ROYAL ARSENAL RIVERSIDE

THE ROPEYARDS

PLOTS D & K

ENERGY STATEMENT
(INC. OVERHEATING ANALYSIS)

To Support a Reserved Matters Application

MARCH 2024

Berkeley
Designed for life

HODKINSON

Berkeley Homes (East Thames) Ltd

The Ropeyards

Energy Statement

Final v2

Jonathan Lloyd-Davies BSc (Hons), MSc
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Executive Summary

This energy statement has been prepared in support of the Reserved Matters Application (RMA) for The Ropeyards, Royal Arsenal Riverside, in the Royal Borough of Greenwich. It has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development for Berkeley Homes (East Thames) Ltd. The site already benefits from an outline consent (reference 13/0117/O). This energy statement seeks to support the RMA and satisfy the S106 obligation to connect the sitewide heat network.

The RMA proposes to deliver 663 homes and approximately 959 m^2 (GIA) of commercial shell non-residential floorspace. The overriding objective is the formulation of a strategy which effectively balances several elements, including CO_2 emissions, affordability of heat, climate change adaption, and the provision of high-quality buildings.

This report is presented in line with the Greater London Authorities (GLAs) London Plan Energy Hierarchy: Be Lean, Be Clean, Be Green, and Be Seen. The GLA requirements for new developments have set the minimum targets for this application as the energy and carbon obligations set out in the outline consent make reference to outdated standards. The Be Green requirement for a 35% regulated CO_2 emissions reduction beyond the Part L (2021) baseline has been achieved. This builds upon compliance with the respective 10% and 15% Be Lean requirements for residential and non-residential spaces.

The London Plan requires connection to and further development of the site-wide heat network. One of the central commitments in this report was to connect all buildings in The Ropeyards to the existing Royal Arsenal Riverside heat network. To facilitate compliance with the project requirements, the network is decarbonising with the installation of air source heat pumps (ASHPs) outside The Ropeyards application area, as per the local Council and GLA approved strategy. In this way a single site network is retained, but low carbon heating is prioritised.

Proposed Strategy

The strategy presented in this report can be summarised as follows:

> Energy demands are to be reduced substantially through fabric '***Be Lean***' measures in order for the London Plan energy efficiency targets for both residential and commercial uses to be achieved. This locks in CO_2 savings irrespective of the source of the delivered energy;

> A holistic approach which balances further considerations such as daylighting, overheating, air quality and noise to ensure resident comfort; and

> A balanced strategy for the generation and delivery of decentralised heating. The Applicant is committed to the delivery of heat which is both low in CO_2 and reasonably priced. A strategy has

therefore been proposed which both meets the ambition of a single site heating network, but also ensures the heat delivered to The Ropeyards buildings originates from heat pumps.

The summary table, below, outlines the indicative Regulated, Unregulated and Total CO_2 savings over the Part L (2021) baseline at each stage of the hierarchy for The Ropeyards. SAP 10.2 CO_2 emission factors have been used in the calculations.

Summary Table: The Ropeyards			
	Regulated CO_2 (tonnes/yr)	Unregulated CO_2 (tonnes/yr)	Total CO_2 (tonnes/yr)
Residential			
Baseline (TER)	690.2	117.2	807.4
Following *Be Lean* Measures	600.6	117.2	717.8
Following *Be Clean* Measures	160.9	117.2	278.1
Following *Be Green* Measures	161.0	117.2	278.2
% Improvement	**76.7%**		**65.5%**
Non-Residential			
Baseline (TER)	4.0	2.6	6.6
Following *Be Lean* Measures	3.3	2.6	5.9
Following *Be Clean* Measures	3.3	2.6	5.9
Following *Be Green* Measures	2.4	2.6	5.0
% Improvement	**40.0%**		**24.2%**

The Ropeyards will also need to achieve a standard of Zero Carbon through an offsetting contribution for the remaining regulated emissions. Based on the energy strategy in this report, this has been calculated at £465,865.

CONTENTS

1. INTRODUCTION

1.1 This Energy Statement has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development.

1.2 The document sets out the energy strategy on behalf of Berkeley Homes (East Thames) Ltd (the 'Developer') for The Ropeyards in the Royal Arsenal Riverside development, located in the Royal Borough of Greenwich.

1.3 The Ropeyards will provide 663 dwellings and a small proportion of non-residential space. It is currently envisaged that the non-residential spaces will be purposed for residential facilities and commercial usages. The non-residential spaces, envisaged to be approximately 985 m^2 (GIA), are proposed to be delivered as shells for a tenant to fit-out. Relevant assumptions will be used for the commercial space because of an unknown fit-out specification.

1.4 The site already benefits from an outline consent (reference 13/0117/O), with an Energy Statement for Royal Arsenal Riverside outlining the site-wide strategy. The strategy for The Ropeyards RMA has been formulated in line with this approach:

> Implementing energy efficiency measures to reduce energy consumption through improvements to building fabric performance and auxiliary systems; then

> Connection to the site heating network, with ASHPs installed to maximise the proportion of low carbon plant on the network.

1.5 All calculations will be undertaken against a Part L 2021 baseline using SAP 10.2 emission factors.

1.6 The energy strategy provides a route to compliance within the described framework. Any future adaptation, deviations, or alterations because of design developments will be expected to meet the overall objectives set within the framework addressed by this statement.

1.7 This statement has been developed with the knowledge that all buildings in The Ropeyards are expected to be constructed under Part L 2021.

Aims

1.8 The aims of this energy strategy can be summarised as follows:

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

> To be low carbon from the outset, with plans for further decarbonisation;

- To provide consistency with the wider development by connecting into the site heat network;
- To take account of specific site characteristics that link to the energy strategy, for instance acoustics and air quality;
- To supply a resilient supply of reasonably-priced heat to residents; and
- To address the requirements of the outline planning consent and, as a far as practicable at this stage, relevant Building Regulations Part L.

2. DEVELOPMENT OVERVIEW

Site Location

2.1 The Site is located on the western edge of the wider Royal Arsenal Riverside masterplan and is approximately 2.3 ha. The Site currently sits on a temporary park and is bound to the south by the A206, the RAR A & B Blocks to the north (and north east) and RAR Phase 3, the Brass Foundry and The Guard House to the west.

2.2 Beyond the immediate site boundaries, to the north of the site is the River Thames and to the south and south east of the site is Woolwich Town Centre including the main shopping area along Powis Street, General Gordon Square, the Woolwich Arsenal Overground Train Station and the Woolwich DLR Station.

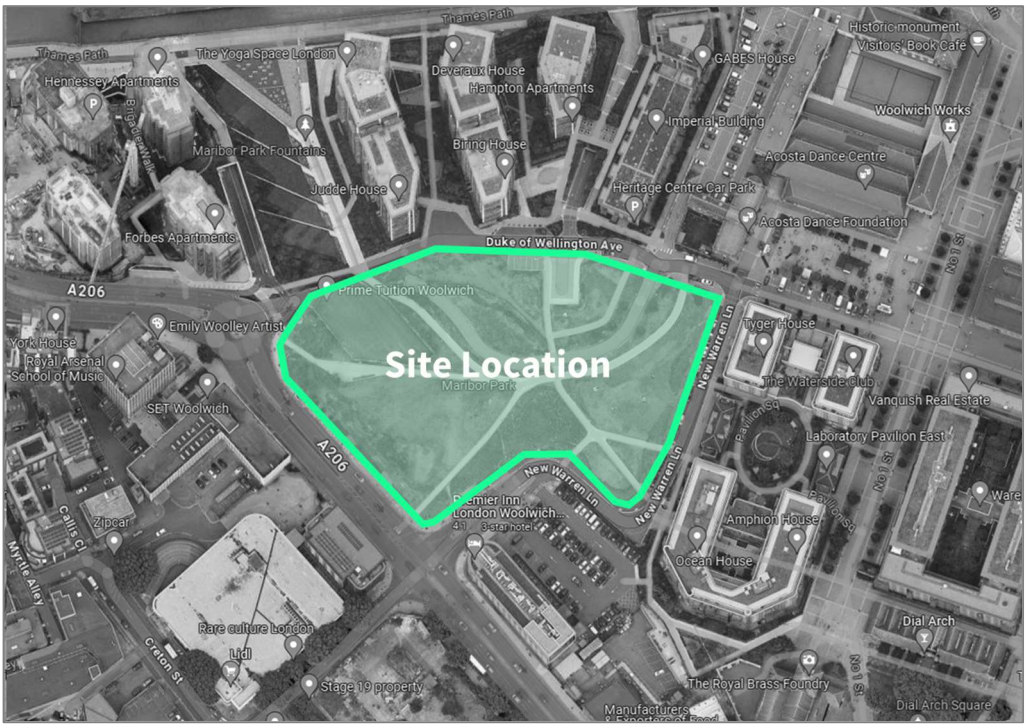

Figure 1: Site Location (Google Maps © February 2024)

Development Description

2.3 The proposed development is described as follows:

'Submission of Reserved Matters (Appearance, Landscaping, Layout and Scale) pursuant to Condition 2 of planning permission reference 16/3025/MA, dated 17.03.2017, for residential units and non-residential floorspace within Plots D and K, along with public / private landscaping details, car / cycle parking, refuse / recycling facilities and play provision.'

2.4 Figure 2 overleaf indicates the proposed ground floor layout.

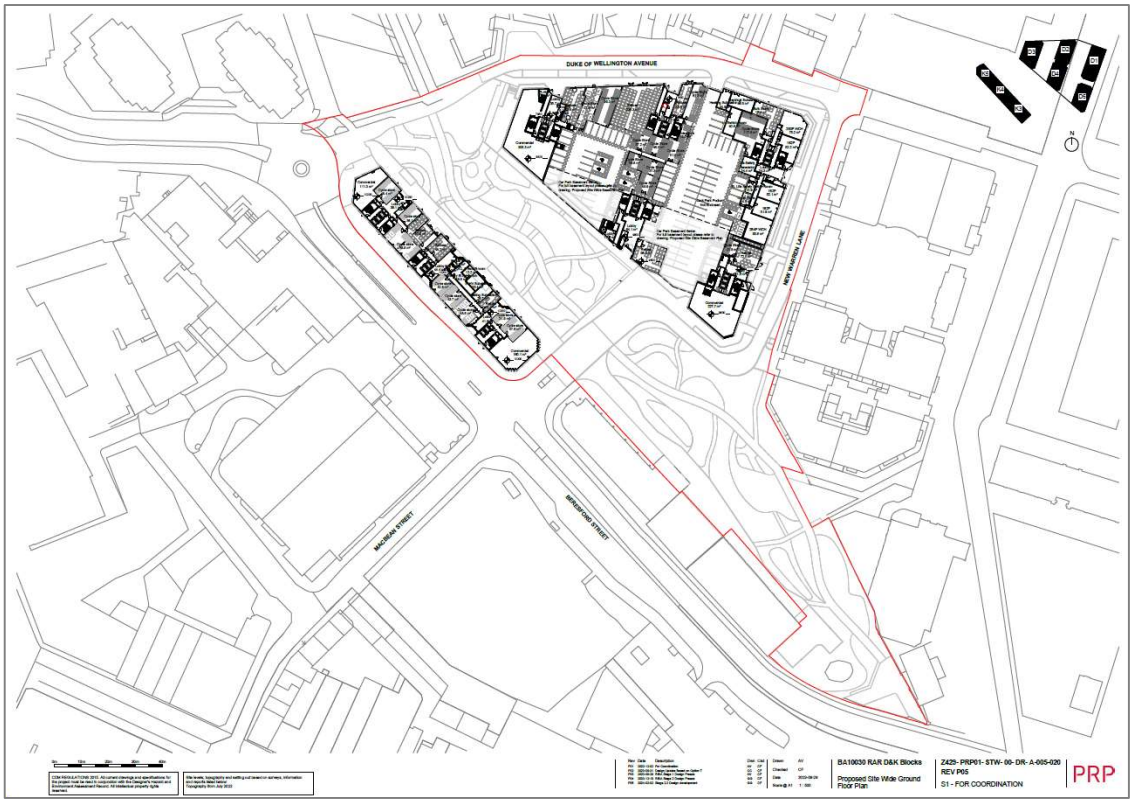

Figure 2: Proposed Ground Floor Layout – PRP Architects (February 2024)

Royal Arsenal Riverside Heat Network

2.5 The wider Royal Arsenal Riverside development has around 3,000 homes currently connected a sitewide heat network powered from a central on-site Energy Centre (located on Arsenal Way). This is operated by SSE under a long term ESCO contract. The Energy Centre is built and operational.

2.6 The existing heat network is supplied via a combination of gas fired CHP and gas boilers. The CHP has been sized to supply 70% of the annual heat demand of the existing site, with the gas boilers supplying the remaining 30%.

Planning History

2.7 The site benefits from an existing outline consent (reference 13/0117/O) for the provision of 3,711 dwellings and circa 26,000 sqm of commercial floorspace.

2.8 Written in the S106 agreement is the obligation for all apartments and non-residential space to connect to the existing heat network.

2.9 An S73 application (reference 16/3025/MA) was also consented in 2017. It sought to vary Condition 1 of the outline consent, which lists the approved drawing numbers, to provide for changes in the approved scheme. It did not alter or introduce new obligations relating to energy or carbon.

2.10 The energy and carbon obligations set out in the outline consent make reference to outdated standards. Therefore, GLA and Part L (2021) requirements for new developments have set the minimum targets for this application.

3. RELEVANT PLANNING POLICY

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

National Planning Policy

3.2 The revised National Planning Policy Framework (NPPF) was published on the 19th December 2023 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 following policies in this issue of the London Plan 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.*

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. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either: 1) through a cash in lieu contribution to the borough's carbon offset fund, or 2) off-site provided that an alternative proposal is identified and delivery is certain.'

Referable applications are also required to undertake a Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

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.

Energy Assessment Guidance

3.9 The Greater London Authority (GLA) Energy Assessment Guidance provides advice on how the energy statement can demonstrate compliance with the London Plan Policy SI2. An updated guidance document was released in the summer of 2022, with this energy statement demonstrating compliance against the enhanced SI2 targets.

3.10 The Energy Assessment Guidance proposes an additional benchmark CO_2 reduction target of 50% for residential units in major developments. Therefore, a strategy that achieves 50% is considered.

Greenwich Local Plan (2014)

3.11 The Royal Borough of Greenwich necessitates that developments reduce carbon emissions "in accordance with the Mayor's energy hierarchy". The adopted Local Plan does not introduce more onerous requirements relating to energy than the London Plan. Therefore, the London Plan and GLA Energy Assessment Guidance set the CO_2 requirements for the development.

Project Requirements

3.12 The Ropeyards will demonstrate how compliance with the following targets can be achieved:

> Energy Efficiency standards to meet a 10% and 15% reduction in Regulated CO_2 emissions beyond the Part L 2021 baseline for residential and non-residential areas respectively;

> An on-site reduction in Regulated CO_2 emissions of 50% and 35% beyond the Part L 2021 baseline for residential and non-residential areas respectively;

> Connection to the existing site-wide heat network;

> A carbon offset payment to cover remaining emissions up to a standard of Zero Carbon.

4. METHODOLOGY AND BASELINE

4.1 This energy statement will demonstrate how the planning policy and development targets have been achieved by applying the energy hierarchy.

Energy hierarchy

4.2 The energy hierarchy will be followed by:

> Considering energy efficiency, Be Lean, measures to help deliver low energy usage and manage overheating risk following the GLA's cooling hierarchy;

> Applying the heating infrastructure hierarchy, Be Clean, to exploit local energy resources;

> Considering renewables, Be Green, energy generation technologies to offset energy use onsite;

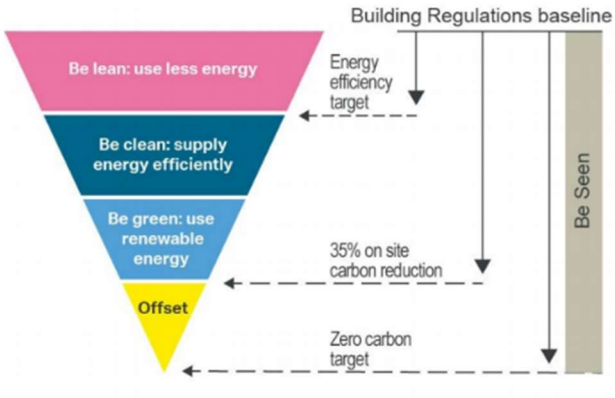

Figure 3: New London Plan Energy Hierarchy (GLA)

> Offsetting any remaining regulated CO_2 emissions to net zero carbon emissions through a cash in lieu contribution or relevant alternative proposal;

> Confirming an ability to measure, monitor and verify energy performance for Be Seen.

4.3 This report first establishes a baseline assessment of the energy demands and associated CO_2 emissions based on Part L (2021) of the Building Regulations.

4.4 This statement utilises the Part L 2021 methodology to determine the energy use, which uses SAP 10.2 CO_2 factors.

Residential

4.5 The estimated annual energy demand for the residential portion of the development has been calculated using Standard Assessment Procedure (SAP 10.2) methodology. SAP calculates the Regulated energy demands associated with hot water, space heating and fixed electrical items. SAP 10.2 uses emission factors which are reflective of the mix of generation technologies contributing to the grid.

4.6 SAP calculations have been carried out for representative home types. These encompass exposed floor, mid floor, top floor and corner flats, at different orientations, and therefore represent a fair aggregation of the unit mix of the site.

4.7 To provide energy demands across the entirety of The Ropeyards, the accommodation schedule has been used to extrapolate the energy performance across the whole development.

4.8 The unregulated energy demands, discussed further in *Be Seen*, for the residential units have been calculated using the Passive House Planning Package (PHPP) Unregulated Energy Calculator. This calculates the CO_2 emissions associated with appliances, plug loads, cooking and other sources not directly related to heating, cooling, or ventilation.

Non-domestic

4.9 The estimated energy demand for the non-residential elements of the development has been calculated using Simplified Building Energy Model (SBEM) software, using the National Calculation Method (NCM 2021 Edition). SBEM calculates the Regulated energy demands associated with hot water, space heating and fixed electrical items, as well as unregulated energy demands. Operational unregulated energy demands associated with non-residential items outside of the commercial space (i.e. electric vehicle charging, external lighting, corridors, and lifts) are accounted for separately. They are presented as the landlord's energy demands at the ***Be Seen*** stage, in line with the London Plan Energy Hierarchy.

4.10 Sample SBEM calculations has been carried out on example units of the expected use types for the proposed development. Sample calculations have been extrapolated to gain energy demand estimates representative of the total area to be provided.

4.11 As discussed earlier the non-residential elements of the development are shells and as such suitable assumptions to achieve planning targets have been applied for the purposes of this statement. The services would not be provided by the developer but designed for, should they be installed by tenants.

Baseline Emissions

4.12 A baseline calculation has been carried out to establish the Regulated CO_2 emissions by which this energy strategy will be compared against. SAP 10.2 calculates the baseline using the Part L (2021) notional specification and SAP 10.2 emission factors. SAP 10.2 outputs the Target Emission Rate (TER) and Dwelling/Building Emission Rate (DER/BER).

4.13 In line with Energy Assessment Guidance (GLA, 2022), the baseline heating strategy has been formulated using a 100% contribution to heat demand from the existing heat network. The network parameters are as follows:

> 70% contribution from a Combined Heat and Power (CHP) Engine – 79% efficiency;

> 30% contribution from Gas Boilers – 80% efficiency;

> 1.5 Distribution loss factor.

4.14 Characteristics associated with the planned heat network will be incorporated at the ***Be Clean*** stage.

4.15 The table below shows the Regulated, Unregulated and Total baseline CO_2 emissions rates for The Ropeyards.

Table 1: TER Baseline Case

Baseline CO_2 emissions (tonnes CO_2 per annum)			
	Regulated	Unregulated	Total
Residential			
Baseline (TER)	690.2	117.2	807.4
Non-Residential			
Baseline (TER)	4.0	2.6	6.6

5. *BE LEAN*: DEMAND REDUCTION

5.1 This section describes how the development has been designed to achieve the ***Be Lean*** requirements of Policy SI2 of the London Plan 2021. The residential and non-residential elements will demonstrate their respective 10% and 15% targets from energy efficiency measures.

5.2 Throughout the design process, the developer has given consideration to building form and massing, and what impacts these have on energy use, daylighting and overheating. The objective of this consideration is to carefully balance these sometimes-opposing objectives.

Residential

Insulation Standards

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

> Glazing with a U-value of 0.90 W/m^2.K ;

> External wall U-value of 0.16 W/m^2.K;

> Party walls will be fully insulated and sealed (achieving an effective U-Value of 0.00 W/m^2.K);

> Exposed and ground floor U-values of 0.11 W/m^2.K; and

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

Air Tightness & Ventilation

5.4 Air tightness standards will conform to, and exceed, Approved Document Part L requirements. By reducing air leakage loss and convective bypass of insulation, an improvement of design air permeability rate from 8 m^3/h.m^2 to 3.0 m^3/h.m^2 or less for all dwellings will further reduce space heating requirements.

5.5 Parts L & F compliant (System 4) Mechanical Ventilation Heat Recovery (MVHR) is expected to be installed in all dwellings. These systems will remove stale air and odours from kitchens and wet rooms, whilst retaining the heat within the home, as shown in the figure overleaf. In this way substantial energy savings will be made.

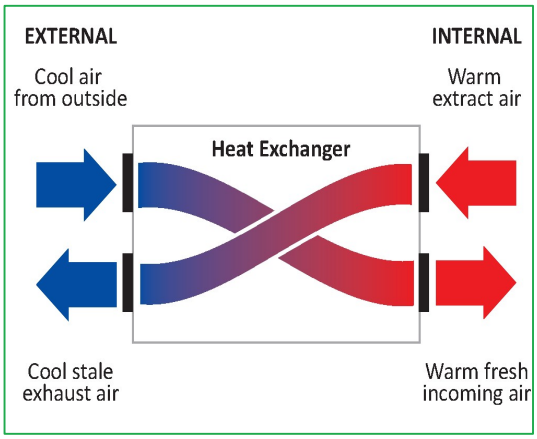

Figure 4: MVHR in operation

5.6 The selected MVHR units are likely to have heat recovery efficiencies of at least 91%, with the Specific Fan Power (SFP) targeted as follows:

> ≤ 0.47 SFP for units with a kitchen and 1 wet rooms; and

> ≤ 0.50 SFP for units with a kitchen and 2 wet rooms.

5.7 Additionally, all homes will have openable windows and therefore the ability to naturally ventilate should the occupant desire.

5.8 Some noise affected units will require comfort cooling to mitigate the residual overheating risk. This can be provided via a bolt-on peak lopping unit that connects to the MVHR system. The exact system will be determined at detailed design stage and will be suitably designed to ensure that thermal comfort levels can be achieved in accordance with CIBSE TM59 criteria. The SAP calculations reflect this consideration.

Thermal Bridging

5.9 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.

5.10 The figure overleaf illustrates the benefits of reducing thermal bridges.

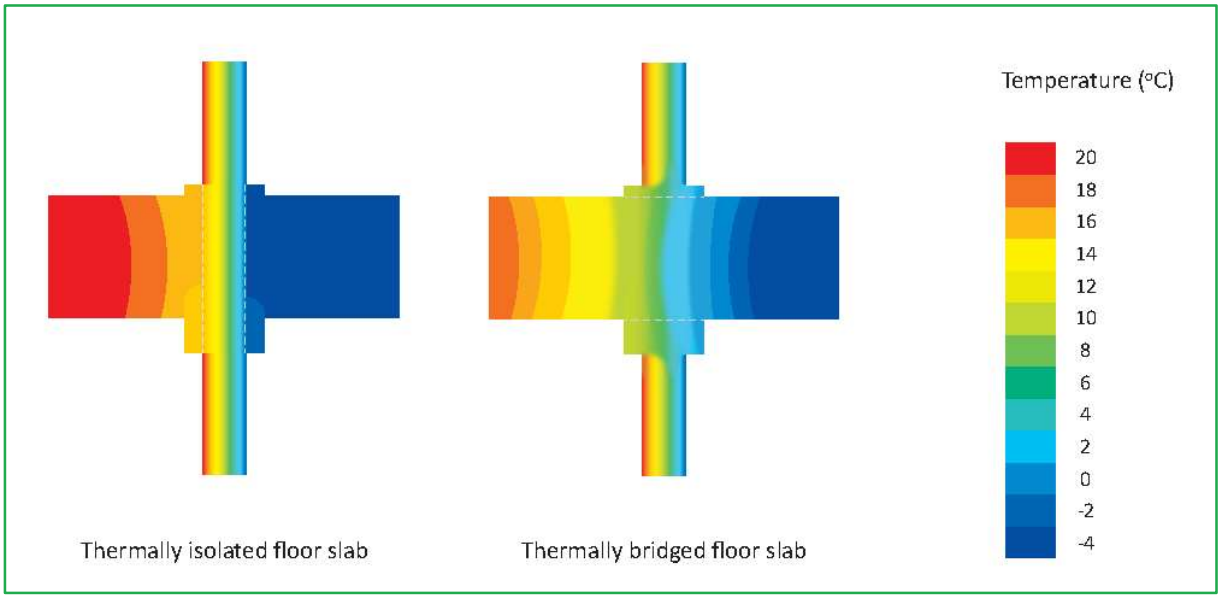

Figure 5: Thermal Bridging

5.11 Detailed modelling of all major junctions will be undertaken at design stage. The results of initial assessments will be used to inform the design process and further modelling will continue to take place until the required performance is met. It should be noted that this bespoke approach to junction design goes significantly beyond the process followed for many other developments, thus achieving a better energy performance.

5.12 It is also considered that a specification which actively seeks to design out poor junction performance demonstrates a more balanced approach than the use of very low U-values which have been specified to mitigate a lack of junction modelling.

5.13 The following psi values have been used in the initial modelling:

> Exposed floor - 0.20 W/m.K;

> Intermediate floor – 0.12 W/m.K;

> Balcony junction to wall – 0.30 W/m.K;

> Flat roof with parapet – 0.30 W/m.K;

> Corner (normal) – 0.16 W/m.K;

> Corner (inverted) – 0.00 W/m.K;

- Party corner – 0.09 W/mK;
- Lintels – 0.05 W/m.K;
- Sills – 0.05 W/m.K;
- Jambs – 0.10 W/m.K.

5.14 The psi value targets are based on what is known to be achievable for developments of this construction type. The selected psi values will facilitate compliance the Fabric Energy Efficiency metric of Part L (2021) and the 10% ***Be Lean*** requirement of the London Plan.

5.15 Further details will be determined during the detailed design stage when bespoke calculations are 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 Heating and hot water will be delivered to each flat via connection to the Royal Arsenal Riverside site heat network. Connections points are anticipated to be provided to most of the non-residential spaces.

5.18 In line with Energy Assessment Guidance (GLA, 2022), the improvement of the ***Be Lean*** case over the baseline has been formulated using a 100% contribution to heat demand from the existing heat network.

5.19 Characteristics associated with the planned heat network will be incorporated at the ***Be Clean*** stage.

Lighting & Appliances

5.20 Energy efficient lighting will be installed in 100% of internal fittings in the homes. A lamp efficacy of 70 lm/W will be targeted.

5.21 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

5.22 Minimising the risk of summer overheating is important to ensure that homes are adapted to climate change and remain comfortable to occupy. An overheating report has also been provided as part of this application (Appendix G), summarising the methods and central aims of the overheating mitigation strategy.

5.23 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.

5.24 Detailed dynamic overheating modelling has been undertaken on The Ropeyards with results and detailed mitigation strategies presented in the accompanying overheating report. As a summary, the strategies are as follows:

> Solar control glazing (low g-value) to reduce uncomfortable solar heat gains across all blocks. A g-value of 0.4 has been used in the calculations as it represents reasonable balance between passive solar gains in winter months and reduced solar filtration in summer months;

> Shading to a significant proportion of the windows from the presence of balconies on the above homes. The balconies will provide solar shading during the summer months when the sun is high in the sky, but allow the beneficial winter solar gains when the sun is lower in the sky;

> MVHR to assist in background ventilation; and

> Openable windows to allow for purging of internal heat.

5.25 It is likely that some of the flats in The Ropeyards will be provided with comfort cooling, however it is reiterated that it is not intended to act as a key overheating mitigation measures. The passive measures identified above will address much of the risk. This ensures compliance with the GLA's cooling hierarchy.

Commercial Areas

5.26 The commercial areas are to be provided as shell for future fit-out. The specification for the space has therefore been assumed as the tenant will be responsible for fit out and how it is used. This impacts all services and consideration of overheating.

Insulation Standards

5.27 Fabric standards for walls and floors are expected to align closely to those of the residential elements. Glazing standards may differ, with a g-value of 0.3 assumed in these calculations.

Ventilation & Air Permeability

5.28 It is expected that MVHR will be utilised to maximise space heating savings. For this report it has been assumed to achieve a Specific Fan Power of ≤1.4 W/l/s and a heat recovery efficiency of 85%.

5.29 Air leakage is to be minimised and an air permeability of 4.0m^3/hr/m^2 will be targeted.

Limiting the Risk of Summer Overheating

5.30 The design limits solar gains in line with Part L requirements as the final space use is unknown.

5.31 Solar control glazing with a g value of 0.30 is to be specified to the commercial spaces to mitigate overheating risk.

Lighting

5.32 One of the major energy demands within commercial spaces is likely to be lighting. Specified lighting throughout these areas is therefore assumed to be LEDs and designed to CIBSE Illuminance levels. Demand reducing lighting controls, occupancy sensors and daylight dimmers will also be specified where appropriate, allowing light output to be automatically adjusted to suit prevailing conditions. Zoning of lighting circuits also allows greater benefit to be made of natural daylight in the areas where it is available, without compromising light levels further away from windows.

5.33 A target LED lamp efficacy of 120 lm/W and a light output ratio of 1 have been assumed in these calculations.

Heating and Cooling

5.34 For the purpose of this stage of the energy statement it has been assumed that commercial areas will be heated with localised heat pumps in line with the GLA Energy Assessment Guidance. This is discussed further in the next sections of this report. The heat pumps have an assumed SEER of 2.64.

5.35 Cooling is proposed for the commercial units provided by a system with a SEER of 6.7 and an EER of 4.1.

CO_2 Emissions at *Be Lean* Stage

5.36 The table below shows the indicative CO_2 emissions if the aforementioned energy efficiency measures were adopted. In these circumstances, the energy efficiency requirements of Policy SI2 are achieved for both residential and non-residential areas.

Table 2: Regulated and Total emissions following *Be Lean* measures

The Ropeyards			
	Regulated CO_2 (tonnes/yr)	Unregulated CO_2 (tonnes/yr)	Total CO_2 (tonnes/yr)
Residential			
Baseline (TER)	690.2	117.2	807.4
Following *Be Lean* Measures	600.6	117.2	717.8
% Improvement	**13.0%**		**11.1%**
Non-Residential			
Baseline (TER)	4.0	2.6	6.6
Following *Be Lean* Measures	3.3	2.6	5.9
% Improvement	**17.5%**		**10.6%**

5.37 Further calculations including Dwelling Emission Rate (DER) worksheets on representative dwelling types can be seen in Appendices A and B. BRUKL worksheets for the non-residential space are provided in Appendix C.

6. *BE CLEAN*: HEATING INFRASTRUCTURE

6.1 In line with Policy SI3 of the New London Plan, the application of heat networks as a ***Be Clean*** measure has been evaluated.

6.2 Returning to the aims of energy strategy as set out in the introduction, the following key points can be extracted in relation to the supply of heat for The Ropeyards:

> To be low carbon from the outset, with a trajectory of further decarbonisation;

> Provision of a resilient supply of low-cost heat to residents; and

> To address the S106 obligation to connect the sitewide heat network.

6.3 The development of the proposed strategy for the generation and delivery of heat has kept these three aims central.

Royal Arsenal Riverside Heat Network

6.4 The wider Royal Arsenal Riverside site already benefits from a heat network, as set out within the original 2013 Outline consent (13/0117/O). In line with the heating hierarchy set out in Policy SI3, The Ropeyards will connect into this wider network which is already connected to circa 3,000 dwellings and over 10,000 m^2 of non-residential area. The main Energy Centre is located at the East of the wider site in close proximity to Building 10.

6.5 The existing heat network is operated by SSE under a long term ESCO agreement.

6.6 An indicative primary pipe route for the site network has been provided in Appendix D.

6.7 A gas CHP-led site heat network was established as the most appropriate ***Be Clean*** measure in the existing Outline consent. At the time, CHP engines had the potential to significantly reduce site CO_2 emissions due to the carbon-intensive nature of electricity generation onto the mains electricity grid.

6.8 Berkeley Homes acknowledged that as CHP engines no longer provide the CO_2 savings relative to the electricity grid that they used to, The Ropeyards would thus best be served predominantly by a heating system which locks in CO_2 reductions for the lifetime of the development. It was determined that the most appropriate means of achieving this would be to install ASHPs. This would deliver approximately 75% of annual heating requirements to all dwellings across the wider site, and 100% of the annual heating requirements of The Ropeyards.

6.9 This approach therefore provides future-proofed low carbon heating to all buildings in The Ropeyards and continues the expansion of the existing Royal Arsenal Riverside heating network.

Network Parameters

6.10 As outlined above, it is currently expected that across a given year 100% of the heat delivered to The Ropeyards will be from ASHPs.

6.11 The Ropeyards is proposed to be separated from the wider network hydraulically (i.e. by a set of heat exchangers). Physical separation of the networks allows for The Ropeyards to consider operating on a different (i.e. lower) set of flow/return temperatures. Lower network temperatures will both reduce heat losses from pipework and ensure the best conditions for maximising heat pump operation are applied, therefore locking in CO_2 reductions. A Heat Loss Factor of 1.50 has been used in the ***Be Clean*** stage calculations, which reflects the design being in line with the Heat Networks Code of Practice (CP1).

6.12 A Seasonal Coefficient of Performance (SCOP) of 2.70 for the heat pumps has been assumed in the Energy Statement calculations, which aligns with manufacturer information for what can realistically be achieved.

6.13 All dwellings in The Ropeyards are to be connected to the site network via heat interface units (HIUs), with connections to the non-residential spaces to be considered on a case-by-case basis.

6.14 The non-residential shell provided by the developer is expected to be connected to the site heat network. The developer will therefore provide a connection point for future tenants. The feasibility of making this connection will be determined by the tenant following building completion. For the purposes of this statement the commercial space is assumed to be served by localised condensing units with a SEER of 4.5.

6.15 It is planned to house the ASHPs in Wellington Park, at the East side of the wider development.

6.16 Details of the decarbonisation of the heat network are set out in Hodkinson's GLA-approved RAR Heat Network Decarbonisation & Expansion Report.

6.17 With the electricity grid projected to continue to decarbonise into the 2020s and 2030s, the heat pumps will ensure the site continues to improve its carbon performance even after occupation.

CO_2 Emissions at *Be Clean* Stage

6.18 The table overleaf shows that the regulated CO_2 emissions achieves the required reductions for both the residential and non-residential elements at the ***Be Clean*** stage.

Table 3: *Be Clean* Emissions

The Ropeyards			
	Regulated CO_2 (tonnes/yr)	Unregulated CO_2 (tonnes/yr)	Total CO_2 (tonnes/yr)
Residential			
Baseline (TER)	690.2	117.2	807.4
Following *Be Lean* Measures	600.6	117.2	717.8
Following *Be Clean* Measures	160.9	117.2	278.1
% Improvement	**76.7%**		**65.6%**
Non-Residential			
Baseline (TER)	4.0	2.6	6.6
Following *Be Lean* Measures	3.3	2.6	5.9
Following *Be Clean* Measures	3.3	2.6	5.9
% Improvement	**17.5%**		**10.6%**

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 further reduction in expected CO_2 emissions.

7.2 Connection to the site heat network have been specified in Section 6 as a ***Be Clean*** measure. Heat pumps have already been provided as the sole heat source for the heat network, therefore the energy strategy has already demonstrated a significant commitment to the inclusion of low carbon technologies.

Solar Thermal Panels

7.3 Solar thermal panels generate heat for hot water. They would therefore conflict with the heat network and would not enable any substantial further reductions in CO_2 emissions.

Wind Turbines

7.4 Small rooftop wind turbines are designed to generate electricity from the wind for use within each dwelling. However, urban rooftop wind turbines do not generally perform sufficiently well to warrant their installation, due to the low and turbulent wind conditions present.

ASHPs

7.5 Individual ASHPs may provide heating and cooling to the non-residential spaces should connection to the site heat network be deemed inappropriate. For the ***Be Green*** non-residential calculations, this has been assumed. The localised heat pumps have an assumed SEER of 4.5 for heating. For cooling, a SEER of 6.7 and an EER of 4.1 is assumed.

Photovoltaic (PV) Panels

7.6 Unlike solar thermal panels, solar PV panels are not constrained by the presence of a site heat network. The Applicant has thus assessed the appropriateness of The Ropeyards roof spaces to determine whether PV panels can be accommodated.

7.7 The roof layouts show a reasonable amount of space is available for photovoltaic panels. A cumulative 2,029m^2 has been measured for the application, which could accommodate approximately 169 kWp of PV panels. This would generate 148,265 kWh/yr of electricity on-site,

reducing CO_2 emissions by 20,164 kg/yr. The CO_2 reductions from this 169 kWp capacity of panels has been used within these ***Be Green*** calculations.

CO_2 Emissions at *Be Green* Stage

7.8 The table below shows the Regulated, Unregulated and Total CO_2 emissions following the aforementioned ***Be Green*** measures.

Table 4: *Be Green* Emissions

Summary Table: The Ropeyards			
	Regulated CO_2 (tonnes/yr)	Unregulated CO_2 (tonnes/yr)	Total CO_2 (tonnes/yr)
Residential			
Baseline (TER)	690.2	117.2	807.4
Following *Be Lean* Measures	600.6	117.2	717.8
Following *Be Clean* Measures	160.9	117.2	278.1
Following *Be Green* Measures	161.0	117.2	278.2
% Improvement	**76.7%**		**65.5%**
Non-Residential			
Baseline (TER)	4.0	2.6	6.6
Following *Be Lean* Measures	3.3	2.6	5.9
Following *Be Clean* Measures	3.3	2.6	5.9
Following *Be Green* Measures	2.4	2.6	5.0
% Improvement	**40.0%**		**24.2%**

8. *BE SEEN*

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.

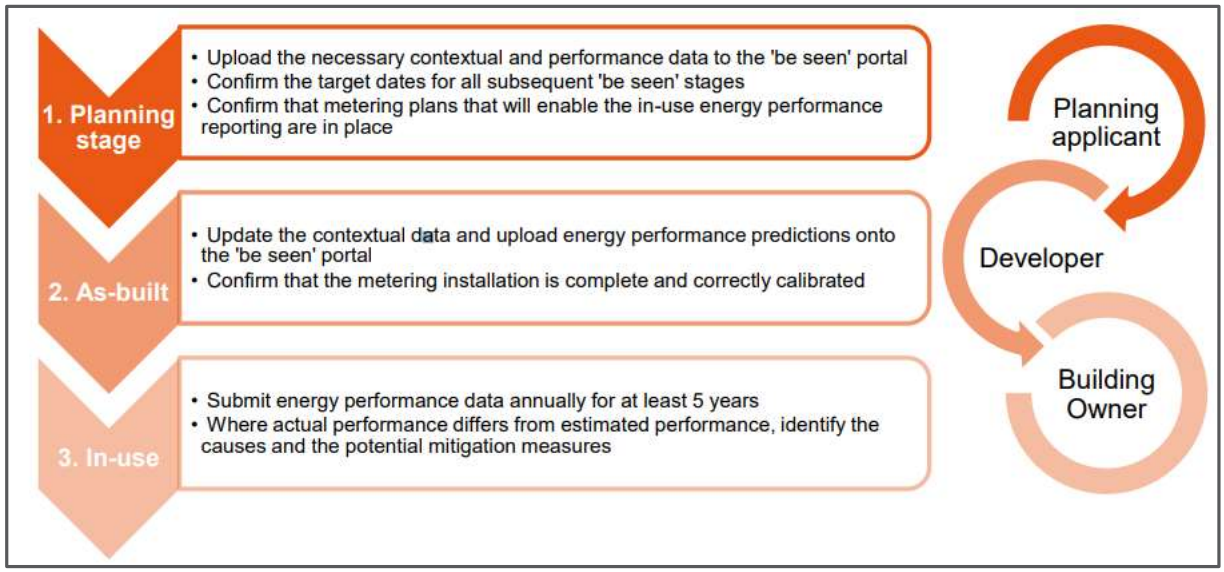

Figure 6: *Be Seen* Stages

8.5 In line with the GLA guidance document (June 2022), the following data points are to be monitored:

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

> Heat consumption from the communal heating network from The Ropeyards dwellings;

- Electricity consumption for non-residential units;
- Electricity consumption for common areas; and
- 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 development is required to be zero carbon, with a minimum 35% reduction in Regulated CO_2 beyond Part L 2021 delivered from on-site measures. Any residual CO_2 emissions are subject to an off-setting contribution, set at £95/tonne for a period of 30 years.

Offsetting Calculation

9.2 Table 5 below shows the calculated carbon offsetting cost to the application, should the aforementioned ***Be Lean***, ***Be Clean***, *and* ***Be Green*** measures be adopted.

Table 5: Carbon Offset Payment

	Residual CO_2 (Tonnes)	**Offset Payment (£95/tonne/30yrs)**
Residential	161.0	458,977
Non-Residential	2.4	6,888
Total	**163.4**	**465,865**

10.SUMMARY

10.1 This energy statement has been prepared in support of the Reserved Matters Application (RMA) for The Ropeyards, Royal Arsenal Riverside, in the Royal Borough of Greenwich. It has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development for Berkeley Homes (East Thames) Ltd. The site already benefits from an outline consent (reference 13/0117/O). This energy statement seeks to support the RMA and satisfy the S106 obligation to connect the sitewide heat network.

10.2 The RMA proposes to deliver 663 homes and approximately 959 m^2 (GIA) of commercial shell non-residential floorspace. The overriding objective is the formulation of a strategy which effectively balances several elements, including CO_2 emissions, affordability of heat, climate change adaption, and the provision of high-quality buildings.

10.3 This report is presented in line with the Greater London Authorities (GLAs) London Plan Energy Hierarchy: Be Lean, Be Clean, Be Green, and Be Seen. The GLA requirements for new developments have set the minimum targets for this application as the energy and carbon obligations set out in the outline consent make reference to outdated standards. The Be Green requirement for a 35% regulated CO_2 emissions reduction beyond the Part L (2021) baseline has been achieved. This builds upon compliance with the respective 10% and 15% Be Lean requirements for residential and non-residential spaces.

10.4 The London Plan requires connection to and further development of the site-wide heat network. One of the central commitments in this report was to connect all buildings in The Ropeyards to the existing Royal Arsenal Riverside heat network. To facilitate compliance with the project requirements, the network is decarbonising with the installation of air source heat pumps (ASHPs) outside The Ropeyards application area, as per the local Council and GLA approved strategy. In this way a single site network is retained, but low carbon heating is prioritised.

Proposed Strategy

10.5 The strategy presented in this report can be summarised as follows:

> Energy demands are to be reduced substantially through fabric '***Be Lean***' measures in order for the London Plan energy efficiency targets for both residential and commercial uses to be achieved. This locks in CO_2 savings irrespective of the source of the delivered energy;

> A holistic approach which balances further considerations such as daylighting, overheating, air quality and noise to ensure resident comfort; and

> A balanced strategy for the generation and delivery of decentralised heating. The Applicant is committed to the delivery of heat which is both low in CO_2 and reasonably priced. A strategy has therefore been proposed which both meets the ambition of a single site heating network, but also ensures the heat delivered to The Ropeyards buildings originates from heat pumps.

10.6 The summary table, below, outlines the indicative Regulated, Unregulated and Total CO_2 savings over the Part L (2021) baseline at each stage of the hierarchy for The Ropeyards. SAP 10.2 CO_2 emission factors have been used in the calculations.

Summary Table: The Ropeyards			
	Regulated CO_2 (tonnes/yr)	Unregulated CO_2 (tonnes/yr)	Total CO_2 (tonnes/yr)
Residential			
Baseline (TER)	690.2	117.2	807.4
Following *Be Lean* Measures	600.6	117.2	717.8
Following *Be Clean* Measures	160.9	117.2	278.1
Following *Be Green* Measures	161.0	117.2	278.2
% Improvement	**76.7%**		**65.5%**
Non-Residential			
Baseline (TER)	4.0	2.6	6.6
Following *Be Lean* Measures	3.3	2.6	5.9
Following *Be Clean* Measures	3.3	2.6	5.9
Following *Be Green* Measures	2.4	2.6	5.0
% Improvement	**40.0%**		**24.2%**

10.7 The Ropeyards will also need to achieve a standard of Zero Carbon through an offsetting contribution for the remaining regulated emissions. Based on the energy strategy in this report, this has been calculated at £465,865.

