12	Gable (insulation at ceiling level)	9.7000	0.0600	0.5820
E16	Corner (normal)	14.0448	0.0900	1.2640
E18	Party wall between dwellings	14.0448	0.0600	0.8427
P1	Party wall - Ground floor	9.8900	0.0800	0.7912
P2	Party wall - Intermediate floor within a dwelling	9.8900	0.0000	0.0000
P4	Party wall - Roof (insulation at ceiling level)	9.8900	0.1200	1.1868

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.0622 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 71.1353 (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	74.6529	74.2230	73.8017	71.8225	71.4522	69.7285	69.7285	69.4093	70.3924	71.4522	72.2013	72.9845	(38)

Heat transfer coeff

	145.7882	145.3583	144.9369	142.9578	142.5875	140.8637	140.8637	140.5445	141.5277	142.5875	143.3366	144.1197 (39)
Average = Sum(39)m / 12 =												142.9560

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0164	1.0134	1.0105	0.9967	0.9941	0.9821	0.9821	0.9799	0.9867	0.9941	0.9993	1.0048	(40)
HLP (average)												0.9967	
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												2.9233	(42)
Hot water usage for mixer showers													
	73.2348	72.1342	70.5304	67.4620	65.1975	62.6722	61.2368	62.8284	64.5731	67.2845	70.4189	72.9542	(42a)
Hot water usage for baths													
	31.6166	31.1470	30.4858	29.2666	28.3537	27.3414	26.7947	27.4513	28.1662	29.2493	30.4936	31.5097	(42b)
Hot water usage for other uses													
	44.5680	42.9474	41.3267	39.7060	38.0854	36.4647	36.4647	38.0854	39.7060	41.3267	42.9474	44.5680	(42c)
Average daily hot water use (litres/day)												137.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	149.4194	146.2286	142.3429	136.4346	131.6366	126.4783	124.4962	128.3650	132.4453	137.8606	143.8599	149.0319	(44)
Energy conte	236.6437	208.2276	218.7758	186.7722	177.2081	155.5199	150.5673	158.9427	163.3183	187.0755	204.9548	233.3479	(45)
Energy content (annual)											Total = Sum(45)m =	2281.3539	
Distribution loss (46)m = 0.15 x (45)m													
	35.4966	31.2341	32.8164	28.0158	26.5812	23.3280	22.5851	23.8414	24.4977	28.0613	30.7432	35.0022	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	287.6027	254.2549	269.7347	236.0872	228.1670	204.8349	201.5262	209.9016	212.6334	238.0344	254.2699	284.3068	(62)
WWHRS	-33.4799	-29.6099	-31.0058	-25.6740	-23.9272	-20.4747	-19.1918	-20.4085	-21.1839	-24.9735	-28.2920	-32.8599	(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													
	254.1228	224.6451	238.7289	210.4132	204.2398	184.3602	182.3344	189.4931	191.4495	213.0609	225.9779	251.4469	(64)
										Total per year (kWh/year) = Sum(64)m =		2570.2728	(64)
12Total per year (kWh/year)												2570	(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													
	91.4238	80.7425	85.4827	74.4305	71.6614	64.0391	62.8034	65.5882	66.6321	74.9423	80.4762	90.3279	(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	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	165.7121	183.4669	165.7121	171.2358	165.7121	171.2358	165.7121	165.7121	171.2358	165.7121	171.2358	165.7121	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	313.2793	316.5301	308.3381	290.8982	268.8834	248.1926	234.3699	231.1190	239.3111	256.7510	278.7658	299.4566	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	(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)													
	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	(71)
Water heating gains (Table 5)													
	122.8814	120.1525	114.8961	103.3757	96.3191	88.9432	84.4131	88.1562	92.5446	100.7289	111.7726	121.4085	(72)
Total internal gains													
	671.7230	689.9998	658.7964	635.3599	600.7648	575.2219	551.3453	551.8375	569.9417	593.0422	631.6244	656.4273	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	10.6100	19.6403	0.6300	0.7000	0.7700	63.6846	(76)
West	11.7500	19.6403	0.6300	0.7000	0.7700	70.5273	(80)

Solar gains	134.2119	262.5469	432.3773	630.5966	772.8198	791.1186	753.1771	646.9680	502.8727	311.5340	167.3464	110.3693	(83)
Total gains	805.9349	952.5467	1091.1738	1265.9565	1373.5846	1366.3404	1304.5224	1198.8055	1072.8145	904.5762	798.9708	766.7967	(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	68.3212	68.5232	68.7224	69.6738	69.8548	70.7096	70.7096	70.8702	70.3779	69.8548	69.4897	69.1121	
alpha	5.5547	5.5682	5.5815	5.6449	5.6570	5.7140	5.7140	5.7247	5.6919	5.6570	5.6326	5.6075	
util living area													
	0.9986	0.9960	0.9874	0.9474	0.8344	0.6376	0.4715	0.5319	0.8078	0.9753	0.9965	0.9989	(86)
MIT	19.7515	19.9335	20.2146	20.5921	20.8616	20.9766	20.9964	20.9932	20.9154	20.5379	20.0808	19.7293	(87)
Th 2	20.0697	20.0721	20.0746	20.0861	20.0882	20.0983	20.0983	20.1001	20.0944	20.0882	20.0839	20.0793	(88)
util rest of house													
	0.9981	0.9947	0.9831	0.9293	0.7853	0.5570	0.3768	0.4317	0.7359	0.9635	0.9951	0.9986	(89)
MIT 2	18.6005	18.8350	19.1941	19.6691	19.9724	20.0850	20.0971	20.0977	20.0362	19.6131	19.0327	18.5792	(90)
Living area fraction										fLA = Living area / (4) =		0.1162	(91)
MIT	18.7342	18.9626	19.3126	19.7763	20.0757	20.1886	20.2016	20.2017	20.1383	19.7205	19.1544	18.7128	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7342	18.9626	19.3126	19.7763	20.0757	20.1886	20.2016	20.2017	20.1383	19.7205	19.1544	18.7128	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9923	0.9781	0.9218	0.7846	0.5654	0.3878	0.4433	0.7398	0.9571	0.9930	0.9977	(94)
Useful gains	803.5244	945.2555	1067.3153	1166.9915	1077.6510	772.5769	505.9218	531.3949	793.6430	865.7922	793.3628	765.0459	(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													
	2104.3350	2044.1134	1857.0255	1554.8520	1194.2653	787.2290	507.3295	534.3077	854.5861	1300.4756	1727.8423	2091.5805	(97)
Space heating kWh													
	967.8031	738.4325	587.5444	279.2596	86.7611	0.0000	0.0000	0.0000	0.0000	323.4044	672.8253	986.9417	(98a)
Space heating requirement - total per year (kWh/year)												4642.9720	
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													
	967.8031	738.4325	587.5444	279.2596	86.7611	0.0000	0.0000	0.0000	0.0000	323.4044	672.8253	986.9417	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4642.9720	
Space heating per m2											(98c) / (4) =	32.3710	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.4000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	967.8031	738.4325	587.5444	279.2596	86.7611	0.0000	0.0000	0.0000	0.0000	323.4044	672.8253	986.9417	(98)
Space heating efficiency (main heating system 1)													
	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)													
	1047.4059	799.1693	635.8706	302.2290	93.8972	0.0000	0.0000	0.0000	0.0000	350.0048	728.1659	1068.1188	(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													
	254.1228	224.6451	238.7289	210.4132	204.2398	184.3602	182.3344	189.4931	191.4495	213.0609	225.9779	251.4469	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.9631	86.7333	86.2317	84.9888	82.6848	80.3000	80.3000	80.3000	80.3000	85.2729	86.5690	87.0080	(217)
Fuel for water heating, kWh/month													
	292.2192	259.0068	276.8459	247.5776	247.0101	229.5893	227.0666	235.9814	238.4178	249.8576	261.0380	288.9930	(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	34.4317	27.6224	24.8709	18.2215	14.0748	11.4992	12.8395	16.6893	21.6777	28.4423	32.1255	35.3887	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-46.1264	-65.7592	-95.5374	-108.5537	-117.9354	-110.3003	-108.8542	-102.2950	-90.9237	-75.6304	-50.9374	-39.7870	(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	-23.8769	-50.4691	-100.7891	-152.1079	-201.8821	-203.2058	-200.9015	-169.8291	-124.0580	-72.5173	-31.9821	-18.8701	(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	5024.8615 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	80.3000
Water heating fuel used	3053.6033 (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)	277.8835 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2363.1290 (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	6079.2192 (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	5024.8615	0.2100	1055.2209	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3053.6033	0.2100	641.2567	(264)
Space and water heating			1696.4776	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	277.8835	0.1443	40.1072	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1012.6400	0.1344	-136.0791	
PV Unit electricity exported	-1350.4890	0.1257	-169.8154	
Total			-305.8945	(269)
Total CO2, kg/year			1442.6195	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.0600	(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	5024.8615	1.1300	5678.0935	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3053.6033	1.1300	3450.5717	(278)
Space and water heating			9128.6652	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	277.8835	1.5338	426.2270	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1012.6400	1.4966	-1515.5539	
PV Unit electricity exported	-1350.4890	0.4616	-623.3283	
Total			-2138.8822	(283)
Total Primary energy kWh/year			7546.1107	(286)
Target Primary Energy Rate (TPER)			52.6100	(287)

Full SAP Calculation Printout

Property Reference	Parkman Mid Terrace_Be Lean	Issued on Date	30/08/2023
Assessment Reference	Parkman (Mid Terrace)	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	86 B	DER	10.29	TER	10.06
Environmental	91 B	% DER < TER			-2.29
CO_2 Emissions (t/year)	0.98	DFEE	30.15	TFEE	31.12
Compliance Check	See BREL	% DFEE < TFEE			3.13
% DPER < TPER	-13.97	DPER	59.81	TPER	52.48

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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	36.3500 (1b)	x	2.5000 (2b)	=	90.8750 (1b)	-
First floor	36.3500 (1c)	x	2.7800 (2c)	=	101.0530 (1c)	-
Second floor	36.3500 (1d)	x	2.7800 (2d)	=	101.0530 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	292.9810	(5)

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

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5)	=	0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			4.0000 (17)
Infiltration rate			0.2000 (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)	=	0.1700 (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	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		79.2000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3207	0.3165	0.3123	0.2910	0.2867	0.2655	0.2655	0.2612	0.2740	0.2867	0.2953	0.3037	(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	
Opening Type 1 (Uw = 0.90)			22.8200	0.8687	19.8243			(27)

Door			1.7500	0.9500	1.6625	(26)
Ground Floor			36.3500	0.1000	3.6350	(28a)
External Wall	77.3800	24.5700	52.8100	0.2400	12.6744	(29a)
External Roof	36.3500		36.3500	0.1000	3.6350	(30)
Total net area of external elements Aum(A, m2)			150.0800			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.4312	(33)
Party Wall			143.7900	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)	11.3700	0.0800	0.9096
E3 Sill	11.3700	0.1000	1.1370
E4 Jamb	23.2000	0.0500	1.1600
E5 Ground floor (normal)	9.6000	0.1200	1.1520
E6 Intermediate floor within a dwelling	19.2000	0.0500	0.9600
E12 Gable (insulation at ceiling level)	8.1600	0.0500	0.4080
E18 Party wall between dwellings	21.1200	0.0500	1.0560
P1 Party wall - Ground floor	17.8400	0.0560	0.9990
P2 Party wall - Intermediate floor within a dwelling	35.6800	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	17.8400	0.0300	0.5352

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3168 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 49.7481 (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	31.0113	30.6004	30.1895	28.1350	27.7241	25.6695	25.6695	25.2586	26.4913	27.7241	28.5459	29.3677	(38)
Heat transfer coeff	80.7594	80.3485	79.9376	77.8830	77.4721	75.4176	75.4176	75.0067	76.2394	77.4721	78.2939	79.1157	(39)

Average = Sum(39)m / 12 = 77.7803

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7406	0.7368	0.7330	0.7142	0.7104	0.6916	0.6916	0.6878	0.6991	0.7104	0.7180	0.7255	(40)
HLP (average)												0.7133	
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 2.8090 (42)

Hot water usage for mixer showers	80.2322	79.0265	77.2695	73.9078	71.4270	68.6604	67.0878	68.8315	70.7429	73.7134	77.1473	79.9248 (42a)
Hot water usage for baths	30.7921	30.3348	29.6908	28.5034	27.6143	26.6284	26.0959	26.7354	27.4317	28.4866	29.6984	30.6880 (42b)
Hot water usage for other uses	43.3970	41.8189	40.2408	38.6628	37.0847	35.5066	35.5066	37.0847	38.6628	40.2408	41.8189	43.3970 (42c)

Average daily hot water use (litres/day) 141.9724 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	154.4213	151.1802	147.2011	141.0740	136.1260	130.7954	128.6904	132.6516	136.8374	142.4409	148.6647	154.0098	(44)
Energy conte	244.5656	215.2786	226.2427	193.1233	183.2517	160.8282	155.6399	164.2504	168.7342	193.2909	211.8001	241.1421	(45)

Energy content (annual) Total = Sum(45)m = 2358.1476

Distribution loss (46)m = 0.15 x (45)m	36.6848	32.2918	33.9364	28.9685	27.4878	24.1242	23.3460	24.6376	25.3101	28.9936	31.7700	36.1713 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	42.2324	38.0965	42.0730	40.4912	41.6990	40.2102	41.4588	41.5337	40.2790	41.7863	40.6537	42.2026 (61)
Total heat required for water heating calculated for each month	286.7980	253.3751	268.3157	233.6144	224.9507	201.0384	197.0986	205.7841	209.0132	235.0772	252.4537	283.3448 (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	286.7980	253.3751	268.3157	233.6144	224.9507	201.0384	197.0986	205.7841	209.0132	235.0772	252.4537	283.3448 (64)

Total per year (kWh/year) = Sum(64)m = 2850.8640 (64)

12Total per year (kWh/year) 2851 (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	91.8762	81.1043	85.7439	74.3363	71.3560	63.5279	62.1149	64.9967	66.1739	74.7158	80.5869	90.7304 (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	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	136.6850	151.3298	136.6850	141.2411	136.6850	141.2411	136.6850	136.6850	141.2411	136.6850	141.2411	136.6850	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	270.1840	272.9877	265.9225	250.8817	231.8953	214.0508	202.1295	199.3259	206.3910	221.4319	240.4182	258.2628	(68)

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

	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	(69)
Pumps, fans	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)												
	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	(71)
Water heating gains (Table 5)												
	123.4895	120.6909	115.2472	103.2448	95.9085	88.2333	83.4878	87.3611	91.9081	100.4245	111.9263	121.9495 (72)
Total internal gains												
	598.4935	613.1434	585.9898	563.5027	532.6238	508.6602	487.4374	488.5070	504.6753	526.6764	561.7207	585.0323 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6600	10.6334	0.4000	0.8000	0.7700	25.1369	(74)
South	12.1600	46.7521	0.4000	0.8000	0.7700	126.0717	(78)

Solar gains	151.2086	254.5109	344.6381	428.3742	486.3866	487.1857	467.7977	422.9148	372.8885	279.8834	180.4476	129.8929 (83)
Total gains	749.7021	867.6543	930.6279	991.8768	1019.0105	995.8459	955.2350	911.4218	877.5638	806.5597	742.1683	714.9252 (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	93.7714	94.2509	94.7354	97.2345	97.7502	100.4131	100.4131	100.9632	99.3307	97.7502	96.7242	95.7195	
alpha	7.2514	7.2834	7.3157	7.4823	7.5167	7.6942	7.6942	7.7309	7.6220	7.5167	7.4483	7.3813	
util living area													
	0.9937	0.9814	0.9528	0.8583	0.6909	0.4837	0.3473	0.3784	0.5945	0.8821	0.9809	0.9952	(86)
MIT	20.3587	20.5300	20.7103	20.9028	20.9824	20.9990	20.9999	20.9999	20.9954	20.8993	20.6156	20.3420	(87)
Th 2	20.3051	20.3084	20.3117	20.3283	20.3316	20.3483	20.3483	20.3516	20.3416	20.3316	20.3250	20.3184	(88)
util rest of house													
	0.9918	0.9763	0.9407	0.8292	0.6465	0.4349	0.2959	0.3252	0.5399	0.8507	0.9748	0.9938	(89)
MIT 2	19.7220	19.8928	20.0685	20.2561	20.3210	20.3478	20.3483	20.3516	20.3394	20.2592	19.9921	19.7167	(90)
Living area fraction										fLA = Living area / (4) =		0.2135	(91)
MIT	19.8579	20.0289	20.2055	20.3942	20.4622	20.4868	20.4874	20.4900	20.4794	20.3959	20.1252	19.8502	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.7079	19.8789	20.0555	20.2442	20.3122	20.3368	20.3374	20.3400	20.3294	20.2459	19.9752	19.7002	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9898	0.9724	0.9354	0.8253	0.6451	0.4341	0.2951	0.3242	0.5389	0.8463	0.9708	0.9921	(94)
Useful gains	742.0238	843.7259	870.5181	818.5514	657.3899	432.2577	281.8471	295.4910	472.8961	682.5545	720.5303	709.3093	(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													
	1244.3329	1203.5287	1083.5943	883.5186	667.2043	432.6588	281.8637	295.5240	474.9286	747.2854	1008.0502	1226.3106	(97)
Space heating kWh													
	373.7179	241.7875	158.5287	46.7764	7.3020	0.0000	0.0000	0.0000	0.0000	48.1598	207.0144	384.6490	(98a)
Space heating requirement - total per year (kWh/year)												1467.9357	
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													
	373.7179	241.7875	158.5287	46.7764	7.3020	0.0000	0.0000	0.0000	0.0000	48.1598	207.0144	384.6490	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1467.9357	
Space heating per m2											(98c) / (4) =	13.4611	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	88.3000	(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													
	373.7179	241.7875	158.5287	46.7764	7.3020	0.0000	0.0000	0.0000	0.0000	48.1598	207.0144	384.6490	(98)
Space heating efficiency (main heating system 1)													
	88.3000	88.3000	88.3000	88.3000	88.3000	0.0000	0.0000	0.0000	0.0000	88.3000	88.3000	88.3000	(210)
Space heating fuel (main heating system)													
	423.2366	273.8251	179.5342	52.9744	8.2695	0.0000	0.0000	0.0000	0.0000	54.5411	234.4443	435.6160	(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

	286.7980	253.3751	268.3157	233.6144	224.9507	201.0384	197.0986	205.7841	209.0132	235.0772	252.4537	283.3448 (64)

Efficiency of water heater 87.3000 (216)

(217)m	87.8630	87.7855	87.6687	87.4652	87.3311	87.3000	87.3000	87.3000	87.3000	87.4684	87.7477	87.8730 (217)

Fuel for water heating, kWh/month

	326.4150	288.6299	306.0563	267.0940	257.5838	230.2846	225.7716	235.7206	239.4194	268.7567	287.7040	322.4479 (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	33.1081	29.9041	33.1081	32.0401	33.1081	32.0401	33.1081	33.1081	32.0401	33.1081	32.0401	33.1081 (231)
Lighting	30.3152	24.3200	21.8974	16.0430	12.3921	10.1244	11.3045	14.6940	19.0860	25.0419	28.2848	31.1577 (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 1662.4413 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 87.3000
Water heating fuel used 3255.8838 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8500)
mechanical ventilation fans (SFP = 0.8500) 303.8213 (230a)
central heating pump 41.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 389.8213 (231)
Electricity for lighting (calculated in Appendix L) 244.6610 (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 5552.8073 (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	1662.4413	0.2100	349.1127	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3255.8838	0.2100	683.7356	(264)
Space and water heating			1032.8483	(265)
Pumps, fans and electric keep-hot	389.8213	0.1387	54.0730	(267)
Energy for lighting	244.6610	0.1443	35.3121	(268)
Total CO2, kg/year			1122.2334	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.2900	(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	1662.4413	1.1300	1878.5587	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3255.8838	1.1300	3679.1487	(278)
Space and water heating			5557.7073	(279)
Pumps, fans and electric keep-hot	389.8213	1.5128	589.7217	(281)
Energy for lighting	244.6610	1.5338	375.2692	(282)
Total Primary energy kWh/year			6522.6982	(286)
Dwelling Primary energy Rate (DPER)			59.8100	(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	36.3500 (1b)	x	2.5000 (2b)	=	90.8750 (1b)	-
First floor	36.3500 (1c)	x	2.7800 (2c)	=	101.0530 (1c)	-
Second floor	36.3500 (1d)	x	2.7800 (2d)	=	101.0530 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	292.9810	(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) =	0.1365 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3865 (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) =	0.3285 (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	0.4189	0.4107	0.4025	0.3614	0.3532	0.3121	0.3121	0.3039	0.3285	0.3532	0.3696	0.3860	(22b)
Effective ac	0.5877	0.5843	0.5810	0.5653	0.5624	0.5487	0.5487	0.5462	0.5540	0.5624	0.5683	0.5745	(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			1.7500	1.0000	1.7500			(26)
TER Opening Type (Uw = 1.20)			22.8200	1.1450	26.1298			(27)
Ground Floor			36.3500	0.1300	4.7255			(28a)
External Wall	77.3800	24.5700	52.8100	0.1800	9.5058			(29a)
External Roof	36.3500		36.3500	0.1100	3.9985			(30)
Total net area of external elements Aum(A, m2)			150.0800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.1096			(33)
Party Wall			143.7900	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)	11.3700	0.0500	0.5685
E3 Sill	11.3700	0.0500	0.5685
E4 Jamb	23.2000	0.0500	1.1600
E5 Ground floor (normal)	9.6000	0.1600	1.5360
E6 Intermediate floor within a dwelling	19.2000	0.0000	0.0000
E12 Gable (insulation at ceiling level)	8.1600	0.0600	0.4896
E18 Party wall between dwellings	21.1200	0.0600	1.2672
P1 Party wall - Ground floor	17.8400	0.0800	1.4272
P2 Party wall - Intermediate floor within a dwelling	35.6800	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	17.8400	0.1200	2.1408

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.1578 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	55.2674 (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	56.8247	56.4953	56.1725	54.6559	54.3722	53.0513	53.0513	52.8067	53.5601	54.3722	54.9462	55.5463	(38)
Heat transfer coeff	112.0921	111.7627	111.4398	109.9233	109.6395	108.3187	108.3187	108.0741	108.8275	109.6395	110.2135	110.8136	(39)

Average = Sum(39)m / 12 = 109.9219

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0279	1.0249	1.0219	1.0080	1.0054	0.9933	0.9933	0.9911	0.9980	1.0054	1.0107	1.0162	(40)
HLP (average)												1.0080	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8090 (42)
Hot water usage for mixer showers												
	71.3175	70.2458	68.6840	65.6958	63.4906	61.0314	59.6336	61.1836	62.8826	65.5230	68.5754	71.0443 (42a)
Hot water usage for baths												
	30.7921	30.3348	29.6908	28.5034	27.6143	26.6284	26.0959	26.7354	27.4317	28.4866	29.6984	30.6880 (42b)
Hot water usage for other uses												
	43.3970	41.8189	40.2408	38.6628	37.0847	35.5066	35.5066	37.0847	38.6628	40.2408	41.8189	43.3970 (42c)
Average daily hot water use (litres/day)												133.7533 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	145.5066	142.3995	138.6156	132.8620	128.1897	123.1665	121.2362	125.0037	128.9770	134.2505	140.0927	145.1293	(44)
Energy conte	230.4469	202.7749	213.0471	181.8815	172.5679	151.4476	146.6246	154.7807	159.0416	182.1766	199.5878	227.2374	(45)
Energy content (annual)										Total = Sum(45)m =		2221.6146	
Distribution loss (46)m = 0.15 x (45)m													
	34.5670	30.4162	31.9571	27.2822	25.8852	22.7171	21.9937	23.2171	23.8562	27.3265	29.9382	34.0856	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	281.4058	248.8023	264.0060	231.1965	223.5268	200.7627	197.5835	205.7396	208.3567	233.1355	248.9029	278.1963	(62)
WWHRS	-32.6034	-28.8347	-30.1940	-25.0019	-23.3008	-19.9387	-18.6893	-19.8742	-20.6293	-24.3197	-27.5513	-31.9996	(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													
	248.8024	219.9676	233.8119	206.1947	200.2260	180.8240	178.8942	185.8653	187.7273	208.8158	221.3516	246.1966	(64)
										Total per year (kWh/year) = Sum(64)m =		2518.6775	(64)
12Total per year (kWh/year)												2519	(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													
	89.3633	78.9295	83.5779	72.8044	70.1186	62.6851	61.4924	64.2043	65.2101	73.3135	78.6917	88.2961	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	136.6850	151.3298	136.6850	141.2411	136.6850	141.2411	136.6850	136.6850	141.2411	136.6850	141.2411	136.6850	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	270.1840	272.9877	265.9225	250.8817	231.8953	214.0508	202.1295	199.3259	206.3910	221.4319	240.4182	258.2628	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	(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)													
	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	(71)
Water heating gains (Table 5)													
	120.1120	117.4546	112.3359	101.1172	94.2454	87.0626	82.6511	86.2961	90.5696	98.5396	109.2940	118.6776	(72)
Total internal gains													
	595.1160	609.9071	583.0784	561.3750	530.9607	507.4896	486.6006	487.4420	503.3368	524.7915	559.0885	581.7604	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6600	10.6334	0.6300	0.7000	0.7700	34.6418	(74)
South	12.1600	46.7521	0.6300	0.7000	0.7700	173.7426	(78)

Solar gains	208.3844	350.7478	474.9544	590.3532	670.3016	671.4028	644.6837	582.8295	513.8870	385.7143	248.6793	179.0087	(83)
Total gains	803.5004	960.6550	1058.0328	1151.7282	1201.2622	1178.8924	1131.2843	1070.2715	1017.2237	910.5057	807.7678	760.7691	(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	67.5598	67.7589	67.9552	68.8927	69.0710	69.9133	69.9133	70.0715	69.5865	69.0710	68.7113	68.3392	
alpha	5.5040	5.5173	5.5303	5.5928	5.6047	5.6609	5.6609	5.6714	5.6391	5.6047	5.5808	5.5559	
util living area													
	0.9945	0.9851	0.9646	0.9022	0.7714	0.5757	0.4195	0.4613	0.6979	0.9262	0.9865	0.9959	(86)
MIT	19.9214	20.1419	20.4008	20.7064	20.9061	20.9853	20.9979	20.9965	20.9586	20.7002	20.2586	19.8876	(87)
Th 2	20.0602	20.0627	20.0651	20.0767	20.0788	20.0889	20.0889	20.0908	20.0850	20.0788	20.0745	20.0699	(88)
util rest of house													
	0.9928	0.9806	0.9538	0.8743	0.7165	0.4991	0.3336	0.3718	0.6206	0.8987	0.9816	0.9946	(89)
MIT 2	18.8103	19.0912	19.4161	19.7897	20.0038	20.0809	20.0883	20.0896	20.0591	19.7925	19.2500	18.7745	(90)
Living area fraction										fLA = Living area / (4) =		0.2135	(91)
MIT	19.0475	19.3155	19.6263	19.9854	20.1964	20.2740	20.2825	20.2832	20.2511	19.9863	19.4653	19.0121	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0475	19.3155	19.6263	19.9854	20.1964	20.2740	20.2825	20.2832	20.2511	19.9863	19.4653	19.0121	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9902	0.9759	0.9475	0.8712	0.7240	0.5150	0.3520	0.3909	0.6354	0.8954	0.9773	0.9925	(94)
Useful gains	795.6397	937.4860	1002.5330	1003.3577	869.7214	607.1326	398.1714	418.4092	646.3567	815.2475	789.4183	755.0385	(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													
	1653.0748	1611.1180	1462.7912	1218.5446	931.5439	614.5963	398.8787	419.6730	669.4101	1029.1077	1362.8219	1641.3822	(97)
Space heating kWh													
	637.9317	452.6807	342.4321	154.9345	45.9959	0.0000	0.0000	0.0000	0.0000	159.1119	412.8507	659.4397	(98a)
Space heating requirement - total per year (kWh/year)												2865.3773	
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													
	637.9317	452.6807	342.4321	154.9345	45.9959	0.0000	0.0000	0.0000	0.0000	159.1119	412.8507	659.4397	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2865.3773	
Space heating per m2											(98c) / (4) =	26.2758	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	637.9317	452.6807	342.4321	154.9345	45.9959	0.0000	0.0000	0.0000	0.0000	159.1119	412.8507	659.4397	(98)
Space heating efficiency (main heating system 1)													
	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)													
	690.4023	489.9142	370.5975	167.6781	49.7791	0.0000	0.0000	0.0000	0.0000	172.1991	446.8081	713.6793	(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													
	248.8024	219.9676	233.8119	206.1947	200.2260	180.8240	178.8942	185.8653	187.7273	208.8158	221.3516	246.1966	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.3065	85.8918	85.1977	83.7770	81.7778	80.3000	80.3000	80.3000	80.3000	83.8060	85.6967	86.3849	(217)
Fuel for water heating, kWh/month													
	288.2777	256.0985	274.4346	246.1232	244.8414	225.1855	222.7823	231.4636	233.7825	249.1657	258.2966	284.9995	(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	28.4004	22.7839	20.5144	15.0297	11.6094	9.4850	10.5905	13.7659	17.8805	23.4602	26.4982	29.1898	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-36.0354	-51.8912	-76.1574	-87.4667	-95.8547	-89.9786	-88.8220	-83.0689	-73.2133	-60.1115	-39.9830	-31.0248	(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	-17.1882	-36.4773	-73.1099	-110.7146	-147.3030	-148.3804	-146.6855	-123.8273	-90.2375	-52.5254	-23.0609	-13.5722	(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												3101.0577	(211)
Space heating fuel - main system 2												0.0000	(213)

Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	80.3000
Water heating fuel used	3015.4511 (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)	229.2078 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1796.6898 (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	4635.0268 (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	3101.0577	0.2100	651.2221	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3015.4511	0.2100	633.2447	(264)
Space and water heating			1284.4668	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	229.2078	0.1443	33.0818	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-813.6075	0.1342	-109.1511	
PV Unit electricity exported	-983.0823	0.1256	-123.5202	
Total			-232.6713	(269)
Total CO2, kg/year			1096.8066	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.0600	(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	3101.0577	1.1300	3504.1952	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3015.4511	1.1300	3407.4598	(278)
Space and water heating			6911.6549	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	229.2078	1.5338	351.5666	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-813.6075	1.4958	-1216.9918	
PV Unit electricity exported	-983.0823	0.4612	-453.3919	
Total			-1670.3837	(283)
Total Primary energy kWh/year			5722.9387	(286)
Target Primary Energy Rate (TPER)			52.4800	(287)

Appendix B

SBEM BRUKL Worksheets – *Be Lean*

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Cafe Gym & Retail Units

As designed

Date: Wed Aug 23 16:16:44 2023

Administrative information

Building Details

Address: Cafe, Gym & Retail Units, Belvedere, DA17

Certifier details

Name:

Telephone number:

Address: , ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.e.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.2.0

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 303.21

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	8.52	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	6.96	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	92.74	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	75.8	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.21	0.25	00 Ground Floor - Retail Unit 1_W_8
Floors	0.18	0.12	0.12	00 Ground Floor - Retail Unit 1_S_3
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	-	-	No heat loss flat roofs
Windows** and roof windows	1.6	1.2	1.2	00 Ground Floor - Retail Unit 1_G_7
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	-	-	No external personnel doors
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.86	6.5	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

1- Heat Pump

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.64	0.003
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
00 Ground Floor - Retail Unit 1	-	-	-	-	1.2	-	-	-	-	0.85	N/A
00 Ground Floor - Cafe	-	-	-	-	1.2	-	-	-	-	0.85	N/A
00 Ground Floor - Gym	-	-	-	-	1.2	-	-	-	-	0.85	N/A
00 Ground Floor - Retail Unit 2	-	-	-	-	1.2	-	-	-	-	0.85	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
00 Ground Floor - Retail Unit 1	120	120	1.25
00 Ground Floor - Cafe	120	120	1.25
00 Ground Floor - Gym	120	-	-
00 Ground Floor - Retail Unit 2	120	120	1.25

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 Ground Floor - Retail Unit 1	NO (-76.4%)	NO
00 Ground Floor - Cafe	NO (-33.7%)	NO
00 Ground Floor - Gym	NO (-34.4%)	NO
00 Ground Floor - Retail Unit 2	NO (-76.1%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	303.2	303.2
External area [m^2]	643.2	643.2
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	197.9	260.99
Average U-value [W/m^2K]	0.31	0.41
Alpha value* [%]	24.27	21.17

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
37	**Retail/Financial and Professional Services**
31	**Restaurants and Cafes/Drinking Establishments/Takeaways**
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
31	**General Assembly and Leisure, Night Clubs, and Theatres**
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	3.42	5.54
Cooling	9.55	14.22
Auxiliary	11.17	11.36
Lighting	11.89	14.87
Hot water	15.32	16.82
Equipment*	70.03	70.03
TOTAL**	**51.35**	**62.81**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	201.62	277.88
Primary energy [kWh_{PE}/m^2]	75.8	92.74
Total emissions [kg/m^2]	6.96	8.52

HVAC Systems Performance

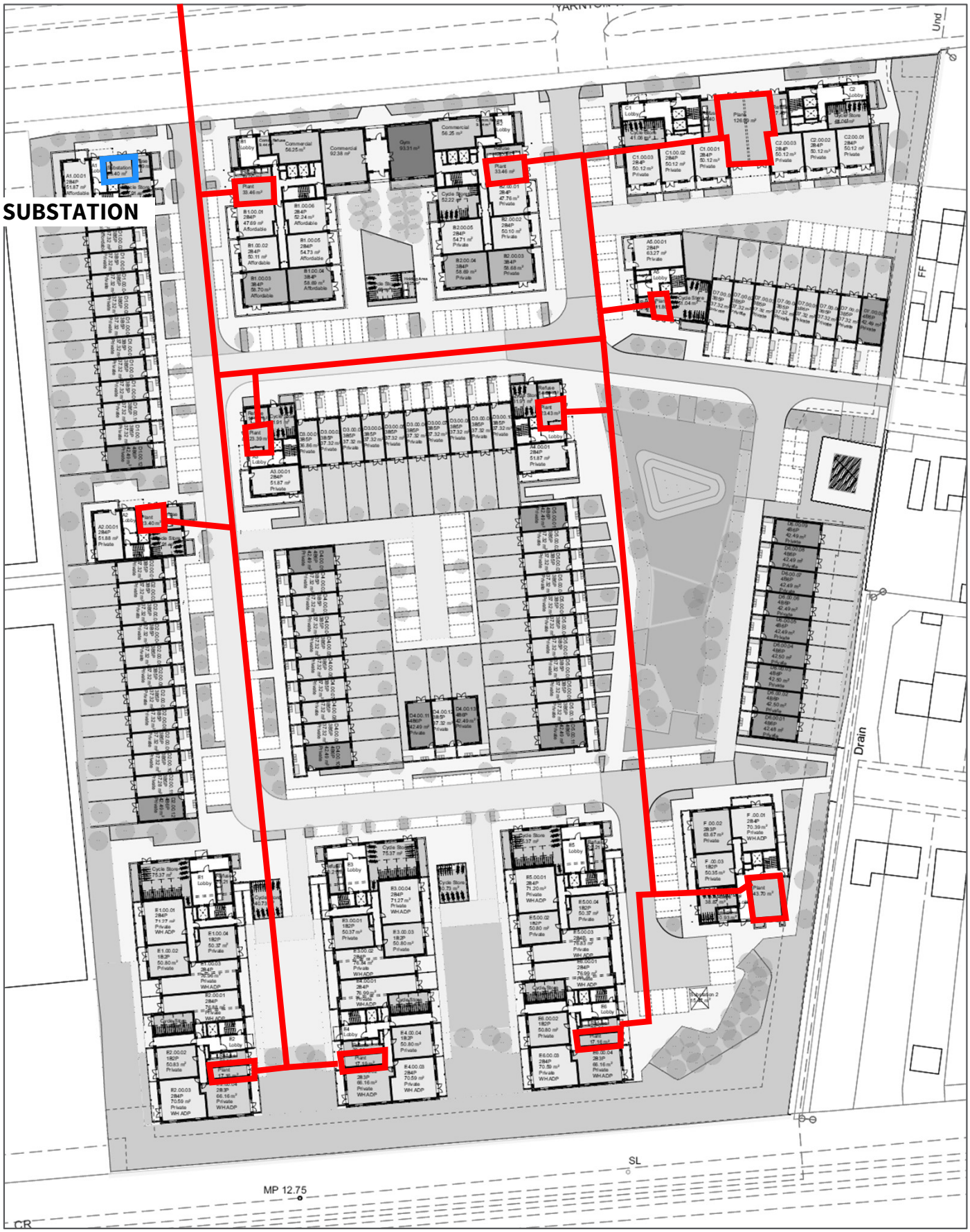
System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	34.6	167	3.4	9.6	11.2	2.81	4.86	2.86	6.5
	Notional	52.7	225.2	5.5	14.2	8.4	2.64	4.4	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Appendix C
Indicative Heat Network Layout

Indicative Heat Network Layout



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Appendix D
Indicative Roof Plan

Indicative Roof Plan

Mid terrace houses: 9.6m² each (Six 1.0x1.6m panels)

End terrace houses: 12.8 m² each (Eight 1.0x1.6m panels)

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Appendix E

SAP TER/DER Worksheets – *Be Clean*

Full SAP Calculation Printout

Property Reference	E1 03 06 (MF Flat) E_BeCLean	Issued on Date	30/08/2023
Assessment Reference	E1 03 06 (MF Flat) E_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	84 B	DER	2.17	TER	14.61
Environmental	98 A	% DER < TER			85.15
CO_2 Emissions (t/year)	0.1	DFEE	33.18	TFEE	32.25
Compliance Check	See BREL	% DFEE < TFEE			-2.87
% DPER < TPER	80.92	DPER	14.94	TPER	78.32

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
Client			

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

---
1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		50.5400 (1b)	x	2.8000 (2b)	=	141.5120	(1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.5400						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	141.5120	(5)

---
2. Ventilation rate
---

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1162	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.0000 (23c)

Effective ac	0.2432	0.2403	0.2374	0.2229	0.2200	0.2054	0.2054	0.2025	0.2112	0.2200	0.2258	0.2316	(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	
Opening Type 1 (Uw = 0.90)			8.3700	0.8687	7.2712			(27)
Door			4.0400	1.0000	4.0400			(26)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)

Wall to Corridor	40.8400	40.8400	0.1800	7.3512	(29a)
Total net area of external elements Aum(A, m2)		57.8400			(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		19.4886	(33)
Party Wall		22.4000	0.0000	0.0000	(32)
Party Floor 1		50.5400			(32d)
Party Ceiling 1		50.5400			(32b)

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

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	4.9300	0.0800	0.3944
E3 Sill	3.9100	0.1000	0.3910
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0500	0.2880
E18 Party wall between dwellings	5.2000	0.0400	0.2080
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.1000	2.9060
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.1500	1.0980
E16 Corner (normal)	5.2000	0.1000	0.5200
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.1124 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 25.6010 (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	11.3581	11.2223	11.0866	10.4080	10.2723	9.5937	9.5937	9.4580	9.8652	10.2723	10.5437	10.8152	(38)
Heat transfer coeff	36.9591	36.8234	36.6877	36.0091	35.8733	35.1948	35.1948	35.0590	35.4662	35.8733	36.1448	36.4162	(39)

Average = Sum(39)m / 12 = 35.9751

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7313	0.7286	0.7259	0.7125	0.7098	0.6964	0.6964	0.6937	0.7017	0.7098	0.7152	0.7205	(40)
HLP (average)												0.7118	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7060 (42)

Hot water usage for mixer showers

59.4266	58.5335	57.2322	54.7422	52.9047	50.8555	49.6908	50.9823	52.3980	54.5982	57.1417	59.1989	(42a)

Hot water usage for baths

22.8391	22.4999	22.0223	21.1416	20.4821	19.7509	19.3559	19.8302	20.3466	21.1291	22.0279	22.7619	(42b)

Hot water usage for other uses

32.1012	30.9339	29.7666	28.5993	27.4320	26.2646	26.2646	27.4320	28.5993	29.7666	30.9339	32.1012	(42c)

Average daily hot water use (litres/day) 105.1477 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3670	111.9674	109.0210	104.4831	100.8188	96.8710	95.3113	98.2445	101.3440	105.4939	110.1035	114.0621	(44)
Energy conte	181.1293	159.4401	167.5613	143.0321	135.7214	119.1142	115.2708	121.6472	124.9672	143.1543	156.8626	178.5936	(45)

Energy content (annual) Total = Sum(45)m = 1746.4941

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

27.1694	23.9160	25.1342	21.4548	20.3582	17.8671	17.2906	18.2471	18.7451	21.4731	23.5294	26.7890	(46)

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss

32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)

If cylinder contains dedicated solar storage

32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(57)
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)
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)

Primary loss / Combi loss

Total heat required for water heating calculated for each month

236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704	(62)
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)
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)
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)
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)

WWHRS / PV diverter / Solar input / FGHRS

Output from w/h

236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704	(64)

Total per year (kWh/year) = Sum(64)m = 2397.3339 (64)

12Total per year (kWh/year) 2397 (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

