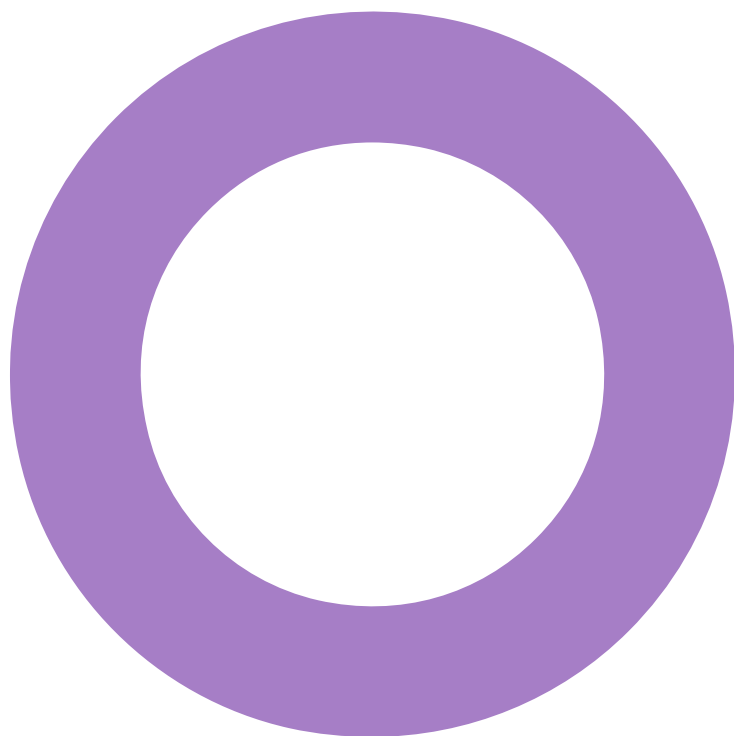


Thamesfield Retirement Village. Thamesfield Phase 2. Retirement Villages Group.

SUSTAINABILITY
ENERGY AND SUSTAINABILITY STATEMENT

REVISION 04 – 05 SEPTEMBER 2025



Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
04	05/09/2025	Update to Planning Issue	M. Treglia	J. Drane	R. Horder

This document has been prepared for Retirement Villages Group only and solely for the purposes expressly defined herein. We owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law. The consequences of climate change and the effects of future changes in climatic conditions cannot be accurately predicted. This report has been based solely on the specific design assumptions and criteria stated herein.

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Contents.

Audit sheet.	2
Executive summary.	4
The Proposed Development.	4
Sustainability Strategy.	4
Energy Strategy.	4
Proposed site-wide energy strategy.	4
1. Introduction.	5
1.1 Purpose of this Report	5
Development Description	5
2. Overview of Policy and Drivers.	6
2.3 Local Policy	6
2.4 Client Vision.	7
3. Energy Strategy.	7
3.1 Energy Hierarchy.	7
3.2 Definitions and limitations.	7
4. Cooling and overheating.	8
4.1 Cooling hierarchy.	8
4.2 Commercial Mitigation strategy.	8
4.3 Part O: Residential Assessment methodology.	8
4.4 Overheating results.	9
5. Be Lean.	10
5.1 Passive design and energy efficiency features	10
5.2 Fabric Permeability	10
5.3 Active measures.	11
6. Be Clean.	12
6.1 Be Clean: network and technologies.	12
7. Be Green.	12
7.1 Low and zero carbon (LZC) technology assessment.	12
7.2 Photovoltaic panel incorporation	13
7.3 Proposed heating infrastructure.	13
8. Energy Strategy Summary.	14
8.1 Results	14

9. Approach to Sustainability.	15
10. Sustainability Strategy.	16
10.1 Physical Capital: Fit for the future.	16
10.2 Natural Capital: Positive impact	17
10.3 Human Capital: People-centred design	18
10.4 Economic Capital: Enable new opportunities.	19
10.5 Social Capital: Community engagement	19
Appendix A: SAP Worksheets.	20
Appendix B: Part L2 Calculation extents for Communal Residential Areas and associated BRUKL Report.	48
Appendix C: Detailed Part O Criteria and Results Graphs.	51
Mitigation strategy.	51

Executive summary.

This report provides a summary of the sustainability targets and approach as well as the energy strategy, inputs and analysis undertaken on the development and forms part of the full planning application for the proposed development at Thamesfield, Henley on Thames, hereafter referred to as the 'Proposed Development'.

The Proposed Development.

Thamesfield is an established and operational Integrated Retirement Community (IRC) providing extra care retirement accommodation and associated communal facilities. The site currently comprises extra care units (use class C2).

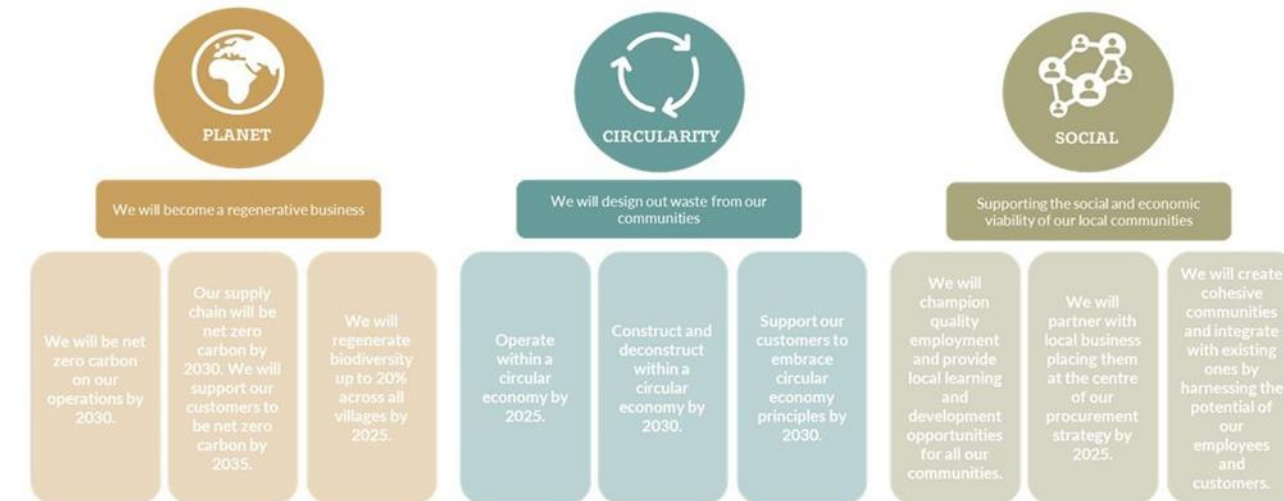
Sustainability Strategy.

RVGs mission to create positive life choices for older people - built on community, wellbeing, and flexibility. they strive to support people to live their best lives for longer, while ensuring the planet, and our healthcare system, offer the same opportunities to future generations.

The strategy is a blueprint that will reshape us as a sustainability leader within our sector. The strategy enables us to take a holistic approach across three core pillars of sustainability: "Planet", "Circularity" and "Social". Under each pillar we have set objectives and targets that will enable us to drive meaningful sustainable outcomes and systemic change for our business, residents, supply chain, investors and wider society. At the same time, we see this as an opportunity to return economic, environmental and social value.

Figure 3below outlines RVGs Corporate ESG commitments that help to drive Sustainable outcomes not only across their new and existing developments but also their business as a whole.

Key Sustainable Features



The following list details the key sustainable features to be incorporated into the report:

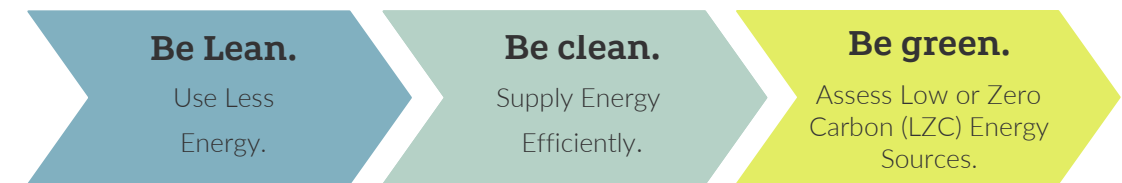
- The Proposed Development will incorporate an all-electric, low carbon energy strategy complete with Exhaust Air Heat Pump DHW Solution.
- The scheme will significantly reduce energy consumption through an on-site photovoltaic (PV) array of 38.5kWp.
- A strategy to reduce, reuse and recycle materials in alignment with the principles of circular economy throughout design, construction and operation will be applied, minimising waste generation and the use of virgin materials.
- The Proposed Development will achieve a CO₂ emissions reduction and a primary energy reduction well in excess of Building Regulations Part L 2021.
- Landscaping enhancements will be considered and incorporated where practical.

Energy Strategy.

The Energy Strategy takes a holistic approach to energy demand reduction, and carbon emission reductions. Principles of the Energy Hierarchy are followed in terms of ensuring the design is energy efficient prior to incorporation of low and zero carbon energy sources.

Passive design and energy efficiency measures will provide the cornerstone to the energy demand and CO₂ emission reduction achieved for the Proposed Development.

The baseline scenario, which each step of the Energy Hierarchy will be compared against, is established by the Part L Target Emission Rate. The energy hierarchy includes the following three steps:



Be Lean: High energy efficient building fabric and building services have been utilised to reduce carbon emissions and energy demand through good practice passive measures.

Be Clean: Incorporation of an onsite CHP system has been deemed to be unsuitable, therefore a heat network and CHP technology have been discounted.

Be Green: A number of renewable technologies have been appraised in terms of their technical, physical and financial feasibility, for incorporation within the development. Roof mounted PV and DHW Exhaust Air Heat Pumps (EAHP) was considered the most appropriate technology.

Proposed site-wide energy strategy.

Overall, it is anticipated that the domestic element of the development will achieve up to an **78% reduction in CO₂ emissions** beyond the Building Regulations Part L 2021 'baseline' This exceeds the planning policy target.

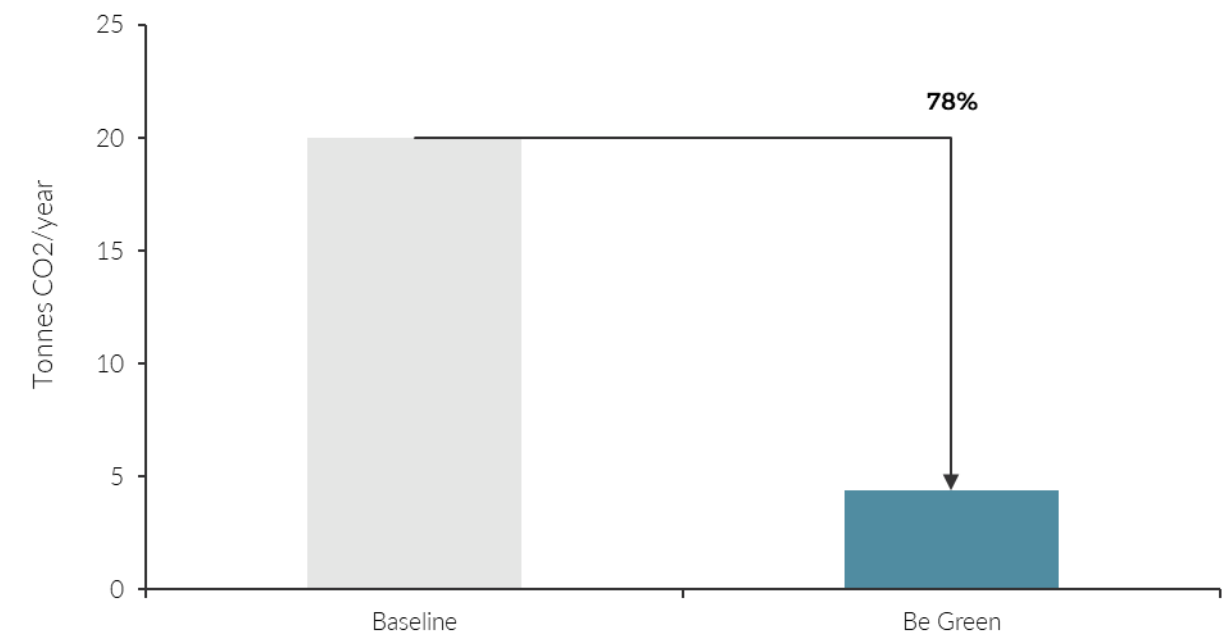


Figure 1: Domestic - Regulated carbon emissions summary.

1. Introduction.

1.1 Purpose of this Report

This strategy has been developed on behalf of RVG, hereafter referred to as 'the Applicant'. The following strategy forms part of the full planning application for the proposed development at Thamesfield, hereafter referred to as the 'Proposed Development'.

Development Description

Thamesfield is an established and operational Integrated Retirement Community (IRC) providing extra care retirement accommodation and associated communal facilities. The Site currently comprises extra care units (use class C2).

Site name: Thamesfield Retirement Village, Wargrave Road, Remenham, RG9 2LX.

Client: Retirement Villages Group (RVG)

Full Description of Existing Site:

The application site is located within the village of Remenham, directly opposite Henley-on-Thames. The site is bordered by the river Thames to the southwest, and Wargrave Road to the northeast. To the northwest there are retirement properties known as Remenham Row and to the southeast is the Eyot Centre. The site is broadly square in shape and comprises approximately 0.88ha of land. Vehicular and pedestrian access to the site is currently directly off Wargrave Road.

Thamesfield is a retirement village comprising 50 extra care units (use class C2) and 12 care rooms/suites. It contains two distinct buildings - the main building which covers the northern part of the site and Thamesfield Lodge which is located in the eastern corner. The main building comprises three elements: the original Stucco Fronted building which fronts on to the Thames and late 20th century extension to the north; the 1993 extension which is adjacent to the northern boundary of the site and the 1995 extension which is broadly centrally located within the site. A mix of hard and soft landscaping cover the remainder of the site including car parking, a croquet lawn and a landscaped lawn down to the banks of the river Thames.

The surrounding area comprises a diverse mix of uses, including residential, sports and hospitality. The site is a short distance (c. 300m) from Henley Bridge and, as such, is well located in respect of the facilities and services within Henley.

The following constraints and designations are relevant to the site:

- The site is entirely within Flood Zone 3.
- The site is within the Green Belt.
- Park Palace and Temple Combe Grade II* Registered Park and Garden, which is also designated as a Local Wildlife Site, is located at approximately 320m to the east of the site.
- The site is within Remenham Henley Bridge Conservation Area and is opposite the Henley Conservation Area on the western side of the River Thames.
- The site is on a 'Green Route'; and there are a number of trees covered by a Tree Preservation Order (TPO-0206-1981).



Figure 2: Site Location (Credit: Design Engine Architects)

2. Overview of Policy and Drivers.

The strategy will respond first and foremost to the Universal Challenges of the Climate Emergency, Biodiversity Crisis facing humanity, and Health and Wellbeing, in addition to national and local policy which will shape the baseline of performance, with the UN Sustainable Development Goals alongside best practice principles of masterplan design, delivery, and operation shaping the eventual strategy.

2.1 Global Challenges.

People the world over face three universal challenges to which any sustainable development must respond effectively to be successful.

These are as follows:



Climate change

In 2019, the Intergovernmental Panel on Climate Change (IPCC) confirmed via publication that, in order to mitigate the most devastating impacts of climate change, the world must demonstrate net zero carbon emissions by 2050. Reflecting this urgent call for action, the Committee on Climate Change published *Net Zero – The UK’s contribution to stopping global warming*, identifying a route for the UK to achieve the net zero target. The UK government then joined a number of other nations in declaring a **Climate Emergency** and the target was ratified into law, meaning the UK has a legally binding obligation to reduce its emissions to zero by 2050 at the latest.

The built environment contributes around 40% (UKGBC) of our national greenhouse gas emissions footprint, so any new development must minimise its footprint on day 1 and demonstrate a realistic route to achieving net zero carbon in future in order to align with our commitments to national decarbonisation.



Biodiversity

As a consequence of the warming climate, deforestation and habitat destruction, pollution and other human processes, the world is experiencing a **biodiversity crisis**. It is estimated that human action is causing the rate of extinction to be around 1,000 times what could be considered a natural background rate and future projections estimate that 30% to 50% of all current species could be extinct by the middle of the century.

Within the UK, the need to provide homes and amenities for an ever-growing population is putting strain on our local ecosystems. The State of Nature Report shows that the UK is one of the most nature-depleted countries in the world, and the UK Government responded to this in 2021 with the introduction of the Environment Act, which sets new, long-term environmental targets to protect and enhance the country’s natural world. Sustainable development must therefore mitigate its impact on local habitats, plants, and wildlife and contribute to a net gain in local biodiversity.



Health and wellbeing

Less of a crisis and more of a revolution, the understanding of the **importance of health and wellbeing** to happiness, productivity, community, and prosperity has become increasingly well-founded in recent years. Where someone lives and works is the primary influence on whether they are healthy and well and through the design of new development, people can be motivated to embrace active, healthy lifestyles and facilitated to be sociable, community-driven, and content.

2.2 National Policy

Building Regulations: Approved Document Part L

Approved Document Part L (2021, England edition), here forward referred to as ADL 2021, is the Building Regulation relating to the conservation of fuel and power in buildings. ADL 2021 has two parts, Part L1 relates to dwellings and Part L2 relates to buildings other than dwellings.

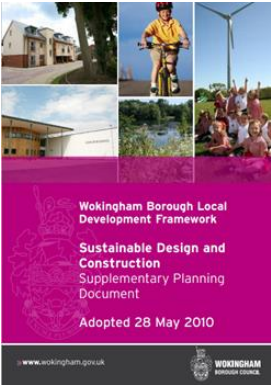
Part L of the Building Regulations is the mechanism by which government is driving reductions in the regulated CO₂ emissions from refurbished, change of use and new buildings. For new buildings ADL 2021 has four performance metrics as follows:

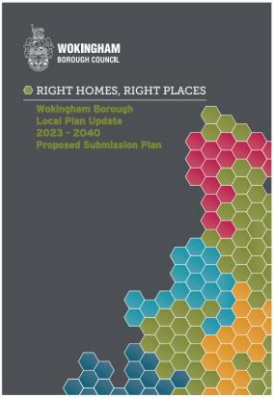
- Primary energy target
- CO₂ emissions target
- Fabric Energy Efficiency (FEE) target
- Minimum standards for fabric and fixed building services

2.3 Local Policy

Table 1 presents a summary of the key targets and requirements found in the Wokingham Borough Council Core Strategy with regards to energy and sustainability.

Table 1: Summary of local policies for energy and sustainability.

Policy	Relevant Policy Requirements
WBC SPD: Sustainable Design and Construction 	WBC: Sustainability Checklist - Measuring and Demonstrating Sustainability, Sustainable Design and Energy Efficiency. - On-site Renewable/Energy Generation - Water Resource Management - Flood Risk Management - Biodiversity - Waste, Recycling and Composting Facilities - Sustainable Transport - Health, Safety and Well-being - Sustainable Construction Key Targets: - Looking at glazing ratios in coordination with daylight/sunlight and solar gain (Part O compliance) - A ‘fabric first’ approach has been taken in order to reduce the energy demand and CO₂ emissions from the Proposed Development. - Targeting 10% over Part L for renewable energy – from the use of PV and Exhaust Air Heat Pumps. - Water efficiency measures are being targeted to interrogate a reduction in potable water use from the 105 litres per person per day.
WBC Right Homes, Right Places (2023-2040) Proposed Submission Plan	Climate change 1. Make the fullest contribution possible to the mitigation of, and adaptation to, climate change and the transition to a low-carbon economy. Getting around 2. Reduce the need to travel and widen travel choice, by providing local opportunities to access learning and employment, services and facilities, through ensuring that options for walking, cycling and public

Policy	Relevant Policy Requirements
	transport are attractive, accessible for all, convenient and safe, and by enabling digital connectivity. 3. Improve strategic transport connectivity by walking, cycling, wheeling, public transport and road, both between places within and outside of the borough. Natural, built and historic environment 4. Maintain and strengthen the sense of place by securing quality designed development through protecting and enhancing the distinctive historic environment, landscape character, townscape character and biodiversity value, assisting vibrancy, and by keeping settlements separate. 5. Promote quality and innovation in the design of buildings and public spaces, ensuring they are attractive, accessible, welcoming and meet needs of all groups in the community

2.4 Client Vision.

RVGs mission to create positive life choices for older people - built on community, wellbeing, and flexibility. they strive to support people to live their best lives for longer, while ensuring the planet, and our healthcare system, offer the same opportunities to future generations.