APPENDICES

Appendix A: DER Worksheets – *Be Lean*

Appendix B: DER Worksheets – *Be Clean/Be Green*

Appendix C: BRUKL Non-Residential Calculations (Be Lean & Be Clean/Be Green)

Appendix D: Indicative primary Pipe Route

Appendix E: Site Roof Plan

Appendix F: GLA Reporting Spreadsheet Results

Appendix G: Overheating Report

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Appendix A

SAP DER/TER Worksheets – *Be Lean*

Full SAP Calculation Printout

Property Reference	D1 Terrace	**Issued on Date**	20/02/2024
Assessment Reference	00001_Copy	**Prop Type Ref**	
Property			

SAP Rating	84 B	**DER**	15.94	**TER**	19.02
Environmental	87 B	**% DER < TER**			16.19
CO_2 Emissions (t/year)	1.08	**DFEE**	32.97	**TFEE**	38.28
Compliance Check	See BREL	**% DFEE < TFEE**			13.86
% DPER < TPER	10.26	**DPER**	76.74	**TPER**	85.51

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	75.1900	(1b)	x 2.5000	(2b) =	187.9750	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	75.1900					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		187.9750	(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) =												81.0000	(23c)
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448	(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)			14.0100	0.8687	12.1708			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
External Wall 1	41.7300	14.0100	27.7200	0.1600	4.4352	150.0000	4158.0000	(29a)
Corridor	12.7500	2.3100	10.4400	0.1600	1.6704	150.0000	1566.0000	(29a)
External Roof 1	31.0100		31.0100	0.1400	4.3414	9.0000	279.0900	(30)
Total net area of external elements Aum(A, m2)			85.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		24.9278			(33)
Party Wall 1			32.7800	0.0000	0.0000	70.0000	2294.6000	(32)
Party Floor 1			75.1900			40.0000	3007.6000	(32d)
Party Ceiling 1			44.1800			30.0000	1325.4000	(32b)
Internal Wall 1			130.0000			9.0000	1170.0000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		13800.6900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							183.5442	(35)
List of Thermal Bridges								

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	13.2100	0.0600	0.7926
E7 Party floor between dwellings (in blocks of flats)	10.2000	0.1100	1.1220
E16 Corner (normal)	5.0000	0.1600	0.8000
E17 Corner (inverted - internal area greater than external area)	2.5000	0.0000	0.0000
E18 Party wall between dwellings	5.0000	0.0450	0.2250
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	3.4800	0.1500	0.5220
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	22.0700	0.0000	0.0000
E25 Staggered party wall between dwellings	2.5000	0.1200	0.3000
E16 Corner (normal)	2.5000	0.1300	0.3250
E18 Party wall between dwellings	2.5000	0.1000	0.2500
P4 Party wall - Roof (insulation at ceiling level)	4.1500	0.0170	0.0706
E15 Flat roof with parapet	16.6900	0.3000	5.0070
E24 Eaves (insulation at ceiling level - inverted)	13.1800	0.1500	1.9770
E2 Other lintels (including other steel lintels)	6.9000	0.0500	0.3450
E3 Sill	5.8000	0.0500	0.2900
E4 Jamb	22.8000	0.1000	2.2800

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.3061 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 39.2340 (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	15.9771	15.7793	15.5816	14.5930	14.3952	13.4066	13.4066	13.2089	13.8021	14.3952	14.7907	15.1861	(38)
Heat transfer coeff	55.2111	55.0133	54.8156	53.8270	53.6292	52.6406	52.6406	52.4429	53.0361	53.6292	54.0247	54.4201	(39)
Average = Sum(39)m / 12 =												53.7775	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7343	0.7317	0.7290	0.7159	0.7132	0.7001	0.7001	0.6975	0.7054	0.7132	0.7185	0.7238	(40)
HLP (average)												0.7152	
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 2.3653 (42)

Hot water usage for mixer showers

63.8775	62.9175	61.5187	58.8423	56.8671	54.6645	53.4125	54.8007	56.3225	58.6875	61.4214	63.6328	(42a)

Hot water usage for baths

27.5926	27.1829	26.6058	25.5418	24.7450	23.8616	23.3844	23.9575	24.5814	25.5267	26.6126	27.4994	(42b)

Hot water usage for other uses

38.8527	37.4399	36.0271	34.6143	33.2014	31.7886	31.7886	33.2014	34.6143	36.0271	37.4399	38.8527	(42c)

Average daily hot water use (litres/day) 119.7963 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	130.3229	127.5403	124.1516	118.9983	114.8136	110.3147	108.5855	111.9596	115.5182	120.2413	125.4740	129.9849	(44)
Energy conte	206.3996	181.6157	190.8163	162.9027	154.5612	135.6448	131.3248	138.6294	142.4455	163.1663	178.7607	203.5249	(45)
Energy content (annual)										Total = Sum(45)m =		1989.7919	
Distribution loss (46)m = 0.15 x (45)m	30.9599	27.2424	28.6225	24.4354	23.1842	20.3467	19.6987	20.7944	21.3668	24.4749	26.8141	30.5287	(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	261.6764	231.5431	246.0931	216.3964	209.8380	189.1385	186.6016	193.9062	195.9391	218.4431	232.2543	258.8017	(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	261.6764	231.5431	246.0931	216.3964	209.8380	189.1385	186.6016	193.9062	195.9391	218.4431	232.2543	258.8017	(64)
										Total per year (kWh/year) = Sum(64)m =		2640.6316	(64)
12Total per year (kWh/year)												2641	(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	112.8493	100.3292	107.6679	96.9601	95.6130	87.8968	87.8869	90.3157	90.1581	98.4742	102.2329	111.8935	(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	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	107.1526	118.6332	107.1526	110.7244	107.1526	110.7244	107.1526	107.1526	110.7244	107.1526	110.7244	107.1526	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	209.0956	211.2653	205.7976	194.1575	179.4639	165.6540	156.4282	154.2584	159.7261	171.3663	186.0598	199.8697	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	(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)	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	(71)
Water heating gains (Table 5)	151.6792	149.2994	144.7149	134.6668	128.5122	122.0789	118.1276	121.3921	125.2195	132.3578	141.9901	150.3944	(72)
Total internal gains	526.4064	537.6770	516.1442	498.0277	473.6077	456.9364	440.1874	441.2822	454.1491	469.3558	497.2533	515.8958	(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	2.4200	10.6334	0.4000	0.8000	0.7700	5.7065	(74)
Northeast	6.7500	11.2829	0.4000	0.8000	0.7700	16.8892	(75)
East	4.8400	19.6403	0.4000	0.8000	0.7700	21.0803	(76)

Solar gains	43.6760	86.5214	148.3823	230.5332	298.2154	312.9564	294.7427	242.1262	176.7387	103.9264	54.5753	35.8852	(83)
Total gains	570.0824	624.1983	664.5264	728.5609	771.8231	769.8928	734.9302	683.4084	630.8878	573.2822	551.8287	551.7810	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	69.4340	69.6836	69.9349	71.2194	71.4820	72.8245	72.8245	73.0990	72.2815	71.4820	70.9588	70.4431	
alpha	5.6289	5.6456	5.6623	5.7480	5.7655	5.8550	5.8550	5.8733	5.8188	5.7655	5.7306	5.6962	
util living area	0.9734	0.9546	0.9146	0.8002	0.6267	0.4356	0.3149	0.3525	0.5696	0.8402	0.9481	0.9769	(86)
MIT	20.2671	20.4210	20.6261	20.8629	20.9699	20.9970	20.9996	20.9993	20.9867	20.8473	20.5435	20.2489	(87)
Th 2	20.3106	20.3130	20.3153	20.3268	20.3291	20.3407	20.3407	20.3431	20.3361	20.3291	20.3245	20.3199	(88)
util rest of house	0.9682	0.9462	0.8995	0.7713	0.5866	0.3915	0.2678	0.3024	0.5184	0.8093	0.9371	0.9723	(89)
MIT 2	19.4601	19.6533	19.9059	20.1900	20.3033	20.3388	20.3406	20.3427	20.3265	20.1802	19.8170	19.4446	(90)
Living area fraction									fLA = Living area / (4) =			0.4054	(91)
MIT	19.7873	19.9645	20.1979	20.4628	20.5735	20.6056	20.6077	20.6089	20.5941	20.4506	20.1115	19.7707	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7873	19.9645	20.1979	20.4628	20.5735	20.6056	20.6077	20.6089	20.5941	20.4506	20.1115	19.7707	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9635	0.9412	0.8966	0.7774	0.6014	0.4093	0.2869	0.3227	0.5385	0.8152	0.9332	0.9679	(94)
Useful gains	549.2699	587.5252	595.8098	566.3505	464.2090	315.1187	210.8690	220.5305	339.7265	467.3535	514.9631	534.0615	(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	855.0683	828.7485	750.8562	622.3906	475.8804	316.1372	210.9698	220.7264	344.4228	528.2828	702.9429	847.3576	(97)
Space heating kWh	227.5140	162.1021	115.3545	40.3489	8.6835	0.0000	0.0000	0.0000	0.0000	45.3314	135.3454	233.0923	(98a)
Space heating requirement - total per year (kWh/year)												967.7721	
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	227.5140	162.1021	115.3545	40.3489	8.6835	0.0000	0.0000	0.0000	0.0000	45.3314	135.3454	233.0923	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												967.7721	
Space heating per m2											(98c) / (4) =	12.8710	(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 Combined Heat and Power-Space and Water												0.7000	(303a)
Fraction of heat from community Boilers-Space and Water												0.3000	(303b)
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	227.5140	162.1021	115.3545	40.3489	8.6835	0.0000	0.0000	0.0000	0.0000	45.3314	135.3454	233.0923	(98)
Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50													
307a	238.8897	170.2072	121.1222	42.3663	9.1177	0.0000	0.0000	0.0000	0.0000	47.5979	142.1127	244.7469	
Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50													
307b	102.3813	72.9459	51.9095	18.1570	3.9076	0.0000	0.0000	0.0000	0.0000	20.3991	60.9054	104.8915	
Space heating requirement	341.2711	243.1531	173.0317	60.5233	13.0253	0.0000	0.0000	0.0000	0.0000	67.9971	203.0181	349.6384	(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	261.6764	231.5431	246.0931	216.3964	209.8380	189.1385	186.6016	193.9062	195.9391	218.4431	232.2543	258.8017	(64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50													
310a	274.7602	243.1203	258.3978	227.2162	220.3299	198.5954	195.9317	203.6015	205.7361	229.3653	243.8671	271.7418	
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50													
310b	117.7544	104.1944	110.7419	97.3784	94.4271	85.1123	83.9707	87.2578	88.1726	98.2994	104.5145	116.4608	
Water heating fuel	392.5146	347.3147	369.1397	324.5946	314.7570	283.7077	279.9024	290.8593	293.9087	327.6647	348.3815	388.2025	(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	12.4265	11.2240	12.4265	12.0257	12.4265	12.0257	12.4265	12.4265	12.0257	12.4265	12.0257	12.4265	(331)
Lighting	25.6303	20.5616	18.5134	13.5637	10.4770	8.5598	9.5575	12.4232	16.1365	21.1719	23.9137	26.3427	(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												1451.6582	(307)
Space heating fuel - secondary												0.0000	(309)

Water heating fuel - community heating	3960.9474	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	14.5166	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)		
mechanical ventilation fans (SFP = 0.6380)	146.3122	(330a)
Total electricity for the above, kWh/year	146.3122	(331)
Electricity for lighting (calculated in Appendix L)	206.8513	(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	5765.7691	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	2502.8589	0.2100	525.6004	(363)
less credit emissions for electricity	-959.8464	0.3480	-334.0265	(364)
Water heating from Combined Heat and Power	6829.2197	0.2100	1434.1361	(365)
less credit emissions for electricity	-2619.0058	0.3480	-911.4140	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	2029.7271	0.2100	114.3181	(368)
Electrical energy for heat distribution (space & water)	14.5166	0.0000	7.8626	(372)
Overall CO2 factor for heat network			0.2122	(386)
Total CO2 associated with community systems			1148.4013	(373)
Space and water heating			1148.4013	(376)
Pumps, fans and electric keep-hot	146.3122	0.1387	20.2953	(378)
Energy for lighting	206.8513	0.1443	29.8550	(379)
Total CO2, kg/year			1198.5516	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			15.9400	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	2502.8589	1.1300	2828.2305	(463)
less credit emissions for electricity	-959.8464	2.1490	-2062.7099	(464)
Water heating from Combined Heat and Power	6829.2197	1.1300	7717.0183	(465)
less credit emissions for electricity	-2619.0058	2.1490	-5628.2434	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	2029.7271	1.1300	615.1401	(468)
Electrical energy for heat distribution (space & water)	14.5166	0.0000	83.2090	(472)
Overall CO2 factor for heat network			0.9665	(486)
Total CO2 associated with community systems			5231.0962	(473)
Space and water heating			5231.0962	(476)
Pumps, fans and electric keep-hot	146.3122	1.5128	221.3411	(478)
Energy for lighting	206.8513	1.5338	317.2754	(479)
Total Primary energy kWh/year			5769.7127	(483)
Dwelling Primary energy Rate (DPER)			76.7400	(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	75.1900	(1b)	x 2.5000	(2b) =	187.9750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 75.1900						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		187.9750	(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) = 0.1596	(8)

Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.4096	(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) = 0.3482	(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	0.4439	0.4352	0.4265	0.3830	0.3743	0.3307	0.3307	0.3220	0.3482	0.3743	0.3917	0.4091	(22b)
Effective ac	0.5985	0.5947	0.5909	0.5733	0.5700	0.5547	0.5547	0.5519	0.5606	0.5700	0.5767	0.5837	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			14.0100	1.1450	16.0420			(27)
External Wall 1	41.7300	14.0100	27.7200	0.1800	4.9896			(29a)
Corridor	12.7500	2.3100	10.4400	0.1800	1.8792			(29a)
External Roof 1	31.0100		31.0100	0.1100	3.4111			(30)
Total net area of external elements Aum(A, m2)			85.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		28.6319			(33)
Party Wall 1			32.7800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 189.4200 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	13.2100	0.0700	0.9247
E7 Party floor between dwellings (in blocks of flats)	10.2000	0.0700	0.7140
E16 Corner (normal)	5.0000	0.0900	0.4500
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	3.4800	0.0200	0.0696
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	22.0700	0.0000	0.0000
E25 Staggered party wall between dwellings	2.5000	0.0600	0.1500
E16 Corner (normal)	2.5000	0.0900	0.2250
E18 Party wall between dwellings	2.5000	0.0600	0.1500
P4 Party wall - Roof (insulation at ceiling level)	4.1500	0.1200	0.4980
E15 Flat roof with parapet	16.6900	0.5600	9.3464
E24 Eaves (insulation at ceiling level - inverted)	13.1800	0.2400	3.1632
E2 Other lintels (including other steel lintels)	6.9000	0.0500	0.3450
E3 Sill	5.8000	0.0500	0.2900
E4 Jamb	22.8000	0.0500	1.1400

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	17.5409	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 46.1728	(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	37.1274	36.8901	36.6575	35.5649	35.3605	34.4088	34.4088	34.2326	34.7754	35.3605	35.7740	36.2064	(38)
Heat transfer coeff	83.3002	83.0629	82.8303	81.7377	81.5333	80.5816	80.5816	80.4054	80.9482	81.5333	81.9468	82.3791	(39)
Average = Sum(39)m / 12 =												81.7367	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1079	1.1047	1.1016	1.0871	1.0844	1.0717	1.0717	1.0694	1.0766	1.0844	1.0899	1.0956	(40)
HLP (average)												1.0871	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3653	(42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	63.8775	62.9175	61.5187	58.8423	56.8671	54.6645	53.4125	54.8007	56.3225	58.6875	61.4214	63.6328	(42a)
Hot water usage for baths	27.5926	27.1829	26.6058	25.5418	24.7450	23.8616	23.3844	23.9575	24.5814	25.5267	26.6126	27.4994	(42b)
Hot water usage for other uses	38.8527	37.4399	36.0271	34.6143	33.2014	31.7886	31.7886	33.2014	34.6143	36.0271	37.4399	38.8527	(42c)
Average daily hot water use (litres/day)												119.7963	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	130.3229	127.5403	124.1516	118.9983	114.8136	110.3147	108.5855	111.9596	115.5182	120.2413	125.4740	129.9849	(44)
Energy conte	206.3996	181.6157	190.8163	162.9027	154.5612	135.6448	131.3248	138.6294	142.4455	163.1663	178.7607	203.5249	(45)
Energy content (annual)											Total = Sum(45)m =	1989.7919	
Distribution loss (46)m = 0.15 x (45)m	30.9599	27.2424	28.6225	24.4354	23.1842	20.3467	19.6987	20.7944	21.3668	24.4749	26.8141	30.5287	(46)
Water storage loss:													
Store volume												0.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												1.4400	(51)
Volume factor from Table 2a												0.0000	(52)
Temperature factor from Table 2b												1.0000	(53)
Enter (49) or (54) in (55)												1.4400	(55)
Total storage loss	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(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	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	251.0396	221.9357	235.4563	206.1027	199.2012	178.8448	175.9648	183.2694	185.6455	207.8063	221.9607	248.1649	(62)
WWHRS	-29.2021	-25.8266	-27.0441	-22.3936	-20.8700	-17.8586	-16.7396	-17.8009	-18.4772	-21.7826	-24.6771	-28.6613	(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	221.8375	196.1091	208.4122	183.7091	178.3312	160.9862	159.2251	165.4685	167.1682	186.0237	197.2836	219.5035	(64)

											Total per year (kWh/year) = Sum(64)m =	2244.0579	(64)
12Total per year (kWh/year)												2244	(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													
104.3399	92.6432	99.1584	88.7252	87.1036	79.6619	79.3775	81.8063	81.9231	89.9648	93.9979	103.3840		(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	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	107.1526	118.6332	107.1526	110.7244	107.1526	110.7244	107.1526	107.1526	110.7244	107.1526	110.7244	107.1526	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	209.0956	211.2653	205.7976	194.1575	179.4639	165.6540	156.4282	154.2584	159.7261	171.3663	186.0598	199.8697	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	(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)													
	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	(71)
Water heating gains (Table 5)													
	140.2418	137.8619	133.2775	123.2294	117.0747	110.6415	106.6902	109.9547	113.7821	120.9204	130.5527	138.9570	(72)
Total internal gains													
	514.9690	526.2396	504.7067	486.5903	462.1703	445.4990	428.7500	429.8448	442.7117	457.9184	485.8159	504.4584	(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	2.4200	10.6334	0.6300	0.7000	0.7700	7.8643	(74)
Northeast	6.7500	11.2829	0.6300	0.7000	0.7700	23.2754	(75)
East	4.8400	19.6403	0.6300	0.7000	0.7700	29.0512	(76)

Solar gains	60.1910	119.2372	204.4893	317.7035	410.9780	431.2931	406.1923	333.6802	243.5680	143.2236	75.2116	49.4543	(83)
Total gains	575.1599	645.4768	709.1961	804.2938	873.1483	876.7920	834.9423	763.5250	686.2797	601.1420	561.0275	553.9127	(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	47.4938	47.6295	47.7633	48.4018	48.5231	49.0961	49.0961	49.2037	48.8738	48.5231	48.2782	48.0249	
alpha	4.1663	4.1753	4.1842	4.2268	4.2349	4.2731	4.2731	4.2802	4.2583	4.2349	4.2185	4.2017	
util living area													
	0.9850	0.9747	0.9517	0.8820	0.7480	0.5615	0.4183	0.4729	0.7186	0.9188	0.9738	0.9871	(86)
MIT	19.5320	19.7383	20.0620	20.4998	20.8118	20.9580	20.9905	20.9843	20.8827	20.4708	19.9403	19.5053	(87)
Th 2	19.9944	19.9970	19.9995	20.0114	20.0136	20.0240	20.0240	20.0259	20.0200	20.0136	20.0091	20.0044	(88)
util rest of house													
	0.9814	0.9687	0.9399	0.8544	0.6954	0.4854	0.3285	0.3780	0.6445	0.8933	0.9664	0.9840	(89)
MIT 2	18.2973	18.5595	18.9663	19.5040	19.8513	19.9976	20.0202	20.0191	19.9351	19.4841	18.8262	18.2703	(90)
Living area fraction										fLA = Living area / (4) =		0.4054	(91)
MIT	18.7978	19.0374	19.4105	19.9077	20.2407	20.3869	20.4135	20.4104	20.3192	19.8841	19.2778	18.7709	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7978	19.0374	19.4105	19.9077	20.2407	20.3869	20.4135	20.4104	20.3192	19.8841	19.2778	18.7709	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9757	0.9612	0.9314	0.8511	0.7083	0.5145	0.3648	0.4162	0.6686	0.8893	0.9594	0.9787	(94)
Useful gains	561.1569	620.4533	660.5742	684.5424	618.4220	451.0697	304.5756	317.7525	458.8347	534.6067	538.2665	542.1279	(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													
1207.6679	1174.2905	1069.3785	899.7406	696.3496	466.3159	307.3019	322.4562	503.4350	756.9622	997.9340	1200.3415		(97)
Space heating kWh													
481.0041	372.1786	304.1504	154.9428	57.9782	0.0000	0.0000	0.0000	0.0000	165.4325	330.9606	489.7109		(98a)
Space heating requirement - total per year (kWh/year)												2356.3580	
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													
481.0041	372.1786	304.1504	154.9428	57.9782	0.0000	0.0000	0.0000	0.0000	165.4325	330.9606	489.7109		(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2356.3580	
Space heating per m2											(98c) / (4) =	31.3387	(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 Combined Heat and Power-Space and Water	0.7000	(303a)
Fraction of heat from community Boilers-Space and Water	0.3000	(303b)
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		
481.0041 372.1786 304.1504 154.9428 57.9782 0.0000 0.0000 0.0000 0.0000 165.4325 330.9606 489.7109		(98)
Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50		
307a 505.0543 390.7875 319.3579 162.6899 60.8771 0.0000 0.0000 0.0000 0.0000 173.7041 347.5087 514.1964		

Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50

307b	216.4519	167.4803	136.8677	69.7242	26.0902	0.0000	0.0000	0.0000	0.0000	74.4446	148.9323	220.3699	
Space heating requirement													
	721.5062	558.2678	456.2256	232.4141	86.9673	0.0000	0.0000	0.0000	0.0000	248.1488	496.4409	734.5663	(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													
	221.8375	196.1091	208.4122	183.7091	178.3312	160.9862	159.2251	165.4685	167.1682	186.0237	197.2836	219.5035	(64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50													
310a	232.9293	205.9146	218.8328	192.8946	187.2477	169.0355	167.1864	173.7419	175.5266	195.3249	207.1478	230.4787	
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50													
310b	99.8269	88.2491	93.7855	82.6691	80.2490	72.4438	71.6513	74.4608	75.2257	83.7107	88.7776	98.7766	
Water heating fuel													
	332.7562	294.1637	312.6183	275.5637	267.4967	241.4792	238.8377	248.2027	250.7523	279.0355	295.9254	329.2553	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(331)
Lighting	22.2642	17.8612	16.0820	11.7824	9.1010	7.4356	8.3023	10.7916	14.0172	18.3914	20.7730	22.8830	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-11.0035	-16.8367	-26.2342	-32.0448	-36.8392	-35.2153	-34.7708	-31.6661	-26.6448	-20.3088	-12.5526	-9.3643	(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	-2.7581	-6.0121	-12.3607	-19.1975	-26.0323	-26.4154	-26.1226	-21.8295	-15.6174	-8.8148	-3.7482	-2.1668	(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	3534.5371	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	3366.0869	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	35.3454	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	179.6848	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-464.5568	(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	6615.7520	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	6094.0294	0.2100	1279.7462	(363)
less credit emissions for electricity	-2337.0603	0.3480	-813.2970	(364)
Water heating from Combined Heat and Power	5803.5980	0.2100	1218.7556	(365)
less credit emissions for electricity	-2225.6798	0.3480	-774.5366	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	2587.7340	0.2100	278.3448	(368)
Electrical energy for heat distribution (space & water)	35.3454	0.0000	10.2392	(372)
Overall CO2 factor for heat network			0.2122	(386)
Total CO2 associated with community systems			1464.3316	(373)
Space and water heating			1464.3316	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	179.6848	0.1443	25.9341	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-293.4812	0.1329	-39.0130	
PV Unit electricity exported	-171.0756	0.1249	-21.3695	
Total			-60.3825	(380)
Total CO2, kg/year			1429.8832	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			19.0200	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	6094.0294	1.1300	6886.2532	(463)
less credit emissions for electricity	-2337.0603	2.1490	-5022.3425	(464)
Water heating from Combined Heat and Power	5803.5980	1.1300	6558.0658	(465)
less credit emissions for electricity	-2225.6798	2.1490	-4782.9860	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	2587.7340	1.1300	1497.7601	(468)
Electrical energy for heat distribution (space & water)	35.3454	0.0000	106.8924	(472)
Overall CO2 factor for heat network			0.9666	(486)
Total CO2 associated with community systems			6670.0223	(473)
Space and water heating			6670.0223	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	179.6848	1.5338	275.6066	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-293.4812	1.4912	-437.6386	
PV Unit electricity exported	-171.0756	0.4585	-78.4323	
Total			-516.0709	(480)
Total Primary energy kWh/year			6429.5579	(483)
Target Primary Energy Rate (TPER)			85.5100	(484)

Full SAP Calculation Printout

Property Reference	D2 Exposed	**Issued on Date**	20/02/2024
Assessment Reference	00001_Copy	**Prop Type Ref**	
Property			

SAP Rating	84 B	**DER**	14.82	**TER**	17.58
Environmental	88 B	**% DER < TER**			15.70
CO_2 Emissions (t/year)	1	**DFEE**	29.27	**TFEE**	33.44
Compliance Check	See BREL	**% DFEE < TFEE**			12.47
% DPER < TPER	9.30	**DPER**	71.69	**TPER**	79.04

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	74.2900	(1b)	x 2.5000	(2b) =	185.7250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.2900					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	185.7250	(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)			11.5900	0.8687	10.0685			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
Heatloss Floor 1			74.2900	0.1100	8.1719	110.0000	8171.9000	(28a)
External Wall 1	26.5800	11.5900	14.9900	0.1600	2.3984	150.0000	2248.5000	(29a)
Lift	6.7300		6.7300	0.1600	1.0768	150.0000	1009.5000	(29a)
Corridor	17.5500	2.3100	15.2400	0.1600	2.4384	150.0000	2286.0000	(29a)
Total net area of external elements Aum(A, m2)			125.1500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.4640			(33)
Party Wall 1			40.1000	0.0000	0.0000	70.0000	2807.0000	(32)
Party Ceiling 1			74.2900			30.0000	2228.7000	(32b)
Internal Wall 1			123.8000			9.0000	1114.2000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19865.8000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		267.4088 (35)
List of Thermal Bridges		

K1 Element	Length	Psi-value	Total
E20 Exposed floor (normal)	10.6300	0.2000	2.1260
E20 Exposed floor (normal)	9.7100	0.2600	2.5246
E7 Party floor between dwellings (in blocks of flats)	5.7900	0.0600	0.3474
E7 Party floor between dwellings (in blocks of flats)	9.7100	0.1100	1.0681
E16 Corner (normal)	2.5000	0.1600	0.4000
E16 Corner (normal)	5.0000	0.1300	0.6500
E17 Corner (inverted - internal area greater than external area)	5.0000	0.0000	0.0000
E18 Party wall between dwellings	5.0000	0.0450	0.2250
E18 Party wall between dwellings	2.5000	0.1000	0.2500
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.8400	0.1500	0.7260
P7 Party Wall - Exposed floor (normal)	15.7700	0.0350	0.5520
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	15.7700	0.0000	0.0000
E2 Other lintels (including other steel lintels)	5.8000	0.0500	0.2900
E3 Sill	4.7000	0.0500	0.2350
E4 Jamb	18.4000	0.1000	1.8400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.2340 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 37.6981 (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	14.9067	14.7286	14.5505	13.6598	13.4817	12.5911	12.5911	12.4130	12.9474	13.4817	13.8380	14.1942	(38)
Heat transfer coeff	52.6048	52.4267	52.2485	51.3579	51.1798	50.2892	50.2892	50.1111	50.6454	51.1798	51.5360	51.8923	(39)
Average = Sum(39)m / 12 =												51.3134	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7081	0.7057	0.7033	0.6913	0.6889	0.6769	0.6769	0.6745	0.6817	0.6889	0.6937	0.6985	(40)
HLP (average)												0.6907	
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 2.3456 (42)
Hot water usage for mixer showers

63.5480	62.5930	61.2014	58.5387	56.5738	54.3825	53.1370	54.5180	56.0320	58.3848	61.1046	63.3045	(42a)

Hot water usage for baths

27.4509	27.0433	26.4691	25.4106	24.6180	23.7391	23.2643	23.8344	24.4551	25.3956	26.4759	27.3581	(42b)

Hot water usage for other uses

38.6515	37.2460	35.8405	34.4350	33.0294	31.6239	31.6239	33.0294	34.4350	35.8405	37.2460	38.6515	(42c)

Average daily hot water use (litres/day) 119.1782 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.6504	126.8822	123.5110	118.3843	114.2212	109.7455	108.0252	111.3819	114.9221	119.6208	124.8265	129.3141	(44)
Energy conte	205.3346	180.6786	189.8318	162.0622	153.7637	134.9449	130.6472	137.9141	141.7104	162.3243	177.8382	202.4747	(45)
Energy content (annual)										Total = Sum(45)m =		1979.5245	
Distribution loss (46)m = 0.15 x (45)m	30.8002	27.1018	28.4748	24.3093	23.0646	20.2417	19.5971	20.6871	21.2566	24.3487	26.6757	30.3712	(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	260.6114	230.6060	245.1086	215.5559	209.0405	188.4386	185.9240	193.1909	195.2041	217.6011	231.3319	257.7515	(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	260.6114	230.6060	245.1086	215.5559	209.0405	188.4386	185.9240	193.1909	195.2041	217.6011	231.3319	257.7515	(64)
										Total per year (kWh/year) = Sum(64)m =		2630.3643	(64)
12Total per year (kWh/year)												2630	(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	112.4952	100.0176	107.3405	96.6806	95.3479	87.6641	87.6616	90.0779	89.9137	98.1943	101.9262	111.5443	(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	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	109.5289	121.2641	109.5289	113.1799	109.5289	113.1799	109.5289	109.5289	113.1799	109.5289	113.1799	109.5289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.0958	209.2448	203.8294	192.3006	177.7476	164.0698	154.9321	152.7831	158.1986	169.7274	184.2804	197.9582	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	(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)	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	(71)
Water heating gains (Table 5)	151.2032	148.8357	144.2749	134.2786	128.1557	121.7557	117.8248	121.0724	124.8801	131.9816	141.5641	149.9251	(72)
Total internal gains	526.0122	537.5289	515.8175	497.9434	473.6165	457.1896	440.4701	441.5687	454.4428	469.4221	497.2087	515.5965	(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	
East	4.8400	19.6403	0.4000	0.8000	0.7700	21.0803	(76)
Southeast	6.7500	36.7938	0.4000	0.8000	0.7700	55.0760	(77)

Solar gains	76.1562	135.0522	196.2736	258.0919	299.5292	301.1151	288.8078	257.8773	217.9730	152.6170	92.2529	64.4689	(83)
Total gains	602.1684	672.5811	712.0911	756.0353	773.1457	758.3048	729.2779	699.4461	672.4157	622.0391	589.4616	580.0654	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	104.9007	105.2571	105.6159	107.4474	107.8214	109.7309	109.7309	110.1209	108.9590	107.8214	107.0761	106.3410	
alpha	7.9934	8.0171	8.0411	8.1632	8.1881	8.3154	8.3154	8.3414	8.2639	8.1881	8.1384	8.0894	
util living area	0.9841	0.9622	0.9149	0.7866	0.6111	0.4242	0.3034	0.3295	0.5186	0.8104	0.9564	0.9873	(86)
MIT	20.5767	20.7084	20.8427	20.9602	20.9948	20.9998	21.0000	21.0000	20.9989	20.9581	20.7735	20.5564	(87)
Th 2	20.3337	20.3358	20.3379	20.3485	20.3506	20.3613	20.3613	20.3634	20.3570	20.3506	20.3464	20.3421	(88)
util rest of house	0.9797	0.9528	0.8960	0.7530	0.5701	0.3820	0.2594	0.2839	0.4708	0.7722	0.9440	0.9837	(89)
MIT 2	19.8520	20.0156	20.1764	20.3130	20.3469	20.3611	20.3613	20.3634	20.3564	20.3149	20.1060	19.8339	(90)
Living area fraction									fLA = Living area / (4) =			0.3555	(91)
MIT	20.1096	20.2619	20.4133	20.5431	20.5772	20.5882	20.5883	20.5897	20.5848	20.5436	20.3433	20.0907	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1096	20.2619	20.4133	20.5431	20.5772	20.5882	20.5883	20.5897	20.5848	20.5436	20.3433	20.0907	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9779	0.9516	0.8984	0.7633	0.5845	0.3970	0.2750	0.3002	0.4878	0.7840	0.9440	0.9820	(94)
Useful gains	588.8602	640.0107	639.7077	577.1068	451.9046	301.0566	200.5663	209.9433	327.9734	487.6619	556.4264	569.6448	(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	831.6621	805.3730	726.9476	597.9640	454.3336	301.1405	200.5695	209.9497	328.4244	508.9114	682.5058	824.6054	(97)
Space heating kWh	180.6446	111.1235	64.9065	15.0172	1.8072	0.0000	0.0000	0.0000	0.0000	15.8096	90.7772	189.6907	(98a)
Space heating requirement - total per year (kWh/year)												669.7764	
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	180.6446	111.1235	64.9065	15.0172	1.8072	0.0000	0.0000	0.0000	0.0000	15.8096	90.7772	189.6907	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												669.7764	
Space heating per m2											(98c) / (4) =	9.0157	(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 Combined Heat and Power-Space and Water												0.7000	(303a)
Fraction of heat from community Boilers-Space and Water												0.3000	(303b)
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													
	180.6446	111.1235	64.9065	15.0172	1.8072	0.0000	0.0000	0.0000	0.0000	15.8096	90.7772	189.6907	(98)
Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50													
307a	189.6769	116.6797	68.1518	15.7680	1.8975	0.0000	0.0000	0.0000	0.0000	16.6001	95.3161	199.1752	
Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50													
307b	81.2901	50.0056	29.2079	6.7577	0.8132	0.0000	0.0000	0.0000	0.0000	7.1143	40.8497	85.3608	
Space heating requirement													
	270.9669	166.6852	97.3598	22.5257	2.7107	0.0000	0.0000	0.0000	0.0000	23.7145	136.1658	284.5360	(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													
	260.6114	230.6060	245.1086	215.5559	209.0405	188.4386	185.9240	193.1909	195.2041	217.6011	231.3319	257.7515	(64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50													
310a	273.6419	242.1363	257.3640	226.3336	219.4925	197.8605	195.2202	202.8504	204.9643	228.4812	242.8985	270.6390	
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50													
310b	117.2751	103.7727	110.2989	97.0001	94.0682	84.7974	83.6658	86.9359	87.8418	97.9205	104.0994	115.9882	
Water heating fuel													
	390.9170	345.9090	367.6628	323.3338	313.5607	282.6579	278.8859	289.7863	292.8062	326.4017	346.9979	386.6272	(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	12.2778	11.0896	12.2778	11.8817	12.2778	11.8817	12.2778	12.2778	11.8817	12.2778	11.8817	12.2778	(331)
Lighting	26.1017	20.9397	18.8539	13.8132	10.6697	8.7172	9.7333	12.6517	16.4333	21.5613	24.3535	26.8271	(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												1004.6647	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3945.5465	(310)
Efficiency of water heater												0.0000	(311)

Electricity used for heat distribution	10.0466	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)		
mechanical ventilation fans (SFP = 0.6380)	144.5609	(330a)
Total electricity for the above, kWh/year	144.5609	(331)
Electricity for lighting (calculated in Appendix L)	210.6556	(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	5305.4277	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	1732.1805	0.2100	363.7579	(363)
less credit emissions for electricity	-664.2912	0.3480	-231.1733	(364)
Water heating from Combined Heat and Power	6802.6663	0.2100	1428.5599	(365)
less credit emissions for electricity	-2608.8225	0.3480	-907.8702	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	1856.3292	0.2100	79.1173	(368)
Electrical energy for heat distribution (space & water)	10.0466	0.0000	7.1528	(372)
Overall CO2 factor for heat network			0.2122	(386)
Total CO2 associated with community systems			1050.2562	(373)
Space and water heating			1050.2562	(376)
Pumps, fans and electric keep-hot	144.5609	0.1387	20.0524	(378)
Energy for lighting	210.6556	0.1443	30.4041	(379)
Total CO2, kg/year			1100.7127	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.8200	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	1732.1805	1.1300	1957.3639	(463)
less credit emissions for electricity	-664.2912	2.1490	-1427.5618	(464)
Water heating from Combined Heat and Power	6802.6663	1.1300	7687.0130	(465)
less credit emissions for electricity	-2608.8225	2.1490	-5606.3596	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	1856.3292	1.1300	425.7267	(468)
Electrical energy for heat distribution (space & water)	10.0466	0.0000	75.9569	(472)
Overall CO2 factor for heat network			0.9664	(486)
Total CO2 associated with community systems			4784.0643	(473)
Space and water heating			4784.0643	(476)
Pumps, fans and electric keep-hot	144.5609	1.5128	218.6917	(478)
Energy for lighting	210.6556	1.5338	323.1106	(479)
Total Primary energy kWh/year			5325.8667	(483)
Dwelling Primary energy Rate (DPER)			71.6900	(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		74.2900	(1b)	x 2.5000	(2b) =	185.7250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.2900						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		185.7250	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1615	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	

Measured/design AP50	5.0000	(17)
Infiltration rate	0.4115	(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) =	0.3189	(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	0.4066	0.3987	0.3907	0.3508	0.3429	0.3030	0.3030	0.2950	0.3189	0.3429	0.3588	0.3747	(22b)
Effective ac	0.5827	0.5795	0.5763	0.5615	0.5588	0.5459	0.5459	0.5435	0.5509	0.5588	0.5644	0.5702	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			11.5900	1.1450	13.2710			(27)
Heatloss Floor 1			74.2900	0.1300	9.6577			(28a)
External Wall 1	26.5800	11.5900	14.9900	0.1800	2.6982			(29a)
Lift	6.7300		6.7300	0.1800	1.2114			(29a)
Corridor	17.5500	2.3100	15.2400	0.1800	2.7432			(29a)
Total net area of external elements Aum(A, m2)			125.1500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.8915			(33)
Party Wall 1			40.1000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 277.4088 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E20	Exposed floor (normal)	10.6300	0.3200	3.4016
E20	Exposed floor (normal)	9.7100	0.3200	3.1072
E7	Party floor between dwellings (in blocks of flats)	5.7900	0.0700	0.4053
E7	Party floor between dwellings (in blocks of flats)	9.7100	0.0700	0.6797
E16	Corner (normal)	2.5000	0.0900	0.2250
E16	Corner (normal)	5.0000	0.0900	0.4500
E17	Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500
E18	Party wall between dwellings	5.0000	0.0600	0.3000
E18	Party wall between dwellings	2.5000	0.0600	0.1500
E23	Balcony within or between dwellings, balcony support penetrates wall insulation	4.8400	0.0200	0.0968
P7	Party Wall - Exposed floor (normal)	15.7700	0.1600	2.5232
P3	Party wall - Intermediate floor between dwellings (in blocks of flats)	15.7700	0.0000	0.0000
E2	Other lintels (including other steel lintels)	5.8000	0.0500	0.2900
E3	Sill	4.7000	0.0500	0.2350
E4	Jamb	18.4000	0.0500	0.9200

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.3338	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	44.2253	(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	35.7120	35.5152	35.3223	34.4164	34.2469	33.4579	33.4579	33.3117	33.7618	34.2469	34.5898	34.9483	(38)
Heat transfer coeff	79.9372	79.7405	79.5476	78.6417	78.4722	77.6832	77.6832	77.5370	77.9871	78.4722	78.8151	79.1735	(39)
Average = Sum(39)m / 12 =												78.6409	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0760	1.0734	1.0708	1.0586	1.0563	1.0457	1.0457	1.0437	1.0498	1.0563	1.0609	1.0657	(40)
HLP (average)												1.0586	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3456	(42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	63.5480	62.5930	61.2014	58.5387	56.5738	54.3825	53.1370	54.5180	56.0320	58.3848	61.1046	63.3045	(42a)
Hot water usage for baths	27.4509	27.0433	26.4691	25.4106	24.6180	23.7391	23.2643	23.8344	24.4551	25.3956	26.4759	27.3581	(42b)
Hot water usage for other uses	38.6515	37.2460	35.8405	34.4350	33.0294	31.6239	31.6239	33.0294	34.4350	35.8405	37.2460	38.6515	(42c)
Average daily hot water use (litres/day)												119.1782	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.6504	126.8822	123.5110	118.3843	114.2212	109.7455	108.0252	111.3819	114.9221	119.6208	124.8265	129.3141	(44)
Energy conte	205.3346	180.6786	189.8318	162.0622	153.7637	134.9449	130.6472	137.9141	141.7104	162.3243	177.8382	202.4747	(45)
Energy content (annual)										Total = Sum(45)m =		1979.5245	
Distribution loss (46)m = 0.15 x (45)m	30.8002	27.1018	28.4748	24.3093	23.0646	20.2417	19.5971	20.6871	21.2566	24.3487	26.6757	30.3712	(46)
Water storage loss:													
Store volume												0.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												1.4400	(51)
Volume factor from Table 2a												0.0000	(52)
Temperature factor from Table 2b												1.0000	(53)
Enter (49) or (54) in (55)												1.4400	(55)
Total storage loss	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(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	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	249.9746	220.9986	234.4718	205.2622	198.4037	178.1449	175.2872	182.5541	184.9104	206.9643	221.0382	247.1147	(62)
WWHRS	-29.0515	-25.6934	-26.9046	-22.2781	-20.7624	-17.7665	-16.6533	-17.7091	-18.3819	-21.6703	-24.5498	-28.5135	(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	220.9231	195.3052	207.5671	182.9841	177.6413	160.3784	158.6339	164.8450	166.5285	185.2941	196.4885	218.6012	(64)
										Total per year (kWh/year) = Sum(64)m =		2235.1903	(64)
12Total per year (kWh/year)												2235	(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

	103.9857	92.3316	98.8311	88.4457	86.8384	79.4292	79.1522	81.5684	81.6787	89.6848	93.6912	103.0348 (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	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	(66)

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

	109.5289	121.2641	109.5289	113.1799	109.5289	113.1799	109.5289	109.5289	113.1799	109.5289	113.1799	109.5289	(67)

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

	207.0958	209.2448	203.8294	192.3006	177.7476	164.0698	154.9321	152.7831	158.1986	169.7274	184.2804	197.9582	(68)

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

	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	(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)

	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	(71)

Water heating gains (Table 5)

	139.7658	137.3983	132.8374	122.8412	116.7183	110.3183	106.3873	109.6350	113.4427	120.5441	130.1267	138.4877	(72)

Total internal gains

	514.5748	526.0915	504.3800	486.5060	462.1791	445.7522	429.0326	430.1313	443.0054	457.9847	485.7712	504.1591	(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	4.8400	19.6403	0.6300	0.7000	0.7700	29.0512	(76)
Southeast	6.7500	36.7938	0.6300	0.7000	0.7700	75.9015	(77)

Solar gains	104.9528	186.1188	270.4896	355.6829	412.7887	414.9743	398.0133	355.3872	300.3940	210.3253	127.1360	88.8462	(83)
Total gains	619.5276	712.2103	774.8696	842.1889	874.9678	860.7265	827.0459	785.5185	743.3993	668.3099	612.9073	593.0053	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	71.6142	71.7909	71.9649	72.7940	72.9512	73.6922	73.6922	73.8310	73.4050	72.9512	72.6338	72.3049	
alpha	5.7743	5.7861	5.7977	5.8529	5.8634	5.9128	5.9128	5.9221	5.8937	5.8634	5.8423	5.8203	
util living area	0.9936	0.9850	0.9650	0.9008	0.7670	0.5679	0.4120	0.4517	0.6905	0.9248	0.9849	0.9949	(86)
MIT	20.0328	20.2167	20.4540	20.7398	20.9208	20.9887	20.9985	20.9975	20.9665	20.7328	20.3370	20.0032	(87)
Th 2	20.0205	20.0226	20.0248	20.0348	20.0367	20.0454	20.0454	20.0471	20.0421	20.0367	20.0329	20.0289	(88)
util rest of house	0.9914	0.9800	0.9532	0.8702	0.7080	0.4877	0.3233	0.3595	0.6083	0.8943	0.9789	0.9932	(89)
MIT 2	18.9120	19.1459	19.4424	19.7877	19.9766	20.0398	20.0450	20.0463	20.0227	19.7894	19.3076	18.8809	(90)
Living area fraction									fLA = Living area / (4) =			0.3555	(91)
MIT	19.3105	19.5266	19.8021	20.1262	20.3123	20.3771	20.3840	20.3845	20.3582	20.1248	19.6735	19.2798	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3105	19.5266	19.8021	20.1262	20.3123	20.3771	20.3840	20.3845	20.3582	20.1248	19.6735	19.2798	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9892	0.9767	0.9500	0.8734	0.7258	0.5160	0.3549	0.3923	0.6365	0.8975	0.9761	0.9914	(94)
Useful gains	612.8612	695.6503	736.1419	735.5866	635.0613	444.1670	293.5356	308.1977	473.2041	599.8265	598.2409	587.8804	(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	1199.8941	1166.3317	1058.1465	882.8454	675.8223	448.7861	293.9540	308.9449	488.0587	747.4300	990.9836	1193.9242	(97)
Space heating kWh	436.7525	316.2979	239.5714	106.0263	30.3262	0.0000	0.0000	0.0000	0.0000	109.8170	282.7748	450.8966	(98a)

Space heating requirement - total per year (kWh/year) 1972.4626

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	436.7525	316.2979	239.5714	106.0263	30.3262	0.0000	0.0000	0.0000	0.0000	109.8170	282.7748	450.8966	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 1972.4626

Space heating per m2 (98c) / (4) = 26.5508 (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 Combined Heat and Power-Space and Water	0.7000 (303a)
Fraction of heat from community Boilers-Space and Water	0.3000 (303b)
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

	436.7525	316.2979	239.5714	106.0263	30.3262	0.0000	0.0000	0.0000	0.0000	109.8170	282.7748	450.8966	(98)

Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50

307a	458.5901	332.1128	251.5500	111.3276	31.8425	0.0000	0.0000	0.0000	0.0000	115.3079	296.9135	473.4414	

Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50

307b	196.5386	142.3340	107.8071	47.7118	13.6468	0.0000	0.0000	0.0000	0.0000	49.4177	127.2486	202.9035	

Space heating requirement

	655.1287	474.4468	359.3571	159.0394	45.4893	0.0000	0.0000	0.0000	0.0000	164.7255	424.1621	676.3449	(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													
	220.9231	195.3052	207.5671	182.9841	177.6413	160.3784	158.6339	164.8450	166.5285	185.2941	196.4885	218.6012	(64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50													
310a	231.9692	205.0705	217.9455	192.1333	186.5234	168.3973	166.5656	173.0872	174.8549	194.5588	206.3129	229.5312	
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50													
310b	99.4154	87.8873	93.4052	82.3428	79.9386	72.1703	71.3852	74.1802	74.9378	83.3823	88.4198	98.3705	
Water heating fuel													
	331.3846	292.9578	311.3507	274.4761	266.4620	240.5676	237.9508	247.2675	249.7928	277.9411	294.7327	327.9018	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(331)
Lighting	22.7579	18.2573	16.4386	12.0437	9.3029	7.6005	8.4864	11.0309	14.3281	18.7992	21.2337	23.3905	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-10.8786	-16.6487	-25.9450	-31.6955	-36.4405	-34.8354	-34.3976	-31.3270	-26.3583	-20.0863	-12.4118	-9.2578	(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	-2.7183	-5.9266	-12.1880	-18.9334	-25.6784	-26.0576	-25.7670	-21.5283	-15.3981	-8.6888	-3.6939	-2.1353	(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	2958.6938	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	3352.7854	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	29.5869	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	183.6696	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-458.9962	(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	6036.1527	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	5101.1963	0.2100	1071.2512	(363)
less credit emissions for electricity	-1956.3088	0.3480	-680.7954	(364)
Water heating from Combined Heat and Power	5780.6645	0.2100	1213.9396	(365)
less credit emissions for electricity	-2216.8848	0.3480	-771.4759	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	2366.8047	0.2100	232.9971	(368)
Electrical energy for heat distribution (space & water)	29.5869	0.0000	9.3527	(372)
Overall CO2 factor for heat network			0.2122	(386)
Total CO2 associated with community systems			1339.3011	(373)
Space and water heating			1339.3011	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	183.6696	0.1443	26.5092	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-290.2825	0.1329	-38.5868	
PV Unit electricity exported	-168.7137	0.1249	-21.0736	
Total			-59.6605	(380)
Total CO2, kg/year			1306.1498	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			17.5800	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	5101.1963	1.1300	5764.3518	(463)
less credit emissions for electricity	-1956.3088	2.1490	-4204.1075	(464)
Water heating from Combined Heat and Power	5780.6645	1.1300	6532.1509	(465)
less credit emissions for electricity	-2216.8848	2.1490	-4764.0855	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	2366.8047	1.1300	1253.7465	(468)
Electrical energy for heat distribution (space & water)	29.5869	0.0000	97.7182	(472)
Overall CO2 factor for heat network			0.9666	(486)
Total CO2 associated with community systems			6100.5171	(473)
Space and water heating			6100.5171	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	183.6696	1.5338	281.7186	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-290.2825	1.4912	-432.8653	
PV Unit electricity exported	-168.7137	0.4584	-77.3462	
Total			-510.2116	(480)
Total Primary energy kWh/year			5872.0241	(483)
Target Primary Energy Rate (TPER)			79.0400	(484)

Full SAP Calculation Printout

Property Reference	D3 Mid 1B	**Issued on Date**	20/02/2024
Assessment Reference	00001_Copy	**Prop Type Ref**	
Property			

SAP Rating	84 B	**DER**	16.70	**TER**	17.88
Environmental	88 B	**% DER < TER**			6.60
CO_2 Emissions (t/year)	0.8	**DFEE**	25.67	**TFEE**	26.29
Compliance Check	See BREL	**% DFEE < TFEE**			2.35
% DPER < TPER	2.17	**DPER**	80.13	**TPER**	81.91

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	50.7300	(1b)	x 2.5000	(2b) =	126.8250	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.7300					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		126.8250	(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) =		81.9000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2387	0.2358	0.2329	0.2184	0.2155	0.2009	0.2009	0.1980	0.2067	0.2155	0.2213	0.2271	(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)			9.8300	0.8687	8.5396			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
External Wall 1	17.3800	9.8300	7.5500	0.1600	1.2080	150.0000	1132.5000	(29a)
Lift	15.2300		15.2300	0.1600	2.4368	150.0000	2284.5000	(29a)
Corridor	9.7800	2.3100	7.4700	0.1600	1.1952	150.0000	1120.5000	(29a)
Total net area of external elements Aum(A, m2)			42.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		15.6896			(33)
Party Wall 1			35.5500	0.0000	0.0000	70.0000	2488.5000	(32)
Party Floor 1			50.7300			40.0000	2029.2000	(32d)
Party Ceiling 1			50.7300			30.0000	1521.9000	(32b)
Internal Wall 1			57.2000			9.0000	514.8000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11091.9000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		218.6458 (35)
List of Thermal Bridges		

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	7.1600	0.0600	0.4296
E7 Party floor between dwellings (in blocks of flats)	20.0000	0.1100	2.2000
E16 Corner (normal)	2.5000	0.1600	0.4000
E17 Corner (inverted - internal area greater than external area)	2.5000	0.0000	0.0000
E18 Party wall between dwellings	5.0000	0.0450	0.2250
E18 Party wall between dwellings	2.5000	0.1000	0.2500
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	6.7400	0.1500	1.0110
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	28.4400	0.0000	0.0000
E25 Staggered party wall between dwellings	2.5000	0.1200	0.3000
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500
E3 Sill	3.9000	0.0500	0.1950
E4 Jamb	14.0000	0.1000	1.4000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.6606 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 22.3502 (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	9.9909	9.8693	9.7477	9.1395	9.0179	8.4097	8.4097	8.2881	8.6530	9.0179	9.2611	9.5044	(38)
Heat transfer coeff	32.3411	32.2195	32.0978	31.4897	31.3680	30.7599	30.7599	30.6382	31.0031	31.3680	31.6113	31.8546	(39)
Average = Sum(39)m / 12 =												31.4593	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6375	0.6351	0.6327	0.6207	0.6183	0.6063	0.6063	0.6039	0.6111	0.6183	0.6231	0.6279	(40)
HLP (average)												0.6201	
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 1.7116 (42)
Hot water usage for mixer showers

52.9176	52.1223	50.9635	48.7463	47.1100	45.2853	44.2481	45.3982	46.6588	48.6181	50.8829	52.7148	(42a)

Hot water usage for baths

22.8795	22.5397	22.0612	21.1790	20.5183	19.7858	19.3901	19.8653	20.3826	21.1664	22.0669	22.8022	(42b)

Hot water usage for other uses

32.1586	30.9892	29.8198	28.6504	27.4810	26.3116	26.3116	27.4810	28.6504	29.8198	30.9892	32.1586	(42c)

Average daily hot water use (litres/day) 99.2362 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.9557	105.6512	102.8445	98.5756	95.1093	91.3826	89.9498	92.7444	95.6918	99.6043	103.9390	107.6756	(44)
Energy conte	170.9754	150.4459	158.0681	134.9451	128.0354	112.3656	108.7865	114.8369	117.9976	135.1621	148.0801	168.5939	(45)
Energy content (annual)										Total = Sum(45)m =		1648.2926	
Distribution loss (46)m = 0.15 x (45)m	25.6463	22.5669	23.7102	20.2418	19.2053	16.8548	16.3180	17.2255	17.6996	20.2743	22.2120	25.2891	(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

226.2522	200.3734	213.3449	188.4387	183.3122	165.8593	164.0633	170.1137	171.4913	190.4389	201.5738	223.8707	(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

226.2522	200.3734	213.3449	188.4387	183.3122	165.8593	164.0633	170.1137	171.4913	190.4389	201.5738	223.8707	(64)
									Total per year (kWh/year) = Sum(64)m =		2299.1324	(64)
12Total per year (kWh/year)											2299	(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