104.4469	92.9558	99.9356	90.3531	89.3488	82.4004	82.5490	84.6691	84.3466	91.8202	94.9518	103.6038	(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	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)

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

	77.6959	86.0205	77.6959	80.2858	77.6959	80.2858	77.6959	77.6959	80.2858	77.6959	80.2858	77.6959 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	148.6364	150.1787	146.2920	138.0176	127.5726	117.7558	111.1975	109.6552	113.5419	121.8163	132.2613	142.0781 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300 (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)												
	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403 (71)
Water heating gains (Table 5)												
	140.3857	138.3270	134.3220	125.4904	120.0925	114.4450	110.9529	113.8026	117.1480	123.4143	131.8775	139.2524 (72)
Total internal gains												
	415.3081	423.1164	406.9000	392.3839	373.9511	361.0767	348.4365	349.7438	359.5658	371.5167	393.0147	407.6166 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3700	19.6403	0.3000	0.8000	0.7700	27.3412	(76)

Solar gains	27.3412	53.4851	88.0824	128.4630	157.4362	161.1639	153.4346	131.7981	102.4435	63.4646	34.0912	22.4841 (83)
Total gains	442.6493	476.6015	494.9825	520.8469	531.3873	522.2407	501.8712	481.5419	462.0093	434.9813	427.1059	430.1007 (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	94.9623	95.3123	95.6649	97.4677	97.8365	99.7229	99.7229	100.1089	98.9597	97.8365	97.1018	96.3780	
alpha	7.3308	7.3542	7.3777	7.4978	7.5224	7.6482	7.6482	7.6739	7.5973	7.5224	7.4735	7.4252	
util living area													
	0.9736	0.9530	0.9099	0.7906	0.6207	0.4309	0.3085	0.3349	0.5277	0.8050	0.9404	0.9771	(86)
MIT	20.5724	20.6815	20.8124	20.9448	20.9912	20.9995	21.0000	20.9999	20.9979	20.9471	20.7679	20.5593	(87)
Th 2	20.3133	20.3156	20.3180	20.3298	20.3322	20.3440	20.3440	20.3464	20.3393	20.3322	20.3275	20.3227	(88)
util rest of house													
	0.9671	0.9423	0.8909	0.7574	0.5785	0.3869	0.2626	0.2873	0.4780	0.7668	0.9254	0.9714	(89)
MIT 2	19.8308	19.9661	20.1234	20.2793	20.3255	20.3438	20.3440	20.3464	20.3380	20.2861	20.0825	19.8228	(90)
Living area fraction									fLA = Living area / (4) =			0.5006	(91)
MIT	20.2020	20.3242	20.4683	20.6125	20.6588	20.6720	20.6724	20.6736	20.6683	20.6170	20.4256	20.1915	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2020	20.3242	20.4683	20.6125	20.6588	20.6720	20.6724	20.6736	20.6683	20.6170	20.4256	20.1915	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9659	0.9424	0.8953	0.7718	0.5993	0.4089	0.2856	0.3111	0.5028	0.7836	0.9278	0.9701	(94)
Useful gains	427.5501	449.1514	443.1796	401.9734	318.4498	213.5680	143.3196	149.8135	232.3162	340.8667	396.2685	417.2515	(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													
	587.7243	567.9717	512.4648	421.7547	321.3808	213.7039	143.3267	149.8267	232.9537	359.3436	481.6521	582.3485	(97)
Space heating kWh													
	119.1696	79.8472	51.5482	14.2426	2.1807	0.0000	0.0000	0.0000	0.0000	13.7469	61.4762	122.8321	(98a)
Space heating requirement - total per year (kWh/year)												465.0435	
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													
	119.1696	79.8472	51.5482	14.2426	2.1807	0.0000	0.0000	0.0000	0.0000	13.7469	61.4762	122.8321	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												465.0435	
Space heating per m2											(98c) / (4) =	9.2015	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(301)
Fraction of space heat from community system												1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water												1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating												1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system												1.5000	(306)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating:													
Space heating requirement													
	119.1696	79.8472	51.5482	14.2426	2.1807	0.0000	0.0000	0.0000	0.0000	13.7469	61.4762	122.8321	(98)
Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50													
307a	178.7544	119.7708	77.3222	21.3639	3.2711	0.0000	0.0000	0.0000	0.0000	20.6203	92.2144	184.2482	
Space heating requirement													
	178.7544	119.7708	77.3222	21.3639	3.2711	0.0000	0.0000	0.0000	0.0000	20.6203	92.2144	184.2482	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)

Space heating fuel for secondary/supplementary system

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)

Water heating

Annual water heating requirement

236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704 (64)

Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50

310a 354.6092	314.0512	334.2571	294.7887	286.4974	258.9119	255.8213	265.3859	267.6914	297.6466	315.5345	350.8056

Water heating fuel

354.6092	314.0512	334.2571	294.7887	286.4974	258.9119	255.8213	265.3859	267.6914	297.6466	315.5345	350.8056 (310)

Cooling System Energy Efficiency Ratio 0.0000 (314)

Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.5471	10.4296	11.5471	11.1746	11.5471	11.1746	11.5471	11.5471	11.1746	11.5471	11.1746	11.5471 (331)
Lighting	17.2321	13.8242	12.4472	9.1193	7.0440	5.7550	6.4258	8.3525	10.8491	14.2346	16.0779	17.7110 (332)

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

(333a)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 (333a)

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

(334a)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 (334a)

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

(335a)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 (335a)

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

(333b)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 (333b)

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

(334b)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 (334b)

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

(335b)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 (335b)

Annual totals kWh/year

Space heating fuel - community heating	697.5653 (307)
Space heating fuel - secondary	0.0000 (309)
Water heating fuel - community heating	3596.0008 (310)
Efficiency of water heater	0.0000 (311)
Electricity used for heat distribution	6.9757 (313)
Space cooling fuel	0.0000 (321)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)

mechanical ventilation fans (SFP = 0.7875)	135.9577 (330a)
Total electricity for the above, kWh/year	135.9577 (331)
Electricity for lighting (calculated in Appendix L)	139.0728 (332)

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

PV generation	0.0000 (333)
Wind generation	0.0000 (334)
Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	4568.5965 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	4293.5661	0.0150	10.4635	(367)
Electrical energy for heat distribution (space & water)	6.9757	0.0000	6.1670	(372)
Overall CO2 factor for heat network			0.0164	(386)
Total CO2 associated with community systems			70.5705	(373)
Space and water heating			70.5705	(376)
Pumps, fans and electric keep-hot	135.9577	0.1387	18.8590	(378)
Energy for lighting	139.0728	0.1443	20.0725	(379)
Total CO2, kg/year			109.5020	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.1700	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	4293.5661	0.0630	43.9466	(467)
Electrical energy for heat distribution (space & water)	6.9757	0.0000	65.7433	(472)
Overall CO2 factor for heat network			0.0783	(486)
Total CO2 associated with community systems			336.2380	(473)
Space and water heating			336.2380	(476)
Pumps, fans and electric keep-hot	135.9577	1.5128	205.6767	(478)
Energy for lighting	139.0728	1.5338	213.3144	(479)
Total Primary energy kWh/year			755.2291	(483)
Dwelling Primary energy Rate (DPER)			14.9400	(484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.5400 (1b)	x	2.8000 (2b)	=	141.5120 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 50.5400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	141.5120	(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	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1413 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3913 (18)
Number of sides sheltered		3 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =		0.7750 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) =		0.3033 (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	0.3867	0.3791	0.3715	0.3336	0.3260	0.2881	0.2881	0.2805	0.3033	0.3260	0.3412	0.3564	(22b)
Effective ac	0.5748	0.5719	0.5690	0.5556	0.5531	0.5415	0.5415	0.5394	0.5460	0.5531	0.5582	0.5635	(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			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			8.3700	1.1450	9.5840			(27)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)
Wall to Corridor	40.8400		40.8400	0.1800	7.3512			(29a)
Total net area of external elements Aum(A, m2)			57.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		21.8014			(33)
Party Wall			22.4000	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)	4.9300	0.0500	0.2465
E3 Sill	3.9100	0.0500	0.1955
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0700	0.4032
E18 Party wall between dwellings	5.2000	0.0600	0.3120
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.0700	2.0342
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.0200	0.1464
E16 Corner (normal)	5.2000	0.0900	0.4680
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.1128 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	25.9142 (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	26.8408	26.7052	26.5723	25.9482	25.8314	25.2878	25.2878	25.1871	25.4972	25.8314	26.0676	26.3146	(38)
Heat transfer coeff	52.7550	52.6194	52.4865	51.8623	51.7456	51.2019	51.2019	51.1013	51.4113	51.7456	51.9818	52.2288	(39)
Average = Sum(39)m / 12 =												51.8618	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0438	1.0411	1.0385	1.0262	1.0239	1.0131	1.0131	1.0111	1.0172	1.0239	1.0285	1.0334	(40)
HLP (average)												1.0262	
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 1.7060 (42)
Hot water usage for mixer showers
52.8236 52.0298 50.8730 48.6598 47.0264 45.2049 44.1696 45.3176 46.5760 48.5318 50.7926 52.6213 (42a)
Hot water usage for baths
22.8391 22.4999 22.0223 21.1416 20.4821 19.7509 19.3559 19.8302 20.3466 21.1291 22.0279 22.7619 (42b)
Hot water usage for other uses
32.1012 30.9339 29.7666 28.5993 27.4320 26.2646 26.2646 27.4320 28.5993 29.7666 30.9339 32.1012 (42c)
Average daily hot water use (litres/day) 99.0600 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.7640	105.4637	102.6619	98.4006	94.9405	91.2204	89.7901	92.5798	95.5220	99.4275	103.7544	107.4844	(44)
Energy conte	170.6718	150.1788	157.7875	134.7055	127.8081	112.1661	108.5933	114.6331	117.7881	134.9221	147.8172	168.2946	(45)

Energy content (annual) Total = Sum(45)m = 1645.3665
Distribution loss (46)m = 0.15 x (45)m
25.6008 22.5268 23.6681 20.2058 19.1712 16.8249 16.2890 17.1950 17.6682 20.2383 22.1726 25.2442 (46)
Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.7527 (55)
Total storage loss
23.3325 21.0745 23.3325 22.5798 23.3325 22.5798 23.3325 23.3325 22.5798 23.3325 22.5798 23.3325 (56)
If cylinder contains dedicated solar storage
23.3325 21.0745 23.3325 22.5798 23.3325 22.5798 23.3325 23.3325 22.5798 23.3325 22.5798 23.3325 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Combi loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (61)
Total heat required for water heating calculated for each month
217.2667 192.2646 204.3824 179.7973 174.4030 157.2580 155.1882 161.2280 162.8800 181.5170 192.9091 214.8895 (62)
WWHRS -24.1488 -21.3574 -22.3642 -18.5184 -17.2585 -14.7682 -13.8429 -14.7205 -15.2798 -18.0132 -20.4068 -23.7016 (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
193.1180 170.9072 182.0182 161.2789 157.1445 142.4897 141.3454 146.5075 147.6002 163.5038 172.5023 191.1879 (64)
Total per year (kWh/year) = Sum(64)m = 1969.6037 (64)
12Total per year (kWh/year) 1970 (64)
Electric shower(s)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month
94.0243 83.6030 89.7403 80.8631 79.7721 73.3687 73.3832 75.3914 75.2380 82.1375 85.2227 93.2339 (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	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
77.6959 86.0205 77.6959 80.2858 77.6959 80.2858 77.6959 77.6959 80.2858 77.6959 80.2858 77.6959 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
148.6364 150.1787 146.2920 138.0176 127.5726 117.7558 111.1975 109.6552 113.5419 121.8163 132.2613 142.0781 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
31.5300 31.5300 31.5300 31.5300 31.5300 31.5300 31.5300 31.5300 31.5300 31.5300 31.5300 31.5300 (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)
-68.2403 -68.2403 -68.2403 -68.2403 -68.2403 -68.2403 -68.2403 -68.2403 -68.2403 -68.2403 -68.2403 -68.2403 (71)
Water heating gains (Table 5)
126.3768 124.4093 120.6187 112.3098 107.2206 101.9010 98.6333 101.3326 104.4973 110.3999 118.3649 125.3144 (72)
Total internal gains
404.2992 412.1986 396.1967 382.2033 364.0792 348.5327 336.1169 337.2738 346.9151 361.5023 382.5021 396.6785 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3700	19.6403	0.6300	0.7000	0.7700	50.2394	(76)

Solar gains	50.2394	98.2790	161.8514	236.0507	289.2890	296.1387	281.9362	242.1790	188.2399	116.6163	62.6426	41.3145	(83)
Total gains	454.5386	510.4776	558.0481	618.2540	653.3682	644.6714	618.0531	579.4528	535.1550	478.1186	445.1447	437.9930	(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	66.5288	66.7002	66.8690	67.6738	67.8265	68.5467	68.5467	68.6817	68.2675	67.8265	67.5183	67.1990	
alpha	5.4353	5.4467	5.4579	5.5116	5.5218	5.5698	5.5698	5.5788	5.5512	5.5218	5.5012	5.4799	
util living area													
	0.9865	0.9738	0.9433	0.8527	0.6950	0.5025	0.3637	0.4041	0.6384	0.8920	0.9721	0.9888	(86)
MIT	20.0644	20.2425	20.4920	20.7822	20.9411	20.9918	20.9989	20.9980	20.9716	20.7576	20.3713	20.0370	(87)
Th 2	20.0470	20.0492	20.0514	20.0616	20.0635	20.0724	20.0724	20.0741	20.0690	20.0635	20.0596	20.0556	(88)
util rest of house													
	0.9826	0.9664	0.9276	0.8173	0.6377	0.4323	0.2875	0.3236	0.5620	0.8566	0.9628	0.9854	(89)
MIT 2	18.9809	19.2055	19.5134	19.8567	20.0186	20.0681	20.0721	20.0734	20.0519	19.8403	19.3775	18.9530	(90)
Living area fraction										fLA = Living area / (4) =		0.5006	(91)
MIT	19.5233	19.7246	20.0033	20.3200	20.4804	20.5305	20.5360	20.5363	20.5123	20.2995	19.8750	19.4956	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5233	19.7246	20.0033	20.3200	20.4804	20.5305	20.5360	20.5363	20.5123	20.2995	19.8750	19.4956	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9798	0.9633	0.9267	0.8277	0.6640	0.4672	0.3256	0.3639	0.5992	0.8664	0.9606	0.9829	(94)
Useful gains	445.3601	491.7404	517.1217	511.7185	433.8061	301.2121	201.2678	210.8843	320.6902	414.2651	427.5872	430.4947	(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													
	803.1038	780.0626	708.7405	592.2665	454.3467	303.6546	201.5324	211.3686	329.6630	501.9049	664.0671	798.8725	(97)
Space heating kWh													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(98a)
Space heating requirement - total per year (kWh/year)												1185.2976	
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													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1185.2976	
Space heating per m2											(98c) / (4) =	23.4527	(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													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(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)													
	288.3654	209.9161	154.4576	62.8327	16.5571	0.0000	0.0000	0.0000	0.0000	70.6436	184.4697	296.9373	(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													
	193.1180	170.9072	182.0182	161.2789	157.1445	142.4897	141.3454	146.5075	147.6002	163.5038	172.5023	191.1879	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.7795	84.3418	83.5179	81.9980	80.5233	79.8000	79.8000	79.8000	79.8000	82.1744	84.0305	84.8668	(217)
Fuel for water heating, kWh/month													
	227.7884	202.6363	217.9393	196.6863	195.1540	178.5586	177.1245	183.5933	184.9626	198.9717	205.2853	225.2799	(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	16.1437	12.9511	11.6610	8.5433	6.5991	5.3915	6.0199	7.8249	10.1638	13.3355	15.0624	16.5924	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-11.3138	-17.0291	-26.1177	-31.4068	-35.6997	-34.0167	-33.6213	-30.8312	-26.2323	-20.3627	-12.8211	-9.6609	(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	-3.4863	-7.5439	-15.3897	-23.7023	-31.9162	-32.2648	-31.8673	-26.7013	-19.2192	-10.9587	-4.7098	-2.7404	(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												1284.1794	(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	2393.9803 (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)	130.2887 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-499.6132 (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	3394.8352 (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	1284.1794	0.2100	269.6777	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2393.9803	0.2100	502.7359	(264)
Space and water heating			772.4135	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	130.2887	0.1443	18.8047	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	0.1332	-38.5158	
PV Unit electricity exported	-210.4999	0.1252	-26.3508	
Total			-64.8666	(269)
Total CO2, kg/year			738.2809	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.6100	(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	1284.1794	1.1300	1451.1227	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2393.9803	1.1300	2705.1977	(278)
Space and water heating			4156.3204	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	130.2887	1.5338	199.8412	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	1.4923	-431.4386	
PV Unit electricity exported	-210.4999	0.4595	-96.7185	
Total			-528.1571	(283)
Total Primary energy kWh/year			3958.1053	(286)
Target Primary Energy Rate (TPER)			78.3200	(287)

Full SAP Calculation Printout

Property Reference	E1 03 06 (MF Flat)_BeCLean	Issued on Date	30/08/2023
Assessment Reference	E1 03 06 (MF Flat)_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	84 B	DER	2.15	TER	14.61
Environmental	99 A	% DER < TER			85.28
CO_2 Emissions (t/year)	0.1	DFEE	31.94	TFEE	32.25
Compliance Check	See BREL	% DFEE < TFEE			0.97
% DPER < TPER	81.03	DPER	14.85	TPER	78.32

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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		50.5400 (1b)	x	2.8000 (2b)	=	141.5120 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.5400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	141.5120 (5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80	=	0.0000 (6a)
Number of open flues	0 * 20	=	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10	=	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20	=	0.0000 (6d)
Number of flues attached to other heater	0 * 35	=	0.0000 (6e)
Number of blocked chimneys	0 * 20	=	0.0000 (6f)
Number of intermittent extract fans	0 * 10	=	0.0000 (7a)
Number of passive vents	0 * 10	=	0.0000 (7b)
Number of flueless gas fires	0 * 40	=	0.0000 (7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5)	=	0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			3.0000 (17)
Infiltration rate			0.1500 (18)
Number of sides sheltered			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1162 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1162	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.0000 (23c)

Effective ac	0.2432	0.2403	0.2374	0.2229	0.2200	0.2054	0.2054	0.2025	0.2112	0.2200	0.2258	0.2316	(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	
Opening Type 1 (Uw = 0.90)			8.3700	0.8687	7.2712			(27)
Door			4.0400	1.0000	4.0400			(26)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)

Wall to Corridor	40.8400	40.8400	0.1800	7.3512	(29a)
Total net area of external elements Aum(A, m2)		57.8400			(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		19.4886	(33)
Party Wall		22.4000	0.0000	0.0000	(32)
Party Floor 1		50.5400			(32d)
Party Ceiling 1		50.5400			(32b)

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

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	4.9300	0.0800	0.3944
E3 Sill	3.9100	0.1000	0.3910
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0500	0.2880
E18 Party wall between dwellings	5.2000	0.0400	0.2080
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.1000	2.9060
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.1500	1.0980
E16 Corner (normal)	5.2000	0.1000	0.5200
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.1124 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 25.6010 (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	11.3581	11.2223	11.0866	10.4080	10.2723	9.5937	9.5937	9.4580	9.8652	10.2723	10.5437	10.8152	(38)
Heat transfer coeff	36.9591	36.8234	36.6877	36.0091	35.8733	35.1948	35.1948	35.0590	35.4662	35.8733	36.1448	36.4162	(39)

Average = Sum(39)m / 12 = 35.9751

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7313	0.7286	0.7259	0.7125	0.7098	0.6964	0.6964	0.6937	0.7017	0.7098	0.7152	0.7205	(40)
HLP (average)												0.7118	
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 1.7060 (42)

Hot water usage for mixer showers

59.4266	58.5335	57.2322	54.7422	52.9047	50.8555	49.6908	50.9823	52.3980	54.5982	57.1417	59.1989	(42a)

Hot water usage for baths

22.8391	22.4999	22.0223	21.1416	20.4821	19.7509	19.3559	19.8302	20.3466	21.1291	22.0279	22.7619	(42b)

Hot water usage for other uses

32.1012	30.9339	29.7666	28.5993	27.4320	26.2646	26.2646	27.4320	28.5993	29.7666	30.9339	32.1012	(42c)

Average daily hot water use (litres/day) 105.1477 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3670	111.9674	109.0210	104.4831	100.8188	96.8710	95.3113	98.2445	101.3440	105.4939	110.1035	114.0621	(44)
Energy conte	181.1293	159.4401	167.5613	143.0321	135.7214	119.1142	115.2708	121.6472	124.9672	143.1543	156.8626	178.5936	(45)

Energy content (annual) Total = Sum(45)m = 1746.4941

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

27.1694	23.9160	25.1342	21.4548	20.3582	17.8671	17.2906	18.2471	18.7451	21.4731	23.5294	26.7890	(46)

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss

32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)

If cylinder contains dedicated solar storage

32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(57)
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)
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)

Primary loss / Combi loss

Total heat required for water heating calculated for each month

236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704	(62)
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)
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)
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)
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)

WWHRS / PV diverter / Solar input / FGHRS

Output from w/h

236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704	(64)

Total per year (kWh/year) = Sum(64)m = 2397.3339 (64)

12Total per year (kWh/year) 2397 (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

104.4469	92.9558	99.9356	90.3531	89.3488	82.4004	82.5490	84.6691	84.3466	91.8202	94.9518	103.6038	(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	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)

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

	77.6959	86.0205	77.6959	80.2858	77.6959	80.2858	77.6959	77.6959	80.2858	77.6959	80.2858	77.6959 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	148.6364	150.1787	146.2920	138.0176	127.5726	117.7558	111.1975	109.6552	113.5419	121.8163	132.2613	142.0781 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300 (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)												
	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403 (71)
Water heating gains (Table 5)												
	140.3857	138.3270	134.3220	125.4904	120.0925	114.4450	110.9529	113.8026	117.1480	123.4143	131.8775	139.2524 (72)
Total internal gains												
	415.3081	423.1164	406.9000	392.3839	373.9511	361.0767	348.4365	349.7438	359.5658	371.5167	393.0147	407.6166 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
West	8.3700	19.6403	0.4000	0.8000	0.7700	36.4549	(80)

Solar gains	36.4549	71.3135	117.4432	171.2839	209.9149	214.8853	204.5795	175.7308	136.5913	84.6195	45.4550	29.9787 (83)
Total gains	451.7630	494.4299	524.3433	563.6679	583.8660	575.9620	553.0160	525.4746	496.1571	456.1362	438.4697	437.5954 (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	94.9623	95.3123	95.6649	97.4677	97.8365	99.7229	99.7229	100.1089	98.9597	97.8365	97.1018	96.3780	
alpha	7.3308	7.3542	7.3777	7.4978	7.5224	7.6482	7.6482	7.6739	7.5973	7.5224	7.4735	7.4252	
util living area													
	0.9706	0.9440	0.8869	0.7443	0.5677	0.3909	0.2800	0.3069	0.4921	0.7779	0.9328	0.9749	(86)
MIT	20.5896	20.7103	20.8461	20.9628	20.9951	20.9998	21.0000	21.0000	20.9987	20.9579	20.7848	20.5739	(87)
Th 2	20.3133	20.3156	20.3180	20.3298	20.3322	20.3440	20.3440	20.3464	20.3393	20.3322	20.3275	20.3227	(88)
util rest of house													
	0.9635	0.9318	0.8653	0.7102	0.5282	0.3509	0.2383	0.2633	0.4455	0.7386	0.9164	0.9687	(89)
MIT 2	19.8519	20.0003	20.1609	20.2964	20.3285	20.3439	20.3440	20.3464	20.3385	20.2960	20.1020	19.8407	(90)
Living area fraction									fLA = Living area / (4) =			0.5006	(91)
MIT	20.2212	20.3557	20.5039	20.6300	20.6622	20.6722	20.6724	20.6736	20.6690	20.6273	20.4438	20.2077	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2212	20.3557	20.5039	20.6300	20.6622	20.6722	20.6724	20.6736	20.6690	20.6273	20.4438	20.2077	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9624	0.9325	0.8715	0.7257	0.5478	0.3709	0.2592	0.2851	0.4688	0.7564	0.9195	0.9674	(94)
Useful gains	434.7686	461.0767	456.9521	409.0723	319.8698	213.6419	143.3236	149.8203	232.5799	345.0338	403.1791	423.3513	(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													
	588.4336	569.1321	513.7718	422.3860	321.5037	213.7104	143.3270	149.8274	232.9765	359.7146	482.3095	582.9403	(97)
Space heating kWh													
	114.3268	72.6133	42.2739	9.5859	1.2156	0.0000	0.0000	0.0000	0.0000	10.9225	56.9739	118.7342	(98a)
Space heating requirement - total per year (kWh/year)												426.6460	
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													
	114.3268	72.6133	42.2739	9.5859	1.2156	0.0000	0.0000	0.0000	0.0000	10.9225	56.9739	118.7342	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												426.6460	
Space heating per m2											(98c) / (4) =	8.4417	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(301)
Fraction of space heat from community system												1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water												1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating												1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system												1.5000	(306)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating:													
Space heating requirement													
	114.3268	72.6133	42.2739	9.5859	1.2156	0.0000	0.0000	0.0000	0.0000	10.9225	56.9739	118.7342	(98)
Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50													
307a	171.4902	108.9199	63.4108	14.3788	1.8233	0.0000	0.0000	0.0000	0.0000	16.3838	85.4609	178.1013	
Space heating requirement													
	171.4902	108.9199	63.4108	14.3788	1.8233	0.0000	0.0000	0.0000	0.0000	16.3838	85.4609	178.1013	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)

Space heating fuel for secondary/supplementary system

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)

Water heating

Annual water heating requirement

236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704 (64)

Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50

310a 354.6092	314.0512	334.2571	294.7887	286.4974	258.9119	255.8213	265.3859	267.6914	297.6466	315.5345	350.8056

Water heating fuel

354.6092	314.0512	334.2571	294.7887	286.4974	258.9119	255.8213	265.3859	267.6914	297.6466	315.5345	350.8056 (310)

Cooling System Energy Efficiency Ratio 0.0000 (314)

Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.5471	10.4296	11.5471	11.1746	11.5471	11.1746	11.5471	11.5471	11.1746	11.5471	11.1746	11.5471 (331)
Lighting	17.2321	13.8242	12.4472	9.1193	7.0440	5.7550	6.4258	8.3525	10.8491	14.2346	16.0779	17.7110 (332)

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

(333a)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 (333a)

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

(334a)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 (334a)

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

(335a)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 (335a)

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

(333b)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 (333b)

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

(334b)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 (334b)

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

(335b)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 (335b)

Annual totals kWh/year

Space heating fuel - community heating	639.9690 (307)
Space heating fuel - secondary	0.0000 (309)
Water heating fuel - community heating	3596.0008 (310)
Efficiency of water heater	0.0000 (311)
Electricity used for heat distribution	6.3997 (313)
Space cooling fuel	0.0000 (321)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)

mechanical ventilation fans (SFP = 0.7875)	135.9577 (330a)
Total electricity for the above, kWh/year	135.9577 (331)
Electricity for lighting (calculated in Appendix L)	139.0728 (332)

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

PV generation	0.0000 (333)
Wind generation	0.0000 (334)
Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	4511.0002 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	4235.9698	0.0150	9.5995	(367)
Electrical energy for heat distribution (space & water)	6.3997	0.0000	6.0786	(372)
Overall CO2 factor for heat network			0.0164	(386)
Total CO2 associated with community systems			69.6181	(373)
Space and water heating			69.6181	(376)
Pumps, fans and electric keep-hot	135.9577	0.1387	18.8590	(378)
Energy for lighting	139.0728	0.1443	20.0725	(379)
Total CO2, kg/year			108.5496	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.1500	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	4235.9698	0.0630	40.3180	(467)
Electrical energy for heat distribution (space & water)	6.3997	0.0000	64.8400	(472)
Overall CO2 factor for heat network			0.0783	(486)
Total CO2 associated with community systems			331.7061	(473)
Space and water heating			331.7061	(476)
Pumps, fans and electric keep-hot	135.9577	1.5128	205.6767	(478)
Energy for lighting	139.0728	1.5338	213.3144	(479)
Total Primary energy kWh/year			750.6973	(483)
Dwelling Primary energy Rate (DPER)			14.8500	(484)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.5400 (1b)	x	2.8000 (2b)	=	141.5120 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 50.5400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	141.5120	(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	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1413 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3913 (18)
Number of sides sheltered		3 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =		0.7750 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) =		0.3033 (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	0.3867	0.3791	0.3715	0.3336	0.3260	0.2881	0.2881	0.2805	0.3033	0.3260	0.3412	0.3564	(22b)
Effective ac	0.5748	0.5719	0.5690	0.5556	0.5531	0.5415	0.5415	0.5394	0.5460	0.5531	0.5582	0.5635	(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			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			8.3700	1.1450	9.5840			(27)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)
Wall to Corridor	40.8400		40.8400	0.1800	7.3512			(29a)
Total net area of external elements Aum(A, m2)			57.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		21.8014			(33)
Party Wall			22.4000	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)	4.9300	0.0500	0.2465
E3 Sill	3.9100	0.0500	0.1955
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0700	0.4032
E18 Party wall between dwellings	5.2000	0.0600	0.3120
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.0700	2.0342
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.0200	0.1464
E16 Corner (normal)	5.2000	0.0900	0.4680
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.1128 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	25.9142 (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	26.8408	26.7052	26.5723	25.9482	25.8314	25.2878	25.2878	25.1871	25.4972	25.8314	26.0676	26.3146	(38)
Heat transfer coeff	52.7550	52.6194	52.4865	51.8623	51.7456	51.2019	51.2019	51.1013	51.4113	51.7456	51.9818	52.2288	(39)
Average = Sum(39)m / 12 =												51.8618	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0438	1.0411	1.0385	1.0262	1.0239	1.0131	1.0131	1.0111	1.0172	1.0239	1.0285	1.0334	(40)
HLP (average)												1.0262	
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 1.7060 (42)
Hot water usage for mixer showers
52.8236 52.0298 50.8730 48.6598 47.0264 45.2049 44.1696 45.3176 46.5760 48.5318 50.7926 52.6213 (42a)
Hot water usage for baths
22.8391 22.4999 22.0223 21.1416 20.4821 19.7509 19.3559 19.8302 20.3466 21.1291 22.0279 22.7619 (42b)
Hot water usage for other uses
32.1012 30.9339 29.7666 28.5993 27.4320 26.2646 26.2646 27.4320 28.5993 29.7666 30.9339 32.1012 (42c)
Average daily hot water use (litres/day) 99.0600 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.7640	105.4637	102.6619	98.4006	94.9405	91.2204	89.7901	92.5798	95.5220	99.4275	103.7544	107.4844	(44)
Energy conte	170.6718	150.1788	157.7875	134.7055	127.8081	112.1661	108.5933	114.6331	117.7881	134.9221	147.8172	168.2946	(45)
Energy content (annual)										Total = Sum(45)m =		1645.3665	
Distribution loss (46)m = 0.15 x (45)m													
	25.6008	22.5268	23.6681	20.2058	19.1712	16.8249	16.2890	17.1950	17.6682	20.2383	22.1726	25.2442	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	217.2667	192.2646	204.3824	179.7973	174.4030	157.2580	155.1882	161.2280	162.8800	181.5170	192.9091	214.8895	(62)
WWHRS	-24.1488	-21.3574	-22.3642	-18.5184	-17.2585	-14.7682	-13.8429	-14.7205	-15.2798	-18.0132	-20.4068	-23.7016	(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													
	193.1180	170.9072	182.0182	161.2789	157.1445	142.4897	141.3454	146.5075	147.6002	163.5038	172.5023	191.1879	(64)
										Total per year (kWh/year) = Sum(64)m =		1969.6037	(64)
12Total per year (kWh/year)												1970	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	94.0243	83.6030	89.7403	80.8631	79.7721	73.3687	73.3832	75.3914	75.2380	82.1375	85.2227	93.2339	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	77.6959	86.0205	77.6959	80.2858	77.6959	80.2858	77.6959	77.6959	80.2858	77.6959	80.2858	77.6959	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.6364	150.1787	146.2920	138.0176	127.5726	117.7558	111.1975	109.6552	113.5419	121.8163	132.2613	142.0781	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	(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)													
	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	(71)
Water heating gains (Table 5)													
	126.3768	124.4093	120.6187	112.3098	107.2206	101.9010	98.6333	101.3326	104.4973	110.3999	118.3649	125.3144	(72)
Total internal gains													
	404.2992	412.1986	396.1967	382.2033	364.0792	348.5327	336.1169	337.2738	346.9151	361.5023	382.5021	396.6785	(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	
West	8.3700	19.6403	0.6300	0.7000	0.7700	50.2394	(80)

Solar gains	50.2394	98.2790	161.8514	236.0507	289.2890	296.1387	281.9362	242.1790	188.2399	116.6163	62.6426	41.3145	(83)
Total gains	454.5386	510.4776	558.0481	618.2540	653.3682	644.6714	618.0531	579.4528	535.1550	478.1186	445.1447	437.9930	(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	66.5288	66.7002	66.8690	67.6738	67.8265	68.5467	68.5467	68.6817	68.2675	67.8265	67.5183	67.1990	
alpha	5.4353	5.4467	5.4579	5.5116	5.5218	5.5698	5.5698	5.5788	5.5512	5.5218	5.5012	5.4799	
util living area													
	0.9865	0.9738	0.9433	0.8527	0.6950	0.5025	0.3637	0.4041	0.6384	0.8920	0.9721	0.9888	(86)
MIT	20.0644	20.2425	20.4920	20.7822	20.9411	20.9918	20.9989	20.9980	20.9716	20.7576	20.3713	20.0370	(87)
Th 2	20.0470	20.0492	20.0514	20.0616	20.0635	20.0724	20.0724	20.0741	20.0690	20.0635	20.0596	20.0556	(88)
util rest of house													
	0.9826	0.9664	0.9276	0.8173	0.6377	0.4323	0.2875	0.3236	0.5620	0.8566	0.9628	0.9854	(89)
MIT 2	18.9809	19.2055	19.5134	19.8567	20.0186	20.0681	20.0721	20.0734	20.0519	19.8403	19.3775	18.9530	(90)
Living area fraction										fLA = Living area / (4) =		0.5006	(91)
MIT	19.5233	19.7246	20.0033	20.3200	20.4804	20.5305	20.5360	20.5363	20.5123	20.2995	19.8750	19.4956	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5233	19.7246	20.0033	20.3200	20.4804	20.5305	20.5360	20.5363	20.5123	20.2995	19.8750	19.4956	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9798	0.9633	0.9267	0.8277	0.6640	0.4672	0.3256	0.3639	0.5992	0.8664	0.9606	0.9829	(94)
Useful gains	445.3601	491.7404	517.1217	511.7185	433.8061	301.2121	201.2678	210.8843	320.6902	414.2651	427.5872	430.4947	(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													
	803.1038	780.0626	708.7405	592.2665	454.3467	303.6546	201.5324	211.3686	329.6630	501.9049	664.0671	798.8725	(97)
Space heating kWh													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(98a)
Space heating requirement - total per year (kWh/year)												1185.2976	
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													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1185.2976	
Space heating per m2											(98c) / (4) =	23.4527	(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													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(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)													
	288.3654	209.9161	154.4576	62.8327	16.5571	0.0000	0.0000	0.0000	0.0000	70.6436	184.4697	296.9373	(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													
	193.1180	170.9072	182.0182	161.2789	157.1445	142.4897	141.3454	146.5075	147.6002	163.5038	172.5023	191.1879	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.7795	84.3418	83.5179	81.9980	80.5233	79.8000	79.8000	79.8000	79.8000	82.1744	84.0305	84.8668	(217)
Fuel for water heating, kWh/month													
	227.7884	202.6363	217.9393	196.6863	195.1540	178.5586	177.1245	183.5933	184.9626	198.9717	205.2853	225.2799	(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	16.1437	12.9511	11.6610	8.5433	6.5991	5.3915	6.0199	7.8249	10.1638	13.3355	15.0624	16.5924	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-11.3138	-17.0291	-26.1177	-31.4068	-35.6997	-34.0167	-33.6213	-30.8312	-26.2323	-20.3627	-12.8211	-9.6609	(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	-3.4863	-7.5439	-15.3897	-23.7023	-31.9162	-32.2648	-31.8673	-26.7013	-19.2192	-10.9587	-4.7098	-2.7404	(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												1284.1794	(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	2393.9803 (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)	130.2887 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-499.6132 (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	3394.8352 (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	1284.1794	0.2100	269.6777	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2393.9803	0.2100	502.7359	(264)
Space and water heating			772.4135	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	130.2887	0.1443	18.8047	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	0.1332	-38.5158	
PV Unit electricity exported	-210.4999	0.1252	-26.3508	
Total			-64.8666	(269)
Total CO2, kg/year			738.2809	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.6100	(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	1284.1794	1.1300	1451.1227	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2393.9803	1.1300	2705.1977	(278)
Space and water heating			4156.3204	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	130.2887	1.5338	199.8412	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	1.4923	-431.4386	
PV Unit electricity exported	-210.4999	0.4595	-96.7185	
Total			-528.1571	(283)
Total Primary energy kWh/year			3958.1053	(286)
Target Primary Energy Rate (TPER)			78.3200	(287)

Full SAP Calculation Printout

Property Reference	E2 00 04 (GF Flat)_BeCLean	Issued on Date	30/08/2023
Assessment Reference	E2 00 04 (GF Flat)_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	83 B	DER	2.16	TER	15.09
Environmental	98 A	% DER < TER			85.69
CO_2 Emissions (t/year)	0.13	DFEE	39.13	TFEE	40.59
Compliance Check	See BREL	% DFEE < TFEE			3.60
% DPER < TPER	81.69	DPER	14.76	TPER	80.62

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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		64.9200 (1b)	x	2.8000 (2b)	=	181.7760 (1b)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.9200						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.7760	(5)

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493	(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	
Opening Type 1 (Uw = 0.90)			16.1800	0.8687	14.0560			(27)
Door			4.0400	1.0000	4.0400			(26)
Ground Floor			64.9200	0.1000	6.4920			(28a)

External Wall	44.9400	20.2200	24.7200	0.1800	4.4496	(29a)
Wall to Corridor	6.7200		6.7200	0.2000	1.3440	(29a)
Wall to Cycle Store	22.4200		22.4200	0.2000	4.4840	(29a)
Total net area of external elements Aum(A, m2)			139.0000			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.8656	(33)
Party Wall			20.0000	0.0000	0.0000	(32)
Party Ceiling 1			64.9200			(32b)

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)	7.9400	0.0800	0.6352
E3 Sill	6.9200	0.1000	0.6920
E4 Jamb	11.3000	0.0500	0.5650
E5 Ground floor (normal)	16.0500	0.1200	1.9260
E7 Party floor between dwellings (in blocks of flats)	11.3700	0.0500	0.5685
E18 Party wall between dwellings	8.4000	0.0500	0.4200
P1 Party wall - Ground floor	7.7200	0.0560	0.4323
E5 Ground floor (normal)	2.4000	0.1200	0.2880
E7 Party floor between dwellings (in blocks of flats)	2.4000	0.1200	0.2880
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.1500	0.7020
E16 Corner (normal)	8.4000	0.1000	0.8400
E17 Corner (inverted – internal area greater than external area)	5.6000	0.0000	0.0000
E5 Ground floor (normal)	8.0100	0.3200	2.5632
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	7.7200	0.0000	0.0000
P7 Party Wall - Exposed floor (normal)	8.0100	0.1200	0.9612

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.8814 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 45.7470 (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	15.7201	15.5289	15.3377	14.3817	14.1905	13.2344	13.2344	13.0432	13.6168	14.1905	14.5729	14.9553	(38)
Heat transfer coeff	61.4671	61.2759	61.0847	60.1287	59.9375	58.9814	58.9814	58.7902	59.3638	59.9375	60.3199	60.7023	(39)

Average = Sum(39)m / 12 = 60.0809

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9468	0.9439	0.9409	0.9262	0.9233	0.9085	0.9085	0.9056	0.9144	0.9233	0.9291	0.9350	(40)
HLP (average)												0.9255	
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 2.1168 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	67.1752	66.1657	64.6946	61.8800	59.8029	57.4865	56.1699	57.6298	59.2302	61.7172	64.5923	66.9178	(42a)
Hot water usage for baths	25.8010	25.4178	24.8782	23.8833	23.1383	22.3123	21.8661	22.4019	22.9853	23.8692	24.8846	25.7138	(42b)
Hot water usage for other uses	36.3081	34.9878	33.6675	32.3472	31.0269	29.7066	29.7066	31.0269	32.3472	33.6675	34.9878	36.3081	(42c)

Average daily hot water use (litres/day) 118.8622 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.2843	126.5713	123.2403	118.1105	113.9681	109.5054	107.7425	111.0586	114.5626	119.2539	124.4647	128.9397	(44)
Energy conte	204.7547	180.2358	189.4158	161.6874	153.4230	134.6496	130.3053	137.5137	141.2672	161.8265	177.3228	201.8883	(45)