The strategy is a blueprint that will reshape us as a sustainability leader within our sector. The strategy enables us to take a holistic approach across three core pillars of sustainability: “Planet”, “Circularity” and “Social”. Under each pillar we have set objectives and targets that will enable us to drive meaningful sustainable outcomes and systemic change for our business, residents, supply chain, investors and wider society. At the same time, we see this as an opportunity to return economic, environmental and social value.

Figure 3 below outlines RVGs Corporate ESG commitments that help to drive Sustainable outcomes not only across their new and existing developments but also their business as a whole.

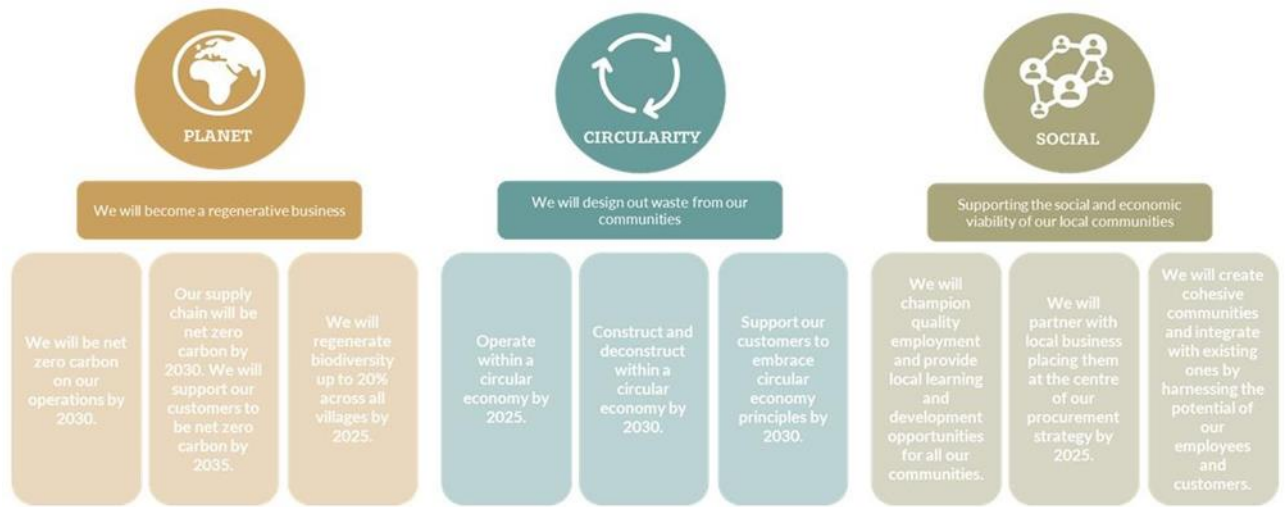


Figure 3: RVGs Corporate ESG Commitments.Energy Strategy.

3. Energy Strategy.

3.1 Energy Hierarchy.

The Energy Strategy takes a step-by-step approach to energy demand reduction, and carbon emission reductions. Principles of the Energy Hierarchy are followed in terms of ensuring the design is energy efficient prior to incorporation of low and zero carbon energy sources.

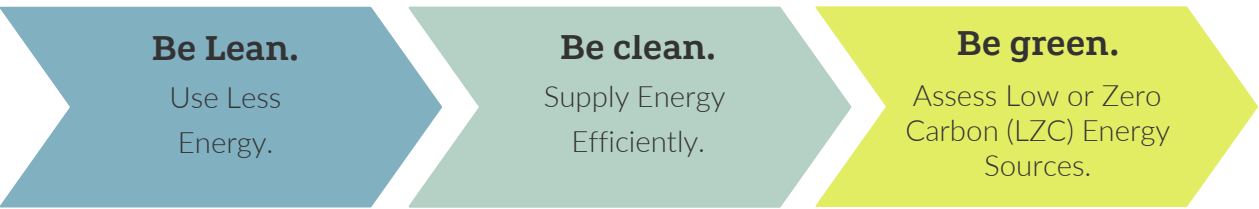


Figure 4: The Energy Hierarchy

The strategic approach to the design of the Development has been to reduce demand for energy prior to the consideration of integrating Low or Zero Carbon (LZC) technologies, since controlling demand is the most effective way of reducing energy requirements and CO₂ emissions.

Further reductions are ensured through the specification of high efficiency building services to limit losses in energy supply, storage, and distribution.

After the inclusion of passive design and energy efficiency measures, various options have been investigated to reduce CO₂ emissions associated with energy supply.

The feasibility of LZC technologies has been investigated in line with the policy aspirations and as part of the Energy Strategy submitted in support of the application.

3.2 Definitions and limitations.

Definitions:

The following definitions should be understood throughout this statement:

- **Energy demand:** the ‘room-side’ amount of energy which must be input to a space to achieve comfortable conditions. In the context of space heating, this is the amount of heat which is emitted by a radiator, or other heat delivery mechanism.
- **Energy requirement:** the ‘system-side’ requirement for energy (fuel). In the context of a space heating system using a gas boiler, this is the amount of energy combusted (e.g., gas) to generate useful heat (i.e., the energy demand).
- **Regulated CO₂ emissions:** the CO₂ emissions emitted as a result of the combustion of fuel, or ‘consumption’ of electricity from the grid, associated with regulated sources (those controlled by Part L of the Building Regulations).

Limitations:

The appraisals within this statement are based on Part L calculation methodology and should not be understood as a predictive assessment of likely future energy requirements or otherwise. Occupants may operate their systems differently, and / or the weather may be different from the assumptions made by Part L approved calculation methods, leading to differing energy requirements.

4. Cooling and overheating.

In tandem with the energy and CO₂ emissions appraisal, an assessment has been undertaken to determine the risk of summertime overheating and subsequently consider measures for the minimisation of cooling demand and mitigating risk of overheating.

4.1 Cooling hierarchy.

The following cooling hierarchy has been followed to limit the effects of heat gains in summer:

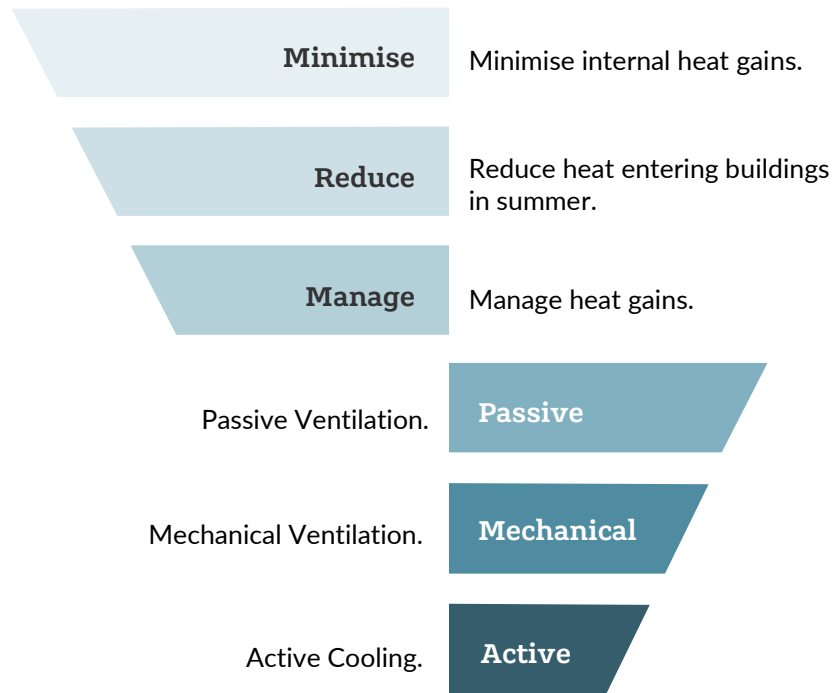


Figure 5: Cooling hierarchy.

4.2 Commercial Mitigation strategy.

Minimising internal heat gains

The following mitigation methods will be implemented to minimise the internal heat generation through energy efficient design at the Proposed Development:

- Energy efficient lighting (i.e. LED) with low heat output.
- Insulation to heating and hot water pipework and minimisation of dead-legs to avoid standing heat loss.
- Energy efficient equipment with low heat output to reduce unnecessary heat gain.

Reducing the amount of heat entering the building in summer

The following mitigation methods will be implemented to reduce the amount of heat entering the building in summer within the Proposed Development:

- Facades have been developed with suitable glazing-to-solid ratios, with particular focus on south facing orientations. Glazing ratios for the commercial development complete with internal blinds ensure we have no Criterion 3 Solar gain failures. See BRUKL in appendix B.
- Suitable g-values will be specified to further control solar heat gains as required; and

- Buildings will have the capability for internal blinds to be installed to improve occupant comfort.

Manage heat gains

- Opportunities to expose thermal mass to help to further regulate internal temperatures will be explored where possible, although the potential use of cross-laminated timber (CLT) slabs does mean that the main office floor soffits will be thermally lightweight.

Passive ventilation

The potential for passive ventilation via opening facades to facilitate a mixed-mode ventilation strategy has been considered within the facade design and will be evaluated further during the next stage of design.

Mechanical ventilation

Mechanical ventilation is an important element of building services, to maintain good indoor air quality throughout the day by providing fresh air and extracting vitiated air. Providing fresh air minimises the risk of stale and stagnant air and limits the risk of condensation and mould growth as well as benefitting the occupants' physical and mental wellbeing. Heat recovery mechanisms will be provided to save heating energy.

Mechanical ventilation plant will be located away from pollution sources, typically at roof level. It is anticipated that the design flow rates specified will aid the regulation of internal temperatures in summer months.

Active cooling

As the final step active cooling is specified in order to keep internal temperatures within acceptable limits. The façade and building services have the ability to enable a VRF fan coil unit cooling solution.

4.3 Part O: Residential Assessment methodology.

Thermal comfort methodology has been used to assess the occupied spaces within a representative sample of 5 No. Dwellings to determine their risk of overheating during the summer period (May to September inclusive).

The spaces have been assessed against criteria stated within CIBSE Technical Memorandum 59 (TM59): Design methodology for the assessment of overheating risk in homes, in accordance with the dynamic thermal modelling method.

During design development passive design principles have been adopted to reduce overheating risk which include:

1. Juliette Balcony Doors side panel reduced by 200mm.
2. Single windows reduced Width by 200mm.
3. Solid lower casements have been introduced within most exposed façade
4. Balcony railings

The assessment has utilised dynamic simulation modelling to anticipate the internal temperatures likely to be experienced within the apartments during the summer months.

The model developed for this study consists of the following input parameters to determine the thermal conditions within the occupied spaces:

- Fabric performance,
- Ventilation strategy,
- Internal gains,
- Occupancy profiles, and;
- External weather conditions taken from CIBSE London weather centre future climate data: **London_GTW_DSY1_2020High50.epw** (Design Summer Year 1: 2020, high emissions scenario (50th percentile)).

For further information on the calculation parameters see Specific TM59 report in Appendix C.

4.4 Overheating results.

CIBSE TM59 is shown to be satisfied when the following criteria are achieved:

- Criterion A is achieved when the threshold temperature is not exceeded for more than 3% of the occupied hours.
- Criterion B is achieved when the operative temperature in bedrooms (from 10 pm to 7 am) does not exceed 26 °C for more than 1% of annual hours.

The results for the overheating assessment are shown below for each occupied space within the sample apartments assessed.

4.4.1 Dwellings

Table 2: Natural Ventilation iteration - CIBSE TM59 results

Sample rooms	TM59 Criterion A Rooms that are passing	TM59 Criterion A Rooms that area failing	Pass %
13 Zones/Rooms	13	0	100
5 Zones/Living + Kitchen	5	0	100
Sample rooms	TM59 Criterion B Rooms that are passing	TM59 Criterion B Rooms that area failing	Pass %
8 Zones/Bedrooms	8	0	100

The development is compliant via natural ventilation via openable windows by implementing:

- Side-hung fully operable windows
- Side hung fully operable juliette balconies
- Opaque spandrel panels
- Triple glazing with solar control (g-value 0.4)
- Glazing to floor ratio<25%

Due to noise constraints identified in the acoustic survey, we have evaluated the use of acoustic louvered opening or attenuated passive measures, however these we're not feasible due to:

- % Free area required was too high.
- The thermal performance of a large façade acoustic louvres was too poor effecting the DFEE.
- The size of the attenuation to achieve the sound power reduction was not possible within reveal depth.

A mixed-mode solution has been therefore proposed including restricted natural ventilation (bedrooms natural ventilation during daytime only) and mechanical ventilation with tempered air at a rate of 80l/s per dwellings.

Table 3 - Mechanical ventilation iteration - CIBSE TM59 results

Sample rooms	TM59 Criterion A Rooms that are passing	TM59 Criterion A Rooms that area failing	Pass %
13 Zones/Rooms	13	0	100
5 Zones/Living + Kitchen	5	0	100
Sample rooms	TM59 Criterion B Rooms that are passing	TM59 Criterion B Rooms that area failing	Pass %
8 Zones/Bedrooms	8	0	100

4.4.2 Communal Corridor.

CIBSE TM59 states that for communal corridors if an operative temperature of 28°C is exceeded for more than 3% of annual hours, then this should be identified as a significant risk within the TM59 overheating report.

The modelling demonstrated the corridors of the Proposed Development pass this test.

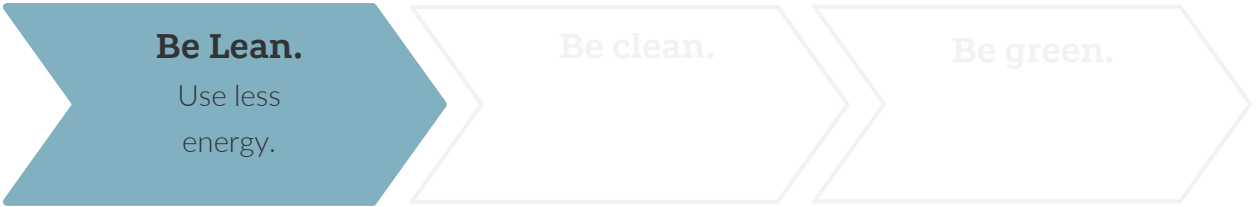
Table 5: CIBSE TM59 results for communal corridors.

Sample corridors	Number of rooms passing	Number of rooms failing	Pass %
6 communal corridors tested	6	0	100

Detailed results are provided in Appendix C.

5. Be Lean.

Passive design and energy efficiency measures form the basis for the reduction in overall energy demand and carbon emissions for the Proposed Development. This energy strategy aims to reduce the energy demand initially by optimising the envelope and building services within the development.



5.1 Passive design and energy efficiency features

Passive Design measures are those which reduce the demand for energy within buildings, without consuming energy in the process.

These are the most robust and effective measures for reducing CO₂ emissions as the performance of the solutions, such as wall insulation, is unlikely to deteriorate significantly with time, or be subject to change by future property owners. In this sense, it is possible to have confidence that the benefits these measures will continue at a similar level for the duration of their installation.

	Fabric performance A ‘fabric first’ approach has been taken in order to reduce the energy demand and CO ₂ emissions from the Proposed Development. The overriding objective for the façade design of all of the new building elements will be to achieve the optimum balance between providing natural daylighting benefits to reduce the use of artificial lighting, the provision of passive solar heating to limit the need for space heating in winter and limiting summertime solar gains to reduce space cooling demands. Thermal Insulation The new elements will Proposed Development will benefit from an efficient thermal envelope. Typically, demand for space heating can be dominant in dwellings, whilst space heating is less dominant in commercial spaces such as retail (lighting dominant). Heat losses and gains will be controlled by the optimisation of the fabric, i.e., ensuring appropriate levels of glazing to control winter heat loss and summer heat gain. Reducing the thermal transmittance of the building envelope where appropriate will help to reduce both heating and cooling requirement and result in lower energy requirements.
	Space cooling No cooling is proposed for the dwellings. Some cooling will be provided for the non-domestic elements, efficient systems are proposed in line with the standards outlined in the Non-Domestic Building Services Guide (2021). For Part O compliance Tempered Air Unit has been included into the MVHR package to mitigate overheating when windows need to remain closed due to acoustic reasons.
	Mechanical ventilation MVHR units are an important addition to the building services to maintain good indoor air quality. Providing fresh air minimises the risk of stale and stagnant air and limits the risk of condensation and mould growth.

	Coupled to a heat exchanger, the warmth in extracted air can be recovered and delivered to the supply air. In this mode, the MVHR unit reduces space heating demand. The heat recovery mechanism will be provided with a bypass to avoid returning hot air to the dwellings in summer months.
	Natural daylight and lighting strategy Lighting tends to provide a significant contribution to regulated CO ₂ emissions. As such, the implementation of energy efficiency lighting design is paramount to reducing overall emissions for these spaces. Therefore, it is anticipated that the Proposed Development will be supplied with efficient electric lighting ‘Light Emitting Diodes’ (LED) or similar low energy lamps. The lighting specification for the Proposed Development will be carried out in conjunction with lighting control systems incorporating daylight linkage and presence detection. As well as reduced energy requirement that will be achieved by implementing these strategies, the contribution to the cooling requirements and internal heat gains will be reduced. This will further reduce the total energy requirements and CO ₂ emissions of each building.

5.2 Fabric Permeability

Fabric permeability is a measure of how ‘leaky’ a structure is. Air leakage can occur in both directions i.e. both out of, and into a building. The volume of air that either enters or leaves the building leads to additional energy demand as generally the air either cools (in winter) or heats (in summer) the building. An air permeability of 3.00m³/m².h at 50Pa is proposed for the building.

Table 6 below summarises the fabric parameters of the Proposed Development for the development’s domestic elements.

Table 6: Proposed Development Domestic fabric parameters

Elements		Domestic	Non-Domestic
External walls	U-Value (W/m ² K)	0.14	0.14
Floors	U-Value (W/m ² K)	0.18	0.18
Roofs	U-Value (W/m ² K)	0.18	0.18
Windows / Glazed Doors	U-Value (W/m ² K)	0.80 (Triple Glazing)	0.80 (Triple Glazing) 1.20 ((Double Glazing Rooflights))
	g-value	0.40	0.40
Party walls	U-Value (W/m ² K)	Solid or Fully Filled Cavities with Sealed Edges	n/a
Air permeability	m ³ /(h.m ²) at 50 Pa	3.00	3.00
Thermal Mass Parameter (kJ/m ² .K)	-	175	-
Thermal bridging	y-Value Range	0.07-0.12	-
Sheltered Wall	U-Value (W/m ² K)	0.18	-
Party Wall	Zero Heat Loss	Fully filled and sealed.	-
Opaque Doors	U-Value (W/m ² K)	1.00	1.00

5.3 Active measures.

In addition to the passive design measures, the following energy efficiency measures will be included in the Proposed Development in order to limit the demand for primary energy. Table 7. below includes the building services parameters to be included in the preliminary Part L calculation for both the domestic and non-domestic elements.

Table 7. Proposed Development Mechanical Information

	Domestic	Non-Domestic
Heating	Direct Electric	VRF Heating – SCOP 3.20
Cooling	Tempered Air only.	VRF Cooling SEER 4.5 (Multi-Function)
Ventilation	Nuaire MRXBOXAB-ECO Balanced Mechanical Ventilation with Heat Recovery	Multi-Function: SFP 1.6 – 80% HR
DHW	Dimplex EDEL 200 (EAHP)	POU Electric
Lighting	100% efficient lighting at 90lm/W	110 lm/W as per MEP Scheme Design.