101.0708	89.9652	96.7791	87.6642	86.7932	80.1565	80.3929	82.4047	82.0291	89.1628	92.0316	100.2789	(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	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	76.0226	84.1678	76.0226	78.5567	76.0226	78.5567	76.0226	76.0226	78.5567	76.0226	78.5567	76.0226	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	149.1297	150.6772	146.7776	138.4757	127.9961	118.1467	111.5667	110.0192	113.9188	122.2207	132.7004	142.5497	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	(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)	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	(71)
Water heating gains (Table 5)	135.8478	133.8768	130.0794	121.7558	116.6575	111.3285	108.0550	110.7590	113.9294	119.8425	127.8216	134.7835	(72)
Total internal gains	409.6742	417.3960	401.5537	387.4623	369.3503	356.7059	344.3184	345.4749	355.0790	366.7599	387.7528	402.0300	(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				9.8300	19.6403	0.4000	0.8000	0.7700				42.8138	(80)
Solar gains	42.8138	83.7529	137.9291	201.1614	246.5309	252.3682	240.2648	206.3839	160.4173	99.3799	53.3838	35.2080	(83)
Total gains	452.4881	501.1490	539.4829	588.6237	615.8812	609.0742	584.5832	551.8589	515.4963	466.1398	441.1366	437.2380	(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	95.2684	95.6280	95.9904	97.8443	98.2237	100.1657	100.1657	100.5634	99.3798	98.2237	97.4678	96.7235	
alpha	7.3512	7.3752	7.3994	7.5230	7.5482	7.6777	7.6777	7.7042	7.6253	7.5482	7.4979	7.4482	
util living area	0.9428	0.8952	0.8068	0.6384	0.4728	0.3232	0.2315	0.2554	0.4147	0.6849	0.8806	0.9504	(86)
MIT	20.7030	20.8165	20.9210	20.9863	20.9986	20.9999	21.0000	21.0000	20.9996	20.9817	20.8663	20.6863	(87)
Th 2	20.3964	20.3985	20.4006	20.4114	20.4135	20.4243	20.4243	20.4264	20.4200	20.4135	20.4092	20.4049	(88)
util rest of house	0.9323	0.8790	0.7830	0.6096	0.4433	0.2941	0.2012	0.2235	0.3800	0.6503	0.8604	0.9411	(89)
MIT 2	20.0649	20.2008	20.3208	20.3989	20.4124	20.4243	20.4243	20.4264	20.4197	20.3977	20.2705	20.0525	(90)
Living area fraction									fLA = Living area / (4) =			0.6862	(91)
MIT	20.5028	20.6233	20.7327	20.8020	20.8146	20.8193	20.8193	20.8200	20.8176	20.7985	20.6793	20.4874	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.5028	20.6233	20.7327	20.8020	20.8146	20.8193	20.8193	20.8200	20.8176	20.7985	20.6793	20.4874	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9343	0.8853	0.7964	0.6288	0.4635	0.3141	0.2220	0.2454	0.4038	0.6732	0.8699	0.9425	(94)
Useful gains	422.7629	443.6693	429.6671	370.1273	285.4397	191.2861	129.7850	135.4190	208.1435	313.8071	383.7591	412.0852	(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	524.0152	506.5953	456.8376	374.7886	285.9076	191.3042	129.7860	135.4211	208.2673	319.9053	429.2593	518.8288	(97)
Space heating kWh	75.3318	42.2863	20.2149	3.3561	0.3482	0.0000	0.0000	0.0000	0.0000	4.5370	32.7601	79.4172	(98a)
Space heating requirement - total per year (kWh/year)												258.2517	
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	75.3318	42.2863	20.2149	3.3561	0.3482	0.0000	0.0000	0.0000	0.0000	4.5370	32.7601	79.4172	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												258.2517	
Space heating per m2										(98c) / (4) =		5.0907	(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 Combined Heat and Power-Space and Water												0.7000	(303a)
Fraction of heat from community Boilers-Space and Water												0.3000	(303b)
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	75.3318	42.2863	20.2149	3.3561	0.3482	0.0000	0.0000	0.0000	0.0000	4.5370	32.7601	79.4172	(98)
Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50													
307a	79.0984	44.4006	21.2256	3.5239	0.3656	0.0000	0.0000	0.0000	0.0000	4.7639	34.3982	83.3881	
Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50													
307b	33.8993	19.0288	9.0967	1.5103	0.1567	0.0000	0.0000	0.0000	0.0000	2.0417	14.7421	35.7378	
Space heating requirement	112.9976	63.4295	30.3223	5.0342	0.5222	0.0000	0.0000	0.0000	0.0000	6.8056	49.1402	119.1259	(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	226.2522	200.3734	213.3449	188.4387	183.3122	165.8593	164.0633	170.1137	171.4913	190.4389	201.5738	223.8707	(64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50													
310a	237.5648	210.3920	224.0122	197.8607	192.4778	174.1523	172.2664	178.6194	180.0658	199.9608	211.6525	235.0642	
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50													
310b	101.8135	90.1680	96.0052	84.7974	82.4905	74.6367	73.8285	76.5512	77.1711	85.6975	90.7082	100.7418	
Water heating fuel	339.3783	300.5600	320.0174	282.6581	274.9683	248.7889	246.0949	255.1706	257.2369	285.6583	302.3607	335.8061	(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	8.3841	7.5727	8.3841	8.1136	8.3841	8.1136	8.3841	8.3841	8.1136	8.3841	8.1136	8.3841	(331)
Lighting	16.8707	13.5343	12.1862	8.9281	6.8963	5.6344	6.2911	8.1774	10.6216	13.9361	15.7408	17.3396	(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												387.3775	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3448.6985	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												3.8738	(313)
Space cooling fuel												0.0000	(321)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)		
mechanical ventilation fans (SFP = 0.6380)	98.7155	(330a)
Total electricity for the above, kWh/year	98.7155	(331)
Electricity for lighting (calculated in Appendix L)	136.1566	(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	4070.9482	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	667.8923	0.2100	140.2574	(363)
less credit emissions for electricity	-256.1367	0.3480	-89.1356	(364)
Water heating from Combined Heat and Power	5946.0320	0.2100	1248.6667	(365)
less credit emissions for electricity	-2280.3033	0.3480	-793.5455	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	1438.5285	0.2100	30.5060	(368)
Electrical energy for heat distribution (space & water)	3.8738	0.0000	5.4722	(372)
Overall CO2 factor for heat network			0.2121	(386)
Total CO2 associated with community systems			813.8062	(373)
Space and water heating			813.8062	(376)
Pumps, fans and electric keep-hot	98.7155	0.1387	13.6931	(378)
Energy for lighting	136.1566	0.1443	19.6516	(379)
Total CO2, kg/year			847.1509	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			16.7000	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	667.8923	1.1300	754.7183	(463)
less credit emissions for electricity	-256.1367	2.1490	-550.4378	(464)
Water heating from Combined Heat and Power	5946.0320	1.1300	6719.0161	(465)
less credit emissions for electricity	-2280.3033	2.1490	-4900.3717	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	1438.5285	1.1300	164.1512	(468)
Electrical energy for heat distribution (space & water)	3.8738	0.0000	58.5970	(472)
Overall CO2 factor for heat network			0.9664	(486)
Total CO2 associated with community systems			3707.0592	(473)
Space and water heating			3707.0592	(476)
Pumps, fans and electric keep-hot	98.7155	1.5128	149.3368	(478)
Energy for lighting	136.1566	1.5338	208.8415	(479)
Total Primary energy kWh/year			4065.2376	(483)
Dwelling Primary energy Rate (DPER)			80.1300	(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	50.7300	(1b)	x 2.5000	(2b) =	126.8250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.7300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		126.8250	(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) =	0.1577	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4077	(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) = 0.3160 (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	0.4029	0.3950	0.3871	0.3476	0.3397	0.3002	0.3002	0.2923	0.3160	0.3397	0.3555	0.3713	(22b)
Effective ac	0.5811	0.5780	0.5749	0.5604	0.5577	0.5451	0.5451	0.5427	0.5499	0.5577	0.5632	0.5689	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			9.8300	1.1450	11.2557			(27)
External Wall 1	17.3800	9.8300	7.5500	0.1800	1.3590			(29a)
Lift	15.2300		15.2300	0.1800	2.7414			(29a)
Corridor	9.7800	2.1300	7.4700	0.1800	1.3446			(29a)
Total net area of external elements Aum(A, m2)			42.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		19.0107			(33)
Party Wall 1			35.5500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 228.6458 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	7.1600	0.0700	0.5012
E7 Party floor between dwellings (in blocks of flats)	20.0000	0.0700	1.4000
E16 Corner (normal)	2.5000	0.0900	0.2250
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E18 Party wall between dwellings	2.5000	0.0600	0.1500
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	6.7400	0.0200	0.1348
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	28.4400	0.0000	0.0000
E25 Staggered party wall between dwellings	2.5000	0.0600	0.1500
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500
E3 Sill	3.9000	0.0500	0.1950
E4 Jamb	14.0000	0.0500	0.7000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 3.7810 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 22.7917 (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	24.3223	24.1904	24.0611	23.4540	23.3404	22.8116	22.8116	22.7136	23.0153	23.3404	23.5702	23.8105	(38)
Heat transfer coeff	47.1140	46.9821	46.8529	46.2457	46.1321	45.6033	45.6033	45.5054	45.8070	46.1321	46.3619	46.6022	(39)
Average = Sum(39)m / 12 =												46.2452	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9287	0.9261	0.9236	0.9116	0.9094	0.8989	0.8989	0.8970	0.9030	0.9094	0.9139	0.9186	(40)
HLP (average)												0.9116	
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 1.7116 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	52.9176	52.1223	50.9635	48.7463	47.1100	45.2853	44.2481	45.3982	46.6588	48.6181	50.8829	52.7148	(42a)
Hot water usage for baths	22.8795	22.5397	22.0612	21.1790	20.5183	19.7858	19.3901	19.8653	20.3826	21.1664	22.0669	22.8022	(42b)
Hot water usage for other uses	32.1586	30.9892	29.8198	28.6504	27.4810	26.3116	26.3116	27.4810	28.6504	29.8198	30.9892	32.1586	(42c)
Average daily hot water use (litres/day)												99.2362	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.9557	105.6512	102.8445	98.5756	95.1093	91.3826	89.9498	92.7444	95.6918	99.6043	103.9390	107.6756	(44)
Energy conte	170.9754	150.4459	158.0681	134.9451	128.0354	112.3656	108.7865	114.8369	117.9976	135.1621	148.0801	168.5939	(45)
Energy content (annual)											Total = Sum(45)m =	1648.2926	
Distribution loss (46)m = 0.15 x (45)m	25.6463	22.5669	23.7102	20.2418	19.2053	16.8548	16.3180	17.2255	17.6996	20.2743	22.2120	25.2891	(46)

Water storage loss:
Store volume 0.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 1.4400 (51)
Volume factor from Table 2a 0.0000 (52)
Temperature factor from Table 2b 1.0000 (53)
Enter (49) or (54) in (55) 1.4400 (55)
Total storage loss

	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(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	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	215.6154	190.7659	202.7081	178.1451	172.6754	155.5656	153.4265	159.4769	161.1976	179.8021	191.2801	213.2339	(62)
WWHRS	-24.1917	-21.3953	-22.4040	-18.5514	-17.2892	-14.7945	-13.8675	-14.7467	-15.3070	-18.0452	-20.4430	-23.7437	(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	191.4237	169.3706	180.3042	159.5937	155.3862	140.7711	139.5590	144.7303	145.8906	161.7569	170.8371	189.4902	(64)
										Total per year (kWh/year) = Sum(64)m =		1949.1135	(64)
12Total per year (kWh/year)												1949	(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	92.5613	82.2793	88.2697	79.4292	78.2838	71.9216	71.8835	73.8953	73.7942	80.6534	83.7966	91.7695	(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	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	76.0226	84.1678	76.0226	78.5567	76.0226	78.5567	76.0226	76.0226	78.5567	76.0226	78.5567	76.0226	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	149.1297	150.6772	146.7776	138.4757	127.9961	118.1467	111.5667	110.0192	113.9188	122.2207	132.7004	142.5497	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	(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)													
	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	(71)
Water heating gains (Table 5)													
	124.4104	122.4394	118.6420	110.3184	105.2201	99.8911	96.6176	99.3216	102.4919	108.4051	116.3842	123.3461	(72)
Total internal gains													
	398.2368	405.9586	390.1163	376.0249	357.9129	345.2685	332.8810	334.0375	343.6416	355.3225	376.3154	390.5925	(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	9.8300	19.6403	0.6300	0.7000	0.7700	59.0028	(80)

Solar gains	59.0028	115.4220	190.0836	277.2256	339.7504	347.7950	331.1150	284.4229	221.0751	136.9579	73.5696	48.5210	(83)
Total gains	457.2396	521.3806	580.1999	653.2505	697.6633	693.0635	663.9960	618.4604	564.7167	492.2804	449.8849	439.1136	(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	68.3873	68.5793	68.7685	69.6713	69.8429	70.6528	70.6528	70.8048	70.3386	69.8429	69.4967	69.1384	
alpha	5.5592	5.5720	5.5846	5.6448	5.6562	5.7102	5.7102	5.7203	5.6892	5.6562	5.6331	5.6092	
util living area													
	0.9789	0.9572	0.9064	0.7768	0.5992	0.4194	0.3020	0.3380	0.5504	0.8386	0.9561	0.9825	(86)
MIT	20.1966	20.3902	20.6361	20.8761	20.9739	20.9971	20.9996	20.9993	20.9875	20.8408	20.4909	20.1658	(87)
Th 2	20.1432	20.1454	20.1475	20.1576	20.1595	20.1684	20.1684	20.1700	20.1650	20.1595	20.1557	20.1517	(88)
util rest of house													
	0.9735	0.9471	0.8861	0.7392	0.5500	0.3656	0.2450	0.2773	0.4875	0.7994	0.9439	0.9780	(89)
MIT 2	19.2275	19.4688	19.7663	20.0427	20.1395	20.1668	20.1683	20.1698	20.1573	20.0146	19.6050	19.1956	(90)
Living area fraction									fLA = Living area / (4) =			0.6862	(91)
MIT	19.8925	20.1010	20.3632	20.6145	20.7120	20.7365	20.7387	20.7390	20.7270	20.5815	20.2129	19.8613	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8925	20.1010	20.3632	20.6145	20.7120	20.7365	20.7387	20.7390	20.7270	20.5815	20.2129	19.8613	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9717	0.9465	0.8916	0.7602	0.5826	0.4024	0.2841	0.3189	0.5302	0.8200	0.9448	0.9761	(94)
Useful gains	444.2908	493.4713	517.3290	496.5717	406.4594	278.9040	188.6378	197.2521	299.3895	403.6582	425.0639	428.6299	(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													
	734.6232	714.1774	649.5296	541.7475	415.7438	279.8466	188.7404	197.4480	303.5629	460.4699	607.9386	729.8509	(97)
Space heating kWh													
	216.0073	148.3145	98.3572	32.5266	6.9076	0.0000	0.0000	0.0000	0.0000	42.2679	131.6698	224.1084	(98a)
Space heating requirement - total per year (kWh/year)												900.1591	
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													
	216.0073	148.3145	98.3572	32.5266	6.9076	0.0000	0.0000	0.0000	0.0000	42.2679	131.6698	224.1084	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												900.1591	
Space heating per m2											(98c) / (4) =	17.7441	(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 Combined Heat and Power-Space and Water	0.7000	(303a)
Fraction of heat from community Boilers-Space and Water	0.3000	(303b)
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

	216.0073	148.3145	98.3572	32.5266	6.9076	0.0000	0.0000	0.0000	0.0000	42.2679	131.6698	224.1084	(98)
Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50													
307a	226.8076	155.7302	103.2750	34.1529	7.2529	0.0000	0.0000	0.0000	0.0000	44.3813	138.2533	235.3138	
Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50													
307b	97.2033	66.7415	44.2607	14.6370	3.1084	0.0000	0.0000	0.0000	0.0000	19.0205	59.2514	100.8488	
Space heating requirement													
	324.0109	222.4717	147.5358	48.7898	10.3613	0.0000	0.0000	0.0000	0.0000	63.4018	197.5046	336.1626	(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

	191.4237	169.3706	180.3042	159.5937	155.3862	140.7711	139.5590	144.7303	145.8906	161.7569	170.8371	189.4902	(64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50													

310a	200.9949	177.8391	189.3194	167.5734	163.1555	147.8097	146.5369	151.9668	153.1852	169.8447	179.3789	198.9647	
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50													
310b	86.1407	76.2168	81.1369	71.8172	69.9238	63.3470	62.8015	65.1286	65.6508	72.7906	76.8767	85.2706	
Water heating fuel													
	287.1355	254.0559	270.4563	239.3905	233.0793	211.1567	209.3385	217.0954	218.8360	242.6353	256.2556	284.2353	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(331)
Lighting	15.7960	12.6721	11.4098	8.3593	6.4570	5.2754	5.8903	7.6564	9.9449	13.0483	14.7380	16.2350	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-3.5789	-5.6410	-9.0520	-11.3995	-13.4232	-12.9537	-12.7957	-11.5008	-9.4550	-6.9449	-4.1395	-3.0287	(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	-0.5477	-1.2105	-2.5212	-3.9662	-5.4296	-5.5271	-5.4639	-4.5406	-3.2178	-1.7882	-0.7485	-0.4290	(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	1350.2386	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	2923.6702	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	13.5024	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	127.4827	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-139.3032	(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	4262.0883	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	2327.9976	0.2100	488.8795	(363)
less credit emissions for electricity	-892.7871	0.3480	-310.6899	(364)
Water heating from Combined Heat and Power	5040.8107	0.2100	1058.5702	(365)
less credit emissions for electricity	-1933.1509	0.3480	-672.7365	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	1602.7158	0.2100	106.3313	(368)
Electrical energy for heat distribution (space & water)	13.5024	0.0000	6.2401	(372)
Overall CO2 factor for heat network			0.2122	(386)
Total CO2 associated with community systems			906.8337	(373)
Space and water heating			906.8337	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	127.4827	0.1443	18.3997	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-103.9130	0.1323	-13.7525	
PV Unit electricity exported	-35.3902	0.1246	-4.4084	
Total			-18.1608	(380)
Total CO2, kg/year			907.0726	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			17.8800	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	2327.9976	1.1300	2630.6372	(463)
less credit emissions for electricity	-892.7871	2.1490	-1918.5994	(464)
Water heating from Combined Heat and Power	5040.8107	1.1300	5696.1161	(465)
less credit emissions for electricity	-1933.1509	2.1490	-4154.3413	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	1602.7158	1.1300	572.1636	(468)
Electrical energy for heat distribution (space & water)	13.5024	0.0000	65.8214	(472)
Overall CO2 factor for heat network			0.9665	(486)
Total CO2 associated with community systems			4130.7029	(473)
Space and water heating			4130.7029	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	127.4827	1.5338	195.5372	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-103.9130	1.4890	-154.7263	
PV Unit electricity exported	-35.3902	0.4572	-16.1793	
Total			-170.9056	(480)
Total Primary energy kWh/year			4155.3344	(483)
Target Primary Energy Rate (TPER)			81.9100	(484)

Full SAP Calculation Printout

Property Reference	D3 Mid 2B	**Issued on Date**	20/02/2024
Assessment Reference	00001_Copy	**Prop Type Ref**	
Property			

SAP Rating	85 B	**DER**	13.25	**TER**	14.63
Environmental	89 B	**% DER < TER**			9.43
CO_2 Emissions (t/year)	0.93	**DFEE**	22.21	**TFEE**	23.08
Compliance Check	See BREL	**% DFEE < TFEE**			3.75
% DPER < TPER	3.81	**DPER**	64.45	**TPER**	67.00

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	74.9500 (1b)	x	2.5000 (2b)	=	187.3750	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.9500					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	187.3750	(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) =		81.9000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2531	0.2499	0.2467	0.2307	0.2276	0.2116	0.2116	0.2084	0.2180	0.2276	0.2339	0.2403	(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)			14.6700	0.8687	12.7442			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
External Wall 1	40.9500	14.6700	26.2800	0.1600	4.2048	150.0000	3942.0000	(29a)
Corridor	11.3500	2.3100	9.0400	0.1600	1.4464	150.0000	1356.0000	(29a)
Total net area of external elements Aum(A, m2)			52.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		20.7054			(33)
Party Wall 1			47.9500	0.0000	0.0000	70.0000	3356.5000	(32)
Party Floor 1			74.9500			40.0000	2998.0000	(32d)
Party Ceiling 1			74.9500			30.0000	2248.5000	(32b)
Internal Wall 1			115.6000			9.0000	1040.4000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14941.4000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		199.3516 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E7 Party floor between dwellings (in blocks of flats)	23.1000	0.0600	1.3860	
E7 Party floor between dwellings (in blocks of flats)	9.0800	0.1100	0.9988	
E16 Corner (normal)	2.5000	0.1600	0.4000	
E17 Corner (inverted - internal area greater than external area)	2.5000	0.0000	0.0000	
E18 Party wall between dwellings	5.0000	0.0450	0.2250	
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	9.6600	0.1500	1.4490	
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	38.3600	0.0000	0.0000	
E25 Staggered party wall between dwellings	5.0000	0.1200	0.6000	
E16 Corner (normal)	2.5000	0.1300	0.3250	
E2 Other lintels (including other steel lintels)	7.2000	0.0500	0.3600	
E3 Sill	6.1000	0.0500	0.3050	
E4 Jamb	22.8000	0.1000	2.2800	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3288 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 29.0342 (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	15.6478	15.4507	15.2536	14.2681	14.0710	13.0856	13.0856	12.8885	13.4798	14.0710	14.4652	14.8594	(38)
Heat transfer coeff	44.6820	44.4849	44.2878	43.3023	43.1053	42.1198	42.1198	41.9227	42.5140	43.1053	43.4994	43.8936	(39)

Average = Sum(39)m / 12 = 43.2531

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.5962	0.5935	0.5909	0.5777	0.5751	0.5620	0.5620	0.5593	0.5672	0.5751	0.5804	0.5856	(40)
HLP (average)												0.5771	
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 2.3601 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	63.7903	62.8317	61.4348	58.7620	56.7895	54.5899	53.3396	54.7260	56.2457	58.6074	61.3376	63.5459	(42a)
Hot water usage for baths	27.5552	27.1459	26.5696	25.5071	24.7114	23.8292	23.3527	23.9249	24.5480	25.4920	26.5765	27.4620	(42b)
Hot water usage for other uses	38.7995	37.3886	35.9777	34.5668	33.1559	31.7451	31.7451	33.1559	34.5668	35.9777	37.3886	38.7995	(42c)

Average daily hot water use (litres/day) 119.6328 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	130.1450	127.3662	123.9821	118.8359	114.6569	110.1641	108.4373	111.8068	115.3605	120.0772	125.3027	129.8074	(44)
Energy conte	206.1179	181.3678	190.5559	162.6804	154.3502	135.4597	131.1455	138.4402	142.2510	162.9436	178.5167	203.2471	(45)

Energy content (annual) Total = Sum(45)m = 1987.0760

Distribution loss (46)m = 0.15 x (45)m	30.9177	27.2052	28.5834	24.4021	23.1525	20.3189	19.6718	20.7660	21.3377	24.4415	26.7775	30.4871	(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

	261.3947	231.2953	245.8327	216.1741	209.6271	188.9533	186.4223	193.7170	195.7447	218.2204	232.0104	258.5239	(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

	261.3947	231.2953	245.8327	216.1741	209.6271	188.9533	186.4223	193.7170	195.7447	218.2204	232.0104	258.5239	(64)

Total per year (kWh/year) = Sum(64)m = 2637.9158 (64)

12Total per year (kWh/year) 2638 (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

	112.7556	100.2467	107.5813	96.8862	95.5429	87.8353	87.8273	90.2528	90.0934	98.4002	102.1517	111.8011	(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	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	106.1919	117.5696	106.1919	109.7316	106.1919	109.7316	106.1919	106.1919	109.7316	106.1919	109.7316	106.1919	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	208.5642	210.7285	205.2747	193.6641	179.0079	165.2331	156.0307	153.8664	159.3203	170.9308	185.5870	199.3618	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	(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)	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	(71)
Water heating gains (Table 5)	151.5533	149.1767	144.5985	134.5641	128.4179	121.9934	118.0475	121.3075	125.1297	132.2583	141.8774	150.2703	(72)
Total internal gains	524.7105	535.8759	514.4662	496.3610	472.0188	455.3593	438.6712	439.7670	452.5827	467.7821	495.5972	514.2251	(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	
Southwest	11.5900	36.7938	0.4000	0.8000	0.7700	94.5674	(79)

West			3.0800		19.6403		0.4000		0.8000		0.7700		13.4147 (80)
Solar gains	107.9822	187.3254	263.6181	336.1171	383.1258	382.7429	368.0509	332.9698	288.9110	209.1698	129.9966	91.9616	(83)
Total gains	632.6927	723.2013	778.0843	832.4780	855.1446	838.1021	806.7220	772.7368	741.4937	676.9519	625.5938	606.1868	(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	92.8872	93.2988	93.7140	95.8467	96.2850	98.5378	98.5378	99.0010	97.6241	96.2850	95.4125	94.5556	
alpha	7.1925	7.2199	7.2476	7.3898	7.4190	7.5692	7.5692	7.6001	7.5083	7.4190	7.3608	7.3037	
util living area													
	0.9374	0.8740	0.7802	0.6216	0.4679	0.3216	0.2297	0.2496	0.3954	0.6514	0.8649	0.9471	(86)
MIT	20.7036	20.8371	20.9320	20.9874	20.9985	20.9999	21.0000	21.0000	20.9997	20.9857	20.8765	20.6831	(87)
Th 2	20.4335	20.4358	20.4382	20.4501	20.4524	20.4643	20.4643	20.4667	20.4596	20.4524	20.4477	20.4429	(88)
util rest of house													
	0.9271	0.8575	0.7574	0.5952	0.4406	0.2947	0.2018	0.2206	0.3645	0.6199	0.8451	0.9381	(89)
MIT 2	20.0999	20.2595	20.3686	20.4384	20.4512	20.4643	20.4643	20.4667	20.4594	20.4398	20.3182	20.0837	(90)
Living area fraction										fLA = Living area / (4) =		0.4950	(91)
MIT	20.3988	20.5454	20.6475	20.7101	20.7221	20.7294	20.7295	20.7307	20.7268	20.7100	20.5945	20.3804	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3988	20.5454	20.6475	20.7101	20.7221	20.7294	20.7295	20.7307	20.7268	20.7100	20.5945	20.3804	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9264	0.8608	0.7661	0.6077	0.4541	0.3080	0.2156	0.2349	0.3798	0.6348	0.8506	0.9370	(94)
Useful gains	586.1524	622.5634	596.0584	505.9288	388.2869	258.1465	173.9320	181.5519	281.6100	429.7307	532.1033	568.0151	(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													
	719.3250	695.9843	626.5610	511.4068	388.9009	258.1706	173.9332	181.5542	281.7321	435.7943	587.0047	710.2156	(97)
Space heating kWh													
	99.0803	49.3389	22.6939	3.9441	0.4568	0.0000	0.0000	0.0000	0.0000	4.5113	39.5290	105.7972	(98a)
Space heating requirement - total per year (kWh/year)												325.3516	
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													
	99.0803	49.3389	22.6939	3.9441	0.4568	0.0000	0.0000	0.0000	0.0000	4.5113	39.5290	105.7972	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												325.3516	
Space heating per m2											(98c) / (4) =	4.3409	(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 Combined Heat and Power-Space and Water												0.7000	(303a)
Fraction of heat from community Boilers-Space and Water												0.3000	(303b)
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													
	99.0803	49.3389	22.6939	3.9441	0.4568	0.0000	0.0000	0.0000	0.0000	4.5113	39.5290	105.7972	(98)
Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50													
307a	104.0344	51.8058	23.8286	4.1413	0.4797	0.0000	0.0000	0.0000	0.0000	4.7369	41.5054	111.0870	
Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50													
307b	44.5862	22.2025	10.2123	1.7749	0.2056	0.0000	0.0000	0.0000	0.0000	2.0301	17.7880	47.6087	
Space heating requirement													
	148.6205	74.0083	34.0409	5.9162	0.6853	0.0000	0.0000	0.0000	0.0000	6.7670	59.2935	158.6958	(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													
	261.3947	231.2953	245.8327	216.1741	209.6271	188.9533	186.4223	193.7170	195.7447	218.2204	232.0104	258.5239	(64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50													
310a	274.4644	242.8600	258.1244	226.9828	220.1084	198.4010	195.7435	203.4029	205.5320	229.1314	243.6109	271.4501	
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50													
310b	117.6276	104.0829	110.6247	97.2783	94.3322	85.0290	83.8901	87.1727	88.0851	98.1992	104.4047	116.3358	
Water heating fuel													
	392.0920	346.9429	368.7491	324.2611	314.4406	283.4300	279.6335	290.5755	293.6171	327.3306	348.0155	387.7858	(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	12.3869	11.1881	12.3869	11.9873	12.3869	11.9873	12.3869	12.3869	11.9873	12.3869	11.9873	12.3869	(331)
Lighting	25.3757	20.3573	18.3295	13.4290	10.3729	8.4748	9.4625	12.2997	15.9762	20.9616	23.6761	26.0809	(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												488.0274	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3956.8737	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												4.8803	(313)
Space cooling fuel												0.0000	(321)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)		
mechanical ventilation fans (SFP = 0.6380)	145.8452	(330a)
Total electricity for the above, kWh/year	145.8452	(331)
Electricity for lighting (calculated in Appendix L)	204.7961	(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	4795.5424	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	841.4265	0.2100	176.6996	(363)
less credit emissions for electricity	-322.6871	0.3480	-112.2951	(364)
Water heating from Combined Heat and Power	6822.1961	0.2100	1432.6612	(365)
less credit emissions for electricity	-2616.3122	0.3480	-910.4766	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	1666.8379	0.2100	38.4322	(368)
Electrical energy for heat distribution (space & water)	4.8803	0.0000	6.3536	(372)
Overall CO2 factor for heat network			0.2121	(386)
Total CO2 associated with community systems			942.9786	(373)
Space and water heating			942.9786	(376)
Pumps, fans and electric keep-hot	145.8452	0.1387	20.2305	(378)
Energy for lighting	204.7961	0.1443	29.5584	(379)
Total CO2, kg/year			992.7675	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			13.2500	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	841.4265	1.1300	950.8120	(463)
less credit emissions for electricity	-322.6871	2.1490	-693.4545	(464)
Water heating from Combined Heat and Power	6822.1961	1.1300	7709.0816	(465)
less credit emissions for electricity	-2616.3122	2.1490	-5622.4549	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	1666.8379	1.1300	206.8016	(468)
Electrical energy for heat distribution (space & water)	4.8803	0.0000	67.9450	(472)
Overall CO2 factor for heat network			0.9664	(486)
Total CO2 associated with community systems			4295.4560	(473)
Space and water heating			4295.4560	(476)
Pumps, fans and electric keep-hot	145.8452	1.5128	220.6346	(478)
Energy for lighting	204.7961	1.5338	314.1230	(479)
Total Primary energy kWh/year			4830.2136	(483)
Dwelling Primary energy Rate (DPER)			64.4500	(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		74.9500 (1b)	x	2.5000 (2b)	=	187.3750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.9500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	187.3750	(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) =	0.1601	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4101	(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) = 0.3486 (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	0.4445	0.4357	0.4270	0.3834	0.3747	0.3312	0.3312	0.3224	0.3486	0.3747	0.3922	0.4096	(22b)
Effective ac	0.5988	0.5949	0.5912	0.5735	0.5702	0.5548	0.5548	0.5520	0.5608	0.5702	0.5769	0.5839	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			14.6700	1.1450	16.7977			(27)
External Wall 1	40.9500	14.6700	26.2800	0.1800	4.7304			(29a)
Corridor	11.3500	2.3100	9.0400	0.1800	1.6272			(29a)
Total net area of external elements Aum(A, m2)			52.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.4653			(33)
Party Wall 1			47.9500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 209.3516 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	23.1000	0.0700	1.6170
E7 Party floor between dwellings (in blocks of flats)	9.0800	0.0700	0.6356
E16 Corner (normal)	2.5000	0.0900	0.2250
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	9.6600	0.0200	0.1932
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	38.3600	0.0000	0.0000
E25 Staggered party wall between dwellings	5.0000	0.0600	0.3000
E16 Corner (normal)	2.5000	0.0900	0.2250
E2 Other lintels (including other steel lintels)	7.2000	0.0500	0.3600
E3 Sill	6.1000	0.0500	0.3050
E4 Jamb	22.8000	0.0500	1.1400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.0758 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 30.5411 (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	37.0242	36.7870	36.5545	35.4627	35.2584	34.3075	34.3075	34.1314	34.6738	35.2584	35.6717	36.1037	(38)
Heat transfer coeff	67.5653	67.3281	67.0957	66.0038	65.7995	64.8486	64.8486	64.6725	65.2149	65.7995	66.2128	66.6448	(39)
Average = Sum(39)m / 12 =												66.0028	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9015	0.8983	0.8952	0.8806	0.8779	0.8652	0.8652	0.8629	0.8701	0.8779	0.8834	0.8892	(40)
HLP (average)												0.8806	
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 2.3601 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	63.7903	62.8317	61.4348	58.7620	56.7895	54.5899	53.3396	54.7260	56.2457	58.6074	61.3376	63.5459	(42a)
Hot water usage for baths	27.5552	27.1459	26.5696	25.5071	24.7114	23.8292	23.3527	23.9249	24.5480	25.4920	26.5765	27.4620	(42b)
Hot water usage for other uses	38.7995	37.3886	35.9777	34.5668	33.1559	31.7451	31.7451	33.1559	34.5668	35.9777	37.3886	38.7995	(42c)
Average daily hot water use (litres/day)												119.6328	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	130.1450	127.3662	123.9821	118.8359	114.6569	110.1641	108.4373	111.8068	115.3605	120.0772	125.3027	129.8074	(44)
Energy conte	206.1179	181.3678	190.5559	162.6804	154.3502	135.4597	131.1455	138.4402	142.2510	162.9436	178.5167	203.2471	(45)
Energy content (annual)										Total = Sum(45)m =		1987.0760	
Distribution loss (46)m = 0.15 x (45)m	30.9177	27.2052	28.5834	24.4021	23.1525	20.3189	19.6718	20.7660	21.3377	24.4415	26.7775	30.4871	(46)
Water storage loss:													
Store volume												0.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												1.4400	(51)
Volume factor from Table 2a												0.0000	(52)
Temperature factor from Table 2b												1.0000	(53)
Enter (49) or (54) in (55)												1.4400	(55)
Total storage loss	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(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	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	250.7579	221.6878	235.1959	205.8804	198.9902	178.6597	175.7855	183.0802	185.4510	207.5836	221.7167	247.8871	(62)
WWHRS	-29.1623	-25.7914	-27.0072	-22.3631	-20.8416	-17.8343	-16.7168	-17.7766	-18.4520	-21.7529	-24.6434	-28.6222	(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	221.5956	195.8965	208.1887	183.5173	178.1487	160.8254	159.0687	165.3036	166.9990	185.8307	197.0733	219.2649	(64)
									Total per year (kWh/year) = Sum(64)m =			2241.7123	(64)
12Total per year (kWh/year)												2242	(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	104.2462	92.5608	99.0718	88.6512	87.0335	79.6003	79.3179	81.7434	81.8585	89.8907	93.9168	103.2917	(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	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	106.1919	117.5696	106.1919	109.7316	106.1919	109.7316	106.1919	106.1919	109.7316	106.1919	109.7316	106.1919	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	208.5642	210.7285	205.2747	193.6641	179.0079	165.2331	156.0307	153.8664	159.3203	170.9308	185.5870	199.3618	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	(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)													
	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	(71)
Water heating gains (Table 5)													
	140.1159	137.7393	133.1611	123.1267	116.9805	110.5560	106.6101	109.8701	113.6923	120.8209	130.4400	138.8329	(72)
Total internal gains													
	513.2731	524.4385	503.0287	484.9235	460.5813	443.9218	427.2337	428.3295	441.1453	456.3447	484.1598	502.7877	(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	
Southwest	11.5900	36.7938	0.6300	0.7000	0.7700	130.3258	(79)
West	3.0800	19.6403	0.6300	0.7000	0.7700	18.4871	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	148.8129	258.1578	363.2987	463.2113	527.9953	527.4675	507.2201	458.8740	398.1554	288.2621	179.1515	126.7346	(83)
Total gains	662.0860	782.5963	866.3275	948.1349	988.5766	971.3893	934.4538	887.2036	839.3007	744.6068	663.3113	629.5223	(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	64.5092	64.7365	64.9607	66.0353	66.2403	67.2117	67.2117	67.3947	66.8342	66.2403	65.8269	65.4002	
alpha	5.3006	5.3158	5.3307	5.4024	5.4160	5.4808	5.4808	5.4930	5.4556	5.4160	5.3885	5.3600	
util living area													
	0.9746	0.9436	0.8866	0.7635	0.6006	0.4249	0.3050	0.3348	0.5277	0.8064	0.9454	0.9795	(86)
MIT	20.1638	20.4014	20.6449	20.8700	20.9683	20.9961	20.9995	20.9991	20.9876	20.8541	20.4904	20.1268	(87)
Th 2	20.1662	20.1689	20.1716	20.1840	20.1863	20.1972	20.1972	20.1992	20.1930	20.1863	20.1816	20.1767	(88)
util rest of house													
	0.9688	0.9318	0.8651	0.7274	0.5534	0.3726	0.2495	0.2768	0.4692	0.7666	0.9320	0.9747	(89)
MIT 2	19.2097	19.5048	19.7982	20.0610	20.1611	20.1948	20.1970	20.1988	20.1850	20.0525	19.6286	19.1717	(90)
Living area fraction									fLA = Living area / (4) =			0.4950	(91)
MIT	19.6820	19.9486	20.2173	20.4615	20.5607	20.5914	20.5942	20.5950	20.5823	20.4493	20.0552	19.6445	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6820	19.9486	20.2173	20.4615	20.5607	20.5914	20.5942	20.5950	20.5823	20.4493	20.0552	19.6445	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9647	0.9283	0.8664	0.7401	0.5754	0.3984	0.2770	0.3055	0.4977	0.7802	0.9297	0.9709	(94)
Useful gains	638.7031	726.4774	750.5581	701.7258	568.8489	386.9963	258.8533	271.0189	417.7060	580.9115	616.6578	611.1891	(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													
	1039.2880	1013.1944	920.3721	763.1004	583.0276	388.5366	259.0186	271.2998	422.7427	648.0776	857.7990	1029.2959	(97)
Space heating kWh													
	298.0352	192.6739	126.3416	44.1897	10.5490	0.0000	0.0000	0.0000	0.0000	49.9716	173.6217	311.0715	(98a)
Space heating requirement - total per year (kWh/year)												1206.4540	
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													
	298.0352	192.6739	126.3416	44.1897	10.5490	0.0000	0.0000	0.0000	0.0000	49.9716	173.6217	311.0715	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1206.4540	
Space heating per m2										(98c) / (4) =		16.0968	(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 Combined Heat and Power-Space and Water	0.7000	(303a)
Fraction of heat from community Boilers-Space and Water	0.3000	(303b)
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

	298.0352	192.6739	126.3416	44.1897	10.5490	0.0000	0.0000	0.0000	0.0000	49.9716	173.6217	311.0715	(98)
Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50													
307a	312.9369	202.3075	132.6587	46.3992	11.0764	0.0000	0.0000	0.0000	0.0000	52.4701	182.3027	326.6251	
Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50													
307b	134.1158	86.7032	56.8537	19.8854	4.7470	0.0000	0.0000	0.0000	0.0000	22.4872	78.1297	139.9822	
Space heating requirement													
	447.0527	289.0108	189.5124	66.2846	15.8235	0.0000	0.0000	0.0000	0.0000	74.9573	260.4325	466.6072	(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

	221.5956	195.8965	208.1887	183.5173	178.1487	160.8254	159.0687	165.3036	166.9990	185.8307	197.0733	219.2649	(64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50													

310a	232.6754	205.6913	218.5981	192.6932	187.0561	168.8667	167.0222	173.5688	175.3490	195.1222	206.9269	230.2281	
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50													
310b	99.7180	88.1534	93.6849	82.5828	80.1669	72.3714	71.5809	74.3866	75.1496	83.6238	88.6830	98.6692	
Water heating fuel													
	332.3934	293.8447	312.2830	275.2760	267.2230	241.2381	238.6031	247.9554	250.4985	278.7460	295.6099	328.8973	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(331)
Lighting	22.0646	17.7010	15.9378	11.6767	9.0194	7.3690	8.2278	10.6948	13.8915	18.2265	20.5867	22.6778	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-5.2592	-8.2734	-13.2495	-16.6488	-19.5676	-18.8655	-18.6315	-16.7616	-13.8049	-10.1682	-6.0767	-4.4522	(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	-0.8375	-1.8492	-3.8491	-6.0529	-8.2861	-8.4385	-8.3459	-6.9383	-4.9184	-2.7344	-1.1450	-0.6564	(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	1809.6810	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	3362.5685	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	18.0968	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	178.0738	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-205.8106	(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	5144.5127	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	3120.1397	0.2100	655.2293	(363)
less credit emissions for electricity	-1196.5736	0.3480	-416.4076	(364)
Water heating from Combined Heat and Power	5797.5319	0.2100	1217.4817	(365)
less credit emissions for electricity	-2223.3535	0.3480	-773.7270	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	1939.5936	0.2100	142.5124	(368)
Electrical energy for heat distribution (space & water)	18.0968	0.0000	7.5879	(372)
Overall CO2 factor for heat network			0.2122	(386)
Total CO2 associated with community systems			1097.4789	(373)
Space and water heating			1097.4789	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	178.0738	0.1443	25.7016	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-151.7591	0.1324	-20.0915	
PV Unit electricity exported	-54.0516	0.1246	-6.7328	
Total			-26.8243	(380)
Total CO2, kg/year			1096.3562	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			14.6300	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	3120.1397	1.1300	3525.7579	(463)
less credit emissions for electricity	-1196.5736	2.1490	-2571.4366	(464)
Water heating from Combined Heat and Power	5797.5319	1.1300	6551.2110	(465)
less credit emissions for electricity	-2223.3535	2.1490	-4777.9866	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	1939.5936	1.1300	766.8523	(468)
Electrical energy for heat distribution (space & water)	18.0968	0.0000	79.7912	(472)
Overall CO2 factor for heat network			0.9665	(486)
Total CO2 associated with community systems			4999.0775	(473)
Space and water heating			4999.0775	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	178.0738	1.5338	273.1355	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-151.7591	1.4892	-225.9944	
PV Unit electricity exported	-54.0516	0.4572	-24.7104	
Total			-250.7048	(480)
Total Primary energy kWh/year			5021.5083	(483)
Target Primary Energy Rate (TPER)			67.0000	(484)

Full SAP Calculation Printout

Property Reference	K2 Top	**Issued on Date**	20/02/2024
Assessment Reference	00001_Copy	**Prop Type Ref**	
Property			

SAP Rating	84 B	**DER**	15.70	**TER**	19.35
Environmental	87 B	**% DER < TER**			18.86
CO_2 Emissions (t/year)	1.06	**DFEE**	32.51	**TFEE**	37.75
Compliance Check	See BREL	**% DFEE < TFEE**			13.89
% DPER < TPER	14.47	**DPER**	75.65	**TPER**	88.45

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	74.6000 (1b)	x	2.5000 (2b)	=	186.5000	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.6000					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	186.5000	(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) =												81.9000	(23c)
Effective ac	0.2387	0.2358	0.2329	0.2184	0.2155	0.2009	0.2009	0.1980	0.2067	0.2155	0.2213	0.2271	(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)			12.9100	0.8687	11.2153			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
External Wall 1	31.3300	12.9100	18.4200	0.1600	2.9472	150.0000	2763.0000	(29a)
Corridor	20.3500	2.3100	18.0400	0.1600	2.8864	150.0000	2706.0000	(29a)
External Roof 1	74.6000		74.6000	0.1000	7.4600	9.0000	671.4000	(30)
Total net area of external elements Aum(A, m2)			126.2800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.8189			(33)
Party Wall 1			35.8800	0.0000	0.0000	70.0000	2511.6000	(32)
Party Floor 1			74.6000			40.0000	2984.0000	(32d)
Party Ceiling 1			44.1800			30.0000	1325.4000	(32b)
Internal Wall 1			122.1000			9.0000	1098.9000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14060.3000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		188.4759 (35)
List of Thermal Bridges		

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	7.6900	0.0600	0.4614
E7 Party floor between dwellings (in blocks of flats)	8.1400	0.1100	0.8954
E16 Corner (normal)	2.5000	0.1600	0.4000
E18 Party wall between dwellings	2.5000	0.0450	0.1125
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.8400	0.1500	0.7260
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.3500	0.0000	0.0000
E25 Staggered party wall between dwellings	5.0000	0.1200	0.6000
E18 Party wall between dwellings	2.5000	0.1000	0.2500
E15 Flat roof with parapet	12.5300	0.3000	3.7590
E14 Flat roof	8.1400	0.1600	1.3024
E2 Other lintels (including other steel lintels)	6.4000	0.0500	0.3200
E3 Sill	5.3000	0.0500	0.2650
E4 Jamb	18.4000	0.1000	1.8400
P4 Party wall - Roof (insulation at ceiling level)	14.3500	0.0170	0.2440

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.1757 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 37.9945 (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	14.6919	14.5131	14.3342	13.4399	13.2610	12.3667	12.3667	12.1878	12.7244	13.2610	13.6188	13.9765	(38)
Heat transfer coeff	52.6864	52.5076	52.3287	51.4344	51.2555	50.3612	50.3612	50.1823	50.7189	51.2555	51.6133	51.9710	(39)
Average = Sum(39)m / 12 =												51.3897	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7063	0.7039	0.7015	0.6895	0.6871	0.6751	0.6751	0.6727	0.6799	0.6871	0.6919	0.6967	(40)
HLP (average)												0.6889	
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 2.3524 (42)
Hot water usage for mixer showers

63.6623	62.7056	61.3115	58.6440	56.6756	54.4803	53.2325	54.6161	56.1328	58.4898	61.2145	63.4184	(42a)

Hot water usage for baths

27.5001	27.0917	26.5166	25.4561	24.6621	23.7816	23.3060	23.8771	24.4989	25.4411	26.5234	27.4071	(42b)

Hot water usage for other uses

38.7213	37.3133	35.9052	34.4972	33.0891	31.6811	31.6811	33.0891	34.4972	35.9052	37.3133	38.7213	(42c)

Average daily hot water use (litres/day) 119.3926 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.8837	127.1105	123.7332	118.5973	114.4267	109.9430	108.2196	111.5823	115.1289	119.8361	125.0511	129.5468	(44)
Energy conte	205.7040	181.0037	190.1733	162.3538	154.0404	135.1877	130.8822	138.1623	141.9654	162.6164	178.1583	202.8390	(45)
Energy content (annual)										Total = Sum(45)m =		1983.0866	
Distribution loss (46)m = 0.15 x (45)m													
	30.8556	27.1506	28.5260	24.3531	23.1061	20.2782	19.6323	20.7243	21.2948	24.3925	26.7237	30.4259	(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	260.9808	230.9311	245.4501	215.8475	209.3172	188.6814	186.1590	193.4391	195.4591	217.8932	231.6519	258.1158	(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	260.9808	230.9311	245.4501	215.8475	209.3172	188.6814	186.1590	193.4391	195.4591	217.8932	231.6519	258.1158	(64)
									Total per year (kWh/year) = Sum(64)m =			2633.9264	(64)
12Total per year (kWh/year)												2634	(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	112.6180	100.1257	107.4541	96.7776	95.4399	87.7449	87.7398	90.1604	89.9985	98.2914	102.0326	111.6654	(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	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	107.7501	119.2948	107.7501	111.3418	107.7501	111.3418	107.7501	107.7501	111.3418	107.7501	111.3418	107.7501	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.7869	209.9431	204.5096	192.9423	178.3407	164.6172	155.4491	153.2929	158.7264	170.2937	184.8953	198.6188	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	(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)	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	(71)
Water heating gains (Table 5)	151.3683	148.9965	144.4275	134.4133	128.2794	121.8679	117.9298	121.1833	124.9978	132.1121	141.7119	150.0879	(72)
Total internal gains	525.1919	536.5209	514.9738	496.9840	472.6568	456.1134	439.4156	440.5130	453.3527	468.4425	496.2356	514.7434	(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			
Northeast					12.9100	11.2829		0.4000	0.8000	0.7700		32.3022	(75)
Solar gains	32.3022	65.7520	118.4642	194.5523	261.5164	278.8042	260.8156	207.9252	144.3505	80.3542	40.6445	26.3796	(83)
Total gains	557.4941	602.2730	633.4380	691.5362	734.1732	734.9176	700.2312	648.4382	597.7032	548.7967	536.8801	541.1230	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	74.1299	74.3824	74.6366	75.9344	76.1994	77.5525	77.5525	77.8290	77.0055	76.1994	75.6712	75.1504	
alpha	5.9420	5.9588	5.9758	6.0623	6.0800	6.1702	6.1702	6.1886	6.1337	6.0800	6.0447	6.0100	
util living area	0.9746	0.9579	0.9216	0.8094	0.6320	0.4370	0.3163	0.3556	0.5762	0.8460	0.9499	0.9778	(86)
MIT	20.3326	20.4673	20.6526	20.8753	20.9747	20.9978	20.9997	20.9995	20.9889	20.8629	20.5871	20.3162	(87)
Th 2	20.3353	20.3374	20.3395	20.3501	20.3523	20.3629	20.3629	20.3650	20.3586	20.3523	20.3480	20.3438	(88)
util rest of house	0.9695	0.9499	0.9073	0.7813	0.5926	0.3941	0.2706	0.3067	0.5259	0.8157	0.9391	0.9733	(89)
MIT 2	19.5609	19.7302	19.9586	20.2258	20.3307	20.3614	20.3628	20.3648	20.3507	20.2188	19.8894	19.5471	(90)
Living area fraction										fLA = Living area / (4) =		0.3610	(91)
MIT	19.8395	19.9963	20.2091	20.4603	20.5632	20.5911	20.5927	20.5939	20.5811	20.4513	20.1413	19.8247	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8395	19.9963	20.2091	20.4603	20.5632	20.5911	20.5927	20.5939	20.5811	20.4513	20.1413	19.8247	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9651	0.9452	0.9041	0.7863	0.6056	0.4096	0.2871	0.3244	0.5435	0.8206	0.9352	0.9691	(94)
Useful gains	538.0104	569.2388	572.7145	543.7251	444.6090	300.9879	201.0133	210.3259	324.8809	450.3483	502.1152	524.4076	(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	818.7207	792.6697	717.3812	594.5963	454.2873	301.7211	201.0783	210.4604	328.7134	504.9334	673.1029	812.0335	(97)
Space heating kWh	208.8484	150.1456	107.6320	36.6273	7.2007	0.0000	0.0000	0.0000	0.0000	40.6113	123.1111	213.9936	(98a)
Space heating requirement - total per year (kWh/year)												888.1701	
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	208.8484	150.1456	107.6320	36.6273	7.2007	0.0000	0.0000	0.0000	0.0000	40.6113	123.1111	213.9936	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												888.1701	
Space heating per m2										(98c) / (4) =		11.9058	(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 Combined Heat and Power-Space and Water												0.7000	(303a)
Fraction of heat from community Boilers-Space and Water												0.3000	(303b)
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	208.8484	150.1456	107.6320	36.6273	7.2007	0.0000	0.0000	0.0000	0.0000	40.6113	123.1111	213.9936	(98)
Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50													
307a	219.2909	157.6528	113.0136	38.4586	7.5607	0.0000	0.0000	0.0000	0.0000	42.6419	129.2667	224.6933	
Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50													
307b	93.9818	67.5655	48.4344	16.4823	3.2403	0.0000	0.0000	0.0000	0.0000	18.2751	55.4000	96.2971	
Space heating requirement	313.2727	225.2183	161.4480	54.9409	10.8010	0.0000	0.0000	0.0000	0.0000	60.9170	184.6667	320.9904	(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	260.9808	230.9311	245.4501	215.8475	209.3172	188.6814	186.1590	193.4391	195.4591	217.8932	231.6519	258.1158	(64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50													
310a	274.0299	242.4777	257.7227	226.6398	219.7830	198.1155	195.4670	203.1110	205.2321	228.7879	243.2345	271.0216	
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50													
310b	117.4414	103.9190	110.4526	97.1314	94.1927	84.9066	83.7716	87.0476	87.9566	98.0520	104.2434	116.1521	
Water heating fuel	391.4713	346.3967	368.1752	323.7712	313.9758	283.0221	279.2386	290.1586	293.1887	326.8399	347.4779	387.1737	(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	12.3290	11.1359	12.3290	11.9313	12.3290	11.9313	12.3290	12.3290	11.9313	12.3290	11.9313	12.3290	(331)
Lighting	25.7109	20.6263	18.5717	13.6064	10.5100	8.5867	9.5875	12.4623	16.1872	21.2385	23.9889	26.4255	(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												1332.2551	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3950.8895	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												13.3226	(313)
Space cooling fuel												0.0000	(321)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)		
mechanical ventilation fans (SFP = 0.6380)	145.1641	(330a)
Total electricity for the above, kWh/year	145.1641	(331)
Electricity for lighting (calculated in Appendix L)	207.5020	(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	5635.8108	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	2296.9916	0.2100	482.3682	(363)
less credit emissions for electricity	-880.8963	0.3480	-306.5519	(364)
Water heating from Combined Heat and Power	6811.8785	0.2100	1430.4945	(365)
less credit emissions for electricity	-2612.3554	0.3480	-909.0997	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	1981.1793	0.2100	104.9151	(368)
Electrical energy for heat distribution (space & water)	13.3226	0.0000	7.6613	(372)
Overall CO2 factor for heat network			0.2122	(386)
Total CO2 associated with community systems			1120.9201	(373)
Space and water heating			1120.9201	(376)
Pumps, fans and electric keep-hot	145.1641	0.1387	20.1361	(378)
Energy for lighting	207.5020	0.1443	29.9489	(379)
Total CO2, kg/year			1171.0051	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			15.7000	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	2296.9916	1.1300	2595.6005	(463)
less credit emissions for electricity	-880.8963	2.1490	-1893.0461	(464)
Water heating from Combined Heat and Power	6811.8785	1.1300	7697.4227	(465)
less credit emissions for electricity	-2612.3554	2.1490	-5613.9518	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	1981.1793	1.1300	564.5431	(468)
Electrical energy for heat distribution (space & water)	13.3226	0.0000	81.1695	(472)
Overall CO2 factor for heat network			0.9665	(486)
Total CO2 associated with community systems			5105.9274	(473)
Space and water heating			5105.9274	(476)
Pumps, fans and electric keep-hot	145.1641	1.5128	219.6043	(478)
Energy for lighting	207.5020	1.5338	318.2734	(479)
Total Primary energy kWh/year			5643.8052	(483)
Dwelling Primary energy Rate (DPER)			75.6500	(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		74.6000 (1b)	x	2.5000 (2b)	=	186.5000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.6000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	186.5000	(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) =	0.1609 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.4109 (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) = 0.3184 (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	0.4060	0.3980	0.3901	0.3503	0.3423	0.3025	0.3025	0.2945	0.3184	0.3423	0.3582	0.3741	(22b)
Effective ac	0.5824	0.5792	0.5761	0.5613	0.5586	0.5458	0.5458	0.5434	0.5507	0.5586	0.5642	0.5700	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			12.9100	1.1450	14.7824			(27)
External Wall 1	31.3300	12.9100	18.4200	0.1800	3.3156			(29a)
Corridor	20.3500	2.3100	18.0400	0.1800	3.2472			(29a)
External Roof 1	74.6000		74.6000	0.1100	8.2060			(30)
Total net area of external elements Aum(A, m2)			126.2800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.8612			(33)
Party Wall 1			35.8800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 194.3981 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E7	Party floor between dwellings (in blocks of flats)	7.6900	0.0700	0.5383
E7	Party floor between dwellings (in blocks of flats)	8.1400	0.0700	0.5698
E16	Corner (normal)	2.5000	0.0900	0.2250
E18	Party wall between dwellings	2.5000	0.0600	0.1500
E23	Balcony within or between dwellings, balcony support penetrates wall insulation	4.8400	0.0200	0.0968
P3	Party wall - Intermediate floor between dwellings (in blocks of flats)	14.3500	0.0000	0.0000
E25	Staggered party wall between dwellings	5.0000	0.0600	0.3000
E18	Party wall between dwellings	2.5000	0.0600	0.1500
E15	Flat roof with parapet	12.5300	0.5600	7.0168
E14	Flat roof	8.1400	0.0800	0.6512
E2	Other lintels (including other steel lintels)	6.4000	0.0500	0.3200
E3	Sill	5.3000	0.0500	0.2650
E4	Jamb	18.4000	0.0500	0.9200
P4	Party wall - Roof (insulation at ceiling level)	14.3500	0.1200	1.7220