Energy content (annual) Total = Sum(45)m = 1974.2900

Distribution loss (46)m = 0.15 x (45)m	30.7132	27.0354	28.4124	24.2531	23.0134	20.1974	19.5458	20.6271	21.1901	24.2740	26.5984	30.2833	(46)

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)
If cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(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	260.0315	230.1632	244.6926	215.1810	208.6998	188.1433	185.5821	192.7905	194.7609	217.1033	230.8165	257.1651	(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	260.0315	230.1632	244.6926	215.1810	208.6998	188.1433	185.5821	192.7905	194.7609	217.1033	230.8165	257.1651	(64)

Total per year (kWh/year) = Sum(64)m = 2625.1298 (64)

12Total per year (kWh/year) 2625 (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	112.3024	99.8704	107.2022	96.5560	95.2346	87.5659	87.5479	89.9448	89.7663	98.0287	101.7548	111.3493	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	93.3937	103.4002	93.3937	96.5069	93.3937	96.5069	93.3937	93.3937	96.5069	93.3937	96.5069	93.3937	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	185.1635	187.0849	182.2430	171.9352	158.9234	146.6941	138.5242	136.6028	141.4447	151.7525	164.7643	176.9936	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	(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)													
	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	(71)
Water heating gains (Table 5)													
	150.9440	148.6166	144.0890	134.1055	128.0035	121.6194	117.6720	120.8935	124.6754	131.7591	141.3261	149.6631	(72)
Total internal gains													
	484.2532	493.8536	474.4776	457.2995	435.0724	419.5722	404.3418	405.6419	417.3788	431.6572	457.3492	474.8023	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	6.0300	46.7521	0.4000	0.8000	0.7700	62.5175	(78)
West	10.1500	19.6403	0.4000	0.8000	0.7700	44.2076	(80)

Solar gains	106.7250	188.8669	272.8427	355.1168	408.1634	408.4096	392.5212	353.3688	301.8822	213.0496	129.2261	90.3750	(83)
Total gains	590.9782	682.7205	747.3203	812.4162	843.2358	827.9818	796.8630	759.0106	719.2610	644.7068	586.5753	565.1773	(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	73.3455	73.5743	73.8046	74.9781	75.2173	76.4365	76.4365	76.6851	75.9441	75.2173	74.7404	74.2696	
alpha	5.8897	5.9050	5.9203	5.9985	6.0145	6.0958	6.0958	6.1123	6.0629	6.0145	5.9827	5.9513	
util living area													
	0.9832	0.9620	0.9174	0.8058	0.6414	0.4538	0.3254	0.3559	0.5613	0.8426	0.9614	0.9865	(86)
MIT	20.2362	20.4342	20.6564	20.8745	20.9714	20.9970	20.9997	20.9995	20.9898	20.8620	20.5277	20.2056	(87)
Th 2	20.1279	20.1304	20.1329	20.1453	20.1478	20.1603	20.1603	20.1628	20.1553	20.1478	20.1428	20.1378	(88)
util rest of house													
	0.9785	0.9521	0.8975	0.7681	0.5890	0.3952	0.2635	0.2913	0.4960	0.8017	0.9496	0.9826	(89)
MIT 2	19.2596	19.5068	19.7759	20.0301	20.1264	20.1587	20.1602	20.1626	20.1493	20.0253	19.6356	19.2291	(90)
Living area fraction										fLA = Living area / (4) =		0.3880	(91)
MIT	19.6385	19.8667	20.1175	20.3578	20.4543	20.4840	20.4859	20.4873	20.4754	20.3500	19.9818	19.6080	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6385	19.8667	20.1175	20.3578	20.4543	20.4840	20.4859	20.4873	20.4754	20.3500	19.9818	19.6080	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9752	0.9486	0.8971	0.7780	0.6082	0.4179	0.2875	0.3164	0.5211	0.8121	0.9470	0.9796	(94)
Useful gains	576.3067	647.6026	670.4127	632.0425	512.8565	346.0384	229.1142	240.1477	374.7739	523.5701	555.4717	553.6711	(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													
	942.8149	917.0952	831.8234	688.9413	524.7092	347.0462	229.1962	240.2931	378.4690	584.3878	777.0263	935.2993	(97)
Space heating kWh													
	272.6821	181.0990	120.0896	40.9671	8.8184	0.0000	0.0000	0.0000	0.0000	45.2484	159.5193	283.9314	(98a)
Space heating requirement - total per year (kWh/year)												1112.3553	
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													
	272.6821	181.0990	120.0896	40.9671	8.8184	0.0000	0.0000	0.0000	0.0000	45.2484	159.5193	283.9314	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1112.3553	
Space heating per m2											(98c) / (4) =	17.1342	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.5000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

Space heating:
Space heating requirement

	272.6821	181.0990	120.0896	40.9671	8.8184	0.0000	0.0000	0.0000	0.0000	45.2484	159.5193	283.9314 (98)

Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50

307a	409.0232	271.6485	180.1344	61.4507	13.2276	0.0000	0.0000	0.0000	0.0000	67.8726	239.2790	425.8971

Space heating requirement

	409.0232	271.6485	180.1344	61.4507	13.2276	0.0000	0.0000	0.0000	0.0000	67.8726	239.2790	425.8971 (307)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0.0000 (308)
Space heating fuel for secondary/supplementary system

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)

Water heating
Annual water heating requirement

	260.0315	230.1632	244.6926	215.1810	208.6998	188.1433	185.5821	192.7905	194.7609	217.1033	230.8165	257.1651 (64)

Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50

310a	390.0472	345.2448	367.0389	322.7716	313.0497	282.2150	278.3731	289.1858	292.1413	325.6549	346.2247	385.7477

Water heating fuel

	390.0472	345.2448	367.0389	322.7716	313.0497	282.2150	278.3731	289.1858	292.1413	325.6549	346.2247	385.7477 (310)

Cooling System Energy Efficiency Ratio 0.0000 (314)

Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	14.3617	12.9718	14.3617	13.8984	14.3617	13.8984	14.3617	14.3617	13.8984	14.3617	13.8984	14.3617 (331)
Lighting	21.2352	17.0357	15.3387	11.2378	8.6804	7.0920	7.9186	10.2929	13.3694	17.5414	19.8129	21.8254 (332)

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

(333a)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 (333a)

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

(334a)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 (334a)

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

(335a)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 (335a)

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

(333b)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 (333b)

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

(334b)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 (334b)

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

(335b)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 (335b)

Annual totals kWh/year
Space heating fuel - community heating 1668.5330 (307)
Space heating fuel - secondary 0.0000 (309)
Water heating fuel - community heating 3937.6947 (310)
Efficiency of water heater 0.0000 (311)
Electricity used for heat distribution 16.6853 (313)
Space cooling fuel 0.0000 (321)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7625)
mechanical ventilation fans (SFP = 0.7625) 169.0971 (330a)
Total electricity for the above, kWh/year 169.0971 (331)
Electricity for lighting (calculated in Appendix L) 171.3805 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation 0.0000 (333)
Wind generation 0.0000 (334)
Hydro-electric generation (Appendix N) 0.0000 (335a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (335)
Appendix Q - special features
Energy saved or generated -0.0000 (336)
Energy used 0.0000 (337)
Total delivered energy for all uses 5946.7053 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	5606.2277	0.0150	25.0280	(367)
Electrical energy for heat distribution (space & water)	16.6853	0.0000	8.1771	(372)
Overall CO2 factor for heat network			0.0165	(386)
Total CO2 associated with community systems			92.2705	(373)
Space and water heating			92.2705	(376)
Pumps, fans and electric keep-hot	169.0971	0.1387	23.4559	(378)
Energy for lighting	171.3805	0.1443	24.7355	(379)
Total CO2, kg/year			140.4618	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.1600	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	5606.2277	0.0630	105.1176	(467)
Electrical energy for heat distribution (space & water)	16.6853	0.0000	86.3089	(472)
Overall CO2 factor for heat network			0.0784	(486)
Total CO2 associated with community systems			439.5013	(473)
Space and water heating			439.5013	(476)
Pumps, fans and electric keep-hot	169.0971	1.5128	255.8101	(478)
Energy for lighting	171.3805	1.5338	262.8691	(479)
Total Primary energy kWh/year			958.1805	(483)
Dwelling Primary energy Rate (DPER)			14.7600	(484)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	64.9200 (1b)	x	2.8000 (2b)	=	181.7760 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.7760	(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	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1100 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3600 (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) =	0.3060 (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	0.3902	0.3825	0.3749	0.3366	0.3290	0.2907	0.2907	0.2831	0.3060	0.3290	0.3443	0.3596	(22b)
Effective ac	0.5761	0.5732	0.5703	0.5567	0.5541	0.5423	0.5423	0.5401	0.5468	0.5541	0.5593	0.5646	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			12.2000	1.1450	13.9695			(27)
Ground Floor			64.9200	0.1300	8.4396			(28a)
External Wall	44.9400	16.2400	28.7000	0.1800	5.1660			(29a)
Wall to Corridor	6.7200		6.7200	0.1800	1.2096			(29a)
Wall to Cycle Store	22.4200		22.4200	0.1800	4.0356			(29a)
Total net area of external elements Aum(A, m2)			139.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		36.8603			(33)
Party Wall			20.0000	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)	7.9400	0.0500	0.3970
E3 Sill	6.9200	0.0500	0.3460
E4 Jamb	11.3000	0.0500	0.5650
E5 Ground floor (normal)	16.0500	0.1600	2.5680
E7 Party floor between dwellings (in blocks of flats)	11.3700	0.0700	0.7959
E18 Party wall between dwellings	8.4000	0.0600	0.5040
P1 Party wall - Ground floor	7.7200	0.0800	0.6176
E5 Ground floor (normal)	2.4000	0.1600	0.3840
E7 Party floor between dwellings (in blocks of flats)	2.4000	0.0700	0.1680
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.0200	0.0936
E16 Corner (normal)	8.4000	0.0900	0.7560
E17 Corner (inverted – internal area greater than external area)	5.6000	-0.0900	-0.5040
E5 Ground floor (normal)	8.0100	0.1600	1.2816
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	7.7200	0.0000	0.0000
P7 Party Wall - Exposed floor (normal)	8.0100	0.1600	1.2816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.2543 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 46.1146 (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	34.5591	34.3818	34.2080	33.3917	33.2390	32.5280	32.5280	32.3963	32.8019	33.2390	33.5480	33.8710	(38)
Heat transfer coeff	80.6737	80.4964	80.3226	79.5063	79.3536	78.6426	78.6426	78.5109	78.9164	79.3536	79.6625	79.9855	(39)

Average = Sum(39)m / 12 = 79.5056

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2427	1.2399	1.2373	1.2247	1.2223	1.2114	1.2114	1.2093	1.2156	1.2223	1.2271	1.2321	(40)
HLP (average)												1.2247	
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 2.1168 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
59.7113	58.8139	57.5063	55.0044	53.1581	51.0991	49.9288	51.2265	52.6490	54.8598	57.4154	59.4825	(42a)

Hot water usage for baths

25.8010	25.4178	24.8782	23.8833	23.1383	22.3123	21.8661	22.4019	22.9853	23.8692	24.8846	25.7138	(42b)

Hot water usage for other uses

36.3081	34.9878	33.6675	32.3472	31.0269	29.7066	29.7066	31.0269	32.3472	33.6675	34.9878	36.3081	(42c)

Average daily hot water use (litres/day) 111.9807 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	121.8203	119.2195	116.0520	111.2349	107.3233	103.1180	101.5014	104.6553	107.9815	112.3965	117.2878	121.5043	(44)
Energy conte	192.9337	169.7670	178.3676	152.2751	144.4778	126.7956	122.7572	129.5851	133.1520	152.5209	167.0980	190.2464	(45)

Energy content (annual) Total = Sum(45)m = 1859.9765

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

28.9400	25.4651	26.7551	22.8413	21.6717	19.0193	18.4136	19.4378	19.9728	22.8781	25.0647	28.5370	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.7527 (55)
Total storage loss

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

If cylinder contains dedicated solar storage

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

239.5286	211.8527	224.9625	197.3669	191.0728	171.8874	169.3521	176.1800	178.2438	199.1159	212.1898	236.8413	(62)
WWHRS -27.2975	-24.1421	-25.2802	-20.9330	-19.5088	-16.6939	-15.6478	-16.6399	-17.2721	-20.3619	-23.0676	-26.7920	(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

212.2311	187.7106	199.6823	176.4339	171.5639	155.1936	153.7043	159.5401	160.9717	178.7539	189.1222	210.0494	(64)

Total per year (kWh/year) = Sum(64)m = 2154.9570 (64)
12Total per year (kWh/year) 2155 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

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

Heat gains from water heating, kWh/month

101.4264	90.1161	96.5832	86.7049	85.3148	78.2330	78.0927	80.3630	80.3465	87.9891	91.6335	100.5329	(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	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	(66)

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

94.7737	104.9280	94.7737	97.9328	94.7737	97.9328	94.7737	94.7737	97.9328	94.7737	97.9328	94.7737	(67)

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

185.1635	187.0849	182.2430	171.9352	158.9234	146.6941	138.5242	136.6028	141.4447	151.7525	164.7643	176.9936	(68)

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

33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	(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)

-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	(71)

Water heating gains (Table 5)

136.3258	134.1014	129.8161	120.4235	114.6704	108.6570	104.9633	108.0147	111.5924	118.2650	127.2688	135.1248	(72)

Total internal gains

474.0148	483.8662	464.5847	448.0434	426.1193	408.0357	393.0130	394.1430	405.7217	422.5430	447.7178	464.6440	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a	g Specific data	FF Specific data	Access factor	Gains W

					W/m2	or Table 6b		or Table 6c		Table 6d			
South					4.5500	46.7521		0.6300		0.7000		0.7700	65.0106 (78)
West					7.6500	19.6403		0.6300		0.7000		0.7700	45.9177 (80)
Solar gains	110.9283	196.2954	283.5534	369.0305	424.1366	424.3855	407.8784	367.2063	313.7232	221.4233	134.3137	93.9356	(83)
Total gains	584.9431	680.1616	748.1380	817.0739	850.2560	832.4212	800.8914	761.3494	719.4449	643.9663	582.0316	558.5796	(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	55.8836	56.0066	56.1278	56.7041	56.8132	57.3269	57.3269	57.4230	57.1279	56.8132	56.5929	56.3644	
alpha	4.7256	4.7338	4.7419	4.7803	4.7875	4.8218	4.8218	4.8282	4.8085	4.7875	4.7729	4.7576	
util living area	0.9889	0.9770	0.9524	0.8870	0.7640	0.5823	0.4277	0.4675	0.6967	0.9121	0.9774	0.9910	(86)
MIT	19.7516	19.9741	20.2651	20.6135	20.8559	20.9697	20.9943	20.9914	20.9294	20.6122	20.1233	19.7144	(87)
Th 2	19.8860	19.8882	19.8903	19.9003	19.9022	19.9109	19.9109	19.9125	19.9075	19.9022	19.8984	19.8944	(88)
util rest of house	0.9854	0.9699	0.9378	0.8539	0.7020	0.4926	0.3241	0.3605	0.6085	0.8785	0.9692	0.9881	(89)
MIT 2	18.4671	18.7483	19.1104	19.5305	19.7893	19.8949	19.9093	19.9098	19.8646	19.5415	18.9468	18.4260	(90)
Living area fraction										fLA = Living area / (4) =		0.3880	(91)
MIT	18.9656	19.2239	19.5585	19.9507	20.2032	20.3119	20.3303	20.3295	20.2777	19.9570	19.4033	18.9259	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9656	19.2239	19.5585	19.9507	20.2032	20.3119	20.3303	20.3295	20.2777	19.9570	19.4033	18.9259	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9816	0.9646	0.9325	0.8556	0.7202	0.5266	0.3645	0.4021	0.6401	0.8804	0.9645	0.9847	(94)
Useful gains	574.1525	656.0632	697.6758	699.0786	612.3329	438.3400	291.8900	306.1535	460.5149	566.9671	561.3590	550.0225	(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	1183.1245	1153.0253	1048.8891	878.6005	674.7573	449.2023	293.3603	308.5068	487.5260	742.5099	980.1105	1177.8615	(97)
Space heating kWh	453.0752	333.9586	261.3027	129.2558	46.4437	0.0000	0.0000	0.0000	0.0000	130.6038	301.5010	467.1122	(98a)
Space heating requirement - total per year (kWh/year)												2123.2530	
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	453.0752	333.9586	261.3027	129.2558	46.4437	0.0000	0.0000	0.0000	0.0000	130.6038	301.5010	467.1122	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2123.2530	
Space heating per m2											(98c) / (4) =	32.7057	(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	453.0752	333.9586	261.3027	129.2558	46.4437	0.0000	0.0000	0.0000	0.0000	130.6038	301.5010	467.1122	(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)	490.8724	361.8186	283.1015	140.0388	50.3182	0.0000	0.0000	0.0000	0.0000	141.4993	326.6533	506.0804	(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	212.2311	187.7106	199.6823	176.4339	171.5639	155.1936	153.7043	159.5401	160.9717	178.7539	189.1222	210.0494	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.7162	85.3369	84.6639	83.3729	81.5610	79.8000	79.8000	79.8000	79.8000	83.3671	85.1003	85.7984	(217)
Fuel for water heating, kWh/month	247.5974	219.9643	235.8529	211.6201	210.3503	194.4782	192.6119	199.9249	201.7190	214.4178	222.2345	244.8172	(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	19.6921	15.7977	14.2241	10.4212	8.0496	6.5766	7.3431	9.5449	12.3979	16.2667	18.3732	20.2394	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-14.4302	-21.6645	-33.1394	-39.7339	-45.0493	-42.8675	-42.3521	-38.8832	-33.1632	-25.8402	-16.3283	-12.3270	(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	-4.5809	-9.9002	-20.1780	-31.0552	-41.8051	-42.2729	-41.7698	-35.0188	-25.2205	-14.3930	-6.1906	-3.6028 (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	2300.3825 (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	2595.5885 (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)	158.9265 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-641.7667 (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	4499.1308 (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	2300.3825	0.2100	483.0803	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2595.5885	0.2100	545.0736	(264)
Space and water heating			1028.1539	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	158.9265	0.1443	22.9380	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-365.7789	0.1333	-48.7524	
PV Unit electricity exported	-275.9878	0.1252	-34.5513	
Total			-83.3037	(269)
Total CO2, kg/year			979.7175	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.0900	(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	2300.3825	1.1300	2599.4322	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2595.5885	1.1300	2933.0151	(278)
Space and water heating			5532.4473	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	158.9265	1.5338	243.7667	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-365.7789	1.4925	-545.9323	
PV Unit electricity exported	-275.9878	0.4595	-126.8177	
Total			-672.7500	(283)
Total Primary energy kWh/year			5233.5648	(286)
Target Primary Energy Rate (TPER)			80.6200	(287)

Full SAP Calculation Printout

Property Reference	E6 04 04 (TF Flat)_BeCLean	Issued on Date	30/08/2023
Assessment Reference	E6 04 04 (TF Flat)_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	84 B	DER	1.99	TER	14.49
Environmental	98 A	% DER < TER			86.27
CO_2 Emissions (t/year)	0.13	DFEE	33.79	TFEE	39.74
Compliance Check	See BREL	% DFEE < TFEE			14.97
% DPER < TPER	81.89	DPER	14.00	TPER	77.31

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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		70.6700 (1b)	x	2.8000 (2b)	=	197.8760	(1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6700						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.8760	(5)

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493	(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	
Opening Type 1 (Uw = 0.90)			13.5100	0.8687	11.7365			(27)
Door			4.0400	1.0000	4.0400			(26)
External Wall	44.9000	17.5500	27.3500	0.1800	4.9230			(29a)

External Wall 2	4.0300	4.0300	0.2000	0.8060	(29a)
External Roof 1	70.6700	70.6700	0.1000	7.0670	(30)
Total net area of external elements Aum(A, m2)		119.6000			(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		28.5725	(33)
Party Wall		40.8700	0.0000	0.0000	(32)
Party Floor 1		70.6700			(32d)

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)	7.9300	0.0800	0.6344
E3 Sill	6.9100	0.1000	0.6910
E4 Jamb	9.5800	0.0500	0.4790
E7 Party floor between dwellings (in blocks of flats)	12.5900	0.0500	0.6295
E18 Party wall between dwellings	14.0000	0.0500	0.7000
E7 Party floor between dwellings (in blocks of flats)	1.5500	0.1000	0.1550
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.1500	0.7020
E16 Corner (normal)	2.8000	0.1000	0.2800
E17 Corner (inverted – internal area greater than external area)	2.8000	0.0000	0.0000
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	15.7200	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	15.7200	0.0500	0.7860
E15 Flat roof with parapet	17.2700	0.3000	5.1810
E14 Flat roof	1.5500	0.1600	0.2480

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.4859 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	39.0584 (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	17.1124	16.9043	16.6962	15.6555	15.4473	14.4066	14.4066	14.1985	14.8229	15.4473	15.8636	16.2799	(38)
Heat transfer coeff	56.1708	55.9627	55.7545	54.7138	54.5057	53.4650	53.4650	53.2569	53.8813	54.5057	54.9220	55.3383	(39)

Average = Sum(39)m / 12 = 54.6618

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7948	0.7919	0.7889	0.7742	0.7713	0.7565	0.7565	0.7536	0.7624	0.7713	0.7772	0.7831	(40)
HLP (average)												0.7735	
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 2.2623 (42)

Hot water usage for mixer showers	69.9195	68.8687	67.3376	64.4080	62.2460	59.8350	58.4646	59.9842	61.6499	64.2386	67.2311	69.6516 (42a)
Hot water usage for baths	26.8500	26.4513	25.8897	24.8544	24.0791	23.2194	22.7551	23.3127	23.9198	24.8397	25.8964	26.7593 (42b)
Hot water usage for other uses	37.7980	36.4235	35.0491	33.6746	32.3001	30.9256	30.9256	32.3001	33.6746	35.0491	36.4235	37.7980 (42c)

Average daily hot water use (litres/day) 123.7195 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	134.5675	131.7436	128.2764	122.9370	118.6252	113.9801	112.1453	115.5970	119.2443	124.1274	129.5510	134.2089	(44)
Energy conte	213.1221	187.6011	197.1560	168.2945	159.6924	140.1518	135.6301	143.1332	147.0402	168.4396	184.5692	210.1387	(45)
Energy content (annual)										Total = Sum(45)m =		2054.9690	
Distribution loss (46)m = 0.15 x (45)m	31.9683	28.1402	29.5734	25.2442	23.9539	21.0228	20.3445	21.4700	22.0560	25.2659	27.6854	31.5208	(46)

Water storage loss:	
Store volume	110.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0152 (51)
Volume factor from Table 2a	1.0294 (52)
Temperature factor from Table 2b	0.6000 (53)
Enter (49) or (54) in (55)	1.0327 (55)

Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)
If cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(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	268.3989	237.5285	252.4328	221.7882	214.9692	193.6455	190.9069	198.4100	200.5339	223.7165	238.0629	265.4155	(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	268.3989	237.5285	252.4328	221.7882	214.9692	193.6455	190.9069	198.4100	200.5339	223.7165	238.0629	265.4155	(64)

Total per year (kWh/year) = Sum(64)m = 2705.8087 (64)

12Total per year (kWh/year) 2706 (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

	115.0845	102.3193	109.7758	98.7529	97.3192	89.3954	89.3184	91.8132	91.6858	100.2276	104.1642	114.0926 (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	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	(66)

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

	101.5460	112.4259	101.5460	104.9309	101.5460	104.9309	101.5460	101.5460	104.9309	101.5460	104.9309	101.5460	(67)

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

	198.8557	200.9192	195.7193	184.6492	170.6752	157.5416	148.7676	146.7041	151.9040	162.9741	176.9481	190.0817	(68)

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

	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	(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)

	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	(71)

Water heating gains (Table 5)

	154.6835	152.2609	147.5481	137.1568	130.8053	124.1603	120.0517	123.4049	127.3414	134.7146	144.6725	153.3502	(72)

Total internal gains

	512.0195	522.5402	501.7476	483.6710	459.9607	443.5670	427.2995	428.5892	441.1105	456.1689	483.4857	501.9121	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3500	19.6403	0.4000	0.8000	0.7700	36.3678	(76)
South	5.1600	46.7521	0.4000	0.8000	0.7700	53.4975	(78)

Solar gains	89.8653	158.7583	228.7688	297.0139	340.8582	340.8696	327.6867	295.3398	252.8508	178.9185	108.7592	76.1339	(83)
Total gains	601.8848	681.2985	730.5164	780.6849	800.8189	784.4366	754.9862	723.9289	693.9613	635.0874	592.2449	578.0460	(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	87.3699	87.6948	88.0222	89.6965	90.0390	91.7916	91.7916	92.1504	91.0825	90.0390	89.3566	88.6844	
alpha	6.8247	6.8463	6.8681	6.9798	7.0026	7.1194	7.1194	7.1434	7.0722	7.0026	6.9571	6.9123	
util living area	0.9821	0.9595	0.9126	0.7923	0.6233	0.4355	0.3115	0.3383	0.5327	0.8201	0.9558	0.9855	(86)
MIT	20.4373	20.5987	20.7698	20.9291	20.9873	20.9991	20.9999	20.9999	20.9966	20.9250	20.6788	20.4148	(87)
Th 2	20.2578	20.2604	20.2629	20.2757	20.2783	20.2912	20.2912	20.2937	20.2860	20.2783	20.2732	20.2680	(88)
util rest of house	0.9773	0.9496	0.8933	0.7575	0.5782	0.3876	0.2614	0.2864	0.4789	0.7810	0.9434	0.9816	(89)
MIT 2	19.6166	19.8176	20.0238	20.2109	20.2688	20.2907	20.2911	20.2937	20.2840	20.2125	19.9291	19.5968	(90)
Living area fraction									fLA = Living area / (4) =			0.3835	(91)
MIT	19.9313	20.1172	20.3099	20.4863	20.5443	20.5624	20.5629	20.5645	20.5572	20.4857	20.2166	19.9105	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9313	20.1172	20.3099	20.4863	20.5443	20.5624	20.5629	20.5645	20.5572	20.4857	20.2166	19.9105	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9748	0.9475	0.8946	0.7680	0.5950	0.4060	0.2806	0.3063	0.4995	0.7928	0.9423	0.9792	(94)
Useful gains	586.7082	645.5069	653.5538	599.5460	476.4816	318.4664	211.8605	221.7549	346.6047	503.5173	558.0918	566.0380	(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	878.0238	851.5935	769.9631	633.9313	482.0664	318.7777	211.8784	221.7878	347.9240	538.8278	720.3908	869.3917	(97)
Space heating kWh	216.7388	138.4901	86.6085	24.7574	4.1551	0.0000	0.0000	0.0000	0.0000	26.2710	116.8553	225.6952	(98a)

Space heating requirement - total per year (kWh/year) 839.5714

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													
	216.7388	138.4901	86.6085	24.7574	4.1551	0.0000	0.0000	0.0000	0.0000	26.2710	116.8553	225.6952	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 839.5714

Space heating per m2 (98c) / (4) = 11.8802 (99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (301)

Fraction of space heat from community system 1.0000 (302)

Fraction of heat from community Waste Heat-Space and Water 1.0000 (303a)

Factor for control and charging method (Table 4c(3)) for space heating 1.0000 (305)

Factor for charging method (Table 4c(3)) for water heating 1.0000 (305a)

Distribution loss factor (Table 12c) for community heating system 1.5000 (306)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

Space heating:

Space heating requirement

	216.7388	138.4901	86.6085	24.7574	4.1551	0.0000	0.0000	0.0000	0.0000	26.2710	116.8553	225.6952	(98)

Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50

307a	325.1082	207.7352	129.9127	37.1361	6.2326	0.0000	0.0000	0.0000	0.0000	39.4065	175.2830	338.5428	
Space heating requirement													
	325.1082	207.7352	129.9127	37.1361	6.2326	0.0000	0.0000	0.0000	0.0000	39.4065	175.2830	338.5428	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)
Space heating fuel for secondary/supplementary system													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)

Water heating

Annual water heating requirement												
	268.3989	237.5285	252.4328	221.7882	214.9692	193.6455	190.9069	198.4100	200.5339	223.7165	238.0629	265.4155	(64)
Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50													
310a	402.5983	356.2928	378.6493	332.6823	322.4538	290.4683	286.3603	297.6150	300.8008	335.5747	357.0943	398.1232	
Water heating fuel													
	402.5983	356.2928	378.6493	332.6823	322.4538	290.4683	286.3603	297.6150	300.8008	335.5747	357.0943	398.1232	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	15.6337	14.1208	15.6337	15.1294	15.6337	15.1294	15.6337	15.6337	15.1294	15.6337	15.1294	15.6337	(331)
Lighting	23.7895	19.0848	17.1838	12.5896	9.7245	7.9450	8.8711	11.5309	14.9775	19.6513	22.1961	24.4507	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)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	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)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	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)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	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)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	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)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	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)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	(335b)

Annual totals kWh/year		
Space heating fuel - community heating	1259.3571	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	4058.7131	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	12.5936	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7625)		
mechanical ventilation fans (SFP = 0.7625)	184.0741	(330a)
Total electricity for the above, kWh/year	184.0741	(331)
Electricity for lighting (calculated in Appendix L)	191.9949	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	5694.1393	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	5318.0702	0.0150	18.8904	(367)
Electrical energy for heat distribution (space & water)	12.5936	0.0000	7.7108	(372)
Overall CO2 factor for heat network			0.0164	(386)
Total CO2 associated with community systems			87.4818	(373)
Space and water heating			87.4818	(376)
Pumps, fans and electric keep-hot	184.0741	0.1387	25.5334	(378)
Energy for lighting	191.9949	0.1443	27.7108	(379)
Total CO2, kg/year			140.7260	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.9900	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	5318.0702	0.0630	79.3395	(467)
Electrical energy for heat distribution (space & water)	12.5936	0.0000	81.7004	(472)
Overall CO2 factor for heat network			0.0784	(486)
Total CO2 associated with community systems			416.7388	(473)
Space and water heating			416.7388	(476)
Pumps, fans and electric keep-hot	184.0741	1.5128	278.4674	(478)
Energy for lighting	191.9949	1.5338	294.4882	(479)
Total Primary energy kWh/year			989.6944	(483)
Dwelling Primary energy Rate (DPER)			14.0000	(484)

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		70.6700 (1b)	x	2.8000 (2b)	=	197.8760 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6700						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.8760	(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) =	0.1516	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4016	(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) =	0.3414	(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	0.4352	0.4267	0.4182	0.3755	0.3670	0.3243	0.3243	0.3158	0.3414	0.3670	0.3840	0.4011	(22b)
Effective ac	0.5947	0.5910	0.5874	0.5705	0.5673	0.5526	0.5526	0.5499	0.5583	0.5673	0.5737	0.5804	(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			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			13.5100	1.1450	15.4695			(27)
External Wall	44.9000	17.5500	27.3500	0.1800	4.9230			(29a)
External Wall 2	4.0300		4.0300	0.1800	0.7254			(29a)
External Roof 1	70.6700		70.6700	0.1100	7.7737			(30)
Total net area of external elements Aum(A, m2)			119.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.9316			(33)
Party Wall			40.8700	0.0000	0.0000			(32)

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

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	7.9300	0.0500	0.3965
E3	Sill	6.9100	0.0500	0.3455
E4	Jamb	9.5800	0.0500	0.4790
E7	Party floor between dwellings (in blocks of flats)	12.5900	0.0700	0.8813
E18	Party wall between dwellings	14.0000	0.0600	0.8400
E7	Party floor between dwellings (in blocks of flats)	1.5500	0.0700	0.1085
E23	Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.0200	0.0936
E16	Corner (normal)	2.8000	0.0900	0.2520
E17	Corner (inverted – internal area greater than external area)	2.8000	-0.0900	-0.2520
P3	Party wall - Intermediate floor between dwellings (in blocks of flats)	15.7200	0.0000	0.0000
P4	Party wall - Roof (insulation at ceiling level)	15.7200	0.1200	1.8864
E15	Flat roof with parapet	17.2700	0.5600	9.6712
E14	Flat roof	1.5500	0.0800	0.1240

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.8260	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	47.7576	(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	38.8346	38.5944	38.3590	37.2533	37.0464	36.0833	36.0833	35.9050	36.4543	37.0464	37.4649	37.9024	(38)
Heat transfer coeff													
	86.5922	86.3520	86.1166	85.0108	84.8040	83.8409	83.8409	83.6625	84.2118	84.8040	85.2225	85.6600	(39)
Average = Sum(39)m / 12 =												85.0098	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2253	1.2219	1.2186	1.2029	1.2000	1.1864	1.1864	1.1838	1.1916	1.2000	1.2059	1.2121	(40)
HLP (average)												1.2029	
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												2.2623	(42)
Hot water usage for mixer showers													
	62.1507	61.2167	59.8556	57.2515	55.3298	53.1867	51.9685	53.3193	54.7999	57.1010	59.7610	61.9125	(42a)
Hot water usage for baths													
	26.8500	26.4513	25.8897	24.8544	24.0791	23.2194	22.7551	23.3127	23.9198	24.8397	25.8964	26.7593	(42b)
Hot water usage for other uses													
	37.7980	36.4235	35.0491	33.6746	32.3001	30.9256	30.9256	32.3001	33.6746	35.0491	36.4235	37.7980	(42c)
Average daily hot water use (litres/day)												116.5569	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	126.7987	124.0915	120.7944	115.7805	111.7090	107.3318	105.6493	108.9321	112.3943	116.9897	122.0809	126.4698	(44)
Energy conte	200.8182	176.7046	185.6565	158.4977	150.3818	131.9769	127.7736	134.8807	138.5935	158.7540	173.9266	198.0212	(45)
Energy content (annual)										Total = Sum(45)m =		1935.9854	
Distribution loss (46)m = 0.15 x (45)m													
	30.1227	26.5057	27.8485	23.7747	22.5573	19.7965	19.1660	20.2321	20.7890	23.8131	26.0890	29.7032	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	247.4131	218.7903	232.2515	203.5896	196.9767	177.0688	174.3685	181.4756	183.6853	205.3489	219.0185	244.6161	(62)
WWHRS	-28.4127	-25.1284	-26.3130	-21.7882	-20.3058	-17.3759	-16.2871	-17.3197	-17.9777	-21.1938	-24.0100	-27.8865	(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													
	219.0004	193.6619	205.9384	181.8013	176.6709	159.6929	158.0815	164.1559	165.7076	184.1551	195.0085	216.7295	(64)
										Total per year (kWh/year) = Sum(64)m =		2220.6040	(64)
12Total per year (kWh/year)												2221	(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													
	104.0480	92.4229	99.0067	88.7740	87.2779	79.9558	79.7607	82.1237	82.1558	90.0616	93.9041	103.1180	(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	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	101.5460	112.4259	101.5460	104.9309	101.5460	104.9309	101.5460	101.5460	104.9309	101.5460	104.9309	101.5460	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	198.8557	200.9192	195.7193	184.6492	170.6752	157.5416	148.7676	146.7041	151.9040	162.9741	176.9481	190.0817	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	(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)													
	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	(71)
Water heating gains (Table 5)													
	139.8494	137.5340	133.0736	123.2972	117.3090	111.0497	107.2052	110.3814	114.1053	121.0506	130.4223	138.5994	(72)
Total internal gains													
	500.1854	510.8134	490.2730	472.8114	449.4644	430.4564	414.4530	415.5657	427.8744	445.5049	472.2355	490.1613	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3500	19.6403	0.6300	0.7000	0.7700	50.1194	(76)
South	5.1600	46.7521	0.6300	0.7000	0.7700	73.7263	(78)

Solar gains	123.8457	218.7888	315.2720	409.3222	469.7452	469.7609	451.5933	407.0151	348.4600	246.5720	149.8837	104.9220 (83)
Total gains	624.0310	729.6022	805.5450	882.1337	919.2095	900.2173	866.0462	822.5808	776.3344	692.0769	622.1193	595.0833 (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	56.6753	56.8329	56.9883	57.7296	57.8704	58.5352	58.5352	58.6599	58.2773	57.8704	57.5862	57.2921	
alpha	4.7784	4.7889	4.7992	4.8486	4.8580	4.9023	4.9023	4.9107	4.8852	4.8580	4.8391	4.8195	
util living area	0.9897	0.9778	0.9530	0.8860	0.7602	0.5761	0.4222	0.4618	0.6926	0.9126	0.9785	0.9916	(86)
MIT	19.7603	19.9866	20.2794	20.6288	20.8649	20.9729	20.9951	20.9925	20.9347	20.6236	20.1353	19.7266	(87)
Th 2	19.8998	19.9025	19.9052	19.9177	19.9200	19.9309	19.9309	19.9329	19.9267	19.9200	19.9153	19.9103	(88)
util rest of house	0.9864	0.9710	0.9386	0.8529	0.6988	0.4883	0.3216	0.3578	0.6055	0.8793	0.9706	0.9890	(89)
MIT 2	18.4880	18.7747	19.1395	19.5624	19.8143	19.9166	19.9295	19.9305	19.8870	19.5693	18.9744	18.4529	(90)

Living area fraction fLA = Living area / (4) = 0.3835 (91)

MIT	18.9759	19.2394	19.5766	19.9713	20.2172	20.3217	20.3381	20.3378	20.2887	19.9736	19.4196	18.9414	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9759	19.2394	19.5766	19.9713	20.2172	20.3217	20.3381	20.3378	20.2887	19.9736	19.4196	18.9414	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9827	0.9658	0.9334	0.8547	0.7168	0.5212	0.3603	0.3978	0.6365	0.8813	0.9660	0.9857	(94)
Useful gains	613.2379	704.6322	751.9218	753.9771	658.8796	469.2154	312.0335	327.2256	494.1249	609.9011	600.9801	586.5994	(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	1270.8178	1238.2348	1126.1129	941.1827	722.2933	479.7100	313.4077	329.4440	521.1648	794.9200	1049.9052	1262.7446	(97)
Space heating kWh	489.2395	358.5810	278.3981	134.7880	47.1798	0.0000	0.0000	0.0000	0.0000	137.6541	323.2261	503.0520	(98a)

Space heating requirement - total per year (kWh/year) 2272.1186

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	489.2395	358.5810	278.3981	134.7880	47.1798	0.0000	0.0000	0.0000	0.0000	137.6541	323.2261	503.0520	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 2272.1186

Space heating per m2 (98c) / (4) = 32.1511 (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	489.2395	358.5810	278.3981	134.7880	47.1798	0.0000	0.0000	0.0000	0.0000	137.6541	323.2261	503.0520	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	530.0536	388.4951	301.6231	146.0325	51.1157	0.0000	0.0000	0.0000	0.0000	149.1377	350.1908	545.0185	(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	219.0004	193.6619	205.9384	181.8013	176.6709	159.6929	158.0815	164.1559	165.7076	184.1551	195.0085	216.7295	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.8075	85.4215	84.7365	83.3987	81.5418	79.8000	79.8000	79.8000	79.8000	83.4164	85.1848	85.8835	(217)
Fuel for water heating, kWh/month	255.2228	226.7133	243.0339	217.9907	216.6628	200.1164	198.0971	205.7091	207.6536	220.7662	228.9240	252.3530	(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	21.0993	16.9266	15.2405	11.1659	8.6248	7.0466	7.8679	10.2269	13.2838	17.4291	19.6861	21.6857	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-15.6659	-23.4967	-35.9056	-43.0029	-48.7093	-46.3280	-45.7656	-42.0367	-35.8852	-28.0005	-17.7169	-13.3848	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.0290	-10.8637	-22.1341	-34.0561	-45.8379	-46.3534	-45.8070	-38.4110	-27.6695	-15.7962	-6.7965	-3.9559	(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	(234b)

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

(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

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

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year	
Space heating fuel - main system 1	2461.6670 (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	2673.2430 (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)	170.2831 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-698.6084 (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	4692.5847 (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	2461.6670	0.2100	516.9501	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2673.2430	0.2100	561.3810	(264)
Space and water heating			1078.3311	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	170.2831	0.1443	24.5771	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-395.8982	0.1333	-52.7761	
PV Unit electricity exported	-302.7101	0.1252	-37.8983	
Total			-90.6744	(269)
Total CO2, kg/year			1024.1631	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.4900	(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	2461.6670	1.1300	2781.6837	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2673.2430	1.1300	3020.7645	(278)
Space and water heating			5802.4483	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	170.2831	1.5338	261.1859	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-395.8982	1.4926	-590.9209	
PV Unit electricity exported	-302.7101	0.4595	-139.1025	
Total			-730.0234	(283)
Total Primary energy kWh/year			5463.7115	(286)
Target Primary Energy Rate (TPER)			77.3100	(287)

Full SAP Calculation Printout

Property Reference	Harper End Terrace_BeCLean	Issued on Date	30/08/2023
Assessment Reference	Harper (End Terrace)_Copy	Prop Type Ref	Harper (End Terrace)
Property	Harper ET, Harper (End Terrace)		

SAP Rating	85 B	DER	1.79	TER	9.78
Environmental	98 A	% DER < TER			81.70
CO_2 Emissions (t/year)	0.23	DFEE	36.88	TFEE	36.60
Compliance Check	See BREL	% DFEE < TFEE			-0.76
% DPER < TPER	74.50	DPER	13.04	TPER	51.13