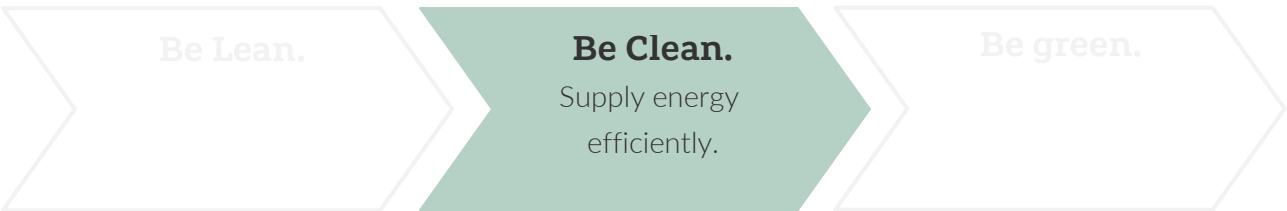
Utilising the passive and active elements as listed within this Section the dwellings achieve compliance with the fabric energy efficiency requirements of Part L 2021.

Table 8: Dwelling Fabric Energy Efficiency

	Dwelling fabric energy efficiency (DFEE) kWh/year	Target fabric energy efficiency (TFEE) kWh/year	Percentage variance
Area-weighted average:	25.65	29.32	12%

6. Be Clean.

This stage of the energy hierarchy refers to the use of heat networks or on-site Combined Heat and Power (CHP) in order to provide energy and reducing consumption from the national grid and gas networks, through the generation of electricity, heating and cooling on-site.



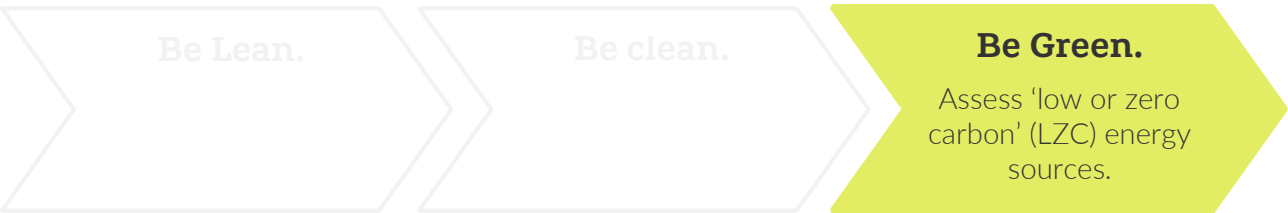
6.1 Be Clean: network and technologies.

In line with policy aspirations, the following sections summarise the considerations of the low-carbon energy supply measures that have been considered, and those which will be implemented at the Proposed Development.

	Decentralised heat and energy networks Offsite heating network There are currently no District Heat Networks (DHNs) in close proximity to the Proposed Development, therefore at present a connection is not possible.
	Combined heat and power (CHP) Changes to the carbon factor of grid electricity have meant that previously favoured systems such as Combined Heat and Power (CHP) are becoming much less carbon efficient. In fact, CHP systems are now expected to lead to greater carbon emissions than conventional gas-fired boilers due to their lower efficiency. Due to the decarbonisation of the electricity grid, schemes using CHP engines for the delivery of heating energy at the Proposed Development leads to a net increase in carbon emissions (over the baseline). Furthermore, CHP engines are an on-site source of particulate pollutants which will adversely affect local air quality. In light of grid decarbonisation and increased focus on air quality, CHP is therefore not proposed.

7. Be Green.

The final step of the energy hierarchy explores the feasibility of Low and Zero Carbon (LZC) technologies to allow for the production of renewable energy onsite in order to offer a further reduction in carbon emissions.



7.1 Low and zero carbon (LZC) technology assessment.

Renewable or zero carbon technologies harness energy from the environment and convert this to a useful form. Many renewable technologies are available, however, not all of these are commercially viable or suitable for city locations.

	Photovoltaics Photovoltaic panels harness energy from daylight and convert this into useful energy in the form of electricity. A PV system requires viable roof space in order for the system array to be installed and function effectively. Suitability to Proposed Development: Areas have been identified on the roof of Block B that would house approximately 38.5kWp; 8-10kWp of PV serving the landlords systems and contributing to the carbon reductions of the Amenity areas and incorporate into the L2 calculation; and the remaining split between the dwellings ~1.6kWp. On the basis that a solar PV array can provide a significant reduction in CO ₂ a PV array is considered appropriate for the Proposed Development.
	Solar thermal Solar Thermal Panels are similar to PV Panels in that they harness energy from solar. This technology however converts solar into thermal energy that can offset the demand on hot water generation systems. Suitability to Proposed Development: As above, roof area is available for solar panels. However, it would be to prioritise solar PVs, since the electrical output from PV panels will be more suitable for implementation with the electrical led Energy Strategy and building energy usage. Therefore, solar thermal is not proposed for the development.
	Ground source heat pumps Ground Source systems work to extract heat or cooling energy from the ground. They are generally slightly more efficient than air source systems, as the ground temperature is more stable over the course of the year relative to air temperature. There are four common varieties of ground source systems: - Vertical, open loop, direct cooling (i.e., without heat pump) - Vertical, open loop, with heat pump - Horizontal, closed loop, with heat pump

	– Vertical, closed loop, with heat pump Regardless of the type of ground source heat loop used, all would require extensive below ground works to bury and install the system on site. Ground Source Heat Pumps are not considered a feasible option and are not proposed.
	Air source heat pumps Air source heat pumps (ASHP) use thermodynamic principles to convert heat from the air into useable heat within the building. Unlike some other sources of renewable energy, heat pumps do require energy (typically electricity or gas) to pump and compress refrigerant through the system. However, under the Renewable Energy Directive 2009/28/EC they are classified as renewable technologies provided that the final energy output significantly exceeds the primary energy input required to drive the heat pump. ASHP need to be located externally with access to the ambient air, typically at roof level. Suitability to Proposed Development: The main benefits of ASHPs are that they can provide both heating and cooling as the heat pump can be operated in reverse, and they are suitable for centralised heat networks. They are easy to install (more so than GSHP) and require very little maintenance once installed. This solution requires a large outdoor space at roof or ground level to accommodate ASHPs to provide a portion of the heat demand. ASHPs are considered an appropriate technology for areas of the Proposed Development. On the residential this is explicitly for the DHW production via EAHPs.
	Wind turbine For efficient operation and to yield high energy output, wind turbines require a smooth laminar flow of air. The Proposed Development is located within a dense urban environment therefore the wind flow profile is erratic and consequently, is not conducive to high annual yields. Suitability to Proposed Development: Moreover, mounting wind turbines on the roofs of the Proposed Development could result in unacceptable vibration and resonance being felt within the occupied spaces. The turbines are also likely to generate noise which may be a nuisance to neighbouring properties. This scenario could result in the turbines being switched off. Considering the impacts described above, the limited CO₂ emission benefit and visual impact of wind turbines on the character and appearance of the area, the use of micro wind turbines will not be implemented at the Proposed Development.
	Biomass Biomass boilers burn wood fuel or other bio-fuel sources to generate heat. These boilers can operate at high efficiencies, comparable to condensing gas boilers. However, they require a large fuel store to maintain continuous operation during the winter months. As such, area take for such plant is high. Furthermore, fuel deliveries in city-centre locations can prove difficult and security of fuel supply is an important consideration. Suitability to Proposed Development: The calculations indicate that the use of a biomass boiler could yield good, regulated CO₂ emissions savings however this would also lead to in an increase of NO_x emissions from the Site and require a store footprint for the biomass fuel which would take up additional building footprint.

	As such, the use of biomass boilers at the Proposed Development is considered to be unsuitable.
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7.2 Photovoltaic panel incorporation

The Proposed Development will include approximately 180 sqm of PV panels. These will be at a 20° inclination facing southeast. This equates to 110 no. 1.85m x 1m south facing panels on the roof accessible flat roof of building. These panels will provide approximately 38.5 kWp of energy.

This reduces the carbon output of the landlord Amenity areas and the dwellings compared to the baseline scheme.

7.3 Proposed heating infrastructure.

With the recognition that the generation of electricity is much greener now than it used to be due to the decarbonisation of the grid, along with the reduction of the electricity carbon factors, a decentralised direct electric and Air Source Heat Pump (ASHP) system is considered an appropriate heat infrastructure for this development. This has been adopted as the preferred option.

8. Energy Strategy Summary.

The strategy has been developed using the ‘Be Lean, Clean and Green’ energy hierarchy which utilises a fabric first approach to maximise reduction in energy through passive design measures.

The following table provides a summary of the energy strategy for the Proposed Development for both the dwelling and site wide scale.

Be Lean	High energy efficient building fabric and building services have been utilised to reduce carbon emissions and energy demand through good practice passive measures with a 12% reduction on the Part L 2021 TFEE achieved.
Be Clean	Incorporation of an onsite district heating and a CHP system has been deemed to be unsuitable, therefore a heat network and CHP technology has been discounted.
Be Green	Utilisation of on-site renewable energy from ASHP and roof mounted PV will also be implemented at the Proposed Development to further reduce carbon emissions.

8.1 Results

Through the measures outlined in the energy strategy, it is anticipated that overall, up to an 78%reduction in CO₂ emissions can be achieved beyond the Building Regulations Part L 2021 baseline.

Table 9 details the performance levels achieved against the Part L 2021 compliance metrics for the domestic and non-domestic areas.

Table 9: Regulated carbon savings – Sitewide data

	Building/ Dwelling Emission Rate (BER/ DER)	Target Emission Rate (TER)	% Reduction over Target Emission Rate (TER)
	kgCO ₂ e/m ²	kgCO ₂ e/m ²	
Residential	2.6	11.8	78%
Non-Residential	-3.27	0.33	1091%

Please refer to Appendix A for the sample SAP reports and Appendix B for the BRUKL document.

Figure 6 below demonstrates the site wide carbon reduction.

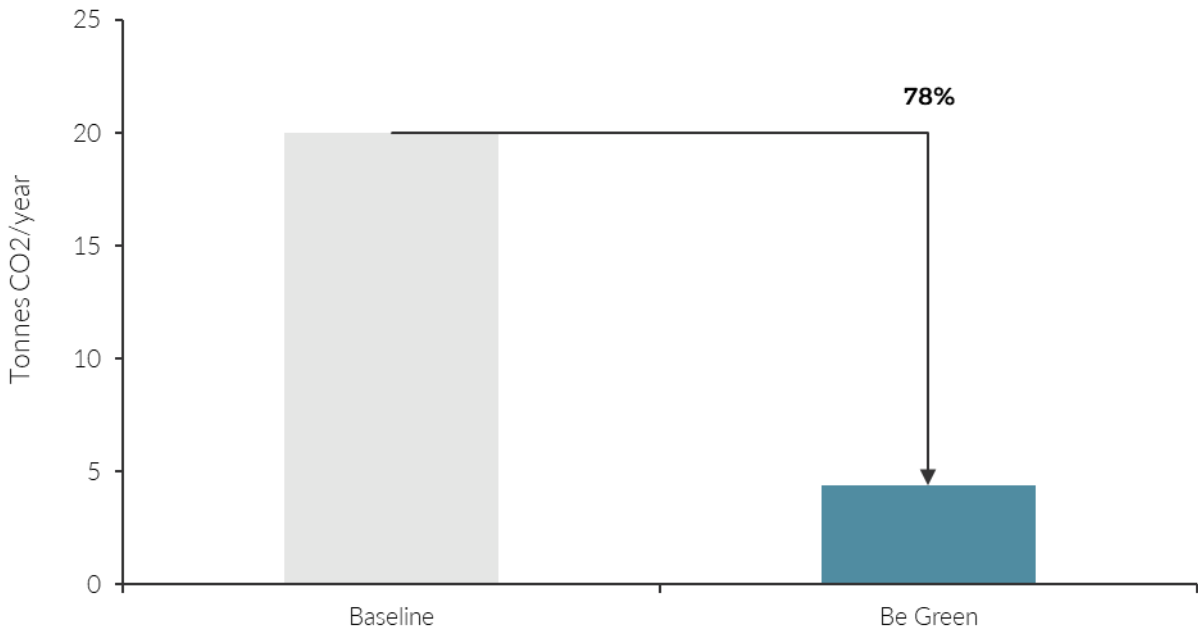


Figure 6 Sitewide regulated carbon reduction.

The energy strategy for the Proposed Development has addressed the key elements of Wiltshire Local Plan on energy and will make a positive contribution to reducing the county's CO₂ emissions.

9. Approach to Sustainability.

The following strategy addresses a wide range of sustainability subject areas and covers various headline sustainability categories. The strategy confirms the applicable policies and the Applicant's aspirations and measures of sustainability that would be implemented at the Proposed Development.

The design of the Proposed Development is based on sustainable design and construction principles as informed by planning requirements and industry best practice. It is on this basis that we are utilising a sustainability framework based on five defined factors, i.e., the people, the buildings, the social network, the natural environment, and the economic aspects as illustrated in Figure 7 to capture the multi-faceted sustainability benefits and values that the Proposed Development could bring to the following areas:

- Application Site,
- Local community,
- Surrounding businesses, and
- Future building users.

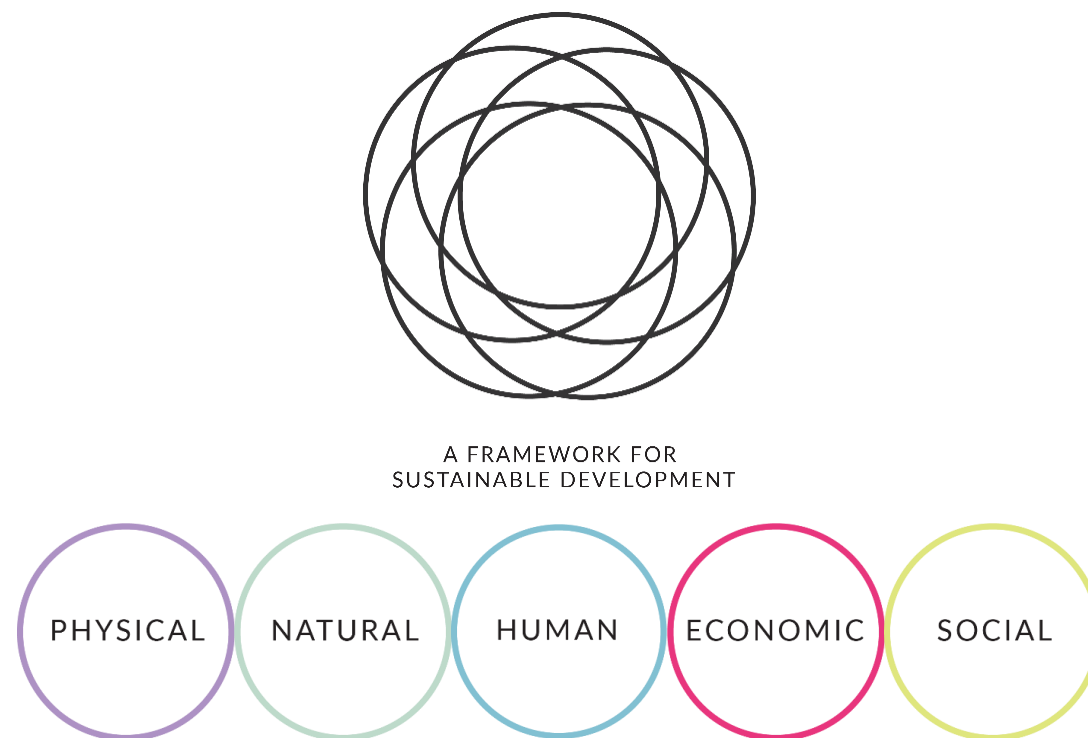


Figure 7: Framework for Sustainable Development

- **Physical: fit for the future** – buildings that are robust and equipped to navigate future environmental challenges.
- **Natural: positive impact** – integrity is maintained through design and operation through enhancement of ecological assets and responsible resource management.
- **Human: Occupant Wellness** – putting people at the heart of the design process and ensuring that the physical and mental wellbeing of occupants and visitors is catered for.
- **Economic: Enable new Opportunities** – ensuring that priority is given to local small / medium enterprises and independent service providers as means of boosting the local economy.
- **Social: Active Community** – creating a safe and sociable place for people to live and interact, enhancing existing communities and fostering new connections.

- **Physical: Fit for the Future** – buildings that are robust and equipped to navigate future environmental challenges.

The Delivery Framework

Working with all key stakeholders, an overall vision for the development has been defined. Workshops have been held in collaboration with the client and project team to help create a charter including innovative initiatives and key objectives to be delivered as a result of the project.

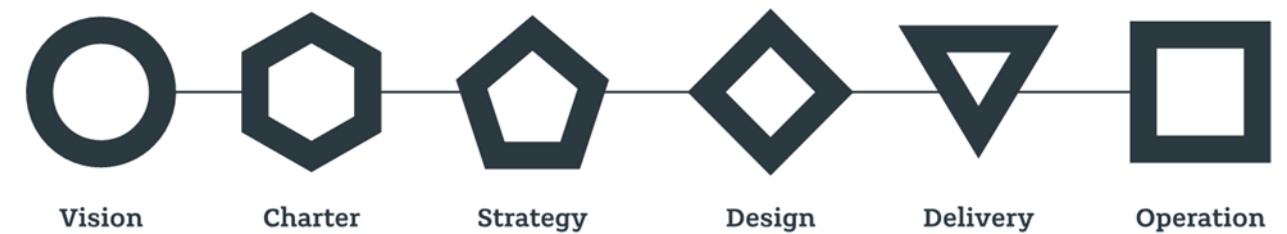


Figure 8 Sustainability strategy – Delivery phase (inception to completion).

10. Sustainability Strategy.

The design of the Proposed Development is based on high sustainability aspirations and is compliant with industry best practice. In addition, it also attempts to push the boundaries of conventional construction by deploying innovative methods and approaches during design and construction. The strategy for the Proposed Development addresses key sustainability challenges and opportunities, responds to the requirements of the applicable policies, and implements the Applicant's aspirations.

It embraces the Five Capitals framework, responding to the challenges of climate, biodiversity and health and wellbeing, UN sustainable development goals and Applicant vision, aiming to create long term value and generate a flow of environmental, social and economic benefits. Each Capital has been contextualised to the specific needs, challenges and opportunities arising from the Proposed Development, resulting in five themes.

Wiltshire Climate Change Pre-App Feedback

A pre-app consultation was undertaken where for planning there was a requirement for submission of a Sustainability Strategy - with a plan annotating how design maximises resilience (see NDG para. 135 -149).

10.1 Physical Capital: Fit for the future.

Energy strategy

The Proposed Development is targeting energy and carbon emission reductions over the existing pre-refurbishment building. The following energy efficiency measures have been incorporated into the design to meet the targeted CO₂ emissions reductions.

- Low carbon heating and cooling via ASHP/VRF.
- Good fabric performance – Low U-Values and implementation of Triple Glazing.
- Modern building services including high efficiency ventilation plant with variable speed fans and high levels of heat recovery.
- Efficient low-energy lighting throughout all spaces with low heat output to minimise risk of high internal heat gains.
- Inclusion of Photovoltaics for the Landlord Amenity space.

Flood risk management and sustainable drainage

Based on information from the Environment Agency has indicated that the site is located within Flood Zone 2/3 and has a high probability of flooding from rivers and the sea.

Flood zone 2

Locations in flood zone 2 have a medium probability of flooding. This means in any year land has between a 1% and 0.1% chance of flooding from rivers and between a 0.5% and 0.1% chance of flooding from the sea. Flood zone 2 developments need a flood risk assessment as part of their planning application.

Flood zone 3

Locations in flood zone 3 have a high probability of flooding. This means in any year land has a 1% or more chance of flooding from rivers, or a 0.5% or more chance of flooding from the sea. Flood zone 3 developments need to submit a flood risk assessment as part of their planning application.