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.9249 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 44.7861 (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	35.8444	35.6474	35.4544	34.5477	34.3780	33.5883	33.5883	33.4420	33.8925	34.3780	34.7212	35.0800	(38)
Heat transfer coeff	80.6305	80.4336	80.2405	79.3338	79.1642	78.3744	78.3744	78.2282	78.6786	79.1642	79.5073	79.8661	(39)
Average = Sum(39)m / 12 =												79.3330	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0808	1.0782	1.0756	1.0635	1.0612	1.0506	1.0506	1.0486	1.0547	1.0612	1.0658	1.0706	(40)
HLP (average)												1.0634	
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 2.3524 (42)
Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
63.6623	62.7056	61.3115	58.6440	56.6756	54.4803	53.2325	54.6161	56.1328	58.4898	61.2145	63.4184	(42a)

Hot water usage for baths

27.5001	27.0917	26.5166	25.4561	24.6621	23.7816	23.3060	23.8771	24.4989	25.4411	26.5234	27.4071	(42b)

Hot water usage for other uses

38.7213	37.3133	35.9052	34.4972	33.0891	31.6811	31.6811	33.0891	34.4972	35.9052	37.3133	38.7213	(42c)

Average daily hot water use (litres/day) 119.3926 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.8837	127.1105	123.7332	118.5973	114.4267	109.9430	108.2196	111.5823	115.1289	119.8361	125.0511	129.5468	(44)
Energy conte	205.7040	181.0037	190.1733	162.3538	154.0404	135.1877	130.8822	138.1623	141.9654	162.6164	178.1583	202.8390	(45)
Energy content (annual)										Total = Sum(45)m =		1983.0866	
Distribution loss (46)m = 0.15 x (45)m	30.8556	27.1506	28.5260	24.3531	23.1061	20.2782	19.6323	20.7243	21.2948	24.3925	26.7237	30.4259	(46)

Water storage loss:
Store volume 0.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 1.4400 (51)
Volume factor from Table 2a 0.0000 (52)
Temperature factor from Table 2b 1.0000 (53)
Enter (49) or (54) in (55) 1.4400 (55)
Total storage loss

44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)

If cylinder contains dedicated solar storage

44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(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 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

250.3440	221.3237	234.8133	205.5538	198.6804	178.3877	175.5222	182.8023	185.1654	207.2564	221.3583	247.4790	(62)
WWHRS -29.1037	-25.7396	-26.9530	-22.3182	-20.7997	-17.7985	-16.6832	-17.7409	-18.4150	-21.7092	-24.5939	-28.5648	(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

221.2403	195.5841	207.8603	183.2356	177.8806	160.5892	158.8390	165.0613	166.7504	185.5472	196.7643	218.9142	(64)

Total per year (kWh/year) = Sum(64)m = 2238.2667 (64)
12Total per year (kWh/year) 2238 (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

	104.1086	92.4397	98.9446	88.5426	86.9304	79.5099	79.2303	81.6509	81.7635	89.7820	93.7976	103.1560 (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	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	(66)

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

	107.7501	119.2948	107.7501	111.3418	107.7501	111.3418	107.7501	107.7501	111.3418	107.7501	111.3418	107.7501	(67)

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

	207.7869	209.9431	204.5096	192.9423	178.3407	164.6172	155.4491	153.2929	158.7264	170.2937	184.8953	198.6188	(68)

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

	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	(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)

	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	(71)

Water heating gains (Table 5)

	139.9309	137.5591	132.9901	122.9759	116.8420	110.4304	106.4924	109.7459	113.5604	120.6747	130.2745	138.6505	(72)

Total internal gains

	513.7545	525.0835	503.5364	485.5465	461.2193	444.6760	427.9782	429.0755	441.9152	457.0051	484.7982	503.3060	(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	
Northeast	12.9100	11.2829	0.6300	0.7000	0.7700	44.5164	(75)

Solar gains	44.5164	90.6145	163.2585	268.1174	360.4023	384.2270	359.4365	286.5470	198.9330	110.7381	56.0132	36.3544	(83)
Total gains	558.2709	615.6980	666.7949	753.6639	821.6217	828.9031	787.4147	715.6225	640.8483	567.7432	540.8114	539.6603	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.9607	50.0831	50.2036	50.7774	50.8862	51.3989	51.3989	51.4950	51.2002	50.8862	50.6665	50.4389	
alpha	4.3307	4.3389	4.3469	4.3852	4.3924	4.4266	4.4266	4.4330	4.4133	4.3924	4.3778	4.3626	
util living area	0.9870	0.9788	0.9600	0.8979	0.7673	0.5775	0.4315	0.4907	0.7421	0.9299	0.9772	0.9887	(86)
MIT	19.5914	19.7734	20.0723	20.4965	20.8119	20.9591	20.9910	20.9845	20.8801	20.4747	19.9755	19.5657	(87)
Th 2	20.0165	20.0187	20.0208	20.0308	20.0327	20.0414	20.0414	20.0430	20.0380	20.0327	20.0289	20.0249	(88)
util rest of house	0.9837	0.9735	0.9498	0.8726	0.7159	0.5009	0.3406	0.3942	0.6693	0.9068	0.9706	0.9859	(89)
MIT 2	18.3851	18.6169	18.9936	19.5166	19.8697	20.0157	20.0378	20.0363	19.9505	19.5035	18.8821	18.3584	(90)
Living area fraction									fLA = Living area / (4) =			0.3610	(91)
MIT	18.8206	19.0344	19.3830	19.8704	20.2098	20.3563	20.3819	20.3786	20.2861	19.8541	19.2768	18.7942	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8206	19.0344	19.3830	19.8704	20.2098	20.3563	20.3819	20.3786	20.2861	19.8541	19.2768	18.7942	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9784	0.9667	0.9416	0.8678	0.7260	0.5268	0.3733	0.4287	0.6894	0.9017	0.9639	0.9810	(94)
Useful gains	546.2199	595.1979	627.8693	654.0085	596.4970	436.6932	293.9463	306.8028	441.8268	511.9306	521.3066	529.4229	(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	1170.8040	1136.8775	1033.7401	870.3196	673.6695	451.1433	296.4048	311.2390	486.7105	732.5911	968.1455	1165.5833	(97)
Space heating kWh	464.6905	364.0086	301.9679	155.7440	57.4163	0.0000	0.0000	0.0000	0.0000	164.1714	321.7240	473.3034	(98a)
Space heating requirement - total per year (kWh/year)												2303.0262	
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	464.6905	364.0086	301.9679	155.7440	57.4163	0.0000	0.0000	0.0000	0.0000	164.1714	321.7240	473.3034	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2303.0262	
Space heating per m2										(98c) / (4) =		30.8717	(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 Combined Heat and Power-Space and Water	0.7000	(303a)
Fraction of heat from community Boilers-Space and Water	0.3000	(303b)
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

	464.6905	364.0086	301.9679	155.7440	57.4163	0.0000	0.0000	0.0000	0.0000	164.1714	321.7240	473.3034	(98)

Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50

307a	487.9251	382.2091	317.0663	163.5312	60.2871	0.0000	0.0000	0.0000	0.0000	172.3800	337.8102	496.9685	

Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50

307b	209.1107	163.8039	135.8855	70.0848	25.8373	0.0000	0.0000	0.0000	0.0000	73.8772	144.7758	212.9865	

Space heating requirement

	697.0358	546.0130	452.9518	233.6160	86.1244	0.0000	0.0000	0.0000	0.0000	246.2572	482.5860	709.9550	(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

	221.2403	195.5841	207.8603	183.2356	177.8806	160.5892	158.8390	165.0613	166.7504	185.5472	196.7643	218.9142 (64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50												
310a	232.3023	205.3633	218.2533	192.3974	186.7747	168.6187	166.7810	173.3144	175.0880	194.8246	206.6025	229.8599
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50												
310b	99.5581	88.0128	93.5371	82.4560	80.0463	72.2652	71.4776	74.2776	75.0377	83.4962	88.5439	98.5114
Water heating fuel												
	331.8604	293.3762	311.7905	274.8534	266.8210	240.8839	238.2585	247.5920	250.1257	278.3208	295.1465	328.3713 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (331)
Lighting	22.3884	17.9608	16.1717	11.8481	9.1518	7.4771	8.3486	10.8518	14.0954	18.4939	20.8888	23.0106 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-5.5195	-8.6695	-13.8624	-17.3911	-20.4143	-19.6723	-19.4285	-17.4912	-14.4235	-10.6442	-6.3730	-4.6740 (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	-0.9057	-1.9985	-4.1574	-6.5337	-8.9401	-9.1028	-9.0024	-7.4857	-5.3086	-2.9536	-1.2378	-0.7099 (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	3454.5393	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	3357.4001	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	34.5454	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	180.6868	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-216.8995	(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	6775.7267	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	5956.1022	0.2100	1250.7815	(363)
less credit emissions for electricity	-2284.1652	0.3480	-794.8895	(364)
Water heating from Combined Heat and Power	5788.6209	0.2100	1215.6104	(365)
less credit emissions for electricity	-2219.9361	0.3480	-772.5378	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	2554.4773	0.2100	272.0450	(368)
Electrical energy for heat distribution (space & water)	34.5454	0.0000	10.0994	(372)
Overall CO2 factor for heat network			0.2122	(386)
Total CO2 associated with community systems			1445.5043	(373)
Space and water heating			1445.5043	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	180.6868	0.1443	26.0787	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-158.5634	0.1324	-20.9971	
PV Unit electricity exported	-58.3361	0.1246	-7.2676	
Total			-28.2646	(380)
Total CO2, kg/year			1443.3183	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			19.3500	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	5956.1022	1.1300	6730.3955	(463)
less credit emissions for electricity	-2284.1652	2.1490	-4908.6710	(464)
Water heating from Combined Heat and Power	5788.6209	1.1300	6541.1416	(465)
less credit emissions for electricity	-2219.9361	2.1490	-4770.6427	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	2554.4773	1.1300	1463.8610	(468)
Electrical energy for heat distribution (space & water)	34.5454	0.0000	105.4883	(472)
Overall CO2 factor for heat network			0.9666	(486)
Total CO2 associated with community systems			6584.2710	(473)
Space and water heating			6584.2710	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	180.6868	1.5338	277.1435	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-158.5634	1.4893	-236.1451	
PV Unit electricity exported	-58.3361	0.4572	-26.6730	
Total			-262.8181	(480)
Total Primary energy kWh/year			6598.5964	(483)
Target Primary Energy Rate (TPER)			88.4500	(484)

Full SAP Calculation Printout

Property Reference	K3 Mid	**Issued on Date**	20/02/2024
Assessment Reference	00001_Copy	**Prop Type Ref**	
Property			

SAP Rating	86 B	**DER**	12.34	**TER**	13.53
Environmental	89 B	**% DER < TER**			8.80
CO_2 Emissions (t/year)	1	**DFEE**	22.69	**TFEE**	23.16
Compliance Check	See BREL	**% DFEE < TFEE**			2.05
% DPER < TPER	0.65	**DPER**	60.38	**TPER**	60.78

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	87.4200	(1b)	x 2.5000	(2b) =	218.5500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		218.5500	(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) =		81.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448	(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)			15.3300	0.8687	13.3176			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
External Wall 1	30.8800	15.3300	15.5500	0.1600	2.4880	150.0000	2332.5000	(29a)
Corridor	12.2000	2.3100	9.8900	0.1600	1.5824	150.0000	1483.5000	(29a)
External Wall 3	14.3500		14.3500	0.1600	2.2960	150.0000	2152.5000	(29a)
Total net area of external elements Aum(A, m2)			57.4300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		21.9940			(33)
Party Wall 1			53.8500	0.0000	0.0000	70.0000	3769.5000	(32)
Party Floor 1			87.4200			40.0000	3496.8000	(32d)
Party Ceiling 1			87.4200			30.0000	2622.6000	(32b)
Internal Wall 1			133.6000			9.0000	1202.4000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17059.8000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		195.1476 (35)
List of Thermal Bridges		

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	11.2400	0.0600	0.6744
E7 Party floor between dwellings (in blocks of flats)	21.2400	0.1100	2.3364
E16 Corner (normal)	2.5000	0.1600	0.4000
E17 Corner (inverted - internal area greater than external area)	2.5000	0.0000	0.0000
E18 Party wall between dwellings	5.0000	0.0450	0.2250
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	13.4600	0.1500	2.0190
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	43.0800	0.0000	0.0000
E25 Staggered party wall between dwellings	5.0000	0.1200	0.6000
E16 Corner (normal)	2.5000	0.1300	0.3250
E2 Other lintels (including other steel lintels)	7.5000	0.0500	0.3750
E3 Sill	6.4000	0.0500	0.3200
E4 Jamb	22.8000	0.1000	2.2800

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.5548 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 31.5488 (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	18.5758	18.3459	18.1160	16.9666	16.7367	15.5873	15.5873	15.3574	16.0470	16.7367	17.1965	17.6562	(38)
Heat transfer coeff	50.1246	49.8947	49.6648	48.5154	48.2855	47.1360	47.1360	46.9061	47.5958	48.2855	48.7452	49.2050	(39)

Average = Sum(39)m / 12 = 48.4579

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.5734	0.5707	0.5681	0.5550	0.5523	0.5392	0.5392	0.5366	0.5444	0.5523	0.5576	0.5629	(40)
HLP (average)												0.5543	
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 2.5887 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
67.6243	66.6080	65.1271	62.2937	60.2027	57.8709	56.5454	58.0151	59.6262	62.1299	65.0242	67.3652	(42a)

Hot water usage for baths

29.2039	28.7702	28.1594	27.0333	26.1900	25.2550	24.7499	25.3564	26.0168	27.0173	28.1666	29.1052	(42b)

Hot water usage for other uses

41.1412	39.6452	38.1491	36.6531	35.1570	33.6610	33.6610	35.1570	36.6531	38.1491	39.6452	41.1412	(42c)

Average daily hot water use (litres/day) 126.8251 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	137.9694	135.0234	131.4357	125.9801	121.5498	116.7869	114.9564	118.5286	122.2961	127.2963	132.8360	137.6116	(44)
Energy conte	218.5098	192.2715	202.0117	172.4604	163.6294	143.6031	139.0298	146.7632	150.8033	172.7399	189.2492	215.4665	(45)
Energy content (annual)										Total = Sum(45)m =		2106.5377	
Distribution loss (46)m = 0.15 x (45)m	32.7765	28.8407	30.3018	25.8691	24.5444	21.5405	20.8545	22.0145	22.6205	25.9110	28.3874	32.3200	(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

273.7866	242.1989	257.2885	225.9541	218.9062	197.0968	194.3066	202.0400	204.2970	228.0167	242.7429	270.7433	(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

273.7866	242.1989	257.2885	225.9541	218.9062	197.0968	194.3066	202.0400	204.2970	228.0167	242.7429	270.7433	(64)
									Total per year (kWh/year) = Sum(64)m =		2757.3775	(64)
12Total per year (kWh/year)											2757	(64)

Electric shower(s)

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

Heat gains from water heating, kWh/month

116.8760	103.8722	111.3903	100.1380	98.6282	90.5430	90.4488	93.0202	92.9370	101.6575	105.7203	115.8640	(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	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	121.1964	134.1818	121.1964	125.2363	121.1964	125.2363	121.1964	121.1964	125.2363	121.1964	125.2363	121.1964	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	234.2503	236.6811	230.5556	217.5151	201.0539	185.5826	175.2469	172.8161	178.9416	191.9821	208.4433	223.9146	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	(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)	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)	157.0913	154.5718	149.7182	139.0806	132.5648	125.7541	121.5710	125.0271	129.0792	136.6364	146.8338	155.7312	(72)
Total internal gains	574.3691	587.2656	563.3013	543.6631	516.6461	498.4041	479.8454	480.8707	495.0882	511.6459	542.3444	562.6733	(73)

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6. Solar gains

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

Northeast				6.7500	11.2829	0.4000	0.8000	0.7700				16.8892	(75)
Southwest				8.5800	36.7938	0.4000	0.8000	0.7700				70.0077	(79)
Solar gains	86.8969	153.6274	225.1007	303.8869	363.1758	370.5772	353.1029	307.3376	252.1432	173.8087	105.1040	73.7045	(83)
Total gains	661.2660	740.8931	788.4019	847.5500	879.8219	868.9813	832.9483	788.2084	747.2314	685.4546	647.4484	636.3778	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	94.5411	94.9767	95.4164	97.6770	98.1420	100.5353	100.5353	101.0280	99.5641	98.1420	97.2163	96.3079	
alpha	7.3027	7.3318	7.3611	7.5118	7.5428	7.7024	7.7024	7.7352	7.6376	7.5428	7.4811	7.4205	
util living area	0.9563	0.9124	0.8370	0.6785	0.5088	0.3471	0.2490	0.2737	0.4390	0.7125	0.9011	0.9629	(86)
MIT	20.6521	20.7835	20.8974	20.9796	20.9976	20.9999	21.0000	21.0000	20.9994	20.9764	20.8394	20.6355	(87)
Th 2	20.4540	20.4564	20.4588	20.4707	20.4731	20.4850	20.4850	20.4874	20.4803	20.4731	20.4683	20.4635	(88)
util rest of house	0.9487	0.8994	0.8168	0.6519	0.4805	0.3192	0.2199	0.2432	0.4061	0.6812	0.8849	0.9562	(89)
MIT 2	20.0563	20.2168	20.3512	20.4513	20.4711	20.4850	20.4850	20.4874	20.4798	20.4515	20.2960	20.0443	(90)
Living area fraction									fLA = Living area / (4) =			0.3284	(91)
MIT	20.2519	20.4029	20.5306	20.6248	20.6440	20.6541	20.6542	20.6558	20.6505	20.6239	20.4745	20.2385	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2519	20.4029	20.5306	20.6248	20.6440	20.6541	20.6542	20.6558	20.6505	20.6239	20.4745	20.2385	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9455	0.8981	0.8196	0.6597	0.4897	0.3283	0.2294	0.2533	0.4169	0.6903	0.8851	0.9531	(94)
Useful gains	625.2489	665.3617	646.1664	559.1520	430.8392	285.3294	191.0950	199.6176	311.5460	473.1468	573.0679	606.5522	(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	799.5840	773.5121	696.8250	568.8329	431.8675	285.3655	191.0967	199.6212	311.7752	484.0094	651.9410	789.1740	(97)
Space heating kWh	129.7053	72.6770	37.6900	6.9702	0.7651	0.0000	0.0000	0.0000	0.0000	8.0818	56.7886	135.8706	(98a)
Space heating requirement - total per year (kWh/year)												448.5487	
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	129.7053	72.6770	37.6900	6.9702	0.7651	0.0000	0.0000	0.0000	0.0000	8.0818	56.7886	135.8706	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												448.5487	
Space heating per m2										(98c) / (4) =		5.1310	(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 Combined Heat and Power-Space and Water												0.7000	(303a)
Fraction of heat from community Boilers-Space and Water												0.3000	(303b)
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	129.7053	72.6770	37.6900	6.9702	0.7651	0.0000	0.0000	0.0000	0.0000	8.0818	56.7886	135.8706	(98)
Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50													
307a	136.1906	76.3109	39.5745	7.3187	0.8033	0.0000	0.0000	0.0000	0.0000	8.4859	59.6280	142.6641	
Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50													
307b	58.3674	32.7047	16.9605	3.1366	0.3443	0.0000	0.0000	0.0000	0.0000	3.6368	25.5549	61.1418	
Space heating requirement	194.5580	109.0156	56.5350	10.4553	1.1476	0.0000	0.0000	0.0000	0.0000	12.1227	85.1829	203.8059	(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	273.7866	242.1989	257.2885	225.9541	218.9062	197.0968	194.3066	202.0400	204.2970	228.0167	242.7429	270.7433	(64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50													
310a	287.4759	254.3089	270.1530	237.2518	229.8515	206.9516	204.0219	212.1420	214.5118	239.4175	254.8800	284.2804	
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50													
310b	123.2040	108.9895	115.7798	101.6793	98.5078	88.6935	87.4380	90.9180	91.9336	102.6075	109.2343	121.8345	
Water heating fuel	410.6799	363.2984	385.9328	338.9311	328.3593	295.6451	291.4599	303.0600	306.4454	342.0251	364.1143	406.1149	(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	14.4477	13.0496	14.4477	13.9817	14.4477	13.9817	14.4477	14.4477	13.9817	14.4477	13.9817	14.4477	(331)
Lighting	30.2291	24.2509	21.8353	15.9975	12.3569	10.0957	11.2724	14.6523	19.0318	24.9708	28.2045	31.0693	(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												672.8230	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												4136.0662	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												6.7282	(313)
Space cooling fuel												0.0000	(321)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)		
mechanical ventilation fans (SFP = 0.6380)	170.1106	(330a)
Total electricity for the above, kWh/year	170.1106	(331)
Electricity for lighting (calculated in Appendix L)	243.9665	(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	5222.9663	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	1160.0397	0.2100	243.6083	(363)
less credit emissions for electricity	-444.8752	0.3480	-154.8166	(364)
Water heating from Combined Heat and Power	7131.1487	0.2100	1497.5412	(365)
less credit emissions for electricity	-2734.7955	0.3480	-951.7088	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	1803.3335	0.2100	52.9848	(368)
Electrical energy for heat distribution (space & water)	6.7282	0.0000	6.8996	(372)
Overall CO2 factor for heat network			0.2122	(386)
Total CO2 associated with community systems			1020.2238	(373)
Space and water heating			1020.2238	(376)
Pumps, fans and electric keep-hot	170.1106	0.1387	23.5964	(378)
Energy for lighting	243.9665	0.1443	35.2119	(379)
Total CO2, kg/year			1079.0321	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.3400	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	1160.0397	1.1300	1310.8448	(463)
less credit emissions for electricity	-444.8752	2.1490	-956.0368	(464)
Water heating from Combined Heat and Power	7131.1487	1.1300	8058.1980	(465)
less credit emissions for electricity	-2734.7955	2.1490	-5877.0756	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	1803.3335	1.1300	285.1087	(468)
Electrical energy for heat distribution (space & water)	6.7282	0.0000	73.6052	(472)
Overall CO2 factor for heat network			0.9664	(486)
Total CO2 associated with community systems			4647.3024	(473)
Space and water heating			4647.3024	(476)
Pumps, fans and electric keep-hot	170.1106	1.5128	257.3433	(478)
Energy for lighting	243.9665	1.5338	374.2040	(479)
Total Primary energy kWh/year			5278.8497	(483)
Dwelling Primary energy Rate (DPER)			60.3800	(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	87.4200 (1b)	x	2.5000 (2b)	=	218.5500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 87.4200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.5500	(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) =	0.1373	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3873	(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) = 0.3292 (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	0.4197	0.4115	0.4032	0.3621	0.3539	0.3127	0.3127	0.3045	0.3292	0.3539	0.3703	0.3868	(22b)
Effective ac	0.5881	0.5847	0.5813	0.5656	0.5626	0.5489	0.5489	0.5464	0.5542	0.5626	0.5686	0.5748	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			15.3300	1.1450	17.5534			(27)
External Wall 1	30.8800	15.3300	15.5500	0.1800	2.7990			(29a)
Corridor	12.2000	2.3100	9.8900	0.1800	1.7802			(29a)
External Wall 3	14.3500		14.3500	0.1800	2.5830			(29a)
Total net area of external elements Aum(A, m2)			57.4300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.0256			(33)
Party Wall 1			53.8500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 205.1476 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	11.2400	0.0700	0.7868
E7 Party floor between dwellings (in blocks of flats)	21.2400	0.0700	1.4868
E16 Corner (normal)	2.5000	0.0900	0.2250
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	13.4600	0.0200	0.2692
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	43.0800	0.0000	0.0000
E25 Staggered party wall between dwellings	5.0000	0.0600	0.3000
E16 Corner (normal)	2.5000	0.0900	0.2250
E2 Other lintels (including other steel lintels)	7.5000	0.0500	0.3750
E3 Sill	6.4000	0.0500	0.3200
E4 Jamb	22.8000	0.0500	1.1400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.2028 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.2284 (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	42.4128	42.1662	41.9244	40.7888	40.5763	39.5872	39.5872	39.4041	39.9682	40.5763	41.0062	41.4555	(38)
Heat transfer coeff	74.6413	74.3946	74.1528	73.0172	72.8048	71.8157	71.8157	71.6325	72.1967	72.8048	73.2346	73.6839	(39)
Average = Sum(39)m / 12 =												73.0162	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8538	0.8510	0.8482	0.8352	0.8328	0.8215	0.8215	0.8194	0.8259	0.8328	0.8377	0.8429	(40)
HLP (average)												0.8352	
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 2.5887 (42)
Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
67.6243	66.6080	65.1271	62.2937	60.2027	57.8709	56.5454	58.0151	59.6262	62.1299	65.0242	67.3652	(42a)

Hot water usage for baths

29.2039	28.7702	28.1594	27.0333	26.1900	25.2550	24.7499	25.3564	26.0168	27.0173	28.1666	29.1052	(42b)

Hot water usage for other uses

41.1412	39.6452	38.1491	36.6531	35.1570	33.6610	33.6610	35.1570	36.6531	38.1491	39.6452	41.1412	(42c)

Average daily hot water use (litres/day) 126.8251 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	137.9694	135.0234	131.4357	125.9801	121.5498	116.7869	114.9564	118.5286	122.2961	127.2963	132.8360	137.6116	(44)
Energy conte	218.5098	192.2715	202.0117	172.4604	163.6294	143.6031	139.0298	146.7632	150.8033	172.7399	189.2492	215.4665	(45)
Energy content (annual)										Total = Sum(45)m =		2106.5377	
Distribution loss (46)m = 0.15 x (45)m	32.7765	28.8407	30.3018	25.8691	24.5444	21.5405	20.8545	22.0145	22.6205	25.9110	28.3874	32.3200	(46)

Water storage loss:
Store volume 0.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 1.4400 (51)
Volume factor from Table 2a 0.0000 (52)
Temperature factor from Table 2b 1.0000 (53)
Enter (49) or (54) in (55) 1.4400 (55)
Total storage loss

44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)

If cylinder contains dedicated solar storage

44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(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 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

263.1498	232.5915	246.6517	215.6604	208.2694	186.8031	183.6698	191.4032	194.0033	217.3799	232.4492	260.1065	(62)
WWHRS -30.9150	-27.3415	-28.6304	-23.7071	-22.0942	-18.9062	-17.7215	-18.8450	-19.5610	-23.0603	-26.1245	-30.3425	(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													
232.2348	205.2500	218.0213	191.9533	186.1752	167.8969	165.9483	172.5581	174.4422	194.3196	206.3247	229.7640	(64)
									Total per year (kWh/year) = Sum(64)m =		2344.8884	(64)
12Total per year (kWh/year)											2345	(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

108.3665	96.1863	102.8809	91.9031	90.1188	82.3080	81.9394	84.5108	84.7021	93.1480	97.4854	107.3546	(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	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)

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

	121.1964	134.1818	121.1964	125.2363	121.1964	125.2363	121.1964	121.1964	125.2363	121.1964	125.2363	121.1964	(67)

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

	234.2503	236.6811	230.5556	217.5151	201.0539	185.5826	175.2469	172.8161	178.9416	191.9821	208.4433	223.9146	(68)

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

	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	(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)

	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)

Water heating gains (Table 5)

	145.6539	143.1343	138.2808	127.6432	121.1274	114.3167	110.1336	113.5897	117.6418	125.1989	135.3963	144.2938	(72)

Total internal gains

	562.9317	575.8282	551.8638	532.2256	505.2087	486.9667	468.4080	469.4333	483.6507	500.2085	530.9070	551.2358	(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	
Northeast	6.7500	11.2829	0.6300	0.7000	0.7700	23.2754	(75)
Southwest	8.5800	36.7938	0.6300	0.7000	0.7700	96.4793	(79)

Solar gains	119.7547	211.7178	310.2169	418.7941	500.5016	510.7017	486.6199	423.5497	347.4849	239.5301	144.8465	101.5741	(83)
Total gains	682.6864	787.5460	862.0807	951.0198	1005.7104	997.6684	955.0279	892.9830	831.1356	739.7386	675.7535	652.8099	(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	66.7414	66.9627	67.1811	68.2259	68.4250	69.3674	69.3674	69.5448	69.0013	68.4250	68.0234	67.6086	
alpha	5.4494	5.4642	5.4787	5.5484	5.5617	5.6245	5.6245	5.6363	5.6001	5.5617	5.5349	5.5072	
util living area	0.9826	0.9629	0.9224	0.8144	0.6469	0.4575	0.3304	0.3682	0.5852	0.8573	0.9626	0.9858	(86)
MIT	20.1222	20.3295	20.5724	20.8332	20.9594	20.9951	20.9994	20.9988	20.9820	20.8116	20.4377	20.0916	(87)
Th 2	20.2069	20.2093	20.2117	20.2229	20.2250	20.2347	20.2347	20.2365	20.2310	20.2250	20.2208	20.2163	(88)
util rest of house	0.9786	0.9547	0.9062	0.7823	0.6003	0.4041	0.2732	0.3075	0.5251	0.8237	0.9530	0.9825	(89)
MIT 2	19.1910	19.4516	19.7503	20.0603	20.1917	20.2318	20.2345	20.2361	20.2188	20.0453	19.5985	19.1596	(90)
Living area fraction									fLA = Living area / (4) =			0.3284	(91)
MIT	19.4968	19.7399	20.0203	20.3141	20.4438	20.4825	20.4857	20.4866	20.4695	20.2970	19.8741	19.4657	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4968	19.7399	20.0203	20.3141	20.4438	20.4825	20.4857	20.4866	20.4695	20.2970	19.8741	19.4657	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9740	0.9490	0.9018	0.7863	0.6138	0.4215	0.2920	0.3274	0.5441	0.8271	0.9479	0.9784	(94)
Useful gains	664.9299	747.3716	777.4196	747.8040	617.2682	420.5074	278.8575	292.3644	452.2332	611.8569	640.5439	638.7148	(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	1134.3105	1104.0120	1002.5685	833.4270	636.5926	422.4527	279.0526	292.7310	459.8532	705.9851	935.5041	1124.8349	(97)
Space heating kWh	349.2191	239.6623	167.5108	61.6486	14.3773	0.0000	0.0000	0.0000	0.0000	70.0314	212.3714	361.6734	(98a)
Space heating requirement - total per year (kWh/year)												1476.4943	
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	349.2191	239.6623	167.5108	61.6486	14.3773	0.0000	0.0000	0.0000	0.0000	70.0314	212.3714	361.6734	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1476.4943	
Space heating per m2											(98c) / (4) =	16.8897	(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 Combined Heat and Power-Space and Water	0.7000	(303a)
Fraction of heat from community Boilers-Space and Water	0.3000	(303b)
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

	349.2191	239.6623	167.5108	61.6486	14.3773	0.0000	0.0000	0.0000	0.0000	70.0314	212.3714	361.6734	(98)

Space heat from Combined Heat and Power = (98) x 0.70 x 1.00 x 1.50

307a	366.6801	251.6454	175.8864	64.7310	15.0962	0.0000	0.0000	0.0000	0.0000	73.5330	222.9899	379.7570	

Space heat from Boilers = (98) x 0.30 x 1.00 x 1.50

307b	157.1486	107.8480	75.3799	27.7419	6.4698	0.0000	0.0000	0.0000	0.0000	31.5141	95.5671	162.7530	

Space heating requirement

	523.8287	359.4934	251.2663	92.4729	21.5660	0.0000	0.0000	0.0000	0.0000	105.0471	318.5570	542.5100	(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

	232.2348	205.2500	218.0213	191.9533	186.1752	167.8969	165.9483	172.5581	174.4422	194.3196	206.3247	229.7640 (64)
Water heat from Combined Heat and Power = (64) x 0.70 x 1.00 x 1.50												
310a	243.8465	215.5125	228.9224	201.5510	195.4839	176.2918	174.2457	181.1860	183.1643	204.0356	216.6409	241.2522
Water heat from Boilers = (64) x 0.30 x 1.00 x 1.50												
310b	104.5057	92.3625	98.1096	86.3790	83.7788	75.5536	74.6767	77.6512	78.4990	87.4438	92.8461	103.3938
Water heating fuel												
	348.3522	307.8750	327.0320	287.9299	279.2628	251.8454	248.9224	258.8372	261.6634	291.4794	309.4870	344.6460 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (331)
Lighting	25.1822	20.2021	18.1898	13.3266	10.2939	8.4102	9.3904	12.2060	15.8544	20.8018	23.4956	25.8821 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-11.4695	-17.6045	-27.5137	-33.7108	-38.8441	-37.1615	-36.6906	-33.3709	-28.0165	-21.2762	-13.1022	-9.7550 (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	-2.7527	-6.0091	-12.3731	-19.2466	-26.1317	-26.5320	-26.2410	-21.9153	-15.6604	-8.8223	-3.7442	-2.1621 (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												2214.7414 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												3517.3326 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												22.1474 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (331)
Electricity for lighting (calculated in Appendix L)												203.2350 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-480.1058 (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												5455.2032 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			38.3500	(361)
Heat efficiency of CHP unit			40.6000	(362)
Space heating from Combined Heat and Power	3818.5197	0.2100	801.8891	(363)
less credit emissions for electricity	-1464.4023	0.3480	-509.6120	(364)
Water heating from Combined Heat and Power	6064.3666	0.2100	1273.5170	(365)
less credit emissions for electricity	-2325.6846	0.3480	-809.3382	(366)
Efficiency of heat source Boilers			80.0000	(367)
Space and Water heating from Boilers	2149.5278	0.2100	174.4109	(368)
Electrical energy for heat distribution (space & water)	22.1474	0.0000	8.4366	(372)
Overall CO2 factor for heat network			0.2122	(386)
Total CO2 associated with community systems			1216.2934	(373)
Space and water heating			1216.2934	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	203.2350	0.1443	29.3331	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-308.5153	0.1329	-40.9935	
PV Unit electricity exported	-171.5905	0.1249	-21.4258	
Total			-62.4193	(380)
Total CO2, kg/year			1183.2071	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			13.5300	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			38.3500	(461)
Heat efficiency of CHP unit			40.6000	(462)
Space heating from Combined Heat and Power	3818.5197	1.1300	4314.9272	(463)
less credit emissions for electricity	-1464.4023	2.1490	-3147.0005	(464)
Water heating from Combined Heat and Power	6064.3666	1.1300	6852.7342	(465)
less credit emissions for electricity	-2325.6846	2.1490	-4997.8962	(466)
Efficiency of heat source Boilers			80.0000	(467b)
Space and Water heating from Boilers	2149.5278	1.1300	938.4967	(468)
Electrical energy for heat distribution (space & water)	22.1474	0.0000	88.5312	(472)
Overall CO2 factor for heat network			0.9665	(486)
Total CO2 associated with community systems			5540.2623	(473)
Space and water heating			5540.2623	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	203.2350	1.5338	311.7286	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-308.5153	1.4910	-459.9902	
PV Unit electricity exported	-171.5905	0.4583	-78.6383	
Total			-538.6284	(480)
Total Primary energy kWh/year			5313.3625	(483)
Target Primary Energy Rate (TPER)			60.7800	(484)

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Appendix B

SAP DER/TER Worksheets – *Be Clean/Be Green*

Full SAP Calculation Printout

Property Reference	D1 Terrace	**Issued on Date**	20/02/2024
Assessment Reference	00001	**Prop Type Ref**	
Property			

SAP Rating	82 B	**DER**	4.64	**TER**	14.39
Environmental	96 A	**% DER < TER**			67.76
CO_2 Emissions (t/year)	0.32	**DFEE**	32.97	**TFEE**	38.28
Compliance Check	See BREL	**% DFEE < TFEE**			13.86
% DPER < TPER	36.50	**DPER**	49.26	**TPER**	77.57

Assessor Details	Mr. Dimitrios Varsamidis	**Assessor ID**	U808-0001
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	75.1900	(1b)	x 2.5000	(2b) =	187.9750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	75.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	187.9750	(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) =		81.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448	(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)			14.0100	0.8687	12.1708			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
External Wall 1	41.7300	14.0100	27.7200	0.1600	4.4352	150.0000	4158.0000	(29a)
Corridor	12.7500	2.3100	10.4400	0.1600	1.6704	150.0000	1566.0000	(29a)
External Roof 1	31.0100		31.0100	0.1400	4.3414	9.0000	279.0900	(30)
Total net area of external elements Aum(A, m2)			85.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		24.9278			(33)
Party Wall 1			32.7800	0.0000	0.0000	70.0000	2294.6000	(32)
Party Floor 1			75.1900			40.0000	3007.6000	(32d)
Party Ceiling 1			44.1800			30.0000	1325.4000	(32b)
Internal Wall 1			130.0000			9.0000	1170.0000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13800.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		183.5442 (35)
List of Thermal Bridges		

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	13.2100	0.0600	0.7926
E7 Party floor between dwellings (in blocks of flats)	10.2000	0.1100	1.1220
E16 Corner (normal)	5.0000	0.1600	0.8000
E17 Corner (inverted - internal area greater than external area)	2.5000	0.0000	0.0000
E18 Party wall between dwellings	5.0000	0.0450	0.2250
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	3.4800	0.1500	0.5220
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	22.0700	0.0000	0.0000
E25 Staggered party wall between dwellings	2.5000	0.1200	0.3000
E16 Corner (normal)	2.5000	0.1300	0.3250
E18 Party wall between dwellings	2.5000	0.1000	0.2500
P4 Party wall - Roof (insulation at ceiling level)	4.1500	0.0170	0.0706
E15 Flat roof with parapet	16.6900	0.3000	5.0070
E24 Eaves (insulation at ceiling level - inverted)	13.1800	0.1500	1.9770
E2 Other lintels (including other steel lintels)	6.9000	0.0500	0.3450
E3 Sill	5.8000	0.0500	0.2900
E4 Jamb	22.8000	0.1000	2.2800

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.3061 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 39.2340 (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	15.9771	15.7793	15.5816	14.5930	14.3952	13.4066	13.4066	13.2089	13.8021	14.3952	14.7907	15.1861	(38)
Heat transfer coeff	55.2111	55.0133	54.8156	53.8270	53.6292	52.6406	52.6406	52.4429	53.0361	53.6292	54.0247	54.4201	(39)
Average = Sum(39)m / 12 =												53.7775	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7343	0.7317	0.7290	0.7159	0.7132	0.7001	0.7001	0.6975	0.7054	0.7132	0.7185	0.7238	(40)
HLP (average)												0.7152	
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 2.3653 (42)

Hot water usage for mixer showers

63.8775	62.9175	61.5187	58.8423	56.8671	54.6645	53.4125	54.8007	56.3225	58.6875	61.4214	63.6328	(42a)

Hot water usage for baths

27.5926	27.1829	26.6058	25.5418	24.7450	23.8616	23.3844	23.9575	24.5814	25.5267	26.6126	27.4994	(42b)

Hot water usage for other uses

38.8527	37.4399	36.0271	34.6143	33.2014	31.7886	31.7886	33.2014	34.6143	36.0271	37.4399	38.8527	(42c)

Average daily hot water use (litres/day) 119.7963 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	130.3229	127.5403	124.1516	118.9983	114.8136	110.3147	108.5855	111.9596	115.5182	120.2413	125.4740	129.9849	(44)
Energy conte	206.3996	181.6157	190.8163	162.9027	154.5612	135.6448	131.3248	138.6294	142.4455	163.1663	178.7607	203.5249	(45)
Energy content (annual)										Total = Sum(45)m =		1989.7919	

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

30.9599	27.2424	28.6225	24.4354	23.1842	20.3467	19.6987	20.7944	21.3668	24.4749	26.8141	30.5287	(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

261.6764	231.5431	246.0931	216.3964	209.8380	189.1385	186.6016	193.9062	195.9391	218.4431	232.2543	258.8017	(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

261.6764	231.5431	246.0931	216.3964	209.8380	189.1385	186.6016	193.9062	195.9391	218.4431	232.2543	258.8017	(64)

Total per year (kWh/year) = Sum(64)m = 2640.6316 (64)

12Total per year (kWh/year) 2641 (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

112.8493	100.3292	107.6679	96.9601	95.6130	87.8968	87.8869	90.3157	90.1581	98.4742	102.2329	111.8935	(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	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	107.1526	118.6332	107.1526	110.7244	107.1526	110.7244	107.1526	107.1526	110.7244	107.1526	110.7244	107.1526	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	209.0956	211.2653	205.7976	194.1575	179.4639	165.6540	156.4282	154.2584	159.7261	171.3663	186.0598	199.8697	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	(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)	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	(71)
Water heating gains (Table 5)	151.6792	149.2994	144.7149	134.6668	128.5122	122.0789	118.1276	121.3921	125.2195	132.3578	141.9901	150.3944	(72)
Total internal gains	526.4064	537.6770	516.1442	498.0277	473.6077	456.9364	440.1874	441.2822	454.1491	469.3558	497.2533	515.8958	(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	2.4200	10.6334	0.4000	0.8000	0.7700	5.7065	(74)
Northeast	6.7500	11.2829	0.4000	0.8000	0.7700	16.8892	(75)
East	4.8400	19.6403	0.4000	0.8000	0.7700	21.0803	(76)

Solar gains	43.6760	86.5214	148.3823	230.5332	298.2154	312.9564	294.7427	242.1262	176.7387	103.9264	54.5753	35.8852	(83)
Total gains	570.0824	624.1983	664.5264	728.5609	771.8231	769.8928	734.9302	683.4084	630.8878	573.2822	551.8287	551.7810	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	69.4340	69.6836	69.9349	71.2194	71.4820	72.8245	72.8245	73.0990	72.2815	71.4820	70.9588	70.4431	
alpha	5.6289	5.6456	5.6623	5.7480	5.7655	5.8550	5.8550	5.8733	5.8188	5.7655	5.7306	5.6962	
util living area	0.9734	0.9546	0.9146	0.8002	0.6267	0.4356	0.3149	0.3525	0.5696	0.8402	0.9481	0.9769	(86)
MIT	20.2671	20.4210	20.6261	20.8629	20.9699	20.9970	20.9996	20.9993	20.9867	20.8473	20.5435	20.2489	(87)
Th 2	20.3106	20.3130	20.3153	20.3268	20.3291	20.3407	20.3407	20.3431	20.3361	20.3291	20.3245	20.3199	(88)
util rest of house	0.9682	0.9462	0.8995	0.7713	0.5866	0.3915	0.2678	0.3024	0.5184	0.8093	0.9371	0.9723	(89)
MIT 2	19.4601	19.6533	19.9059	20.1900	20.3033	20.3388	20.3406	20.3427	20.3265	20.1802	19.8170	19.4446	(90)
Living area fraction									fLA = Living area / (4) =			0.4054	(91)
MIT	19.7873	19.9645	20.1979	20.4628	20.5735	20.6056	20.6077	20.6089	20.5941	20.4506	20.1115	19.7707	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7873	19.9645	20.1979	20.4628	20.5735	20.6056	20.6077	20.6089	20.5941	20.4506	20.1115	19.7707	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9635	0.9412	0.8966	0.7774	0.6014	0.4093	0.2869	0.3227	0.5385	0.8152	0.9332	0.9679	(94)
Useful gains	549.2699	587.5252	595.8098	566.3505	464.2090	315.1187	210.8690	220.5305	339.7265	467.3535	514.9631	534.0615	(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	855.0683	828.7485	750.8562	622.3906	475.8804	316.1372	210.9698	220.7264	344.4228	528.2828	702.9429	847.3576	(97)
Space heating kWh	227.5140	162.1021	115.3545	40.3489	8.6835	0.0000	0.0000	0.0000	0.0000	45.3314	135.3454	233.0923	(98a)
Space heating requirement - total per year (kWh/year)												967.7721	
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	227.5140	162.1021	115.3545	40.3489	8.6835	0.0000	0.0000	0.0000	0.0000	45.3314	135.3454	233.0923	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												967.7721	
Space heating per m2											(98c) / (4) =	12.8710	(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 Heat pump-Space and Water												1.0000	(303c)
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	227.5140	162.1021	115.3545	40.3489	8.6835	0.0000	0.0000	0.0000	0.0000	45.3314	135.3454	233.0923	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50													
307c	341.2711	243.1531	173.0317	60.5233	13.0253	0.0000	0.0000	0.0000	0.0000	67.9971	203.0181	349.6384	
Space heating requirement	341.2711	243.1531	173.0317	60.5233	13.0253	0.0000	0.0000	0.0000	0.0000	67.9971	203.0181	349.6384	(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	261.6764	231.5431	246.0931	216.3964	209.8380	189.1385	186.6016	193.9062	195.9391	218.4431	232.2543	258.8017	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50													
310c	392.5146	347.3147	369.1397	324.5946	314.7570	283.7077	279.9024	290.8593	293.9087	327.6647	348.3815	388.2025	
Water heating fuel	392.5146	347.3147	369.1397	324.5946	314.7570	283.7077	279.9024	290.8593	293.9087	327.6647	348.3815	388.2025	(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	12.4265	11.2240	12.4265	12.0257	12.4265	12.0257	12.4265	12.4265	12.0257	12.4265	12.0257	12.4265	(331)
Lighting	25.6303	20.5616	18.5134	13.5637	10.4770	8.5598	9.5575	12.4232	16.1365	21.1719	23.9137	26.3427	(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												1451.6582	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3960.9474	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												14.5166	(313)
Space cooling fuel												0.0000	(321)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)		
mechanical ventilation fans (SFP = 0.6380)	146.3122	(330a)
Total electricity for the above, kWh/year	146.3122	(331)
Electricity for lighting (calculated in Appendix L)	206.8513	(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	5765.7691	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			270.0000	(367)
Space and Water heating from Heat pump	2004.6687	0.1573	84.5460	(367)
Electrical energy for heat distribution (space & water)	14.5166	0.0000	7.8626	(372)
Overall CO2 factor for heat network			0.0553	(386)
Total CO2 associated with community systems			299.0700	(373)
Space and water heating			299.0700	(376)
Pumps, fans and electric keep-hot	146.3122	0.1387	20.2953	(378)
Energy for lighting	206.8513	0.1443	29.8550	(379)
Total CO2, kg/year			349.2203	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.6400	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			270.0000	(467c)
Space and Water heating from Heat pump	2004.6687	1.5821	850.6415	(467)
Electrical energy for heat distribution (space & water)	14.5166	0.0000	83.2090	(472)
Overall CO2 factor for heat network			0.5848	(486)
Total CO2 associated with community systems			3165.0251	(473)
Space and water heating			3165.0251	(476)
Pumps, fans and electric keep-hot	146.3122	1.5128	221.3411	(478)
Energy for lighting	206.8513	1.5338	317.2754	(479)
Total Primary energy kWh/year			3703.6416	(483)
Dwelling Primary energy Rate (DPER)			49.2600	(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	75.1900	(1b)	x 2.5000	(2b) =	187.9750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	75.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	187.9750	(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) = 0.1596	(8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.4096	(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) =	0.3482	(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	0.4439	0.4352	0.4265	0.3830	0.3743	0.3307	0.3307	0.3220	0.3482	0.3743	0.3917	0.4091	(22b)
Effective ac	0.5985	0.5947	0.5909	0.5733	0.5700	0.5547	0.5547	0.5519	0.5606	0.5700	0.5767	0.5837	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			14.0100	1.1450	16.0420			(27)
External Wall 1	41.7300	14.0100	27.7200	0.1800	4.9896			(29a)
Corridor	12.7500	2.3100	10.4400	0.1800	1.8792			(29a)
External Roof 1	31.0100		31.0100	0.1100	3.4111			(30)
Total net area of external elements Aum(A, m2)			85.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		28.6319			(33)
Party Wall 1			32.7800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 189.4200 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	13.2100	0.0700	0.9247
E7 Party floor between dwellings (in blocks of flats)	10.2000	0.0700	0.7140
E16 Corner (normal)	5.0000	0.0900	0.4500
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	3.4800	0.0200	0.0696
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	22.0700	0.0000	0.0000
E25 Staggered party wall between dwellings	2.5000	0.0600	0.1500
E16 Corner (normal)	2.5000	0.0900	0.2250
E18 Party wall between dwellings	2.5000	0.0600	0.1500
P4 Party wall - Roof (insulation at ceiling level)	4.1500	0.1200	0.4980
E15 Flat roof with parapet	16.6900	0.5600	9.3464
E24 Eaves (insulation at ceiling level - inverted)	13.1800	0.2400	3.1632
E2 Other lintels (including other steel lintels)	6.9000	0.0500	0.3450
E3 Sill	5.8000	0.0500	0.2900
E4 Jamb	22.8000	0.0500	1.1400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 17.5409 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 46.1728 (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	37.1274	36.8901	36.6575	35.5649	35.3605	34.4088	34.4088	34.2326	34.7754	35.3605	35.7740	36.2064	(38)
Heat transfer coeff	83.3002	83.0629	82.8303	81.7377	81.5333	80.5816	80.5816	80.4054	80.9482	81.5333	81.9468	82.3791	(39)
Average = Sum(39)m / 12 =												81.7367	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1079	1.1047	1.1016	1.0871	1.0844	1.0717	1.0717	1.0694	1.0766	1.0844	1.0899	1.0956	(40)
HLP (average)												1.0871	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3653 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	63.8775	62.9175	61.5187	58.8423	56.8671	54.6645	53.4125	54.8007	56.3225	58.6875	61.4214	63.6328	(42a)
Hot water usage for baths	27.5926	27.1829	26.6058	25.5418	24.7450	23.8616	23.3844	23.9575	24.5814	25.5267	26.6126	27.4994	(42b)
Hot water usage for other uses	38.8527	37.4399	36.0271	34.6143	33.2014	31.7886	31.7886	33.2014	34.6143	36.0271	37.4399	38.8527	(42c)
Average daily hot water use (litres/day)												119.7963	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	130.3229	127.5403	124.1516	118.9983	114.8136	110.3147	108.5855	111.9596	115.5182	120.2413	125.4740	129.9849	(44)
Energy conte	206.3996	181.6157	190.8163	162.9027	154.5612	135.6448	131.3248	138.6294	142.4455	163.1663	178.7607	203.5249	(45)
Energy content (annual)										Total = Sum(45)m =		1989.7919	
Distribution loss (46)m = 0.15 x (45)m	30.9599	27.2424	28.6225	24.4354	23.1842	20.3467	19.6987	20.7944	21.3668	24.4749	26.8141	30.5287	(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	252.9945	223.7014	237.4112	207.9946	201.1561	180.7366	177.9197	185.2243	187.5373	209.7612	223.8525	250.1198	(62)
WWHRS	-29.2021	-25.8266	-27.0441	-22.3936	-20.8700	-17.8586	-16.7396	-17.8009	-18.4772	-21.7826	-24.6771	-28.6613	(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	223.7924	197.8748	210.3671	185.6010	180.2861	162.8780	161.1800	167.4234	169.0601	187.9786	199.1754	221.4584	(64)
										Total per year (kWh/year) = Sum(64)m =		2267.0753	(64)
12Total per year (kWh/year)												2267	(64)

Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	105.9038	94.0558	100.7224	90.2386	88.6675	81.1754	80.9414	83.3702	83.4366	91.5287	95.5114	104.9479	(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	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	118.2636	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	107.1526	118.6332	107.1526	110.7244	107.1526	110.7244	107.1526	107.1526	110.7244	107.1526	110.7244	107.1526	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													

	209.0956	211.2653	205.7976	194.1575	179.4639	165.6540	156.4282	154.2584	159.7261	171.3663	186.0598	199.8697 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264	34.8264 (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)												
	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108	-94.6108 (71)
Water heating gains (Table 5)												
	142.3438	139.9640	135.3795	125.3314	119.1768	112.7436	108.7922	112.0567	115.8842	123.0225	132.6547	141.0591 (72)
Total internal gains												
	520.0710	531.3416	509.8088	491.6923	467.2723	447.6010	430.8521	431.9468	444.8137	463.0204	490.9180	509.5604 (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	2.4200	10.6334	0.6300	0.7000	0.7700	7.8643	(74)
Northeast	6.7500	11.2829	0.6300	0.7000	0.7700	23.2754	(75)
East	4.8400	19.6403	0.6300	0.7000	0.7700	29.0512	(76)

Solar gains	60.1910	119.2372	204.4893	317.7035	410.9780	431.2931	406.1923	333.6802	243.5680	143.2236	75.2116	49.4543	(83)
Total gains	580.2620	650.5789	714.2981	809.3959	878.2504	878.8941	837.0444	765.6270	688.3817	606.2440	566.1296	559.0147	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.4938	47.6295	47.7633	48.4018	48.5231	49.0961	49.0961	49.2037	48.8738	48.5231	48.2782	48.0249	
alpha	4.1663	4.1753	4.1842	4.2268	4.2349	4.2731	4.2731	4.2802	4.2583	4.2349	4.2185	4.2017	
util living area													
	0.9846	0.9740	0.9506	0.8801	0.7454	0.5603	0.4173	0.4718	0.7171	0.9168	0.9730	0.9867	(86)
MIT	19.5404	19.7463	20.0692	20.5051	20.8145	20.9583	20.9906	20.9844	20.8837	20.4771	19.9484	19.5138	(87)
Th 2	19.9944	19.9970	19.9995	20.0114	20.0136	20.0240	20.0240	20.0259	20.0200	20.0136	20.0091	20.0044	(88)
util rest of house													
	0.9809	0.9679	0.9386	0.8522	0.6926	0.4843	0.3277	0.3770	0.6430	0.8909	0.9654	0.9834	(89)
MIT 2	18.3079	18.5696	18.9752	19.5099	19.8538	19.9978	20.0203	20.0192	19.9358	19.4912	18.8362	18.2812	(90)
Living area fraction										fLA = Living area / (4) =		0.4054	(91)
MIT	18.8076	19.0466	19.4187	19.9133	20.2432	20.3871	20.4136	20.4105	20.3200	19.8909	19.2870	18.7808	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8076	19.0466	19.4187	19.9133	20.2432	20.3871	20.4136	20.4105	20.3200	19.8909	19.2870	18.7808	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9750	0.9603	0.9301	0.8491	0.7056	0.5134	0.3639	0.4151	0.6672	0.8871	0.9583	0.9781	(94)
Useful gains	565.7414	624.7693	664.3868	687.2270	619.7233	451.2088	304.6053	317.8065	459.2578	537.7809	542.5435	546.7695	(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													
	1208.4825	1175.0602	1070.0585	900.2030	696.5583	466.3367	307.3064	322.4643	503.5011	757.5146	998.6888	1201.1578	(97)
Space heating kWh													
	478.1993	369.7955	301.8198	153.3427	57.1652	0.0000	0.0000	0.0000	0.0000	163.4818	328.4246	486.8649	(98a)
Space heating requirement - total per year (kWh/year)												2339.0939	
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													
	478.1993	369.7955	301.8198	153.3427	57.1652	0.0000	0.0000	0.0000	0.0000	163.4818	328.4246	486.8649	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2339.0939	
Space heating per m2											(98c) / (4) =	31.1091	(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													
	478.1993	369.7955	301.8198	153.3427	57.1652	0.0000	0.0000	0.0000	0.0000	163.4818	328.4246	486.8649	(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)													
	518.0925	400.6452	326.9987	166.1351	61.9342	0.0000	0.0000	0.0000	0.0000	177.1201	355.8230	527.4809	(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													
	223.7924	197.8748	210.3671	185.6010	180.2861	162.8780	161.1800	167.4234	169.0601	187.9786	199.1754	221.4584	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.7181	85.4411	84.8687	83.6349	81.7958	79.8000	79.8000	79.8000	79.8000	83.7482	85.1736	85.7754	(217)
Fuel for water heating, kWh/month													
	261.0796	231.5922	247.8736	221.9181	220.4099	204.1078	201.9800	209.8038	211.8547	224.4569	233.8464	258.1840	(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	22.2642	17.8612	16.0820	11.7824	9.1010	7.4356	8.3023	10.7916	14.0172	18.3914	20.7730	22.8830	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													

(233a)m	-11.0367	-16.9060	-26.3759	-32.2696	-37.1584	-35.5600	-35.1276	-31.9700	-26.8594	-20.4272	-12.6014	-9.3915	(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	-2.7249	-5.9427	-12.2190	-18.9727	-25.7131	-26.0708	-25.7658	-21.5256	-15.4029	-8.6965	-3.6993	-2.1396	(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	2534.2296	(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	2727.1070	(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)	179.6848	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-464.5568	(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	5062.4646	(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	2534.2296	0.2100	532.1882	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2727.1070	0.2100	572.6925	(264)
Space and water heating			1104.8807	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	179.6848	0.1443	25.9341	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-295.6838	0.1329	-39.2945	
PV Unit electricity exported	-168.8730	0.1249	-21.0983	
Total			-60.3928	(269)
Total CO2, kg/year			1082.3512	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.3900	(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	2534.2296	1.1300	2863.6794	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2727.1070	1.1300	3081.6309	(278)
Space and water heating			5945.3103	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	179.6848	1.5338	275.6066	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-295.6838	1.4911	-440.8809	
PV Unit electricity exported	-168.8730	0.4586	-77.4373	
Total			-518.3182	(283)
Total Primary energy kWh/year			5832.6995	(286)
Target Primary Energy Rate (TPER)			77.5700	(287)

Full SAP Calculation Printout

Property Reference	D2 Exposed	**Issued on Date**	20/02/2024
Assessment Reference	00001	**Prop Type Ref**	
Property			

SAP Rating	82 B	**DER**	4.34	**TER**	13.41
Environmental	97 A	**% DER < TER**			67.64
CO_2 Emissions (t/year)	0.29	**DFEE**	29.27	**TFEE**	33.44
Compliance Check	See BREL	**% DFEE < TFEE**			12.47
% DPER < TPER	36.16	**DPER**	46.18	**TPER**	72.34

Assessor Details	Mr. Dimitrios Varsamidis	**Assessor ID**	U808-0001
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	74.2900	(1b)	x 2.5000	(2b) =	185.7250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	185.7250	(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)			11.5900	0.8687	10.0685			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
Heatloss Floor 1			74.2900	0.1100	8.1719	110.0000	8171.9000	(28a)
External Wall 1	26.5800	11.5900	14.9900	0.1600	2.3984	150.0000	2248.5000	(29a)
Lift	6.7300		6.7300	0.1600	1.0768	150.0000	1009.5000	(29a)
Corridor	17.5500	2.3100	15.2400	0.1600	2.4384	150.0000	2286.0000	(29a)
Total net area of external elements Aum(A, m2)			125.1500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.4640			(33)
Party Wall 1			40.1000	0.0000	0.0000	70.0000	2807.0000	(32)
Party Ceiling 1			74.2900			30.0000	2228.7000	(32b)
Internal Wall 1			123.8000			9.0000	1114.2000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		19865.8000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							267.4088	(35)
List of Thermal Bridges								

K1 Element	Length	Psi-value	Total
E20 Exposed floor (normal)	10.6300	0.2000	2.1260
E20 Exposed floor (normal)	9.7100	0.2600	2.5246
E7 Party floor between dwellings (in blocks of flats)	5.7900	0.0600	0.3474
E7 Party floor between dwellings (in blocks of flats)	9.7100	0.1100	1.0681
E16 Corner (normal)	2.5000	0.1600	0.4000
E16 Corner (normal)	5.0000	0.1300	0.6500
E17 Corner (inverted - internal area greater than external area)	5.0000	0.0000	0.0000
E18 Party wall between dwellings	5.0000	0.0450	0.2250
E18 Party wall between dwellings	2.5000	0.1000	0.2500
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.8400	0.1500	0.7260
P7 Party Wall - Exposed floor (normal)	15.7700	0.0350	0.5520
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	15.7700	0.0000	0.0000
E2 Other lintels (including other steel lintels)	5.8000	0.0500	0.2900
E3 Sill	4.7000	0.0500	0.2350
E4 Jamb	18.4000	0.1000	1.8400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.2340 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 37.6981 (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	14.9067	14.7286	14.5505	13.6598	13.4817	12.5911	12.5911	12.4130	12.9474	13.4817	13.8380	14.1942	(38)
Heat transfer coeff	52.6048	52.4267	52.2485	51.3579	51.1798	50.2892	50.2892	50.1111	50.6454	51.1798	51.5360	51.8923	(39)
Average = Sum(39)m / 12 =												51.3134	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7081	0.7057	0.7033	0.6913	0.6889	0.6769	0.6769	0.6745	0.6817	0.6889	0.6937	0.6985	(40)
HLP (average)												0.6907	
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 2.3456 (42)
Hot water usage for mixer showers

63.5480	62.5930	61.2014	58.5387	56.5738	54.3825	53.1370	54.5180	56.0320	58.3848	61.1046	63.3045	(42a)

Hot water usage for baths

27.4509	27.0433	26.4691	25.4106	24.6180	23.7391	23.2643	23.8344	24.4551	25.3956	26.4759	27.3581	(42b)

Hot water usage for other uses

38.6515	37.2460	35.8405	34.4350	33.0294	31.6239	31.6239	33.0294	34.4350	35.8405	37.2460	38.6515	(42c)

Average daily hot water use (litres/day) 119.1782 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.6504	126.8822	123.5110	118.3843	114.2212	109.7455	108.0252	111.3819	114.9221	119.6208	124.8265	129.3141	(44)
Energy conte	205.3346	180.6786	189.8318	162.0622	153.7637	134.9449	130.6472	137.9141	141.7104	162.3243	177.8382	202.4747	(45)
Energy content (annual)										Total = Sum(45)m =		1979.5245	
Distribution loss (46)m = 0.15 x (45)m	30.8002	27.1018	28.4748	24.3093	23.0646	20.2417	19.5971	20.6871	21.2566	24.3487	26.6757	30.3712	(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	260.6114	230.6060	245.1086	215.5559	209.0405	188.4386	185.9240	193.1909	195.2041	217.6011	231.3319	257.7515	(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	260.6114	230.6060	245.1086	215.5559	209.0405	188.4386	185.9240	193.1909	195.2041	217.6011	231.3319	257.7515	(64)
										Total per year (kWh/year) = Sum(64)m =		2630.3643	(64)
12Total per year (kWh/year)												2630	(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	112.4952	100.0176	107.3405	96.6806	95.3479	87.6641	87.6616	90.0779	89.9137	98.1943	101.9262	111.5443	(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	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	109.5289	121.2641	109.5289	113.1799	109.5289	113.1799	109.5289	109.5289	113.1799	109.5289	113.1799	109.5289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.0958	209.2448	203.8294	192.3006	177.7476	164.0698	154.9321	152.7831	158.1986	169.7274	184.2804	197.9582	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	(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)	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	(71)
Water heating gains (Table 5)	151.2032	148.8357	144.2749	134.2786	128.1557	121.7557	117.8248	121.0724	124.8801	131.9816	141.5641	149.9251	(72)
Total internal gains	526.0122	537.5289	515.8175	497.9434	473.6165	457.1896	440.4701	441.5687	454.4428	469.4221	497.2087	515.5965	(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	
East				4.8400		19.6403	0.4000	0.8000		0.7700		21.0803	(76)
Southeast				6.7500		36.7938	0.4000	0.8000		0.7700		55.0760	(77)
Solar gains	76.1562	135.0522	196.2736	258.0919	299.5292	301.1151	288.8078	257.8773	217.9730	152.6170	92.2529	64.4689	(83)
Total gains	602.1684	672.5811	712.0911	756.0353	773.1457	758.3048	729.2779	699.4461	672.4157	622.0391	589.4616	580.0654	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	104.9007	105.2571	105.6159	107.4474	107.8214	109.7309	109.7309	110.1209	108.9590	107.8214	107.0761	106.3410	
alpha	7.9934	8.0171	8.0411	8.1632	8.1881	8.3154	8.3154	8.3414	8.2639	8.1881	8.1384	8.0894	
util living area	0.9841	0.9622	0.9149	0.7866	0.6111	0.4242	0.3034	0.3295	0.5186	0.8104	0.9564	0.9873	(86)
MIT	20.5767	20.7084	20.8427	20.9602	20.9948	20.9998	21.0000	21.0000	20.9989	20.9581	20.7735	20.5564	(87)
Th 2	20.3337	20.3358	20.3379	20.3485	20.3506	20.3613	20.3613	20.3634	20.3570	20.3506	20.3464	20.3421	(88)
util rest of house	0.9797	0.9528	0.8960	0.7530	0.5701	0.3820	0.2594	0.2839	0.4708	0.7722	0.9440	0.9837	(89)
MIT 2	19.8520	20.0156	20.1764	20.3130	20.3469	20.3611	20.3613	20.3634	20.3564	20.3149	20.1060	19.8339	(90)
Living area fraction									fLA = Living area / (4) =			0.3555	(91)
MIT	20.1096	20.2619	20.4133	20.5431	20.5772	20.5882	20.5883	20.5897	20.5848	20.5436	20.3433	20.0907	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1096	20.2619	20.4133	20.5431	20.5772	20.5882	20.5883	20.5897	20.5848	20.5436	20.3433	20.0907	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9779	0.9516	0.8984	0.7633	0.5845	0.3970	0.2750	0.3002	0.4878	0.7840	0.9440	0.9820	(94)
Useful gains	588.8602	640.0107	639.7077	577.1068	451.9046	301.0566	200.5663	209.9433	327.9734	487.6619	556.4264	569.6448	(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	831.6621	805.3730	726.9476	597.9640	454.3336	301.1405	200.5695	209.9497	328.4244	508.9114	682.5058	824.6054	(97)
Space heating kWh	180.6446	111.1235	64.9065	15.0172	1.8072	0.0000	0.0000	0.0000	0.0000	15.8096	90.7772	189.6907	(98a)
Space heating requirement - total per year (kWh/year)												669.7764	
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	180.6446	111.1235	64.9065	15.0172	1.8072	0.0000	0.0000	0.0000	0.0000	15.8096	90.7772	189.6907	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												669.7764	
Space heating per m2										(98c) / (4) =		9.0157	(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 Heat pump-Space and Water												1.0000	(303c)
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													
	180.6446	111.1235	64.9065	15.0172	1.8072	0.0000	0.0000	0.0000	0.0000	15.8096	90.7772	189.6907	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50													
307c	270.9669	166.6852	97.3598	22.5257	2.7107	0.0000	0.0000	0.0000	0.0000	23.7145	136.1658	284.5360	
Space heating requirement													
	270.9669	166.6852	97.3598	22.5257	2.7107	0.0000	0.0000	0.0000	0.0000	23.7145	136.1658	284.5360	(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													
	260.6114	230.6060	245.1086	215.5559	209.0405	188.4386	185.9240	193.1909	195.2041	217.6011	231.3319	257.7515	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50													
310c	390.9170	345.9090	367.6628	323.3338	313.5607	282.6579	278.8859	289.7863	292.8062	326.4017	346.9979	386.6272	
Water heating fuel													
	390.9170	345.9090	367.6628	323.3338	313.5607	282.6579	278.8859	289.7863	292.8062	326.4017	346.9979	386.6272	(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	12.2778	11.0896	12.2778	11.8817	12.2778	11.8817	12.2778	12.2778	11.8817	12.2778	11.8817	12.2778	(331)
Lighting	26.1017	20.9397	18.8539	13.8132	10.6697	8.7172	9.7333	12.6517	16.4333	21.5613	24.3535	26.8271	(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												1004.6647	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3945.5465	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												10.0466	(313)
Space cooling fuel												0.0000	(321)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)

mechanical ventilation fans (SFP = 0.6380)	144.5609	(330a)
Total electricity for the above, kWh/year	144.5609	(331)
Electricity for lighting (calculated in Appendix L)	210.6556	(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	5305.4277	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			270.0000	(367)
Space and Water heating from Heat pump	1833.4115	0.1587	59.0659	(367)
Electrical energy for heat distribution (space & water)	10.0466	0.0000	7.1528	(372)
Overall CO2 factor for heat network			0.0550	(386)
Total CO2 associated with community systems			272.0725	(373)
Space and water heating			272.0725	(376)
Pumps, fans and electric keep-hot	144.5609	0.1387	20.0524	(378)
Energy for lighting	210.6556	0.1443	30.4041	(379)
Total CO2, kg/year			322.5290	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.3400	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			270.0000	(467c)
Space and Water heating from Heat pump	1833.4115	1.5876	590.7343	(467)
Electrical energy for heat distribution (space & water)	10.0466	0.0000	75.9569	(472)
Overall CO2 factor for heat network			0.5836	(486)
Total CO2 associated with community systems			2889.1753	(473)
Space and water heating			2889.1753	(476)
Pumps, fans and electric keep-hot	144.5609	1.5128	218.6917	(478)
Energy for lighting	210.6556	1.5338	323.1106	(479)
Total Primary energy kWh/year			3430.9777	(483)
Dwelling Primary energy Rate (DPER)			46.1800	(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		74.2900 (1b)	x	2.5000 (2b)	=	185.7250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.2900						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	185.7250	(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) =	0.1615	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4115	(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) =	0.3189	(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	0.4066	0.3987	0.3907	0.3508	0.3429	0.3030	0.3030	0.2950	0.3189	0.3429	0.3588	0.3747	(22b)
Effective ac	0.5827	0.5795	0.5763	0.5615	0.5588	0.5459	0.5459	0.5435	0.5509	0.5588	0.5644	0.5702	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			11.5900	1.1450	13.2710			(27)
Heatloss Floor 1			74.2900	0.1300	9.6577			(28a)
External Wall 1	26.5800	11.5900	14.9900	0.1800	2.6982			(29a)
Lift	6.7300		6.7300	0.1800	1.2114			(29a)
Corridor	17.5500	2.3100	15.2400	0.1800	2.7432			(29a)
Total net area of external elements Aum(A, m2)			125.1500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.8915			(33)
Party Wall 1			40.1000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 277.4088 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E20 Exposed floor (normal)	10.6300	0.3200	3.4016
E20 Exposed floor (normal)	9.7100	0.3200	3.1072
E7 Party floor between dwellings (in blocks of flats)	5.7900	0.0700	0.4053
E7 Party floor between dwellings (in blocks of flats)	9.7100	0.0700	0.6797
E16 Corner (normal)	2.5000	0.0900	0.2250
E16 Corner (normal)	5.0000	0.0900	0.4500
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E18 Party wall between dwellings	2.5000	0.0600	0.1500
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.8400	0.0200	0.0968
P7 Party Wall - Exposed floor (normal)	15.7700	0.1600	2.5232
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	15.7700	0.0000	0.0000
E2 Other lintels (including other steel lintels)	5.8000	0.0500	0.2900
E3 Sill	4.7000	0.0500	0.2350
E4 Jamb	18.4000	0.0500	0.9200

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.3338 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 44.2253 (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	35.7120	35.5152	35.3223	34.4164	34.2469	33.4579	33.4579	33.3117	33.7618	34.2469	34.5898	34.9483	(38)
Heat transfer coeff	79.9372	79.7405	79.5476	78.6417	78.4722	77.6832	77.6832	77.5370	77.9871	78.4722	78.8151	79.1735	(39)

Average = Sum(39)m / 12 = 78.6409

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0760	1.0734	1.0708	1.0586	1.0563	1.0457	1.0457	1.0437	1.0498	1.0563	1.0609	1.0657	(40)
HLP (average)												1.0586	
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 2.3456 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	63.5480	62.5930	61.2014	58.5387	56.5738	54.3825	53.1370	54.5180	56.0320	58.3848	61.1046	63.3045	(42a)
Hot water usage for baths	27.4509	27.0433	26.4691	25.4106	24.6180	23.7391	23.2643	23.8344	24.4551	25.3956	26.4759	27.3581	(42b)
Hot water usage for other uses	38.6515	37.2460	35.8405	34.4350	33.0294	31.6239	31.6239	33.0294	34.4350	35.8405	37.2460	38.6515	(42c)

Average daily hot water use (litres/day) 119.1782 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.6504	126.8822	123.5110	118.3843	114.2212	109.7455	108.0252	111.3819	114.9221	119.6208	124.8265	129.3141	(44)
Energy conte	205.3346	180.6786	189.8318	162.0622	153.7637	134.9449	130.6472	137.9141	141.7104	162.3243	177.8382	202.4747	(45)
Energy content (annual)										Total = Sum(45)m =		1979.5245	
Distribution loss (46)m = 0.15 x (45)m	30.8002	27.1018	28.4748	24.3093	23.0646	20.2417	19.5971	20.6871	21.2566	24.3487	26.6757	30.3712	(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	251.9295	222.7643	236.4267	207.1540	200.3586	180.0367	177.2421	184.5090	186.8023	208.9192	222.9301	249.0696	(62)
WWHRS	-29.0515	-25.6934	-26.9046	-22.2781	-20.7624	-17.7665	-16.6533	-17.7091	-18.3819	-21.6703	-24.5498	-28.5135	(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	222.8780	197.0709	209.5220	184.8759	179.5962	162.2702	160.5888	166.7999	168.4203	187.2490	198.3803	220.5561	(64)
										Total per year (kWh/year) = Sum(64)m =		2258.2077	(64)
12Total per year (kWh/year)												2258	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	105.5497	93.7442	100.3950	89.9591	88.4023	80.9426	80.7161	83.1324	83.1922	91.2488	95.2047	104.5987	(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	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	117.2809	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	109.5289	121.2641	109.5289	113.1799	109.5289	113.1799	109.5289	109.5289	113.1799	109.5289	113.1799	109.5289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.0958	209.2448	203.8294	192.3006	177.7476	164.0698	154.9321	152.7831	158.1986	169.7274	184.2804	197.9582	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													

	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	34.7281	(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)													
	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	-93.8247	(71)
Water heating gains (Table 5)													
	141.8678	139.5003	134.9395	124.9433	118.8204	112.4203	108.4894	111.7370	115.5447	122.6462	132.2287	140.5897	(72)
Total internal gains													
	519.6768	531.1936	509.4821	491.6080	467.2811	447.8542	431.1347	432.2333	445.1074	463.0867	490.8733	509.2611	(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	4.8400	19.6403	0.6300	0.7000	0.7700	29.0512	(76)
Southeast	6.7500	36.7938	0.6300	0.7000	0.7700	75.9015	(77)

Solar gains	104.9528	186.1188	270.4896	355.6829	412.7887	414.9743	398.0133	355.3872	300.3940	210.3253	127.1360	88.8462	(83)
Total gains	624.6296	717.3123	779.9716	847.2909	880.0698	862.8285	829.1480	787.6206	745.5014	673.4120	618.0093	598.1073	(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	71.6142	71.7909	71.9649	72.7940	72.9512	73.6922	73.6922	73.8310	73.4050	72.9512	72.6338	72.3049	
alpha	5.7743	5.7861	5.7977	5.8529	5.8634	5.9128	5.9128	5.9221	5.8937	5.8634	5.8423	5.8203	
util living area													
	0.9933	0.9845	0.9640	0.8987	0.7639	0.5666	0.4110	0.4506	0.6889	0.9227	0.9843	0.9947	(86)
MIT	20.0393	20.2230	20.4596	20.7437	20.9225	20.9888	20.9986	20.9976	20.9669	20.7372	20.3432	20.0098	(87)
Th 2	20.0205	20.0226	20.0248	20.0348	20.0367	20.0454	20.0454	20.0471	20.0421	20.0367	20.0329	20.0289	(88)
util rest of house													
	0.9910	0.9793	0.9520	0.8678	0.7048	0.4866	0.3225	0.3585	0.6068	0.8916	0.9781	0.9929	(89)
MIT 2	18.9204	19.1537	19.4492	19.7918	19.9779	20.0399	20.0451	20.0463	20.0229	19.7942	19.3154	18.8893	(90)
Living area fraction									fLA = Living area / (4) =			0.3555	(91)
MIT	19.3182	19.5339	19.8084	20.1302	20.3137	20.3772	20.3840	20.3845	20.3585	20.1294	19.6808	19.2877	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3182	19.5339	19.8084	20.1302	20.3137	20.3772	20.3840	20.3845	20.3585	20.1294	19.6808	19.2877	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9888	0.9760	0.9488	0.8712	0.7227	0.5149	0.3540	0.3913	0.6350	0.8951	0.9752	0.9910	(94)
Useful gains	617.6569	700.1326	740.0322	738.1400	636.0538	444.2285	293.5421	308.2096	473.4063	602.7435	602.7011	592.7311	(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													
	1200.5117	1166.9111	1058.6486	883.1625	675.9380	448.7931	293.9548	308.9464	488.0817	747.7945	991.5543	1194.5429	(97)
Space heating kWh													
	433.6439	313.6752	237.0506	104.4162	29.6738	0.0000	0.0000	0.0000	0.0000	107.9179	279.9743	447.7480	(98a)
Space heating requirement - total per year (kWh/year)												1954.0999	
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													
	433.6439	313.6752	237.0506	104.4162	29.6738	0.0000	0.0000	0.0000	0.0000	107.9179	279.9743	447.7480	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1954.0999	
Space heating per m2											(98c) / (4) =	26.3037	(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													
	433.6439	313.6752	237.0506	104.4162	29.6738	0.0000	0.0000	0.0000	0.0000	107.9179	279.9743	447.7480	(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)													
	469.8201	339.8431	256.8262	113.1269	32.1493	0.0000	0.0000	0.0000	0.0000	116.9208	303.3308	485.1008	(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													
	222.8780	197.0709	209.5220	184.8759	179.5962	162.2702	160.5888	166.7999	168.4203	187.2490	198.3803	220.5561	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.5254	85.0969	84.3373	82.8300	80.9636	79.8000	79.8000	79.8000	79.8000	82.8708	84.8322	85.6134	(217)
Fuel for water heating, kWh/month													
	260.5984	231.5843	248.4334	223.1991	221.8235	203.3461	201.2391	209.0224	211.0531	225.9528	233.8502	257.6186	(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	22.7579	18.2573	16.4386	12.0437	9.3029	7.6005	8.4864	11.0309	14.3281	18.7992	21.2337	23.3905	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-10.9115	-16.7175	-26.0858	-31.9190	-36.7580	-35.1783	-34.7524	-31.6290	-26.5714	-20.2038	-12.4603	-9.2848	(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	-2.6854	-5.8578	-12.0472	-18.7099	-25.3609	-25.7148	-25.4121	-21.2263	-15.1850	-8.5713	-3.6454	-2.1083	(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	2117.1180	(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	2727.7211	(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)	183.6696	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-458.9962	(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	4655.5125	(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	2117.1180	0.2100	444.5948	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2727.7211	0.2100	572.8214	(264)
Space and water heating			1017.4162	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	183.6696	0.1443	26.5092	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-292.4718	0.1329	-38.8667	
PV Unit electricity exported	-166.5244	0.1249	-20.8041	
Total			-59.6708	(269)
Total CO2, kg/year			996.1839	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.4100	(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	2117.1180	1.1300	2392.3433	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2727.7211	1.1300	3082.3249	(278)
Space and water heating			5474.6682	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	183.6696	1.5338	281.7186	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-292.4718	1.4910	-436.0879	
PV Unit electricity exported	-166.5244	0.4585	-76.3573	
Total			-512.4453	(283)
Total Primary energy kWh/year			5374.0423	(286)
Target Primary Energy Rate (TPER)			72.3400	(287)

Full SAP Calculation Printout

Property Reference	D3 Mid 1B	**Issued on Date**	20/02/2024
Assessment Reference	00001	**Prop Type Ref**	
Property			

SAP Rating	82 B	**DER**	4.76	**TER**	14.19
Environmental	97 A	**% DER < TER**			66.46
CO_2 Emissions (t/year)	0.23	**DFEE**	25.67	**TFEE**	26.29
Compliance Check	See BREL	**% DFEE < TFEE**			2.35
% DPER < TPER	34.69	**DPER**	51.00	**TPER**	78.08

Assessor Details	Mr. Dimitrios Varsamidis	**Assessor ID**	U808-0001
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		50.7300	(1b)	x 2.5000	(2b) =	126.8250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.7300						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	126.8250	(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) =		81.9000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2387	0.2358	0.2329	0.2184	0.2155	0.2009	0.2009	0.1980	0.2067	0.2155	0.2213	0.2271	(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)			9.8300	0.8687	8.5396			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
External Wall 1	17.3800	9.8300	7.5500	0.1600	1.2080	150.0000	1132.5000	(29a)
Lift	15.2300		15.2300	0.1600	2.4368	150.0000	2284.5000	(29a)
Corridor	9.7800	2.3100	7.4700	0.1600	1.1952	150.0000	1120.5000	(29a)
Total net area of external elements Aum(A, m2)			42.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		15.6896			(33)
Party Wall 1			35.5500	0.0000	0.0000	70.0000	2488.5000	(32)
Party Floor 1			50.7300			40.0000	2029.2000	(32d)
Party Ceiling 1			50.7300			30.0000	1521.9000	(32b)
Internal Wall 1			57.2000			9.0000	514.8000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11091.9000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		218.6458 (35)
List of Thermal Bridges		

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	7.1600	0.0600	0.4296
E7 Party floor between dwellings (in blocks of flats)	20.0000	0.1100	2.2000
E16 Corner (normal)	2.5000	0.1600	0.4000
E17 Corner (inverted - internal area greater than external area)	2.5000	0.0000	0.0000
E18 Party wall between dwellings	5.0000	0.0450	0.2250
E18 Party wall between dwellings	2.5000	0.1000	0.2500
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	6.7400	0.1500	1.0110
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	28.4400	0.0000	0.0000
E25 Staggered party wall between dwellings	2.5000	0.1200	0.3000
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500
E3 Sill	3.9000	0.0500	0.1950
E4 Jamb	14.0000	0.1000	1.4000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.6606 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 22.3502 (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	9.9909	9.8693	9.7477	9.1395	9.0179	8.4097	8.4097	8.2881	8.6530	9.0179	9.2611	9.5044	(38)
Heat transfer coeff	32.3411	32.2195	32.0978	31.4897	31.3680	30.7599	30.7599	30.6382	31.0031	31.3680	31.6113	31.8546	(39)
Average = Sum(39)m / 12 =												31.4593	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6375	0.6351	0.6327	0.6207	0.6183	0.6063	0.6063	0.6039	0.6111	0.6183	0.6231	0.6279	(40)
HLP (average)												0.6201	
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 1.7116 (42)
Hot water usage for mixer showers

52.9176	52.1223	50.9635	48.7463	47.1100	45.2853	44.2481	45.3982	46.6588	48.6181	50.8829	52.7148	(42a)

Hot water usage for baths

22.8795	22.5397	22.0612	21.1790	20.5183	19.7858	19.3901	19.8653	20.3826	21.1664	22.0669	22.8022	(42b)

Hot water usage for other uses

32.1586	30.9892	29.8198	28.6504	27.4810	26.3116	26.3116	27.4810	28.6504	29.8198	30.9892	32.1586	(42c)

Average daily hot water use (litres/day) 99.2362 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.9557	105.6512	102.8445	98.5756	95.1093	91.3826	89.9498	92.7444	95.6918	99.6043	103.9390	107.6756	(44)
Energy conte	170.9754	150.4459	158.0681	134.9451	128.0354	112.3656	108.7865	114.8369	117.9976	135.1621	148.0801	168.5939	(45)
Energy content (annual)										Total = Sum(45)m =		1648.2926	
Distribution loss (46)m = 0.15 x (45)m	25.6463	22.5669	23.7102	20.2418	19.2053	16.8548	16.3180	17.2255	17.6996	20.2743	22.2120	25.2891	(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

226.2522	200.3734	213.3449	188.4387	183.3122	165.8593	164.0633	170.1137	171.4913	190.4389	201.5738	223.8707	(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

226.2522	200.3734	213.3449	188.4387	183.3122	165.8593	164.0633	170.1137	171.4913	190.4389	201.5738	223.8707	(64)
									Total per year (kWh/year) = Sum(64)m =		2299.1324	(64)
12Total per year (kWh/year)											2299	(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

101.0708	89.9652	96.7791	87.6642	86.7932	80.1565	80.3929	82.4047	82.0291	89.1628	92.0316	100.2789	(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	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	76.0226	84.1678	76.0226	78.5567	76.0226	78.5567	76.0226	76.0226	78.5567	76.0226	78.5567	76.0226	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	149.1297	150.6772	146.7776	138.4757	127.9961	118.1467	111.5667	110.0192	113.9188	122.2207	132.7004	142.5497	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	(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)	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	(71)
Water heating gains (Table 5)	135.8478	133.8768	130.0794	121.7558	116.6575	111.3285	108.0550	110.7590	113.9294	119.8425	127.8216	134.7835	(72)
Total internal gains	409.6742	417.3960	401.5537	387.4623	369.3503	356.7059	344.3184	345.4749	355.0790	366.7599	387.7528	402.0300	(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			9.8300		19.6403		0.4000		0.8000		0.7700		42.8138 (80)
Solar gains	42.8138	83.7529	137.9291	201.1614	246.5309	252.3682	240.2648	206.3839	160.4173	99.3799	53.3838	35.2080	(83)
Total gains	452.4881	501.1490	539.4829	588.6237	615.8812	609.0742	584.5832	551.8589	515.4963	466.1398	441.1366	437.2380	(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	95.2684	95.6280	95.9904	97.8443	98.2237	100.1657	100.1657	100.5634	99.3798	98.2237	97.4678	96.7235	
alpha	7.3512	7.3752	7.3994	7.5230	7.5482	7.6777	7.6777	7.7042	7.6253	7.5482	7.4979	7.4482	
util living area													
	0.9428	0.8952	0.8068	0.6384	0.4728	0.3232	0.2315	0.2554	0.4147	0.6849	0.8806	0.9504	(86)
MIT	20.7030	20.8165	20.9210	20.9863	20.9986	20.9999	21.0000	21.0000	20.9996	20.9817	20.8663	20.6863	(87)
Th 2	20.3964	20.3985	20.4006	20.4114	20.4135	20.4243	20.4243	20.4264	20.4200	20.4135	20.4092	20.4049	(88)
util rest of house													
	0.9323	0.8790	0.7830	0.6096	0.4433	0.2941	0.2012	0.2235	0.3800	0.6503	0.8604	0.9411	(89)
MIT 2	20.0649	20.2008	20.3208	20.3989	20.4124	20.4243	20.4243	20.4264	20.4197	20.3977	20.2705	20.0525	(90)
Living area fraction										fLA = Living area / (4) =		0.6862	(91)
MIT	20.5028	20.6233	20.7327	20.8020	20.8146	20.8193	20.8193	20.8200	20.8176	20.7985	20.6793	20.4874	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.5028	20.6233	20.7327	20.8020	20.8146	20.8193	20.8193	20.8200	20.8176	20.7985	20.6793	20.4874	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9343	0.8853	0.7964	0.6288	0.4635	0.3141	0.2220	0.2454	0.4038	0.6732	0.8699	0.9425	(94)
Useful gains	422.7629	443.6693	429.6671	370.1273	285.4397	191.2861	129.7850	135.4190	208.1435	313.8071	383.7591	412.0852	(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													
	524.0152	506.5953	456.8376	374.7886	285.9076	191.3042	129.7860	135.4211	208.2673	319.9053	429.2593	518.8288	(97)
Space heating kWh													
	75.3318	42.2863	20.2149	3.3561	0.3482	0.0000	0.0000	0.0000	0.0000	4.5370	32.7601	79.4172	(98a)
Space heating requirement - total per year (kWh/year)												258.2517	
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													
	75.3318	42.2863	20.2149	3.3561	0.3482	0.0000	0.0000	0.0000	0.0000	4.5370	32.7601	79.4172	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												258.2517	
Space heating per m2											(98c) / (4) =	5.0907	(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 Heat pump-Space and Water												1.0000	(303c)
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													
	75.3318	42.2863	20.2149	3.3561	0.3482	0.0000	0.0000	0.0000	0.0000	4.5370	32.7601	79.4172	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50													
307c	112.9976	63.4295	30.3223	5.0342	0.5222	0.0000	0.0000	0.0000	0.0000	6.8056	49.1402	119.1259	
Space heating requirement													
	112.9976	63.4295	30.3223	5.0342	0.5222	0.0000	0.0000	0.0000	0.0000	6.8056	49.1402	119.1259	(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													
	226.2522	200.3734	213.3449	188.4387	183.3122	165.8593	164.0633	170.1137	171.4913	190.4389	201.5738	223.8707	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50													
310c	339.3783	300.5600	320.0174	282.6581	274.9683	248.7889	246.0949	255.1706	257.2369	285.6583	302.3607	335.8061	
Water heating fuel													
	339.3783	300.5600	320.0174	282.6581	274.9683	248.7889	246.0949	255.1706	257.2369	285.6583	302.3607	335.8061	(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	8.3841	7.5727	8.3841	8.1136	8.3841	8.1136	8.3841	8.3841	8.1136	8.3841	8.1136	8.3841	(331)
Lighting	16.8707	13.5343	12.1862	8.9281	6.8963	5.6344	6.2911	8.1774	10.6216	13.9361	15.7408	17.3396	(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												387.3775	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3448.6985	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												3.8738	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)													
mechanical ventilation fans (SFP = 0.6380)												98.7155	(330a)
Total electricity for the above, kWh/year												98.7155	(331)
Electricity for lighting (calculated in Appendix L)												136.1566	(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	4070.9482	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			270.0000	(367)
Space and Water heating from Heat pump	1420.7689	0.1594	22.8736	(367)
Electrical energy for heat distribution (space & water)	3.8738	0.0000	5.4722	(372)
Overall CO2 factor for heat network			0.0543	(386)
Total CO2 associated with community systems			208.1467	(373)
Space and water heating			208.1467	(376)
Pumps, fans and electric keep-hot	98.7155	0.1387	13.6931	(378)
Energy for lighting	136.1566	0.1443	19.6516	(379)
Total CO2, kg/year			241.4914	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.7600	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			270.0000	(467c)
Space and Water heating from Heat pump	1420.7689	1.5901	228.1347	(467)
Electrical energy for heat distribution (space & water)	3.8738	0.0000	58.5970	(472)
Overall CO2 factor for heat network			0.5810	(486)
Total CO2 associated with community systems			2228.8577	(473)
Space and water heating			2228.8577	(476)
Pumps, fans and electric keep-hot	98.7155	1.5128	149.3368	(478)
Energy for lighting	136.1566	1.5338	208.8415	(479)
Total Primary energy kWh/year			2587.0361	(483)
Dwelling Primary energy Rate (DPER)			51.0000	(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		50.7300 (1b)	x	2.5000 (2b)	=	126.8250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.7300						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	126.8250	(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) =	0.1577	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4077	(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) =	0.3160	(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	0.4029	0.3950	0.3871	0.3476	0.3397	0.3002	0.3002	0.2923	0.3160	0.3397	0.3555	0.3713	(22b)
Effective ac	0.5811	0.5780	0.5749	0.5604	0.5577	0.5451	0.5451	0.5427	0.5499	0.5577	0.5632	0.5689	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			9.8300	1.1450	11.2557			(27)
External Wall 1	17.3800	9.8300	7.5500	0.1800	1.3590			(29a)
Lift	15.2300		15.2300	0.1800	2.7414			(29a)
Corridor	9.7800	2.3100	7.4700	0.1800	1.3446			(29a)
Total net area of external elements Aum(A, m2)			42.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	19.0107			(33)
Party Wall 1			35.5500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 228.6458 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	7.1600	0.0700	0.5012
E7 Party floor between dwellings (in blocks of flats)	20.0000	0.0700	1.4000
E16 Corner (normal)	2.5000	0.0900	0.2250
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E18 Party wall between dwellings	2.5000	0.0600	0.1500
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	6.7400	0.0200	0.1348
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	28.4400	0.0000	0.0000
E25 Staggered party wall between dwellings	2.5000	0.0600	0.1500
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500
E3 Sill	3.9000	0.0500	0.1950
E4 Jamb	14.0000	0.0500	0.7000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 3.7810 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 22.7917 (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	24.3223	24.1904	24.0611	23.4540	23.3404	22.8116	22.8116	22.7136	23.0153	23.3404	23.5702	23.8105	(38)
Heat transfer coeff	47.1140	46.9821	46.8529	46.2457	46.1321	45.6033	45.6033	45.5054	45.8070	46.1321	46.3619	46.6022	(39)

Average = Sum(39)m / 12 = 46.2452

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9287	0.9261	0.9236	0.9116	0.9094	0.8989	0.8989	0.8970	0.9030	0.9094	0.9139	0.9186	(40)
HLP (average)												0.9116	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7116 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	52.9176	52.1223	50.9635	48.7463	47.1100	45.2853	44.2481	45.3982	46.6588	48.6181	50.8829	52.7148	(42a)
Hot water usage for baths	22.8795	22.5397	22.0612	21.1790	20.5183	19.7858	19.3901	19.8653	20.3826	21.1664	22.0669	22.8022	(42b)
Hot water usage for other uses	32.1586	30.9892	29.8198	28.6504	27.4810	26.3116	26.3116	27.4810	28.6504	29.8198	30.9892	32.1586	(42c)

Average daily hot water use (litres/day) 99.2362 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.9557	105.6512	102.8445	98.5756	95.1093	91.3826	89.9498	92.7444	95.6918	99.6043	103.9390	107.6756	(44)
Energy conte	170.9754	150.4459	158.0681	134.9451	128.0354	112.3656	108.7865	114.8369	117.9976	135.1621	148.0801	168.5939	(45)
Energy content (annual)										Total = Sum(45)m =		1648.2926	
Distribution loss (46)m = 0.15 x (45)m	25.6463	22.5669	23.7102	20.2418	19.2053	16.8548	16.3180	17.2255	17.6996	20.2743	22.2120	25.2891	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	217.5703	192.5316	204.6630	180.0369	174.6303	157.4575	155.3814	161.4318	163.0894	181.7570	193.1720	215.1888	(62)
WWHRS	-24.1917	-21.3953	-22.4040	-18.5514	-17.2892	-14.7945	-13.8675	-14.7467	-15.3070	-18.0452	-20.4430	-23.7437	(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	193.3786	171.1363	182.2591	161.4855	157.3411	142.6630	141.5139	146.6852	147.7825	163.7118	172.7289	191.4451	(64)
										Total per year (kWh/year) = Sum(64)m =		1972.1309	(64)
12Total per year (kWh/year)												1972	(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	94.1252	83.6918	89.8336	80.9427	79.8477	73.4350	73.4474	75.4592	75.3077	82.2173	85.3101	93.3334	(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	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	85.5805	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	76.0226	84.1678	76.0226	78.5567	76.0226	78.5567	76.0226	76.0226	78.5567	76.0226	78.5567	76.0226	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	149.1297	150.6772	146.7776	138.4757	127.9961	118.1467	111.5667	110.0192	113.9188	122.2207	132.7004	142.5497	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	31.5580	(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)	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	-68.4644	(71)
Water heating gains (Table 5)	126.5124	124.5414	120.7441	112.4204	107.3222	101.9931	98.7197	101.4237	104.5940	110.5071	118.4863	125.4481	(72)
Total internal gains	403.3389	411.0607	395.2184	381.1269	363.0149	347.3706	334.9830	336.1395	345.7436	360.4246	381.4174	395.6946	(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	9.8300	19.6403	0.6300	0.7000	0.7700	59.0028	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	59.0028	115.4220	190.0836	277.2256	339.7504	347.7950	331.1150	284.4229	221.0751	136.9579	73.5696	48.5210	(83)
Total gains	462.3417	526.4827	585.3020	658.3525	702.7653	695.1655	666.0980	620.5624	566.8187	497.3825	454.9870	444.2156	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	68.3873	68.5793	68.7685	69.6713	69.8429	70.6528	70.6528	70.8048	70.3386	69.8429	69.4967	69.1384	
alpha	5.5592	5.5720	5.5846	5.6448	5.6562	5.7102	5.7102	5.7203	5.6892	5.6562	5.6331	5.6092	
util living area	0.9779	0.9555	0.9036	0.7728	0.5953	0.4181	0.3010	0.3369	0.5485	0.8340	0.9541	0.9816	(86)
MIT	20.2073	20.3996	20.6433	20.8793	20.9747	20.9971	20.9996	20.9993	20.9878	20.8456	20.5003	20.1767	(87)
Th 2	20.1432	20.1454	20.1475	20.1576	20.1595	20.1684	20.1684	20.1700	20.1650	20.1595	20.1557	20.1517	(88)
util rest of house	0.9723	0.9451	0.8830	0.7351	0.5463	0.3646	0.2442	0.2763	0.4858	0.7943	0.9414	0.9768	(89)
MIT 2	19.2408	19.4803	19.7745	20.0458	20.1402	20.1668	20.1683	20.1698	20.1574	20.0194	19.6163	19.2092	(90)
Living area fraction									fLA = Living area / (4) =			0.6862	(91)
MIT	19.9040	20.1111	20.3706	20.6178	20.7128	20.7366	20.7387	20.7390	20.7272	20.5863	20.2229	19.8731	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9040	20.1111	20.3706	20.6178	20.7128	20.7366	20.7387	20.7390	20.7272	20.5863	20.2229	19.8731	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9704	0.9446	0.8888	0.7562	0.5788	0.4012	0.2832	0.3179	0.5283	0.8154	0.9426	0.9750	(94)
Useful gains	448.6654	497.3100	520.2027	497.8764	406.7840	278.9200	188.6397	197.2560	299.4687	405.5496	428.8576	433.1030	(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	735.1653	714.6521	649.8785	541.8959	415.7790	279.8483	188.7406	197.4485	303.5714	460.6892	608.4020	730.3997	(97)
Space heating kWh	213.1559	146.0539	96.4788	31.6941	6.6923	0.0000	0.0000	0.0000	0.0000	41.0239	129.2719	221.1888	(98a)
Space heating requirement - total per year (kWh/year)												885.5596	
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	213.1559	146.0539	96.4788	31.6941	6.6923	0.0000	0.0000	0.0000	0.0000	41.0239	129.2719	221.1888	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												885.5596	
Space heating per m2											(98c) / (4) =	17.4563	(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	213.1559	146.0539	96.4788	31.6941	6.6923	0.0000	0.0000	0.0000	0.0000	41.0239	129.2719	221.1888	(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)	230.9382	158.2383	104.5274	34.3381	7.2506	0.0000	0.0000	0.0000	0.0000	44.4463	140.0563	239.6411	(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	193.3786	171.1363	182.2591	161.4855	157.3411	142.6630	141.5139	146.6852	147.7825	163.7118	172.7289	191.4451	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.2786	83.7064	82.7012	81.1494	80.1313	79.8000	79.8000	79.8000	79.8000	81.4542	83.4190	84.3845	(217)
Fuel for water heating, kWh/month	229.4514	204.4482	220.3826	198.9979	196.3540	178.7756	177.3357	183.8160	185.1911	200.9863	207.0618	226.8724	(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	15.7960	12.6721	11.4098	8.3593	6.4570	5.2754	5.8903	7.6564	9.9449	13.0483	14.7380	16.2350	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-3.5883	-5.6613	-9.0945	-11.4688	-13.5238	-13.0629	-12.9086	-11.5957	-9.5207	-6.9799	-4.1535	-3.0364	(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	-0.5383	-1.1902	-2.4786	-3.8968	-5.3290	-5.4179	-5.3510	-4.4456	-3.1522	-1.7532	-0.7345	-0.4214	(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	959.4362	(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	2409.6731	(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)	127.4827	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-139.3032	(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	3443.2887	(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	959.4362	0.2100	201.4816	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2409.6731	0.2100	506.0313	(264)
Space and water heating			707.5129	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	127.4827	0.1443	18.3997	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-104.5944	0.1323	-13.8394	
PV Unit electricity exported	-34.7088	0.1246	-4.3249	
Total			-18.1643	(269)
Total CO2, kg/year			719.6776	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.1900	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	959.4362	1.1300	1084.1629	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2409.6731	1.1300	2722.9305	(278)
Space and water heating			3807.0934	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	127.4827	1.5338	195.5372	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-104.5944	1.4889	-155.7285	
PV Unit electricity exported	-34.7088	0.4573	-15.8733	
Total			-171.6017	(283)
Total Primary energy kWh/year			3961.1297	(286)
Target Primary Energy Rate (TPER)			78.0800	(287)