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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	47.8100 (1b)	x	2.5000 (2b)	=	119.5250 (1b)	-
First floor	47.8100 (1c)	x	2.7800 (2c)	=	132.9118 (1c)	-
Second floor	47.8100 (1d)	x	2.7800 (2d)	=	132.9118 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.4300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	385.3486	(5)

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

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1850	(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	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3399	0.3353	0.3306	0.3075	0.3029	0.2797	0.2797	0.2751	0.2890	0.3029	0.3121	0.3214	(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	
Opening Type 1 (Uw = 0.90)			22.3600	0.8687	19.4247			(27)

Door			1.5800	0.9500	1.5010	(26)
Heat Loss Floor 1			47.8100	0.1000	4.7810	(28a)
External Wall	137.3600	23.9400	113.4200	0.2400	27.2208	(29a)
External Roof	47.8100		47.8100	0.1100	5.2591	(30)
Total net area of external elements Aum(A, m2)			232.9800			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.1866	(33)
Party Wall			52.2200	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)	15.7690	0.0800	1.2615
E3 Sill	14.7550	0.0500	0.7378
E4 Jamb	42.9260	0.0500	2.1463
E5 Ground floor (normal)	19.5600	0.1200	2.3472
E6 Intermediate floor within a dwelling	26.0148	0.0200	0.5203
E10 Eaves (insulation at ceiling level)	9.8900	0.0500	0.4945
E12 Gable (insulation at ceiling level)	9.7000	0.0500	0.4850
E16 Corner (normal)	14.0448	0.1000	1.4045
E18 Party wall between dwellings	14.0448	0.0500	0.7022
P1 Party wall - Ground floor	9.8900	0.0560	0.5538
P2 Party wall - Intermediate floor within a dwelling	9.8900	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	9.8900	0.0300	0.2967

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.9498 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 69.1364 (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	43.2202	42.6321	42.0439	39.1032	38.5151	35.5744	35.5744	34.9863	36.7507	38.5151	39.6914	40.8677	(38)
Heat transfer coeff	112.3567	111.7685	111.1804	108.2397	107.6515	104.7109	104.7109	104.1227	105.8871	107.6515	108.8278	110.0041	(39)

Average = Sum(39)m / 12 = 108.0927

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7834	0.7793	0.7752	0.7547	0.7506	0.7300	0.7300	0.7259	0.7382	0.7506	0.7588	0.7670	(40)
HLP (average)												0.7536	
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 2.9233 (42)

Hot water usage for mixer showers	82.3891	81.1510	79.3468	75.8947	73.3472	70.5062	68.8914	70.6819	72.6447	75.6951	79.2213	82.0735 (42a)
Hot water usage for baths	31.6166	31.1470	30.4858	29.2666	28.3537	27.3414	26.7947	27.4513	28.1662	29.2493	30.4936	31.5097 (42b)
Hot water usage for other uses	44.5680	42.9474	41.3267	39.7060	38.0854	36.4647	36.4647	38.0854	39.7060	41.3267	42.9474	44.5680 (42c)

Average daily hot water use (litres/day) 145.7899 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	158.5737	155.2454	151.1592	144.8674	139.7863	134.3124	132.1508	136.2186	140.5170	146.2711	152.6623	158.1512	(44)
Energy conte	251.1420	221.0673	232.3261	198.3162	188.1792	165.1527	159.8249	168.6671	173.2715	198.4885	217.4954	247.6265	(45)

Energy content (annual) Total = Sum(45)m = 2421.5573

Distribution loss (46)m = 0.15 x (45)m	37.6713	33.1601	34.8489	29.7474	28.2269	24.7729	23.9737	25.3001	25.9907	29.7733	32.6243	37.1440 (46)
Water storage loss:												
Store volume												110.0000 (47)
b) If manufacturer declared loss factor is not known :												
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0152 (51)
Volume factor from Table 2a												1.0294 (52)
Temperature factor from Table 2b												0.6000 (53)
Enter (49) or (54) in (55)												1.0327 (55)
Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144 (56)
If cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144 (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	306.4188	270.9948	287.6029	251.8099	243.4560	218.6464	215.1017	223.9439	226.7651	253.7653	270.9891	302.9033 (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	306.4188	270.9948	287.6029	251.8099	243.4560	218.6464	215.1017	223.9439	226.7651	253.7653	270.9891	302.9033 (64)

Total per year (kWh/year) = Sum(64)m = 3072.3971 (64)

12Total per year (kWh/year) 3072 (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	127.7262	113.4468	121.4699	108.7351	106.7910	97.7082	97.3632	100.3032	100.4077	110.2189	115.1122	126.5573 (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	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	(66)

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

	165.7121	183.4669	165.7121	171.2358	165.7121	171.2358	165.7121	165.7121	171.2358	165.7121	171.2358	165.7121	(67)

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

	313.2793	316.5301	308.3381	290.8982	268.8834	248.1926	234.3699	231.1190	239.3111	256.7510	278.7658	299.4566	(68)

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

	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	(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)

	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	(71)

Water heating gains (Table 5)

	171.6749	168.8197	163.2660	151.0209	143.5363	135.7059	130.8645	134.8162	139.4551	148.1437	159.8780	170.1038	(72)

Total internal gains

	717.5165	735.6670	704.1663	680.0051	644.9820	621.9845	597.7967	598.4975	616.8523	637.4570	676.7298	702.1227	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	10.6100	19.6403	0.4000	0.8000	0.7700	46.2111	(76)
West	11.7500	19.6403	0.4000	0.8000	0.7700	51.1762	(80)

Solar gains	97.3873	190.5102	313.7432	457.5757	560.7763	574.0543	546.5231	469.4552	364.8963	226.0564	121.4305	80.0866	(83)
Total gains	814.9038	926.1772	1017.9095	1137.5809	1205.7582	1196.0388	1144.3198	1067.9528	981.7486	863.5134	798.1603	782.2093	(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	88.6500	89.1165	89.5879	92.0219	92.5246	95.1231	95.1231	95.6604	94.0664	92.5246	91.5245	90.5459	
alpha	6.9100	6.9411	6.9725	7.1348	7.1683	7.3415	7.3415	7.3774	7.2711	7.1683	7.1016	7.0364	
util living area	0.9982	0.9951	0.9847	0.9295	0.7827	0.5568	0.4023	0.4478	0.7199	0.9596	0.9949	0.9986	(86)
MIT	20.1488	20.2964	20.5108	20.7968	20.9538	20.9966	20.9997	20.9994	20.9807	20.7655	20.4217	20.1428	(87)
Th 2	20.2678	20.2713	20.2749	20.2928	20.2964	20.3144	20.3144	20.3180	20.3072	20.2964	20.2892	20.2821	(88)
util rest of house	0.9977	0.9936	0.9798	0.9094	0.7372	0.4987	0.3398	0.3818	0.6571	0.9437	0.9931	0.9982	(89)
MIT 2	19.2596	19.4509	19.7251	20.0876	20.2587	20.3124	20.3143	20.3178	20.2945	20.0596	19.6255	19.2632	(90)
Living area fraction										fLA = Living area / (4) =		0.1162	(91)
MIT	19.3628	19.5491	19.8164	20.1699	20.3394	20.3919	20.3939	20.3969	20.3742	20.1416	19.7180	19.3654	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3628	19.5491	19.8164	20.1699	20.3394	20.3919	20.3939	20.3969	20.3742	20.1416	19.7180	19.3654	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9916	0.9759	0.9054	0.7402	0.5054	0.3471	0.3895	0.6634	0.9394	0.9910	0.9974	(94)
Useful gains	812.1876	918.3830	993.3326	1030.0042	892.4681	604.4247	397.1513	415.9284	651.2878	811.1817	790.9823	780.1911	(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	1692.4103	1637.3067	1480.5188	1219.8538	930.0447	606.4752	397.2612	416.1713	664.3608	1027.1657	1373.1907	1668.2511	(97)
Space heating kWh	654.8857	483.1167	362.4665	136.6917	27.9570	0.0000	0.0000	0.0000	0.0000	160.6921	419.1900	660.7167	(98a)
Space heating requirement - total per year (kWh/year)												2905.7164	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	654.8857	483.1167	362.4665	136.6917	27.9570	0.0000	0.0000	0.0000	0.0000	160.6921	419.1900	660.7167	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2905.7164	
Space heating per m2											(98c) / (4) =	20.2588	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.5000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		

	654.8857	483.1167	362.4665	136.6917	27.9570	0.0000	0.0000	0.0000	0.0000	160.6921	419.1900	660.7167	(98)

Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50

307a	982.3286	724.6750	543.6997	205.0376	41.9355	0.0000	0.0000	0.0000	0.0000	241.0381	628.7851	991.0750	
Space heating requirement													
	982.3286	724.6750	543.6997	205.0376	41.9355	0.0000	0.0000	0.0000	0.0000	241.0381	628.7851	991.0750	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)
Space heating fuel for secondary/supplementary system													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)

Water heating

Annual water heating requirement

	306.4188	270.9948	287.6029	251.8099	243.4560	218.6464	215.1017	223.9439	226.7651	253.7653	270.9891	302.9033	(64)
Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50													
310a	459.6282	406.4921	431.4044	377.7148	365.1840	327.9696	322.6525	335.9158	340.1477	380.6480	406.4836	454.3549	
Water heating fuel													
	459.6282	406.4921	431.4044	377.7148	365.1840	327.9696	322.6525	335.9158	340.1477	380.6480	406.4836	454.3549	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	33.9392	30.6547	33.9392	32.8444	33.9392	32.8444	33.9392	33.9392	32.8444	33.9392	32.8444	33.9392	(331)
Lighting	45.3708	36.3981	32.7725	24.0105	18.5464	15.1526	16.9187	21.9915	28.5648	37.4786	42.3319	46.6318	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)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	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)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	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)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	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)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	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)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	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)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	(335b)

Annual totals kWh/year		
Space heating fuel - community heating	4358.5746	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	4608.5957	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	43.5857	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8500)		
mechanical ventilation fans (SFP = 0.8500)	399.6065	(330a)
Total electricity for the above, kWh/year	399.6065	(331)
Electricity for lighting (calculated in Appendix L)	366.1680	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	9732.9448	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	8967.1703	0.0150	65.3786	(367)
Electrical energy for heat distribution (space & water)	43.5857	0.0000	13.3306	(372)
Overall CO2 factor for heat network			0.0165	(386)
Total CO2 associated with community systems			147.8382	(373)
Space and water heating			147.8382	(376)
Pumps, fans and electric keep-hot	399.6065	0.1387	55.4303	(378)
Energy for lighting	366.1680	0.1443	52.8494	(379)
Total CO2, kg/year			256.1179	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.7900	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	8967.1703	0.0630	274.5902	(467)
Electrical energy for heat distribution (space & water)	43.5857	0.0000	138.9943	(472)
Overall CO2 factor for heat network			0.0785	(486)
Total CO2 associated with community systems			703.9260	(473)
Space and water heating			703.9260	(476)
Pumps, fans and electric keep-hot	399.6065	1.5128	604.5247	(478)
Energy for lighting	366.1680	1.5338	561.6407	(479)
Total Primary energy kWh/year			1870.0914	(483)
Dwelling Primary energy Rate (DPER)			13.0400	(484)

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	47.8100 (1b)	x	2.5000 (2b)	=	119.5250 (1b)	-
First floor	47.8100 (1c)	x	2.7800 (2c)	=	132.9118 (1c)	-
Second floor	47.8100 (1d)	x	2.7800 (2d)	=	132.9118 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.4300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	385.3486	(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) =	0.1038 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3538 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3273 (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	0.4173	0.4091	0.4009	0.3600	0.3518	0.3109	0.3109	0.3027	0.3273	0.3518	0.3682	0.3845	(22b)
Effective ac	0.5871	0.5837	0.5804	0.5648	0.5619	0.5483	0.5483	0.5458	0.5536	0.5619	0.5678	0.5739	(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			1.5800	1.0000	1.5800			(26)
TER Opening Type (Uw = 1.20)			22.3600	1.1450	25.6031			(27)
Heat Loss Floor 1			47.8100	0.1300	6.2153			(28a)
External Wall	137.3600	23.9400	113.4200	0.1800	20.4156			(29a)
External Roof	47.8100		47.8100	0.1100	5.2591			(30)
Total net area of external elements Aum(A, m2)			232.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.0731			(33)
Party Wall			52.2200	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)	15.7690	0.0500	0.7885
E3 Sill	14.7550	0.0500	0.7378
E4 Jamb	42.9260	0.0500	2.1463
E5 Ground floor (normal)	19.5600	0.1600	3.1296
E6 Intermediate floor within a dwelling	26.0148	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	9.8900	0.0600	0.5934
E12 Gable (insulation at ceiling level)	9.7000	0.0600	0.5820
E16 Corner (normal)	14.0448	0.0900	1.2640
E18 Party wall between dwellings	14.0448	0.0600	0.8427
P1 Party wall - Ground floor	9.8900	0.0800	0.7912
P2 Party wall - Intermediate floor within a dwelling	9.8900	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	9.8900	0.1200	1.1868

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.0622 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 71.1353 (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	74.6529	74.2230	73.8017	71.8225	71.4522	69.7285	69.7285	69.4093	70.3924	71.4522	72.2013	72.9845	(38)
Heat transfer coeff													
	145.7882	145.3583	144.9369	142.9578	142.5875	140.8637	140.8637	140.5445	141.5277	142.5875	143.3366	144.1197	(39)
Average = Sum(39)m / 12 =												142.9560	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0164	1.0134	1.0105	0.9967	0.9941	0.9821	0.9821	0.9799	0.9867	0.9941	0.9993	1.0048	(40)
HLP (average)												0.9967	
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												2.9233	(42)
Hot water usage for mixer showers													
	73.2348	72.1342	70.5304	67.4620	65.1975	62.6722	61.2368	62.8284	64.5731	67.2845	70.4189	72.9542	(42a)
Hot water usage for baths													
	31.6166	31.1470	30.4858	29.2666	28.3537	27.3414	26.7947	27.4513	28.1662	29.2493	30.4936	31.5097	(42b)
Hot water usage for other uses													
	44.5680	42.9474	41.3267	39.7060	38.0854	36.4647	36.4647	38.0854	39.7060	41.3267	42.9474	44.5680	(42c)
Average daily hot water use (litres/day)												137.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	149.4194	146.2286	142.3429	136.4346	131.6366	126.4783	124.4962	128.3650	132.4453	137.8606	143.8599	149.0319	(44)
Energy conte	236.6437	208.2276	218.7758	186.7722	177.2081	155.5199	150.5673	158.9427	163.3183	187.0755	204.9548	233.3479	(45)
Energy content (annual)										Total = Sum(45)m =		2281.3539	
Distribution loss (46)m = 0.15 x (45)m													
	35.4966	31.2341	32.8164	28.0158	26.5812	23.3280	22.5851	23.8414	24.4977	28.0613	30.7432	35.0022	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	283.2387	250.3133	265.3707	231.8640	223.8030	200.6117	197.1622	205.5376	208.4102	233.6704	250.0467	279.9428	(62)
WWHRS	-33.4799	-29.6099	-31.0058	-25.6740	-23.9272	-20.4747	-19.1918	-20.4085	-21.1839	-24.9735	-28.2920	-32.8599	(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													
	249.7588	220.7034	234.3649	206.1900	199.8758	180.1370	177.9704	185.1291	187.2262	208.6969	221.7547	247.0829	(64)
										Total per year (kWh/year) = Sum(64)m =		2518.8902	(64)
12Total per year (kWh/year)												2519	(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													
	115.9600	102.9042	110.0189	98.1752	96.1976	87.7838	87.3396	90.1244	90.3768	99.4785	104.2209	114.8641	(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	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	165.7121	183.4669	165.7121	171.2358	165.7121	171.2358	165.7121	165.7121	171.2358	165.7121	171.2358	165.7121	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	313.2793	316.5301	308.3381	290.8982	268.8834	248.1926	234.3699	231.1190	239.3111	256.7510	278.7658	299.4566	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	(71)
Water heating gains (Table 5)													
	155.8602	153.1313	147.8748	136.3545	129.2979	121.9220	117.3919	121.1349	125.5234	133.7077	144.7513	154.3872	(72)
Total internal gains													
	704.7017	722.9786	691.7752	668.3386	633.7436	608.2006	584.3241	584.8162	602.9205	626.0210	664.6031	689.4061	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	10.6100	19.6403	0.6300	0.7000	0.7700	63.6846	(76)
West	11.7500	19.6403	0.6300	0.7000	0.7700	70.5273	(80)

Solar gains	134.2119	262.5469	432.3773	630.5966	772.8198	791.1186	753.1771	646.9680	502.8727	311.5340	167.3464	110.3693	(83)
Total gains	838.9136	985.5255	1124.1525	1298.9352	1406.5633	1399.3192	1337.5012	1231.7843	1105.7932	937.5550	831.9496	799.7754	(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	68.3212	68.5232	68.7224	69.6738	69.8548	70.7096	70.7096	70.8702	70.3779	69.8548	69.4897	69.1121	
alpha	5.5547	5.5682	5.5815	5.6449	5.6570	5.7140	5.7140	5.7247	5.6919	5.6570	5.6326	5.6075	
util living area	0.9982	0.9953	0.9856	0.9419	0.8236	0.6247	0.4603	0.5185	0.7930	0.9711	0.9957	0.9987	(86)
MIT	19.7765	19.9581	20.2380	20.6107	20.8711	20.9788	20.9968	20.9940	20.9233	20.5597	20.1055	19.7544	(87)
Th 2	20.0697	20.0721	20.0746	20.0861	20.0882	20.0983	20.0983	20.1001	20.0944	20.0882	20.0839	20.0793	(88)
util rest of house	0.9976	0.9937	0.9807	0.9225	0.7733	0.5449	0.3677	0.4204	0.7196	0.9578	0.9940	0.9982	(89)
MIT 2	18.6325	18.8663	19.2234	19.6906	19.9813	20.0864	20.0972	20.0980	20.0424	19.6392	19.0642	18.6114	(90)
Living area fraction										fLA = Living area / (4) =		0.1162	(91)
MIT	18.7654	18.9931	19.3412	19.7974	20.0846	20.1901	20.2017	20.2021	20.1447	19.7461	19.1851	18.7441	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7654	18.9931	19.3412	19.7974	20.0846	20.1901	20.2017	20.2021	20.1447	19.7461	19.1851	18.7441	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9911	0.9754	0.9150	0.7731	0.5533	0.3784	0.4317	0.7241	0.9511	0.9916	0.9972	(94)
Useful gains	835.8886	976.7582	1096.4568	1188.5811	1087.3727	774.2714	506.1139	531.8126	800.7219	891.7154	824.9484	797.5439	(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	2108.8821	2048.5561	1861.1663	1557.8743	1195.5420	787.4365	507.3537	534.3596	855.4913	1304.1188	1732.2433	2096.0986	(97)
Space heating kWh	947.1072	720.2482	568.9439	265.8911	80.4779	0.0000	0.0000	0.0000	0.0000	306.8281	653.2523	966.1248	(98a)
Space heating requirement - total per year (kWh/year)												4508.8734	
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	947.1072	720.2482	568.9439	265.8911	80.4779	0.0000	0.0000	0.0000	0.0000	306.8281	653.2523	966.1248	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4508.8734	
Space heating per m2											(98c) / (4) =	31.4361	(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	947.1072	720.2482	568.9439	265.8911	80.4779	0.0000	0.0000	0.0000	0.0000	306.8281	653.2523	966.1248	(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)	1026.1183	780.3339	616.4072	288.0727	87.1917	0.0000	0.0000	0.0000	0.0000	332.4248	707.7490	1046.7224	(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	249.7588	220.7034	234.3649	206.1900	199.8758	180.1370	177.9704	185.1291	187.2262	208.6969	221.7547	247.0829	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7581	86.5115	85.9712	84.6311	82.1913	79.8000	79.8000	79.8000	79.8000	84.9227	86.3324	86.8061	(217)
Fuel for water heating, kWh/month	287.8793	255.1146	272.6087	243.6338	243.1838	225.7356	223.0206	231.9913	234.6193	245.7492	256.8615	284.6377	(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	34.4317	27.6224	24.8709	18.2215	14.0748	11.4992	12.8395	16.6893	21.6777	28.4423	32.1255	35.3887	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-46.1264	-65.7592	-95.5374	-108.5537	-117.9354	-110.3003	-108.8542	-102.2950	-90.9237	-75.6304	-50.9374	-39.7870	(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	-23.8769	-50.4691	-100.7891	-152.1079	-201.8821	-203.2058	-200.9015	-169.8291	-124.0580	-72.5173	-31.9821	-18.8701	(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	4885.0200	(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	3005.0355	(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)	277.8835	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2363.1290	(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	5890.8099	(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	4885.0200	0.2100	1025.8542	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3005.0355	0.2100	631.0574	(264)
Space and water heating			1656.9116	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	277.8835	0.1443	40.1072	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1012.6400	0.1344	-136.0791	
PV Unit electricity exported	-1350.4890	0.1257	-169.8154	
Total			-305.8945	(269)
Total CO2, kg/year			1403.0536	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.7800	(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	4885.0200	1.1300	5520.0726	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3005.0355	1.1300	3395.6901	(278)
Space and water heating			8915.7626	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	277.8835	1.5338	426.2270	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1012.6400	1.4966	-1515.5539	
PV Unit electricity exported	-1350.4890	0.4616	-623.3283	
Total			-2138.8822	(283)
Total Primary energy kWh/year			7333.2082	(286)
Target Primary Energy Rate (TPER)			51.1300	(287)

Full SAP Calculation Printout

Property Reference	Parkman Mid Terrace_BeCLean	Issued on Date	30/08/2023
Assessment Reference	Parkman (Mid Terrace)	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	86 B	DER	1.70	TER	9.73
Environmental	98 A	% DER < TER			82.53
CO_2 Emissions (t/year)	0.17	DFEE	30.15	TFEE	31.12
Compliance Check	See BREL	% DFEE < TFEE			3.13
% DPER < TPER	75.62	DPER	12.36	TPER	50.71

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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	36.3500 (1b)	x	2.5000 (2b)	=	90.8750 (1b)	-
First floor	36.3500 (1c)	x	2.7800 (2c)	=	101.0530 (1c)	-
Second floor	36.3500 (1d)	x	2.7800 (2d)	=	101.0530 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	292.9810	(5)

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

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	0.0000 / (5)	=	0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			4.0000 (17)
Infiltration rate			0.2000 (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)	=	0.1700 (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	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		79.2000 (23c)

Effective ac	0.3207	0.3165	0.3123	0.2910	0.2867	0.2655	0.2655	0.2612	0.2740	0.2867	0.2953	0.3037	(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	
Opening Type 1 (Uw = 0.90)			22.8200	0.8687	19.8243			(27)

Door			1.7500	0.9500	1.6625	(26)
Ground Floor			36.3500	0.1000	3.6350	(28a)
External Wall	77.3800	24.5700	52.8100	0.2400	12.6744	(29a)
External Roof	36.3500		36.3500	0.1000	3.6350	(30)
Total net area of external elements Aum(A, m2)			150.0800			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.4312	(33)
Party Wall			143.7900	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)	11.3700	0.0800	0.9096
E3 Sill	11.3700	0.1000	1.1370
E4 Jamb	23.2000	0.0500	1.1600
E5 Ground floor (normal)	9.6000	0.1200	1.1520
E6 Intermediate floor within a dwelling	19.2000	0.0500	0.9600
E12 Gable (insulation at ceiling level)	8.1600	0.0500	0.4080
E18 Party wall between dwellings	21.1200	0.0500	1.0560
P1 Party wall - Ground floor	17.8400	0.0560	0.9990
P2 Party wall - Intermediate floor within a dwelling	35.6800	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	17.8400	0.0300	0.5352

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.3168 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	49.7481 (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	31.0113	30.6004	30.1895	28.1350	27.7241	25.6695	25.6695	25.2586	26.4913	27.7241	28.5459	29.3677	(38)
Heat transfer coeff	80.7594	80.3485	79.9376	77.8830	77.4721	75.4176	75.4176	75.0067	76.2394	77.4721	78.2939	79.1157	(39)
Average = Sum(39)m / 12 =												77.7803	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7406	0.7368	0.7330	0.7142	0.7104	0.6916	0.6916	0.6878	0.6991	0.7104	0.7180	0.7255	(40)
HLP (average)												0.7133	
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												2.8090 (42)
Hot water usage for mixer showers	80.2322	79.0265	77.2695	73.9078	71.4270	68.6604	67.0878	68.8315	70.7429	73.7134	77.1473	79.9248 (42a)
Hot water usage for baths	30.7921	30.3348	29.6908	28.5034	27.6143	26.6284	26.0959	26.7354	27.4317	28.4866	29.6984	30.6880 (42b)
Hot water usage for other uses	43.3970	41.8189	40.2408	38.6628	37.0847	35.5066	35.5066	37.0847	38.6628	40.2408	41.8189	43.3970 (42c)
Average daily hot water use (litres/day)												141.9724 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	154.4213	151.1802	147.2011	141.0740	136.1260	130.7954	128.6904	132.6516	136.8374	142.4409	148.6647	154.0098	(44)
Energy conte	244.5656	215.2786	226.2427	193.1233	183.2517	160.8282	155.6399	164.2504	168.7342	193.2909	211.8001	241.1421	(45)
Energy content (annual)										Total = Sum(45)m =		2358.1476	
Distribution loss (46)m = 0.15 x (45)m	36.6848	32.2918	33.9364	28.9685	27.4878	24.1242	23.3460	24.6376	25.3101	28.9936	31.7700	36.1713	(46)
Water storage loss:													
Store volume												110.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0152	(51)
Volume factor from Table 2a												1.0294	(52)
Temperature factor from Table 2b												0.6000	(53)
Enter (49) or (54) in (55)												1.0327	(55)
Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)
If cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(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	299.8424	265.2060	281.5195	246.6169	238.5285	214.3219	210.9167	219.5272	222.2278	248.5677	265.2938	296.4189	(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	299.8424	265.2060	281.5195	246.6169	238.5285	214.3219	210.9167	219.5272	222.2278	248.5677	265.2938	296.4189	(64)
										Total per year (kWh/year) = Sum(64)m =		3008.9874	(64)
12Total per year (kWh/year)												3009	(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	125.5395	111.5221	119.4471	107.0084	105.1526	96.2703	95.9717	98.8347	98.8991	108.4907	113.2185	124.4012	(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	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	136.6850	151.3298	136.6850	141.2411	136.6850	141.2411	136.6850	136.6850	141.2411	136.6850	141.2411	136.6850	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	270.1840	272.9877	265.9225	250.8817	231.8953	214.0508	202.1295	199.3259	206.3910	221.4319	240.4182	258.2628	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	(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)													
	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	(71)
Water heating gains (Table 5)													
	168.7359	165.9555	160.5472	148.6228	141.3342	133.7088	128.9942	132.8423	137.3598	145.8208	157.2479	167.2059	(72)
Total internal gains													
	640.7399	655.4080	628.2897	605.8807	575.0495	554.1357	532.9438	533.9882	550.1270	569.0727	604.0423	627.2887	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6600	10.6334	0.4000	0.8000	0.7700	25.1369	(74)
South	12.1600	46.7521	0.4000	0.8000	0.7700	126.0717	(78)

Solar gains	151.2086	254.5109	344.6381	428.3742	486.3866	487.1857	467.7977	422.9148	372.8885	279.8834	180.4476	129.8929	(83)
Total gains	791.9485	909.9189	972.9279	1034.2548	1061.4361	1041.3215	1000.7414	956.9031	923.0155	848.9560	784.4899	757.1816	(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	93.7714	94.2509	94.7354	97.2345	97.7502	100.4131	100.4131	100.9632	99.3307	97.7502	96.7242	95.7195	
alpha	7.2514	7.2834	7.3157	7.4823	7.5167	7.6942	7.6942	7.7309	7.6220	7.5167	7.4483	7.3813	
util living area													
	0.9912	0.9758	0.9418	0.8372	0.6665	0.4628	0.3315	0.3605	0.5665	0.8582	0.9740	0.9932	(86)
MIT	20.4012	20.5687	20.7417	20.9183	20.9860	20.9993	21.0000	20.9999	20.9966	20.9176	20.6541	20.3851	(87)
Th 2	20.3051	20.3084	20.3117	20.3283	20.3316	20.3483	20.3483	20.3516	20.3416	20.3316	20.3250	20.3184	(88)
util rest of house													
	0.9887	0.9695	0.9276	0.8064	0.6226	0.4160	0.2825	0.3097	0.5139	0.8240	0.9661	0.9912	(89)
MIT 2	19.6106	19.8230	20.0366	20.2515	20.3209	20.3479	20.3483	20.3516	20.3396	20.2571	19.9450	19.6011	(90)
Living area fraction										fLA = Living area / (4) =		0.2135	(91)
MIT	19.7794	19.9822	20.1871	20.3939	20.4629	20.4869	20.4874	20.4900	20.4798	20.3981	20.0964	19.7685	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7794	19.9822	20.1871	20.3939	20.4629	20.4869	20.4874	20.4900	20.4798	20.3981	20.0964	19.7685	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9659	0.9247	0.8096	0.6314	0.4260	0.2929	0.3206	0.5251	0.8277	0.9629	0.9892	(94)
Useful gains	781.1008	878.9041	899.6728	837.3272	670.1830	443.6161	293.1603	306.7443	484.6454	702.6796	755.3664	749.0037	(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													
	1250.1041	1211.8306	1094.1144	895.1789	678.8798	443.9772	293.1767	306.7759	486.3953	759.0805	1017.5364	1231.7105	(97)
Space heating kWh													
	348.9385	223.7266	144.6646	41.6532	6.4705	0.0000	0.0000	0.0000	0.0000	41.9623	188.7624	359.1339	(98a)
Space heating requirement - total per year (kWh/year)												1355.3119	
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													
	348.9385	223.7266	144.6646	41.6532	6.4705	0.0000	0.0000	0.0000	0.0000	41.9623	188.7624	359.1339	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1355.3119	
Space heating per m2											(98c) / (4) =	12.4284	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.5000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		

	348.9385	223.7266	144.6646	41.6532	6.4705	0.0000	0.0000	0.0000	0.0000	41.9623	188.7624	359.1339	(98)
Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50													
307a	523.4077	335.5900	216.9969	62.4799	9.7057	0.0000	0.0000	0.0000	0.0000	62.9434	283.1436	538.7008	

Space heating requirement

523.4077	335.5900	216.9969	62.4799	9.7057	0.0000	0.0000	0.0000	0.0000	62.9434	283.1436	538.7008 (307)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0.0000 (308)

Space heating fuel for secondary/supplementary system

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)

Water heating

Annual water heating requirement

299.8424	265.2060	281.5195	246.6169	238.5285	214.3219	210.9167	219.5272	222.2278	248.5677	265.2938	296.4189 (64)

Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50

310a 449.7636	397.8090	422.2792	369.9254	357.7928	321.4829	316.3750	329.2908	333.3418	372.8516	397.9406	444.6284

Water heating fuel

449.7636	397.8090	422.2792	369.9254	357.7928	321.4829	316.3750	329.2908	333.3418	372.8516	397.9406	444.6284 (310)

Cooling System Energy Efficiency Ratio 0.0000 (314)

Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	25.8040	23.3068	25.8040	24.9716	25.8040	24.9716	25.8040	25.8040	24.9716	25.8040	24.9716	25.8040 (331)
Lighting	30.3152	24.3200	21.8974	16.0430	12.3921	10.1244	11.3045	14.6940	19.0860	25.0419	28.2848	31.1577 (332)

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

(333a)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 (333a)

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

(334a)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 (334a)

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

(335a)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 (335a)

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

(333b)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 (333b)

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

(334b)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 (334b)

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

(335b)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 (335b)

Annual totals kWh/year

Space heating fuel - community heating 2032.9679 (307)
Space heating fuel - secondary 0.0000 (309)
Water heating fuel - community heating 4513.4811 (310)
Efficiency of water heater 0.0000 (311)
Electricity used for heat distribution 20.3297 (313)
Space cooling fuel 0.0000 (321)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8500)
mechanical ventilation fans (SFP = 0.8500) 303.8213 (330a)
Total electricity for the above, kWh/year 303.8213 (331)
Electricity for lighting (calculated in Appendix L) 244.6610 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation 0.0000 (333)
Wind generation 0.0000 (334)
Hydro-electric generation (Appendix N) 0.0000 (335a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (335)
Appendix Q - special features
Energy saved or generated -0.0000 (336)
Energy used 0.0000 (337)
Total delivered energy for all uses 7094.9313 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	6546.4490	0.0150	30.4945	(367)
Electrical energy for heat distribution (space & water)	20.3297	0.0000	9.5776	(372)
Overall CO2 factor for heat network			0.0165	(386)
Total CO2 associated with community systems			107.7744	(373)
Space and water heating			107.7744	(376)
Pumps, fans and electric keep-hot	303.8213	0.1387	42.1438	(378)
Energy for lighting	244.6610	0.1443	35.3121	(379)
Total CO2, kg/year			185.2303	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.7000	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	6546.4490	0.0630	128.0770	(467)
Electrical energy for heat distribution (space & water)	20.3297	0.0000	100.8923	(472)
Overall CO2 factor for heat network			0.0784	(486)
Total CO2 associated with community systems			513.3186	(473)
Space and water heating			513.3186	(476)
Pumps, fans and electric keep-hot	303.8213	1.5128	459.6209	(478)
Energy for lighting	244.6610	1.5338	375.2692	(479)
Total Primary energy kWh/year			1348.2086	(483)
Dwelling Primary energy Rate (DPER)			12.3600	(484)

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	36.3500 (1b)	x	2.5000 (2b)	=	90.8750 (1b)	-
First floor	36.3500 (1c)	x	2.7800 (2c)	=	101.0530 (1c)	-
Second floor	36.3500 (1d)	x	2.7800 (2d)	=	101.0530 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	292.9810	(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) =	0.1365	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3865	(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) =	0.3285	(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	0.4189	0.4107	0.4025	0.3614	0.3532	0.3121	0.3121	0.3039	0.3285	0.3532	0.3696	0.3860	(22b)
Effective ac	0.5877	0.5843	0.5810	0.5653	0.5624	0.5487	0.5487	0.5462	0.5540	0.5624	0.5683	0.5745	(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			1.7500	1.0000	1.7500			(26)
TER Opening Type (Uw = 1.20)			22.8200	1.1450	26.1298			(27)
Ground Floor			36.3500	0.1300	4.7255			(28a)
External Wall	77.3800	24.5700	52.8100	0.1800	9.5058			(29a)
External Roof	36.3500		36.3500	0.1100	3.9985			(30)
Total net area of external elements Aum(A, m2)			150.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.1096			(33)
Party Wall			143.7900	0.0000	0.0000			(32)

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

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	11.3700	0.0500	0.5685
E3	Sill	11.3700	0.0500	0.5685
E4	Jamb	23.2000	0.0500	1.1600
E5	Ground floor (normal)	9.6000	0.1600	1.5360
E6	Intermediate floor within a dwelling	19.2000	0.0000	0.0000
E12	Gable (insulation at ceiling level)	8.1600	0.0600	0.4896
E18	Party wall between dwellings	21.1200	0.0600	1.2672
P1	Party wall - Ground floor	17.8400	0.0800	1.4272
P2	Party wall - Intermediate floor within a dwelling	35.6800	0.0000	0.0000
P4	Party wall - Roof (insulation at ceiling level)	17.8400	0.1200	2.1408

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.1578 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.2674 (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	56.8247	56.4953	56.1725	54.6559	54.3722	53.0513	53.0513	52.8067	53.5601	54.3722	54.9462	55.5463	(38)
Heat transfer coeff	112.0921	111.7627	111.4398	109.9233	109.6395	108.3187	108.3187	108.0741	108.8275	109.6395	110.2135	110.8136	(39)

Average = Sum(39)m / 12 = 109.9219

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0279	1.0249	1.0219	1.0080	1.0054	0.9933	0.9933	0.9911	0.9980	1.0054	1.0107	1.0162	(40)
HLP (average)												1.0080	
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 2.8090 (42)

Hot water usage for mixer showers

71.3175	70.2458	68.6840	65.6958	63.4906	61.0314	59.6336	61.1836	62.8826	65.5230	68.5754	71.0443	(42a)

Hot water usage for baths

30.7921	30.3348	29.6908	28.5034	27.6143	26.6284	26.0959	26.7354	27.4317	28.4866	29.6984	30.6880	(42b)

Hot water usage for other uses

43.3970	41.8189	40.2408	38.6628	37.0847	35.5066	35.5066	37.0847	38.6628	40.2408	41.8189	43.3970	(42c)

Average daily hot water use (litres/day) 133.7533 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	145.5066	142.3995	138.6156	132.8620	128.1897	123.1665	121.2362	125.0037	128.9770	134.2505	140.0927	145.1293	(44)
Energy conte	230.4469	202.7749	213.0471	181.8815	172.5679	151.4476	146.6246	154.7807	159.0416	182.1766	199.5878	227.2374	(45)
Energy content (annual)										Total = Sum(45)m =		2221.6146	
Distribution loss (46)m = 0.15 x (45)m													
	34.5670	30.4162	31.9571	27.2822	25.8852	22.7171	21.9937	23.2171	23.8562	27.3265	29.9382	34.0856	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	277.0418	244.8607	259.6420	226.9733	219.1628	196.5394	193.2195	201.3756	204.1334	228.7715	244.6796	273.8323	(62)
WWHRS	-32.6034	-28.8347	-30.1940	-25.0019	-23.3008	-19.9387	-18.6893	-19.8742	-20.6293	-24.3197	-27.5513	-31.9996	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	244.4384	216.0260	229.4479	201.9714	195.8620	176.6007	174.5302	181.5013	183.5041	204.4518	217.1283	241.8326	(64)
										Total per year (kWh/year) = Sum(64)m =		2467.2949	(64)
12Total per year (kWh/year)												2467	(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													
	113.8995	101.0912	108.1141	96.5491	94.6548	86.4298	86.0286	88.7405	88.9548	97.8497	102.4364	112.8323	(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	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	136.6850	151.3298	136.6850	141.2411	136.6850	141.2411	136.6850	136.6850	141.2411	136.6850	141.2411	136.6850	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	270.1840	272.9877	265.9225	250.8817	231.8953	214.0508	202.1295	199.3259	206.3910	221.4319	240.4182	258.2628	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	(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)													
	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	(71)
Water heating gains (Table 5)													
	153.0908	150.4334	145.3146	134.0959	127.2241	120.0414	115.6299	119.2749	123.5483	131.5184	142.2728	151.6564	(72)
Total internal gains													
	628.0948	642.8859	616.0571	594.3538	563.9394	540.4683	519.5794	520.4207	536.3155	557.7702	592.0672	614.7392	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6600	10.6334	0.6300	0.7000	0.7700	34.6418	(74)
South	12.1600	46.7521	0.6300	0.7000	0.7700	173.7426	(78)

Solar gains	208.3844	350.7478	474.9544	590.3532	670.3016	671.4028	644.6837	582.8295	513.8870	385.7143	248.6793	179.0087	(83)
Total gains	836.4791	993.6337	1091.0116	1184.7069	1234.2410	1211.8712	1164.2631	1103.2502	1050.2025	943.4845	840.7466	793.7478	(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	67.5598	67.7589	67.9552	68.8927	69.0710	69.9133	69.9133	70.0715	69.5865	69.0710	68.7113	68.3392	
alpha	5.5040	5.5173	5.5303	5.5928	5.6047	5.6609	5.6609	5.6714	5.6391	5.6047	5.5808	5.5559	
util living area													
	0.9934	0.9827	0.9599	0.8928	0.7574	0.5614	0.4078	0.4479	0.6806	0.9164	0.9838	0.9949	(86)
MIT	19.9534	20.1722	20.4277	20.7252	20.9144	20.9870	20.9982	20.9970	20.9634	20.7217	20.2891	19.9200	(87)
Th 2	20.0602	20.0627	20.0651	20.0767	20.0788	20.0889	20.0889	20.0908	20.0850	20.0788	20.0745	20.0699	(88)
util rest of house													
	0.9913	0.9776	0.9480	0.8633	0.7019	0.4861	0.3242	0.3608	0.6036	0.8864	0.9781	0.9934	(89)
MIT 2	18.8509	19.1290	19.4485	19.8102	20.0110	20.0819	20.0884	20.0898	20.0624	19.8159	19.2880	18.8156	(90)
Living area fraction										fLA = Living area / (4) =		0.2135	(91)
MIT	19.0863	19.3517	19.6575	20.0055	20.2039	20.2751	20.2826	20.2834	20.2547	20.0093	19.5017	19.0514	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0863	19.3517	19.6575	20.0055	20.2039	20.2751	20.2826	20.2834	20.2547	20.0093	19.5017	19.0514	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9884	0.9725	0.9416	0.8607	0.7099	0.5018	0.3421	0.3794	0.6185	0.8838	0.9734	0.9909	(94)
Useful gains	826.7542	966.2753	1027.3314	1019.7210	876.2111	608.1529	398.2825	418.6143	649.5763	833.8261	818.3444	786.5372	(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													
	1657.4232	1615.1649	1466.2738	1220.7531	932.3628	614.7195	398.8929	419.6988	669.8045	1031.6310	1366.8384	1645.7340	(97)
Space heating kWh													
	618.0177	436.0538	326.5731	144.7431	41.7769	0.0000	0.0000	0.0000	0.0000	147.1668	394.9157	639.2424	(98a)
Space heating requirement - total per year (kWh/year)												2748.4896	
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													
	618.0177	436.0538	326.5731	144.7431	41.7769	0.0000	0.0000	0.0000	0.0000	147.1668	394.9157	639.2424	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2748.4896	
Space heating per m2											(98c) / (4) =	25.2039	(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													
	618.0177	436.0538	326.5731	144.7431	41.7769	0.0000	0.0000	0.0000	0.0000	147.1668	394.9157	639.2424	(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)													
	669.5750	472.4309	353.8170	156.8181	45.2621	0.0000	0.0000	0.0000	0.0000	159.4440	427.8610	692.5703	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	244.4384	216.0260	229.4479	201.9714	195.8620	176.6007	174.5302	181.5013	183.5041	204.4518	217.1283	241.8326	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.0494	85.6016	84.8510	83.3256	81.2476	79.8000	79.8000	79.8000	79.8000	83.3350	85.3838	86.1337	(217)
Fuel for water heating, kWh/month													
	284.0674	252.3619	270.4128	242.3882	241.0679	221.3042	218.7095	227.4452	229.9550	245.3371	254.2970	280.7644	(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	28.4004	22.7839	20.5144	15.0297	11.6094	9.4850	10.5905	13.7659	17.8805	23.4602	26.4982	29.1898	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-36.0354	-51.8912	-76.1574	-87.4667	-95.8547	-89.9786	-88.8220	-83.0689	-73.2133	-60.1115	-39.9830	-31.0248	(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	-17.1882	-36.4773	-73.1099	-110.7146	-147.3030	-148.3804	-146.6855	-123.8273	-90.2375	-52.5254	-23.0609	-13.5722	(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	2977.7785 (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	2968.1107 (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)	229.2078 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1796.6898 (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	4464.4072 (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	2977.7785	0.2100	625.3335	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2968.1107	0.2100	623.3033	(264)
Space and water heating			1248.6367	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	229.2078	0.1443	33.0818	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-813.6075	0.1342	-109.1511	
PV Unit electricity exported	-983.0823	0.1256	-123.5202	
Total			-232.6713	(269)
Total CO2, kg/year			1060.9765	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.7300	(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	2977.7785	1.1300	3364.8897	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2968.1107	1.1300	3353.9651	(278)
Space and water heating			6718.8548	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	229.2078	1.5338	351.5666	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-813.6075	1.4958	-1216.9918	
PV Unit electricity exported	-983.0823	0.4612	-453.3919	
Total			-1670.3837	(283)
Total Primary energy kWh/year			5530.1386	(286)
Target Primary Energy Rate (TPER)			50.7100	(287)

Appendix F
Analysis of renewable technology measures

Feasibility Study Table								
Technology	**Payback**	**Land Use Issues**	**Local Planning Requirements**	**Noise**	**Ability for exporting heat or electricity**	**Carbon Payback**	**Feasible**	**Reason not Feasible or Selected**
Biomass	None	Air quality in residential area	Encouraged for large scale developments	In Plant Room	Plant would be sized for development so no heat export.	Yes	No	Not selected due to air quality concerns
Solar Thermal	Long period	Sufficient roof space required	Encouraged	None	Insufficent heat generated for export	~2 years	Yes	Not selected because PV has been preferred.
Solar Photovoltaic (PV)	Circa 20 years	Sufficient roof space required	Encouraged	None	Generated electricity expected to be used onsite.	2-5 years	Yes	Selected and **388** kWp specified for the development
Air Source Heat Pumps (ASHPs)	Long term	Visual intrusion of external units	Encouraged	Depends on location, can be high	Connection point provided for potential link to wider heat network.	No	Yes	Selected as lead technology for heat network, and smaller units for non-residential units
Ground Source Heat Pumps (GSHPs)	Long term	Requires large area for coils or borehole	Encouraged	Depends on location, can be medium	Plant would be sized for development so no heat export.	No	No	Not selected due to complexity and high cost associated with the ground excavation work.
Water Source Heat Pumps (WSHPs)	Long term	Requires large area for coils or abstration rates (suitable water resource)	Encouraged	Depends on location, can be medium	Plant would be sized for development so no heat export.	No	No	Not selected as no water running through development.
Wind Power	Long term	Urban Area - low and turbulent wind; Visual impact	Encouraged for large scale developments	Yes	Insufficient energy produced for export	~1 year	No	Not selected due to insufficient wind speeds in area
Hydro Power	Medium	Requires suitable water resource; Visual impact	None	Low	Insufficient energy produced for export	~1 year	No	Not selected due to no nearby sources
Energy storage - Battery	None	Requries space and sufficient ventilation	None	Low	Insufficient energy produced for export	Depends on source	No	Not selected due to lack of payback.