Flood defences

There are flood defences in part or all of the location you selected. Flood defences reduce the probability of flooding from a specific source (a river or the sea) do not completely stop the chance of flooding because there may be a flood that is bigger than the one the defence is designed to protect against (this is called overtopping), or the defence can fail may provide reduced protection over time because of climate change increasing flood risk in the future. There are different types of flood defence. They include:

- culverts
- embankments

- flood walls

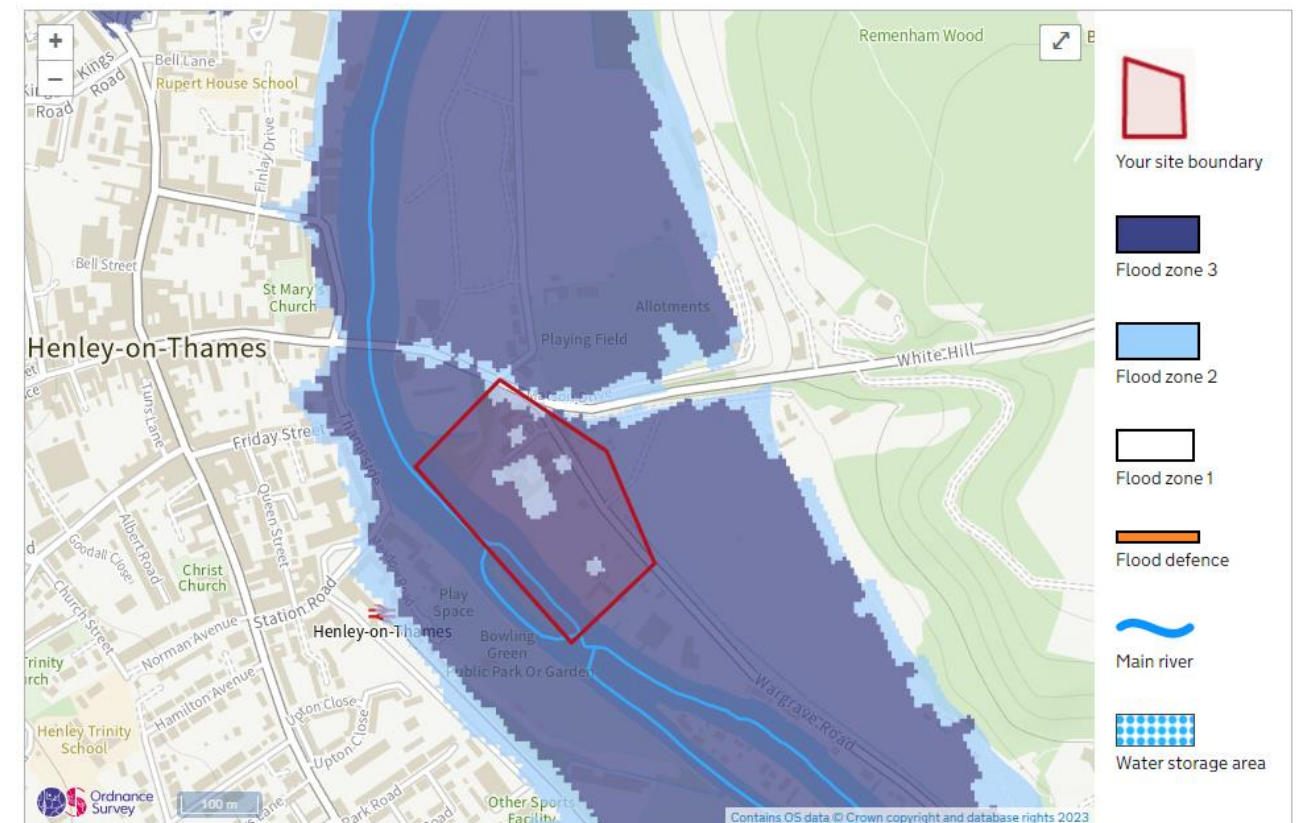


Figure 9 Flood Risk Map (Credit: <https://flood-map-for-planning.service.gov.uk/>)

The map shows the flood risk to your site and the surrounding area. The flood zones in the map show the areas of land at risk of flooding. They only show flood risk from rivers and the sea are based on present day flood risk; they do not show how it may change in future because of climate change ignore the effect any flood defences shown could have.

Flood defences

Flood defences have been built to protect against flooding from rivers or the sea (shown as an orange line on the map). Flood defences reduce, but do not completely stop the chance of flooding because they can be overtopped or fail.

Flood Risk Assessment

To assess the risk of fluvial flooding from the River Thames, hydraulic modelling was undertaken by JBA in 2022. Hydraulic modelling results indicated that:

- Water enters the site (from overtopping of the River Thames' banks) for all of the modelled flood scenarios (i.e. 30-year, 100-year, 100-year +31% CC and 1,000-year)
- Flood depths of up to 1.89m are predicted to occur within the site during the 100-year with 31% climate change 'design' flood event.
- During the 100-year with 31% climate change fluvial flood event, the peak water levels will range between 32.24 and 32.29m AOD on site and will exceed the existing floor levels of 2 existing buildings.
- During the 100-year with 31% climate change scenario, the majority of the site falls within the 'low' to 'significant' hazard categories (based on Defra's Hazard-to-People categories).
- The 'design' flood level will increase by 0.77m in the event of a 25% blockage at Henley Bridge.

To mitigate against flood risk, it is recommended to:

For the new buildings;

- Raise the ground floor levels of the new buildings to a minimum of 600mm above the ‘design’ flood level.
- Install emergency generators to be used in extreme cases of flooding where the power might be affected to maintain power on site (e.g. to power medical equipment).

Sustainable transport

The main access to the site is proposed from the A321 Wargrave Road to the Northeast of the site, which also provides access to the remaining existing development.

Bus Services

The nearest bus stops are located 60m north of the site access (northbound) and 25m for the southbound stop. The 850 bus service routes via these stops at an hourly frequency. A number of additional services are available from Henley-on-Thames with several bus stops along Hart Street/Market Place.

The bus stops known as the ‘Two Brewers’ both feature bus flags. Hart Street (Stop B) also has a bus flag, raised kerb line and a dedicated bus cage. Hart Street (Stop A) in addition to the features of Stop B also has a sheltered seating area. The Market Place stop has a dedicated bus cage and bus flag.

Train Services

The nearest train station is Henley-on-Thames and is located approximately 900m walking distance from the site access. The main service from the station is to Twyford with services running every half hour.

Cycleways

Cycling also has the potential to substitute for short car trips, particularly those less than 5km, and to form part of a longer journey by public transport. In addition, the Department for Transport’s (DfT) ‘Cycle Infrastructure Design LTN1/20’ (July 2020) document states that a cycle trip distance of over five miles (8 km) is common. A 5km cycle will take approximately 19 minutes at an average speed of 268m per minute whilst an 8km cycle will take approximately 30 minutes at an average speed of 268m per minute.

Car parking

A total of 39 parking spaces are provided across the site an increase of 8 and of those 39, 36 are formal, 2 disabled bays and 1 space will be provided with active electric vehicle charging infrastructure.

Pedestrians and Cyclists.

Walking is a key mode of travel at the local level and offers the greatest potential to replace short car trips, particularly under 2km. A 2km walk equates to a walking time of 25 minutes (based on an average walking speed of 80 metres per minute.

Travel Plan

In planning terms, a Travel Plan is not required for the low level of staff working on these types of residential development and a TP has not been requested for the planning application. However, a number of travel planning measures and facilities would in any case will be implemented at Thamesfield to encourage sustainable travel.

10.2 Natural Capital: Positive impact

Ecology & biodiversity.

RPS was commissioned to undertake a Preliminary Ecological Appraisal (PEA) at land at Thamesfield Retirement Village, Wargrave Road, Henley on Thames RG9 2LX. This comprised a desk study, Phase 1 Habitat Survey, and a Preliminary Bat Roost Assessment (PBRA). There are 16 non-statutory sites located within the 2 km search radius of the site, this includes 12 Local Wildlife Sites, one potential Local Wildlife Site, one Woodland Trust

Reserve, a Biodiversity Opportunity Area and a Conservation Target Area. The closest LWS site is Branfords Woods which is 0.33km from the site boundary.

The Phase 1 Habitat Survey identified that the site predominantly comprised amenity grassland, hard standing, and buildings, with the grounds displaying areas of mixed woodland, introduced shrubs, and scattered trees. The PBRA identified four buildings (B1, B2, B3 and B6) with high potential, one building (B5) with low potential, one building (B4) with negligible potential, and two trees with moderate potential to support roosting bats. Bat droppings were found beneath external features located on B1, B3 and B6. Further surveys may be required to determine whether these buildings are currently being used by bats.

In addition to the mitigation measures outlined above, enhancement measures would also include the provision of bird boxes located within existing hedgerows and on mature trees. Boxes will comprise various designs suitable for species including: robin, wren, blue tit, great tit, coal tit, nuthatch, house sparrow and starling.

A Biodiversity Net Gain (BNG) assessment will be required using current guidance from CIEEM, et al (2019). This would involve using the recognised scoring system to assess the habitats on site prior to development and post development. There would be a requirement to show a net gain of approximately 10% and therefore it will be necessary to work with the project team to ensure high value habitats were being re-created. If biodiversity gains cannot be achieved on-site, off-site opportunities would need to be investigated.

The information gathered during the Phase 1 Habitat Survey would be used to calculate the baseline biodiversity value of the site. A masterplan/landscaping plan of the site would be used to calculate the biodiversity value of the development.

Biodiversity Net Gain Summary

FINAL RESULTS		
Total net unit change (Including all on-site & off-site habitat retention, creation & enhancement)	Habitat units	0.66
	Hedgerow units	0.05
	Watercourse units	0.00
Total net % change (Including all on-site & off-site habitat retention, creation & enhancement)	Habitat units	12.30%
	Hedgerow units	89.28%
	Watercourse units	0.00%
Trading rules satisfied?	Yes ✓	

External Lighting

Lighting to be installed as part of the development should be in line with Guidance Note 08/18 Bats and Artificial Lighting in the UK, the following will be required:

- LED lighting will be used, and light levels should be kept as low as possible. Metal halide, fluorescent sources should not be used;
- Lighting will be directed to where it is needed (away from boundary features and existing potential roost features);
- Only luminaires with an upward light ratio of 0% and with good optical control should be used, luminaires should always be mounted on the horizontal, i.e. no upward tilt;
- Any external security lighting should be set on motion-sensors and short (one minute) timers;

- Internal lighting within any new structures should be recessed where installed in proximity to windows to reduce glare and light spill; and
- Light sources should emit minimal ultra-violet light, peak higher than 550nm and be of a warm white spectrum (ideally <2700 Kelvin).

Water consumption

The Development will be fitted with water efficient fixtures and fittings, and water meters will be provided to enable the monitoring of water consumption.

Through the use of efficiency sanitaryware all dwellings will comply with the Building Regulations target of 110 litres/person/day.

Mains water metering will be incorporated in the design. Meters will be connected to the central Building Management System.

No rainwater or waste water recycling facilities are proposed within the buildings however facilities to collect rainwater for landscape irrigation via water butts will be provided.

Climate change adaptation

The design will contribute to adaptation and mitigation of the effects of climate change by the specification of high performing elements to minimise heat gains and losses.

The Proposed Development will be designed in accordance with the cooling hierarchy to minimise cooling demand. Mitigation measures such as an appropriate glazing ratios and g-values, high levels of insulation and minimisation of internal heat gains are targeted. A tempered air system via the MVHR has been allowed for, installation as the climate becomes warmer and mindful that we have vulnerable occupants that may need/require active cooling in future.

Measures outlined include the provision and installation of PV panels and the improvement of site water drainage through paving material selection.

Responsible sourcing

The use of construction products leads to a wide range of environmental and social impacts across the life cycle through initial procurement, wastage, maintenance and replacement. Taken together, construction products make a highly significant contribution to the overall life cycle impacts of a building. In some cases, they may even outweigh operational impacts (such as energy consumption).

Building elements will be selected to minimise environmental impact, in line with the sustainable procurement plan to be developed for the development. A full review of the materials specified for the development will be undertaken during the detailed design development stages aiming for materials to meet the following requirements where possible:

- Responsible sourcing certificates
- Environmental Product Declarations
- Low emitting materials

Insulation will be specified to have a Green Guide Rating of A where possible, and minimise Global Warming Potential (GWP), and all timber used at the Proposed Development aims to be FSC or PFC certified or similar.

Waste management

During the construction phase, the Principal Contractor, once appointed, will develop a Resource Management Plan (RMP) for the Proposed Development. This will outline opportunities to steer the direction of waste management and ensure good practice is adopted for the construction phase of the Proposed Development.

The Principal Contractor will be required to adopt the recommendation measures made in line with the waste hierarchy with the aim of maximising diversion from landfill. A Construction Environmental Management Plan (CEMP) will be developed to outline opportunities for waste management and ensure good practice will be adopted in the construction phase of the Proposed Development. The Proposed Development will be

constructed in a manner which aims to protect the environment and local community through reusing, recycling and recovering waste which would otherwise be disposed of at landfill.

Refuse collection will continue as private waste collection for the recycling and general waste. However, as the development will increase the number of available units on site, it is anticipated that additional waste bins will be required. At present, the general waste bins are approximately 75% full when collected, whilst the recycling bins are 100% full.

The proposed development would result in a requirement for an additional 2no. general waste bins and 3no. recycling bins. However, in order to avoid a requirement for additional hardstanding, it is proposed that the number of private waste collections will be increased from once per week to twice per week.

Future Weekly Waste storage requirement for 49 units – 5,390L Total; 5no. 1100L bins, based on 75% existing usage – 4,042.5L Total; 4no. 1100L bins, at two collections per week – 2,021.25L Total; 2no. 1100L bins.

Future Recycling storage requirement for 49 units – 5,390L Total; 5no. 1100L bins, at two collections per week – 2,695L Total; 3no. 1100L bins.

Based on the above, with two collections per week, there is requirement for 1 additional recycling bin in comparison to the existing provision, which will be provided within the existing bin storage area. There is no change to the existing general waste storage.

10.3 Human Capital: People-centred design

People-centred Design

Human centric design centres on development that puts user needs, desires and abilities at the centre of the design process. Multiple options have been considered for the design including maximising natural daylight and limiting the use of artificial lighting within the scheme, ensuring adequate views out of the surrounding environment, ensuring appropriate thermal comfortability is maintained throughout key areas of the building. Adopting appropriate acoustic measures will be incorporated into the scheme in order to minimise disturbance for the occupants of the development.

The overarching design strategy for the village reconnects the new communal and well-being facilities into this unique landscaped setting, celebrating the vistas and providing a sensational place to live. The new buildings are designed to be calming and respectful of the immediate and local context. Their arrangement on the site will reconnect the existing residential units to vibrant a new village centre, focussed on the wellbeing of the resident. The design focus for the gardens and external spaces is to celebrate the uniqueness of the site from its lawns with extensive vistas to the rustic quarry wall that forms the backbone to the village. An abundance of places where people can sit and socialise in the grounds is complemented with good active frontages, strong connectivity between gardens and dwellings and sheltered thresholds at entrances.

Local air quality

An air quality assessment has not been requested for the planning application, however, the quality of the air within buildings can have a considerable effect on health due to the amount of time people spend indoors. All finishes installed in the building will aim to have low volatile organic compound (VOC) content. The development will be combustion free and is therefore expected to have a minimal impact on local air quality.

Daylight & thermal comfort

The Proposed Development will target glazing ratios, VLT and g-values which maximise exposure to daylight achieving at least 70% EN Spatial Daylight Autonomy compliance, whilst considering the level of incoming solar gains in order to minimise the energy consumption necessary for cooling.

Part O (CIBSE TM59 Analysis) analysis has been completed and provides a route to compliance using Natural ventilation supplemented by background ventilation via MVHR installed to meet Part F of the building regulations. Where noise is an issue, noted in the section below, a tempered air system via the MVHR has been allowed for.

Noise

Hoare Lea has conducted an environmental noise survey the following summarises the assessment procedure and findings contained within this report:

- Environmental noise monitoring was undertaken at the proposed development site across a seven-day period between Wednesday 2nd August 2023 and Wednesday 9th August 2023.
- Background noise levels typical of the daytime and night-time have been measured and used to define building services plant noise emission limits at the nearest noise sensitive receptors.
- The nearest receptors have been identified as the proposed development itself and existing residential dwellings within Thamesfield Retirement Village and those along Wargrave Road to the north including Cognatum Retirement Property to the north.
- During the daytime and night-time, the combined building services plant noise emission contribution limit advised is 40 dB(A) and 38 dB(A) respectively, one metre from the nearest residential façade.
- An assessment of the building envelope acoustic performance is provided and indicates that the ventilation strategy should allow for full mechanical ventilation of bedrooms as the level differences required are above those achievable by simple means of natural ventilation via an open door or window.
- For a number of living rooms on certain elevations, compliance with the internal noise levels with a 5 dB relaxation applied (as detailed within the ANC's Acoustics Ventilation and Overheating Residential Design Guide) can be achieved with open windows during the daytime.
- Notional glazing requirements and indicative glazing configurations have been provided for guidance purposes only. Detailed calculations based on façade areas will be required to refine and finalise the performance requirements during the next design stage.
- On the basis of the guidance contained within this report, it is concluded that the Site is suitable for the proposed development.
- The guidance provided within this report is sufficient to satisfy the requirements of Wokingham Borough Council, in our professional opinion.

10.4 Economic Capital: Enable new opportunities.

Please review the Economic and Social Statement issued by Stantec (not available at the time of re-issue of this report).

10.5 Social Capital: Community engagement

Please review the Economic and Social Statement issued by Stantec (not available at the time of re-issue of this report).

Appendix A: SAP Worksheets.