Full SAP Calculation Printout

Property Reference	D3 Mid 2B	**Issued on Date**	20/02/2024
Assessment Reference	00001	**Prop Type Ref**	
Property			

SAP Rating	83 B	**DER**	3.89	**TER**	11.50
Environmental	97 A	**% DER < TER**			66.17
CO_2 Emissions (t/year)	0.27	**DFEE**	22.21	**TFEE**	23.08
Compliance Check	See BREL	**% DFEE < TFEE**			3.75
% DPER < TPER	34.09	**DPER**	41.62	**TPER**	63.14

Assessor Details	Mr. Dimitrios Varsamidis	**Assessor ID**	U808-0001
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	74.9500	(1b)	x 2.5000	(2b) =	187.3750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.9500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		187.3750	(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) =	81.9000 (23c)

Effective ac	0.2531	0.2499	0.2467	0.2307	0.2276	0.2116	0.2116	0.2084	0.2180	0.2276	0.2339	0.2403	(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)			14.6700	0.8687	12.7442			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
External Wall 1	40.9500	14.6700	26.2800	0.1600	4.2048	150.0000	3942.0000	(29a)
Corridor	11.3500	2.3100	9.0400	0.1600	1.4464	150.0000	1356.0000	(29a)
Total net area of external elements Aum(A, m2)			52.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		20.7054			(33)
Party Wall 1			47.9500	0.0000	0.0000	70.0000	3356.5000	(32)
Party Floor 1			74.9500			40.0000	2998.0000	(32d)
Party Ceiling 1			74.9500			30.0000	2248.5000	(32b)
Internal Wall 1			115.6000			9.0000	1040.4000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14941.4000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		199.3516 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E7 Party floor between dwellings (in blocks of flats)	23.1000	0.0600	1.3860	
E7 Party floor between dwellings (in blocks of flats)	9.0800	0.1100	0.9988	
E16 Corner (normal)	2.5000	0.1600	0.4000	
E17 Corner (inverted - internal area greater than external area)	2.5000	0.0000	0.0000	
E18 Party wall between dwellings	5.0000	0.0450	0.2250	
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	9.6600	0.1500	1.4490	
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	38.3600	0.0000	0.0000	
E25 Staggered party wall between dwellings	5.0000	0.1200	0.6000	
E16 Corner (normal)	2.5000	0.1300	0.3250	
E2 Other lintels (including other steel lintels)	7.2000	0.0500	0.3600	
E3 Sill	6.1000	0.0500	0.3050	
E4 Jamb	22.8000	0.1000	2.2800	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3288 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 29.0342 (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	15.6478	15.4507	15.2536	14.2681	14.0710	13.0856	13.0856	12.8885	13.4798	14.0710	14.4652	14.8594	(38)
Heat transfer coeff	44.6820	44.4849	44.2878	43.3023	43.1053	42.1198	42.1198	41.9227	42.5140	43.1053	43.4994	43.8936	(39)

Average = Sum(39)m / 12 = 43.2531

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.5962	0.5935	0.5909	0.5777	0.5751	0.5620	0.5620	0.5593	0.5672	0.5751	0.5804	0.5856	(40)
HLP (average)												0.5771	
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 2.3601 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	63.7903	62.8317	61.4348	58.7620	56.7895	54.5899	53.3396	54.7260	56.2457	58.6074	61.3376	63.5459	(42a)
Hot water usage for baths	27.5552	27.1459	26.5696	25.5071	24.7114	23.8292	23.3527	23.9249	24.5480	25.4920	26.5765	27.4620	(42b)
Hot water usage for other uses	38.7995	37.3886	35.9777	34.5668	33.1559	31.7451	31.7451	33.1559	34.5668	35.9777	37.3886	38.7995	(42c)

Average daily hot water use (litres/day) 119.6328 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	130.1450	127.3662	123.9821	118.8359	114.6569	110.1641	108.4373	111.8068	115.3605	120.0772	125.3027	129.8074	(44)
Energy conte	206.1179	181.3678	190.5559	162.6804	154.3502	135.4597	131.1455	138.4402	142.2510	162.9436	178.5167	203.2471	(45)

Energy content (annual) Total = Sum(45)m = 1987.0760

Distribution loss (46)m = 0.15 x (45)m	30.9177	27.2052	28.5834	24.4021	23.1525	20.3189	19.6718	20.7660	21.3377	24.4415	26.7775	30.4871	(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

	261.3947	231.2953	245.8327	216.1741	209.6271	188.9533	186.4223	193.7170	195.7447	218.2204	232.0104	258.5239	(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

	261.3947	231.2953	245.8327	216.1741	209.6271	188.9533	186.4223	193.7170	195.7447	218.2204	232.0104	258.5239	(64)

Total per year (kWh/year) = Sum(64)m = 2637.9158 (64)

12Total per year (kWh/year) 2638 (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

	112.7556	100.2467	107.5813	96.8862	95.5429	87.8353	87.8273	90.2528	90.0934	98.4002	102.1517	111.8011	(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	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	106.1919	117.5696	106.1919	109.7316	106.1919	109.7316	106.1919	106.1919	109.7316	106.1919	109.7316	106.1919	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	208.5642	210.7285	205.2747	193.6641	179.0079	165.2331	156.0307	153.8664	159.3203	170.9308	185.5870	199.3618	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	(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)	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	(71)
Water heating gains (Table 5)	151.5533	149.1767	144.5985	134.5641	128.4179	121.9934	118.0475	121.3075	125.1297	132.2583	141.8774	150.2703	(72)
Total internal gains	524.7105	535.8759	514.4662	496.3610	472.0188	455.3593	438.6712	439.7670	452.5827	467.7821	495.5972	514.2251	(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	
Southwest	11.5900	36.7938	0.4000	0.8000	0.7700	94.5674	(79)

West			3.0800		19.6403		0.4000		0.8000		0.7700		13.4147 (80)
Solar gains	107.9822	187.3254	263.6181	336.1171	383.1258	382.7429	368.0509	332.9698	288.9110	209.1698	129.9966	91.9616	(83)
Total gains	632.6927	723.2013	778.0843	832.4780	855.1446	838.1021	806.7220	772.7368	741.4937	676.9519	625.5938	606.1868	(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	92.8872	93.2988	93.7140	95.8467	96.2850	98.5378	98.5378	99.0010	97.6241	96.2850	95.4125	94.5556	
alpha	7.1925	7.2199	7.2476	7.3898	7.4190	7.5692	7.5692	7.6001	7.5083	7.4190	7.3608	7.3037	
util living area													
	0.9374	0.8740	0.7802	0.6216	0.4679	0.3216	0.2297	0.2496	0.3954	0.6514	0.8649	0.9471	(86)
MIT	20.7036	20.8371	20.9320	20.9874	20.9985	20.9999	21.0000	21.0000	20.9997	20.9857	20.8765	20.6831	(87)
Th 2	20.4335	20.4358	20.4382	20.4501	20.4524	20.4643	20.4643	20.4667	20.4596	20.4524	20.4477	20.4429	(88)
util rest of house													
	0.9271	0.8575	0.7574	0.5952	0.4406	0.2947	0.2018	0.2206	0.3645	0.6199	0.8451	0.9381	(89)
MIT 2	20.0999	20.2595	20.3686	20.4384	20.4512	20.4643	20.4643	20.4667	20.4594	20.4398	20.3182	20.0837	(90)
Living area fraction										fLA = Living area / (4) =		0.4950	(91)
MIT	20.3988	20.5454	20.6475	20.7101	20.7221	20.7294	20.7295	20.7307	20.7268	20.7100	20.5945	20.3804	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3988	20.5454	20.6475	20.7101	20.7221	20.7294	20.7295	20.7307	20.7268	20.7100	20.5945	20.3804	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9264	0.8608	0.7661	0.6077	0.4541	0.3080	0.2156	0.2349	0.3798	0.6348	0.8506	0.9370	(94)
Useful gains	586.1524	622.5634	596.0584	505.9288	388.2869	258.1465	173.9320	181.5519	281.6100	429.7307	532.1033	568.0151	(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													
	719.3250	695.9843	626.5610	511.4068	388.9009	258.1706	173.9332	181.5542	281.7321	435.7943	587.0047	710.2156	(97)
Space heating kWh													
	99.0803	49.3389	22.6939	3.9441	0.4568	0.0000	0.0000	0.0000	0.0000	4.5113	39.5290	105.7972	(98a)
Space heating requirement - total per year (kWh/year)												325.3516	
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													
	99.0803	49.3389	22.6939	3.9441	0.4568	0.0000	0.0000	0.0000	0.0000	4.5113	39.5290	105.7972	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												325.3516	
Space heating per m2											(98c) / (4) =	4.3409	(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 Heat pump-Space and Water												1.0000	(303c)
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													
	99.0803	49.3389	22.6939	3.9441	0.4568	0.0000	0.0000	0.0000	0.0000	4.5113	39.5290	105.7972	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50													
307c	148.6205	74.0083	34.0409	5.9162	0.6853	0.0000	0.0000	0.0000	0.0000	6.7670	59.2935	158.6958	
Space heating requirement													
	148.6205	74.0083	34.0409	5.9162	0.6853	0.0000	0.0000	0.0000	0.0000	6.7670	59.2935	158.6958	(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													
	261.3947	231.2953	245.8327	216.1741	209.6271	188.9533	186.4223	193.7170	195.7447	218.2204	232.0104	258.5239	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50													
310c	392.0920	346.9429	368.7491	324.2611	314.4406	283.4300	279.6335	290.5755	293.6171	327.3306	348.0155	387.7858	
Water heating fuel													
	392.0920	346.9429	368.7491	324.2611	314.4406	283.4300	279.6335	290.5755	293.6171	327.3306	348.0155	387.7858	(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	12.3869	11.1881	12.3869	11.9873	12.3869	11.9873	12.3869	12.3869	11.9873	12.3869	11.9873	12.3869	(331)
Lighting	25.3757	20.3573	18.3295	13.4290	10.3729	8.4748	9.4625	12.2997	15.9762	20.9616	23.6761	26.0809	(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												488.0274	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3956.8737	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												4.8803	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)													
mechanical ventilation fans (SFP = 0.6380)												145.8452	(330a)
Total electricity for the above, kWh/year												145.8452	(331)
Electricity for lighting (calculated in Appendix L)												204.7961	(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	4795.5424	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			270.0000	(367)
Space and Water heating from Heat pump	1646.2597	0.1597	28.8712	(367)
Electrical energy for heat distribution (space & water)	4.8803	0.0000	6.3536	(372)
Overall CO2 factor for heat network			0.0544	(386)
Total CO2 associated with community systems			241.6726	(373)
Space and water heating			241.6726	(376)
Pumps, fans and electric keep-hot	145.8452	0.1387	20.2305	(378)
Energy for lighting	204.7961	0.1443	29.5584	(379)
Total CO2, kg/year			291.4615	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.8900	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			270.0000	(467c)
Space and Water heating from Heat pump	1646.2597	1.5912	287.6063	(467)
Electrical energy for heat distribution (space & water)	4.8803	0.0000	67.9450	(472)
Overall CO2 factor for heat network			0.5814	(486)
Total CO2 associated with community systems			2584.4271	(473)
Space and water heating			2584.4271	(476)
Pumps, fans and electric keep-hot	145.8452	1.5128	220.6346	(478)
Energy for lighting	204.7961	1.5338	314.1230	(479)
Total Primary energy kWh/year			3119.1848	(483)
Dwelling Primary energy Rate (DPER)			41.6200	(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		74.9500 (1b)	x	2.5000 (2b)	=	187.3750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.9500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	187.3750	(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) =	0.1601	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4101	(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) =	0.3486	(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	0.4445	0.4357	0.4270	0.3834	0.3747	0.3312	0.3312	0.3224	0.3486	0.3747	0.3922	0.4096	(22b)
Effective ac	0.5988	0.5949	0.5912	0.5735	0.5702	0.5548	0.5548	0.5520	0.5608	0.5702	0.5769	0.5839	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			14.6700	1.1450	16.7977			(27)
External Wall 1	40.9500	14.6700	26.2800	0.1800	4.7304			(29a)
Corridor	11.3500	2.3100	9.0400	0.1800	1.6272			(29a)
Total net area of external elements Aum(A, m2)			52.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.4653			(33)
Party Wall 1			47.9500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 209.3516 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	23.1000	0.0700	1.6170
E7 Party floor between dwellings (in blocks of flats)	9.0800	0.0700	0.6356
E16 Corner (normal)	2.5000	0.0900	0.2250
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	9.6600	0.0200	0.1932
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	38.3600	0.0000	0.0000
E25 Staggered party wall between dwellings	5.0000	0.0600	0.3000
E16 Corner (normal)	2.5000	0.0900	0.2250
E2 Other lintels (including other steel lintels)	7.2000	0.0500	0.3600
E3 Sill	6.1000	0.0500	0.3050
E4 Jamb	22.8000	0.0500	1.1400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.0758 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 30.5411 (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	37.0242	36.7870	36.5545	35.4627	35.2584	34.3075	34.3075	34.1314	34.6738	35.2584	35.6717	36.1037	(38)
Heat transfer coeff	67.5653	67.3281	67.0957	66.0038	65.7995	64.8486	64.8486	64.6725	65.2149	65.7995	66.2128	66.6448	(39)
Average = Sum(39)m / 12 =												66.0028	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9015	0.8983	0.8952	0.8806	0.8779	0.8652	0.8652	0.8629	0.8701	0.8779	0.8834	0.8892	(40)
HLP (average)												0.8806	
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 2.3601 (42)

Hot water usage for mixer showers

63.7903	62.8317	61.4348	58.7620	56.7895	54.5899	53.3396	54.7260	56.2457	58.6074	61.3376	63.5459	(42a)

Hot water usage for baths

27.5552	27.1459	26.5696	25.5071	24.7114	23.8292	23.3527	23.9249	24.5480	25.4920	26.5765	27.4620	(42b)

Hot water usage for other uses

38.7995	37.3886	35.9777	34.5668	33.1559	31.7451	31.7451	33.1559	34.5668	35.9777	37.3886	38.7995	(42c)

Average daily hot water use (litres/day) 119.6328 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	130.1450	127.3662	123.9821	118.8359	114.6569	110.1641	108.4373	111.8068	115.3605	120.0772	125.3027	129.8074	(44)
Energy conte	206.1179	181.3678	190.5559	162.6804	154.3502	135.4597	131.1455	138.4402	142.2510	162.9436	178.5167	203.2471	(45)
Energy content (annual)										Total = Sum(45)m =		1987.0760	
Distribution loss (46)m = 0.15 x (45)m	30.9177	27.2052	28.5834	24.4021	23.1525	20.3189	19.6718	20.7660	21.3377	24.4415	26.7775	30.4871	(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	252.7128	223.4535	237.1508	207.7722	200.9451	180.5515	177.7404	185.0351	187.3429	209.5385	223.6085	249.8420	(62)
WWHRS	-29.1623	-25.7914	-27.0072	-22.3631	-20.8416	-17.8343	-16.7168	-17.7766	-18.4520	-21.7529	-24.6434	-28.6222	(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	223.5505	197.6622	210.1436	185.4092	180.1036	162.7172	161.0237	167.2585	168.8909	187.7856	198.9651	221.2198	(64)
										Total per year (kWh/year) = Sum(64)m =		2264.7297	(64)
12Total per year (kWh/year)												2265	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)

Heat gains from water heating, kWh/month

105.8101	93.9734	100.6358	90.1647	88.5974	81.1138	80.8818	83.3073	83.3719	91.4547	95.4303	104.8556	(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	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	118.0036	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	106.1919	117.5696	106.1919	109.7316	106.1919	109.7316	106.1919	106.1919	109.7316	106.1919	109.7316	106.1919	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	208.5642	210.7285	205.2747	193.6641	179.0079	165.2331	156.0307	153.8664	159.3203	170.9308	185.5870	199.3618	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	34.8004	(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)	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	-94.4029	(71)
Water heating gains (Table 5)	142.2179	139.8413	135.2631	125.2288	119.0825	112.6581	108.7121	111.9722	115.7944	122.9229	132.5420	140.9349	(72)
Total internal gains	518.3751	529.5405	508.1308	490.0256	465.6834	446.0239	429.3358	430.4316	443.2474	461.4467	489.2618	507.8898	(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	
Southwest	11.5900	36.7938	0.6300	0.7000	0.7700	130.3258	(79)
West	3.0800	19.6403	0.6300	0.7000	0.7700	18.4871	(80)

Solar gains	148.8129	258.1578	363.2987	463.2113	527.9953	527.4675	507.2201	458.8740	398.1554	288.2621	179.1515	126.7346	(83)
Total gains	667.1881	787.6983	871.4295	953.2369	993.6787	973.4914	936.5559	889.3056	841.4028	749.7089	668.4133	634.6244	(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	64.5092	64.7365	64.9607	66.0353	66.2403	67.2117	67.2117	67.3947	66.8342	66.2403	65.8269	65.4002	
alpha	5.3006	5.3158	5.3307	5.4024	5.4160	5.4808	5.4808	5.4930	5.4556	5.4160	5.3885	5.3600	
util living area	0.9738	0.9422	0.8845	0.7608	0.5979	0.4240	0.3043	0.3340	0.5265	0.8032	0.9439	0.9788	(86)
MIT	20.1715	20.4079	20.6497	20.8723	20.9690	20.9961	20.9995	20.9992	20.9878	20.8570	20.4969	20.1347	(87)
Th 2	20.1662	20.1689	20.1716	20.1840	20.1863	20.1972	20.1972	20.1992	20.1930	20.1863	20.1816	20.1767	(88)
util rest of house	0.9678	0.9303	0.8628	0.7246	0.5508	0.3718	0.2490	0.2761	0.4681	0.7632	0.9302	0.9738	(89)
MIT 2	19.2193	19.5126	19.8036	20.0633	20.1616	20.1949	20.1970	20.1988	20.1851	20.0554	19.6365	19.1816	(90)
Living area fraction									fLA = Living area / (4) =			0.4950	(91)
MIT	19.6906	19.9558	20.2224	20.4637	20.5613	20.5915	20.5942	20.5950	20.5824	20.4522	20.0624	19.6534	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6906	19.9558	20.2224	20.4637	20.5613	20.5915	20.5942	20.5950	20.5824	20.4522	20.0624	19.6534	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9637	0.9268	0.8643	0.7374	0.5728	0.3976	0.2764	0.3048	0.4965	0.7769	0.9279	0.9700	(94)
Useful gains	642.9570	730.0277	753.1364	702.9363	569.1877	387.0143	258.8554	271.0227	417.7696	582.4650	620.2170	615.5701	(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	1039.8700	1013.6773	920.7139	763.2502	583.0675	388.5387	259.0189	271.3003	422.7501	648.2720	858.2759	1029.8880	(97)
Space heating kWh	295.3033	190.6125	124.6777	43.4260	10.3266	0.0000	0.0000	0.0000	0.0000	48.9604	171.4024	308.2525	(98a)
Space heating requirement - total per year (kWh/year)												1192.9615	
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	295.3033	190.6125	124.6777	43.4260	10.3266	0.0000	0.0000	0.0000	0.0000	48.9604	171.4024	308.2525	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1192.9615	
Space heating per m2										(98c) / (4) =		15.9168	(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	295.3033	190.6125	124.6777	43.4260	10.3266	0.0000	0.0000	0.0000	0.0000	48.9604	171.4024	308.2525	(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)	319.9386	206.5141	135.0787	47.0488	11.1881	0.0000	0.0000	0.0000	0.0000	53.0449	185.7014	333.9681	(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	223.5505	197.6622	210.1436	185.4092	180.1036	162.7172	161.0237	167.2585	168.8909	187.7856	198.9651	221.2198	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.6849	83.9784	82.9298	81.3649	80.2410	79.8000	79.8000	79.8000	79.8000	81.5084	83.7272	84.8039	(217)
Fuel for water heating, kWh/month	263.9791	235.3727	253.3994	227.8736	224.4533	203.9063	201.7840	209.5971	211.6427	230.3880	237.6351	260.8603	(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	22.0646	17.7010	15.9378	11.6767	9.0194	7.3690	8.2278	10.6948	13.8915	18.2265	20.5867	22.6778	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-5.2697	-8.2960	-13.2968	-16.7260	-19.6797	-18.9876	-18.7579	-16.8680	-13.8784	-10.2074	-6.0924	-4.4608	(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	-0.8270	-1.8266	-3.8017	-5.9756	-8.1740	-8.3164	-8.2195	-6.8320	-4.8449	-2.6952	-1.1293	-0.6478	(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	1292.4826	(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	2760.8915	(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)	178.0738	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-205.8106	(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	4111.6372	(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	1292.4826	0.2100	271.4213	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2760.8915	0.2100	579.7872	(264)
Space and water heating			851.2086	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	178.0738	0.1443	25.7016	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-152.5207	0.1324	-20.1886	
PV Unit electricity exported	-53.2899	0.1246	-6.6396	
Total			-26.8282	(269)
Total CO2, kg/year			862.0112	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.5000	(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	1292.4826	1.1300	1460.5054	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2760.8915	1.1300	3119.8074	(278)
Space and water heating			4580.3127	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	178.0738	1.5338	273.1355	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-152.5207	1.4891	-227.1146	
PV Unit electricity exported	-53.2899	0.4573	-24.3684	
Total			-251.4830	(283)
Total Primary energy kWh/year			4732.0661	(286)
Target Primary Energy Rate (TPER)			63.1400	(287)

Full SAP Calculation Printout

Property Reference	K2 Top	**Issued on Date**	20/02/2024
Assessment Reference	00001	**Prop Type Ref**	
Property			

SAP Rating	82 B	**DER**	4.58	**TER**	14.76
Environmental	96 A	**% DER < TER**			68.97
CO_2 Emissions (t/year)	0.31	**DFEE**	32.51	**TFEE**	37.75
Compliance Check	See BREL	**% DFEE < TFEE**			13.89
% DPER < TPER	39.74	**DPER**	48.60	**TPER**	80.64

Assessor Details	Mr. Dimitrios Varsamidis	**Assessor ID**	U808-0001
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	74.6000 (1b)	x	2.5000 (2b)	=	186.5000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.6000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	186.5000	(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) =		81.9000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2387	0.2358	0.2329	0.2184	0.2155	0.2009	0.2009	0.1980	0.2067	0.2155	0.2213	0.2271	(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)			12.9100	0.8687	11.2153			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
External Wall 1	31.3300	12.9100	18.4200	0.1600	2.9472	150.0000	2763.0000	(29a)
Corridor	20.3500	2.3100	18.0400	0.1600	2.8864	150.0000	2706.0000	(29a)
External Roof 1	74.6000		74.6000	0.1000	7.4600	9.0000	671.4000	(30)
Total net area of external elements Aum(A, m2)			126.2800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.8189			(33)
Party Wall 1			35.8800	0.0000	0.0000	70.0000	2511.6000	(32)
Party Floor 1			74.6000			40.0000	2984.0000	(32d)
Party Ceiling 1			44.1800			30.0000	1325.4000	(32b)
Internal Wall 1			122.1000			9.0000	1098.9000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14060.3000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		188.4759 (35)
List of Thermal Bridges		

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	7.6900	0.0600	0.4614
E7 Party floor between dwellings (in blocks of flats)	8.1400	0.1100	0.8954
E16 Corner (normal)	2.5000	0.1600	0.4000
E18 Party wall between dwellings	2.5000	0.0450	0.1125
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.8400	0.1500	0.7260
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.3500	0.0000	0.0000
E25 Staggered party wall between dwellings	5.0000	0.1200	0.6000
E18 Party wall between dwellings	2.5000	0.1000	0.2500
E15 Flat roof with parapet	12.5300	0.3000	3.7590
E14 Flat roof	8.1400	0.1600	1.3024
E2 Other lintels (including other steel lintels)	6.4000	0.0500	0.3200
E3 Sill	5.3000	0.0500	0.2650
E4 Jamb	18.4000	0.1000	1.8400
P4 Party wall - Roof (insulation at ceiling level)	14.3500	0.0170	0.2440

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.1757 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 37.9945 (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	14.6919	14.5131	14.3342	13.4399	13.2610	12.3667	12.3667	12.1878	12.7244	13.2610	13.6188	13.9765	(38)
Heat transfer coeff	52.6864	52.5076	52.3287	51.4344	51.2555	50.3612	50.3612	50.1823	50.7189	51.2555	51.6133	51.9710	(39)
Average = Sum(39)m / 12 =												51.3897	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7063	0.7039	0.7015	0.6895	0.6871	0.6751	0.6751	0.6727	0.6799	0.6871	0.6919	0.6967	(40)
HLP (average)												0.6889	
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 2.3524 (42)
Hot water usage for mixer showers

63.6623	62.7056	61.3115	58.6440	56.6756	54.4803	53.2325	54.6161	56.1328	58.4898	61.2145	63.4184	(42a)

Hot water usage for baths

27.5001	27.0917	26.5166	25.4561	24.6621	23.7816	23.3060	23.8771	24.4989	25.4411	26.5234	27.4071	(42b)

Hot water usage for other uses

38.7213	37.3133	35.9052	34.4972	33.0891	31.6811	31.6811	33.0891	34.4972	35.9052	37.3133	38.7213	(42c)

Average daily hot water use (litres/day) 119.3926 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.8837	127.1105	123.7332	118.5973	114.4267	109.9430	108.2196	111.5823	115.1289	119.8361	125.0511	129.5468	(44)
Energy conte	205.7040	181.0037	190.1733	162.3538	154.0404	135.1877	130.8822	138.1623	141.9654	162.6164	178.1583	202.8390	(45)
Energy content (annual)										Total = Sum(45)m =		1983.0866	
Distribution loss (46)m = 0.15 x (45)m													
	30.8556	27.1506	28.5260	24.3531	23.1061	20.2782	19.6323	20.7243	21.2948	24.3925	26.7237	30.4259	(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	260.9808	230.9311	245.4501	215.8475	209.3172	188.6814	186.1590	193.4391	195.4591	217.8932	231.6519	258.1158	(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	260.9808	230.9311	245.4501	215.8475	209.3172	188.6814	186.1590	193.4391	195.4591	217.8932	231.6519	258.1158	(64)
									Total per year (kWh/year) = Sum(64)m =			2633.9264	(64)
12Total per year (kWh/year)												2634	(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	112.6180	100.1257	107.4541	96.7776	95.4399	87.7449	87.7398	90.1604	89.9985	98.2914	102.0326	111.6654	(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	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	107.7501	119.2948	107.7501	111.3418	107.7501	111.3418	107.7501	107.7501	111.3418	107.7501	111.3418	107.7501	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.7869	209.9431	204.5096	192.9423	178.3407	164.6172	155.4491	153.2929	158.7264	170.2937	184.8953	198.6188	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	(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)	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	(71)
Water heating gains (Table 5)	151.3683	148.9965	144.4275	134.4133	128.2794	121.8679	117.9298	121.1833	124.9978	132.1121	141.7119	150.0879	(72)
Total internal gains	525.1919	536.5209	514.9738	496.9840	472.6568	456.1134	439.4156	440.5130	453.3527	468.4425	496.2356	514.7434	(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			
Northeast					12.9100	11.2829		0.4000	0.8000	0.7700		32.3022	(75)
Solar gains	32.3022	65.7520	118.4642	194.5523	261.5164	278.8042	260.8156	207.9252	144.3505	80.3542	40.6445	26.3796	(83)
Total gains	557.4941	602.2730	633.4380	691.5362	734.1732	734.9176	700.2312	648.4382	597.7032	548.7967	536.8801	541.1230	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	74.1299	74.3824	74.6366	75.9344	76.1994	77.5525	77.5525	77.8290	77.0055	76.1994	75.6712	75.1504	
alpha	5.9420	5.9588	5.9758	6.0623	6.0800	6.1702	6.1702	6.1886	6.1337	6.0800	6.0447	6.0100	
util living area	0.9746	0.9579	0.9216	0.8094	0.6320	0.4370	0.3163	0.3556	0.5762	0.8460	0.9499	0.9778	(86)
MIT	20.3326	20.4673	20.6526	20.8753	20.9747	20.9978	20.9997	20.9995	20.9889	20.8629	20.5871	20.3162	(87)
Th 2	20.3353	20.3374	20.3395	20.3501	20.3523	20.3629	20.3629	20.3650	20.3586	20.3523	20.3480	20.3438	(88)
util rest of house	0.9695	0.9499	0.9073	0.7813	0.5926	0.3941	0.2706	0.3067	0.5259	0.8157	0.9391	0.9733	(89)
MIT 2	19.5609	19.7302	19.9586	20.2258	20.3307	20.3614	20.3628	20.3648	20.3507	20.2188	19.8894	19.5471	(90)
Living area fraction										fLA = Living area / (4) =		0.3610	(91)
MIT	19.8395	19.9963	20.2091	20.4603	20.5632	20.5911	20.5927	20.5939	20.5811	20.4513	20.1413	19.8247	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8395	19.9963	20.2091	20.4603	20.5632	20.5911	20.5927	20.5939	20.5811	20.4513	20.1413	19.8247	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9651	0.9452	0.9041	0.7863	0.6056	0.4096	0.2871	0.3244	0.5435	0.8206	0.9352	0.9691	(94)
Useful gains	538.0104	569.2388	572.7145	543.7251	444.6090	300.9879	201.0133	210.3259	324.8809	450.3483	502.1152	524.4076	(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	818.7207	792.6697	717.3812	594.5963	454.2873	301.7211	201.0783	210.4604	328.7134	504.9334	673.1029	812.0335	(97)
Space heating kWh	208.8484	150.1456	107.6320	36.6273	7.2007	0.0000	0.0000	0.0000	0.0000	40.6113	123.1111	213.9936	(98a)
Space heating requirement - total per year (kWh/year)												888.1701	
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	208.8484	150.1456	107.6320	36.6273	7.2007	0.0000	0.0000	0.0000	0.0000	40.6113	123.1111	213.9936	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												888.1701	
Space heating per m2										(98c) / (4) =		11.9058	(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 Heat pump-Space and Water												1.0000	(303c)
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	208.8484	150.1456	107.6320	36.6273	7.2007	0.0000	0.0000	0.0000	0.0000	40.6113	123.1111	213.9936	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50													
307c	313.2727	225.2183	161.4480	54.9409	10.8010	0.0000	0.0000	0.0000	0.0000	60.9170	184.6667	320.9904	
Space heating requirement	313.2727	225.2183	161.4480	54.9409	10.8010	0.0000	0.0000	0.0000	0.0000	60.9170	184.6667	320.9904	(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	260.9808	230.9311	245.4501	215.8475	209.3172	188.6814	186.1590	193.4391	195.4591	217.8932	231.6519	258.1158	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50													
310c	391.4713	346.3967	368.1752	323.7712	313.9758	283.0221	279.2386	290.1586	293.1887	326.8399	347.4779	387.1737	
Water heating fuel	391.4713	346.3967	368.1752	323.7712	313.9758	283.0221	279.2386	290.1586	293.1887	326.8399	347.4779	387.1737	(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	12.3290	11.1359	12.3290	11.9313	12.3290	11.9313	12.3290	12.3290	11.9313	12.3290	11.9313	12.3290	(331)
Lighting	25.7109	20.6263	18.5717	13.6064	10.5100	8.5867	9.5875	12.4623	16.1872	21.2385	23.9889	26.4255	(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												1332.2551	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3950.8895	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												13.3226	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)													
mechanical ventilation fans (SFP = 0.6380)												145.1641	(330a)
Total electricity for the above, kWh/year												145.1641	(331)

Electricity for lighting (calculated in Appendix L)	207.5020	(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	5635.8108	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			270.0000	(367)
Space and Water heating from Heat pump	1956.7202	0.1573	77.6196	(367)
Electrical energy for heat distribution (space & water)	13.3226	0.0000	7.6613	(372)
Overall CO2 factor for heat network			0.0552	(386)
Total CO2 associated with community systems			291.4150	(373)
Space and water heating			291.4150	(376)
Pumps, fans and electric keep-hot	145.1641	0.1387	20.1361	(378)
Energy for lighting	207.5020	0.1443	29.9489	(379)
Total CO2, kg/year			341.5000	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.5800	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			270.0000	(467c)
Space and Water heating from Heat pump	1956.7202	1.5824	780.7798	(467)
Electrical energy for heat distribution (space & water)	13.3226	0.0000	81.1695	(472)
Overall CO2 factor for heat network			0.5844	(486)
Total CO2 associated with community systems			3087.4484	(473)
Space and water heating			3087.4484	(476)
Pumps, fans and electric keep-hot	145.1641	1.5128	219.6043	(478)
Energy for lighting	207.5020	1.5338	318.2734	(479)
Total Primary energy kWh/year			3625.3262	(483)
Dwelling Primary energy Rate (DPER)			48.6000	(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		74.6000	(1b)	x 2.5000	(2b) =	186.5000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.6000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		186.5000	(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) =	0.1609	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4109	(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) =	0.3184	(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	0.4060	0.3980	0.3901	0.3503	0.3423	0.3025	0.3025	0.2945	0.3184	0.3423	0.3582	0.3741	(22b)
Effective ac	0.5824	0.5792	0.5761	0.5613	0.5586	0.5458	0.5458	0.5434	0.5507	0.5586	0.5642	0.5700	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			12.9100	1.1450	14.7824			(27)
External Wall 1	31.3300	12.9100	18.4200	0.1800	3.3156			(29a)
Corridor	20.3500	2.3100	18.0400	0.1800	3.2472			(29a)
External Roof 1	74.6000		74.6000	0.1100	8.2060			(30)
Total net area of external elements Aum(A, m2)			126.2800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.8612			(33)
Party Wall 1			35.8800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 194.3981 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	7.6900	0.0700	0.5383
E7 Party floor between dwellings (in blocks of flats)	8.1400	0.0700	0.5698
E16 Corner (normal)	2.5000	0.0900	0.2250
E18 Party wall between dwellings	2.5000	0.0600	0.1500
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	4.8400	0.0200	0.0968
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.3500	0.0000	0.0000
E25 Staggered party wall between dwellings	5.0000	0.0600	0.3000
E18 Party wall between dwellings	2.5000	0.0600	0.1500
E15 Flat roof with parapet	12.5300	0.5600	7.0168
E14 Flat roof	8.1400	0.0800	0.6512
E2 Other lintels (including other steel lintels)	6.4000	0.0500	0.3200
E3 Sill	5.3000	0.0500	0.2650
E4 Jamb	18.4000	0.0500	0.9200
P4 Party wall - Roof (insulation at ceiling level)	14.3500	0.1200	1.7220

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.9249 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 44.7861 (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	35.8444	35.6474	35.4544	34.5477	34.3780	33.5883	33.5883	33.4420	33.8925	34.3780	34.7212	35.0800	(38)
Heat transfer coeff	80.6305	80.4336	80.2405	79.3338	79.1642	78.3744	78.3744	78.2282	78.6786	79.1642	79.5073	79.8661	(39)
Average = Sum(39)m / 12 =												79.3330	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0808	1.0782	1.0756	1.0635	1.0612	1.0506	1.0506	1.0486	1.0547	1.0612	1.0658	1.0706	(40)
HLP (average)												1.0634	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3524 (42)

Hot water usage for mixer showers

63.6623	62.7056	61.3115	58.6440	56.6756	54.4803	53.2325	54.6161	56.1328	58.4898	61.2145	63.4184	(42a)

Hot water usage for baths

27.5001	27.0917	26.5166	25.4561	24.6621	23.7816	23.3060	23.8771	24.4989	25.4411	26.5234	27.4071	(42b)

Hot water usage for other uses

38.7213	37.3133	35.9052	34.4972	33.0891	31.6811	31.6811	33.0891	34.4972	35.9052	37.3133	38.7213	(42c)

Average daily hot water use (litres/day) 119.3926 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.8837	127.1105	123.7332	118.5973	114.4267	109.9430	108.2196	111.5823	115.1289	119.8361	125.0511	129.5468	(44)
Energy conte	205.7040	181.0037	190.1733	162.3538	154.0404	135.1877	130.8822	138.1623	141.9654	162.6164	178.1583	202.8390	(45)
Energy content (annual)										Total = Sum(45)m =		1983.0866	
Distribution loss (46)m = 0.15 x (45)m	30.8556	27.1506	28.5260	24.3531	23.1061	20.2782	19.6323	20.7243	21.2948	24.3925	26.7237	30.4259	(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

252.2989	223.0894	236.7682	207.4456	200.6353	180.2795	177.4771	184.7572	187.0573	209.2113	223.2501	249.4339	(62)
WWHRS -29.1037	-25.7396	-26.9530	-22.3182	-20.7997	-17.7985	-16.6832	-17.7409	-18.4150	-21.7092	-24.5939	-28.5648	(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

223.1952	197.3498	209.8152	185.1275	179.8355	162.4811	160.7939	167.0162	168.6423	187.5021	198.6562	220.8691	(64)
									Total per year (kWh/year) = Sum(64)m =		2261.2841	(64)

12Total per year (kWh/year) 2261 (64)

Electric shower(s)

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

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

Heat gains from water heating, kWh/month

105.6725	93.8523	100.5086	90.0561	88.4943	81.0234	80.7943	83.2149	83.2770	91.3459	95.3111	104.7199	(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	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	117.6218	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	107.7501	119.2948	107.7501	111.3418	107.7501	111.3418	107.7501	107.7501	111.3418	107.7501	111.3418	107.7501	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.7869	209.9431	204.5096	192.9423	178.3407	164.6172	155.4491	153.2929	158.7264	170.2937	184.8953	198.6188	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	34.7622	(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)	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	-94.0975	(71)

Water heating gains (Table 5)
142.0330 139.6612 135.0921 125.0779 118.9440 112.5325 108.5944 111.8479 115.6625 122.7767 132.3765 140.7525 (72)
Total internal gains
518.8565 530.1856 508.6384 490.6486 466.3214 446.7781 430.0803 431.1776 444.0173 462.1071 489.9002 508.4080 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	12.9100	11.2829	0.6300	0.7000	0.7700	44.5164	(75)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	44.5164	90.6145	163.2585	268.1174	360.4023	384.2270	359.4365	286.5470	198.9330	110.7381	56.0132	36.3544	(83)
Total gains	563.3730	620.8001	671.8969	758.7659	826.7237	831.0051	789.5168	717.7245	642.9503	572.8452	545.9134	544.7624	(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	49.9607	50.0831	50.2036	50.7774	50.8862	51.3989	51.3989	51.4950	51.2002	50.8862	50.6665	50.4389	
alpha	4.3307	4.3389	4.3469	4.3852	4.3924	4.4266	4.4266	4.4330	4.4133	4.3924	4.3778	4.3626	
util living area	0.9865	0.9781	0.9590	0.8960	0.7645	0.5762	0.4304	0.4894	0.7405	0.9280	0.9764	0.9883	(86)
MIT	19.5999	19.7816	20.0797	20.5021	20.8147	20.9594	20.9910	20.9846	20.8811	20.4812	19.9836	19.5743	(87)
Th 2	20.0165	20.0187	20.0208	20.0308	20.0327	20.0414	20.0414	20.0430	20.0380	20.0327	20.0289	20.0249	(88)
util rest of house	0.9832	0.9728	0.9486	0.8704	0.7129	0.4998	0.3397	0.3931	0.6676	0.9044	0.9696	0.9854	(89)
MIT 2	18.3958	18.6271	19.0028	19.5229	19.8724	20.0159	20.0379	20.0364	19.9513	19.5109	18.8922	18.3692	(90)
Living area fraction										fLA = Living area / (4) =		0.3610	(91)
MIT	18.8305	19.0438	19.3916	19.8764	20.2125	20.3565	20.3820	20.3787	20.2870	19.8612	19.2862	18.8042	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8305	19.0438	19.3916	19.8764	20.2125	20.3565	20.3820	20.3787	20.2870	19.8612	19.2862	18.8042	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9778	0.9658	0.9404	0.8657	0.7232	0.5257	0.3723	0.4275	0.6879	0.8994	0.9629	0.9804	(94)
Useful gains	550.8462	599.5964	631.8206	656.8587	597.8848	436.8367	293.9756	306.8587	442.2875	515.2430	525.6475	534.1000	(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	1171.6023	1137.6392	1034.4255	870.8001	673.8876	451.1643	296.4091	311.2473	486.7812	733.1542	968.8908	1166.3832	(97)
Space heating kWh	461.8425	361.5648	299.5381	154.0378	56.5461	0.0000	0.0000	0.0000	0.0000	162.1259	319.1352	470.4187	(98a)
Space heating requirement - total per year (kWh/year)												2285.2091	
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	461.8425	361.5648	299.5381	154.0378	56.5461	0.0000	0.0000	0.0000	0.0000	162.1259	319.1352	470.4187	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2285.2091	
Space heating per m2											(98c) / (4) =	30.6328	(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	461.8425	361.5648	299.5381	154.0378	56.5461	0.0000	0.0000	0.0000	0.0000	162.1259	319.1352	470.4187	(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)	500.3711	391.7278	324.5266	166.8882	61.2634	0.0000	0.0000	0.0000	0.0000	175.6510	345.7586	509.6628	(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	223.1952	197.3498	209.8152	185.1275	179.8355	162.4811	160.7939	167.0162	168.6423	187.5021	198.6562	220.8691	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.6526	85.3992	84.8577	83.6505	81.7828	79.8000	79.8000	79.8000	79.8000	83.7354	85.1170	85.7115	(217)
Fuel for water heating, kWh/month	260.5819	231.0910	247.2554	221.3107	219.8941	203.6104	201.4961	209.2935	211.3312	223.9222	233.3919	257.6892	(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	22.3884	17.9608	16.1717	11.8481	9.1518	7.4771	8.3486	10.8518	14.0954	18.4939	20.8888	23.0106	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-5.5309	-8.6939	-13.9135	-17.4743	-20.5350	-19.8037	-19.5644	-17.6056	-14.5027	-10.6865	-6.3899	-4.6832	(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	-0.8944	-1.9741	-4.1063	-6.4505	-8.8194	-8.9715	-8.8665	-7.3712	-5.2294	-2.9113	-1.2208	-0.7006	(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	2475.8495	(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	2720.8676	(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)	180.6868	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-216.8995	(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	5246.5044	(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	2475.8495	0.2100	519.9284	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2720.8676	0.2100	571.3822	(264)
Space and water heating			1091.3106	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	180.6868	0.1443	26.0787	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-159.3835	0.1324	-21.1016	
PV Unit electricity exported	-57.5160	0.1246	-7.1672	
Total			-28.2688	(269)
Total CO2, kg/year			1101.0498	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.7600	(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	2475.8495	1.1300	2797.7099	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2720.8676	1.1300	3074.5804	(278)
Space and water heating			5872.2903	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	180.6868	1.5338	277.1435	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-159.3835	1.4892	-237.3512	
PV Unit electricity exported	-57.5160	0.4573	-26.3047	
Total			-263.6560	(283)
Total Primary energy kWh/year			6015.8787	(286)
Target Primary Energy Rate (TPER)			80.6400	(287)

Full SAP Calculation Printout

Property Reference	K3 Mid	**Issued on Date**	20/02/2024
Assessment Reference	00001	**Prop Type Ref**	
Property			

SAP Rating	84 B	**DER**	3.67	**TER**	10.48
Environmental	97 A	**% DER < TER**			64.98
CO_2 Emissions (t/year)	0.3	**DFEE**	22.69	**TFEE**	23.16
Compliance Check	See BREL	**% DFEE < TFEE**			2.05
% DPER < TPER	30.58	**DPER**	39.25	**TPER**	56.54

Assessor Details	Mr. Dimitrios Varsamidis	**Assessor ID**	U808-0001
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	87.4200	(1b)	x 2.5000	(2b) =	218.5500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		218.5500	(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) =	81.0000 (23c)

Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448	(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)			15.3300	0.8687	13.3176			(27)
Opening Type 2			2.3100	1.0000	2.3100			(26)
External Wall 1	30.8800	15.3300	15.5500	0.1600	2.4880	150.0000	2332.5000	(29a)
Corridor	12.2000	2.3100	9.8900	0.1600	1.5824	150.0000	1483.5000	(29a)
External Wall 3	14.3500		14.3500	0.1600	2.2960	150.0000	2152.5000	(29a)
Total net area of external elements Aum(A, m2)			57.4300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		21.9940			(33)
Party Wall 1			53.8500	0.0000	0.0000	70.0000	3769.5000	(32)
Party Floor 1			87.4200			40.0000	3496.8000	(32d)
Party Ceiling 1			87.4200			30.0000	2622.6000	(32b)
Internal Wall 1			133.6000			9.0000	1202.4000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17059.8000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	195.1476 (35)
List of Thermal Bridges	

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	11.2400	0.0600	0.6744
E7 Party floor between dwellings (in blocks of flats)	21.2400	0.1100	2.3364
E16 Corner (normal)	2.5000	0.1600	0.4000
E17 Corner (inverted - internal area greater than external area)	2.5000	0.0000	0.0000
E18 Party wall between dwellings	5.0000	0.0450	0.2250
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	13.4600	0.1500	2.0190
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	43.0800	0.0000	0.0000
E25 Staggered party wall between dwellings	5.0000	0.1200	0.6000
E16 Corner (normal)	2.5000	0.1300	0.3250
E2 Other lintels (including other steel lintels)	7.5000	0.0500	0.3750
E3 Sill	6.4000	0.0500	0.3200
E4 Jamb	22.8000	0.1000	2.2800

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.5548 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 31.5488 (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	18.5758	18.3459	18.1160	16.9666	16.7367	15.5873	15.5873	15.3574	16.0470	16.7367	17.1965	17.6562	(38)
Heat transfer coeff	50.1246	49.8947	49.6648	48.5154	48.2855	47.1360	47.1360	46.9061	47.5958	48.2855	48.7452	49.2050	(39)

Average = Sum(39)m / 12 = 48.4579

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.5734	0.5707	0.5681	0.5550	0.5523	0.5392	0.5392	0.5366	0.5444	0.5523	0.5576	0.5629	(40)
HLP (average)												0.5543	
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 2.5887 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
67.6243	66.6080	65.1271	62.2937	60.2027	57.8709	56.5454	58.0151	59.6262	62.1299	65.0242	67.3652	(42a)

Hot water usage for baths

29.2039	28.7702	28.1594	27.0333	26.1900	25.2550	24.7499	25.3564	26.0168	27.0173	28.1666	29.1052	(42b)

Hot water usage for other uses

41.1412	39.6452	38.1491	36.6531	35.1570	33.6610	33.6610	35.1570	36.6531	38.1491	39.6452	41.1412	(42c)

Average daily hot water use (litres/day) 126.8251 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	137.9694	135.0234	131.4357	125.9801	121.5498	116.7869	114.9564	118.5286	122.2961	127.2963	132.8360	137.6116	(44)
Energy conte	218.5098	192.2715	202.0117	172.4604	163.6294	143.6031	139.0298	146.7632	150.8033	172.7399	189.2492	215.4665	(45)
Energy content (annual)										Total = Sum(45)m =		2106.5377	
Distribution loss (46)m = 0.15 x (45)m	32.7765	28.8407	30.3018	25.8691	24.5444	21.5405	20.8545	22.0145	22.6205	25.9110	28.3874	32.3200	(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

273.7866	242.1989	257.2885	225.9541	218.9062	197.0968	194.3066	202.0400	204.2970	228.0167	242.7429	270.7433	(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

273.7866	242.1989	257.2885	225.9541	218.9062	197.0968	194.3066	202.0400	204.2970	228.0167	242.7429	270.7433	(64)
									Total per year (kWh/year) = Sum(64)m =		2757.3775	(64)
12Total per year (kWh/year)											2757	(64)

Electric shower(s)

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

Heat gains from water heating, kWh/month

116.8760	103.8722	111.3903	100.1380	98.6282	90.5430	90.4488	93.0202	92.9370	101.6575	105.7203	115.8640	(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	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	121.1964	134.1818	121.1964	125.2363	121.1964	125.2363	121.1964	121.1964	125.2363	121.1964	125.2363	121.1964	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	234.2503	236.6811	230.5556	217.5151	201.0539	185.5826	175.2469	172.8161	178.9416	191.9821	208.4433	223.9146	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	(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)	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)	157.0913	154.5718	149.7182	139.0806	132.5648	125.7541	121.5710	125.0271	129.0792	136.6364	146.8338	155.7312	(72)
Total internal gains	574.3691	587.2656	563.3013	543.6631	516.6461	498.4041	479.8454	480.8707	495.0882	511.6459	542.3444	562.6733	(73)