Appendix G

SBEM BRUKL Worksheets – *Be Green*

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Cafe Gym & Retail Units

As designed

Date: Wed Aug 23 16:14:54 2023

Administrative information

Building Details

Address: Cafe, Gym & Retail Units, Belvedere, DA17

Certifier details

Name:

Telephone number:

Address: , ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.e.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.2.0

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 303.21

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	8.52	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	5.26	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	92.74	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	56.52	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.21	0.25	00 Ground Floor - Retail Unit 1_W_8
Floors	0.18	0.12	0.12	00 Ground Floor - Retail Unit 1_S_3
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	-	-	No heat loss flat roofs
Windows** and roof windows	1.6	1.2	1.2	00 Ground Floor - Retail Unit 1_G_7
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	-	-	No external personnel doors
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- VRF

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4.3	6.5	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- Heat Pump

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	3	0.003
Standard value	2*	N/A
* Standard shown is for all types except absorption and gas engine heat pumps.		

Zone-level mechanical ventilation, exhaust, and terminal units

ID	**System type in the Approved Documents**
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
00 Ground Floor - Retail Unit 1	-	-	-	-	1.2	-	-	-	-	0.85	N/A
00 Ground Floor - Cafe	-	-	-	-	1.2	-	-	-	-	0.85	N/A
00 Ground Floor - Gym	-	-	-	-	1.2	-	-	-	-	0.85	N/A
00 Ground Floor - Retail Unit 2	-	-	-	-	1.2	-	-	-	-	0.85	N/A

General lighting and display lighting	**General luminaire**	**Display light source**	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
00 Ground Floor - Retail Unit 1	120	120	1.25
00 Ground Floor - Cafe	120	120	1.25
00 Ground Floor - Gym	120	-	-
00 Ground Floor - Retail Unit 2	120	120	1.25

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 Ground Floor - Retail Unit 1	NO (-76.4%)	NO
00 Ground Floor - Cafe	NO (-33.7%)	NO
00 Ground Floor - Gym	NO (-34.4%)	NO
00 Ground Floor - Retail Unit 2	NO (-76.1%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	303.2	303.2
External area [m^2]	643.2	643.2
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	197.9	260.99
Average U-value [W/m^2K]	0.31	0.41
Alpha value* [%]	24.27	21.17

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
37	**Retail/Financial and Professional Services**
31	**Restaurants and Cafes/Drinking Establishments/Takeaways**
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
31	**General Assembly and Leisure, Night Clubs, and Theatres**
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	2.28	5.54
Cooling	9.55	14.22
Auxiliary	11.17	11.36
Lighting	11.89	14.87
Hot water	13.48	16.82
Equipment*	70.03	70.03
TOTAL**	**48.36**	**62.81**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	10.13	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*10.13*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	201.62	277.88
Primary energy [kWh_{PE}/m^2]	56.52	92.74
Total emissions [kg/m^2]	5.26	8.52

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	34.6	167	2.3	9.6	11.2	4.22	4.86	4.3	6.5
	Notional	52.7	225.2	5.5	14.2	8.4	2.64	4.4	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Appendix H

Correspondence with Heat Network Operator

Rodrigo Guedes

From: james.greener@vattenfall.com
Sent: 03 August 2023 22:07
To: Rodrigo Guedes; AndyK@ener-vate.co.uk; Matthew Bailey; Jake Robson
Cc: robert.hunter@vattenfall.com; DavidB@ener-vate.co.uk; Nasser Farooq; Michael Olapoju; hannah.wright@vattenfall.com
Subject: RE: Riverside Heat Network - Belvedere/Bellway

Evening Rod,

Apologies in the delay getting the technical note over to you. It is currently stuck with our marketing team however they assured me this week that it would be ready next week. Respecting your deadlines however I have copied the key tables below as well as answers to your questions. If you have any further questions please let me know and I shall do my best to answer them. I am travelling tomorrow but will have sporadic access to my emails.

In answer to your questions:

- High grade heat fed directly from the EfW into the network. No use of heat pumps.
- Distribution losses anticipated to be no greater than 10% therefore 90% efficiency would be a reasonable number to use for SAP.
- 100% waste heat recovery from the EfW. No electrical generation anticipated other than as a backup.

Operational Temperatures

Primary Network	
Flow Temperature	< 65°C*
Return Temperature	< 40°C
Secondary Network	
Flow Temperature	< 60°C
Return Temperature	< 35°C

* Elevated temperatures can be provided to existing buildings that are looking to decarbonise.

Carbon Intensity

Heat Source	**Kg CO_2/kWh**	**Note**
Vattenfall RHN	<0.045	RHN heat is generated predominantly via the Cory Riverside EfW, supported by heat pumps. We are undertaking a detailed calculation of the blended RHN carbon intensity however this will be less than the heat pump counterfactual due to the significant % heat fraction delivered by the waste heat from the EfW.
Gas boiler	0.256	Gas carbon factor of 0.218 kgCO_2/kWh and 85% boiler efficiency.
Heat pump	0.045	Grid Carbon content of 0.136 kgCO_2/kWh and a sCoP of 3.

All the best,

James

James Greener
Commercial Manager
BA Heat
BU Heat UK

M: +44(0) 7729 916 097
E: james.greener@vattenfall.com

The Tun Building, 4 Jackson's Entry, Edinburgh, EH8 8PJ

VATTENFALL
ISO 45001:2018, ISO 14001:2015, ISO 9001:2015

Please consider the environment before printing this e-mail.

Rodrigo Guedes

From: james.greener@vattenfall.com
Sent: 10 August 2023 17:46
To: Rodrigo Guedes; David8@ener-vate.co.uk; AndyK@ener-vate.co.uk; Matthew Bailey; Jake Robson
Cc: robert.hunter@vattenfall.com; Nasser Farooq; Michael Olapoju; hannah.wright@vattenfall.com; Zoe Croft; Donald Sinclair
Subject: RE: Riverside Heat Network - Belvedere/Bellway

Evening Rod,

The documents are due to be delivered to us tomorrow (digitally) and will also be sent to you tomorrow. In terms of the below bullet points:

- **Connection costs**
  - Two parts
    - Connection to the Strategic Heat Main (SHM) c[redacted] capacity of supply
    - Bespoke cost for the branch connecting the site to the SHM established as part of the Connection Development Agreement and will depend on the location of your substation and the route to the SHM. Given the SHM is planned to be routed down Yarnton Way, I suspect this branch will be a relatively modest sum.

- **Service levels**
  - The RHN will target 100% availability balanced across several heat sources.
  - Other KPIs i.e. Carbon Intensity can be contracted for as part of an ESA.

- **Heat charge review formula**
  - Anticipated heat price of [redacted]
  - [redacted]

- **When the connection will be available/any expectation of temporary plants**
  - Current time lines suggest a connection to the EfW at Cory would be late 2025/early 2026.
  - The SHM will be built in advance of this with the first sections installed in 2024.
  - Temporary low carbon plant solutions available comprising of either HVO Boilers or ASHPs depending on the anticipated load and location of heat demand.

- **Design requirements that the developer would need to follow as conditions**
  - The flow and return temperatures required for the design are in my previous email and will be in the technical specification document which will follow tomorrow along with a high level one page summary of the project.

I hope these help for now. I am around tomorrow if a call would be helpful to clarify any points and will follow up with the documents as soon as I have them.

All the best,

James

James Greener
Commercial Manager
BA Heat
BU Heat UK

M: +44(0) 7729 916 097
E: james.greener@vattenfall.com

The Tun Building, 4 Jackson's Entry, Edinburgh, EH8 8PJ

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An introduction to Vattenfall's Riverside Heat Network

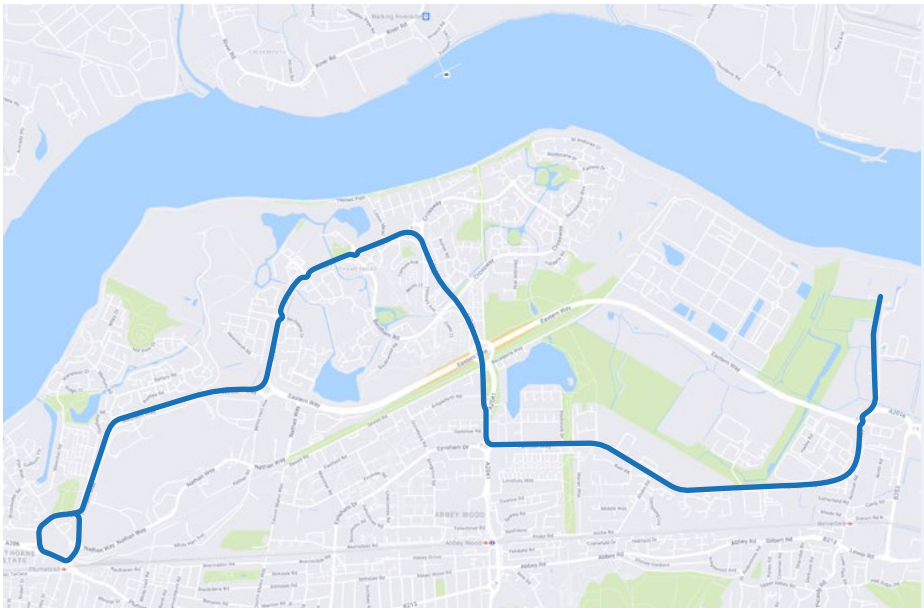
London needs to accelerate the transition to low carbon and renewable energy for homes and businesses. Heating is an often overlooked but crucial part of that change.

The Mayor of London has set a target for London to be net zero carbon by 2030. District heating is integral to delivering this goal: up to 460,000 buildings across London will need to be connected to district heating networks.

Representing a multimillion-pound investment, Vattenfall's Riverside Heat Network will connect over 25,000 homes across London Borough of Bexley and Royal Borough of Greenwich to a low carbon heat network by 2030, creating jobs for local contractors and boosting businesses in the area.

In a volatile energy market, the Riverside Heat Network will contribute to energy security, affordability and resilience. Customers connected to the heat network will benefit from an all-inclusive service with all servicing and maintenance included; better local air quality; dedicated monitoring and support; and expert customer care.

Crucially, Riverside Heat Network represents a future-proofed energy system. Buildings that currently use fossil fuels for heating will need to replace their systems to meet government targets. Soon, gas boilers simply won't be allowed. By connecting to Riverside Heat Network, developments are future proofing their heating and hot water supply, as the district heating network can connect to multiple low carbon and renewables heat sources after installation.



10km
district heat network

£50m
investment opportunity by 2030

25,000
homes with low carbon heat

90%
reduction in carbon emissions

What is district heating
The Riverside Heat Network comprises a network of two sets of insulated underground pipe, carrying heated water from the local energy from waste (EfW) plant to each building connected (flow pipe). A return pipe takes heat depleted water back to the EfW to be reheated.

An Energy Centre houses the main operating plant and water treatment equipment to ensure longevity and reliability of the heat system.

Metering equipment in each substation measures the amount of heat consumed by building connected to the heat network, ensuring customers are charged accurately for heat consumed.

About Vattenfall
We are the European market leader in district heating, supplying households and industries across Sweden, Germany, and the Netherlands with low carbon, low-cost heat. Our network in Amsterdam, for example, serves 200,000 customers and has reduced city-wide emissions by 75%.

Here in the UK, we are working with three progressive UK cities to transform the way communities are heated and help deliver net zero ambitions.

- In London, in addition to our Riverside Heat Network, we are designing, delivering and running heating and cooling networks powered by heat pumps and clean electricity to serve 6,700 new homes and three million square feet of commercial space as part of a major regeneration project at Brent Cross Town.
- In Bristol, we have embarked on a 20-year partnership with Ameresco and Bristol City Council to decarbonise and transform the city's energy infrastructure. Over the next five years alone, we are investing more than £300m in expanding the existing heat network.
- In Scotland, Vattenfall is working with Midlothian Council to deliver low-carbon district heating networks that are partly powered by waste heat from a recycling centre, to heat 170,000 homes near Edinburgh by 2050. The initial district heating network is at Shawfair Town, in the north of Midlothian Council area.

Our low temperature networks enable the use of high-efficiency heat pumps & integration of low-cost clean heat recovered from factories, data centres, waste processing plants, and even rivers. This is energy efficiency in its purest form. After all, the greenest, cheapest and safest energy is that which would otherwise go to waste.

Our commitment to a fossil free future
At Vattenfall, sustainability is the business. It is a fundamental part of our strategy. We identify industries and sectors where we can have the biggest impact, create collaborations and partnerships throughout full value chains, put sustainability demands on ourselves and our suppliers, and we drive others to act as well. We are signatories to the UN Sustainable Development Goals.

Vattenfall is committed to reducing our climate impact with a target of reaching net zero across our full value chain by 2040. Since 2017, we have achieved a 48% reduction in emissions intensity and we continue to remain on track for reaching our 1.5° SBTi target across Scope 1 and 2 emissions, and for our customers emissions (Scope 3).

Beyond emissions, we are a leader in Biodiversity, topping the Ecogain Biodiversity Index out of the 300 largest companies in Europe. We are committed to respecting internationally recognised human rights and have multiple policies to identify, prevent and mitigate human rights risk throughout our value chain. We apply the Global Diversity, Equity and Inclusion Benchmarks, and continue to expand our D&I activities.

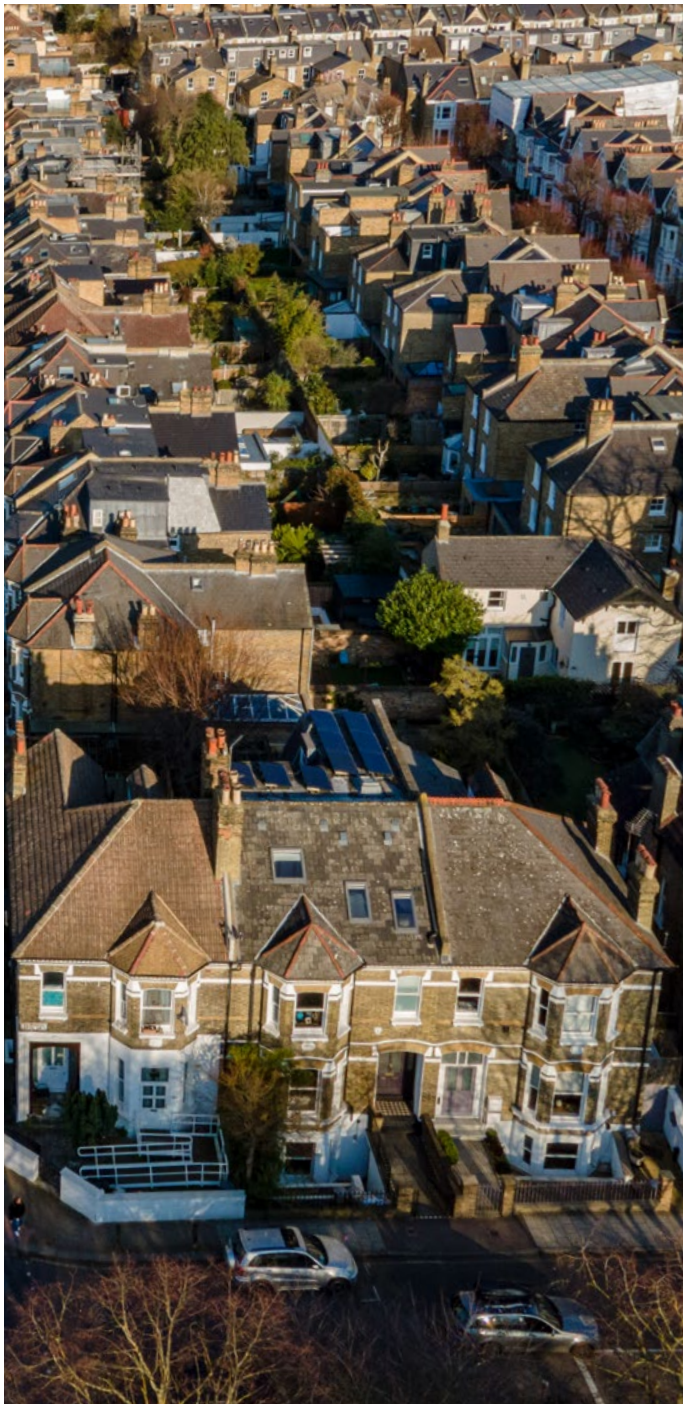
Get in touch

We develop long-term partnerships with local authorities, commercial organisations and communities to free UK cities from fossil-fuelled heating altogether. To find out how district heating networks can form part of your net zero revolution, contact Vattenfall: **riversideheatnetwork@vattenfall.com**

Riverside Heat Network

Technical Note

VATTENFALL



Overview

The Vattenfall Riverside Heat Network (RHN) comprises a network of two sets of insulated underground pipe, carrying heated water from the local EfW plant to the heat customers (flow pipe) and then carrying the heat depleted water back to the EfW to be reheated (return pipe).

The Heat Transfer Station comprises the main operating plant and water treatment equipment to ensure longevity and reliability of the heat system as well as back up heat generating plant in the event of EfW outages.

Metering equipment in each substation measures the amount of heat consumed by each customer on the network and Vattenfall as the network operator levies appropriate charges for the heat consumed

Primary/Secondary Network

Heat customers will have a point of demarcation at the Plate Heat Exchanger (PHE) in the heat customers substation. This point of demarcation usually indicates the extent of ownership and responsibility between the network operator (responsible for Primary Network) and the Heat Customer (responsible for Secondary Network).

Heat customers will be charged by the network operator on the basis of all heat consumed through the bulk heat supply (across the PHE) on a p/kWh basis.

Technical Details

Primary Network	
Flow Temperature	< 65°C *
Return Temperature	< 40°C
Secondary Network	
Flow Temperature	< 60°C
Return Temperature	< 35°C

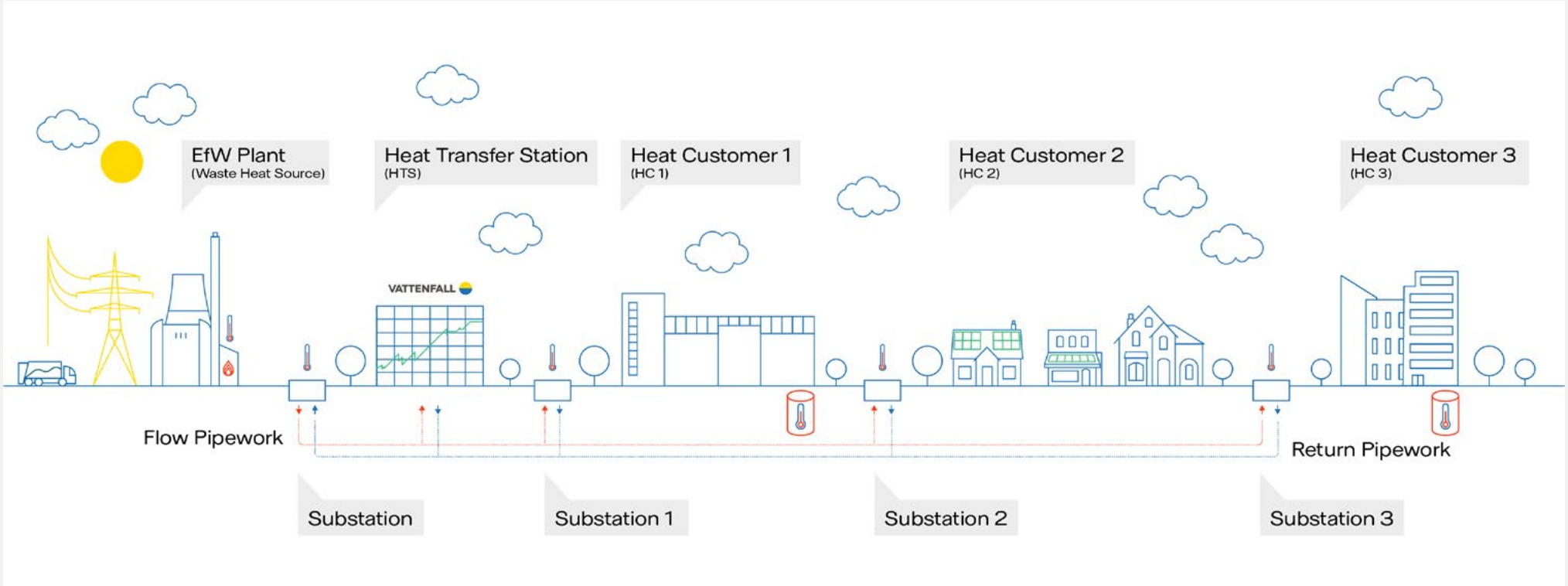
* Elevated temperatures can be provided to existing buildings that are looking to decarbonise. Please contact us to discuss this.

Carbon Intensity

Heat Source	Kg CO_2/ kWh	Note
Vattenfall RHN	<0.045	RHN heat is generated predominantly via the Cory Riverside EfW, supported by heat pumps. We are undertaking a detailed calculation of the blended RHN carbon intensity however this will be less than the heat pump counterfactual due to the significant % heat fraction delivered by the waste heat from the EfW.
Gas boiler	0.256	Gas carbon factor of 0.218 $kgCO_2$/kWh and 85% boiler efficiency.
Heat pump	0.045	Grid Carbon content of 0.136 $kgCO_2$/kWh and a sCoP of 3.

* Carbon associated with pumping not included as it will be identical for each heat source

Ener-Vate CORY VATTENFALL



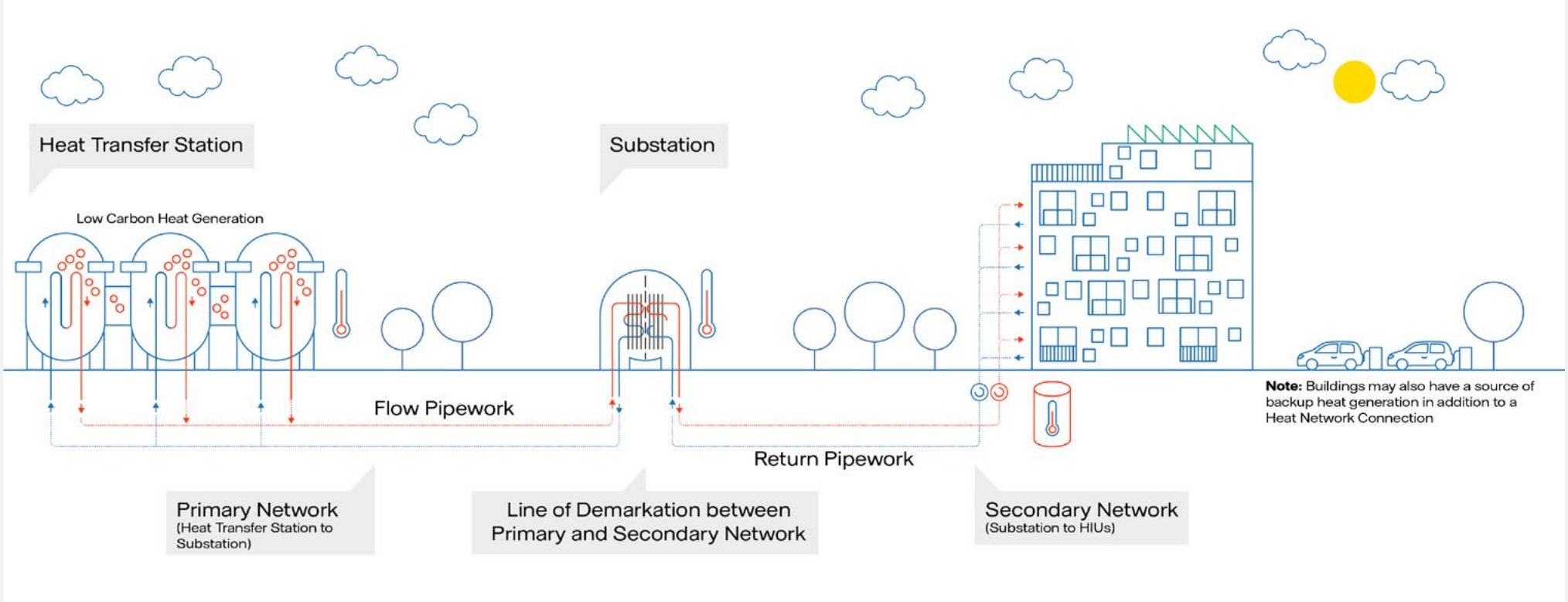
Heat Transfer Station (HTS)	The Heat Transfer Station houses the main network infrastructure, including heat generating plant, pumps, water conditioning and treatment plant.
Substations (SS)	Heat Substations are the interface between the heat network and the heat customers and/or suppliers. They usually involve a Plate Heat Exchanger (PHE) to transfer the heat from the network to the building. Some sites may have a Secondary System/Network to transfer this heat within the building to the individual heat customers within the building/development.
Primary System	The Primary System is the main distribution for flow pipework takes the heat from the heat-generating plant (HTS) to the heat customers.

Primary Network

- Hot water from Low Carbon Heat Generation is pumped from the Heat Transfer Station (HTS) through the Primary Network to the building bulk supply substations.
- Plate Heat Exchangers (PHEs) in the substation transfer the heat across the PHE from the flow pipe in the Primary Network to the Flow Pipe in the Secondary Network.
- Once heat has been extracted from at the PHE, the water in the Primary Network is returned to the Heat Transfer Station through the Return Pipe.

Secondary Network

- Hot water from the PHEs in the substation is pumped through the flow pipe work, up the risers and laterals in the building and transferred to the end heat customers HIU.
- The water is returned from the HIU through the return pipe of the Secondary Network.



Appendix I

SAP TER/DER Worksheets – *Be Green*

Full SAP Calculation Printout

Property Reference	E1 03 06 (MF Flat) E_BeGreen	Issued on Date	30/08/2023
Assessment Reference	E1 03 06 (MF Flat) E_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	89 B	DER	0.40	TER	14.61
Environmental	100 A	% DER < TER			97.26
CO_2 Emissions (t/year)	0.01	DFEE	33.18	TFEE	32.25
Compliance Check	See BREL	% DFEE < TFEE			-2.87
% DPER < TPER	98.48	DPER	1.19	TPER	78.32

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.5400	(1b)	x 2.8000	(2b) =	141.5120	(1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.5400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	141.5120	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1162	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.0000 (23c)

Effective ac	0.2432	0.2403	0.2374	0.2229	0.2200	0.2054	0.2054	0.2025	0.2112	0.2200	0.2258	0.2316	(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	
Opening Type 1 (Uw = 0.90)			8.3700	0.8687	7.2712			(27)
Door			4.0400	1.0000	4.0400			(26)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)

Wall to Corridor	40.8400	40.8400	0.1800	7.3512	(29a)
Total net area of external elements Aum(A, m2)		57.8400			(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		19.4886	(33)
Party Wall		22.4000	0.0000	0.0000	(32)
Party Floor 1		50.5400			(32d)
Party Ceiling 1		50.5400			(32b)

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

List of Thermal Bridges

	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	4.9300	0.0800	0.3944
E3 Sill	3.9100	0.1000	0.3910
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0500	0.2880
E18 Party wall between dwellings	5.2000	0.0400	0.2080
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.1000	2.9060
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.1500	1.0980
E16 Corner (normal)	5.2000	0.1000	0.5200
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.1124 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 25.6010 (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	11.3581	11.2223	11.0866	10.4080	10.2723	9.5937	9.5937	9.4580	9.8652	10.2723	10.5437	10.8152	(38)
Heat transfer coeff	36.9591	36.8234	36.6877	36.0091	35.8733	35.1948	35.1948	35.0590	35.4662	35.8733	36.1448	36.4162	(39)

Average = Sum(39)m / 12 = 35.9751

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7313	0.7286	0.7259	0.7125	0.7098	0.6964	0.6964	0.6937	0.7017	0.7098	0.7152	0.7205	(40)
HLP (average)												0.7118	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7060 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	59.4266	58.5335	57.2322	54.7422	52.9047	50.8555	49.6908	50.9823	52.3980	54.5982	57.1417	59.1989	(42a)
Hot water usage for baths	22.8391	22.4999	22.0223	21.1416	20.4821	19.7509	19.3559	19.8302	20.3466	21.1291	22.0279	22.7619	(42b)
Hot water usage for other uses	32.1012	30.9339	29.7666	28.5993	27.4320	26.2646	26.2646	27.4320	28.5993	29.7666	30.9339	32.1012	(42c)

Average daily hot water use (litres/day) 105.1477 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3670	111.9674	109.0210	104.4831	100.8188	96.8710	95.3113	98.2445	101.3440	105.4939	110.1035	114.0621	(44)
Energy conte	181.1293	159.4401	167.5613	143.0321	135.7214	119.1142	115.2708	121.6472	124.9672	143.1543	156.8626	178.5936	(45)

Energy content (annual) Total = Sum(45)m = 1746.4941

Distribution loss (46)m = 0.15 x (45)m	27.1694	23.9160	25.1342	21.4548	20.3582	17.8671	17.2906	18.2471	18.7451	21.4731	23.5294	26.7890	(46)

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)
If cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(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	236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704	(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	236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704	(64)

Total per year (kWh/year) = Sum(64)m = 2397.3339 (64)

12Total per year (kWh/year) 2397 (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	104.4469	92.9558	99.9356	90.3531	89.3488	82.4004	82.5490	84.6691	84.3466	91.8202	94.9518	103.6038	(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	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)

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

	77.6959	86.0205	77.6959	80.2858	77.6959	80.2858	77.6959	77.6959	80.2858	77.6959	80.2858	77.6959 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	148.6364	150.1787	146.2920	138.0176	127.5726	117.7558	111.1975	109.6552	113.5419	121.8163	132.2613	142.0781 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300 (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)												
	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403 (71)
Water heating gains (Table 5)												
	140.3857	138.3270	134.3220	125.4904	120.0925	114.4450	110.9529	113.8026	117.1480	123.4143	131.8775	139.2524 (72)
Total internal gains												
	415.3081	423.1164	406.9000	392.3839	373.9511	361.0767	348.4365	349.7438	359.5658	371.5167	393.0147	407.6166 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3700	19.6403	0.3000	0.8000	0.7700	27.3412	(76)

Solar gains	27.3412	53.4851	88.0824	128.4630	157.4362	161.1639	153.4346	131.7981	102.4435	63.4646	34.0912	22.4841 (83)
Total gains	442.6493	476.6015	494.9825	520.8469	531.3873	522.2407	501.8712	481.5419	462.0093	434.9813	427.1059	430.1007 (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	94.9623	95.3123	95.6649	97.4677	97.8365	99.7229	99.7229	100.1089	98.9597	97.8365	97.1018	96.3780	
alpha	7.3308	7.3542	7.3777	7.4978	7.5224	7.6482	7.6482	7.6739	7.5973	7.5224	7.4735	7.4252	
util living area													
	0.9736	0.9530	0.9099	0.7906	0.6207	0.4309	0.3085	0.3349	0.5277	0.8050	0.9404	0.9771	(86)
MIT	20.5724	20.6815	20.8124	20.9448	20.9912	20.9995	21.0000	20.9999	20.9979	20.9471	20.7679	20.5593	(87)
Th 2	20.3133	20.3156	20.3180	20.3298	20.3322	20.3440	20.3440	20.3464	20.3393	20.3322	20.3275	20.3227	(88)
util rest of house													
	0.9671	0.9423	0.8909	0.7574	0.5785	0.3869	0.2626	0.2873	0.4780	0.7668	0.9254	0.9714	(89)
MIT 2	19.8308	19.9661	20.1234	20.2793	20.3255	20.3438	20.3440	20.3464	20.3380	20.2861	20.0825	19.8228	(90)
Living area fraction									fLA = Living area / (4) =			0.5006	(91)
MIT	20.2020	20.3242	20.4683	20.6125	20.6588	20.6720	20.6724	20.6736	20.6683	20.6170	20.4256	20.1915	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2020	20.3242	20.4683	20.6125	20.6588	20.6720	20.6724	20.6736	20.6683	20.6170	20.4256	20.1915	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9659	0.9424	0.8953	0.7718	0.5993	0.4089	0.2856	0.3111	0.5028	0.7836	0.9278	0.9701	(94)
Useful gains	427.5501	449.1514	443.1796	401.9734	318.4498	213.5680	143.3196	149.8135	232.3162	340.8667	396.2685	417.2515	(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													
	587.7243	567.9717	512.4648	421.7547	321.3808	213.7039	143.3267	149.8267	232.9537	359.3436	481.6521	582.3485	(97)
Space heating kWh													
	119.1696	79.8472	51.5482	14.2426	2.1807	0.0000	0.0000	0.0000	0.0000	13.7469	61.4762	122.8321	(98a)
Space heating requirement - total per year (kWh/year)												465.0435	
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													
	119.1696	79.8472	51.5482	14.2426	2.1807	0.0000	0.0000	0.0000	0.0000	13.7469	61.4762	122.8321	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												465.0435	
Space heating per m2											(98c) / (4) =	9.2015	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(301)
Fraction of space heat from community system												1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water												1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating												1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system												1.5000	(306)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating:													
Space heating requirement													
	119.1696	79.8472	51.5482	14.2426	2.1807	0.0000	0.0000	0.0000	0.0000	13.7469	61.4762	122.8321	(98)
Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50													
307a	178.7544	119.7708	77.3222	21.3639	3.2711	0.0000	0.0000	0.0000	0.0000	20.6203	92.2144	184.2482	
Space heating requirement													
	178.7544	119.7708	77.3222	21.3639	3.2711	0.0000	0.0000	0.0000	0.0000	20.6203	92.2144	184.2482	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)

Space heating fuel for secondary/supplementary system

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)

Water heating

Annual water heating requirement

236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704 (64)

Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50

310a 354.6092	314.0512	334.2571	294.7887	286.4974	258.9119	255.8213	265.3859	267.6914	297.6466	315.5345	350.8056

Water heating fuel

354.6092	314.0512	334.2571	294.7887	286.4974	258.9119	255.8213	265.3859	267.6914	297.6466	315.5345	350.8056 (310)

Cooling System Energy Efficiency Ratio 0.0000 (314)

Space coolin 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa 11.5471	10.4296	11.5471	11.1746	11.5471	11.1746	11.5471	11.5471	11.1746	11.5471	11.1746	11.5471 (331)
Lighting 17.2321	13.8242	12.4472	9.1193	7.0440	5.7550	6.4258	8.3525	10.8491	14.2346	16.0779	17.7110 (332)

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

(333a)m -14.7021	-21.8850	-33.2637	-39.6245	-44.6850	-42.4766	-41.9776	-38.6500	-33.0919	-25.9959	-16.5750	-12.5784 (333a)

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

(334a)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 (334a)

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

(335a)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 (335a)

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

(333b)m -5.3325	-11.5470	-23.6748	-36.6843	-49.5881	-50.2089	-49.4830	-41.2596	-29.4933	-16.7425	-7.1890	-4.1872 (333b)

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

(334b)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 (334b)

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

(335b)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 (335b)

Annual totals kWh/year

Space heating fuel - community heating 697.5653 (307)
Space heating fuel - secondary 0.0000 (309)
Water heating fuel - community heating 3596.0008 (310)
Efficiency of water heater 0.0000 (311)
Electricity used for heat distribution 6.9757 (313)
Space cooling fuel 0.0000 (321)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)
mechanical ventilation fans (SFP = 0.7875) 135.9577 (330a)
Total electricity for the above, kWh/year 135.9577 (331)
Electricity for lighting (calculated in Appendix L) 139.0728 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -690.8958 (333)
Wind generation 0.0000 (334)
Hydro-electric generation (Appendix N) 0.0000 (335a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (335)
Appendix Q - special features
Energy saved or generated -0.0000 (336)
Energy used 0.0000 (337)
Total delivered energy for all uses 3877.7008 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	4293.5661	0.0150	10.4635	(367)
Electrical energy for heat distribution (space & water)	6.9757	0.0000	6.1670	(372)
Overall CO2 factor for heat network			0.0164	(386)
Total CO2 associated with community systems			70.5705	(373)
Space and water heating			70.5705	(376)
Pumps, fans and electric keep-hot	135.9577	0.1387	18.8590	(378)
Energy for lighting	139.0728	0.1443	20.0725	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-365.5057	0.1334	-48.7634	
PV Unit electricity exported	-325.3901	0.1251	-40.6980	
Total			-89.4614	(380)
Total CO2, kg/year			20.0406	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			0.4000	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	4293.5661	0.0630	43.9466	(467)
Electrical energy for heat distribution (space & water)	6.9757	0.0000	65.7433	(472)
Overall CO2 factor for heat network			0.0783	(486)
Total CO2 associated with community systems			336.2380	(473)
Space and water heating			336.2380	(476)
Pumps, fans and electric keep-hot	135.9577	1.5128	205.6767	(478)
Energy for lighting	139.0728	1.5338	213.3144	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-365.5057	1.4930	-545.7023	
PV Unit electricity exported	-325.3901	0.4591	-149.3770	
Total			-695.0793	(480)
Total Primary energy kWh/year			60.1498	(483)
Dwelling Primary energy Rate (DPER)			1.1900	(484)