Full SAP Calculation Printout



Property Reference	U1L1 - Direct + DHP DHW+PV				Issued on Date	05/09/2025
Assessment Reference	Proposed _Option - Unit 1		Prop Type Ref	2B-4P-N-End Terrace Level 3		
Property						
SAP Rating	88 B	DER	0.99	TER	10.79	
Environmental	99 A	% DER < TER				90.82
CO ₂ Emissions (t/year)	0.02	DFEE	24.85	TFEE	28.48	
Compliance Check	See BREL	% DFEE < TFEE				12.74
% DPER < TPER	70.81	DPER	16.53	TPER	56.62	
Assessor Details	Miss Emma Jolly				Assessor ID	T689-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	78.5000 (1b)	3.0000 (2b)	235.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	78.5000		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	235.5000 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	3.0000	(17)
Infiltration rate	0.1500	(18)
Number of sides sheltered	2	(19)

Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												80.1000 (23c)
Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Window			10.1800	0.7752	7.8915		(27)
Door			2.1000	1.0000	2.1000		(26)
External Wall 1	53.0800	10.1800	42.9000	0.1400	6.0060	190.0000	8151.0000 (29a)
Shelter Wall 1	4.1300	2.1000	2.0300	0.1600	0.3248	190.0000	385.7000 (29a)
Total net area of external elements Aum(A, m ²)			57.2100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	16.3223	(33)
Main dwelling							
Party Wall 1			53.6300	0.0000	0.0000	180.0000	9653.4000 (32)
Party Floor 1			80.8700			40.0000	3234.8000 (32d)
Party Ceiling 1			78.5000			30.0000	2355.0000 (32b)
Internal Wall 1			80.5800			9.0000	725.2200 (32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	24505.1200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K		312.1671 (35)
List of Thermal Bridges		

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	20.3662	20.1185	19.8708	18.6322	18.3845	17.1459	17.1459	16.8982	17.6413	18.3845	18.8799	19.3753 (38)
Heat transfer coeff												
	44.9850	44.7372	44.4895	43.2509	43.0032	41.7646	41.7646	41.5169	42.2601	43.0032	43.4987	43.9941 (39)
Average = Sum(39)m / 12 =												43.1890
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.5731	0.5699	0.5667	0.5510	0.5478	0.5320	0.5320	0.5289	0.5383	0.5478	0.5541	0.5604 (40)
HLP (average)												0.5502
Days in month	31	28	31	30	31	30	31	31	30	31	30	31

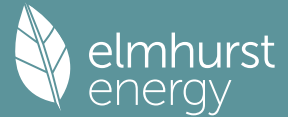
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5. Internal gains (see Table 5 and 5a)												

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	119.0172	131.7690	119.0172	122.9844	119.0172	122.9844	119.0172	119.0172	122.9844	119.0172	122.9844	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	216.2770	218.5213	212.8658	200.8259	185.6276	171.3434	161.8007	159.5565	165.2120	177.2519	192.4501	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	(71)
Water heating gains (Table 5)	96.4209	93.9179	89.1165	78.6202	72.1851	65.4614	61.3437	64.7638	68.7715	76.2322	86.2956	(72)
Total internal gains	491.2218	503.7150	480.5062	461.9373	436.3367	419.2961	401.6684	402.8443	416.4747	432.0081	461.2369	(73)

[Jan]																				
					Area	Solar flux		g	FF		Access		Gains							
					m2	Table 6a		Specific data	or Table 6c		factor		W							
						W/m2		or Table 6b			Table 6d									
Northeast					4.3600	11.2829		0.4000	0.8000		0.7700		10.9092		(75)					
Southeast					5.8200	36.7938		0.4000	0.8000		0.7700		47.4877		(77)					
Solar gains	58.3969	103.0951	150.6841	202.8377	241.9204	246.6481	235.0996	204.9519	168.5892	116.5372	70.6059	49.5486	(83)							
Total gains	549.6187	606.8101	631.1903	664.7750	678.2571	665.9442	636.7680	607.7962	585.0639	548.5452	531.8428	529.8877	(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, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	151.3167	152.1546	153.0018	157.3833	158.2899	162.9842	162.9842	163.9567	161.0735	158.2899	156.4871	154.7248
alpha	11.0878	11.1436	11.2001	11.4922	11.5527	11.8656	11.8656	11.9304	11.7382	11.5527	11.4325	11.3150
util living area	0.9914	0.9734	0.9277	0.7760	0.5891	0.4014	0.2886	0.3142	0.4983	0.7999	0.9651	0.9933 (86)
MIT	20.7418	20.8377	20.9254	20.9906	20.9995	21.0000	21.0000	21.0000	20.9999	20.9894	20.8854	20.7333 (87)
Th 2	20.4543	20.4572	20.4600	20.4743	20.4772	20.4916	20.4916	20.4944	20.4858	20.4772	20.4715	20.4657 (88)
util rest of house	0.9886	0.9657	0.9104	0.7457	0.5562	0.3695	0.2552	0.2797	0.4612	0.7648	0.9542	0.9911 (89)
MIT 2	20.2249	20.3195	20.4019	20.4682	20.4770	20.4916	20.4916	20.4944	20.4858	20.4707	20.3784	20.2270 (90)
Living area fraction									fLA = Living area / (4) =			0.3389 (91)
MIT	20.4001	20.4951	20.5793	20.6452	20.6540	20.6638	20.6638	20.6657	20.6600	20.6464	20.5502	20.3986 (92)
Temperature adjustment												0.3000
adjusted MIT	20.7001	20.7951	20.8793	20.9452	20.9540	20.9638	20.9638	20.9657	20.9600	20.9464	20.8502	20.6986 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9900	0.9707	0.9241	0.7729	0.5862	0.3991	0.2862	0.3119	0.4954	0.7964	0.9623	0.9922 (94)
Useful gains	544.1033	589.0188	583.2566	513.7807	397.6054	265.7806	182.2543	189.5556	289.8661	436.8633	511.7965	525.7350 (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	737.7569	711.1031	639.7270	520.9664	397.9533	265.7836	182.2544	189.5557	289.9046	444.9297	598.1141	725.8391 (97)
Space heating kWh	144.0783	82.0407	42.0139	5.1737	0.2588	0.0000	0.0000	0.0000	0.0000	6.0014	62.1487	148.8774 (98a)
Space heating requirement - total per year (kWh/year)												490.5930
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	144.0783	82.0407	42.0139	5.1737	0.2588	0.0000	0.0000	0.0000	0.0000	6.0014	62.1487	148.8774 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												490.5930
Space heating per m2										(98c) / (4) =		6.2496 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	392.5877	309.0584	315.5287	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9997	1.0000	0.9999	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	392.4573	309.0461	315.5037	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	721.7936	690.8684	659.4575	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	237.1221	284.0758	255.9016	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0302 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	61.0703	73.1631	65.9069	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												200.1402 (107)

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)
Fraction of main heating from main system 2												0.0000 (203)
Fraction of total heating from main system 1												1.0000 (204)
Fraction of total heating from main system 2												0.0000 (205)
Efficiency of main space heating system 1 (in %)												100.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Cooling System Energy Efficiency Ratio (see Table 10c)												8.5000 (209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	144.0783	82.0407	42.0139	5.1737	0.2588	0.0000	0.0000	0.0000	0.0000	6.0014	62.1487	148.8774 (98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)
Space heating fuel (main heating system)	144.0783	82.0407	42.0139	5.1737	0.2588	0.0000	0.0000	0.0000	0.0000	6.0014	62.1487	148.8774 (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)
Space heating fuel used, main system 2												0.0000 (213)
Water heating												
Water heating requirement	242.7022	214.1563	226.3579	196.3273	188.4724	167.8330	164.2136	171.8666	175.0008	197.5282	212.9477	239.7039 (64)
Efficiency of water heater (217)m	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888 (216)
Fuel for water heating, kWh/month	71.0718	62.7126	66.2856	57.4916	55.1914	49.1475	48.0876	50.3286	51.2464	57.8433	62.3586	70.1938 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	7.1847	8.6074	7.7538	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	20.1558	18.2052	20.1558	19.5056	20.1558	19.5056	20.1558	20.1558	19.5056	20.1558	19.5056	20.1558 (231)
Lighting	29.4048	23.5896	21.2398	15.5612	12.0199	9.8204	10.9650	14.2527	18.5128	24.2898	27.4353	30.2220 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-27.2160	-41.3108	-63.3332	-74.4935	-83.9317	-79.7339	-78.6526	-72.4421	-61.4292	-47.5870	-30.3925	-23.1003 (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)

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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	-8.0491	-19.1443	-43.2036	-72.3405	-100.1513	-102.1396	-100.4564	-82.4199	-57.1478	-30.7365	-11.7707	-6.1764	(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												490.5930	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												341.4888	
Water heating fuel used												701.9586	(219)
Space cooling fuel												23.5459	(221)

Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8260)													
mechanical ventilation fans (SFP = 0.8260)												237.3181	(230a)
Total electricity for the above, kWh/year												237.3181	(231)
Electricity for lighting (calculated in Appendix L)												237.3134	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1317.3590	(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												373.3701	(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	490.5930	0.1596	78.2811 (261)
Space heating - main system 2	0.0000	0.0000	0.0000 (262)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	701.9586	0.1412	99.1157 (264)
Space and water heating			177.3968 (265)
Space cooling	23.5459	0.1141	2.6860 (266)
Pumps, fans and electric keep-hot	237.3181	0.1387	32.9189 (267)
Energy for lighting	237.3134	0.1443	34.2517 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-683.6229	0.1334	-91.2003
PV Unit electricity exported	-633.7361	0.1234	-78.2310
Total			-169.4313 (269)
Total CO2, kg/year			77.8220 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			0.9900 (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	490.5930	1.5906	780.3360 (275)
Space heating - main system 2	0.0000	0.0000	0.0000 (276)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	701.9586	1.5221	1068.4628 (278)
Space and water heating			1848.7988 (279)
Space cooling	23.5459	1.4204	33.4457 (280)
Pumps, fans and electric keep-hot	237.3181	1.5128	359.0148 (281)
Energy for lighting	237.3134	1.5338	363.9992 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-683.6229	1.4930	-1020.6397
PV Unit electricity exported	-633.7361	0.4530	-287.1109
Total			-1307.7507 (283)
Total Primary energy kWh/year			1297.5079 (286)
Dwelling Primary energy Rate (DPER)			16.5300 (287)

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

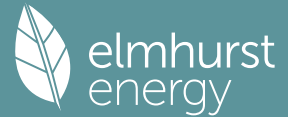
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling	78.5000 (1b)	x 3.0000 (2b)	= 235.5000 (1b) - (3b)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	78.5000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	235.5000 (5)

2. Ventilation rate

m3 per hour

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Number of open chimneys
Number of open flues
Number of chimneys / flues attached to closed fire
Number of flues attached to solid fuel boiler
Number of flues attached to other heater
Number of blocked chimneys
Number of intermittent extract fans
Number of passive vents
Number of flueless gas fires

0 * 80 = 0.0000 (6a)
0 * 20 = 0.0000 (6b)
0 * 10 = 0.0000 (6c)
0 * 20 = 0.0000 (6d)
0 * 35 = 0.0000 (6e)
0 * 20 = 0.0000 (6f)
3 * 10 = 30.0000 (7a)
0 * 10 = 0.0000 (7b)
0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 30.0000 / (5) = 0.1274 (8)
Pressure test
Pressure Test Method
Measured/design AP50
Infiltration rate
Number of sides sheltered
Blower Door
5.0000 (17)
0.3774 (18)
2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3208 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000
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
Adj infilt rate												
	0.4090	0.4010	0.3930	0.3529	0.3448	0.3047	0.3047	0.2967	0.3208	0.3448	0.3609	0.3769
Effective ac	0.5836	0.5804	0.5772	0.5623	0.5595	0.5464	0.5464	0.5440	0.5514	0.5595	0.5651	0.5710
												(22)
												(22a)
												(22b)
												(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
Main dwelling							
TER Opaque door			2.1000	1.0000	2.1000		(26)
TER Opening Type			10.1800	1.1450	11.6565		(27)
External Wall 1	53.0800	10.1800	42.9000	0.1800	7.7220		(29a)
Shelter Wall 1	4.1300	2.1000	2.0300	0.1800	0.3654		(29a)
Total net area of external elements Aum(A, m2)			57.2100				(31)
Fabric heat loss, W/K = Sum (A x U)							(33)
Main dwelling							
Party Wall 1			53.6300	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							322.1671 (35)

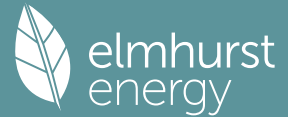
List of Thermal Bridges	Length	Psi-value	Total
K1 Element	34.6000	0.0700	2.4220
E7 Party floor between dwellings (in blocks of flats)	19.4500	0.1200	2.3340
P4 Party wall - Roof (insulation at ceiling level)	8.2500	0.0900	0.7425
E16 Corner (normal)	5.7600	0.0500	0.2880
E2 Other lintels (including other steel lintels)	28.6000	0.0500	1.4300
E4 Jamb	7.2000	0.0200	0.1440
E9 Balcony between dwellings, wall insulation continuous			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			7.3605 (36)
Point Thermal bridges			0.0000 (36a)
Total fabric heat loss			(33) + (36) + (36a) = 29.2044 (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	45.3575	45.1051	44.8577	43.6956	43.4782	42.4661	42.4661	42.2787	42.8559	43.4782	43.9180	44.3778
Heat transfer coeff	74.5618	74.3094	74.0620	72.9000	72.6826	71.6705	71.6705	71.4831	72.0603	72.6826	73.1224	73.5822
Average = Sum(39)m / 12 =												72.8990
												(39)
HLP	0.9498	0.9466	0.9435	0.9287	0.9259	0.9130	0.9130	0.9106	0.9180	0.9259	0.9315	0.9374
HLP (average)												0.9286
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31
												(40)

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.4338 (42)
Hot water usage for mixer showers	65.0262	64.0490	62.6250	59.9005	57.8898	55.6475	54.3730	55.7863	57.3354	59.7429	62.5260	64.7771	(42a)
Hot water usage for baths	28.0866	27.6695	27.0821	25.9991	25.1881	24.2888	23.8031	24.3864	25.0215	25.9837	27.0891	27.9917	(42b)
Hot water usage for other uses	39.5544	38.1160	36.6777	35.2394	33.8010	32.3627	32.3627	33.8010	35.2394	36.6777	38.1160	39.5544	(42c)
Average daily hot water use (litres/day)													121.9513 (43)
Daily hot water use	132.6673	129.8346	126.3848	121.1389	116.8789	112.2990	110.5388	113.9736	117.5962	122.4043	127.7311	132.3232	(44)
Energy conte	210.1125	184.8827	194.2488	165.8331	157.3414	138.0848	133.6871	141.1232	145.0079	166.1015	181.9764	207.1861	(45)
Energy content (annual)													2025.5855
Distribution loss (46)m = 0.15 x (45)m	31.5169	27.7324	29.1373	24.8750	23.6012	20.7127	20.0531	21.1685	21.7512	24.9152	27.2965	31.0779	(46)
Water storage loss:													150.0000 (47)
Store volume													1.3938 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.7527 (55)
Enter (49) or (54) in (55)													
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	256.7074	226.9684	240.8437	210.9249	203.9364	183.1766	180.2820	187.7181	190.0998	212.6964	227.0682	253.7810	(62)
WWHRS	-29.7273	-26.2911	-27.5305	-22.7963	-21.2454	-18.1798	-17.0407	-18.1210	-18.8095	-22.1744	-25.1209	-29.1768	(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													

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226.9801	200.6774	213.3132	188.1286	182.6910	164.9968	163.2413	169.5970	171.2902	190.5221	201.9474	224.6042 (64)
Total per year (kWh/year) = Sum(64)m =											2297.9894 (64)
Electric shower(s)											2298 (64)
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											
107.1383	95.1421	101.8636	91.2130	89.5920	81.9867	81.7269	84.1994	84.2886	92.5047	96.5806	106.1653 (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	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	119.0172	131.7690	119.0172	122.9844	119.0172	122.9844	119.0172	119.0172	122.9844	119.0172	122.9844	119.0172 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	216.2770	218.5213	212.8658	200.8259	185.6276	171.3434	161.8007	159.5565	165.2120	177.2519	192.4501	206.7343 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689 (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)	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513 (71)
Water heating gains (Table 5)	144.0031	141.5805	136.9135	126.6847	120.4193	113.8704	109.8480	113.1712	117.0675	124.3342	134.1398	142.6953 (72)
Total internal gains	541.8041	554.3776	531.3032	513.0017	487.5709	467.7050	450.1726	451.2516	464.7707	483.1101	512.0811	530.9535 (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				4.3600	11.2829		0.6300		0.7000		0.7700		15.0342 (75)	
Southeast				5.8200	36.7938		0.6300		0.7000		0.7700		65.4440 (77)	
Solar gains	80.4782	142.0779	207.6615	279.5357	333.3966	339.9119	323.9967	282.4494	232.3370	160.6028	97.3038	68.2841 (83)		
Total gains	622.2823	696.4555	738.9648	792.5374	820.9674	807.6169	774.1693	733.7010	697.1077	643.7128	609.3848	599.2377 (84)		

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
94.2175	94.5376	94.8534	96.3653	96.6536	98.0185	98.0185	98.2755	97.4882	96.6536	96.0722	95.4719	95.4719
alpha	7.2812	7.3025	7.3236	7.4244	7.4436	7.5346	7.5346	7.5517	7.4992	7.4436	7.4048	7.3648
util living area												
0.9968	0.9919	0.9789	0.9228	0.7809	0.5645	0.4071	0.4476	0.6961	0.9395	0.9908	0.9975	0.9975 (86)
MIT	20.2840	20.4204	20.5979	20.8267	20.9599	20.9968	20.9998	20.9995	20.9862	20.8262	20.5259	20.2670 (87)
Th 2	20.1253	20.1281	20.1307	20.1432	20.1455	20.1565	20.1565	20.1585	20.1523	20.1455	20.1408	20.1359 (88)
util rest of house												
0.9955	0.9887	0.9705	0.8956	0.7240	0.4919	0.3292	0.3661	0.6185	0.9118	0.9866	0.9965	0.9965 (89)
MIT 2	19.3012	19.4764	19.7005	19.9811	20.1168	20.1550	20.1564	20.1584	20.1450	19.9879	19.6213	19.2881 (90)
Living area fraction												
19.6342	19.7962	20.0046	20.2677	20.4025	20.4402	20.4422	20.4434	20.4300	20.2720	19.9278	19.6198	19.6198 (91)
Temperature adjustment												
adjusted MIT	19.6342	19.7962	20.0046	20.2677	20.4025	20.4402	20.4422	20.4434	20.4300	20.2720	19.9278	19.6198 (93)

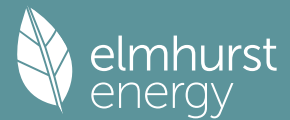
8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.9945	0.9871	0.9690	0.9000	0.7419	0.5165	0.3556	0.3937	0.6447	0.9166	0.9852	0.9957	0.9957 (94)
Useful gains	618.8790	687.5025	716.0935	713.2829	609.0872	417.1421	275.2971	288.8794	449.4073	590.0128	600.3876	596.6579 (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												
1143.3490	1106.9318	1000.1760	828.7039	632.5213	418.5727	275.3706	289.0337	456.1429	702.9833	937.9987	1134.6262	1134.6262 (97)
Space heating kWh												
390.2057	281.8565	211.3574	83.1031	17.4350	0.0000	0.0000	0.0000	0.0000	84.0500	243.0799	400.2485	400.2485 (98a)
Space heating requirement - total per year (kWh/year)												
												1711.3361
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	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												
												0.0000
Space heating kWh												
390.2057	281.8565	211.3574	83.1031	17.4350	0.0000	0.0000	0.0000	0.0000	84.0500	243.0799	400.2485	400.2485 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												
												1711.3361
Space heating per m2												(98c) / (4) =
												21.8005 (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												
390.2057	281.8565	211.3574	83.1031	17.4350	0.0000	0.0000	0.0000	0.0000	84.0500	243.0799	400.2485	400.2485 (98)
Space heating efficiency (main heating system 1)												
92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)												
422.7581	305.3700	228.9896	90.0359	18.8895	0.0000	0.0000	0.0000	0.0000	91.0618	263.3585	433.6386	433.6386 (211)

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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	226.9801	200.6774	213.3132	188.1286	182.6910	164.9968	163.2413	169.5970	171.2902	190.5221	201.9474	224.6042	(64)
Efficiency of water heater	85.2635	84.8215	84.0391	82.3575	80.5109	79.8000	79.8000	79.8000	79.8000	82.3551	84.4766	85.3403	(216)
Fuel for water heating, kWh/month	266.2102	236.5878	253.8261	228.4293	226.9146	206.7629	204.5631	212.5276	214.6494	231.3423	239.0572	263.1865	(217)
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	7.0685	7.3041	7.0685	7.3041	7.0685	(231)
Lighting	24.7294	19.8389	17.8627	13.0870	10.1088	8.2589	9.2215	11.9865	15.5693	20.4278	23.0731	25.4167	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.5882	-38.6261	-57.1849	-66.2775	-73.1690	-68.9064	-68.0662	-63.4312	-55.5191	-45.0641	-29.6362	-22.8559	(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	-11.7249	-24.9862	-50.2657	-76.3839	-101.8689	-102.6771	-101.4648	-85.5038	-62.1415	-36.0179	-15.7461	-9.2474	(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												1854.1019	(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												2784.0570	(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)												199.5806	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1293.3531	(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												3630.3865	(238)

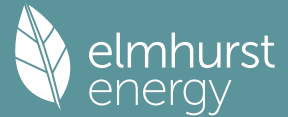
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1854.1019	0.2100	389.3614 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2784.0570	0.2100	584.6520 (264)
Space and water heating			974.0134 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	199.5806	0.1443	28.8057 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-615.3248	0.1340	-82.4304
PV Unit electricity exported	-678.0282	0.1256	-85.1290
Total			-167.5594 (269)
Total CO2, kg/year			847.1889 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7900 (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	1854.1019	1.1300	2095.1352 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2784.0570	1.1300	3145.9844 (278)
Space and water heating			5241.1196 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	199.5806	1.5338	306.1234 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-615.3248	1.4951	-919.9519
PV Unit electricity exported	-678.0282	0.4609	-312.4711
Total			-1232.4230 (283)
Total Primary energy kWh/year			4444.9208 (286)
Target Primary Energy Rate (TPER)			56.6200 (287)