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6. Solar gains

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

Northeast				6.7500		11.2829		0.4000		0.8000		0.7700	16.8892 (75)
Southwest				8.5800		36.7938		0.4000		0.8000		0.7700	70.0077 (79)
Solar gains	86.8969	153.6274	225.1007	303.8869	363.1758	370.5772	353.1029	307.3376	252.1432	173.8087	105.1040	73.7045	(83)
Total gains	661.2660	740.8931	788.4019	847.5500	879.8219	868.9813	832.9483	788.2084	747.2314	685.4546	647.4484	636.3778	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	94.5411	94.9767	95.4164	97.6770	98.1420	100.5353	100.5353	101.0280	99.5641	98.1420	97.2163	96.3079	
alpha	7.3027	7.3318	7.3611	7.5118	7.5428	7.7024	7.7024	7.7352	7.6376	7.5428	7.4811	7.4205	
util living area	0.9563	0.9124	0.8370	0.6785	0.5088	0.3471	0.2490	0.2737	0.4390	0.7125	0.9011	0.9629	(86)
MIT	20.6521	20.7835	20.8974	20.9796	20.9976	20.9999	21.0000	21.0000	20.9994	20.9764	20.8394	20.6355	(87)
Th 2	20.4540	20.4564	20.4588	20.4707	20.4731	20.4850	20.4850	20.4874	20.4803	20.4731	20.4683	20.4635	(88)
util rest of house	0.9487	0.8994	0.8168	0.6519	0.4805	0.3192	0.2199	0.2432	0.4061	0.6812	0.8849	0.9562	(89)
MIT 2	20.0563	20.2168	20.3512	20.4513	20.4711	20.4850	20.4850	20.4874	20.4798	20.4515	20.2960	20.0443	(90)
Living area fraction									fLA = Living area / (4) =			0.3284	(91)
MIT	20.2519	20.4029	20.5306	20.6248	20.6440	20.6541	20.6542	20.6558	20.6505	20.6239	20.4745	20.2385	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2519	20.4029	20.5306	20.6248	20.6440	20.6541	20.6542	20.6558	20.6505	20.6239	20.4745	20.2385	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9455	0.8981	0.8196	0.6597	0.4897	0.3283	0.2294	0.2533	0.4169	0.6903	0.8851	0.9531	(94)
Useful gains	625.2489	665.3617	646.1664	559.1520	430.8392	285.3294	191.0950	199.6176	311.5460	473.1468	573.0679	606.5522	(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	799.5840	773.5121	696.8250	568.8329	431.8675	285.3655	191.0967	199.6212	311.7752	484.0094	651.9410	789.1740	(97)
Space heating kWh	129.7053	72.6770	37.6900	6.9702	0.7651	0.0000	0.0000	0.0000	0.0000	8.0818	56.7886	135.8706	(98a)
Space heating requirement - total per year (kWh/year)												448.5487	
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	129.7053	72.6770	37.6900	6.9702	0.7651	0.0000	0.0000	0.0000	0.0000	8.0818	56.7886	135.8706	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												448.5487	
Space heating per m2										(98c) / (4) =		5.1310	(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 Heat pump-Space and Water												1.0000	(303c)
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	129.7053	72.6770	37.6900	6.9702	0.7651	0.0000	0.0000	0.0000	0.0000	8.0818	56.7886	135.8706	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50													
307c	194.5580	109.0156	56.5350	10.4553	1.1476	0.0000	0.0000	0.0000	0.0000	12.1227	85.1829	203.8059	
Space heating requirement	194.5580	109.0156	56.5350	10.4553	1.1476	0.0000	0.0000	0.0000	0.0000	12.1227	85.1829	203.8059	(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	273.7866	242.1989	257.2885	225.9541	218.9062	197.0968	194.3066	202.0400	204.2970	228.0167	242.7429	270.7433	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50													
310c	410.6799	363.2984	385.9328	338.9311	328.3593	295.6451	291.4599	303.0600	306.4454	342.0251	364.1143	406.1149	
Water heating fuel	410.6799	363.2984	385.9328	338.9311	328.3593	295.6451	291.4599	303.0600	306.4454	342.0251	364.1143	406.1149	(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	14.4477	13.0496	14.4477	13.9817	14.4477	13.9817	14.4477	14.4477	13.9817	14.4477	13.9817	14.4477	(331)
Lighting	30.2291	24.2509	21.8353	15.9975	12.3569	10.0957	11.2724	14.6523	19.0318	24.9708	28.2045	31.0693	(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												672.8230	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												4136.0662	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												6.7282	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6380)													
mechanical ventilation fans (SFP = 0.6380)												170.1106	(330a)
Total electricity for the above, kWh/year												170.1106	(331)
Electricity for lighting (calculated in Appendix L)												243.9665	(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	5222.9663	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			270.0000	(367)
Space and Water heating from Heat pump	1781.0701	0.1593	39.6976	(367)
Electrical energy for heat distribution (space & water)	6.7282	0.0000	6.8996	(372)
Overall CO2 factor for heat network			0.0546	(386)
Total CO2 associated with community systems			262.4412	(373)
Space and water heating			262.4412	(376)
Pumps, fans and electric keep-hot	170.1106	0.1387	23.5964	(378)
Energy for lighting	243.9665	0.1443	35.2119	(379)
Total CO2, kg/year			321.2496	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.6700	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			270.0000	(467c)
Space and Water heating from Heat pump	1781.0701	1.5896	396.1281	(467)
Electrical energy for heat distribution (space & water)	6.7282	0.0000	73.6052	(472)
Overall CO2 factor for heat network			0.5822	(486)
Total CO2 associated with community systems			2799.7227	(473)
Space and water heating			2799.7227	(476)
Pumps, fans and electric keep-hot	170.1106	1.5128	257.3433	(478)
Energy for lighting	243.9665	1.5338	374.2040	(479)
Total Primary energy kWh/year			3431.2700	(483)
Dwelling Primary energy Rate (DPER)			39.2500	(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		87.4200	(1b)	x 2.5000	(2b) =	218.5500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.4200						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		218.5500	(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) =	0.1373	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3873	(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) =	0.3292	(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	0.4197	0.4115	0.4032	0.3621	0.3539	0.3127	0.3127	0.3045	0.3292	0.3539	0.3703	0.3868	(22b)
Effective ac	0.5881	0.5847	0.5813	0.5656	0.5626	0.5489	0.5489	0.5464	0.5542	0.5626	0.5686	0.5748	(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			2.3100	1.0000	2.3100			(26)
TER Opening Type (Uw = 1.20)			15.3300	1.1450	17.5534			(27)
External Wall 1	30.8800	15.3300	15.5500	0.1800	2.7990			(29a)
Corridor	12.2000	2.3100	9.8900	0.1800	1.7802			(29a)
External Wall 3	14.3500		14.3500	0.1800	2.5830			(29a)
Total net area of external elements Aum(A, m2)			57.4300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		27.0256			(33)
Party Wall 1			53.8500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 205.1476 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	11.2400	0.0700	0.7868
E7 Party floor between dwellings (in blocks of flats)	21.2400	0.0700	1.4868
E16 Corner (normal)	2.5000	0.0900	0.2250
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	13.4600	0.0200	0.2692
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	43.0800	0.0000	0.0000
E25 Staggered party wall between dwellings	5.0000	0.0600	0.3000
E16 Corner (normal)	2.5000	0.0900	0.2250
E2 Other lintels (including other steel lintels)	7.5000	0.0500	0.3750
E3 Sill	6.4000	0.0500	0.3200
E4 Jamb	22.8000	0.0500	1.1400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.2028 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.2284 (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	42.4128	42.1662	41.9244	40.7888	40.5763	39.5872	39.5872	39.4041	39.9682	40.5763	41.0062	41.4555	(38)
Heat transfer coeff	74.6413	74.3946	74.1528	73.0172	72.8048	71.8157	71.8157	71.6325	72.1967	72.8048	73.2346	73.6839	(39)
Average = Sum(39)m / 12 =												73.0162	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8538	0.8510	0.8482	0.8352	0.8328	0.8215	0.8215	0.8194	0.8259	0.8328	0.8377	0.8429	(40)
HLP (average)												0.8352	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5887 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	67.6243	66.6080	65.1271	62.2937	60.2027	57.8709	56.5454	58.0151	59.6262	62.1299	65.0242	67.3652	(42a)
Hot water usage for baths	29.2039	28.7702	28.1594	27.0333	26.1900	25.2550	24.7499	25.3564	26.0168	27.0173	28.1666	29.1052	(42b)
Hot water usage for other uses	41.1412	39.6452	38.1491	36.6531	35.1570	33.6610	33.6610	35.1570	36.6531	38.1491	39.6452	41.1412	(42c)
Average daily hot water use (litres/day)												126.8251	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	137.9694	135.0234	131.4357	125.9801	121.5498	116.7869	114.9564	118.5286	122.2961	127.2963	132.8360	137.6116	(44)
Energy conte	218.5098	192.2715	202.0117	172.4604	163.6294	143.6031	139.0298	146.7632	150.8033	172.7399	189.2492	215.4665	(45)
Energy content (annual)										Total = Sum(45)m =		2106.5377	
Distribution loss (46)m = 0.15 x (45)m	32.7765	28.8407	30.3018	25.8691	24.5444	21.5405	20.8545	22.0145	22.6205	25.9110	28.3874	32.3200	(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	265.1047	234.3572	248.6066	217.5523	210.2243	188.6949	185.6247	193.3581	195.8951	219.3348	234.3410	262.0614	(62)
WWHRS	-30.9150	-27.3415	-28.6304	-23.7071	-22.0942	-18.9062	-17.7215	-18.8450	-19.5610	-23.0603	-26.1245	-30.3425	(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	234.1897	207.0157	219.9762	193.8451	188.1301	169.7888	167.9032	174.5130	176.3341	196.2745	208.2165	231.7189	(64)
									Total per year (kWh/year) = Sum(64)m =			2367.9058	(64)
12Total per year (kWh/year)												2368	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	109.9304	97.5988	104.4448	93.4166	91.6827	83.8215	83.5033	86.0747	86.2156	94.7119	98.9988	108.9185	(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	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	129.4367	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	121.1964	134.1818	121.1964	125.2363	121.1964	125.2363	121.1964	121.1964	125.2363	121.1964	125.2363	121.1964	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	234.2503	236.6811	230.5556	217.5151	201.0539	185.5826	175.2469	172.8161	178.9416	191.9821	208.4433	223.9146	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	35.9437	(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)	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	-103.5494	(71)
Water heating gains (Table 5)	147.7560	145.2364	140.3828	129.7452	123.2294	116.4187	112.2357	115.6918	119.7438	127.3010	137.4984	146.3959	(72)
Total internal gains													

	568.0337	580.9303	556.9659	537.3277	510.3108	489.0687	470.5100	471.5353	485.7528	505.3105	536.0090	556.3379 (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	
Northeast	6.7500	11.2829	0.6300	0.7000	0.7700	23.2754	(75)
Southwest	8.5800	36.7938	0.6300	0.7000	0.7700	96.4793	(79)

Solar gains	119.7547	211.7178	310.2169	418.7941	500.5016	510.7017	486.6199	423.5497	347.4849	239.5301	144.8465	101.5741	(83)
Total gains	687.7885	792.6480	867.1827	956.1218	1010.8124	999.7704	957.1299	895.0850	833.2377	744.8406	680.8555	657.9120	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	66.7414	66.9627	67.1811	68.2259	68.4250	69.3674	69.3674	69.5448	69.0013	68.4250	68.0234	67.6086	
alpha	5.4494	5.4642	5.4787	5.5484	5.5617	5.6245	5.6245	5.6363	5.6001	5.5617	5.5349	5.5072	
util living area	0.9821	0.9619	0.9208	0.8119	0.6442	0.4566	0.3297	0.3673	0.5839	0.8545	0.9615	0.9853	(86)
MIT	20.1293	20.3359	20.5775	20.8359	20.9603	20.9952	20.9994	20.9989	20.9822	20.8150	20.4440	20.0987	(87)
Th 2	20.2069	20.2093	20.2117	20.2229	20.2250	20.2347	20.2347	20.2365	20.2310	20.2250	20.2208	20.2163	(88)
util rest of house	0.9779	0.9536	0.9044	0.7797	0.5976	0.4033	0.2726	0.3068	0.5239	0.8206	0.9516	0.9819	(89)
MIT 2	19.1998	19.4594	19.7562	20.0631	20.1924	20.2318	20.2345	20.2361	20.2190	20.0490	19.6062	19.1686	(90)
Living area fraction									fLA = Living area / (4) =			0.3284	(91)
MIT	19.5051	19.7472	20.0260	20.3169	20.4446	20.4825	20.4857	20.4866	20.4696	20.3006	19.8813	19.4741	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5051	19.7472	20.0260	20.3169	20.4446	20.4825	20.4857	20.4866	20.4696	20.3006	19.8813	19.4741	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9732	0.9478	0.9000	0.7838	0.6111	0.4206	0.2914	0.3266	0.5429	0.8242	0.9465	0.9777	(94)
Useful gains	669.3750	751.2891	780.4953	749.3903	617.7191	420.5300	278.8600	292.3694	452.3297	613.8760	644.4275	643.2567	(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	1134.9260	1104.5541	1002.9877	833.6296	636.6468	422.4553	279.0529	292.7316	459.8646	706.2465	936.0340	1125.4562	(97)
Space heating kWh	346.3699	237.3940	165.5344	60.6523	14.0822	0.0000	0.0000	0.0000	0.0000	68.7236	209.9567	358.7564	(98a)
Space heating requirement - total per year (kWh/year)												1461.4696	
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	346.3699	237.3940	165.5344	60.6523	14.0822	0.0000	0.0000	0.0000	0.0000	68.7236	209.9567	358.7564	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1461.4696	
Space heating per m2											(98c) / (4) =	16.7178	(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	346.3699	237.3940	165.5344	60.6523	14.0822	0.0000	0.0000	0.0000	0.0000	68.7236	209.9567	358.7564	(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)	375.2654	257.1983	179.3439	65.7121	15.2569	0.0000	0.0000	0.0000	0.0000	74.4568	227.4720	388.6852	(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	234.1897	207.0157	219.9762	193.8451	188.1301	169.7888	167.9032	174.5130	176.3341	196.2745	208.2165	231.7189	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.9359	84.3676	83.4308	81.7752	80.3672	79.8000	79.8000	79.8000	79.8000	81.9541	84.0785	85.0364	(217)
Fuel for water heating, kWh/month	275.7253	245.3734	263.6629	237.0463	234.0880	212.7679	210.4050	218.6880	220.9700	239.4932	247.6455	272.4938	(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	25.1822	20.2021	18.1898	13.3266	10.2939	8.4102	9.3904	12.2060	15.8544	20.8018	23.4956	25.8821	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-11.4994	-17.6671	-27.6421	-33.9153	-39.1355	-37.4766	-37.0170	-33.6484	-28.2118	-21.3835	-13.1463	-9.7795	(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	-2.7228	-5.9464	-12.2446	-19.0421	-25.8404	-26.2169	-25.9146	-21.6377	-15.4650	-8.7150	-3.7001	-2.1376	(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	1583.3906	(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	2878.3593	(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)	203.2350	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-480.1058	(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	4270.8791	(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	1583.3906	0.2100	332.5120	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2878.3593	0.2100	604.4555	(264)
Space and water heating			936.9675	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	203.2350	0.1443	29.3331	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-310.5226	0.1328	-41.2500	
PV Unit electricity exported	-169.5832	0.1249	-21.1788	
Total			-62.4288	(269)
Total CO2, kg/year			915.8010	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.4800	(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	1583.3906	1.1300	1789.2314	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2878.3593	1.1300	3252.5460	(278)
Space and water heating			5041.7775	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	203.2350	1.5338	311.7286	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-310.5226	1.4909	-462.9445	
PV Unit electricity exported	-169.5832	0.4584	-77.7323	
Total			-540.6768	(283)
Total Primary energy kWh/year			4942.9301	(286)
Target Primary Energy Rate (TPER)			56.5400	(287)

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Appendix C

SBEM BRUKL Worksheets – *Be Lean & Be Clean/Be Green*

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

RAR Commercial Units

As designed

Date: Thu Feb 15 10:31:17 2024

Administrative information

Building Details

Address: London,

Certifier details

Name: Nimco Ali

Telephone number: 020 3603 1600

Address: Trinity Court Batchworth Island Church Street, Rickmansworth, WD3 1RT

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]: 310.86

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	4.18	
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	3.43	
Target primary energy rate (TPER), kWh_{PE}/m^2.annum	45.74	
Building primary energy rate (BPER), kWh_{PE}/m^2.annum	37.45	
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	0.18	0.2	00 Level - Commercial Unit D3_P_4
Floors	0.18	0.11	0.11	00 Level - Commercial Unit D3_S_2
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 Level - Commercial Unit D3_G_11
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	4

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- ASHP

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.64	6.7	-	-	-
Standard value	2.5*	5	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- Project DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

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 Level - Commercial Unit D3	-	-	-	-	1.4	-	-	-	-	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 Level - Commercial Unit D3	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 Level - Commercial Unit D3	NO (-24.7%)	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]	310.9	310.9
External area [m^2]	574.5	574.5
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	4	3
Average conductance [W/K]	166.34	214.68
Average U-value [W/m^2K]	0.29	0.37
Alpha value* [%]	19.36	17.42

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

Building Use

% Area	Building Type
100	**Retail/Financial and Professional Services**
	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
	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	2.54	4.05
Cooling	5.49	7.83
Auxiliary	5.36	3.44
Lighting	10.31	14.03
Hot water	1.7	1.7
Equipment*	20.26	20.26
TOTAL**	**25.4**	**31.05**

* 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]	122.74	162.51
Primary energy [kWh_{PE}/m^2]	37.45	45.74
Total emissions [kg/m^2]	3.43	4.18

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	23.7	99	2.5	5.5	5.4	2.59	5.01	2.64	6.7
	Notional	38.5	124	4.1	7.8	3.4	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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

RAR Commercial Units

As designed

Date: Thu Feb 15 10:34:18 2024

Administrative information

Building Details

Address: London,

Certifier details

Name: Nimco Ali

Telephone number: 020 3603 1600

Address: Trinity Court Batchworth Island Church Street, Rickmansworth, WD3 1RT

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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]: 310.86

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	4.18	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	2.52	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	45.74	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	27.13	
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	0.18	0.2	00 Level - Commercial Unit D3_P_4
Floors	0.18	0.11	0.11	00 Level - Commercial Unit D3_S_2
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 Level - Commercial Unit D3_G_11
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	4

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- ASHP

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4.5	6.7	-	-	-
Standard value	2.5*	5	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- Project DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

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 Level - Commercial Unit D3	-	-	-	-	1.4	-	-	-	-	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 Level - Commercial Unit D3	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 Level - Commercial Unit D3	NO (-24.7%)	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]	310.9	310.9
External area [m^2]	574.5	574.5
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	4	3
Average conductance [W/K]	166.34	214.68
Average U-value [W/m^2K]	0.29	0.37
Alpha value* [%]	19.36	17.42

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

Building Use

% Area	Building Type
100	**Retail/Financial and Professional Services**
	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
	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	1.49	4.05
Cooling	5.49	7.83
Auxiliary	5.36	3.44
Lighting	10.31	14.03
Hot water	1.7	1.7
Equipment*	20.26	20.26
TOTAL**	**24.35**	**31.05**

* 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	5.95	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*5.95*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	122.74	162.51
Primary energy [kWh_{PE}/m^2]	27.13	45.74
Total emissions [kg/m^2]	2.52	4.18

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	23.7	99	1.5	5.5	5.4	4.41	5.01	4.5	6.7
	Notional	38.5	124	4.1	7.8	3.4	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

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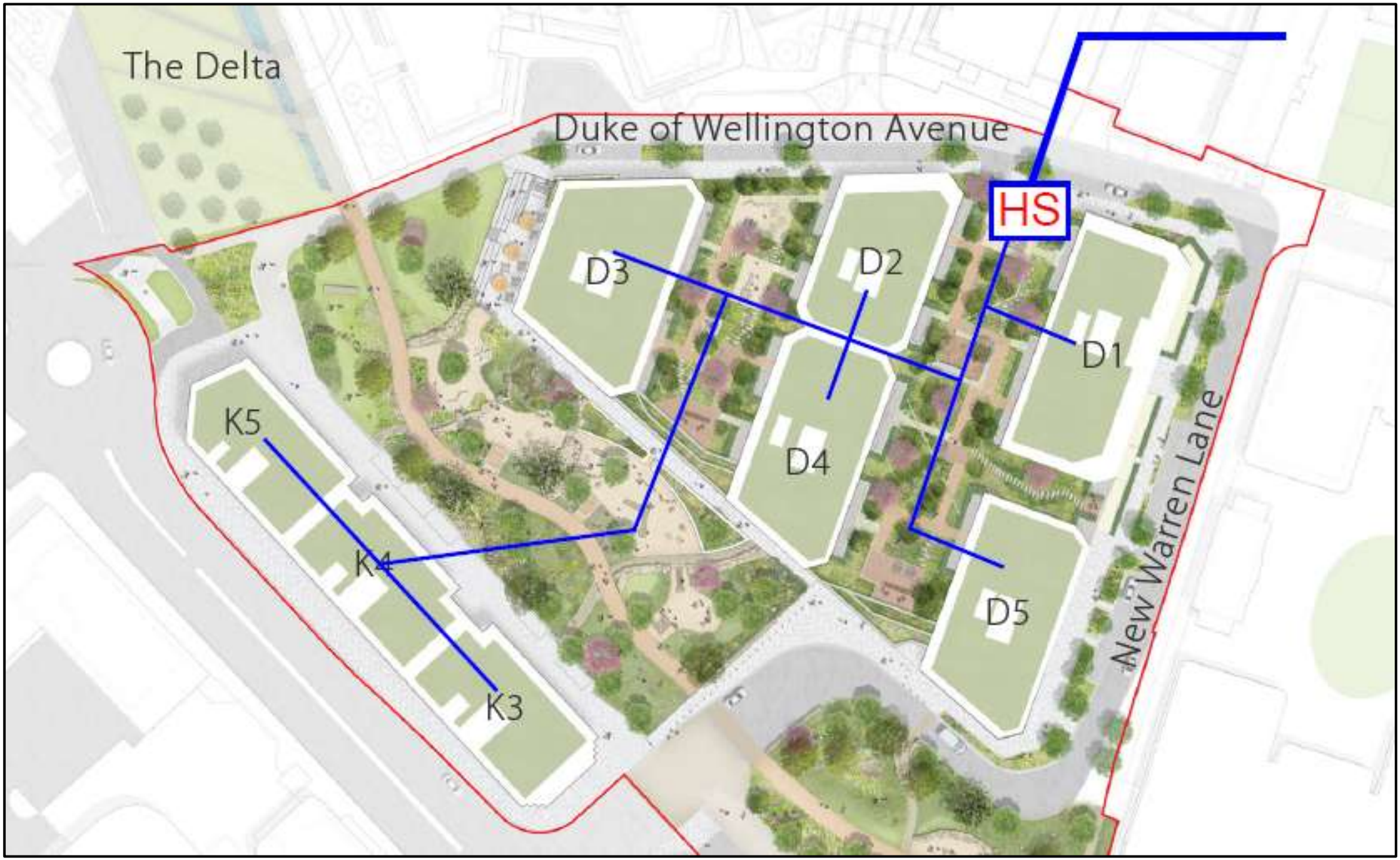
Appendix D

Indicative Primary Pipe Route


The Delta
Duke of Wellington Avenue
HS
D3
D2
D1
D4
D5
K5
K4
K3
New Warren Lane

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Appendix E

Site Roof Plan


PV/MEP location and quantum indicative
DUKE OF WELLINGTON AVENUE
NEW WARREN LANE


OLWICH HIGH ST
BERESFORD ST
NEW WARREN LN

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Appendix F

GLA Reporting Spreadsheet Results

Part L 2021 Performance

Residential

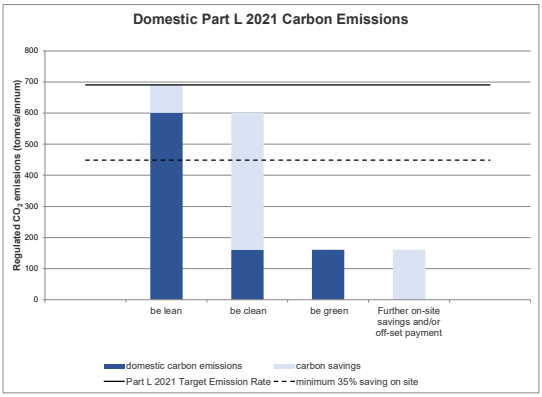
Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for residential buildings

	Carbon Dioxide Emissions for residential buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	690.2	117.2
After energy demand reduction (be lean)	600.6	117.2
After heat network connection (be clean)	160.9	117.2
After renewable energy (be green)	161.0	117.2

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for residential buildings

	Regulated residential carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	89.6	13%
Be clean: savings from heat network	439.7	64%
Be green: savings from renewable energy	-0.1	0%
Cumulative on site savings	**529.1**	**77%**
Annual savings from off-set payment	161.0	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**4,831**	-
Cash in-lieu contribution (£)	**458,977**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab



Non-residential

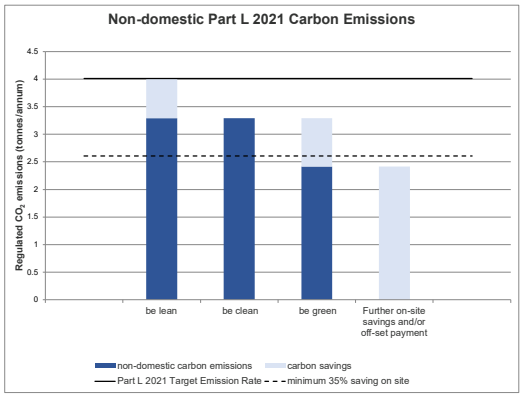
Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-residential buildings

	Carbon Dioxide Emissions for non-residential buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	4.0	2.6
After energy demand reduction (be lean)	3.3	2.6
After heat network connection (be clean)	3.3	2.6
After renewable energy (be green)	2.4	2.6

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-residential buildings

	Regulated non-residential carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	0.7	18%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	0.9	22%
Total Cumulative Savings	**1.6**	**40%**
Annual savings from off-set payment	2.4	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**73**	-
Cash in-lieu contribution (£)	**6,888**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab



SITE-WIDE

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	694.2		
Be lean	603.9	90.3	13%
Be clean	164.2	439.7	63%
Be green	163.5	0.7	0%
Total Savings	-	530.7	76%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**4,903.8**	-

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	26.62	25.10	6%

	Area weighted non-residential cooling demand (MJ/m^2)	Total non-residential cooling demand (MJ/year)
Actual	5.49	5265
Notional	7.83	7509

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Appendix G
Overheating Report

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Dynamic Overheating Report

Berkeley Homes (East Thames) Ltd

The Ropeyards

Final

Harry Fry
BEng (hons), MSc

March 2024

DOCUMENT CONTROL RECORD
REPORT STATUS: DRAFT

Version	Date	Reason for issue	Author	Checked by	Approved for Issue by Project Manager
v.1	14.02.2024	Draft	H Fry	K Paxton	K Paxton
v.1	01.03.2024	Final	H Fry	K Paxton	p.p., J Lloyd-Davies

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.

This report has been prepared by Hodkinson Consultancy using all reasonable skill, care and diligence and using evidence supplied by the design team, client and where relevant through desktop research.

Hodkinson Consultancy can accept no responsibility for misinformation or inaccurate information supplied by any third party as part of this assessment.

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Executive Summary

The purpose of this report is to detail the overheating mitigation strategy for the proposed development at The Ropeyards, Royal Arsenal Riverside, Plots D&K by Berkeley Homes (East Thames Ltd) in the Royal Borough of Greenwich, in support of the Reserved Matters Application (RMA).

The performance of dwellings and communal corridors has been assessed against the Charted Institution of Building Services Engineers (CIBSE) guidance TM59 *Design methodology for the assessment of overheating risk in homes* (2017), taking into account considerations required by Approved Document O *Overheating* (2021).

A sample of dwellings and communal corridors has been selected for the dynamic overheating assessment based on design characteristics that establish them as representative of the overall proposed scheme. This selection of dwellings includes consideration of varying floor levels, occupancy types, orientations and noise risk scenarios.

The following passive mitigation measures have been explored as far as practicable to avoid the need for active cooling:

> Openable areas of windows have been maximised, to ensure adequate natural ventilation;

> Window casements open inwards to allow maximum openability;

> Guarding heights are 1.1 m from finished floor level enabling windows to be fully open without the need for restrictors;

> External shading is provided to some windows in form of balconies and external reveal depth of 215 mm;

> Highly efficient fabric envelope including concrete floor slabs to provide thermal capacity and high performance solar control glazing with g-values optimised to mitigate overheating risk; and

> A background mechanical ventilation system providing ventilation rates between minimum Part F and 2.0 ACH, depending on the level of overheating risk.

All dwellings tested demonstrate compliance with the CIBSE TM59 overheating assessment criteria under the mandatory weather file (DSY1 for the 2020s, high emissions, 50% percentile scenario). The results are based on key design features and passive mitigation measures following the London Plan cooling hierarchy, as outlined within Table i.

Table i: Design features incorporated in accordance with the London Plan cooling hierarchy

Cooling hierarchy	Design feature	Discussion
1. Reduce amount of heat entering the building	Efficient building fabric and air tightness standards	In line with energy strategy (Hodkinson Consultancy, February 2024)
	Solar control glazing with G-value ranging from 0.40 – 0.32 (frame factor 0.8) (mark-up provided in Appendix A)	A low G-value reduces solar gain, but has implications on CO_2 emissions, fabric energy efficiency and internal daylight levels and has therefore been optimised to balance all aspects as far as possible
	External shading provided by balcony overhangs	In line with design proposals (PRP Architects, January 2024)
2. Minimise internal heat generation	Energy efficient design of building services	In line with energy strategy (Hodkinson Consultancy, February 2024) Heat loss calculations based on designed flow and return temperatures and pipe lengths measured from floor plans.
3. Manage the heat	Concrete floor slab between dwellings in apartment buildings	The thermal mass of this will help reduce the risk of overheating by absorbing heat during the daytime
4. Passive ventilation	Openable windows used as the primary means of ventilation	Windows are simulated to open in accordance with the limits set out within Approved Document O (2021)
5. Mechanical ventilation	Background mechanical ventilation rate in line with Part F of the Building Regulations, increasing up to 2.0 ACH where required	Minimum Part F ventilation rates range from 0.88-0.42 ach for the assessed dwellings

Cooling hierarchy	Design feature	Discussion
6. Active cooling	Cooling provision	Dwellings subject to noise risk constraints on window opening will require some form of cooling, either via comfort cooling or bolt-on cooling modules to MVHR units.

CONTENTS

1. INTRODUCTION

1.1 This document has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, to present the overheating mitigation strategy for the proposed development at The Ropeyards, Royal Arsenal Riverside, Plots D&K by Berkeley Homes (East Thames).

Site Location

1.2 The Site is located on the western edge of the wider Royal Arsenal Riverside masterplan and is approximately 2.3 ha. The Site currently sits on a temporary park and is bound to the south by the A206, the RAR A & B Blocks to the north (and north east) and RAR Phase 3, the Brass Foundry and The Guard House to the west.

Beyond the immediate site boundaries, to the north of the site is the River Thames and to the south and south east of the site is Woolwich Town Centre including the main shopping area along Powis Street, General Gordon Square, the Woolwich Arsenal Overground Train Station and the Woolwich DLR Station.

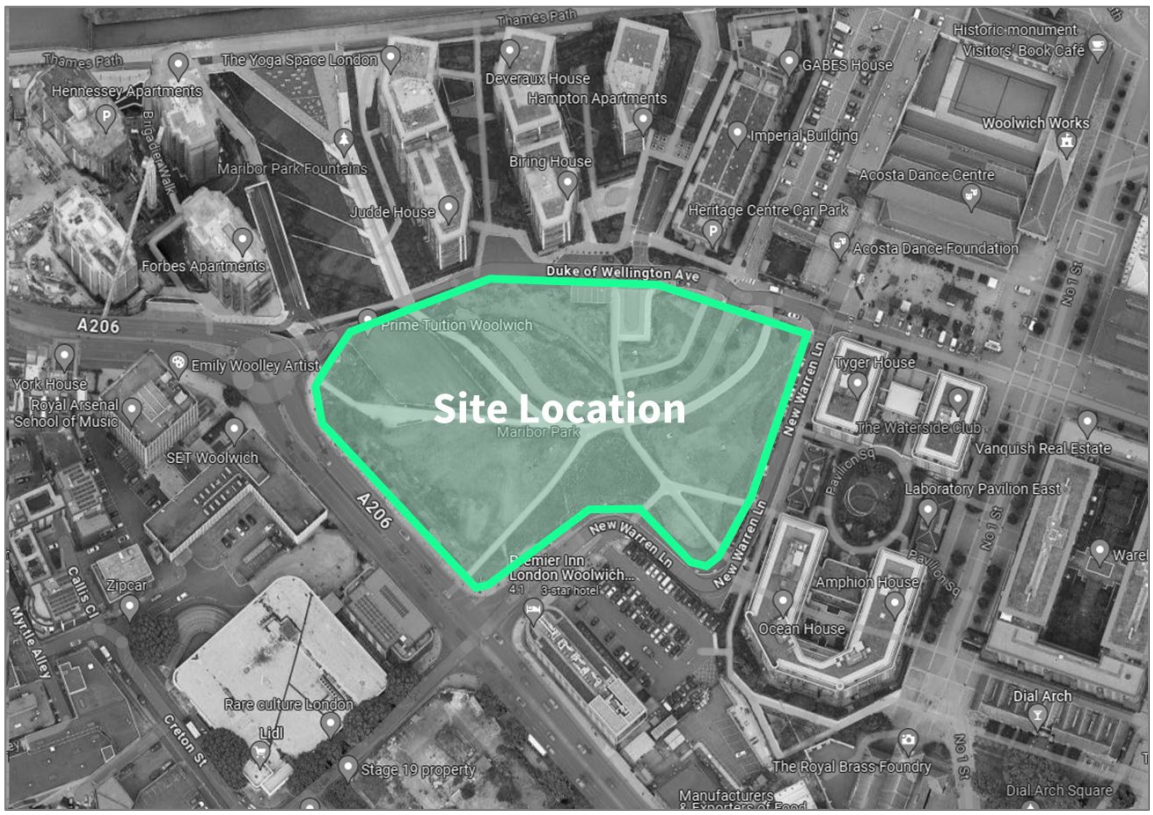

Figure 1: Site Location (Google Maps © February 2024)

Development Description

1.3 The development is described as follows:

Submission of Reserved Matters (Appearance, Landscaping, Layout and Scale) pursuant to Condition 2 of planning permission reference 16/3025/MA, dated 17.03.2017, for residential units and non-residential floorspace within Plots D and K, along with public / private landscaping details, car / cycle parking, refuse / recycling facilities and play provision

1.4 Figure 2 below indicates the proposed ground floor layout.

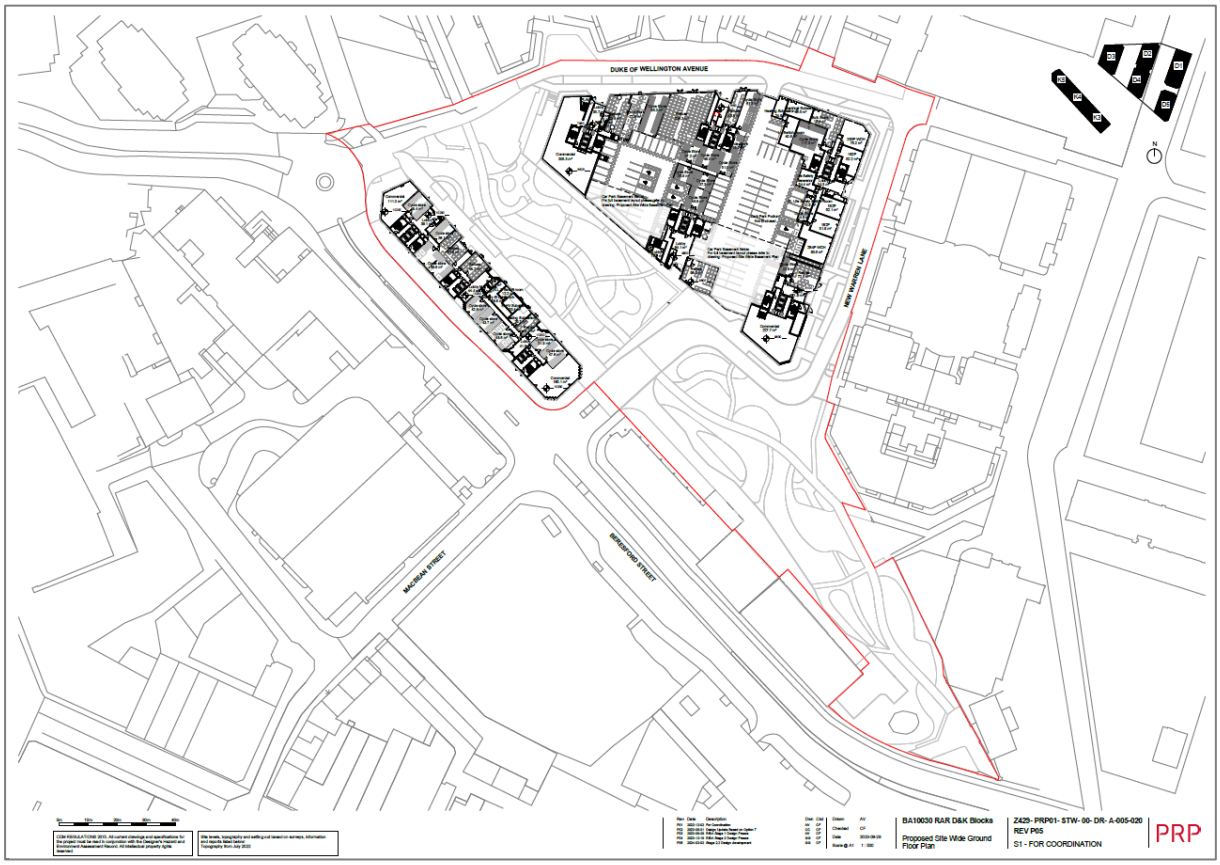

Figure 2: Proposed Ground Floor Layout – PRP Architects (February 2024)

Overheating and Thermal Comfort

1.5 Maintaining comfortable thermal comfort conditions in the face of climate change and increasing temperatures is one of the greatest challenges to be addressed by designers. The main objective is to achieve thermal comfort and minimise summertime overheating without the use of conventional air conditioning systems, which typically have associated greenhouse gas emissions and impact on the urban heat island effect.

1.6 Dynamic thermal simulations have been carried out for representative dwellings, to determine whether there is a risk of overheating. Appropriate mitigation measures have been recommended to mitigate the overheating risk and ensure that comfortable thermal conditions are achieved.

2. PLANNING POLICY

2.1 The following planning policies and requirements have informed the sustainable design of the proposed development.

National Planning Policy: NPPF

2.2 The revised National Planning Policy Framework (NPPF) was published on the 19th December 2023 and sets out the Government's planning policies for England. It describes a proactive approach that plans should take to mitigating and adapting to climate change, considering the risk of overheating from rising temperatures.

2.3 New developments should be planned for in ways that avoid increased vulnerability to the range of impacts arising from climate change.

Local Planning Policy: London Borough of Greenwich Local Plan (2014)

2.4 The Greenwich Local Plan does not make any specific reference to overheating except in deference to the London Plan.

Regional Planning Policy: The London Plan (2021)

2.5 The following key policy of the London Plan is considered relevant to the proposed development and this Overheating Assessment:

2.6 **Policy SI4 Managing Heat Risk** states that development proposals should minimise adverse impacts on urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure and that major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy (Figure 3):

2.7 Low-energy measures should be used to mitigate overheating risk. These include solar shading, building orientation and solar-controlled glazing. Occupant behaviour will also have an impact on overheating risk.

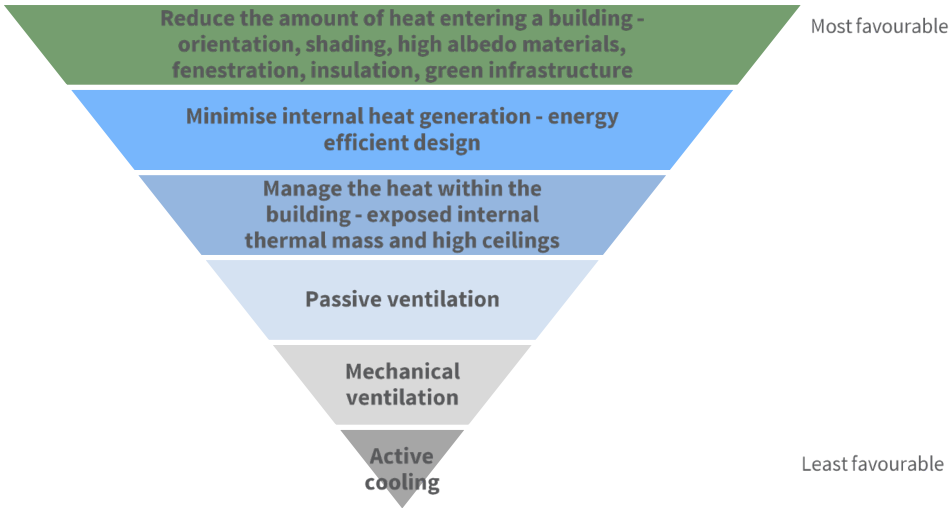

Figure 3: Cooling Hierarchy (London Plan 2021)

2.8 Passive ventilation should be prioritised, (accounting for external noise issues and local air quality). The increased use of air conditioning systems is not desirable. If active cooling systems, such as air conditioning systems, are unavoidable, these should be designed to reuse the waste heat they produce.

GLA Energy Assessment Guidance (2022)

2.9 The GLA Energy Assessment Guidance (2022) requires all developments to undertake a detailed analysis of the risk of overheating. The GHA Early Stage Overheating Risk Tool should be included within the assessment (see Appendix E).

2.10 For dwellings, final proposals must demonstrate compliance with Building Regulations Part O (2021) and CIBSE TM59 (2017).

3. OVERHEATING CRITERIA

3.1 The following building regulations and guidance provide a standardised approach to predicting overheating risk in residential dwellings within the UK. They set out the criteria by which the risk of overheating can be assessed or identified.

Approved Document O (2021)

3.2 The proposed development will be subject to Part O of the Building Regulations, for which requirements are set out within Approved Document O (AD(O)) for Overheating (2021). Compliance is based on meeting the following requirements:

> Reasonable provision to limit unwanted solar gains in summer and to provide adequate means to remove excess heat;

> Taking account of safety, noise, pollution, protection of falling and entrapment when developing the strategy. Mechanical cooling should only be considered when feasible passive means are insufficient.

3.3 There are two methods for demonstrating compliance under AD(O):

> **Simplified**: The simplified method requires dwellings to accommodate design limitations on maximum glazed areas, minimum openable areas for natural ventilation and external shading.

> **Dynamic**: The dynamic method requires dwellings to demonstrate compliance with CIBSE TM59 criteria (with a few specific limitations on use of the TM59 methodology) via dynamic thermal modelling.

CIBSE TM59 (2017) Assessment Criteria

3.4 The criteria for the assessment of overheating risk have been specified by the Chartered Institute of Building Services Engineers (CIBSE) in TM59 *Design methodology for the assessment of overheating risk in homes* (2017). CIBSE TM59 provides a standardised approach to predicting overheating risk for both naturally and mechanically ventilated residential buildings.

3.5 The following criteria must be met in order to demonstrate compliance under a predominantly naturally ventilated scenario:

> **Criterion A**: The indoor operative temperature should not exceed the threshold comfort temperature by 1°C or more for more than 3% of occupied hours in living rooms, kitchens and bedrooms.

> **Criterion B**: To guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am should not exceed 26°C for more than 1% of annual hours.

3.6 Under a predominantly mechanically ventilated scenario, all occupied rooms should not exceed an operative temperature of 26 ˚C for more than 3% of the annual occupied annual hours. This scenario can be used for homes with restricted window openings.

3.7 Where apartment buildings rely on a communal heating or hot water system with significant amounts of horizontal distribution pipework, communal corridors should be assessed. TM59 suggests a threshold temperature of 28ºC to be exceeded for no more than 3% of the total annual hours.

4. MODELLING APPROACH

4.1 Dynamic thermal modelling has been undertaken using DesignBuilder Software (v.7). The performance of the units has been assessed following CIBSE TM59 and the adaptive thermal comfort method for a primarily natural ventilated scenario. Additional modelling limitations set by AD(O) have also been applied.

4.2 Thermal comfort category II has been used, representing normal expectation (for new buildings and renovations).

Unit Selection

4.3 Representative dwelling units with different layouts, sizes, orientation and external shading have been assessed. The selection of the units for overheating risk assessment was based on the following design characteristics:

> Number of occupants;

> Floor levels;

> Orientations;

> Single/dual aspect units;

> Exposure to noise conditions; and

> Inclusive of worst-case scenario units.

4.4 The table below outlines the units selected for overheating assessment. Indicative locations for each are shown in Appendix A.

Table 1: Dwelling unit selection for overheating analysis

Unit	Description	Size (m^2)	Floor Level	Tenure	Orientation	Aspect
1	K5_09_1Bed	50.3	09	1B2P	North-east	Single
2	K4_09_3Bed	88.2	09	3B5P	South-west/North-east	Dual (cross-vent)
3	K3_09_2Bed	63.7	09	2B3P	South-west	Dual
4	K5_04_2Bed	75.0	04	2B4P	North-west	Dual
5	K4_04_2Bed	74.7	04	2B3P	North-east	Single
6	K3_04_1Bed	50.2	04	1B2P	North-east	Single
7	K5_17_1Bed	42.6	17 (top)	1B1P	South-west	Dual
8	D_00_2Bed	71.3	00 (ground)	2B4P	North-east	Dual
9	D1_07_3Bed	86.9	07	3B5P	North-east	Dual
10	D1_07_1Bed	52.5	07	1B2P	West	Single
11	D2_07_2Bed	70.6	07	2B4P	East	Single
12	D1_07_3Bed	86.9	07	3B5P	South	Dual
13	D2_15_2Bed	70.9	15 (top)	2B4P	South	Dual
14	D1_01_1Bed	50.1	01 (podium)	1B2P	South	Dual
15	D3_02_2Bed	61.8	02	2B3P	East	Single
16	D2_02_2Bed	74.3	02	2B4P	West	Single
17	D1_08_1Bed	55.7	08 (top)	1B2P	North-west	Dual
18	D3_17_2Bed	74.9	17 (top)	2B4P	South-west	Dual

4.5 Internal layouts of the homes and communal corridors selected for assessment are presented in Appendix A. Design modelling inputs for the assessed dwellings can be found in Appendix B.

Site External Weather Conditions

4.6 External temperatures and incident solar gains are greatest during summer months, coinciding with periods of lower wind speeds. Solar altitude is also highest during summer months, increasing the effects of façade shading from balcony overhangs and window reveals. Such considerations should be accounted for when designing for overheating risk.

4.7 The effects of external conditions are vital in an overheating assessment as they influence:

> Solar heat gains (a function of incident direct and diffuse solar radiation and solar altitude); and

> Calculated natural ventilation rates (a function of external temperature, wind directions and speeds).

4.8 CIBSE design summer year (DSY) weather data for London Heathrow (representative of low density urban and peri-urban areas) has been used for the 2020s, high emissions, 50 % percentile scenario as required by CIBSE TM59.

4.9 The assessment of overheating risk has been undertaken using the DSY1 weather file, in accordance with the requirements of TM59 and the London Plan and AD(O). The final mitigation strategy has also been tested under the more extreme DSY2 and DSY3 weather files and the results are presented in Appendix C.

Model Geometry and Local Shading

4.10 Overshadowing from the building blocks has been taken into account during the simulation, based on the model geometry and the site orientation.

4.11 Solar control forms an integral part of overheating mitigation strategies. External shading in the form of balconies is applied across many of the façades as part of the design proposals. These were incorporated in the simulation model as shown in Figure 5.

4.12 Horizontal shading devices such as balconies and overhangs are more efficient when applied in south oriented façades and during midday when the solar angle is high. Their role in reducing solar gains in the summer period is considered to be paramount.

4.13 Additionally, external reveal depths have been maximised to 215 mm to give additional external shading.

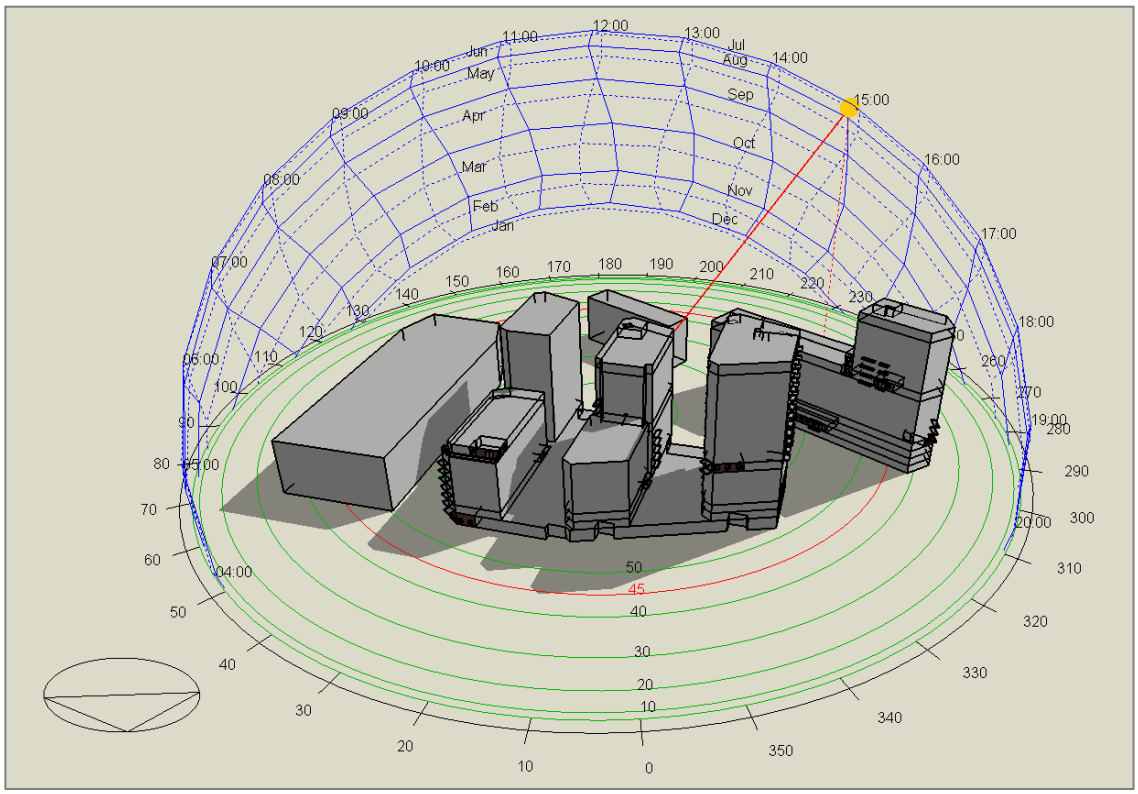

Figure 4: Simulation model from DesignBuilder (15th July, 15:00).