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		50.5400 (1b)	x	2.8000 (2b)	=	141.5120 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.5400						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	141.5120	(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	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1413 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3913 (18)
Number of sides sheltered		3 (19)
Shelter factor (20) = 1 - [0.075 x (19)]	=	0.7750 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20)	=	0.3033 (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	0.3867	0.3791	0.3715	0.3336	0.3260	0.2881	0.2881	0.2805	0.3033	0.3260	0.3412	0.3564	(22b)
Effective ac	0.5748	0.5719	0.5690	0.5556	0.5531	0.5415	0.5415	0.5394	0.5460	0.5531	0.5582	0.5635	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			8.3700	1.1450	9.5840			(27)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)
Wall to Corridor	40.8400		40.8400	0.1800	7.3512			(29a)
Total net area of external elements Aum(A, m2)			57.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		21.8014			(33)
Party Wall			22.4000	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)	4.9300	0.0500	0.2465
E3 Sill	3.9100	0.0500	0.1955
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0700	0.4032
E18 Party wall between dwellings	5.2000	0.0600	0.3120
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.0700	2.0342
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.0200	0.1464
E16 Corner (normal)	5.2000	0.0900	0.4680
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.1128	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	25.9142	(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	26.8408	26.7052	26.5723	25.9482	25.8314	25.2878	25.2878	25.1871	25.4972	25.8314	26.0676	26.3146	(38)
Heat transfer coeff													
	52.7550	52.6194	52.4865	51.8623	51.7456	51.2019	51.2019	51.1013	51.4113	51.7456	51.9818	52.2288	(39)
Average = Sum(39)m / 12 =												51.8618	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0438	1.0411	1.0385	1.0262	1.0239	1.0131	1.0131	1.0111	1.0172	1.0239	1.0285	1.0334	(40)
HLP (average)												1.0262	
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												1.7060	(42)
Hot water usage for mixer showers													
	52.8236	52.0298	50.8730	48.6598	47.0264	45.2049	44.1696	45.3176	46.5760	48.5318	50.7926	52.6213	(42a)
Hot water usage for baths													
	22.8391	22.4999	22.0223	21.1416	20.4821	19.7509	19.3559	19.8302	20.3466	21.1291	22.0279	22.7619	(42b)
Hot water usage for other uses													
	32.1012	30.9339	29.7666	28.5993	27.4320	26.2646	26.2646	27.4320	28.5993	29.7666	30.9339	32.1012	(42c)
Average daily hot water use (litres/day)												99.0600	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.7640	105.4637	102.6619	98.4006	94.9405	91.2204	89.7901	92.5798	95.5220	99.4275	103.7544	107.4844	(44)
Energy conte	170.6718	150.1788	157.7875	134.7055	127.8081	112.1661	108.5933	114.6331	117.7881	134.9221	147.8172	168.2946	(45)
Energy content (annual)											Total = Sum(45)m =	1645.3665	
Distribution loss (46)m = 0.15 x (45)m													
	25.6008	22.5268	23.6681	20.2058	19.1712	16.8249	16.2890	17.1950	17.6682	20.2383	22.1726	25.2442	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	217.2667	192.2646	204.3824	179.7973	174.4030	157.2580	155.1882	161.2280	162.8800	181.5170	192.9091	214.8895	(62)
WWHRS	-24.1488	-21.3574	-22.3642	-18.5184	-17.2585	-14.7682	-13.8429	-14.7205	-15.2798	-18.0132	-20.4068	-23.7016	(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													
	193.1180	170.9072	182.0182	161.2789	157.1445	142.4897	141.3454	146.5075	147.6002	163.5038	172.5023	191.1879	(64)
										Total per year (kWh/year) = Sum(64)m =		1969.6037	(64)
12Total per year (kWh/year)												1970	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
							Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =					0.0000	(64a)
Heat gains from water heating, kWh/month													
	94.0243	83.6030	89.7403	80.8631	79.7721	73.3687	73.3832	75.3914	75.2380	82.1375	85.2227	93.2339	(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	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	77.6959	86.0205	77.6959	80.2858	77.6959	80.2858	77.6959	77.6959	80.2858	77.6959	80.2858	77.6959	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.6364	150.1787	146.2920	138.0176	127.5726	117.7558	111.1975	109.6552	113.5419	121.8163	132.2613	142.0781	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	(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)													
	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	(71)
Water heating gains (Table 5)													
	126.3768	124.4093	120.6187	112.3098	107.2206	101.9010	98.6333	101.3326	104.4973	110.3999	118.3649	125.3144	(72)
Total internal gains													
	404.2992	412.1986	396.1967	382.2033	364.0792	348.5327	336.1169	337.2738	346.9151	361.5023	382.5021	396.6785	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3700	19.6403	0.6300	0.7000	0.7700	50.2394	(76)

Solar gains	50.2394	98.2790	161.8514	236.0507	289.2890	296.1387	281.9362	242.1790	188.2399	116.6163	62.6426	41.3145	(83)

Total gains	454.5386	510.4776	558.0481	618.2540	653.3682	644.6714	618.0531	579.4528	535.1550	478.1186	445.1447	437.9930	(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	66.5288	66.7002	66.8690	67.6738	67.8265	68.5467	68.5467	68.6817	68.2675	67.8265	67.5183	67.1990	
alpha	5.4353	5.4467	5.4579	5.5116	5.5218	5.5698	5.5698	5.5788	5.5512	5.5218	5.5012	5.4799	
util living area													
	0.9865	0.9738	0.9433	0.8527	0.6950	0.5025	0.3637	0.4041	0.6384	0.8920	0.9721	0.9888	(86)
MIT	20.0644	20.2425	20.4920	20.7822	20.9411	20.9918	20.9989	20.9980	20.9716	20.7576	20.3713	20.0370	(87)
Th 2	20.0470	20.0492	20.0514	20.0616	20.0635	20.0724	20.0724	20.0741	20.0690	20.0635	20.0596	20.0556	(88)
util rest of house													
	0.9826	0.9664	0.9276	0.8173	0.6377	0.4323	0.2875	0.3236	0.5620	0.8566	0.9628	0.9854	(89)
MIT 2	18.9809	19.2055	19.5134	19.8567	20.0186	20.0681	20.0721	20.0734	20.0519	19.8403	19.3775	18.9530	(90)
Living area fraction										fLA = Living area / (4) =		0.5006	(91)
MIT	19.5233	19.7246	20.0033	20.3200	20.4804	20.5305	20.5360	20.5363	20.5123	20.2995	19.8750	19.4956	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5233	19.7246	20.0033	20.3200	20.4804	20.5305	20.5360	20.5363	20.5123	20.2995	19.8750	19.4956	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9798	0.9633	0.9267	0.8277	0.6640	0.4672	0.3256	0.3639	0.5992	0.8664	0.9606	0.9829	(94)
Useful gains	445.3601	491.7404	517.1217	511.7185	433.8061	301.2121	201.2678	210.8843	320.6902	414.2651	427.5872	430.4947	(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													
	803.1038	780.0626	708.7405	592.2665	454.3467	303.6546	201.5324	211.3686	329.6630	501.9049	664.0671	798.8725	(97)
Space heating kWh													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(98a)
Space heating requirement - total per year (kWh/year)												1185.2976	
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													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1185.2976	
Space heating per m2											(98c) / (4) =	23.4527	(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													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(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)													
	288.3654	209.9161	154.4576	62.8327	16.5571	0.0000	0.0000	0.0000	0.0000	70.6436	184.4697	296.9373	(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													
	193.1180	170.9072	182.0182	161.2789	157.1445	142.4897	141.3454	146.5075	147.6002	163.5038	172.5023	191.1879	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.7795	84.3418	83.5179	81.9980	80.5233	79.8000	79.8000	79.8000	79.8000	82.1744	84.0305	84.8668	(217)
Fuel for water heating, kWh/month													
	227.7884	202.6363	217.9393	196.6863	195.1540	178.5586	177.1245	183.5933	184.9626	198.9717	205.2853	225.2799	(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	16.1437	12.9511	11.6610	8.5433	6.5991	5.3915	6.0199	7.8249	10.1638	13.3355	15.0624	16.5924	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-11.3138	-17.0291	-26.1177	-31.4068	-35.6997	-34.0167	-33.6213	-30.8312	-26.2323	-20.3627	-12.8211	-9.6609	(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	-3.4863	-7.5439	-15.3897	-23.7023	-31.9162	-32.2648	-31.8673	-26.7013	-19.2192	-10.9587	-4.7098	-2.7404	(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	1284.1794 (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	2393.9803 (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)	130.2887 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-499.6132 (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	3394.8352 (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	1284.1794	0.2100	269.6777	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2393.9803	0.2100	502.7359	(264)
Space and water heating			772.4135	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	130.2887	0.1443	18.8047	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	0.1332	-38.5158	
PV Unit electricity exported	-210.4999	0.1252	-26.3508	
Total			-64.8666	(269)
Total CO2, kg/year			738.2809	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.6100	(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	1284.1794	1.1300	1451.1227	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2393.9803	1.1300	2705.1977	(278)
Space and water heating			4156.3204	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	130.2887	1.5338	199.8412	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	1.4923	-431.4386	
PV Unit electricity exported	-210.4999	0.4595	-96.7185	
Total			-528.1571	(283)
Total Primary energy kWh/year			3958.1053	(286)
Target Primary Energy Rate (TPER)			78.3200	(287)

Full SAP Calculation Printout

Property Reference	E1 03 06 (MF Flat)_BeGreen	Issued on Date	30/08/2023
Assessment Reference	E1 03 06 (MF Flat)_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	89 B	DER	0.38	TER	14.61
Environmental	100 A	% DER < TER			97.40
CO_2 Emissions (t/year)	0.01	DFEE	31.94	TFEE	32.25
Compliance Check	See BREL	% DFEE < TFEE			0.97
% DPER < TPER	98.59	DPER	1.10	TPER	78.32

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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	50.5400	(1b)	x 2.8000	(2b) =	141.5120	(1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.5400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		141.5120	(5)

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2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1162	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.0000 (23c)

Effective ac	0.2432	0.2403	0.2374	0.2229	0.2200	0.2054	0.2054	0.2025	0.2112	0.2200	0.2258	0.2316	(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	
Opening Type 1 (Uw = 0.90)			8.3700	0.8687	7.2712			(27)
Door			4.0400	1.0000	4.0400			(26)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)

Wall to Corridor	40.8400	40.8400	0.1800	7.3512	(29a)
Total net area of external elements Aum(A, m2)		57.8400			(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		19.4886	(33)
Party Wall		22.4000	0.0000	0.0000	(32)
Party Floor 1		50.5400			(32d)
Party Ceiling 1		50.5400			(32b)

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

List of Thermal Bridges

	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	4.9300	0.0800	0.3944
E3 Sill	3.9100	0.1000	0.3910
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0500	0.2880
E18 Party wall between dwellings	5.2000	0.0400	0.2080
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.1000	2.9060
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.1500	1.0980
E16 Corner (normal)	5.2000	0.1000	0.5200
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.1124 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 25.6010 (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	11.3581	11.2223	11.0866	10.4080	10.2723	9.5937	9.5937	9.4580	9.8652	10.2723	10.5437	10.8152	(38)
Heat transfer coeff	36.9591	36.8234	36.6877	36.0091	35.8733	35.1948	35.1948	35.0590	35.4662	35.8733	36.1448	36.4162	(39)

Average = Sum(39)m / 12 = 35.9751

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7313	0.7286	0.7259	0.7125	0.7098	0.6964	0.6964	0.6937	0.7017	0.7098	0.7152	0.7205	(40)
HLP (average)												0.7118	
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 1.7060 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	59.4266	58.5335	57.2322	54.7422	52.9047	50.8555	49.6908	50.9823	52.3980	54.5982	57.1417	59.1989	(42a)
Hot water usage for baths	22.8391	22.4999	22.0223	21.1416	20.4821	19.7509	19.3559	19.8302	20.3466	21.1291	22.0279	22.7619	(42b)
Hot water usage for other uses	32.1012	30.9339	29.7666	28.5993	27.4320	26.2646	26.2646	27.4320	28.5993	29.7666	30.9339	32.1012	(42c)

Average daily hot water use (litres/day) 105.1477 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3670	111.9674	109.0210	104.4831	100.8188	96.8710	95.3113	98.2445	101.3440	105.4939	110.1035	114.0621	(44)
Energy conte	181.1293	159.4401	167.5613	143.0321	135.7214	119.1142	115.2708	121.6472	124.9672	143.1543	156.8626	178.5936	(45)

Energy content (annual) Total = Sum(45)m = 1746.4941

Distribution loss (46)m = 0.15 x (45)m	27.1694	23.9160	25.1342	21.4548	20.3582	17.8671	17.2906	18.2471	18.7451	21.4731	23.5294	26.7890	(46)

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)
If cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(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	236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704	(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	236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704	(64)

Total per year (kWh/year) = Sum(64)m = 2397.3339 (64)

12Total per year (kWh/year) 2397 (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	104.4469	92.9558	99.9356	90.3531	89.3488	82.4004	82.5490	84.6691	84.3466	91.8202	94.9518	103.6038	(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	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)

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

	77.6959	86.0205	77.6959	80.2858	77.6959	80.2858	77.6959	77.6959	80.2858	77.6959	80.2858	77.6959 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	148.6364	150.1787	146.2920	138.0176	127.5726	117.7558	111.1975	109.6552	113.5419	121.8163	132.2613	142.0781 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300 (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)												
	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403 (71)
Water heating gains (Table 5)												
	140.3857	138.3270	134.3220	125.4904	120.0925	114.4450	110.9529	113.8026	117.1480	123.4143	131.8775	139.2524 (72)
Total internal gains												
	415.3081	423.1164	406.9000	392.3839	373.9511	361.0767	348.4365	349.7438	359.5658	371.5167	393.0147	407.6166 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
West	8.3700	19.6403	0.4000	0.8000	0.7700	36.4549	(80)

Solar gains	36.4549	71.3135	117.4432	171.2839	209.9149	214.8853	204.5795	175.7308	136.5913	84.6195	45.4550	29.9787 (83)
Total gains	451.7630	494.4299	524.3433	563.6679	583.8660	575.9620	553.0160	525.4746	496.1571	456.1362	438.4697	437.5954 (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	94.9623	95.3123	95.6649	97.4677	97.8365	99.7229	99.7229	100.1089	98.9597	97.8365	97.1018	96.3780	
alpha	7.3308	7.3542	7.3777	7.4978	7.5224	7.6482	7.6482	7.6739	7.5973	7.5224	7.4735	7.4252	
util living area													
	0.9706	0.9440	0.8869	0.7443	0.5677	0.3909	0.2800	0.3069	0.4921	0.7779	0.9328	0.9749	(86)
MIT	20.5896	20.7103	20.8461	20.9628	20.9951	20.9998	21.0000	21.0000	20.9987	20.9579	20.7848	20.5739	(87)
Th 2	20.3133	20.3156	20.3180	20.3298	20.3322	20.3440	20.3440	20.3464	20.3393	20.3322	20.3275	20.3227	(88)
util rest of house													
	0.9635	0.9318	0.8653	0.7102	0.5282	0.3509	0.2383	0.2633	0.4455	0.7386	0.9164	0.9687	(89)
MIT 2	19.8519	20.0003	20.1609	20.2964	20.3285	20.3439	20.3440	20.3464	20.3385	20.2960	20.1020	19.8407	(90)
Living area fraction									fLA = Living area / (4) =			0.5006	(91)
MIT	20.2212	20.3557	20.5039	20.6300	20.6622	20.6722	20.6724	20.6736	20.6690	20.6273	20.4438	20.2077	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2212	20.3557	20.5039	20.6300	20.6622	20.6722	20.6724	20.6736	20.6690	20.6273	20.4438	20.2077	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9624	0.9325	0.8715	0.7257	0.5478	0.3709	0.2592	0.2851	0.4688	0.7564	0.9195	0.9674	(94)
Useful gains	434.7686	461.0767	456.9521	409.0723	319.8698	213.6419	143.3236	149.8203	232.5799	345.0338	403.1791	423.3513	(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													
	588.4336	569.1321	513.7718	422.3860	321.5037	213.7104	143.3270	149.8274	232.9765	359.7146	482.3095	582.9403	(97)
Space heating kWh													
	114.3268	72.6133	42.2739	9.5859	1.2156	0.0000	0.0000	0.0000	0.0000	10.9225	56.9739	118.7342	(98a)
Space heating requirement - total per year (kWh/year)												426.6460	
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													
	114.3268	72.6133	42.2739	9.5859	1.2156	0.0000	0.0000	0.0000	0.0000	10.9225	56.9739	118.7342	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												426.6460	
Space heating per m2											(98c) / (4) =	8.4417	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(301)
Fraction of space heat from community system												1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water												1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating												1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system												1.5000	(306)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating:													
Space heating requirement													
	114.3268	72.6133	42.2739	9.5859	1.2156	0.0000	0.0000	0.0000	0.0000	10.9225	56.9739	118.7342	(98)
Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50													
307a	171.4902	108.9199	63.4108	14.3788	1.8233	0.0000	0.0000	0.0000	0.0000	16.3838	85.4609	178.1013	
Space heating requirement													
	171.4902	108.9199	63.4108	14.3788	1.8233	0.0000	0.0000	0.0000	0.0000	16.3838	85.4609	178.1013	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)

Space heating fuel for secondary/supplementary system

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)

Water heating

Annual water heating requirement

236.4061	209.3675	222.8381	196.5258	190.9982	172.6079	170.5476	176.9240	178.4609	198.4311	210.3563	233.8704 (64)

Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50

310a 354.6092	314.0512	334.2571	294.7887	286.4974	258.9119	255.8213	265.3859	267.6914	297.6466	315.5345	350.8056

Water heating fuel

354.6092	314.0512	334.2571	294.7887	286.4974	258.9119	255.8213	265.3859	267.6914	297.6466	315.5345	350.8056 (310)

Cooling System Energy Efficiency Ratio 0.0000 (314)

Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.5471	10.4296	11.5471	11.1746	11.5471	11.1746	11.5471	11.5471	11.1746	11.5471	11.1746	11.5471 (331)
Lighting	17.2321	13.8242	12.4472	9.1193	7.0440	5.7550	6.4258	8.3525	10.8491	14.2346	16.0779	17.7110 (332)

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

(333a)m	-14.7021	-21.8850	-33.2637	-39.6245	-44.6850	-42.4766	-41.9776	-38.6500	-33.0919	-25.9959	-16.5750	-12.5784 (333a)

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

(334a)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 (334a)

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

(335a)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 (335a)

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

(333b)m	-5.3325	-11.5470	-23.6748	-36.6843	-49.5881	-50.2089	-49.4830	-41.2596	-29.4933	-16.7425	-7.1890	-4.1872 (333b)

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

(334b)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 (334b)

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

(335b)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 (335b)

Annual totals kWh/year

Space heating fuel - community heating 639.9690 (307)
Space heating fuel - secondary 0.0000 (309)
Water heating fuel - community heating 3596.0008 (310)
Efficiency of water heater 0.0000 (311)
Electricity used for heat distribution 6.3997 (313)
Space cooling fuel 0.0000 (321)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)
mechanical ventilation fans (SFP = 0.7875) 135.9577 (330a)
Total electricity for the above, kWh/year 135.9577 (331)
Electricity for lighting (calculated in Appendix L) 139.0728 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -690.8958 (333)
Wind generation 0.0000 (334)
Hydro-electric generation (Appendix N) 0.0000 (335a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (335)
Appendix Q - special features
Energy saved or generated -0.0000 (336)
Energy used 0.0000 (337)
Total delivered energy for all uses 3820.1045 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	4235.9698	0.0150	9.5995	(367)
Electrical energy for heat distribution (space & water)	6.3997	0.0000	6.0786	(372)
Overall CO2 factor for heat network			0.0164	(386)
Total CO2 associated with community systems			69.6181	(373)
Space and water heating			69.6181	(376)
Pumps, fans and electric keep-hot	135.9577	0.1387	18.8590	(378)
Energy for lighting	139.0728	0.1443	20.0725	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-365.5057	0.1334	-48.7634	
PV Unit electricity exported	-325.3901	0.1251	-40.6980	
Total			-89.4614	(380)
Total CO2, kg/year			19.0883	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			0.3800	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	4235.9698	0.0630	40.3180	(467)
Electrical energy for heat distribution (space & water)	6.3997	0.0000	64.8400	(472)
Overall CO2 factor for heat network			0.0783	(486)
Total CO2 associated with community systems			331.7061	(473)
Space and water heating			331.7061	(476)
Pumps, fans and electric keep-hot	135.9577	1.5128	205.6767	(478)
Energy for lighting	139.0728	1.5338	213.3144	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-365.5057	1.4930	-545.7023	
PV Unit electricity exported	-325.3901	0.4591	-149.3770	
Total			-695.0793	(480)
Total Primary energy kWh/year			55.6180	(483)
Dwelling Primary energy Rate (DPER)			1.1000	(484)

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		50.5400 (1b)	x	2.8000 (2b)	=	141.5120 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.5400						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	141.5120	(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	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1413 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3913 (18)
Number of sides sheltered		3 (19)
Shelter factor (20) = 1 - [0.075 x (19)]	=	0.7750 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20)	=	0.3033 (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	0.3867	0.3791	0.3715	0.3336	0.3260	0.2881	0.2881	0.2805	0.3033	0.3260	0.3412	0.3564	(22b)
Effective ac	0.5748	0.5719	0.5690	0.5556	0.5531	0.5415	0.5415	0.5394	0.5460	0.5531	0.5582	0.5635	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			8.3700	1.1450	9.5840			(27)
External Wall	17.0000	12.4100	4.5900	0.1800	0.8262			(29a)
Wall to Corridor	40.8400		40.8400	0.1800	7.3512			(29a)
Total net area of external elements Aum(A, m2)			57.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		21.8014			(33)
Party Wall			22.4000	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)	4.9300	0.0500	0.2465
E3 Sill	3.9100	0.0500	0.1955
E4 Jamb	6.1400	0.0500	0.3070
E7 Party floor between dwellings (in blocks of flats)	5.7600	0.0700	0.4032
E18 Party wall between dwellings	5.2000	0.0600	0.3120
E7 Party floor between dwellings (in blocks of flats)	29.0600	0.0700	2.0342
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	7.3200	0.0200	0.1464
E16 Corner (normal)	5.2000	0.0900	0.4680
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	16.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.1128	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	25.9142	(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	26.8408	26.7052	26.5723	25.9482	25.8314	25.2878	25.2878	25.1871	25.4972	25.8314	26.0676	26.3146	(38)
Heat transfer coeff													
	52.7550	52.6194	52.4865	51.8623	51.7456	51.2019	51.2019	51.1013	51.4113	51.7456	51.9818	52.2288	(39)
Average = Sum(39)m / 12 =												51.8618	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0438	1.0411	1.0385	1.0262	1.0239	1.0131	1.0131	1.0111	1.0172	1.0239	1.0285	1.0334	(40)
HLP (average)												1.0262	
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												1.7060	(42)
Hot water usage for mixer showers													
	52.8236	52.0298	50.8730	48.6598	47.0264	45.2049	44.1696	45.3176	46.5760	48.5318	50.7926	52.6213	(42a)
Hot water usage for baths													
	22.8391	22.4999	22.0223	21.1416	20.4821	19.7509	19.3559	19.8302	20.3466	21.1291	22.0279	22.7619	(42b)
Hot water usage for other uses													
	32.1012	30.9339	29.7666	28.5993	27.4320	26.2646	26.2646	27.4320	28.5993	29.7666	30.9339	32.1012	(42c)
Average daily hot water use (litres/day)												99.0600	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.7640	105.4637	102.6619	98.4006	94.9405	91.2204	89.7901	92.5798	95.5220	99.4275	103.7544	107.4844	(44)
Energy conte	170.6718	150.1788	157.7875	134.7055	127.8081	112.1661	108.5933	114.6331	117.7881	134.9221	147.8172	168.2946	(45)
Energy content (annual)											Total = Sum(45)m =	1645.3665	
Distribution loss (46)m = 0.15 x (45)m													
	25.6008	22.5268	23.6681	20.2058	19.1712	16.8249	16.2890	17.1950	17.6682	20.2383	22.1726	25.2442	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	217.2667	192.2646	204.3824	179.7973	174.4030	157.2580	155.1882	161.2280	162.8800	181.5170	192.9091	214.8895	(62)
WWHRS	-24.1488	-21.3574	-22.3642	-18.5184	-17.2585	-14.7682	-13.8429	-14.7205	-15.2798	-18.0132	-20.4068	-23.7016	(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													
	193.1180	170.9072	182.0182	161.2789	157.1445	142.4897	141.3454	146.5075	147.6002	163.5038	172.5023	191.1879	(64)
										Total per year (kWh/year) = Sum(64)m =		1969.6037	(64)
12Total per year (kWh/year)												1970	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
							Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =					0.0000	(64a)
Heat gains from water heating, kWh/month													
	94.0243	83.6030	89.7403	80.8631	79.7721	73.3687	73.3832	75.3914	75.2380	82.1375	85.2227	93.2339	(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	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	85.3004	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	77.6959	86.0205	77.6959	80.2858	77.6959	80.2858	77.6959	77.6959	80.2858	77.6959	80.2858	77.6959	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.6364	150.1787	146.2920	138.0176	127.5726	117.7558	111.1975	109.6552	113.5419	121.8163	132.2613	142.0781	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	31.5300	(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)													
	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	-68.2403	(71)
Water heating gains (Table 5)													
	126.3768	124.4093	120.6187	112.3098	107.2206	101.9010	98.6333	101.3326	104.4973	110.3999	118.3649	125.3144	(72)
Total internal gains													
	404.2992	412.1986	396.1967	382.2033	364.0792	348.5327	336.1169	337.2738	346.9151	361.5023	382.5021	396.6785	(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	
West	8.3700	19.6403	0.6300	0.7000	0.7700	50.2394	(80)

Solar gains	50.2394	98.2790	161.8514	236.0507	289.2890	296.1387	281.9362	242.1790	188.2399	116.6163	62.6426	41.3145	(83)

Total gains	454.5386	510.4776	558.0481	618.2540	653.3682	644.6714	618.0531	579.4528	535.1550	478.1186	445.1447	437.9930	(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	66.5288	66.7002	66.8690	67.6738	67.8265	68.5467	68.5467	68.6817	68.2675	67.8265	67.5183	67.1990	
alpha	5.4353	5.4467	5.4579	5.5116	5.5218	5.5698	5.5698	5.5788	5.5512	5.5218	5.5012	5.4799	
util living area													
	0.9865	0.9738	0.9433	0.8527	0.6950	0.5025	0.3637	0.4041	0.6384	0.8920	0.9721	0.9888	(86)
MIT	20.0644	20.2425	20.4920	20.7822	20.9411	20.9918	20.9989	20.9980	20.9716	20.7576	20.3713	20.0370	(87)
Th 2	20.0470	20.0492	20.0514	20.0616	20.0635	20.0724	20.0724	20.0741	20.0690	20.0635	20.0596	20.0556	(88)
util rest of house													
	0.9826	0.9664	0.9276	0.8173	0.6377	0.4323	0.2875	0.3236	0.5620	0.8566	0.9628	0.9854	(89)
MIT 2	18.9809	19.2055	19.5134	19.8567	20.0186	20.0681	20.0721	20.0734	20.0519	19.8403	19.3775	18.9530	(90)
Living area fraction										fLA = Living area / (4) =		0.5006	(91)
MIT	19.5233	19.7246	20.0033	20.3200	20.4804	20.5305	20.5360	20.5363	20.5123	20.2995	19.8750	19.4956	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5233	19.7246	20.0033	20.3200	20.4804	20.5305	20.5360	20.5363	20.5123	20.2995	19.8750	19.4956	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9798	0.9633	0.9267	0.8277	0.6640	0.4672	0.3256	0.3639	0.5992	0.8664	0.9606	0.9829	(94)
Useful gains	445.3601	491.7404	517.1217	511.7185	433.8061	301.2121	201.2678	210.8843	320.6902	414.2651	427.5872	430.4947	(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													
	803.1038	780.0626	708.7405	592.2665	454.3467	303.6546	201.5324	211.3686	329.6630	501.9049	664.0671	798.8725	(97)
Space heating kWh													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(98a)
Space heating requirement - total per year (kWh/year)												1185.2976	
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													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1185.2976	
Space heating per m2											(98c) / (4) =	23.4527	(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													
	266.1613	193.7525	142.5644	57.9946	15.2822	0.0000	0.0000	0.0000	0.0000	65.2040	170.2655	274.0731	(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)													
	288.3654	209.9161	154.4576	62.8327	16.5571	0.0000	0.0000	0.0000	0.0000	70.6436	184.4697	296.9373	(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													
	193.1180	170.9072	182.0182	161.2789	157.1445	142.4897	141.3454	146.5075	147.6002	163.5038	172.5023	191.1879	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.7795	84.3418	83.5179	81.9980	80.5233	79.8000	79.8000	79.8000	79.8000	82.1744	84.0305	84.8668	(217)
Fuel for water heating, kWh/month													
	227.7884	202.6363	217.9393	196.6863	195.1540	178.5586	177.1245	183.5933	184.9626	198.9717	205.2853	225.2799	(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	16.1437	12.9511	11.6610	8.5433	6.5991	5.3915	6.0199	7.8249	10.1638	13.3355	15.0624	16.5924	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-11.3138	-17.0291	-26.1177	-31.4068	-35.6997	-34.0167	-33.6213	-30.8312	-26.2323	-20.3627	-12.8211	-9.6609	(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	-3.4863	-7.5439	-15.3897	-23.7023	-31.9162	-32.2648	-31.8673	-26.7013	-19.2192	-10.9587	-4.7098	-2.7404	(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	1284.1794 (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	2393.9803 (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)	130.2887 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-499.6132 (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	3394.8352 (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	1284.1794	0.2100	269.6777	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2393.9803	0.2100	502.7359	(264)
Space and water heating			772.4135	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	130.2887	0.1443	18.8047	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	0.1332	-38.5158	
PV Unit electricity exported	-210.4999	0.1252	-26.3508	
Total			-64.8666	(269)
Total CO2, kg/year			738.2809	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.6100	(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	1284.1794	1.1300	1451.1227	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2393.9803	1.1300	2705.1977	(278)
Space and water heating			4156.3204	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	130.2887	1.5338	199.8412	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-289.1134	1.4923	-431.4386	
PV Unit electricity exported	-210.4999	0.4595	-96.7185	
Total			-528.1571	(283)
Total Primary energy kWh/year			3958.1053	(286)
Target Primary Energy Rate (TPER)			78.3200	(287)

Full SAP Calculation Printout

Property Reference	E2 00 04 (GF Flat)_BeGreen	Issued on Date	30/08/2023
Assessment Reference	E2 00 04 (GF Flat)_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	88 B	DER	0.78	TER	15.09
Environmental	99 A	% DER < TER			94.83
CO_2 Emissions (t/year)	0.04	DFEE	39.13	TFEE	40.59
Compliance Check	See BREL	% DFEE < TFEE			3.60
% DPER < TPER	95.43	DPER	3.69	TPER	80.62

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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	64.9200	(1b)	x 2.8000	(2b) =	181.7760	(1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		181.7760	(5)

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2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493	(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	
Opening Type 1 (Uw = 0.90)			16.1800	0.8687	14.0560			(27)
Door			4.0400	1.0000	4.0400			(26)
Ground Floor			64.9200	0.1000	6.4920			(28a)

External Wall	44.9400	20.2200	24.7200	0.1800	4.4496	(29a)
Wall to Corridor	6.7200		6.7200	0.2000	1.3440	(29a)
Wall to Cycle Store	22.4200		22.4200	0.2000	4.4840	(29a)
Total net area of external elements Aum(A, m2)			139.0000			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.8656	(33)
Party Wall			20.0000	0.0000	0.0000	(32)
Party Ceiling 1			64.9200			(32b)

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

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	7.9400	0.0800	0.6352
E3	Sill	6.9200	0.1000	0.6920
E4	Jamb	11.3000	0.0500	0.5650
E5	Ground floor (normal)	16.0500	0.1200	1.9260
E7	Party floor between dwellings (in blocks of flats)	11.3700	0.0500	0.5685
E18	Party wall between dwellings	8.4000	0.0500	0.4200
P1	Party wall - Ground floor	7.7200	0.0560	0.4323
E5	Ground floor (normal)	2.4000	0.1200	0.2880
E7	Party floor between dwellings (in blocks of flats)	2.4000	0.1200	0.2880
E23	Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.1500	0.7020
E16	Corner (normal)	8.4000	0.1000	0.8400
E17	Corner (inverted – internal area greater than external area)	5.6000	0.0000	0.0000
E5	Ground floor (normal)	8.0100	0.3200	2.5632
P3	Party wall - Intermediate floor between dwellings (in blocks of flats)	7.7200	0.0000	0.0000
P7	Party Wall - Exposed floor (normal)	8.0100	0.1200	0.9612

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.8814 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 45.7470 (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	15.7201	15.5289	15.3377	14.3817	14.1905	13.2344	13.2344	13.0432	13.6168	14.1905	14.5729	14.9553	(38)
Heat transfer coeff	61.4671	61.2759	61.0847	60.1287	59.9375	58.9814	58.9814	58.7902	59.3638	59.9375	60.3199	60.7023	(39)

Average = Sum(39)m / 12 = 60.0809

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9468	0.9439	0.9409	0.9262	0.9233	0.9085	0.9085	0.9056	0.9144	0.9233	0.9291	0.9350	(40)
HLP (average)												0.9255	
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 2.1168 (42)

Hot water usage for mixer showers

67.1752	66.1657	64.6946	61.8800	59.8029	57.4865	56.1699	57.6298	59.2302	61.7172	64.5923	66.9178	(42a)

Hot water usage for baths

25.8010	25.4178	24.8782	23.8833	23.1383	22.3123	21.8661	22.4019	22.9853	23.8692	24.8846	25.7138	(42b)

Hot water usage for other uses

36.3081	34.9878	33.6675	32.3472	31.0269	29.7066	29.7066	31.0269	32.3472	33.6675	34.9878	36.3081	(42c)

Average daily hot water use (litres/day) 118.8622 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.2843	126.5713	123.2403	118.1105	113.9681	109.5054	107.7425	111.0586	114.5626	119.2539	124.4647	128.9397	(44)
Energy conte	204.7547	180.2358	189.4158	161.6874	153.4230	134.6496	130.3053	137.5137	141.2672	161.8265	177.3228	201.8883	(45)

Energy content (annual) Total = Sum(45)m = 1974.2900

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

30.7132	27.0354	28.4124	24.2531	23.0134	20.1974	19.5458	20.6271	21.1901	24.2740	26.5984	30.2833	(46)

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss

32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)

If cylinder contains dedicated solar storage

32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(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

260.0315	230.1632	244.6926	215.1810	208.6998	188.1433	185.5821	192.7905	194.7609	217.1033	230.8165	257.1651	(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

260.0315	230.1632	244.6926	215.1810	208.6998	188.1433	185.5821	192.7905	194.7609	217.1033	230.8165	257.1651	(64)

Total per year (kWh/year) = Sum(64)m = 2625.1298 (64)

12Total per year (kWh/year) 2625 (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

112.3024	99.8704	107.2022	96.5560	95.2346	87.5659	87.5479	89.9448	89.7663	98.0287	101.7548	111.3493	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	93.3937	103.4002	93.3937	96.5069	93.3937	96.5069	93.3937	93.3937	96.5069	93.3937	96.5069	93.3937	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	185.1635	187.0849	182.2430	171.9352	158.9234	146.6941	138.5242	136.6028	141.4447	151.7525	164.7643	176.9936	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	(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)													
	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	(71)
Water heating gains (Table 5)													
	150.9440	148.6166	144.0890	134.1055	128.0035	121.6194	117.6720	120.8935	124.6754	131.7591	141.3261	149.6631	(72)
Total internal gains													
	484.2532	493.8536	474.4776	457.2995	435.0724	419.5722	404.3418	405.6419	417.3788	431.6572	457.3492	474.8023	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	6.0300	46.7521	0.4000	0.8000	0.7700	62.5175	(78)
West	10.1500	19.6403	0.4000	0.8000	0.7700	44.2076	(80)

Solar gains	106.7250	188.8669	272.8427	355.1168	408.1634	408.4096	392.5212	353.3688	301.8822	213.0496	129.2261	90.3750	(83)
Total gains	590.9782	682.7205	747.3203	812.4162	843.2358	827.9818	796.8630	759.0106	719.2610	644.7068	586.5753	565.1773	(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	73.3455	73.5743	73.8046	74.9781	75.2173	76.4365	76.4365	76.6851	75.9441	75.2173	74.7404	74.2696	
alpha	5.8897	5.9050	5.9203	5.9985	6.0145	6.0958	6.0958	6.1123	6.0629	6.0145	5.9827	5.9513	
util living area													
	0.9832	0.9620	0.9174	0.8058	0.6414	0.4538	0.3254	0.3559	0.5613	0.8426	0.9614	0.9865	(86)
MIT	20.2362	20.4342	20.6564	20.8745	20.9714	20.9970	20.9997	20.9995	20.9898	20.8620	20.5277	20.2056	(87)
Th 2	20.1279	20.1304	20.1329	20.1453	20.1478	20.1603	20.1603	20.1628	20.1553	20.1478	20.1428	20.1378	(88)
util rest of house													
	0.9785	0.9521	0.8975	0.7681	0.5890	0.3952	0.2635	0.2913	0.4960	0.8017	0.9496	0.9826	(89)
MIT 2	19.2596	19.5068	19.7759	20.0301	20.1264	20.1587	20.1602	20.1626	20.1493	20.0253	19.6356	19.2291	(90)
Living area fraction										fLA = Living area / (4) =		0.3880	(91)
MIT	19.6385	19.8667	20.1175	20.3578	20.4543	20.4840	20.4859	20.4873	20.4754	20.3500	19.9818	19.6080	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6385	19.8667	20.1175	20.3578	20.4543	20.4840	20.4859	20.4873	20.4754	20.3500	19.9818	19.6080	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9752	0.9486	0.8971	0.7780	0.6082	0.4179	0.2875	0.3164	0.5211	0.8121	0.9470	0.9796	(94)
Useful gains	576.3067	647.6026	670.4127	632.0425	512.8565	346.0384	229.1142	240.1477	374.7739	523.5701	555.4717	553.6711	(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													
	942.8149	917.0952	831.8234	688.9413	524.7092	347.0462	229.1962	240.2931	378.4690	584.3878	777.0263	935.2993	(97)
Space heating kWh													
	272.6821	181.0990	120.0896	40.9671	8.8184	0.0000	0.0000	0.0000	0.0000	45.2484	159.5193	283.9314	(98a)
Space heating requirement - total per year (kWh/year)												1112.3553	
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													
	272.6821	181.0990	120.0896	40.9671	8.8184	0.0000	0.0000	0.0000	0.0000	45.2484	159.5193	283.9314	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1112.3553	
Space heating per m2											(98c) / (4) =	17.1342	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.5000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

Space heating:
Space heating requirement
272.6821 181.0990 120.0896 40.9671 8.8184 0.0000 0.0000 0.0000 0.0000 45.2484 159.5193 283.9314 (98)
Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50
307a 409.0232 271.6485 180.1344 61.4507 13.2276 0.0000 0.0000 0.0000 0.0000 67.8726 239.2790 425.8971
Space heating requirement
409.0232 271.6485 180.1344 61.4507 13.2276 0.0000 0.0000 0.0000 0.0000 67.8726 239.2790 425.8971 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0.0000 (308)
Space heating fuel for secondary/supplementary system
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (309)