Full SAP Calculation Printout



Property Reference	U1L2 - Direct + DHP DHW+PV				Issued on Date	05/09/2025
Assessment Reference	Proposed _Option - Unit 1		Prop Type Ref	2B-4P-N-End Terrace Level 3		
Property						
SAP Rating	82 B	DER	2.56	TER	13.71	
Environmental	98 A	% DER < TER				81.33
CO ₂ Emissions (t/year)	0.11	DFEE	35.64	TFEE	41.78	
Compliance Check	See BREL	% DFEE < TFEE				14.69
% DPER < TPER	55.49	DPER	32.20	TPER	72.34	
Assessor Details	Miss Emma Jolly				Assessor ID	T689-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	78.5000		
Dwelling volume			

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

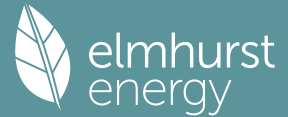
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	3.0000	(17)
Infiltration rate	0.1500	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												80.1000 (23c)
Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Window			10.1800	0.7752	7.8915		(27)
Door			2.1000	1.0000	2.1000		(26)
External Wall 1	53.0800	10.1800	42.9000	0.1400	6.0060	190.0000	8151.0000 (29a)
Shelter Wall 1	4.1300	2.1000	2.0300	0.1600	0.3248	190.0000	385.7000 (29a)
External Roof 1	78.5000		78.5000	0.1800	14.1300	9.0000	706.5000 (30)
Total net area of external elements Aum(A, m ²)			135.7100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	30.4523		(33)
Main dwelling							
Party Wall 1			53.6300	0.0000	0.0000	180.0000	9653.4000 (32)
Party Floor 1			80.8700			40.0000	3234.8000 (32d)
Internal Wall 1			80.5800			9.0000	725.2200 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 22856.6200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							291.1671 (35)
List of Thermal Bridges							

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K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	13.6200	0.0700	0.9534
E14 Flat roof	1.4500	0.0800	0.1160
P4 Party wall - Roof (insulation at ceiling level)	19.5700	0.1200	2.3484
E16 Corner (normal)	8.2500	0.0900	0.7425
E2 Other lintels (including other steel lintels)	5.7600	0.0500	0.2880
E4 Jamb	28.6000	0.0500	1.4300
E9 Balcony between dwellings, wall insulation continuous	7.2000	0.1500	1.0800
E15 Flat roof with parapet	19.5700	0.0800	1.5656

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

Point Thermal Bridges (36a) = 8.5239 (36)

Total fabric heat loss (33) + (36) + (36a) = 38.9762 (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	20.3662	20.1185	19.8708	18.6322	18.3845	17.1459	17.1459	16.8982	17.6413	18.3845	18.8799	19.3753	(38)
Heat transfer coeff	59.3424	59.0946	58.8469	57.6083	57.3606	56.1220	56.1220	55.8743	56.6175	57.3606	57.8561	58.3515	(39)
Average = Sum(39)m / 12 =												57.5464	
HLP	0.7560	0.7528	0.7496	0.7339	0.7307	0.7149	0.7149	0.7118	0.7212	0.7307	0.7370	0.7433	(40)
HLP (average)												0.7331	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.4338 (42)
Hot water usage for mixer showers	65.0262	64.0490	62.6250	59.9005	57.8898	55.6475	54.3730	55.7863	57.3354	59.7429	62.5260	64.7771	(42a)
Hot water usage for baths	29.5649	29.1258	28.5075	27.3674	26.5138	25.5672	25.0559	25.6699	26.3384	27.3513	28.5148	29.4649	(42b)
Hot water usage for other uses	41.6362	40.1221	38.6081	37.0941	35.5800	34.0660	34.0660	35.5800	37.0941	38.6081	40.1221	41.6362	(42c)
Average daily hot water use (litres/day)												125.2144	(43)
Daily hot water use	136.2273	133.2970	129.7406	124.3619	119.9836	115.2807	113.4949	117.0361	120.7679	125.7023	131.1630	135.8782	(44)
Energy conte	215.7508	189.8131	199.4065	170.2453	161.5210	141.7510	137.2622	144.9152	148.9188	170.5768	186.8657	212.7525	(45)
Energy content (annual)										Total = Sum(45)m =		2079.7789	
Distribution loss (46)m = 0.15 x (45)m	32.3626	28.4720	29.9110	25.5368	24.2281	21.2627	20.5893	21.7373	22.3378	25.5865	28.0299	31.9129	(46)
Water storage loss:													
Store volume												201.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8694	(55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(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	242.7022	214.1563	226.3579	196.3273	188.4724	167.8330	164.2136	171.8666	175.0008	197.5282	212.9477	239.7039	(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	242.7022	214.1563	226.3579	196.3273	188.4724	167.8330	164.2136	171.8666	175.0008	197.5282	212.9477	239.7039	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2397.1099	(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	71.7371	63.1129	66.3027	56.6066	53.7057	47.1322	45.6397	48.1843	49.5155	56.7168	62.1328	70.7402	(65)

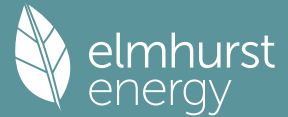
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	119.0172	131.7690	119.0172	122.9844	119.0172	122.9844	119.0172	119.0172	122.9844	119.0172	122.9844	119.0172	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	216.2770	218.5213	212.8658	200.8259	185.6276	171.3434	161.8007	159.5565	165.2120	177.2519	192.4501	206.7343	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	(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)	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	(71)
Water heating gains (Table 5)	96.4209	93.9179	89.1165	78.6202	72.1851	65.4614	61.3437	64.7638	68.7715	76.2322	86.2956	95.0809	(72)
Total internal gains	491.2218	503.7150	480.5062	461.9373	436.3367	419.2961	401.6684	402.8443	416.4747	432.0081	461.2369	480.3392	(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				4.3600	11.2829	0.4000	0.8000	0.7700	10.9092 (75)
Southeast				5.8200	36.7938	0.4000	0.8000	0.7700	47.4877 (77)
Solar gains	58.3969	103.0951	150.6841	202.8377	241.9204	235.0996	204.9519	168.5892	49.5486 (83)
Total gains	549.6187	606.8101	631.1903	664.7750	678.2571	665.9442	607.7962	585.0639	529.8877 (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, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	106.9904	107.4389	107.8911	110.2108	110.6867	113.1295	113.1295	113.6311	112.1396	110.6867	109.7389	108.8072	
alpha	8.1327	8.1626	8.1927	8.3474	8.3791	8.5420	8.5420	8.5754	8.4760	8.3791	8.3159	8.2538	
util living area	0.9963	0.9906	0.9765	0.9129	0.7614	0.5381	0.3877	0.4227	0.6603	0.9269	0.9889	0.9971 (86)	
MIT	20.4279	20.5478	20.6940	20.8832	20.9780	20.9989	20.9999	20.9999	20.9944	20.8858	20.6398	20.4156 (87)	
Th 2	20.2917	20.2944	20.2972	20.3110	20.3138	20.3277	20.3277	20.3304	20.3221	20.3138	20.3082	20.3027 (88)	
util rest of house	0.9950	0.9875	0.9686	0.8879	0.7138	0.4822	0.3285	0.3613	0.5988	0.9002	0.9845	0.9961 (89)	
MIT 2	19.7729	19.8936	20.0382	20.2241	20.3009	20.3272	20.3276	20.3304	20.3196	20.2317	19.9969	19.7703 (90)	
Living area fraction	fLA = Living area / (4) =												0.3389 (91)
MIT	19.9948	20.1153	20.2604	20.4475	20.5303	20.5548	20.5555	20.5573	20.5483	20.4533	20.2147	19.9890 (92)	
Temperature adjustment													0.3000
adjusted MIT	20.2948	20.4153	20.5604	20.7475	20.8303	20.8548	20.8555	20.8573	20.8483	20.7533	20.5147	20.2890 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9950	0.9881	0.9718	0.9044	0.7500	0.5261	0.3750	0.4096	0.6468	0.9181	0.9860	0.9961 (94)
Useful gains	546.8802	599.5821	613.4203	601.2171	508.7229	350.3329	238.7906	248.9768	378.4257	503.6239	524.4000	527.8213 (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	949.1702	916.8688	827.4110	682.5130	523.7209	351.0338	238.8250	249.0467	382.0697	582.4009	776.1234	938.8144 (97)
Space heating kWh	299.3038	213.2166	159.2090	58.5331	11.1586	0.0000	0.0000	0.0000	0.0000	58.6100	181.2409	305.7789 (98a)
Space heating requirement - total per year (kWh/year)												1287.0509
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	299.3038	213.2166	159.2090	58.5331	11.1586	0.0000	0.0000	0.0000	0.0000	58.6100	181.2409	305.7789 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1287.0509
Space heating per m2												(98c) / (4) = 16.3956 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	527.5472	415.3031	424.6449	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9805	0.9948	0.9917	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	517.2772	413.1426	421.1233	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	721.7936	690.8684	659.4575	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	147.2518	206.6280	177.3206	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fc = cooled area / (4) =											1.0302 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	37.9244	53.2166	45.6685	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												136.8095 (107)

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)
Fraction of main heating from main system 2													0.0000 (203)
Fraction of total heating from main system 1													1.0000 (204)
Fraction of total heating from main system 2													0.0000 (205)
Efficiency of main space heating system 1 (in %)													100.0000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Cooling System Energy Efficiency Ratio (see Table 10c)													8.5000 (209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	299.3038	213.2166	159.2090	58.5331	11.1586	0.0000	0.0000	0.0000	0.0000	58.6100	181.2409	305.7789 (98)	
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)	
Space heating fuel (main heating system)	299.3038	213.2166	159.2090	58.5331	11.1586	0.0000	0.0000	0.0000	0.0000	58.6100	181.2409	305.7789 (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)	
Space heating fuel used, main system 2													0.0000 (213)
Water heating													
Water heating requirement	242.7022	214.1563	226.3579	196.3273	188.4724	167.8330	164.2136	171.8666	175.0008	197.5282	212.9477	239.7039 (64)	
Efficiency of water heater (217)m	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888	341.4888 (216)	
Fuel for water heating, kWh/month	71.0718	62.7126	66.2856	57.4916	55.1914	49.1475	48.0876	50.3286	51.2464	57.8433	62.3586	70.1938 (219)	
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	4.4617	6.2608	5.3728	0.0000	0.0000	0.0000	0.0000 (221)	
Pumps and Fa	20.1558	18.2052	20.1558	19.5056	20.1558	19.5056	20.1558	20.1558	19.5056	20.1558	19.5056	20.1558 (231)	
Lighting	29.4048	23.5896	21.2398	15.5612	12.0199	9.8204	10.9650	14.2527	18.5128	24.2898	27.4353	30.2220 (232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-28.1082	-43.3955	-67.4870	-78.3102	-85.0889	-79.7339	-78.6526	-72.4421	-61.4292	-49.3815	-31.6716	-23.8046 (233a)	

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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	-7.1570	-17.0597	-39.0497	-68.5238	-98.9942	-102.1396	-100.4564	-82.4199	-57.1478	-28.9420	-10.4916	-5.4721	(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												1287.0509	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												341.4888	
Water heating fuel used												701.9586	(219)
Space cooling fuel												16.0952	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8260)													
mechanical ventilation fans (SFP = 0.8260)												237.3181	(230a)
Total electricity for the above, kWh/year												237.3181	(231)
Electricity for lighting (calculated in Appendix L)												237.3134	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1317.3590	(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												1162.3772	(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	1287.0509	0.1572	202.2836	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	701.9586	0.1412	99.1157	(264)
Space and water heating			301.3993	(265)
Space cooling	16.0952	0.1138	1.8321	(266)
Pumps, fans and electric keep-hot	237.3181	0.1387	32.9189	(267)
Energy for lighting	237.3134	0.1443	34.2517	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-699.5053	0.1338	-93.5653	
PV Unit electricity exported	-617.8537	0.1224	-75.5974	
Total			-169.1627	(269)
Total CO2, kg/year			201.2393	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.5600	(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	1287.0509	1.5818	2035.9190	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	701.9586	1.5221	1068.4628	(278)
Space and water heating			3104.3818	(279)
Space cooling	16.0952	1.4196	22.8487	(280)
Pumps, fans and electric keep-hot	237.3181	1.5128	359.0148	(281)
Energy for lighting	237.3134	1.5338	363.9992	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-699.5053	1.4943	-1045.2847	
PV Unit electricity exported	-617.8537	0.4490	-277.4005	
Total			-1322.6852	(283)
Total Primary energy kWh/year			2527.5593	(286)
Dwelling Primary energy Rate (DPER)			32.2000	(287)

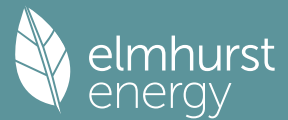
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	78.5000 (1b)	x 3.0000 (2b)	= 235.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	78.5000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)... (3n)	= 235.5000 (5)

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) =	0.1274 (8)
Pressure test											Yes	
Pressure Test Method											Blower Door	
Measured/design AP50											5.0000	(17)
Infiltration rate											0.3774	(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) =	0.3208 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	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)
Adj infilt rate	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)
	0.4090	0.4010	0.3930	0.3529	0.3448	0.3047	0.3047	0.2967	0.3208	0.3448	0.3609	0.3769 (22b)
Effective ac	0.5836	0.5804	0.5772	0.5623	0.5595	0.5464	0.5464	0.5440	0.5514	0.5595	0.5651	0.5710 (25)

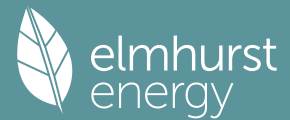
3. Heat losses and heat loss parameter

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						
Main dwelling													
TER Opaque door			2.1000	1.0000	2.1000			(26)					
TER Opening Type			10.1800	1.1450	11.6565			(27)					
External Wall 1	53.0800	10.1800	42.9000	0.1800	7.7220			(29a)					
Shelter Wall 1	4.1300	2.1000	2.0300	0.1800	0.3654			(29a)					
External Roof 1	78.5000		78.5000	0.1100	8.6350			(30)					
Total net area of external elements Aum(A, m2)			135.7100					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	30.4789			(33)					
Main dwelling													
Party Wall 1			53.6300	0.0000	0.0000			(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								291.1671 (35)					
List of Thermal Bridges													
K1 Element				Length	Psi-value		Total						
E7 Party floor between dwellings (in blocks of flats)				13.6200	0.0700		0.9534						
E14 Flat roof				1.4500	0.0800		0.1160						
P4 Party wall - Roof (insulation at ceiling level)				19.5700	0.1200		2.3484						
E16 Corner (normal)				8.2500	0.0900		0.7425						
E2 Other lintels (including other steel lintels)				5.7600	0.0500		0.2880						
E4 Jamb				28.6000	0.0500		1.4300						
E9 Balcony between dwellings, wall insulation continuous				7.2000	0.0200		0.1440						
E15 Flat roof with parapet				19.5700	0.5600		10.9592						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								16.9815 (36)					
Point Thermal bridges						(36a) =	0.0000						
Total fabric heat loss						(33) + (36) + (36a) =	47.4604	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 45.3575	Feb 45.1051	Mar 44.8577	Apr 43.6956	May 43.4782	Jun 42.4661	Jul 42.4661	Aug 42.2787	Sep 42.8559	Oct 43.4782	Nov 43.9180	Dec 44.3778	(38)
Heat transfer coeff	92.8178	92.5654	92.3180	91.1560	90.9386	89.9265	89.9265	89.7391	90.3163	90.9386	91.3784	91.8382	(39)
Average = Sum(39)m / 12 =												91.1550	
HLP	Jan 1.1824	Feb 1.1792	Mar 1.1760	Apr 1.1612	May 1.1585	Jun 1.1456	Jul 1.1456	Aug 1.1432	Sep 1.1505	Oct 1.1585	Nov 1.1641	Dec 1.1699	(40)
HLP (average)												1.1612	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4338 (42)											
Hot water usage for mixer showers	65.0262	64.0490	62.6250	59.9005	57.8898	55.6475	54.3730	55.7863	57.3354	59.7429	62.5260	64.7771 (42a)
Hot water usage for baths	28.0866	27.6695	27.0821	25.9991	25.1881	24.2888	23.8031	24.3864	25.0215	25.9837	27.0891	27.9917 (42b)
Hot water usage for other uses	39.5544	38.1160	36.6777	35.2394	33.8010	32.3627	32.3627	33.8010	35.2394	36.6777	38.1160	39.5544 (42c)
Average daily hot water use (litres/day)												121.9513 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	132.6673	129.8346	126.3848	121.1389	116.8789	112.2990	110.5388	113.9736	117.5962	122.4043	127.7311	132.3232 (44)
Distribution loss (46)m = 0.15 x (45)m	210.1125	184.8827	194.2488	165.8331	157.3414	138.0848	133.6871	141.1232	145.0079	166.1015	181.9764	207.1861 (45)
Total = Sum(45)m =												2025.5855
Water storage loss:	31.5169	27.7324	29.1373	24.8750	23.6012	20.7127	20.0531	21.1685	21.7512	24.9152	27.2965	31.0779 (46)
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	256.7074	226.9684	240.8437	210.9249	203.9364	183.1766	180.2820	187.7181	190.0998	212.6964	227.0682	253.7810 (62)

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WWHRS	-29.7273	-26.2911	-27.5305	-22.7963	-21.2454	-18.1798	-17.0407	-18.1210	-18.8095	-22.1744	-25.1209	-29.1768 (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	226.9801	200.6774	213.3132	188.1286	182.6910	164.9968	163.2413	169.5970	171.2902	190.5221	201.9474	224.6042 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2297.9894 (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)
Heat gains from water heating, kWh/month	107.1383	95.1421	101.8636	91.2130	89.5920	81.9867	81.7269	84.1994	84.2886	92.5047	96.5806	106.1653 (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	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	121.6892	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	119.0172	131.7690	119.0172	122.9844	119.0172	122.9844	119.0172	119.0172	122.9844	119.0172	122.9844	119.0172	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	216.2770	218.5213	212.8658	200.8259	185.6276	171.3434	161.8007	159.5565	165.2120	177.2519	192.4501	206.7343	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	35.1689	(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)	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	-97.3513	(71)
Water heating gains (Table 5)	144.0031	141.5805	136.9135	126.6847	120.4193	113.8704	109.8480	113.1712	117.0675	124.3342	134.1398	142.6953	(72)
Total internal gains	541.8041	554.3776	531.3032	513.0017	487.5709	467.7050	450.1726	451.2516	464.7707	483.1101	512.0811	530.9535	(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				4.3600	11.2829	0.6300	0.7000			0.7700			15.0342 (75)
Southeast				5.8200	36.7938	0.6300	0.7000			0.7700			65.4440 (77)
Solar gains	80.4782	142.0779	207.6615	279.5357	333.3966	339.9119	323.9967	282.4494	232.3370	160.6028	97.3038		68.2841 (83)
Total gains	622.2823	696.4555	738.9648	792.5374	820.9674	807.6169	774.1693	733.7010	697.1077	643.7128	609.3848		599.2377 (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	68.4035	68.5900	68.7738	69.6505	69.8170	70.6028	70.6028	70.7503	70.2980	69.8170	69.4810	69.1331	
alpha	5.5602	5.5727	5.5849	5.6434	5.6545	5.7069	5.7069	5.7167	5.6865	5.6545	5.6321	5.6089	
util living area	0.9962	0.9923	0.9834	0.9510	0.8621	0.6796	0.5056	0.5532	0.7989	0.9607	0.9916	0.9970 (86)	
MIT	19.8820	20.0388	20.2638	20.5787	20.8335	20.9677	20.9949	20.9917	20.9200	20.6050	20.1973	19.8613 (87)	
Th 2	19.9341	19.9367	19.9392	19.9511	19.9534	19.9638	19.9638	19.9657	19.9598	19.9534	19.9489	19.9441 (88)	
util rest of house	0.9948	0.9893	0.9769	0.9309	0.8091	0.5841	0.3896	0.4340	0.7138	0.9404	0.9879	0.9958 (89)	
MIT 2	18.6507	18.8521	19.1382	19.5339	19.8198	19.9474	19.9625	19.9633	19.9108	19.5736	19.0638	18.6317 (90)	
Living area fraction	fLA = Living area / (4) =												0.3389 (91)
MIT	19.0680	19.2542	19.5196	19.8879	20.1633	20.2931	20.3123	20.3118	20.2527	19.9231	19.4479	19.0484 (92)	
Temperature adjustment													0.0000
adjusted MIT	19.0680	19.2542	19.5196	19.8879	20.1633	20.2931	20.3123	20.3118	20.2527	19.9231	19.4479	19.0484 (93)	