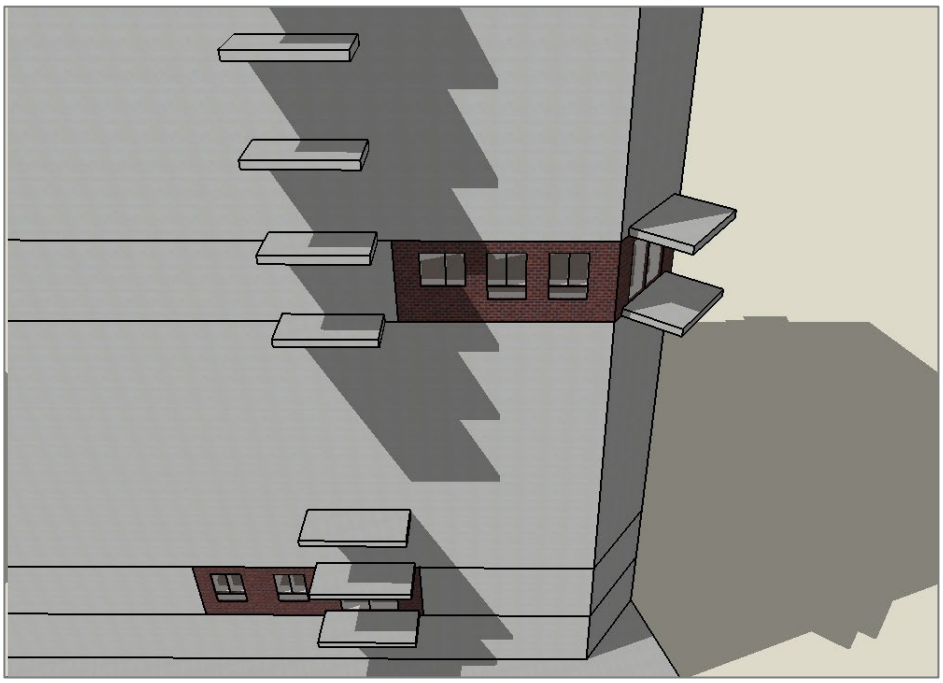

Figure 5: External shading example from DesignBuilder.

5. PASSIVE MITIGATION STRATEGY

5.1 The following passive design measures have been incorporated in order to reduce the risk of overheating to an acceptable level, as determined by CIBSE TM59:

> High performance solar control glazing with g-values optimised to mitigate overheating risk whilst achieving fabric energy efficiency targets and natural daylight provision (see Appendix F);

> External shading is provided to some windows in form of balconies and external reveal depth of 215 mm;

> Highly efficient fabric envelope and high efficiency building services heating system, lighting and appliances are proposed in all dwellings to reduce internal gains;

> Communal heat network designed to minimise heat losses;

> A concrete floor slab within the apartment buildings provides some thermal capacity to absorb excessive heat within the building;

> Openable areas of windows have been maximised, to ensure adequate natural ventilation:

> Window casements open inwards to allow maximum openability;

> Guarding heights are 1.1m from finished floor level, enabling windows to be fully open without the need for safety restrictors;

> A background mechanical ventilation system providing minimum Part F ventilation rates to dwellings, with the capacity to achieve up to 90l/s boosted air flow during hot weather;

> Corridors ventilated through AOV system providing a minimum ventilation rate of 1.0 ach. For corridors with windows, these will have automatic opening based on internal temperature, with maximum opening restricted to 100mm.

Dwelling Results

5.2 The following results presented in Table 2 indicate that, based on the design modelling inputs in Appendix B and passive overheating mitigation measures outlined above, all assessed rooms meet the CIBSE TM59 criteria and therefore demonstrate an acceptable level of overheating risk.

5.3 These results are based on windows being open with no usability constraints, in accordance with paragraph 2.6 of AD(O):

- *When a room is occupied during the day (8am to 11pm), openings should be modelled to do all of the following:*
  - *Start to open when the internal temperature exceeds 22°C;*
  - *Be fully open when the internal temperature exceeds 26°C;*
  - *Start to close when the internal temperature falls below 26°C;*
  - *Be fully closed when the internal temperature falls below 22°C.*
- *At night (11pm to 8am), openings should be modelled as fully open if both of the following apply:*
  - *The opening is on the first floor or above and not easily accessible;*
  - *The internal temperature exceeds 23°C at 11pm.*
- *When a ground floor or easily accessible room is unoccupied, both of the following apply:*
  - *In the day, windows, patio doors and balcony doors should be modelled as open, if this can be done securely;*
  - *At night, windows, patio doors and balcony doors should be modelled as closed.*

Table 2: TM59 overheating results for dwellings (assuming no window opening constraints) under DSY1 2020s

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
K5_09_1Bed	LDK	0.0	n/a	Pass
	Bed 1	0.0	21	Pass
K4_09_3Bed	LDK	0.2	n/a	Pass
	Bed 1	0.1	29	Pass
	Bed 2	0.1	32	Pass
	Bed 3	0.2	25	Pass
K3_09_2Bed	LDK	0.5	n/a	Pass
	Bed 1	0.1	30	Pass
	Bed 2	0.1	32	Pass
K5_04_2Bed	LDK	0.6	n/a	Pass
	Bed 1	0.1	26	Pass

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
	Bed 2	0.0	26	Pass
K4_01_2Bed	LDK	0.0	n/a	Pass
	Bed 1	0.0	20	Pass
	Bed 2	0.0	18	Pass
K4_01_3Bed	LD	0.0	n/a	Pass
	Kitchen	0.0	n/a	Pass
	Bed 1	0.0	17	Pass
	Bed 2	0.0	20	Pass
	Bed 3	0.0	19	Pass
K5_17_1Bed	LDK	2.0	n/a	Pass
	Bed 1	0.1	26	Pass
D_00_2Bed	LDK	0.3	n/a	Pass
	Bed 1	0.0	21	Pass
	Bed 2	0.0	29	Pass
D1_07_3Bed	LDK	0.6	n/a	Pass
	Bed 1	0.1	25	Pass
	Bed 2	0.1	19	Pass
	Bed 3	0.2	30	Pass
D1_07_1Bed	LDK	0.1	n/a	Pass
	Bed 1	0.0	20	Pass
D2_07_2Bed	LDK	0.0	n/a	Pass
	Bed 1	0.0	26	Pass
	Bed 2	0.0	20	Pass
D1_07_3Bed	LDK	0.6	n/a	Pass
	Bed 1	0.1	30	Pass
	Bed 2	0.1	29	Pass
	Bed 3	0.2	29	Pass
D2_15_2Bed	LDK	0.6	n/a	Pass
	Bed 1	0.1	22	Pass
	Bed 2	0.1	29	Pass
D1_01_1Bed	LDK	0.0	n/a	Pass
	Bed 1	0.0	19	Pass

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
D3_02_2Bed	LDK	0.0	n/a	Pass
	Bed 1	0.0	24	Pass
	Bed 2	0.0	17	Pass
D2_02_2Bed	LDK	0.0	n/a	Pass
	Bed 1	0.0	17	Pass
	Bed 2	0.0	18	Pass
D1_08_1Bed	LDK	0.3	n/a	Pass
	Bed 1	0.1	30	Pass
D3_17_2Bed	LDK	0.4	n/a	Pass
	Bed 1	0.0	24	Pass
	Bed 2	0.0	28	Pass

Corridor Results

5.4 The following results presented in Table 3 indicate that, based on the design modelling inputs in Appendix B and passive overheating mitigation measures outlined above, all assessed corridors meet the CIBSE TM59 criteria and therefore demonstrate an acceptable level of overheating risk.

Table 3: TM59 overheating results for corridors under DSY1 2020s

Zone	TM59 Criterion: ≤ 3 % hours over 28°C	Overall compliance with TM59
	% Hours of overheating	
Corridor Zone 1	0.0	Pass
Corridor Zone 2	0.0	Pass
Corridor Zone 3	0.0	Pass
Corridor Zone 4	0.0	Pass

6. WINDOW OPENING CONSTRAINTS

6.1 An Environmental and Intrusive Noise Study has been completed for the development (Sol Acoustics, November 2023). Figure 6 below shows the AD-O façade markup produced, indicating façades where windows cannot be relied on for natural ventilation due to noise risk.

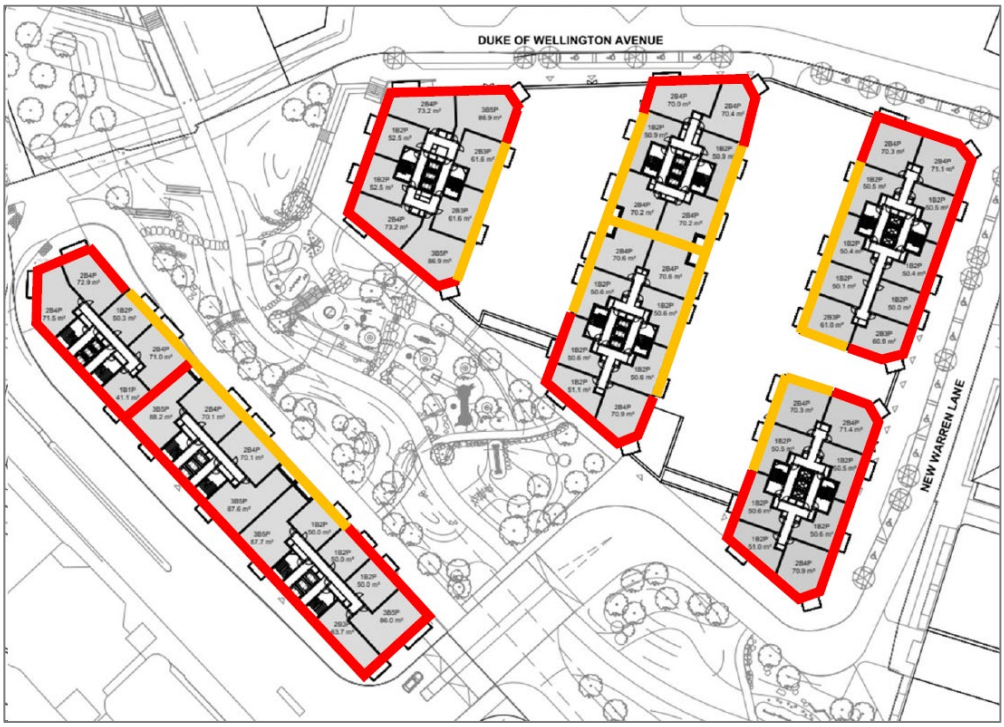

Figure 6: ADO façade markup – red areas indicate exceedance of night time overheating noise criteria, orange may use partially open bedroom windows (Sol Acoustics, November 2023)

6.2 It is understood that the site will not be subject to any air quality risks, as confirmed within the Environmental Statement Addendum (Plowman Craven, February 2024).

6.3 Ground floor units will have openable panes above an 'easily accessible' height to allow air flow without security concern. Podium units will include a louvred grille to the outside allowing 50% openability during night time hours, mitigating security risk.

Dwelling Results

6.4 The following results presented in Table 5 demonstrate the impact that night-time window opening constraints due to external noise has on the risk of overheating within dwellings.

6.5 These results are based on the following limitations applied to bedroom windows:

> Noise risk bedroom windows (those marked in red in Figure 7) – open 07:00 – 23:00 (closed during sleeping hours).

Table 4: TM59 overheating results for dwellings (with window opening constraints due to noise) under DSY1 2020s

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
K5_09_1Bed	LDK	0.1	n/a	Pass
	Bed 1	0.1	126	Fail
K4_09_3Bed	LDK	0.3	n/a	Pass
	Bed 1	0.1	112	Fail
	Bed 2	0.3	107	Fail
	Bed 3	0.7	125	Fail
K3_09_2Bed	LDK	0.5	n/a	Pass
	Bed 1	0.3	111	Fail
	Bed 2	0.2	183	Fail
K5_04_2Bed	LDK	2.1	n/a	Pass
	Bed 1	0.2	282	Fail
	Bed 2	0.4	330	Fail
K4_01_2Bed	LDK	0.0	n/a	Pass
	Bed 1	0.0	130	Fail
	Bed 2	0.0	112	Fail
K4_01_3Bed	LD	0.0	n/a	Pass
	Kitchen	0.0	n/a	Pass
	Bed 1	0.1	107	Fail
	Bed 2	0.0	125	Fail
	Bed 3	0.0	119	Fail
K5_17_1Bed	LDK	3.8	n/a	Fail
	Bed 1	0.3	273	Fail
D_00_2Bed	LDK	0.3	n/a	Pass
	Bed 1	0.0	65	Fail
	Bed 2	0.2	87	Fail
D1_07_3Bed	LDK	0.6	n/a	Pass
	Bed 1	0.1	66	Fail
	Bed 2	0.1	60	Fail

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
	Bed 3	0.3	113	Fail
D1_07_1Bed	LDK	0.1	n/a	Pass
	Bed 1	0.1	71	Fail
D2_07_2Bed	LDK	0.0	n/a	Pass
	Bed 1	0.1	120	Fail
	Bed 2	0.0	90	Fail
D1_07_3Bed	LDK	0.5	n/a	Pass
	Bed 1	0.2	114	Fail
	Bed 2	0.1	95	Fail
	Bed 3	0.3	133	Fail
D2_15_2Bed	LDK	0.6	n/a	Pass
	Bed 1	0.1	71	Fail
	Bed 2	0.2	84	Fail
D1_01_1Bed	LDK	0.1	n/a	Pass
	Bed 1	0.0	60	Fail
D3_02_2Bed	LDK	0.0	n/a	Pass
	Bed 1	0.0	58	Fail
	Bed 2	0.0	52	Fail
D2_02_2Bed	LDK	0.0	n/a	Pass
	Bed 1	0.0	67	Fail
	Bed 2	0.0	64	Fail
D1_08_1Bed	LDK	0.3	n/a	Pass
	Bed 1	0.1	81	Fail
D3_17_2Bed	LDK	0.5	n/a	Pass
	Bed 1	0.0	75	Fail
	Bed 2	0.0	90	Fail

Cooling Provision

6.6 Due to the noise risk at the site, the development is not able to achieve compliance with CIBSE TM59 criteria using passive overheating measures alone. Those units affected by external noise are proposed to include some form of cooling provision to mitigate the residual overheating risk. This

may be through the use of full comfort cooling or cooling bolt-on units to the MVHR system. The exact system will be determined at detailed design stage and will be suitably designed to ensure that thermal comfort levels can be achieved in accordance with CIBSE TM59 criteria.

7. CONCLUSION

7.1 The purpose of this report is to detail the overheating mitigation strategy for the proposed development at The Ropeyards, Royal Arsenal Riverside, Plots D&K by Berkeley Homes (East Thames) in the Royal Borough of Greenwich, in support of the planning application.

7.2 The performance of dwellings and communal corridors has been assessed against the Charted Institution of Building Services Engineers (CIBSE) guidance TM59 *Design methodology for the assessment of overheating risk in homes* (2017) and Approved Document O Overheating (2021).

7.3 A sample of dwellings and communal corridors has been selected for the dynamic overheating assessment based on design characteristics that establish them as representative of the overall proposed scheme. This selection of dwellings includes consideration of varying floors and of different orientations.

7.4 For the purpose of this report, passive mitigation measures have been explored as far as practicable to avoid the need for active cooling. This includes adaptation of window designs to ensure maximised openable areas external shading in the form of large reveal depths and external balconies, high performance solar glazing and enhanced background ventilation.

7.5 Due to noise risk at the site, the development is not able to achieve compliance with CIBSE TM59 criteria through passive mitigation measures alone. Hence, for units affected by noise risk, some form of cooling (either full comfort cooling or through bolt-on cooling modules to MVHR system) is proposed.

7.6 All dwellings tested demonstrate compliance with the CIBSE TM59 and AD(O) overheating assessment criteria under the mandatory weather file (DSY1 for the 2020s, high emissions, 50% percentile scenario). The results are based on key design features and passive mitigation measures following the London Plan cooling hierarchy.

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APPENDICES

Appendix A
Assessed Dwellings and Communal Corridors

Appendix B
Design Modelling Inputs

Appendix C
Results of DSY2 and DSY3 Weather Scenarios

Appendix D
Overheating Mitigation Strategy Mark-up

Appendix E
GHA Early Stage Overheating Risk Tool

Appendix A
Assessed Dwellings and Communal Corridors

K5, 9th Floor, 1B2P, N/E

K4, 9th (Top) Floor, 3B5P, S/W

K3, 9th (Top) Floor, 2B3P, S/W

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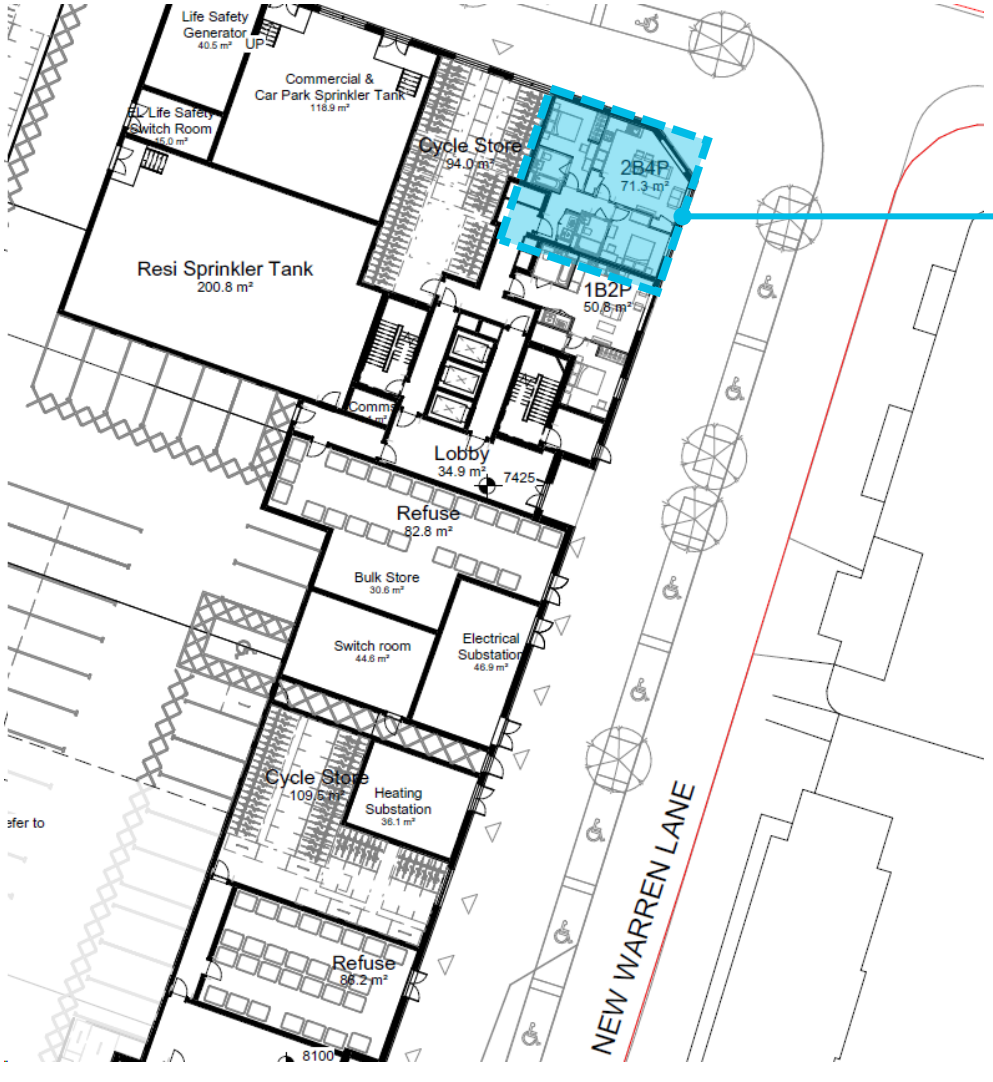

D, Ground Floor, 2B4P, N/E

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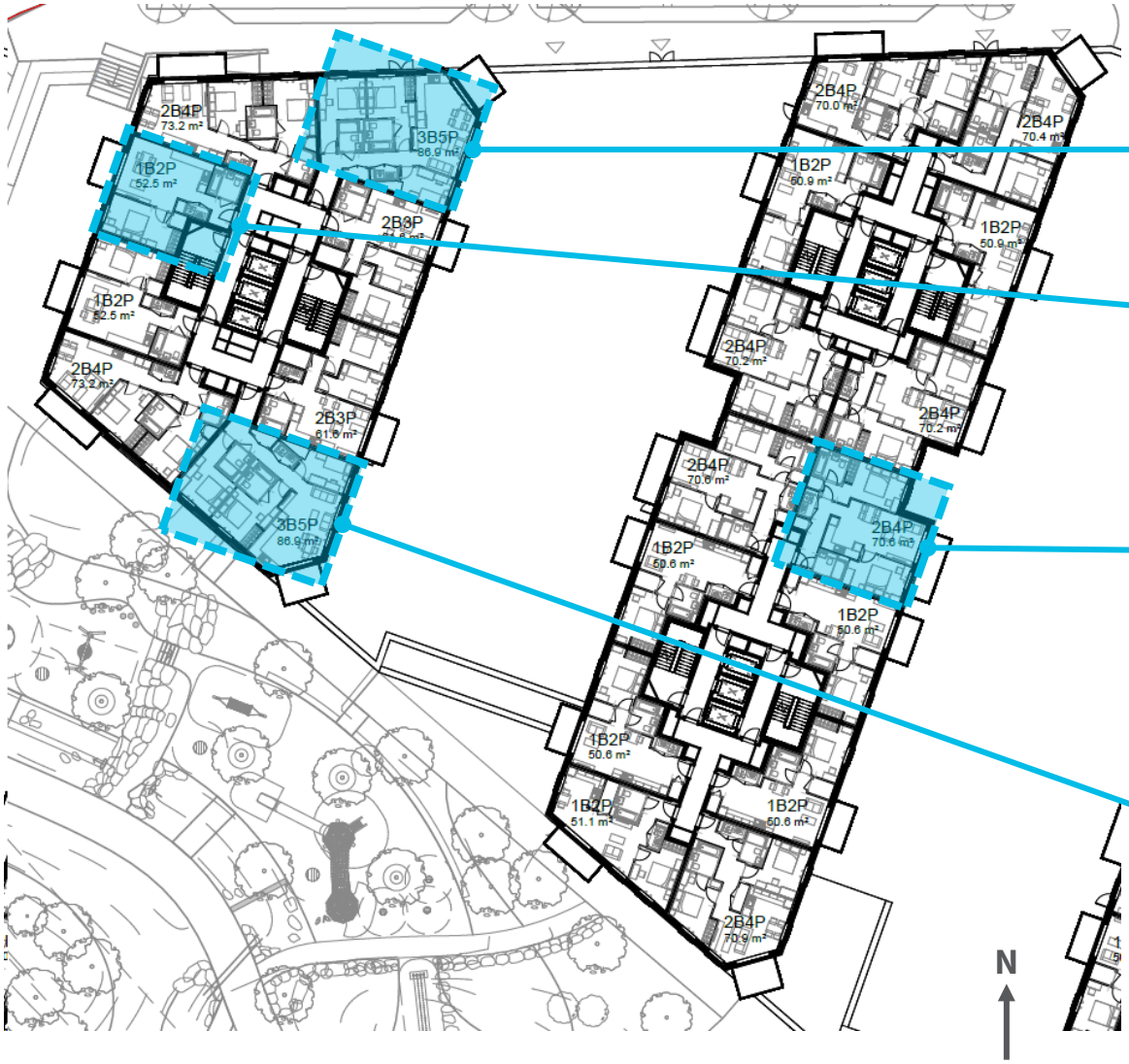

D1, 7th Floor, 3B5P, N/E

D1, 7th Floor, 1B2P, West

D2, 7th Floor, 2B4P, S/E

D1, 7th Floor, 3B5P, South

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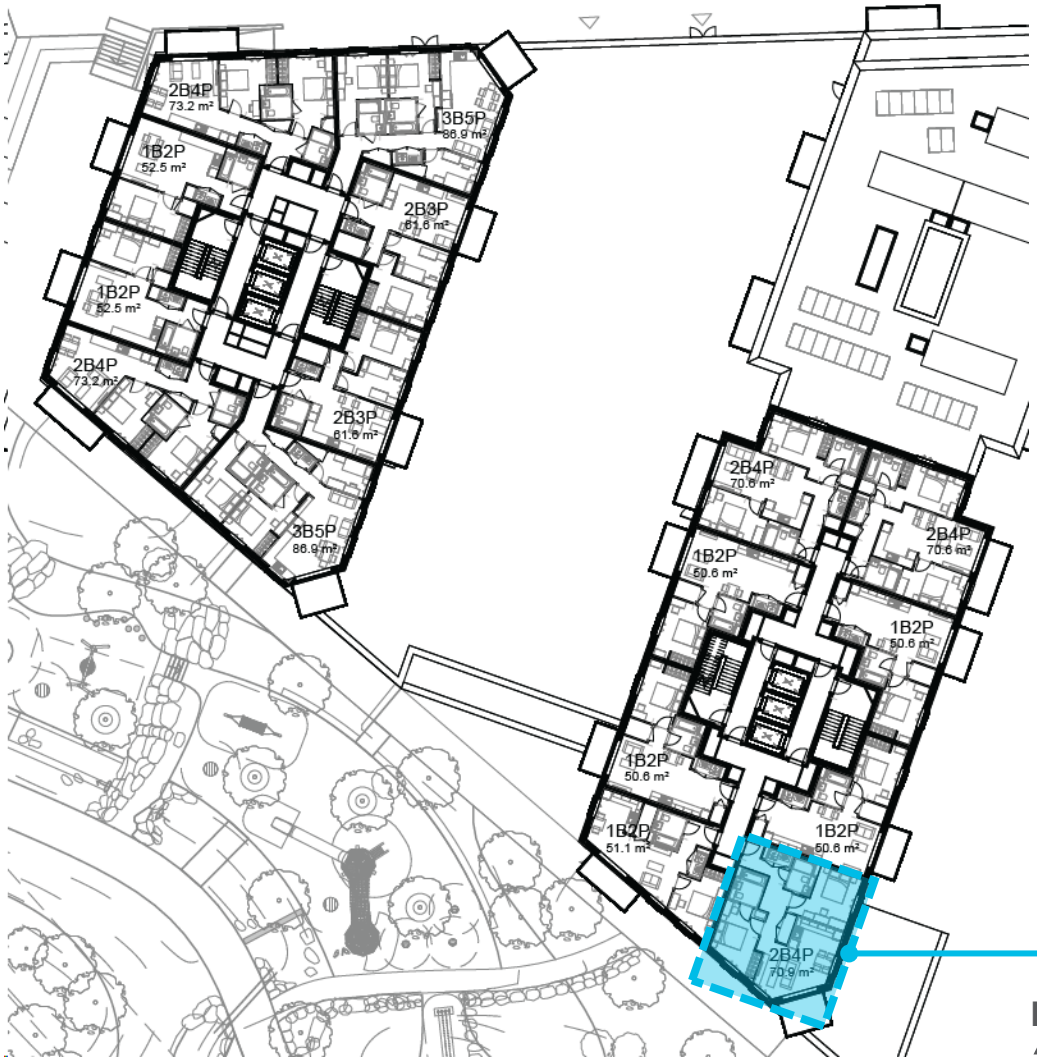

D2, 15th (Top) Floor, 2B4P, South

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D1, 1st (Podium) Floor, 1B2P, South

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D3, 2nd Floor, 2B3P, East

D2, 2nd Floor, 2B4P, West

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D1, 8th (Top) Floor, 1B2P, North/West

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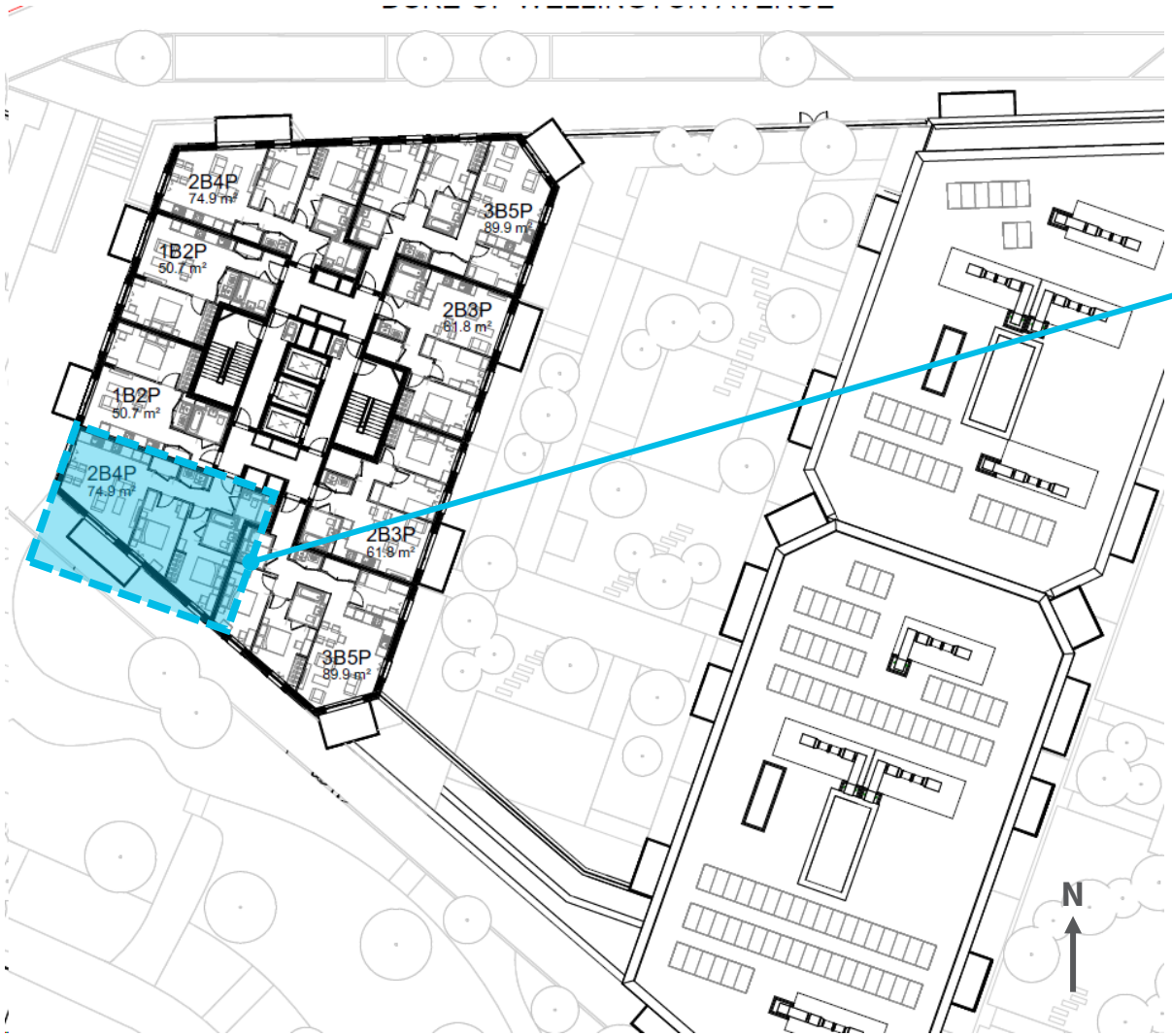

D3, 17th (Top) Floor, 2B4P, South/West

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K5, 4th Floor, 2B4P, North/West

K4, 4th Floor, 2B3P, North/East

K3, 4th Floor, 1B2P, North/East

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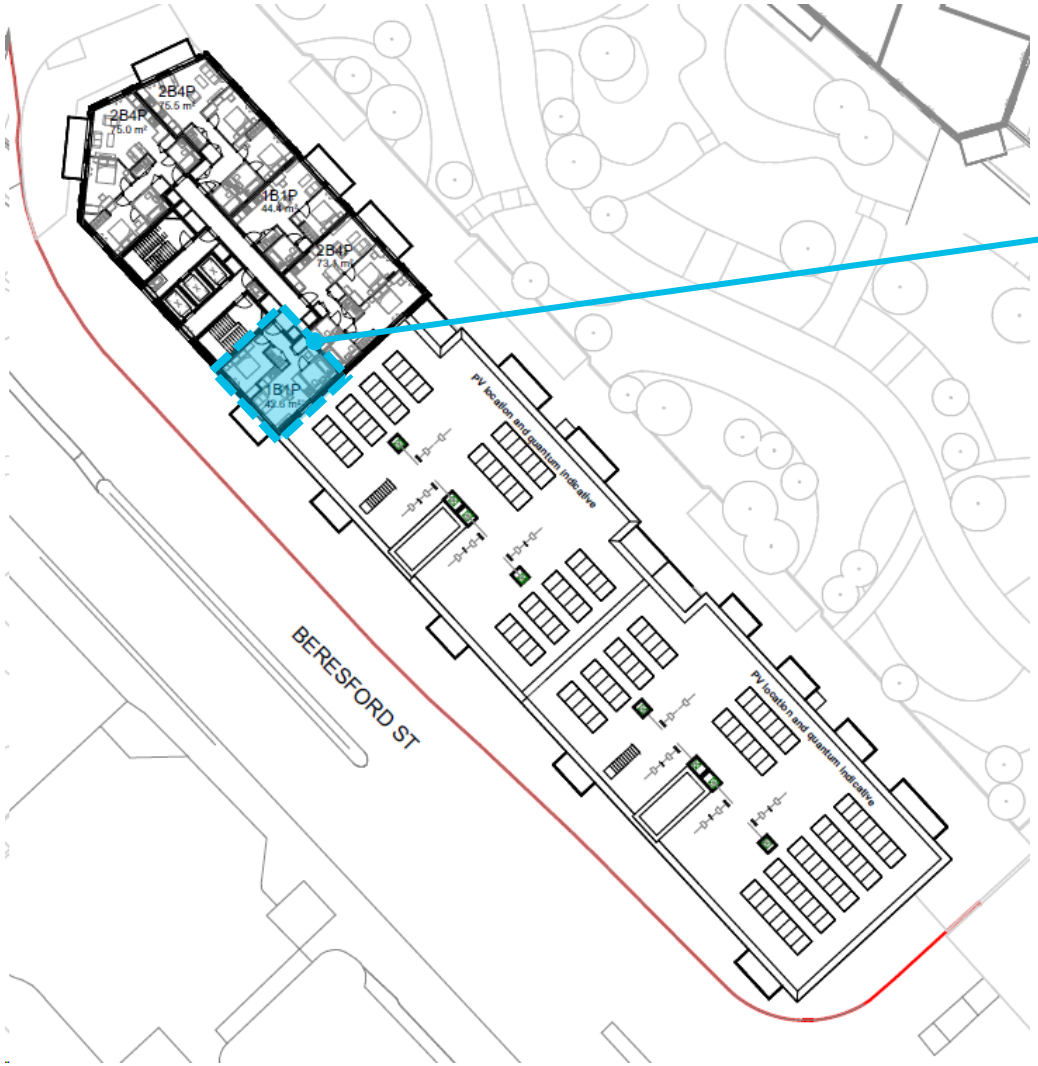

K5, 17th (Top) Floor, 1B1P, South

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Appendix B
Design Modelling Inputs

The following modelling inputs have been included in the baseline dynamic thermal simulation.

Table B.1: Baseline dynamic thermal modelling design assumptions

Data Input			Discussion
Weather data	**Location**	CIBSE London Heathrow Design Summer Years (DSYs) for 2020s, high emissions, 50% percentile scenario	*Geographically closest and most representative industry-standard CIBSE weather data file*
Building Fabric Construction details	**External walls**	0.16 W/m²K	*As per the Energy Statement (Hodkinson Consultancy, January 2024)*
	Roofs	0.14 W/m²K	*As per the Energy Statement (Hodkinson Consultancy, January 2024)*
	Ground floor	0.14 W/m²K	*As per the Energy Statement (Hodkinson Consultancy, January 2024)*
	Ceilings/floors	Assumed to be adiabatic between adjacent floors	*Concrete slabs will add to the thermal capacity of the building* *When dwelling units above / below heat loss is assumed to be zero*
	Party walls between units	Assumed to be adiabatic between adjacent dwellings	*Walls adjacent to other units are assumed to be lightweight partitions* *Adjacent units have been included in the dynamic simulation calculations*
	Partitions within units	Insulated plasterboard partitions	*Assumed thicknesses as per drawings*
	Internal doors	0.842 m width	*As per drawings (PRP Architects, December 2023)*
Windows	**Windows and Glazed Doors**	U value 0.9 W/m²K	*As per the Energy Statement (Hodkinson Consultancy, January 2024)*
	Reveal depth	External reveal: 215 mm	*As per drawings (PRP Architects, December 2023)*
	Sill / transom height	1.10 m	*In line with Part O requirements*

Data Input			Discussion
	Opening type	Windows: Inwards opening angle Glazed doors: Inwards opening angle	*As per drawings (PRP Architects, December 2023)*
	Discharge Coefficient	Discharge coefficient: 0.53 – 0.55	*Calculated from window dimensions as per drawings (PRP Architects, December 2023) using the BB101 discharge coefficient calculator stated within Approved Document O (2021)*
Infiltration	**Air Tightness**	2.0 m^3/hr-m^2 @ 50 pascals	*As per the Energy Statement (Hodkinson Consultancy, January 2024)*

The following occupancy schedules and internal gains assumptions have been used, in accordance with CIBSE TM59 guidance.

Table B.2: Occupancy and equipment gains for dwellings (CIBSE TM59)

Unit/room type	Occupancy	Equipment Load
1-bedroom apartment: living room/kitchen	1 person from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2-bedroom apartment: living room/kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
3-bedroom apartment: living room/kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
Double bedroom	2 people at 70% gains from 11 pm to 8 am, 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm, 1 person at full gain in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single bedroom	1 person at 70% gains from 11 pm to 8 am, 1 person at full gains from 8 am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
Utility cupboard	N/A	10 W on 24/7

A mechanical ventilation system should be provided which is capable of achieving background mechanical ventilation meeting minimum Part F requirements.

Table B.3: Mechanical ventilation rates for dwellings (minimum Part F)

Dwelling	K5_09_1Bed	K4_09_3Bed	K3_09_2Bed	D_00_2Bed	D1_07_3Bed	D1_07_1Bed
Floor area / m^2	50.3	88.2	63.7	71.3	86.9	52.5
Storey height	2.8	2.8	2.8	2.8	2.8	2.8
Volume / m^3	139.6	244.8	176.8	197.9	241.1	145.7
Kitchen	13	13	13	13	13	13
Utility	8	8	8	8	8	8
Bathroom	8	8	8	8	8	8
Ensuite		6		8	8	
Boost rate / l/s	29	35	29	37	37	29
Whole dwelling ventilation	104.4	126	104.4	133.2	133.2	104.4
Air change rate / ach	**0.75**	**0.51**	**0.59**	**0.67**	**0.55**	**0.72**
Dwelling	**D1_07_3Bed**	**D2_07_2Bed**	**D2_15_2Bed**	**D1_00_1Bed**	**K5_04_2Bed**	**K5_17_1Bed**
Floor area / m^2	86.9	70.6	70.9	50.1	75.0	42.6
Storey height	2.8	2.8	2.8	2.8	2.8	2.8
Volume / m^3	241.1	195.9	196.7	140.3	210.0	119.3
Kitchen	13	13	13	13	13	13
Utility	8	8	8	8	8	8
Bathroom	8	8	8	8	8	8
Ensuite	8	8	8		8	
Boost rate / l/s	37	37	37	29	37	29
Whole dwelling ventilation	133.2	133.2	133.2	104.4	133.2	104.4
Air change rate / ach	**0.55**	**0.68**	**0.68**	**0.74**	**0.63**	**0.88**

Dwelling	K4_01_2Bed	K4_01_3Bed
Floor area / m^2	74.8	88.9
Storey height	2.8	2.8
Volume / m^3	209.4	248.9
Kitchen	13	13
Utility	8	8
Bathroom	8	8
Ensuite		
Boost rate / l/s	29	29
Whole dwelling ventilation	104.4	104.4
Air change rate / ach	**0.50**	**0.42**

Corridor inputs

The same building fabric details and glazing properties used in the modelling of the selected homes (Table B.1) were used in the modelling of the corridors. The baseline assumptions were based on information received and involve:

> Flow and return temperatures of 90^0C and 60^0C respectively;

> 25 mm pipe insulation with maximum thermal conductivity of 0.025 W/mK;

The corridor will utilise environmental push pull system which inlet cool air through AVO shaft and extract hot air via smoke vent system. The system will operate at 1.0 air changes per hour.

LTHW heat gains calculated for the assessed corridor is presented in Table B.4.

Table B.4: LTHW Pipework Heat Gains

Location	Pipe Diameter (mm)	Pipe Length-Flow & Return (m)	Flow & Return Temperatures (°C)	Calculated Losses (W)
LTHW Riser	32	6.15	90/60	49.4
Corridor Building D4 -8th floor	32	65.38		525.5

Appendix C
Result of DSY2 and DSY3 Weather Scenarios

The dynamic overheating assessment has also been run under the more extreme DSY2 and DSY3 weather files, with results presented in Tables C.1 and C.2.

TM59 states that compliance should be met for the DSY1 weather scenario, and that additional testing can be undertaken using the 2020 versions of DSY2 and DSY3. However, it is acknowledged that meeting the CIBSE compliance criteria is challenging for the DSY2 and DSY3 weather files.

The overheating mitigation strategy presented within the main body of this report demonstrates the passive measures that have been implemented to reduce the risk of overheating as far as practicable. In the future, residents could use further adaptation measures to combat any additional overheating risk such as the use of fans.

Table C.1: Dwelling overheating results for DSY2 2020s – TM59

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
K5_09_1Bed	LDK	0.6	n/a	Pass
	Bed 1	0.2	55	Fail
K4_09_3Bed	LDK	0.7	n/a	Pass
	Bed 1	0.7	67	Fail
	Bed 2	0.8	72	Fail
	Bed 3	1.1	53	Fail
K3_09_2Bed	LDK	2.1	n/a	Pass
	Bed 1	0.6	65	Fail
	Bed 2	0.7	69	Fail
K5_04_2Bed	LDK	2.0	n/a	Pass
	Bed 1	0.7	60	Fail
	Bed 2	0.5	56	Fail
K4_01_2Bed	LDK	0.5	n/a	Pass

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
	Bed 1	0.1	55	Fail
	Bed 2	0.1	51	Fail
K4_01_3Bed	LD	0.7	n/a	Pass
	Kitchen	0.5	n/a	Pass
	Bed 1	0.4	39	Fail
	Bed 2	0.1	53	Fail
	Bed 3	0.2	50	Fail
K5_17_1Bed	LDK	3.3	n/a	Fail
	Bed 1	0.6	57	Fail
D_00_2Bed	LDK	1.1	n/a	Pass
	Bed 1	0.1	55	Fail
	Bed 2	0.3	64	Fail
D1_07_3Bed	LDK	2.1	n/a	Pass
	Bed 1	0.3	55	Fail
	Bed 2	0.3	45	Fail
	Bed 3	0.9	64	Fail
D1_07_1Bed	LDK	0.7	n/a	Pass
	Bed 1	0.4	56	Fail
D2_07_2Bed	LDK	0.8	n/a	Pass
	Bed 1	0.4	60	Fail
	Bed 2	0.1	54	Fail
D1_07_3Bed	LDK	1.8	n/a	Pass
	Bed 1	0.6	68	Fail
	Bed 2	0.6	66	Fail
	Bed 3	0.5	56	Fail
D2_15_2Bed	LDK	2.4	n/a	Pass
	Bed 1	0.6	51	Fail
	Bed 2	0.5	57	Fail
D1_01_1Bed	LDK	0.7	n/a	Pass
	Bed 1	0.4	56	Fail
D3_02_2Bed	LDK	0.6	n/a	Pass
	Bed 1	0.1	50	Fail

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
	Bed 2	0.1	48	Fail
D2_02_2Bed	LDK	0.4	n/a	Pass
	Bed 1	0.3	57	Fail
	Bed 2	0.1	53	Fail
D1_08_1Bed	LDK	1.0	n/a	Pass
	Bed 1	0.4	63	Fail
D3_17_2Bed	LDK	2.0	n/a	Pass
	Bed 1	0.3	62	Fail
	Bed 2	0.5	64	Fail

Table C.2: Dwelling overheating results for DSY3 2020s – TM59

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
K5_09_1Bed	LDK	0.1	n/a	Pass
	Bed 1	0.0	74	Fail
K4_09_3Bed	LDK	0.6	n/a	Pass
	Bed 1	0.5	89	Fail
	Bed 2	0.9	92	Fail
	Bed 3	1.4	70	Fail
K3_09_2Bed	LDK	2.0	n/a	Pass
	Bed 1	0.4	88	Fail
	Bed 2	0.8	90	Fail
K5_04_2Bed	LDK	2.9	n/a	Pass
	Bed 1	0.4	75	Fail
	Bed 2	0.5	76	Fail
K4_01_2Bed	LDK	0.0	n/a	Pass
	Bed 1	0.0	74	Fail

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
	Bed 2	0.0	68	Fail
K4_01_3Bed	LD	0.2	n/a	Pass
	Kitchen	0.1	n/a	Pass
	Bed 1	0.0	55	Fail
	Bed 2	0.0	72	Fail
	Bed 3	0.0	68	Fail
K5_17_1Bed	LDK	5.1	n/a	Fail
	Bed 1	0.6	75	Fail
D_00_2Bed	LDK	1.2	n/a	Pass
	Bed 1	0.0	81	Fail
	Bed 2	0.1	86	Fail
D1_07_3Bed	LDK	2.6	n/a	Pass
	Bed 1	0.3	81	Fail
	Bed 2	0.2	66	Fail
	Bed 3	0.6	83	Fail
D1_07_1Bed	LDK	0.4	n/a	Pass
	Bed 1	0.0	74	Fail
D2_07_2Bed	LDK	0.2	n/a	Pass
	Bed 1	0.1	81	Fail
	Bed 2	0.0	75	Fail
D1_07_3Bed	LDK	2.1	n/a	Pass
	Bed 1	0.6	92	Fail
	Bed 2	0.4	91	Fail
	Bed 3	0.5	77	Fail
D2_15_2Bed	LDK	3.11	n/a	Fail
	Bed 1	0.4	71	Fail
	Bed 2	0.2	75	Fail
D1_01_1Bed	LDK	0.9	n/a	Pass
	Bed 1	0.3	67	Fail
D3_02_2Bed	LDK	0.1	n/a	Pass
	Bed 1	0.0	67	Fail
	Bed 2	0.0	65	Fail

Unit	Room	TM59 Criterion A: Hours of exceedance (pass ≤ 3 %)	TM59 Criterion B: Bedroom temperature hours > 26 °C (pass ≤ 32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
D2_02_2Bed	LDK	0.2	n/a	Pass
	Bed 1	0.0	75	Fail
	Bed 2	0.0	73	Fail
D1_08_1Bed	LDK	1.1	n/a	Pass
	Bed 1	0.7	91	Fail
D3_17_2Bed	LDK	2.6	n/a	Pass
	Bed 1	0.0	79	Fail
	Bed 2	0.1	83	Fail

Corridor results

Table C.3: TM59 overheating results for corridors under DSY2 2020s

Block	TM59 Criterion: ≤ 3 % hours over 28°C	Overall compliance with TM59
	% Hours of overheating	
Corridor Zone 1	0.0	Pass
Corridor Zone 2	0.0	Pass
Corridor Zone 3	0.0	Pass
Corridor Zone 4	0.0	Pass

Table C.4: TM59 overheating results for corridors under DSY3 2020s

Block	TM59 Criterion: ≤ 3 % hours over 28°C	Overall compliance with TM59
	% Hours of overheating	
Corridor Zone 1	0.0	Pass
Corridor Zone 2	0.0	Pass

Block	TM59 Criterion: ≤ 3 % hours over 28°C	Overall compliance with TM59
	% Hours of overheating	
Corridor Zone 3	0.0	Pass
Corridor Zone 4	0.0	Pass

Appendix D
Overheating Mitigation Strategy Mark-up

- 0.40 G-value, Minimum Part F, original window design
- 0.40 G-value, 2.0 ACH, original window design
- 0.32 G-value, 2.0 ACH, original window design
- 0.40 G-value, Minimum Part F, make lower panel openable

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Appendix E
GHA Overheating Checklist

EARLY STAGE OVERHEATING RISK TOOL

Version 1.0, July 2019

This tool provides guidance on how to assess overheating risk in residential schemes at the early stages of design. It is specifically a pre-detail design assessment intended to help identify factors that could contribute to or mitigate the likelihood of overheating.

The questions can be answered for an overall scheme or for individual units. Score zero wherever the question does not apply. Additional information is provided in the accompanying guidance, with examples of scoring and advice on next steps.

Find out more information and download accompanying guidance at goodhomes.org.uk/overheating-in-new-homes.

Good Homes Alliance

KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING | **KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING**

Geographical and local context

#1 Where is the scheme in the UK?
See guidance for map

South east	4	4
Northern England, Scotland & NI	0	
Rest of England and Wales	2	

#2 Is the site likely to see an Urban Heat Island effect?
See guidance for details

Central London (see guidance)	3	2
Grtr London, Manchester, B'ham	2	
Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure?
Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context

1	1

Site characteristics

#3 Does the site have barriers to windows opening?
- Noise/Acoustic risks
- Poor air quality/smells e.g. near factory or car park or very busy road
- Security risks/crime
- Adjacent to heat rejection plant

Day - reasons to keep all windows closed	8	4
Day - barriers some of the time, or for some windows e.g. on quiet side	4	
Night - reasons to keep all windows closed	8	8
Night - bedroom windows OK to open, but other windows are likely to stay closed	4	

#9 Are immediate surrounding surfaces in majority pale in colour, or blue/green?
Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme

1	0

#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas?
Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels

1	1

Scheme characteristics and dwelling design

#4 Are the dwellings flats?
Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples

3	3

#5 Does the scheme have community heating?
i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures

3	3

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation?
Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance

1	1

#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future?
Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans

>2.8m and fan installed	2	0
> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings?
(as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space

>65%	12	4
>50%	7	
>35%	4	

#13 Is there useful external shading?
Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**

	Full	Part
>65%	6	3
>50%	4	2
>35%	2	1

#7 Are the dwellings single aspect?
Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation

Single-aspect	3	1
Dual aspect	0	

#14 Do windows & openings support effective ventilation?
Larger, effective and secure openings will help dissipate heat - see guidance

	Openings compared to Part F purge rates		
	= Part F	+50%	+100%
Single-aspect	minimum required	3	4
Dual aspect		2	3

3

TOTAL SCORE	23	=	Sum of contributing factors:	29	*minus*	Sum of mitigating factors:	6

High 12 **Medium** 8 **Low**

score >12:
Incorporate design changes to reduce risk factors and increase mitigation factors
AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score between 8 and 12:
Seek design changes to reduce risk factors and/or increase mitigation factors
AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score <8:
Ensure the mitigating measures are retained, and that risk factors do not increase (e.g. in planning conditions)