Water heating
Annual water heating requirement
260.0315 230.1632 244.6926 215.1810 208.6998 188.1433 185.5821 192.7905 194.7609 217.1033 230.8165 257.1651 (64)
Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50
310a 390.0472 345.2448 367.0389 322.7716 313.0497 282.2150 278.3731 289.1858 292.1413 325.6549 346.2247 385.7477
Water heating fuel
390.0472 345.2448 367.0389 322.7716 313.0497 282.2150 278.3731 289.1858 292.1413 325.6549 346.2247 385.7477 (310)
Cooling System Energy Efficiency Ratio 0.0000 (314)
Space coolin 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (315)
Pumps and Fa 14.3617 12.9718 14.3617 13.8984 14.3617 13.8984 14.3617 14.3617 13.8984 14.3617 13.8984 14.3617 (331)
Lighting 21.2352 17.0357 15.3387 11.2378 8.6804 7.0920 7.9186 10.2929 13.3694 17.5414 19.8129 21.8254 (332)
Electricity generated by PVs (Appendix M) (negative quantity)
(333a)m -15.1672 -22.8388 -35.1110 -42.3157 -48.1436 -45.9029 -45.3459 -41.5334 -35.2533 -27.3166 -17.1836 -12.9467 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)
(333b)m -4.8674 -10.5931 -21.8275 -33.9932 -46.1296 -46.7826 -46.1147 -38.3762 -27.3320 -15.4217 -6.5803 -3.8189 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(335b)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 (335b)
Annual totals kWh/year
Space heating fuel - community heating 1668.5330 (307)
Space heating fuel - secondary 0.0000 (309)
Water heating fuel - community heating 3937.6947 (310)
Efficiency of water heater 0.0000 (311)
Electricity used for heat distribution 16.6853 (313)
Space cooling fuel 0.0000 (321)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7625)
mechanical ventilation fans (SFP = 0.7625) 169.0971 (330a)
Total electricity for the above, kWh/year 169.0971 (331)
Electricity for lighting (calculated in Appendix L) 171.3805 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -690.8958 (333)
Wind generation 0.0000 (334)
Hydro-electric generation (Appendix N) 0.0000 (335a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (335)
Appendix Q - special features
Energy saved or generated -0.0000 (336)
Energy used 0.0000 (337)
Total delivered energy for all uses 5255.8095 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	5606.2277	0.0150	25.0280	(367)
Electrical energy for heat distribution (space & water)	16.6853	0.0000	8.1771	(372)
Overall CO2 factor for heat network			0.0165	(386)
Total CO2 associated with community systems			92.2705	(373)
Space and water heating			92.2705	(376)
Pumps, fans and electric keep-hot	169.0971	0.1387	23.4559	(378)
Energy for lighting	171.3805	0.1443	24.7355	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-389.0588	0.1332	-51.8190	
PV Unit electricity exported	-301.8370	0.1249	-37.7078	
Total			-89.5268	(380)
Total CO2, kg/year			50.9350	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			0.7800	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	5606.2277	0.0630	105.1176	(467)
Electrical energy for heat distribution (space & water)	16.6853	0.0000	86.3089	(472)
Overall CO2 factor for heat network			0.0784	(486)
Total CO2 associated with community systems			439.5013	(473)
Space and water heating			439.5013	(476)
Pumps, fans and electric keep-hot	169.0971	1.5128	255.8101	(478)

Energy for lighting	171.3805	1.5338	262.8691 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-389.0588	1.4922	-580.5420
PV Unit electricity exported	-301.8370	0.4585	-138.3993
Total			-718.9413 (480)
Total Primary energy kWh/year			239.2392 (483)
Dwelling Primary energy Rate (DPER)			3.6900 (484)

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	64.9200 (1b)	x	2.8000 (2b)	=	181.7760 (1b)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 64.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.7760	(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	2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1100	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3600	(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) =	0.3060	(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	0.3902	0.3825	0.3749	0.3366	0.3290	0.2907	0.2907	0.2831	0.3060	0.3290	0.3443	0.3596	(22b)
Effective ac	0.5761	0.5732	0.5703	0.5567	0.5541	0.5423	0.5423	0.5401	0.5468	0.5541	0.5593	0.5646	(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			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			12.2000	1.1450	13.9695			(27)
Ground Floor			64.9200	0.1300	8.4396			(28a)
External Wall	44.9400	16.2400	28.7000	0.1800	5.1660			(29a)
Wall to Corridor	6.7200		6.7200	0.1800	1.2096			(29a)
Wall to Cycle Store	22.4200		22.4200	0.1800	4.0356			(29a)
Total net area of external elements Aum(A, m2)			139.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		36.8603			(33)
Party Wall			20.0000	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)	7.9400	0.0500	0.3970
E3 Sill	6.9200	0.0500	0.3460
E4 Jamb	11.3000	0.0500	0.5650
E5 Ground floor (normal)	16.0500	0.1600	2.5680
E7 Party floor between dwellings (in blocks of flats)	11.3700	0.0700	0.7959

E18 Party wall between dwellings	8.4000	0.0600	0.5040	
P1 Party wall - Ground floor	7.7200	0.0800	0.6176	
E5 Ground floor (normal)	2.4000	0.1600	0.3840	
E7 Party floor between dwellings (in blocks of flats)	2.4000	0.0700	0.1680	
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.0200	0.0936	
E16 Corner (normal)	8.4000	0.0900	0.7560	
E17 Corner (inverted – internal area greater than external area)	5.6000	-0.0900	-0.5040	
E5 Ground floor (normal)	8.0100	0.1600	1.2816	
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	7.7200	0.0000	0.0000	
P7 Party Wall - Exposed floor (normal)	8.0100	0.1600	1.2816	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.2543 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 46.1146 (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	34.5591	34.3818	34.2080	33.3917	33.2390	32.5280	32.5280	32.3963	32.8019	33.2390	33.5480	33.8710	(38)
Heat transfer coeff	80.6737	80.4964	80.3226	79.5063	79.3536	78.6426	78.6426	78.5109	78.9164	79.3536	79.6625	79.9855	(39)

Average = Sum(39)m / 12 = 79.5056

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2427	1.2399	1.2373	1.2247	1.2223	1.2114	1.2114	1.2093	1.2156	1.2223	1.2271	1.2321	(40)
HLP (average)												1.2247	
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 2.1168 (42)

Hot water usage for mixer showers

59.7113	58.8139	57.5063	55.0044	53.1581	51.0991	49.9288	51.2265	52.6490	54.8598	57.4154	59.4825	(42a)

Hot water usage for baths

25.8010	25.4178	24.8782	23.8833	23.1383	22.3123	21.8661	22.4019	22.9853	23.8692	24.8846	25.7138	(42b)

Hot water usage for other uses

36.3081	34.9878	33.6675	32.3472	31.0269	29.7066	29.7066	31.0269	32.3472	33.6675	34.9878	36.3081	(42c)

Average daily hot water use (litres/day) 111.9807 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	121.8203	119.2195	116.0520	111.2349	107.3233	103.1180	101.5014	104.6553	107.9815	112.3965	117.2878	121.5043	(44)
Energy conte	192.9337	169.7670	178.3676	152.2751	144.4778	126.7956	122.7572	129.5851	133.1520	152.5209	167.0980	190.2464	(45)

Energy content (annual) Total = Sum(45)m = 1859.9765

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

28.9400	25.4651	26.7551	22.8413	21.6717	19.0193	18.4136	19.4378	19.9728	22.8781	25.0647	28.5370	(46)

Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7527 (55)

Total storage loss

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

If cylinder contains dedicated solar storage

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

239.5286	211.8527	224.9625	197.3669	191.0728	171.8874	169.3521	176.1800	178.2438	199.1159	212.1898	236.8413	(62)
WWHRS -27.2975	-24.1421	-25.2802	-20.9330	-19.5088	-16.6939	-15.6478	-16.6399	-17.2721	-20.3619	-23.0676	-26.7920	(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

212.2311	187.7106	199.6823	176.4339	171.5639	155.1936	153.7043	159.5401	160.9717	178.7539	189.1222	210.0494	(64)

Total per year (kWh/year) = Sum(64)m = 2154.9570 (64)

12Total per year (kWh/year) 2155 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

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

Heat gains from water heating, kWh/month

101.4264	90.1161	96.5832	86.7049	85.3148	78.2330	78.0927	80.3630	80.3465	87.9891	91.6335	100.5329	(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	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	105.8396	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	94.7737	104.9280	94.7737	97.9328	94.7737	97.9328	94.7737	94.7737	97.9328	94.7737	97.9328	94.7737	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	185.1635	187.0849	182.2430	171.9352	158.9234	146.6941	138.5242	136.6028	141.4447	151.7525	164.7643	176.9936	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	33.5840	(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)	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	-84.6717	(71)
Water heating gains (Table 5)	136.3258	134.1014	129.8161	120.4235	114.6704	108.6570	104.9633	108.0147	111.5924	118.2650	127.2688	135.1248	(72)

Total internal gains

	474.0148	483.8662	464.5847	448.0434	426.1193	408.0357	393.0130	394.1430	405.7217	422.5430	447.7178	464.6440 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
South	4.5500	46.7521	0.6300	0.7000	0.7700	65.0106 (78)
West	7.6500	19.6403	0.6300	0.7000	0.7700	45.9177 (80)

Solar gains	110.9283	196.2954	283.5534	369.0305	424.1366	424.3855	407.8784	367.2063	313.7232	221.4233	134.3137	93.9356 (83)
Total gains	584.9431	680.1616	748.1380	817.0739	850.2560	832.4212	800.8914	761.3494	719.4449	643.9663	582.0316	558.5796 (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	55.8836	56.0066	56.1278	56.7041	56.8132	57.3269	57.3269	57.4230	57.1279	56.8132	56.5929	56.3644	
alpha	4.7256	4.7338	4.7419	4.7803	4.7875	4.8218	4.8218	4.8282	4.8085	4.7875	4.7729	4.7576	
util living area	0.9889	0.9770	0.9524	0.8870	0.7640	0.5823	0.4277	0.4675	0.6967	0.9121	0.9774	0.9910	(86)
MIT	19.7516	19.9741	20.2651	20.6135	20.8559	20.9697	20.9943	20.9914	20.9294	20.6122	20.1233	19.7144	(87)
Th 2	19.8860	19.8882	19.8903	19.9003	19.9022	19.9109	19.9109	19.9125	19.9075	19.9022	19.8984	19.8944	(88)
util rest of house	0.9854	0.9699	0.9378	0.8539	0.7020	0.4926	0.3241	0.3605	0.6085	0.8785	0.9692	0.9881	(89)
MIT 2	18.4671	18.7483	19.1104	19.5305	19.7893	19.8949	19.9093	19.9098	19.8646	19.5415	18.9468	18.4260	(90)
Living area fraction										fLA = Living area / (4) =		0.3880	(91)
MIT	18.9656	19.2239	19.5585	19.9507	20.2032	20.3119	20.3303	20.3295	20.2777	19.9570	19.4033	18.9259	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9656	19.2239	19.5585	19.9507	20.2032	20.3119	20.3303	20.3295	20.2777	19.9570	19.4033	18.9259	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9816	0.9646	0.9325	0.8556	0.7202	0.5266	0.3645	0.4021	0.6401	0.8804	0.9645	0.9847	(94)
Useful gains	574.1525	656.0632	697.6758	699.0786	612.3329	438.3400	291.8900	306.1535	460.5149	566.9671	561.3590	550.0225	(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	1183.1245	1153.0253	1048.8891	878.6005	674.7573	449.2023	293.3603	308.5068	487.5260	742.5099	980.1105	1177.8615	(97)
Space heating kWh	453.0752	333.9586	261.3027	129.2558	46.4437	0.0000	0.0000	0.0000	0.0000	130.6038	301.5010	467.1122	(98a)
Space heating requirement - total per year (kWh/year)												2123.2530	
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	453.0752	333.9586	261.3027	129.2558	46.4437	0.0000	0.0000	0.0000	0.0000	130.6038	301.5010	467.1122	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2123.2530	
Space heating per m2										(98c) / (4) =		32.7057	(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	453.0752	333.9586	261.3027	129.2558	46.4437	0.0000	0.0000	0.0000	0.0000	130.6038	301.5010	467.1122	(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)	490.8724	361.8186	283.1015	140.0388	50.3182	0.0000	0.0000	0.0000	0.0000	141.4993	326.6533	506.0804	(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	212.2311	187.7106	199.6823	176.4339	171.5639	155.1936	153.7043	159.5401	160.9717	178.7539	189.1222	210.0494	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.7162	85.3369	84.6639	83.3729	81.5610	79.8000	79.8000	79.8000	79.8000	83.3671	85.1003	85.7984	(217)

Fuel for water heating, kWh/month

	247.5974	219.9643	235.8529	211.6201	210.3503	194.4782	192.6119	199.9249	201.7190	214.4178	222.2345	244.8172 (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	19.6921	15.7977	14.2241	10.4212	8.0496	6.5766	7.3431	9.5449	12.3979	16.2667	18.3732	20.2394 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-14.4302	-21.6645	-33.1394	-39.7339	-45.0493	-42.8675	-42.3521	-38.8832	-33.1632	-25.8402	-16.3283	-12.3270 (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	-4.5809	-9.9002	-20.1780	-31.0552	-41.8051	-42.2729	-41.7698	-35.0188	-25.2205	-14.3930	-6.1906	-3.6028 (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	2300.3825 (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	2595.5885 (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)	158.9265 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-641.7667 (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	4499.1308 (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	2300.3825	0.2100	483.0803	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2595.5885	0.2100	545.0736	(264)
Space and water heating			1028.1539	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	158.9265	0.1443	22.9380	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-365.7789	0.1333	-48.7524	
PV Unit electricity exported	-275.9878	0.1252	-34.5513	
Total			-83.3037	(269)
Total CO2, kg/year			979.7175	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.0900	(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	2300.3825	1.1300	2599.4322	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2595.5885	1.1300	2933.0151	(278)
Space and water heating			5532.4473	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	158.9265	1.5338	243.7667	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-365.7789	1.4925	-545.9323	
PV Unit electricity exported	-275.9878	0.4595	-126.8177	
Total			-672.7500	(283)
Total Primary energy kWh/year			5233.5648	(286)
Target Primary Energy Rate (TPER)			80.6200	(287)

Full SAP Calculation Printout

Property Reference	E6 04 04 (TF Flat)_BeGreen	Issued on Date	30/08/2023
Assessment Reference	E6 04 04 (TF Flat)_Be Lean	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	88 B	DER	0.72	TER	14.49
Environmental	99 A	% DER < TER			95.03
CO_2 Emissions (t/year)	0.04	DFEE	33.79	TFEE	39.74
Compliance Check	See BREL	% DFEE < TFEE			14.97
% DPER < TPER	95.19	DPER	3.72	TPER	77.31

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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		70.6700 (1b)	x	2.8000 (2b)	=	197.8760 (1b)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6700						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.8760	(5)

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2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493	(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	
Opening Type 1 (Uw = 0.90)			13.5100	0.8687	11.7365			(27)
Door			4.0400	1.0000	4.0400			(26)
External Wall	44.9000	17.5500	27.3500	0.1800	4.9230			(29a)

External Wall 2	4.0300	4.0300	0.2000	0.8060	(29a)
External Roof 1	70.6700	70.6700	0.1000	7.0670	(30)
Total net area of external elements Aum(A, m2)		119.6000			(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		28.5725	(33)
Party Wall		40.8700	0.0000	0.0000	(32)
Party Floor 1		70.6700			(32d)

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)	7.9300	0.0800	0.6344
E3 Sill	6.9100	0.1000	0.6910
E4 Jamb	9.5800	0.0500	0.4790
E7 Party floor between dwellings (in blocks of flats)	12.5900	0.0500	0.6295
E18 Party wall between dwellings	14.0000	0.0500	0.7000
E7 Party floor between dwellings (in blocks of flats)	1.5500	0.1000	0.1550
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.1500	0.7020
E16 Corner (normal)	2.8000	0.1000	0.2800
E17 Corner (inverted – internal area greater than external area)	2.8000	0.0000	0.0000
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	15.7200	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	15.7200	0.0500	0.7860
E15 Flat roof with parapet	17.2700	0.3000	5.1810
E14 Flat roof	1.5500	0.1600	0.2480

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.4859 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	39.0584 (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	17.1124	16.9043	16.6962	15.6555	15.4473	14.4066	14.4066	14.1985	14.8229	15.4473	15.8636	16.2799	(38)
Heat transfer coeff	56.1708	55.9627	55.7545	54.7138	54.5057	53.4650	53.4650	53.2569	53.8813	54.5057	54.9220	55.3383	(39)

Average = Sum(39)m / 12 = 54.6618

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7948	0.7919	0.7889	0.7742	0.7713	0.7565	0.7565	0.7536	0.7624	0.7713	0.7772	0.7831	(40)
HLP (average)												0.7735	
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 2.2623 (42)

Hot water usage for mixer showers												
	69.9195	68.8687	67.3376	64.4080	62.2460	59.8350	58.4646	59.9842	61.6499	64.2386	67.2311	69.6516 (42a)
Hot water usage for baths												
	26.8500	26.4513	25.8897	24.8544	24.0791	23.2194	22.7551	23.3127	23.9198	24.8397	25.8964	26.7593 (42b)
Hot water usage for other uses												
	37.7980	36.4235	35.0491	33.6746	32.3001	30.9256	30.9256	32.3001	33.6746	35.0491	36.4235	37.7980 (42c)

Average daily hot water use (litres/day) 123.7195 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	134.5675	131.7436	128.2764	122.9370	118.6252	113.9801	112.1453	115.5970	119.2443	124.1274	129.5510	134.2089	(44)
Energy conte	213.1221	187.6011	197.1560	168.2945	159.6924	140.1518	135.6301	143.1332	147.0402	168.4396	184.5692	210.1387	(45)
Energy content (annual)										Total = Sum(45)m =		2054.9690	
Distribution loss (46)m = 0.15 x (45)m													
	31.9683	28.1402	29.5734	25.2442	23.9539	21.0228	20.3445	21.4700	22.0560	25.2659	27.6854	31.5208	(46)
Water storage loss:													
Store volume												110.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0152	(51)
Volume factor from Table 2a												1.0294	(52)
Temperature factor from Table 2b												0.6000	(53)
Enter (49) or (54) in (55)												1.0327	(55)
Total storage loss													
	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)
If cylinder contains dedicated solar storage													
	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(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													
	268.3989	237.5285	252.4328	221.7882	214.9692	193.6455	190.9069	198.4100	200.5339	223.7165	238.0629	265.4155	(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													
	268.3989	237.5285	252.4328	221.7882	214.9692	193.6455	190.9069	198.4100	200.5339	223.7165	238.0629	265.4155	(64)
										Total per year (kWh/year) = Sum(64)m =		2705.8087	(64)
12Total per year (kWh/year)												2706	(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													
	115.0845	102.3193	109.7758	98.7529	97.3192	89.3954	89.3184	91.8132	91.6858	100.2276	104.1642	114.0926	(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	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	(66)

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

	101.5460	112.4259	101.5460	104.9309	101.5460	104.9309	101.5460	101.5460	104.9309	101.5460	104.9309	101.5460	(67)

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

	198.8557	200.9192	195.7193	184.6492	170.6752	157.5416	148.7676	146.7041	151.9040	162.9741	176.9481	190.0817	(68)

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

	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	(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)

	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	(71)

Water heating gains (Table 5)

	154.6835	152.2609	147.5481	137.1568	130.8053	124.1603	120.0517	123.4049	127.3414	134.7146	144.6725	153.3502	(72)

Total internal gains

	512.0195	522.5402	501.7476	483.6710	459.9607	443.5670	427.2995	428.5892	441.1105	456.1689	483.4857	501.9121	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3500	19.6403	0.4000	0.8000	0.7700	36.3678	(76)
South	5.1600	46.7521	0.4000	0.8000	0.7700	53.4975	(78)

Solar gains	89.8653	158.7583	228.7688	297.0139	340.8582	340.8696	327.6867	295.3398	252.8508	178.9185	108.7592	76.1339	(83)
Total gains	601.8848	681.2985	730.5164	780.6849	800.8189	784.4366	754.9862	723.9289	693.9613	635.0874	592.2449	578.0460	(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	87.3699	87.6948	88.0222	89.6965	90.0390	91.7916	91.7916	92.1504	91.0825	90.0390	89.3566	88.6844	
alpha	6.8247	6.8463	6.8681	6.9798	7.0026	7.1194	7.1194	7.1434	7.0722	7.0026	6.9571	6.9123	
util living area	0.9821	0.9595	0.9126	0.7923	0.6233	0.4355	0.3115	0.3383	0.5327	0.8201	0.9558	0.9855	(86)
MIT	20.4373	20.5987	20.7698	20.9291	20.9873	20.9991	20.9999	20.9999	20.9966	20.9250	20.6788	20.4148	(87)
Th 2	20.2578	20.2604	20.2629	20.2757	20.2783	20.2912	20.2912	20.2937	20.2860	20.2783	20.2732	20.2680	(88)
util rest of house	0.9773	0.9496	0.8933	0.7575	0.5782	0.3876	0.2614	0.2864	0.4789	0.7810	0.9434	0.9816	(89)
MIT 2	19.6166	19.8176	20.0238	20.2109	20.2688	20.2907	20.2911	20.2937	20.2840	20.2125	19.9291	19.5968	(90)
Living area fraction									fLA = Living area / (4) =			0.3835	(91)
MIT	19.9313	20.1172	20.3099	20.4863	20.5443	20.5624	20.5629	20.5645	20.5572	20.4857	20.2166	19.9105	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9313	20.1172	20.3099	20.4863	20.5443	20.5624	20.5629	20.5645	20.5572	20.4857	20.2166	19.9105	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9748	0.9475	0.8946	0.7680	0.5950	0.4060	0.2806	0.3063	0.4995	0.7928	0.9423	0.9792	(94)
Useful gains	586.7082	645.5069	653.5538	599.5460	476.4816	318.4664	211.8605	221.7549	346.6047	503.5173	558.0918	566.0380	(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	878.0238	851.5935	769.9631	633.9313	482.0664	318.7777	211.8784	221.7878	347.9240	538.8278	720.3908	869.3917	(97)
Space heating kWh	216.7388	138.4901	86.6085	24.7574	4.1551	0.0000	0.0000	0.0000	0.0000	26.2710	116.8553	225.6952	(98a)

Space heating requirement - total per year (kWh/year) 839.5714

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													
	216.7388	138.4901	86.6085	24.7574	4.1551	0.0000	0.0000	0.0000	0.0000	26.2710	116.8553	225.6952	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 839.5714

Space heating per m2 (98c) / (4) = 11.8802 (99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (301)

Fraction of space heat from community system 1.0000 (302)

Fraction of heat from community Waste Heat-Space and Water 1.0000 (303a)

Factor for control and charging method (Table 4c(3)) for space heating 1.0000 (305)

Factor for charging method (Table 4c(3)) for water heating 1.0000 (305a)

Distribution loss factor (Table 12c) for community heating system 1.5000 (306)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

Space heating:

Space heating requirement

	216.7388	138.4901	86.6085	24.7574	4.1551	0.0000	0.0000	0.0000	0.0000	26.2710	116.8553	225.6952	(98)

Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50

307a	325.1082	207.7352	129.9127	37.1361	6.2326	0.0000	0.0000	0.0000	0.0000	39.4065	175.2830	338.5428	
Space heating requirement													
	325.1082	207.7352	129.9127	37.1361	6.2326	0.0000	0.0000	0.0000	0.0000	39.4065	175.2830	338.5428	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)
Space heating fuel for secondary/supplementary system													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)

Water heating

Annual water heating requirement

	268.3989	237.5285	252.4328	221.7882	214.9692	193.6455	190.9069	198.4100	200.5339	223.7165	238.0629	265.4155	(64)
Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50													
310a	402.5983	356.2928	378.6493	332.6823	322.4538	290.4683	286.3603	297.6150	300.8008	335.5747	357.0943	398.1232	
Water heating fuel													
	402.5983	356.2928	378.6493	332.6823	322.4538	290.4683	286.3603	297.6150	300.8008	335.5747	357.0943	398.1232	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	15.6337	14.1208	15.6337	15.1294	15.6337	15.1294	15.6337	15.6337	15.1294	15.6337	15.1294	15.6337	(331)
Lighting	23.7895	19.0848	17.1838	12.5896	9.7245	7.9450	8.8711	11.5309	14.9775	19.6513	22.1961	24.4507	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-15.3214	-23.1555	-35.7248	-43.2111	-49.2960	-47.0464	-46.4747	-42.5042	-35.9831	-27.7613	-17.3872	-13.0691	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)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	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)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	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-4.7132	-10.2765	-21.2137	-33.0977	-44.9771	-45.6391	-44.9859	-37.4054	-26.6021	-14.9771	-6.3768	-3.6965	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)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	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)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	(335b)

Annual totals kWh/year

Space heating fuel - community heating	1259.3571	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	4058.7131	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	12.5936	(313)
Space cooling fuel	0.0000	(321)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7625)		
mechanical ventilation fans (SFP = 0.7625)	184.0741	(330a)
Total electricity for the above, kWh/year	184.0741	(331)
Electricity for lighting (calculated in Appendix L)	191.9949	(332)

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

PV generation	-690.8958	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	5003.2435	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	5318.0702	0.0150	18.8904	(367)
Electrical energy for heat distribution (space & water)	12.5936	0.0000	7.7108	(372)
Overall CO2 factor for heat network			0.0164	(386)
Total CO2 associated with community systems			87.4818	(373)
Space and water heating			87.4818	(376)
Pumps, fans and electric keep-hot	184.0741	0.1387	25.5334	(378)
Energy for lighting	191.9949	0.1443	27.7108	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-396.9348	0.1331	-52.8404	
PV Unit electricity exported	-293.9610	0.1249	-36.7088	
Total			-89.5492	(380)
Total CO2, kg/year			51.1768	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			0.7200	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	5318.0702	0.0630	79.3395	(467)
Electrical energy for heat distribution (space & water)	12.5936	0.0000	81.7004	(472)
Overall CO2 factor for heat network			0.0784	(486)
Total CO2 associated with community systems			416.7388	(473)
Space and water heating			416.7388	(476)
Pumps, fans and electric keep-hot	184.0741	1.5128	278.4674	(478)
Energy for lighting	191.9949	1.5338	294.4882	(479)
Energy saving/generation technologies				

PV Unit electricity used in dwelling	-396.9348	1.4919	-592.1904
PV Unit electricity exported	-293.9610	0.4583	-134.7320
Total			-726.9224 (480)
Total Primary energy kWh/year			262.7720 (483)
Dwelling Primary energy Rate (DPER)			3.7200 (484)

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	70.6700 (1b)	x	2.8000 (2b)	=	197.8760 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.8760 (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) =	0.1516 (8)	
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000 (17)	
Infiltration rate		0.4016 (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) =	0.3414 (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	0.4352	0.4267	0.4182	0.3755	0.3670	0.3243	0.3243	0.3158	0.3414	0.3670	0.3840	0.4011	(22b)
Effective ac	0.5947	0.5910	0.5874	0.5705	0.5673	0.5526	0.5526	0.5499	0.5583	0.5673	0.5737	0.5804	(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			4.0400	1.0000	4.0400			(26)
TER Opening Type (Uw = 1.20)			13.5100	1.1450	15.4695			(27)
External Wall	44.9000	17.5500	27.3500	0.1800	4.9230			(29a)
External Wall 2	4.0300		4.0300	0.1800	0.7254			(29a)
External Roof 1	70.6700		70.6700	0.1100	7.7737			(30)
Total net area of external elements Aum(A, m2)			119.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.9316			(33)
Party Wall			40.8700	0.0000	0.0000			(32)

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

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.9300	0.0500	0.3965
E3 Sill	6.9100	0.0500	0.3455
E4 Jamb	9.5800	0.0500	0.4790
E7 Party floor between dwellings (in blocks of flats)	12.5900	0.0700	0.8813
E18 Party wall between dwellings	14.0000	0.0600	0.8400
E7 Party floor between dwellings (in blocks of flats)	1.5500	0.0700	0.1085
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.6800	0.0200	0.0936
E16 Corner (normal)	2.8000	0.0900	0.2520
E17 Corner (inverted – internal area greater than external area)	2.8000	-0.0900	-0.2520

P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	15.7200	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	15.7200	0.1200	1.8864	
E15 Flat roof with parapet	17.2700	0.5600	9.6712	
E14 Flat roof	1.5500	0.0800	0.1240	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.8260 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 47.7576 (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	38.8346	38.5944	38.3590	37.2533	37.0464	36.0833	36.0833	35.9050	36.4543	37.0464	37.4649	37.9024	(38)
Heat transfer coeff	86.5922	86.3520	86.1166	85.0108	84.8040	83.8409	83.8409	83.6625	84.2118	84.8040	85.2225	85.6600	(39)

Average = Sum(39)m / 12 = 85.0098

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2253	1.2219	1.2186	1.2029	1.2000	1.1864	1.1864	1.1838	1.1916	1.2000	1.2059	1.2121	(40)
HLP (average)												1.2029	
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 2.2623 (42)

Hot water usage for mixer showers

62.1507	61.2167	59.8556	57.2515	55.3298	53.1867	51.9685	53.3193	54.7999	57.1010	59.7610	61.9125	(42a)

Hot water usage for baths

26.8500	26.4513	25.8897	24.8544	24.0791	23.2194	22.7551	23.3127	23.9198	24.8397	25.8964	26.7593	(42b)

Hot water usage for other uses

37.7980	36.4235	35.0491	33.6746	32.3001	30.9256	30.9256	32.3001	33.6746	35.0491	36.4235	37.7980	(42c)

Average daily hot water use (litres/day) 116.5569 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	126.7987	124.0915	120.7944	115.7805	111.7090	107.3318	105.6493	108.9321	112.3943	116.9897	122.0809	126.4698	(44)
Energy conte	200.8182	176.7046	185.6565	158.4977	150.3818	131.9769	127.7736	134.8807	138.5935	158.7540	173.9266	198.0212	(45)
Energy content (annual)										Total = Sum(45)m =		1935.9854	
Distribution loss (46)m = 0.15 x (45)m	30.1227	26.5057	27.8485	23.7747	22.5573	19.7965	19.1660	20.2321	20.7890	23.8131	26.0890	29.7032	(46)

Water storage loss:

Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.7527 (55)

Total storage loss

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

If cylinder contains dedicated solar storage

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

247.4131	218.7903	232.2515	203.5896	196.9767	177.0688	174.3685	181.4756	183.6853	205.3489	219.0185	244.6161	(62)
WWHRS -28.4127	-25.1284	-26.3130	-21.7882	-20.3058	-17.3759	-16.2871	-17.3197	-17.9777	-21.1938	-24.0100	-27.8865	(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

219.0004	193.6619	205.9384	181.8013	176.6709	159.6929	158.0815	164.1559	165.7076	184.1551	195.0085	216.7295	(64)

Total per year (kWh/year) = Sum(64)m = 2220.6040 (64)

12Total per year (kWh/year) 2221 (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

104.0480	92.4229	99.0067	88.7740	87.2779	79.9558	79.7607	82.1237	82.1558	90.0616	93.9041	103.1180	(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	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	113.1140	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	101.5460	112.4259	101.5460	104.9309	101.5460	104.9309	101.5460	101.5460	104.9309	101.5460	104.9309	101.5460	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.8557	200.9192	195.7193	184.6492	170.6752	157.5416	148.7676	146.7041	151.9040	162.9741	176.9481	190.0817	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	34.3114	(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)	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	-90.4912	(71)
Water heating gains (Table 5)	139.8494	137.5340	133.0736	123.2972	117.3090	111.0497	107.2052	110.3814	114.1053	121.0506	130.4223	138.5994	(72)
Total internal gains	500.1854	510.8134	490.2730	472.8114	449.4644	430.4564	414.4530	415.5657	427.8744	445.5049	472.2355	490.1613	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.3500	19.6403	0.6300	0.7000	0.7700	50.1194	(76)
South	5.1600	46.7521	0.6300	0.7000	0.7700	73.7263	(78)

Solar gains	123.8457	218.7888	315.2720	409.3222	469.7452	469.7609	451.5933	407.0151	348.4600	246.5720	149.8837	104.9220	(83)
Total gains	624.0310	729.6022	805.5450	882.1337	919.2095	900.2173	866.0462	822.5808	776.3344	692.0769	622.1193	595.0833	(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	56.6753	56.8329	56.9883	57.7296	57.8704	58.5352	58.5352	58.6599	58.2773	57.8704	57.5862	57.2921	
alpha	4.7784	4.7889	4.7992	4.8486	4.8580	4.9023	4.9023	4.9107	4.8852	4.8580	4.8391	4.8195	
util living area	0.9897	0.9778	0.9530	0.8860	0.7602	0.5761	0.4222	0.4618	0.6926	0.9126	0.9785	0.9916	(86)
MIT	19.7603	19.9866	20.2794	20.6288	20.8649	20.9729	20.9951	20.9925	20.9347	20.6236	20.1353	19.7266	(87)
Th 2	19.8998	19.9025	19.9052	19.9177	19.9200	19.9309	19.9309	19.9329	19.9267	19.9200	19.9153	19.9103	(88)
util rest of house	0.9864	0.9710	0.9386	0.8529	0.6988	0.4883	0.3216	0.3578	0.6055	0.8793	0.9706	0.9890	(89)
MIT 2	18.4880	18.7747	19.1395	19.5624	19.8143	19.9166	19.9295	19.9305	19.8870	19.5693	18.9744	18.4529	(90)
Living area fraction										fLA = Living area / (4) =		0.3835	(91)
MIT	18.9759	19.2394	19.5766	19.9713	20.2172	20.3217	20.3381	20.3378	20.2887	19.9736	19.4196	18.9414	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9759	19.2394	19.5766	19.9713	20.2172	20.3217	20.3381	20.3378	20.2887	19.9736	19.4196	18.9414	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9827	0.9658	0.9334	0.8547	0.7168	0.5212	0.3603	0.3978	0.6365	0.8813	0.9660	0.9857	(94)
Useful gains	613.2379	704.6322	751.9218	753.9771	658.8796	469.2154	312.0335	327.2256	494.1249	609.9011	600.9801	586.5994	(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	1270.8178	1238.2348	1126.1129	941.1827	722.2933	479.7100	313.4077	329.4440	521.1648	794.9200	1049.9052	1262.7446	(97)
Space heating kWh	489.2395	358.5810	278.3981	134.7880	47.1798	0.0000	0.0000	0.0000	0.0000	137.6541	323.2261	503.0520	(98a)
Space heating requirement - total per year (kWh/year)												2272.1186	
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	489.2395	358.5810	278.3981	134.7880	47.1798	0.0000	0.0000	0.0000	0.0000	137.6541	323.2261	503.0520	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2272.1186	
Space heating per m2											(98c) / (4) =	32.1511	(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	489.2395	358.5810	278.3981	134.7880	47.1798	0.0000	0.0000	0.0000	0.0000	137.6541	323.2261	503.0520	(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)	530.0536	388.4951	301.6231	146.0325	51.1157	0.0000	0.0000	0.0000	0.0000	149.1377	350.1908	545.0185	(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	219.0004	193.6619	205.9384	181.8013	176.6709	159.6929	158.0815	164.1559	165.7076	184.1551	195.0085	216.7295	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.8075	85.4215	84.7365	83.3987	81.5418	79.8000	79.8000	79.8000	79.8000	83.4164	85.1848	85.8835	(217)
Fuel for water heating, kWh/month	255.2228	226.7133	243.0339	217.9907	216.6628	200.1164	198.0971	205.7091	207.6536	220.7662	228.9240	252.3530	(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	21.0993	16.9266	15.2405	11.1659	8.6248	7.0466	7.8679	10.2269	13.2838	17.4291	19.6861	21.6857	(232)

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

(233a)m	-15.6659	-23.4967	-35.9056	-43.0029	-48.7093	-46.3280	-45.7656	-42.0367	-35.8852	-28.0005	-17.7169	-13.3848 (233a)

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

(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)

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

(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)

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

(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)

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

(233b)m	-5.0290	-10.8637	-22.1341	-34.0561	-45.8379	-46.3534	-45.8070	-38.4110	-27.6695	-15.7962	-6.7965	-3.9559 (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	2461.6670 (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	2673.2430 (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)	170.2831 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-698.6084 (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	4692.5847 (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	2461.6670	0.2100	516.9501	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2673.2430	0.2100	561.3810	(264)
Space and water heating			1078.3311	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	170.2831	0.1443	24.5771	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-395.8982	0.1333	-52.7761	
PV Unit electricity exported	-302.7101	0.1252	-37.8983	
Total			-90.6744	(269)
Total CO2, kg/year			1024.1631	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.4900	(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	2461.6670	1.1300	2781.6837	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2673.2430	1.1300	3020.7645	(278)
Space and water heating			5802.4483	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	170.2831	1.5338	261.1859	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-395.8982	1.4926	-590.9209	
PV Unit electricity exported	-302.7101	0.4595	-139.1025	
Total			-730.0234	(283)
Total Primary energy kWh/year			5463.7115	(286)
Target Primary Energy Rate (TPER)			77.3100	(287)

Full SAP Calculation Printout

Property Reference	Harper End Terrace_BeGreen	Issued on Date	30/08/2023
Assessment Reference	Harper (End Terrace)_Copy	Prop Type Ref	Harper (End Terrace)
Property	Harper ET, Harper (End Terrace)		

SAP Rating	92 A	DER	-0.27	TER	9.78
Environmental	100 A	% DER < TER			102.76
CO_2 Emissions (t/year)	-0.08	DFEE	36.88	TFEE	36.60
Compliance Check	See BREL	% DFEE < TFEE			-0.76
% DPER < TPER	103.06	DPER	-1.56	TPER	51.13

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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		47.8100 (1b)	x	2.5000 (2b)	=	119.5250 (1b)	-
First floor		47.8100 (1c)	x	2.7800 (2c)	=	132.9118 (1c)	-
Second floor		47.8100 (1d)	x	2.7800 (2d)	=	132.9118 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.4300						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	385.3486	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1850	(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	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174	(22b)

Balanced mechanical ventilation with heat recovery		
If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		79.2000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3399	0.3353	0.3306	0.3075	0.3029	0.2797	0.2797	0.2751	0.2890	0.3029	0.3121	0.3214	(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	
Opening Type 1 (Uw = 0.90)			22.3600	0.8687	19.4247			(27)

Door			1.5800	0.9500	1.5010	(26)
Heat Loss Floor 1			47.8100	0.1000	4.7810	(28a)
External Wall	137.3600	23.9400	113.4200	0.2400	27.2208	(29a)
External Roof	47.8100		47.8100	0.1100	5.2591	(30)
Total net area of external elements Aum(A, m2)			232.9800			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.1866	(33)
Party Wall			52.2200	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)	15.7690	0.0800	1.2615
E3 Sill	14.7550	0.0500	0.7378
E4 Jamb	42.9260	0.0500	2.1463
E5 Ground floor (normal)	19.5600	0.1200	2.3472
E6 Intermediate floor within a dwelling	26.0148	0.0200	0.5203
E10 Eaves (insulation at ceiling level)	9.8900	0.0500	0.4945
E12 Gable (insulation at ceiling level)	9.7000	0.0500	0.4850
E16 Corner (normal)	14.0448	0.1000	1.4045
E18 Party wall between dwellings	14.0448	0.0500	0.7022
P1 Party wall - Ground floor	9.8900	0.0560	0.5538
P2 Party wall - Intermediate floor within a dwelling	9.8900	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	9.8900	0.0300	0.2967

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.9498 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 69.1364 (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	43.2202	42.6321	42.0439	39.1032	38.5151	35.5744	35.5744	34.9863	36.7507	38.5151	39.6914	40.8677	(38)
Heat transfer coeff	112.3567	111.7685	111.1804	108.2397	107.6515	104.7109	104.7109	104.1227	105.8871	107.6515	108.8278	110.0041	(39)

Average = Sum(39)m / 12 = 108.0927

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7834	0.7793	0.7752	0.7547	0.7506	0.7300	0.7300	0.7259	0.7382	0.7506	0.7588	0.7670	(40)
HLP (average)												0.7536	
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 2.9233 (42)

Hot water usage for mixer showers	82.3891	81.1510	79.3468	75.8947	73.3472	70.5062	68.8914	70.6819	72.6447	75.6951	79.2213	82.0735 (42a)
Hot water usage for baths	31.6166	31.1470	30.4858	29.2666	28.3537	27.3414	26.7947	27.4513	28.1662	29.2493	30.4936	31.5097 (42b)
Hot water usage for other uses	44.5680	42.9474	41.3267	39.7060	38.0854	36.4647	36.4647	38.0854	39.7060	41.3267	42.9474	44.5680 (42c)

Average daily hot water use (litres/day) 145.7899 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	158.5737	155.2454	151.1592	144.8674	139.7863	134.3124	132.1508	136.2186	140.5170	146.2711	152.6623	158.1512	(44)
Energy conte	251.1420	221.0673	232.3261	198.3162	188.1792	165.1527	159.8249	168.6671	173.2715	198.4885	217.4954	247.6265	(45)

Energy content (annual) Total = Sum(45)m = 2421.5573

Distribution loss (46)m = 0.15 x (45)m	37.6713	33.1601	34.8489	29.7474	28.2269	24.7729	23.9737	25.3001	25.9907	29.7733	32.6243	37.1440 (46)

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144 (56)
If cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144 (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	306.4188	270.9948	287.6029	251.8099	243.4560	218.6464	215.1017	223.9439	226.7651	253.7653	270.9891	302.9033 (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	306.4188	270.9948	287.6029	251.8099	243.4560	218.6464	215.1017	223.9439	226.7651	253.7653	270.9891	302.9033 (64)

Total per year (kWh/year) = Sum(64)m = 3072.3971 (64)

12Total per year (kWh/year) 3072 (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	127.7262	113.4468	121.4699	108.7351	106.7910	97.7082	97.3632	100.3032	100.4077	110.2189	115.1122	126.5573 (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	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	(66)

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

	165.7121	183.4669	165.7121	171.2358	165.7121	171.2358	165.7121	165.7121	171.2358	165.7121	171.2358	165.7121	(67)

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

	313.2793	316.5301	308.3381	290.8982	268.8834	248.1926	234.3699	231.1190	239.3111	256.7510	278.7658	299.4566	(68)

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

	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	(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)

	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	(71)

Water heating gains (Table 5)

	171.6749	168.8197	163.2660	151.0209	143.5363	135.7059	130.8645	134.8162	139.4551	148.1437	159.8780	170.1038	(72)