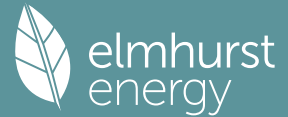
8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9932	0.9868	0.9735	0.9294	0.8210	0.6159	0.4292	0.4747	0.7401	0.9396	0.9854	0.9944	(94)
Ext temp.	618.0490	687.2659	719.3562	736.5892	673.9987	497.3760	332.2656	348.3118	515.9025	604.8447	600.5110	595.8866	(95)
Heat loss rate W	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)
Space heating kWh	1370.7303	1328.7037	1201.9428	1001.6129	769.6393	511.9630	333.8334	351.0373	555.6933	847.8308	1128.3314	1363.6472	(97)
Space heating requirement - total per year (kWh/year)	559.9950	431.0462	359.0444	190.8171	71.1566	0.0000	0.0000	0.0000	0.0000	180.7817	380.0307	571.2139	(98a)
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)	559.9950	431.0462	359.0444	190.8171	71.1566	0.0000	0.0000	0.0000	0.0000	180.7817	380.0307	571.2139	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2744.0854	
Space heating per m2												34.9565	(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)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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Space heating efficiency (main heating system 1)	559.9950	431.0462	359.0444	190.8171	71.1566	0.0000	0.0000	0.0000	0.0000	180.7817	380.0307	571.2139 (98)
Space heating fuel (main heating system)	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 efficiency (main heating system 2)	606.7118	467.0056	388.9972	206.7357	77.0928	0.0000	0.0000	0.0000	0.0000	195.8631	411.7342	618.8666 (211)
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 (212)
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 (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 requirement	226.9801	200.6774	213.3132	188.1286	182.6910	164.9968	163.2413	169.5970	171.2902	190.5221	201.9474	224.6042 (64)
Efficiency of water heater (217)m	86.0025	85.7286	85.2180	84.0916	82.1334	79.8000	79.8000	79.8000	79.8000	83.9422	85.4556	79.8000 (216)
Fuel for water heating, kWh/month	263.9229	234.0845	250.3146	223.7185	222.4320	206.7629	204.5631	212.5276	214.6494	226.9680	236.3184	260.9837 (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	24.7294	19.8389	17.8627	13.0870	10.1088	8.2589	9.2215	11.9865	15.5693	20.4278	23.0731	25.4167 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-26.5882	-38.6261	-57.1849	-66.2775	-73.1690	-68.9064	-68.0662	-63.4312	-55.5191	-45.0641	-29.6362	-22.8559 (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	-11.7249	-24.9862	-50.2657	-76.3839	-101.8689	-102.6771	-101.4648	-85.5038	-62.1415	-36.0179	-15.7461	-9.2474 (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												2973.0070 (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												2757.2456 (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)												199.5806 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1293.3531 (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												4722.4802 (238)

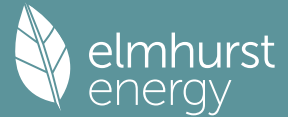
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2973.0070	0.2100	624.3315 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2757.2456	0.2100	579.0216 (264)
Space and water heating			1203.3530 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	199.5806	0.1443	28.8057 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-615.3248	0.1340	-82.4304
PV Unit electricity exported	-678.0282	0.1256	-85.1290
Total			-167.5594 (269)
Total CO2, kg/year			1076.5285 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.7100 (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	2973.0070	1.1300	3359.4979 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2757.2456	1.1300	3115.6876 (278)
Space and water heating			6475.1855 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	199.5806	1.5338	306.1234 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-615.3248	1.4951	-919.9519
PV Unit electricity exported	-678.0282	0.4609	-312.4711
Total			-1232.4230 (283)
Total Primary energy kWh/year			5678.9866 (286)
Target Primary Energy Rate (TPER)			72.3400 (287)

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Property Reference	U2L1 - Direct + DHP DHW+PV				Issued on Date	05/09/2025
Assessment Reference	Proposed _Option - Unit 2	Prop Type Ref		2B-4P-N-End Terrace Level 3		
Property						
SAP Rating	87 B	DER	1.14	TER	11.05	
Environmental	99 A	% DER < TER				89.68
CO ₂ Emissions (t/year)	0.03	DFEE	26.35	TFEE	29.09	
Compliance Check	See BREL	% DFEE < TFEE				9.42
% DPER < TPER	68.59	DPER	18.21	TPER	57.98	
Assessor Details	Miss Emma Jolly				Assessor ID	T689-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	76.2000 (1b)	3.0000 (2b)	228.6000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	228.6000 (5)

2. Ventilation rate

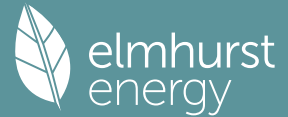
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	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) =												80.1000 (23c)
Effective ac	0.2477	0.2448	0.2419	0.2274	0.2245	0.2099	0.2099	0.2070	0.2157	0.2245	0.2303	0.2361 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Window			10.9100	0.7752	8.4574		(27)
Door			2.1000	1.0000	2.1000		(26)
External Wall 1	34.6500	10.9100	23.7400	0.1400	3.3236	190.0000	4510.6000 (29a)
Shelter Wall 1	45.1000	2.1000	43.0000	0.1600	6.8800	190.0000	8170.0000 (29a)
Total net area of external elements Aum(A, m ²)			79.7500				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	20.7610		(33)
Main dwelling							
Party Wall 1			24.2000	0.0000	0.0000	180.0000	4356.0000 (32)
Party Floor 1			80.8700			40.0000	3234.8000 (32d)
Party Ceiling 1			76.2000			30.0000	2286.0000 (32b)
Internal Wall 1			75.6300			9.0000	680.6700 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	23238.0700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							304.9615 (35)
List of Thermal Bridges							

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K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	47.7000	0.0700	3.3390
P4 Party wall - Roof (insulation at ceiling level)	9.0600	0.1200	1.0872
E16 Corner (normal)	8.2500	0.0900	0.7425
E2 Other lintels (including other steel lintels)	6.3200	0.0500	0.3160
E4 Jamb	31.2000	0.0500	1.5600
E9 Balcony between dwellings, wall insulation continuous	8.8000	0.1500	1.3200
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			8.3647 (36)
Point Thermal Bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	29.1257 (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	18.6874	18.4682	18.2489	17.1527	16.9335	15.8373	15.8373	15.6180	16.2757	16.9335	17.3720	17.8104 (38)
Heat transfer coeff	47.8131	47.5938	47.3746	46.2784	46.0591	44.9629	44.9629	44.7437	45.4014	46.0591	46.4976	46.9361 (39)
Average = Sum(39)m / 12 =												46.2236
HLP	0.6275	0.6246	0.6217	0.6073	0.6045	0.5901	0.5901	0.5872	0.5958	0.6045	0.6102	0.6160 (40)
HLP (average)												0.6066
Days in month	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.3868 (42)
Hot water usage for mixer showers	64.2386	63.2732	61.8665	59.1749	57.1886	54.9735	53.7144	55.1105	56.6409	59.0193	61.7686	63.9925 (42a)
Hot water usage for baths	29.2083	28.7746	28.1637	27.0374	26.1940	25.2588	24.7537	25.3603	26.0208	27.0214	28.1709	29.1096 (42b)
Hot water usage for other uses	41.1298	39.6342	38.1385	36.6429	35.1473	33.6516	33.6516	35.1473	36.6429	38.1385	39.6342	41.1298 (42c)
Average daily hot water use (litres/day)												123.6973 (43)
Daily hot water use	134.5767	131.6819	128.1687	122.8552	118.5299	113.8840	112.1198	115.6181	119.3046	124.1792	129.5737	134.2319 (44)
Energy content (annual)	213.1366	187.5133	196.9905	168.1826	159.5640	140.0336	135.5992	143.1594	147.1145	168.5100	184.6015	210.1747 (45)
Distribution loss (46)m = 0.15 x (45)m	31.9705	28.1270	29.5486	25.2274	23.9346	21.0050	20.3399	21.4739	22.0672	25.2765	27.6902	31.5262 (46)
Water storage loss:												
Store volume												201.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8694 (55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514 (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	240.0880	211.8565	223.9419	194.2646	186.5154	166.1156	162.5506	170.1108	173.1965	195.4614	210.6835	237.1261 (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	240.0880	211.8565	223.9419	194.2646	186.5154	166.1156	162.5506	170.1108	173.1965	195.4614	210.6835	237.1261 (64)
12Total per year (kWh/year)												2371.9110 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	70.8679	62.3482	65.4993	55.9207	53.0550	46.5612	45.0867	47.6005	48.9156	56.0296	61.3800	69.8831 (65)

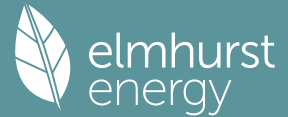
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	113.7916	125.9835	113.7916	117.5846	113.7916	117.5846	113.7916	113.7916	117.5846	113.7916	117.5846	113.7916 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	211.3159	213.5087	207.9829	196.2192	181.3696	167.4131	158.0892	155.8964	161.4222	173.1860	188.0356	201.9921 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340 (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)	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723 (71)
Water heating gains (Table 5)	95.2526	92.7800	88.0368	77.6677	71.3105	64.6683	60.6004	63.9792	67.9383	75.3086	85.2500	93.9289 (72)
Total internal gains	479.1622	491.0744	468.6134	450.2736	425.2738	408.4681	391.2834	392.4693	405.7473	421.0882	449.6723	468.5146 (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			
Southeast				8.7300	36.7938	0.4000	0.8000	0.7700	71.2316 (77)			
Southwest				2.1800	36.7938	0.4000	0.8000	0.7700	17.7875 (79)			
Solar gains	89.0191	151.6324	207.4700	257.0654	287.9347	285.8525	275.5923	252.5625	224.6462	167.5861	106.6243	76.1818 (83)
Total gains	568.1813	642.7068	676.0834	707.3390	713.2085	694.3207	666.8757	645.0318	630.3934	588.6743	556.2966	544.6964 (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, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	135.0053	135.6272	136.2549	139.4824	140.1463	143.5631	143.5631	144.2666	142.1766	140.1463	138.8247	137.5278	
alpha	10.0004	10.0418	10.0837	10.2988	10.3431	10.5709	10.5709	10.6178	10.4784	10.3431	10.2550	10.1685	
util living area	0.9902	0.9678	0.9168	0.7756	0.5994	0.4144	0.2967	0.3191	0.4968	0.7938	0.9633	0.9927 (86)	
MIT	20.6924	20.8118	20.9124	20.9852	20.9988	21.0000	21.0000	21.0000	20.9999	20.9847	20.8555	20.6762 (87)	
Th 2	20.4053	20.4079	20.4105	20.4234	20.4260	20.4390	20.4390	20.4415	20.4338	20.4260	20.4208	20.4157 (88)	
util rest of house	0.9870	0.9589	0.8977	0.7434	0.5629	0.3781	0.2588	0.2803	0.4561	0.7565	0.9517	0.9903 (89)	
MIT 2	20.1324	20.2490	20.3425	20.4136	20.4254	20.4389	20.4389	20.4415	20.4337	20.4165	20.3032	20.1260 (90)	
Living area fraction									fLA = Living area / (4) =				0.3845 (91)
MIT	20.3477	20.4654	20.5616	20.6334	20.6459	20.6547	20.6547	20.6563	20.6514	20.6350	20.5156	20.3375 (92)	
Temperature adjustment												0.3000	
adjusted MIT	20.6477	20.7654	20.8616	20.9334	20.9459	20.9547	20.9547	20.9563	20.9514	20.9350	20.8156	20.6375 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9884	0.9645	0.9126	0.7720	0.5959	0.4115	0.2936	0.3161	0.4933	0.7897	0.9599	0.9913 (94)
Useful gains	561.5930	619.8938	617.0135	546.0711	425.0272	285.7105	195.7989	203.8640	310.9672	464.8958	534.0090	539.9528 (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	781.6351	755.0940	680.3771	556.8865	425.8577	285.7246	195.7992	203.8647	311.0634	476.0192	637.7417	771.5132 (97)
Space heating kWh	163.7113	90.8545	47.1426	7.7871	0.6179	0.0000	0.0000	0.0000	0.0000	8.2758	74.6875	172.2810 (98a)
Space heating requirement - total per year (kWh/year)												565.3577
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	163.7113	90.8545	47.1426	7.7871	0.6179	0.0000	0.0000	0.0000	0.0000	8.2758	74.6875	172.2810 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												565.3577
Space heating per m2										(98c) / (4) =		7.4194 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	422.6515	332.7257	340.0520	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9991	0.9999	0.9998	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	422.2683	332.6811	339.9777	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	759.3311	730.2595	707.0875	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	242.6853	295.7984	273.1297	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0613 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	64.3896	78.4817	72.4672	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												215.3385 (107)

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)
Fraction of main heating from main system 2												0.0000 (203)
Fraction of total heating from main system 1												1.0000 (204)
Fraction of total heating from main system 2												0.0000 (205)
Efficiency of main space heating system 1 (in %)												100.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Cooling System Energy/Efficiency Ratio (see Table 10c)												8.5000 (209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	163.7113	90.8545	47.1426	7.7871	0.6179	0.0000	0.0000	0.0000	0.0000	8.2758	74.6875	172.2810 (98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)
Space heating fuel (main heating system)	163.7113	90.8545	47.1426	7.7871	0.6179	0.0000	0.0000	0.0000	0.0000	8.2758	74.6875	172.2810 (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)
Space heating fuel used, main system 2												0.0000 (213)
Water heating												
Water heating requirement	240.0880	211.8565	223.9419	194.2646	186.5154	166.1156	162.5506	170.1108	173.1965	195.4614	210.6835	237.1261 (64)
Efficiency of water heater (217)m	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692 (216)
Fuel for water heating, kWh/month	70.2075	61.9519	65.4860	56.8076	54.5416	48.5762	47.5337	49.7445	50.6468	57.1576	61.6089	69.3414 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	7.5753	9.2331	8.5256	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	19.5652	17.6718	19.5652	18.9341	19.5652	18.9341	19.5652	19.5652	18.9341	19.5652	18.9341	19.5652 (231)
Lighting	28.4966	22.8610	20.5838	15.0806	11.6487	9.5171	10.6263	13.8125	17.9411	23.5397	26.5880	29.2886 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-27.2952	-41.3425	-63.2306	-74.1643	-83.2651	-79.0315	-77.9608	-71.8523	-60.9928	-47.4211	-30.4629	-23.1833 (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)

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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	-7.9700	-19.1127	-43.3062	-72.6698	-100.8179	-102.8419	-83.0097	-57.5841	-30.9024	-11.7004	-6.0934		(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												565.3577	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												341.9692	
Water heating fuel used												693.6037	(219)
Space cooling fuel												25.3339	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8260)													
mechanical ventilation fans (SFP = 0.8260)												230.3648	(230a)
Total electricity for the above, kWh/year												230.3648	(231)
Electricity for lighting (calculated in Appendix L)												229.9840	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1317.3590	(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												427.2852	(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	565.3577	0.1594	90.1147	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	693.6037	0.1412	97.9332	(264)
Space and water heating			188.0479	(265)
Space cooling	25.3339	0.1140	2.8888	(266)
Pumps, fans and electric keep-hot	230.3648	0.1387	31.9544	(267)
Energy for lighting	229.9840	0.1443	33.1938	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-680.2023	0.1335	-90.7887	
PV Unit electricity exported	-637.1566	0.1234	-78.5994	
Total			-169.3882	(269)
Total CO2, kg/year			86.6967	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.1400	(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	565.3577	1.5900	898.8980	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	693.6037	1.5221	1055.7352	(278)
Space and water heating			1954.6332	(279)
Space cooling	25.3339	1.4203	35.9813	(280)
Pumps, fans and electric keep-hot	230.3648	1.5128	348.4959	(281)
Energy for lighting	229.9840	1.5338	352.7572	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-680.2023	1.4932	-1015.7011	
PV Unit electricity exported	-637.1566	0.4527	-288.4619	
Total			-1304.1630	(283)
Total Primary energy kWh/year			1387.7045	(286)
Dwelling Primary energy Rate (DPER)			18.2100	(287)

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

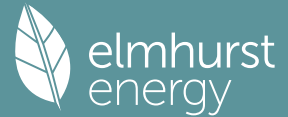
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Main dwelling	76.2000	3.0000	228.6000	(1b) - (3b)
Ground floor				(4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.2000			(5)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	228.6000	

2. Ventilation rate

m3 per hour

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Number of open chimneys
Number of open flues
Number of chimneys / flues attached to closed fire
Number of flues attached to solid fuel boiler
Number of flues attached to other heater
Number of blocked chimneys
Number of intermittent extract fans
Number of passive vents
Number of flueless gas fires

0 * 80 = 0.0000 (6a)
0 * 20 = 0.0000 (6b)
0 * 10 = 0.0000 (6c)
0 * 20 = 0.0000 (6d)
0 * 35 = 0.0000 (6e)
0 * 20 = 0.0000 (6f)
3 * 10 = 30.0000 (7a)
0 * 10 = 0.0000 (7b)
0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 30.0000 / (5) = 0.1312 (8)
Pressure test
Pressure Test Method
Measured/design AP50
Infiltration rate
Number of sides sheltered
Blower Door
5.0000 (17)
0.3812 (18)
3 (19)
Shelter factor (20) = 1 - [0.075 x (19)] = 0.7750 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2955 (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												
Effective ac	0.3767	0.3693	0.3619	0.3250	0.3176	0.2807	0.2807	0.2733	0.2955	0.3176	0.3324	0.3472 (22b)
	0.5710	0.5682	0.5655	0.5528	0.5504	0.5394	0.5394	0.5373	0.5436	0.5504	0.5552	0.5603 (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
Main dwelling							
TER Opaque door			2.1000	1.0000	2.1000		(26)
TER Opening Type			10.9100	1.1450	12.4924		(27)
External Wall 1	34.6500	10.9100	23.7400	0.1800	4.2732		(29a)
Shelter Wall 1	45.1000	2.1000	43.0000	0.1800	7.7400		(29a)
Total net area of external elements Aum(A, m2)			79.7500				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 26.6056		(33)
Main dwelling							
Party Wall 1			24.2000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							314.9615 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	47.7000	0.0700	3.3390
P4 Party wall - Roof (insulation at ceiling level)	9.0600	0.1200	1.0872
E16 Corner (normal)	8.2500	0.0900	0.7425
E2 Other lintels (including other steel lintels)	6.3200	0.0500	0.3160
E4 Jamb	31.2000	0.0500	1.5600
E9 Balcony between dwellings, wall insulation continuous	8.8000	0.0200	0.1760

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

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 33.8263 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	43.0716	42.8638	42.6600	41.7031	41.5241	40.6906	40.6906	40.5363	41.0117	41.5241	41.8863	42.2649 (38)
Heat transfer coeff	76.8979	76.6900	76.4863	75.5294	75.3503	74.5169	74.5169	74.3625	74.8379	75.3503	75.7125	76.0912 (39)
Average = Sum(39)m / 12 =												75.5285

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0092	1.0064	1.0038	0.9912	0.9888	0.9779	0.9779	0.9759	0.9821	0.9888	0.9936	0.9986 (40)
HLP (average)												0.9912
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3868 (42)