Total internal gains

	717.5165	735.6670	704.1663	680.0051	644.9820	621.9845	597.7967	598.4975	616.8523	637.4570	676.7298	702.1227	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	10.6100	19.6403	0.4000	0.8000	0.7700	46.2111	(76)
West	11.7500	19.6403	0.4000	0.8000	0.7700	51.1762	(80)

Solar gains	97.3873	190.5102	313.7432	457.5757	560.7763	574.0543	546.5231	469.4552	364.8963	226.0564	121.4305	80.0866	(83)
Total gains	814.9038	926.1772	1017.9095	1137.5809	1205.7582	1196.0388	1144.3198	1067.9528	981.7486	863.5134	798.1603	782.2093	(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	88.6500	89.1165	89.5879	92.0219	92.5246	95.1231	95.1231	95.6604	94.0664	92.5246	91.5245	90.5459	
alpha	6.9100	6.9411	6.9725	7.1348	7.1683	7.3415	7.3415	7.3774	7.2711	7.1683	7.1016	7.0364	
util living area	0.9982	0.9951	0.9847	0.9295	0.7827	0.5568	0.4023	0.4478	0.7199	0.9596	0.9949	0.9986	(86)
MIT	20.1488	20.2964	20.5108	20.7968	20.9538	20.9966	20.9997	20.9994	20.9807	20.7655	20.4217	20.1428	(87)
Th 2	20.2678	20.2713	20.2749	20.2928	20.2964	20.3144	20.3144	20.3180	20.3072	20.2964	20.2892	20.2821	(88)
util rest of house	0.9977	0.9936	0.9798	0.9094	0.7372	0.4987	0.3398	0.3818	0.6571	0.9437	0.9931	0.9982	(89)
MIT 2	19.2596	19.4509	19.7251	20.0876	20.2587	20.3124	20.3143	20.3178	20.2945	20.0596	19.6255	19.2632	(90)
Living area fraction										fLA = Living area / (4) =		0.1162	(91)
MIT	19.3628	19.5491	19.8164	20.1699	20.3394	20.3919	20.3939	20.3969	20.3742	20.1416	19.7180	19.3654	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3628	19.5491	19.8164	20.1699	20.3394	20.3919	20.3939	20.3969	20.3742	20.1416	19.7180	19.3654	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9916	0.9759	0.9054	0.7402	0.5054	0.3471	0.3895	0.6634	0.9394	0.9910	0.9974	(94)
Useful gains	812.1876	918.3830	993.3326	1030.0042	892.4681	604.4247	397.1513	415.9284	651.2878	811.1817	790.9823	780.1911	(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	1692.4103	1637.3067	1480.5188	1219.8538	930.0447	606.4752	397.2612	416.1713	664.3608	1027.1657	1373.1907	1668.2511	(97)
Space heating kWh	654.8857	483.1167	362.4665	136.6917	27.9570	0.0000	0.0000	0.0000	0.0000	160.6921	419.1900	660.7167	(98a)
Space heating requirement - total per year (kWh/year)												2905.7164	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	654.8857	483.1167	362.4665	136.6917	27.9570	0.0000	0.0000	0.0000	0.0000	160.6921	419.1900	660.7167	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2905.7164	
Space heating per m2											(98c) / (4) =	20.2588	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.5000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		

	654.8857	483.1167	362.4665	136.6917	27.9570	0.0000	0.0000	0.0000	0.0000	160.6921	419.1900	660.7167	(98)

Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50

307a	982.3286	724.6750	543.6997	205.0376	41.9355	0.0000	0.0000	0.0000	0.0000	241.0381	628.7851	991.0750	
Space heating requirement													
	982.3286	724.6750	543.6997	205.0376	41.9355	0.0000	0.0000	0.0000	0.0000	241.0381	628.7851	991.0750	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)
Space heating fuel for secondary/supplementary system													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)

Water heating

Annual water heating requirement

	306.4188	270.9948	287.6029	251.8099	243.4560	218.6464	215.1017	223.9439	226.7651	253.7653	270.9891	302.9033	(64)
Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50													
310a	459.6282	406.4921	431.4044	377.7148	365.1840	327.9696	322.6525	335.9158	340.1477	380.6480	406.4836	454.3549	
Water heating fuel													
	459.6282	406.4921	431.4044	377.7148	365.1840	327.9696	322.6525	335.9158	340.1477	380.6480	406.4836	454.3549	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	33.9392	30.6547	33.9392	32.8444	33.9392	32.8444	33.9392	33.9392	32.8444	33.9392	32.8444	33.9392	(331)
Lighting	45.3708	36.3981	32.7725	24.0105	18.5464	15.1526	16.9187	21.9915	28.5648	37.4786	42.3319	46.6318	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-36.1385	-56.9588	-92.0110	-113.1340	-127.8581	-121.3426	-119.4892	-109.6314	-91.9346	-69.0959	-41.4183	-30.3009	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)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	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)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	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-14.5387	-35.5808	-85.0180	-149.4127	-216.3368	-224.6682	-218.7703	-173.0766	-111.4369	-54.6530	-20.3072	-10.9943	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)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	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)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	(335b)

Annual totals kWh/year		
Space heating fuel - community heating	4358.5746	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	4608.5957	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	43.5857	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8500)		
mechanical ventilation fans (SFP = 0.8500)	399.6065	(330a)
Total electricity for the above, kWh/year	399.6065	(331)
Electricity for lighting (calculated in Appendix L)	366.1680	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2324.1069	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	7408.8380	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	8967.1703	0.0150	65.3786	(367)
Electrical energy for heat distribution (space & water)	43.5857	0.0000	13.3306	(372)
Overall CO2 factor for heat network			0.0165	(386)
Total CO2 associated with community systems			147.8382	(373)
Space and water heating			147.8382	(376)
Pumps, fans and electric keep-hot	399.6065	0.1387	55.4303	(378)
Energy for lighting	366.1680	0.1443	52.8494	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1009.3134	0.1328	-134.0465	
PV Unit electricity exported	-1314.7935	0.1222	-160.6915	
Total			-294.7380	(380)
Total CO2, kg/year			-38.6201	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-0.2700	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	8967.1703	0.0630	274.5902	(467)
Electrical energy for heat distribution (space & water)	43.5857	0.0000	138.9943	(472)
Overall CO2 factor for heat network			0.0785	(486)
Total CO2 associated with community systems			703.9260	(473)
Space and water heating			703.9260	(476)
Pumps, fans and electric keep-hot	399.6065	1.5128	604.5247	(478)
Energy for lighting	366.1680	1.5338	561.6407	(479)
Energy saving/generation technologies				

PV Unit electricity used in dwelling	-1009.3134	1.4907	-1504.6321
PV Unit electricity exported	-1314.7935	0.4484	-589.6157
Total			-2094.2477 (480)
Total Primary energy kWh/year			-224.1563 (483)
Dwelling Primary energy Rate (DPER)			-1.5600 (484)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8100 (1b)	x	2.5000 (2b)	=	119.5250 (1b)	-
First floor	47.8100 (1c)	x	2.7800 (2c)	=	132.9118 (1c)	-
Second floor	47.8100 (1d)	x	2.7800 (2d)	=	132.9118 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.4300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	385.3486 (5)	

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1038	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3538	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3273	(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	0.4173	0.4091	0.4009	0.3600	0.3518	0.3109	0.3109	0.3027	0.3273	0.3518	0.3682	0.3845	(22b)
Effective ac	0.5871	0.5837	0.5804	0.5648	0.5619	0.5483	0.5483	0.5458	0.5536	0.5619	0.5678	0.5739	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.5800	1.0000	1.5800			(26)
TER Opening Type (Uw = 1.20)			22.3600	1.1450	25.6031			(27)
Heat Loss Floor 1			47.8100	0.1300	6.2153			(28a)
External Wall	137.3600	23.9400	113.4200	0.1800	20.4156			(29a)
External Roof	47.8100		47.8100	0.1100	5.2591			(30)
Total net area of external elements Aum(A, m2)			232.9800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		59.0731			(33)
Party Wall			52.2200	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)	15.7690	0.0500	0.7885
E3 Sill	14.7550	0.0500	0.7378
E4 Jamb	42.9260	0.0500	2.1463
E5 Ground floor (normal)	19.5600	0.1600	3.1296
E6 Intermediate floor within a dwelling	26.0148	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	9.8900	0.0600	0.5934
E12 Gable (insulation at ceiling level)	9.7000	0.0600	0.5820

E16 Corner (normal)	14.0448	0.0900	1.2640	
E18 Party wall between dwellings	14.0448	0.0600	0.8427	
P1 Party wall - Ground floor	9.8900	0.0800	0.7912	
P2 Party wall - Intermediate floor within a dwelling	9.8900	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	9.8900	0.1200	1.1868	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				12.0622 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	71.1353 (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	74.6529	74.2230	73.8017	71.8225	71.4522	69.7285	69.7285	69.4093	70.3924	71.4522	72.2013	72.9845	(38)
Heat transfer coeff	145.7882	145.3583	144.9369	142.9578	142.5875	140.8637	140.8637	140.5445	141.5277	142.5875	143.3366	144.1197	(39)
Average = Sum(39)m / 12 =												142.9560	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0164	1.0134	1.0105	0.9967	0.9941	0.9821	0.9821	0.9799	0.9867	0.9941	0.9993	1.0048	(40)
HLP (average)												0.9967	
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 2.9233 (42)

Hot water usage for mixer showers

73.2348	72.1342	70.5304	67.4620	65.1975	62.6722	61.2368	62.8284	64.5731	67.2845	70.4189	72.9542	(42a)

Hot water usage for baths

31.6166	31.1470	30.4858	29.2666	28.3537	27.3414	26.7947	27.4513	28.1662	29.2493	30.4936	31.5097	(42b)

Hot water usage for other uses

44.5680	42.9474	41.3267	39.7060	38.0854	36.4647	36.4647	38.0854	39.7060	41.3267	42.9474	44.5680	(42c)

Average daily hot water use (litres/day) 137.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.4194	146.2286	142.3429	136.4346	131.6366	126.4783	124.4962	128.3650	132.4453	137.8606	143.8599	149.0319	(44)
Energy conte	236.6437	208.2276	218.7758	186.7722	177.2081	155.5199	150.5673	158.9427	163.3183	187.0755	204.9548	233.3479	(45)
Energy content (annual)										Total = Sum(45)m =		2281.3539	
Distribution loss (46)m = 0.15 x (45)m	35.4966	31.2341	32.8164	28.0158	26.5812	23.3280	22.5851	23.8414	24.4977	28.0613	30.7432	35.0022	(46)

Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7527 (55)

Total storage loss

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

If cylinder contains dedicated solar storage

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

283.2387	250.3133	265.3707	231.8640	223.8030	200.6117	197.1622	205.5376	208.4102	233.6704	250.0467	279.9428	(62)
WWHRS -33.4799	-29.6099	-31.0058	-25.6740	-23.9272	-20.4747	-19.1918	-20.4085	-21.1839	-24.9735	-28.2920	-32.8599	(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

249.7588	220.7034	234.3649	206.1900	199.8758	180.1370	177.9704	185.1291	187.2262	208.6969	221.7547	247.0829	(64)

Total per year (kWh/year) = Sum(64)m = 2518.8902 (64)

12Total per year (kWh/year) 2519 (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

115.9600	102.9042	110.0189	98.1752	96.1976	87.7838	87.3396	90.1244	90.3768	99.4785	104.2209	114.8641	(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	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	146.1674	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	165.7121	183.4669	165.7121	171.2358	165.7121	171.2358	165.7121	165.7121	171.2358	165.7121	171.2358	165.7121	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	313.2793	316.5301	308.3381	290.8982	268.8834	248.1926	234.3699	231.1190	239.3111	256.7510	278.7658	299.4566	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	37.6167	(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)	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	-116.9339	(71)
Water heating gains (Table 5)	155.8602	153.1313	147.8748	136.3545	129.2979	121.9220	117.3919	121.1349	125.5234	133.7077	144.7513	154.3872	(72)
Total internal gains	704.7017	722.9786	691.7752	668.3386	633.7436	608.2006	584.3241	584.8162	602.9205	626.0210	664.6031	689.4061	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	10.6100	19.6403	0.6300	0.7000	0.7700	63.6846 (76)
West	11.7500	19.6403	0.6300	0.7000	0.7700	70.5273 (80)

Solar gains	134.2119	262.5469	432.3773	630.5966	772.8198	791.1186	753.1771	646.9680	502.8727	311.5340	167.3464	110.3693 (83)
Total gains	838.9136	985.5255	1124.1525	1298.9352	1406.5633	1399.3192	1337.5012	1231.7843	1105.7932	937.5550	831.9496	799.7754 (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	68.3212	68.5232	68.7224	69.6738	69.8548	70.7096	70.7096	70.8702	70.3779	69.8548	69.4897	69.1121	
alpha	5.5547	5.5682	5.5815	5.6449	5.6570	5.7140	5.7140	5.7247	5.6919	5.6570	5.6326	5.6075	
util living area	0.9982	0.9953	0.9856	0.9419	0.8236	0.6247	0.4603	0.5185	0.7930	0.9711	0.9957	0.9987	(86)
MIT	19.7765	19.9581	20.2380	20.6107	20.8711	20.9788	20.9968	20.9940	20.9233	20.5597	20.1055	19.7544	(87)
Th 2	20.0697	20.0721	20.0746	20.0861	20.0882	20.0983	20.0983	20.1001	20.0944	20.0882	20.0839	20.0793	(88)
util rest of house	0.9976	0.9937	0.9807	0.9225	0.7733	0.5449	0.3677	0.4204	0.7196	0.9578	0.9940	0.9982	(89)
MIT 2	18.6325	18.8663	19.2234	19.6906	19.9813	20.0864	20.0972	20.0980	20.0424	19.6392	19.0642	18.6114	(90)
Living area fraction									fLA = Living area / (4) =			0.1162	(91)
MIT	18.7654	18.9931	19.3412	19.7974	20.0846	20.1901	20.2017	20.2021	20.1447	19.7461	19.1851	18.7441	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7654	18.9931	19.3412	19.7974	20.0846	20.1901	20.2017	20.2021	20.1447	19.7461	19.1851	18.7441	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9911	0.9754	0.9150	0.7731	0.5533	0.3784	0.4317	0.7241	0.9511	0.9916	0.9972	(94)
Useful gains	835.8886	976.7582	1096.4568	1188.5811	1087.3727	774.2714	506.1139	531.8126	800.7219	891.7154	824.9484	797.5439	(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	2108.8821	2048.5561	1861.1663	1557.8743	1195.5420	787.4365	507.3537	534.3596	855.4913	1304.1188	1732.2433	2096.0986	(97)
Space heating kWh	947.1072	720.2482	568.9439	265.8911	80.4779	0.0000	0.0000	0.0000	0.0000	306.8281	653.2523	966.1248	(98a)
Space heating requirement - total per year (kWh/year)												4508.8734	
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	947.1072	720.2482	568.9439	265.8911	80.4779	0.0000	0.0000	0.0000	0.0000	306.8281	653.2523	966.1248	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4508.8734	
Space heating per m2										(98c) / (4) =		31.4361	(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	947.1072	720.2482	568.9439	265.8911	80.4779	0.0000	0.0000	0.0000	0.0000	306.8281	653.2523	966.1248	(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)	1026.1183	780.3339	616.4072	288.0727	87.1917	0.0000	0.0000	0.0000	0.0000	332.4248	707.7490	1046.7224	(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	249.7588	220.7034	234.3649	206.1900	199.8758	180.1370	177.9704	185.1291	187.2262	208.6969	221.7547	247.0829	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7581	86.5115	85.9712	84.6311	82.1913	79.8000	79.8000	79.8000	79.8000	84.9227	86.3324	86.8061	(217)
Fuel for water heating, kWh/month	287.8793	255.1146	272.6087	243.6338	243.1838	225.7356	223.0206	231.9913	234.6193	245.7492	256.8615	284.6377	(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	34.4317	27.6224	24.8709	18.2215	14.0748	11.4992	12.8395	16.6893	21.6777	28.4423	32.1255	35.3887 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-46.1264	-65.7592	-95.5374	-108.5537	-117.9354	-110.3003	-108.8542	-102.2950	-90.9237	-75.6304	-50.9374	-39.7870 (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	-23.8769	-50.4691	-100.7891	-152.1079	-201.8821	-203.2058	-200.9015	-169.8291	-124.0580	-72.5173	-31.9821	-18.8701 (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	4885.0200 (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	3005.0355 (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)	277.8835 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2363.1290 (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	5890.8099 (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	4885.0200	0.2100	1025.8542	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3005.0355	0.2100	631.0574	(264)
Space and water heating			1656.9116	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	277.8835	0.1443	40.1072	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1012.6400	0.1344	-136.0791	
PV Unit electricity exported	-1350.4890	0.1257	-169.8154	
Total			-305.8945	(269)
Total CO2, kg/year			1403.0536	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.7800	(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	4885.0200	1.1300	5520.0726	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3005.0355	1.1300	3395.6901	(278)
Space and water heating			8915.7626	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	277.8835	1.5338	426.2270	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1012.6400	1.4966	-1515.5539	
PV Unit electricity exported	-1350.4890	0.4616	-623.3283	
Total			-2138.8822	(283)
Total Primary energy kWh/year			7333.2082	(286)
Target Primary Energy Rate (TPER)			51.1300	(287)

Full SAP Calculation Printout

Property Reference	Parkman Mid Terrace_BeGreen	Issued on Date	30/08/2023
Assessment Reference	Parkman (Mid Terrace)	Prop Type Ref	Parkman (Mid Terrace)
Property	Parkman (MT), Parkman (Mid Terrace)		

SAP Rating	93 A	DER	-0.33	TER	9.73
Environmental	100 A	% DER < TER			103.39
CO_2 Emissions (t/year)	-0.06	DFEE	30.15	TFEE	31.12
Compliance Check	See BREL	% DFEE < TFEE			3.13
% DPER < TPER	104.72	DPER	-2.39	TPER	50.71

Assessor Details	Miss Eleanor Ballinger	Assessor ID	M976-0001
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		36.3500 (1b)	x	2.5000 (2b)	=	90.8750 (1b)	-
First floor		36.3500 (1c)	x	2.7800 (2c)	=	101.0530 (1c)	-
Second floor		36.3500 (1d)	x	2.7800 (2d)	=	101.0530 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	292.9810	(5)

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2. Ventilation rate
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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(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) =	0.1700	(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	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998	(22b)

Balanced mechanical ventilation with heat recovery		
If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		79.2000 (23c)

Effective ac	0.3207	0.3165	0.3123	0.2910	0.2867	0.2655	0.2655	0.2612	0.2740	0.2867	0.2953	0.3037	(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	
Opening Type 1 (Uw = 0.90)			22.8200	0.8687	19.8243			(27)

Door			1.7500	0.9500	1.6625	(26)
Ground Floor			36.3500	0.1000	3.6350	(28a)
External Wall	77.3800	24.5700	52.8100	0.2400	12.6744	(29a)
External Roof	36.3500		36.3500	0.1000	3.6350	(30)
Total net area of external elements Aum(A, m2)			150.0800			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.4312	(33)
Party Wall			143.7900	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)	11.3700	0.0800	0.9096
E3 Sill	11.3700	0.1000	1.1370
E4 Jamb	23.2000	0.0500	1.1600
E5 Ground floor (normal)	9.6000	0.1200	1.1520
E6 Intermediate floor within a dwelling	19.2000	0.0500	0.9600
E12 Gable (insulation at ceiling level)	8.1600	0.0500	0.4080
E18 Party wall between dwellings	21.1200	0.0500	1.0560
P1 Party wall - Ground floor	17.8400	0.0560	0.9990
P2 Party wall - Intermediate floor within a dwelling	35.6800	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	17.8400	0.0300	0.5352

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.3168 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	49.7481 (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	31.0113	30.6004	30.1895	28.1350	27.7241	25.6695	25.6695	25.2586	26.4913	27.7241	28.5459	29.3677	(38)
Heat transfer coeff	80.7594	80.3485	79.9376	77.8830	77.4721	75.4176	75.4176	75.0067	76.2394	77.4721	78.2939	79.1157	(39)
Average = Sum(39)m / 12 =												77.7803	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7406	0.7368	0.7330	0.7142	0.7104	0.6916	0.6916	0.6878	0.6991	0.7104	0.7180	0.7255	(40)
HLP (average)												0.7133	
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												2.8090 (42)
Hot water usage for mixer showers	80.2322	79.0265	77.2695	73.9078	71.4270	68.6604	67.0878	68.8315	70.7429	73.7134	77.1473	79.9248 (42a)
Hot water usage for baths	30.7921	30.3348	29.6908	28.5034	27.6143	26.6284	26.0959	26.7354	27.4317	28.4866	29.6984	30.6880 (42b)
Hot water usage for other uses	43.3970	41.8189	40.2408	38.6628	37.0847	35.5066	35.5066	37.0847	38.6628	40.2408	41.8189	43.3970 (42c)
Average daily hot water use (litres/day)												141.9724 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	154.4213	151.1802	147.2011	141.0740	136.1260	130.7954	128.6904	132.6516	136.8374	142.4409	148.6647	154.0098	(44)
Energy conte	244.5656	215.2786	226.2427	193.1233	183.2517	160.8282	155.6399	164.2504	168.7342	193.2909	211.8001	241.1421	(45)
Energy content (annual)										Total = Sum(45)m =		2358.1476	
Distribution loss (46)m = 0.15 x (45)m	36.6848	32.2918	33.9364	28.9685	27.4878	24.1242	23.3460	24.6376	25.3101	28.9936	31.7700	36.1713	(46)
Water storage loss:													
Store volume												110.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0152	(51)
Volume factor from Table 2a												1.0294	(52)
Temperature factor from Table 2b												0.6000	(53)
Enter (49) or (54) in (55)												1.0327	(55)
Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)
If cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(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	299.8424	265.2060	281.5195	246.6169	238.5285	214.3219	210.9167	219.5272	222.2278	248.5677	265.2938	296.4189	(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	299.8424	265.2060	281.5195	246.6169	238.5285	214.3219	210.9167	219.5272	222.2278	248.5677	265.2938	296.4189	(64)
										Total per year (kWh/year) = Sum(64)m =		3008.9874	(64)
12Total per year (kWh/year)												3009	(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	125.5395	111.5221	119.4471	107.0084	105.1526	96.2703	95.9717	98.8347	98.8991	108.4907	113.2185	124.4012	(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	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	136.6850	151.3298	136.6850	141.2411	136.6850	141.2411	136.6850	136.6850	141.2411	136.6850	141.2411	136.6850	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	270.1840	272.9877	265.9225	250.8817	231.8953	214.0508	202.1295	199.3259	206.3910	221.4319	240.4182	258.2628	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	(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)													
	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	(71)
Water heating gains (Table 5)													
	168.7359	165.9555	160.5472	148.6228	141.3342	133.7088	128.9942	132.8423	137.3598	145.8208	157.2479	167.2059	(72)
Total internal gains													
	640.7399	655.4080	628.2897	605.8807	575.0495	554.1357	532.9438	533.9882	550.1270	569.0727	604.0423	627.2887	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6600	10.6334	0.4000	0.8000	0.7700	25.1369	(74)
South	12.1600	46.7521	0.4000	0.8000	0.7700	126.0717	(78)

Solar gains	151.2086	254.5109	344.6381	428.3742	486.3866	487.1857	467.7977	422.9148	372.8885	279.8834	180.4476	129.8929	(83)
Total gains	791.9485	909.9189	972.9279	1034.2548	1061.4361	1041.3215	1000.7414	956.9031	923.0155	848.9560	784.4899	757.1816	(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	93.7714	94.2509	94.7354	97.2345	97.7502	100.4131	100.4131	100.9632	99.3307	97.7502	96.7242	95.7195	
alpha	7.2514	7.2834	7.3157	7.4823	7.5167	7.6942	7.6942	7.7309	7.6220	7.5167	7.4483	7.3813	
util living area													
	0.9912	0.9758	0.9418	0.8372	0.6665	0.4628	0.3315	0.3605	0.5665	0.8582	0.9740	0.9932	(86)
MIT	20.4012	20.5687	20.7417	20.9183	20.9860	20.9993	21.0000	20.9999	20.9966	20.9176	20.6541	20.3851	(87)
Th 2	20.3051	20.3084	20.3117	20.3283	20.3316	20.3483	20.3483	20.3516	20.3416	20.3316	20.3250	20.3184	(88)
util rest of house													
	0.9887	0.9695	0.9276	0.8064	0.6226	0.4160	0.2825	0.3097	0.5139	0.8240	0.9661	0.9912	(89)
MIT 2	19.6106	19.8230	20.0366	20.2515	20.3209	20.3479	20.3483	20.3516	20.3396	20.2571	19.9450	19.6011	(90)
Living area fraction										fLA = Living area / (4) =		0.2135	(91)
MIT	19.7794	19.9822	20.1871	20.3939	20.4629	20.4869	20.4874	20.4900	20.4798	20.3981	20.0964	19.7685	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7794	19.9822	20.1871	20.3939	20.4629	20.4869	20.4874	20.4900	20.4798	20.3981	20.0964	19.7685	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9659	0.9247	0.8096	0.6314	0.4260	0.2929	0.3206	0.5251	0.8277	0.9629	0.9892	(94)
Useful gains	781.1008	878.9041	899.6728	837.3272	670.1830	443.6161	293.1603	306.7443	484.6454	702.6796	755.3664	749.0037	(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													
	1250.1041	1211.8306	1094.1144	895.1789	678.8798	443.9772	293.1767	306.7759	486.3953	759.0805	1017.5364	1231.7105	(97)
Space heating kWh													
	348.9385	223.7266	144.6646	41.6532	6.4705	0.0000	0.0000	0.0000	0.0000	41.9623	188.7624	359.1339	(98a)
Space heating requirement - total per year (kWh/year)												1355.3119	
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													
	348.9385	223.7266	144.6646	41.6532	6.4705	0.0000	0.0000	0.0000	0.0000	41.9623	188.7624	359.1339	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1355.3119	
Space heating per m2											(98c) / (4) =	12.4284	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Waste Heat-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.5000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		

	348.9385	223.7266	144.6646	41.6532	6.4705	0.0000	0.0000	0.0000	0.0000	41.9623	188.7624	359.1339	(98)
Space heat from Waste Heat = (98) x 1.00 x 1.00 x 1.50													
307a	523.4077	335.5900	216.9969	62.4799	9.7057	0.0000	0.0000	0.0000	0.0000	62.9434	283.1436	538.7008	

Space heating requirement

	523.4077	335.5900	216.9969	62.4799	9.7057	0.0000	0.0000	0.0000	0.0000	62.9434	283.1436	538.7008 (307)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0.0000 (308)

Space heating fuel for secondary/supplementary system

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)

Water heating

Annual water heating requirement

	299.8424	265.2060	281.5195	246.6169	238.5285	214.3219	210.9167	219.5272	222.2278	248.5677	265.2938	296.4189 (64)

Water heat from Waste Heat = (64) x 1.00 x 1.00 x 1.50

310a	449.7636	397.8090	422.2792	369.9254	357.7928	321.4829	316.3750	329.2908	333.3418	372.8516	397.9406	444.6284

Water heating fuel

	449.7636	397.8090	422.2792	369.9254	357.7928	321.4829	316.3750	329.2908	333.3418	372.8516	397.9406	444.6284 (310)

Cooling System Energy Efficiency Ratio 0.0000 (314)

Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	25.8040	23.3068	25.8040	24.9716	25.8040	24.9716	25.8040	25.8040	24.9716	25.8040	24.9716	25.8040 (331)
Lighting	30.3152	24.3200	21.8974	16.0430	12.3921	10.1244	11.3045	14.6940	19.0860	25.0419	28.2848	31.1577 (332)

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

(333a)m	-27.6247	-43.9284	-71.7258	-89.2865	-101.9345	-97.1221	-95.5245	-87.0073	-72.1861	-53.5477	-31.7589	-23.1198 (333a)

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

(334a)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 (334a)

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

(335a)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 (335a)

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

(333b)m	-10.3832	-25.4763	-61.0460	-107.6236	-156.2117	-162.3860	-158.1701	-125.0237	-80.3426	-39.2639	-14.5352	-7.8515 (333b)

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

(334b)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 (334b)

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

(335b)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 (335b)

Annual totals kWh/year

Space heating fuel - community heating 2032.9679 (307)
Space heating fuel - secondary 0.0000 (309)
Water heating fuel - community heating 4513.4811 (310)
Efficiency of water heater 0.0000 (311)
Electricity used for heat distribution 20.3297 (313)
Space cooling fuel 0.0000 (321)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8500)
mechanical ventilation fans (SFP = 0.8500) 303.8213 (330a)
Total electricity for the above, kWh/year 303.8213 (331)
Electricity for lighting (calculated in Appendix L) 244.6610 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -1743.0801 (333)
Wind generation 0.0000 (334)
Hydro-electric generation (Appendix N) 0.0000 (335a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (335)
Appendix Q - special features
Energy saved or generated -0.0000 (336)
Energy used 0.0000 (337)
Total delivered energy for all uses 5351.8512 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Waste Heat			100.0000	(367)
Space and Water heating from Waste Heat	6546.4490	0.0150	30.4945	(367)
Electrical energy for heat distribution (space & water)	20.3297	0.0000	9.5776	(372)
Overall CO2 factor for heat network			0.0165	(386)
Total CO2 associated with community systems			107.7744	(373)
Space and water heating			107.7744	(376)
Pumps, fans and electric keep-hot	303.8213	0.1387	42.1438	(378)
Energy for lighting	244.6610	0.1443	35.3121	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-794.7664	0.1326	-105.3848	
PV Unit electricity exported	-948.3137	0.1221	-115.8274	
Total			-221.2122	(380)
Total CO2, kg/year			-35.9819	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-0.3300	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Waste Heat			100.0000	(467a)
Space and Water heating from Waste Heat	6546.4490	0.0630	128.0770	(467)
Electrical energy for heat distribution (space & water)	20.3297	0.0000	100.8923	(472)
Overall CO2 factor for heat network			0.0784	(486)
Total CO2 associated with community systems			513.3186	(473)
Space and water heating			513.3186	(476)
Pumps, fans and electric keep-hot	303.8213	1.5128	459.6209	(478)
Energy for lighting	244.6610	1.5338	375.2692	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-794.7664	1.4900	-1184.1656	
PV Unit electricity exported	-948.3137	0.4482	-424.9936	

Total	-1609.1592 (480)
Total Primary energy kWh/year	-260.9506 (483)
Dwelling Primary energy Rate (DPER)	-2.3900 (484)

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	36.3500 (1b)	x	2.5000 (2b)	=	90.8750 (1b)	-
First floor	36.3500 (1c)	x	2.7800 (2c)	=	101.0530 (1c)	-
Second floor	36.3500 (1d)	x	2.7800 (2d)	=	101.0530 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	292.9810	(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) =	0.1365	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3865	(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) =	0.3285	(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	0.4189	0.4107	0.4025	0.3614	0.3532	0.3121	0.3121	0.3039	0.3285	0.3532	0.3696	0.3860	(22b)
Effective ac	0.5877	0.5843	0.5810	0.5653	0.5624	0.5487	0.5487	0.5462	0.5540	0.5624	0.5683	0.5745	(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			1.7500	1.0000	1.7500			(26)
TER Opening Type (Uw = 1.20)			22.8200	1.1450	26.1298			(27)
Ground Floor			36.3500	0.1300	4.7255			(28a)
External Wall	77.3800	24.5700	52.8100	0.1800	9.5058			(29a)
External Roof	36.3500		36.3500	0.1100	3.9985			(30)
Total net area of external elements Aum(A, m2)			150.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.1096			(33)
Party Wall			143.7900	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)	11.3700	0.0500	0.5685
E3 Sill	11.3700	0.0500	0.5685
E4 Jamb	23.2000	0.0500	1.1600
E5 Ground floor (normal)	9.6000	0.1600	1.5360
E6 Intermediate floor within a dwelling	19.2000	0.0000	0.0000
E12 Gable (insulation at ceiling level)	8.1600	0.0600	0.4896
E18 Party wall between dwellings	21.1200	0.0600	1.2672
P1 Party wall - Ground floor	17.8400	0.0800	1.4272
P2 Party wall - Intermediate floor within a dwelling	35.6800	0.0000	0.0000

P4 Party wall - Roof (insulation at ceiling level) 17.8400 0.1200 2.1408
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.1578 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.2674 (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	56.8247	56.4953	56.1725	54.6559	54.3722	53.0513	53.0513	52.8067	53.5601	54.3722	54.9462	55.5463	(38)
Heat transfer coeff	112.0921	111.7627	111.4398	109.9233	109.6395	108.3187	108.3187	108.0741	108.8275	109.6395	110.2135	110.8136	(39)

Average = Sum(39)m / 12 = 109.9219

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0279	1.0249	1.0219	1.0080	1.0054	0.9933	0.9933	0.9911	0.9980	1.0054	1.0107	1.0162	(40)
HLP (average)												1.0080	
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 2.8090 (42)
Hot water usage for mixer showers
71.3175 70.2458 68.6840 65.6958 63.4906 61.0314 59.6336 61.1836 62.8826 65.5230 68.5754 71.0443 (42a)
Hot water usage for baths
30.7921 30.3348 29.6908 28.5034 27.6143 26.6284 26.0959 26.7354 27.4317 28.4866 29.6984 30.6880 (42b)
Hot water usage for other uses
43.3970 41.8189 40.2408 38.6628 37.0847 35.5066 35.5066 37.0847 38.6628 40.2408 41.8189 43.3970 (42c)
Average daily hot water use (litres/day) 133.7533 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	145.5066	142.3995	138.6156	132.8620	128.1897	123.1665	121.2362	125.0037	128.9770	134.2505	140.0927	145.1293	(44)
Energy conte	230.4469	202.7749	213.0471	181.8815	172.5679	151.4476	146.6246	154.7807	159.0416	182.1766	199.5878	227.2374	(45)

Energy content (annual) Total = Sum(45)m = 2221.6146

Distribution loss (46)m = 0.15 x (45)m
34.5670 30.4162 31.9571 27.2822 25.8852 22.7171 21.9937 23.2171 23.8562 27.3265 29.9382 34.0856 (46)
Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.7527 (55)
Total storage loss
23.3325 21.0745 23.3325 22.5798 23.3325 22.5798 23.3325 23.3325 22.5798 23.3325 22.5798 23.3325 (56)
If cylinder contains dedicated solar storage
23.3325 21.0745 23.3325 22.5798 23.3325 22.5798 23.3325 23.3325 22.5798 23.3325 22.5798 23.3325 (57)

Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month
277.0418 244.8607 259.6420 226.9733 219.1628 196.5394 193.2195 201.3756 204.1334 228.7715 244.6796 273.8323 (62)

WWHRS	-32.6034	-28.8347	-30.1940	-25.0019	-23.3008	-19.9387	-18.6893	-19.8742	-20.6293	-24.3197	-27.5513	-31.9996	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h
244.4384 216.0260 229.4479 201.9714 195.8620 176.6007 174.5302 181.5013 183.5041 204.4518 217.1283 241.8326 (64)
Total per year (kWh/year) = Sum(64)m = 2467.2949 (64)
12Total per year (kWh/year) 2467 (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
113.8995 101.0912 108.1141 96.5491 94.6548 86.4298 86.0286 88.7405 88.9548 97.8497 102.4364 112.8323 (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	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	140.4501	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	136.6850	151.3298	136.6850	141.2411	136.6850	141.2411	136.6850	136.6850	141.2411	136.6850	141.2411	136.6850	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	270.1840	272.9877	265.9225	250.8817	231.8953	214.0508	202.1295	199.3259	206.3910	221.4319	240.4182	258.2628	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	37.0450	(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)	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	-112.3601	(71)
Water heating gains (Table 5)	153.0908	150.4334	145.3146	134.0959	127.2241	120.0414	115.6299	119.2749	123.5483	131.5184	142.2728	151.6564	(72)
Total internal gains	628.0948	642.8859	616.0571	594.3538	563.9394	540.4683	519.5794	520.4207	536.3155	557.7702	592.0672	614.7392	(73)

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6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains

	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W
North	10.6600	10.6334	0.6300	0.7000	0.7700	34.6418 (74)
South	12.1600	46.7521	0.6300	0.7000	0.7700	173.7426 (78)

Solar gains	208.3844	350.7478	474.9544	590.3532	670.3016	671.4028	644.6837	582.8295	513.8870	385.7143	248.6793	179.0087 (83)
Total gains	836.4791	993.6337	1091.0116	1184.7069	1234.2410	1211.8712	1164.2631	1103.2502	1050.2025	943.4845	840.7466	793.7478 (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	67.5598	67.7589	67.9552	68.8927	69.0710	69.9133	69.9133	70.0715	69.5865	69.0710	68.7113	68.3392	
alpha	5.5040	5.5173	5.5303	5.5928	5.6047	5.6609	5.6609	5.6714	5.6391	5.6047	5.5808	5.5559	
util living area	0.9934	0.9827	0.9599	0.8928	0.7574	0.5614	0.4078	0.4479	0.6806	0.9164	0.9838	0.9949	(86)
MIT	19.9534	20.1722	20.4277	20.7252	20.9144	20.9870	20.9982	20.9970	20.9634	20.7217	20.2891	19.9200	(87)
Th 2	20.0602	20.0627	20.0651	20.0767	20.0788	20.0889	20.0889	20.0908	20.0850	20.0788	20.0745	20.0699	(88)
util rest of house	0.9913	0.9776	0.9480	0.8633	0.7019	0.4861	0.3242	0.3608	0.6036	0.8864	0.9781	0.9934	(89)
MIT 2	18.8509	19.1290	19.4485	19.8102	20.0110	20.0819	20.0884	20.0898	20.0624	19.8159	19.2880	18.8156	(90)
Living area fraction										fLA = Living area / (4) =		0.2135	(91)
MIT	19.0863	19.3517	19.6575	20.0055	20.2039	20.2751	20.2826	20.2834	20.2547	20.0093	19.5017	19.0514	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0863	19.3517	19.6575	20.0055	20.2039	20.2751	20.2826	20.2834	20.2547	20.0093	19.5017	19.0514	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9884	0.9725	0.9416	0.8607	0.7099	0.5018	0.3421	0.3794	0.6185	0.8838	0.9734	0.9909	(94)
Useful gains	826.7542	966.2753	1027.3314	1019.7210	876.2111	608.1529	398.2825	418.6143	649.5763	833.8261	818.3444	786.5372	(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	1657.4232	1615.1649	1466.2738	1220.7531	932.3628	614.7195	398.8929	419.6988	669.8045	1031.6310	1366.8384	1645.7340	(97)
Space heating kWh	618.0177	436.0538	326.5731	144.7431	41.7769	0.0000	0.0000	0.0000	0.0000	147.1668	394.9157	639.2424	(98a)
Space heating requirement - total per year (kWh/year)												2748.4896	
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	618.0177	436.0538	326.5731	144.7431	41.7769	0.0000	0.0000	0.0000	0.0000	147.1668	394.9157	639.2424	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2748.4896	
Space heating per m2										(98c) / (4) =		25.2039	(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	618.0177	436.0538	326.5731	144.7431	41.7769	0.0000	0.0000	0.0000	0.0000	147.1668	394.9157	639.2424	(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)	669.5750	472.4309	353.8170	156.8181	45.2621	0.0000	0.0000	0.0000	0.0000	159.4440	427.8610	692.5703	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	244.4384	216.0260	229.4479	201.9714	195.8620	176.6007	174.5302	181.5013	183.5041	204.4518	217.1283	241.8326	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.0494	85.6016	84.8510	83.3256	81.2476	79.8000	79.8000	79.8000	79.8000	83.3350	85.3838	86.1337	(217)
Fuel for water heating, kWh/month	284.0674	252.3619	270.4128	242.3882	241.0679	221.3042	218.7095	227.4452	229.9550	245.3371	254.2970	280.7644	(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	28.4004	22.7839	20.5144	15.0297	11.6094	9.4850	10.5905	13.7659	17.8805	23.4602	26.4982	29.1898	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-36.0354	-51.8912	-76.1574	-87.4667	-95.8547	-89.9786	-88.8220	-83.0689	-73.2133	-60.1115	-39.9830	-31.0248	(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	-17.1882	-36.4773	-73.1099	-110.7146	-147.3030	-148.3804	-146.6855	-123.8273	-90.2375	-52.5254	-23.0609	-13.5722 (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	2977.7785 (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	2968.1107 (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)	229.2078 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1796.6898 (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	4464.4072 (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	2977.7785	0.2100	625.3335	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2968.1107	0.2100	623.3033	(264)
Space and water heating			1248.6367	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	229.2078	0.1443	33.0818	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-813.6075	0.1342	-109.1511	
PV Unit electricity exported	-983.0823	0.1256	-123.5202	
Total			-232.6713	(269)
Total CO2, kg/year			1060.9765	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.7300	(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	2977.7785	1.1300	3364.8897	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2968.1107	1.1300	3353.9651	(278)
Space and water heating			6718.8548	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	229.2078	1.5338	351.5666	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-813.6075	1.4958	-1216.9918	
PV Unit electricity exported	-983.0823	0.4612	-453.3919	
Total			-1670.3837	(283)
Total Primary energy kWh/year			5530.1386	(286)
Target Primary Energy Rate (TPER)			50.7100	(287)