Hot water usage for mixer showers

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
64.2386	63.2732	61.8665	59.1749	57.1886	54.9735	53.7144	55.1105	56.6409	59.0193	61.7686	63.9925 (42a)	

Hot water usage for baths

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
27.7479	27.3358	26.7555	25.6855	24.8843	23.9959	23.5160	24.0923	24.7197	25.6704	26.7624	27.6541 (42b)	

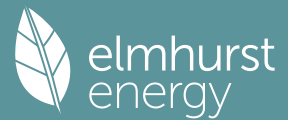
Hot water usage for other uses

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
39.0733	37.6524	36.2316	34.8108	33.3899	31.9691	31.9691	33.3899	34.8108	36.2316	37.6524	39.0733 (42c)	

Average daily hot water use (litres/day) 120.4737 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	131.0598	128.2615	124.8536	119.6712	115.4628	110.9385	109.1995	112.5927	116.1714	120.9212	126.1835	130.7199 (44)
Energy conte	207.5667	182.6427	191.8953	163.8239	155.4352	136.4118	132.0674	139.4133	143.2510	164.0890	179.7715	204.6758 (45)
Energy content (annual)										Total = Sum(45)m =		2001.0433
Distribution loss (46)m = 0.15 x (45)m	31.1350	27.3964	28.7843	24.5736	23.3153	20.4618	19.8101	20.9120	21.4876	24.6133	26.9657	30.7014 (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	254.1616	224.7284	238.4902	208.9157	202.0301	181.5036	178.6623	186.0082	188.3428	210.6839	224.8633	251.2707 (62)
WWHRS	-29.3672	-25.9726	-27.1970	-22.5202	-20.9880	-17.9596	-16.8343	-17.9015	-18.5817	-21.9058	-24.8166	-28.8234 (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												

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224.7944	198.7558	211.2932	186.3955	181.0420	163.5440	161.8280	168.1067	169.7611	188.7781	200.0468	222.4473 (64)
Total per year (kWh/year)											2276.7929 (64)
Electric shower(s)											2277 (64)
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											
106.2919	94.3973	101.0811	90.5449	88.9581	81.4304	81.1883	83.6308	83.7044	91.8355	95.8475	105.3306 (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	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	113.7916	125.9835	113.7916	117.5846	113.7916	117.5846	113.7916	113.7916	117.5846	113.7916	117.5846	113.7916 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	211.3159	213.5087	207.9829	196.2192	181.3696	167.4131	158.0892	155.8964	161.4222	173.1860	188.0356	201.9921 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340 (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)												
	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723 (71)
Water heating gains (Table 5)												
	142.8654	140.4721	135.8617	125.7568	119.5674	113.0978	109.1241	112.4071	116.2561	123.4348	133.1215	141.5734 (72)
Total internal gains												
	529.7750	541.7665	519.4383	501.3627	476.5306	456.8976	439.8070	440.8972	454.0651	472.2145	500.5438	519.1592 (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			
Southeast				8.7300	36.7938	0.6300	0.7000	0.7700	98.1660 (77)			
Southwest				2.1800	36.7938	0.6300	0.7000	0.7700	24.5134 (79)			
Solar gains	122.6794	208.9684	285.9197	354.2683	396.8100	393.9405	379.8007	348.0627	309.5905	230.9546	146.9416	104.9880 (83)
Total gains	652.4544	750.7349	805.3580	855.6311	873.3407	850.8381	819.6077	788.9599	763.6556	703.1691	647.4855	624.1472 (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	86.6953	86.9303	87.1618	88.2661	88.4759	89.4654	89.4654	89.6511	89.0817	88.4759	88.0526	87.6144
alpha	6.7797	6.7954	6.8108	6.8844	6.8984	6.9644	6.9644	6.9767	6.9388	6.8984	6.8702	6.8410
util living area												
	0.9950	0.9864	0.9663	0.9000	0.7603	0.5561	0.3996	0.4328	0.6610	0.9154	0.9860	0.9962 (86)
MIT												
	20.2428	20.4105	20.6051	20.8280	20.9560	20.9955	20.9996	20.9993	20.9861	20.8326	20.5052	20.2158 (87)
Th 2												
	20.0757	20.0780	20.0802	20.0907	20.0926	20.1018	20.1018	20.1035	20.0983	20.0926	20.0887	20.0845 (88)
util rest of house												
	0.9930	0.9814	0.9540	0.8678	0.7007	0.4803	0.3183	0.3489	0.5817	0.8807	0.9799	0.9947 (89)
MIT 2												
	19.2109	19.4240	19.6661	19.9330	20.0613	20.0998	20.1017	20.1033	20.0910	19.9453	19.5535	19.1836 (90)
Living area fraction												
	19.6077	19.8033	20.0272	20.2772	20.4053	20.4442	20.4469	20.4478	20.4352	20.2865	19.9194	19.5805 (91)
MIT												
	19.6077	19.8033	20.0272	20.2772	20.4053	20.4442	20.4469	20.4478	20.4352	20.2865	19.9194	19.5805 (92)
Temperature adjustment												
	19.6077	19.8033	20.0272	20.2772	20.4053	20.4442	20.4469	20.4478	20.4352	20.2865	19.9194	19.5805 (93)
adjusted MIT												

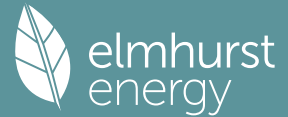
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9918	0.9795	0.9531	0.8750	0.7221	0.5095	0.3496	0.3812	0.6120	0.8891	0.9785	0.9936 (94)
Useful gains	647.0768	735.3425	767.6258	748.7053	630.6455	433.4767	286.5386	300.7828	467.3799	625.1629	633.5522	620.1683 (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												
	1177.1276	1142.9329	1034.6439	859.3104	655.9492	435.4901	286.6625	301.0070	474.1135	729.8805	970.5911	1170.3213 (97)
Space heating kWh												
	394.3578	273.9008	198.6614	79.6357	18.8260	0.0000	0.0000	0.0000	0.0000	77.9099	242.6680	409.3138 (98a)
Space heating requirement - total per year (kWh/year)												1695.2734
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												
	394.3578	273.9008	198.6614	79.6357	18.8260	0.0000	0.0000	0.0000	0.0000	77.9099	242.6680	409.3138 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1695.2734
Space heating per m2												(98c) / (4) = 22.2477 (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												
	394.3578	273.9008	198.6614	79.6357	18.8260	0.0000	0.0000	0.0000	0.0000	77.9099	242.6680	409.3138 (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)												
	427.2566	296.7506	215.2345	86.2792	20.3965	0.0000	0.0000	0.0000	0.0000	84.4094	262.9123	443.4602 (211)

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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	224.7944	198.7558	211.2932	186.3955	181.0420	163.5440	161.8280	168.1067	169.7611	188.7781	200.0468	222.4473 (64)
Efficiency of water heater (217)m	85.3069	84.7793	83.9218	82.2968	80.5692	79.8000	79.8000	79.8000	79.8000	82.2349	84.4940	79.8000 (216)
Fuel for water heating, kWh/month	263.5126	234.4391	251.7741	226.4917	224.7039	204.9424	202.7920	210.6600	212.7332	229.5597	236.7585	85.4083 (217)
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	7.0685	7.3041	7.0685	7.3041	7.0685 (231)
Lighting	23.6436	18.9678	17.0784	12.5124	9.6649	7.8963	8.8167	11.4602	14.8857	19.5309	22.0601	24.3008 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-25.8396	-37.5567	-55.6316	-64.5173	-71.2649	-67.1308	-66.3120	-61.7745	-54.0388	-43.8311	-28.8077	-22.2103 (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	-11.3510	-24.1919	-48.6707	-73.9642	-98.6445	-99.4254	-98.2518	-82.7967	-60.1745	-34.8753	-15.2449	-8.9524 (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												1836.6993 (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												2758.8188 (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)												190.8177 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1255.4586 (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												3616.8771 (238)

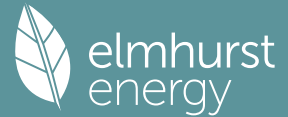
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1836.6993	0.2100	385.7068 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2758.8188	0.2100	579.3519 (264)
Space and water heating			965.0588 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	190.8177	0.1443	27.5409 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-598.9153	0.1339	-80.2246
PV Unit electricity exported	-656.5433	0.1256	-82.4306
Total			-162.6552 (269)
Total CO2, kg/year			841.8737 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.0500 (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	1836.6993	1.1300	2075.4702 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2758.8188	1.1300	3117.4652 (278)
Space and water heating			5192.9354 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	190.8177	1.5338	292.6826 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-598.9153	1.4950	-895.3903
PV Unit electricity exported	-656.5433	0.4608	-302.5665
Total			-1197.9568 (283)
Total Primary energy kWh/year			4417.7620 (286)
Target Primary Energy Rate (TPER)			57.9800 (287)

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Property Reference	U2L2 - Direct + DHP DHW+PV				Issued on Date	05/09/2025
Assessment Reference	Proposed _Option - Unit 2	Prop Type Ref		2B-4P-N-End Terrace Level 3		
Property						
SAP Rating	81 B	DER	2.72	TER	13.44	
Environmental	98 A	% DER < TER				79.76
CO ₂ Emissions (t/year)	0.12	DFEE	37.12	TFEE	39.97	
Compliance Check	See BREL	% DFEE < TFEE				7.13
% DPER < TPER	52.08	DPER	33.96	TPER	70.87	
Assessor Details	Miss Emma Jolly				Assessor ID	T689-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	76.2000 (1b)	x 3.0000 (2b)	= 228.6000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 228.6000 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	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)

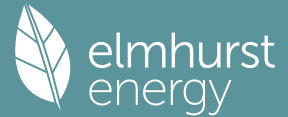
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.1482	0.1453	0.1424	0.1279	0.1250	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) =												80.1000 (23c)
Effective ac	0.2477	0.2448	0.2419	0.2274	0.2245	0.2099	0.2099	0.2070	0.2157	0.2245	0.2303	0.2361 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Window			10.9100	0.7752	8.4574		(27)
Door			2.1000	1.0000	2.1000		(26)
External Wall 1	34.6500	10.9100	23.7400	0.1400	3.3236	190.0000	4510.6000 (29a)
Shelter Wall 1	45.1000	2.1000	43.0000	0.1600	6.8800	190.0000	8170.0000 (29a)
External Roof 1	76.2000		76.2000	0.1800	13.7160	9.0000	685.8000 (30)
Total net area of external elements Aum(A, m ²)			155.9500				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.4770		(33)
Main dwelling							
Party Wall 1			24.2000	0.0000	0.0000	180.0000	4356.0000 (32)
Party Floor 1			80.8700			40.0000	3234.8000 (32d)
Internal Wall 1			75.6300			9.0000	680.6700 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21637.8700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							283.9615 (35)
List of Thermal Bridges							

Page 2 of 7

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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, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	97.0761	97.4210	97.7684	99.5434	99.9062	101.7604	101.7604	102.1395	101.0105	99.9062	99.1833	98.4708
alpha	7.4717	7.4947	7.5179	7.6362	7.6604	7.7840	7.7840	7.8093	7.7340	7.6604	7.6122	7.5647
util living area	0.9948	0.9861	0.9666	0.8980	0.7545	0.5423	0.3896	0.4194	0.6429	0.9096	0.9851	0.9961 (86)
MIT	20.3695	20.5162	20.6797	20.8712	20.9711	20.9979	20.9999	20.9998	20.9928	20.8782	20.6030	20.3492 (87)
Th 2	20.2425	20.2450	20.2475	20.2599	20.2624	20.2749	20.2749	20.2774	20.2699	20.2624	20.2574	20.2524 (88)
util rest of house	0.9931	0.9817	0.9561	0.8702	0.7046	0.4819	0.3255	0.3537	0.5786	0.8789	0.9796	0.9947 (89)
MIT 2	19.6738	19.8200	19.9798	20.1649	20.2454	20.2741	20.2749	20.2774	20.2667	20.1761	19.9169	19.6622 (90)
Living area fraction									fLA = Living area /	(4) =		0.3845 (91)
MIT	19.9413	20.0877	20.2489	20.4365	20.5245	20.5524	20.5537	20.5551	20.5459	20.4461	20.1807	19.9263 (92)
Temperature adjustment												0.3000
adjusted MIT	20.2413	20.3877	20.5489	20.7365	20.8245	20.8524	20.8537	20.8551	20.8459	20.7461	20.4807	20.2263 (93)
8. Space heating requirement												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9931	0.9826	0.9607	0.8887	0.7431	0.5301	0.3766	0.4062	0.6296	0.8999	0.9814	0.9947 (94)
Useful gains	564.2524	631.5525	649.4826	628.6340	529.9557	368.0288	251.1657	262.0306	396.8770	529.7513	545.9757	541.7988 (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	987.0143	955.5353	863.6885	714.6964	548.9425	369.3030	251.2441	262.1683	401.4083	610.4031	810.8723	978.2250 (97)
Space heating kWh	314.5349	217.7165	159.3692	61.9649	14.1262	0.0000	0.0000	0.0000	0.0000	60.0049	190.7256	324.7011 (98a)
Space heating requirement - total per year (kWh/year)												1343.1431
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	314.5349	217.7165	159.3692	61.9649	14.1262	0.0000	0.0000	0.0000	0.0000	60.0049	190.7256	324.7011 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1343.1431
Space heating per m2										(98c) / (4) =		17.6265 (99)
8c. Space cooling requirement												
Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	555.2150	437.0842	447.2310	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9749	0.9925	0.9895	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	541.2770	433.8193	442.5542	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	759.3311	730.2595	707.0875	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	156.9990	220.5516	196.8128	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area /	(4) =		1.0613 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	41.6552	58.5171	52.2187	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												152.3909 (107)
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)
Fraction of main heating from main system 2												0.0000 (203)
Fraction of total heating from main system 1												1.0000 (204)
Fraction of total heating from main system 2												0.0000 (205)
Efficiency of main space heating system 1 (in %)												100.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Cooling System Energy Efficiency Ratio (see Table 10c)												8.5000 (209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	314.5349	217.7165	159.3692	61.9649	14.1262	0.0000	0.0000	0.0000	0.0000	60.0049	190.7256	324.7011 (98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)
Space heating fuel (main heating system)	314.5349	217.7165	159.3692	61.9649	14.1262	0.0000	0.0000	0.0000	0.0000	60.0049	190.7256	324.7011 (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)
Space heating fuel used, main system 2												0.0000 (213)
Water heating												
Water heating requirement	240.0880	211.8565	223.9419	194.2646	186.5154	166.1156	162.5506	170.1108	173.1965	195.4614	210.6835	237.1261 (64)
Efficiency of water heater (217)m	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692	341.9692 (216)
Fuel for water heating, kWh/month	70.2075	61.9519	65.4860	56.8076	54.5416	48.5762	47.5337	49.7445	50.6468	57.1576	61.6089	69.3414 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	4.9006	6.8844	6.1434	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	19.5652	17.6718	19.5652	18.9341	19.5652	18.9341	19.5652	18.9341	18.9341	19.5652	18.9341	19.5652 (231)
Lighting	28.4966	22.8610	20.5838	15.0806	11.6487	9.5171	10.6263	13.8125	17.9411	23.5397	26.5880	29.2886 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-28.1427	-43.3601	-67.2607	-78.0887	-84.7238	-79.0315	-77.9608	-71.8523	-60.9928	-49.2169	-31.6937	-23.8459 (233a)

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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	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	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	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	-7.1224	-17.0950	-39.2761	-68.7454	-99.3592	-102.8419	-101.1483	-83.0097	-57.5841	-29.1066	-10.4695	-5.4308		(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	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	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	0.0000	(235d)
Annual totals kWh/year														
Space heating fuel - main system 1													1343.1431	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													341.9692	
Water heating fuel used													693.6037	(219)
Space cooling fuel													17.9283	(221)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8260)														
mechanical ventilation fans (SFP = 0.8260)													230.3648	(230a)
Total electricity for the above, kWh/year													230.3648	(231)
Electricity for lighting (calculated in Appendix L)													229.9840	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-1317.3590	(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													1197.6650	(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	1343.1431	0.1572	211.0994	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	693.6037	0.1412	97.9332	(264)
Space and water heating			309.0326	(265)
Space cooling	17.9283	0.1138	2.0403	(266)
Pumps, fans and electric keep-hot	230.3648	0.1387	31.9544	(267)
Energy for lighting	229.9840	0.1443	33.1938	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-696.1700	0.1338	-93.1581	
PV Unit electricity exported	-621.1890	0.1223	-75.9697	
Total			-169.1278	(269)
Total CO2, kg/year			207.0933	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.7200	(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	1343.1431	1.5818	2124.6282	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	693.6037	1.5221	1055.7352	(278)
Space and water heating			3180.3634	(279)
Space cooling	17.9283	1.4195	25.4493	(280)
Pumps, fans and electric keep-hot	230.3648	1.5128	348.4959	(281)
Energy for lighting	229.9840	1.5338	352.7572	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-696.1700	1.4945	-1040.4469	
PV Unit electricity exported	-621.1890	0.4488	-278.7640	
Total			-1319.2109	(283)
Total Primary energy kWh/year			2587.8549	(286)
Dwelling Primary energy Rate (DPER)			33.9600	(287)

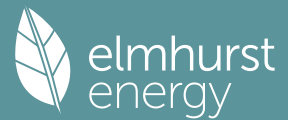
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)	
Main dwelling	76.2000	3.0000	228.6000	(1b) - (3b)
Ground floor				(4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.2000			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	228.6000	(5)

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) =	0.1312 (8)
Pressure test												Yes	
Pressure Test Method												Blower Door	
Measured/design AP50												5.0000	(17)
Infiltration rate												0.3812	(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) =	0.2955 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	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)	
Adj infilt rate	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)	
	0.3767	0.3693	0.3619	0.3250	0.3176	0.2807	0.2807	0.2733	0.2955	0.3176	0.3324	0.3472 (22b)	
Effective ac	0.5710	0.5682	0.5655	0.5528	0.5504	0.5394	0.5394	0.5373	0.5436	0.5504	0.5552	0.5603 (25)	

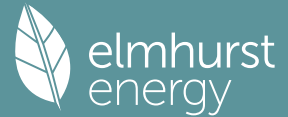
3. Heat losses and heat loss parameter

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					
Main dwelling												
TER Opaque door			2.1000	1.0000	2.1000			(26)				
TER Opening Type			10.9100	1.1450	12.4924			(27)				
External Wall 1	34.6500	10.9100	23.7400	0.1800	4.2732			(29a)				
Shelter Wall 1	45.1000	2.1000	43.0000	0.1800	7.7400			(29a)				
External Roof 1	76.2000		76.2000	0.1100	8.3820			(30)				
Total net area of external elements Aum(A, m2)			155.9500					(31)				
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	34.9876			(33)				
Main dwelling												
Party Wall 1			24.2000	0.0000	0.0000			(32)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								283.9615 (35)				
List of Thermal Bridges												
K1 Element				Length	Psi-value		Total					
E7 Party floor between dwellings (in blocks of flats)				19.9300	0.0700		1.3951					
E14 Flat roof				16.6700	0.0800		1.3336					
P4 Party wall - Roof (insulation at ceiling level)				9.0600	0.1200		1.0872					
E16 Corner (normal)				8.2500	0.0900		0.7425					
E2 Other lintels (including other steel lintels)				6.3200	0.0500		0.3160					
E4 Jamb				31.2000	0.0500		1.5600					
E9 Balcony between dwellings, wall insulation continuous				8.8000	0.0200		0.1760					
E15 Flat roof with parapet				12.4600	0.5600		6.9776					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								13.5880 (36)				
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	48.5756	(37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 43.0716	Feb 42.8638	Mar 42.6600	Apr 41.7031	May 41.5241	Jun 40.6906	Jul 40.6906	Aug 40.5363	Sep 41.0117	Oct 41.5241	Nov 41.8863	Dec 42.2649 (38)
Heat transfer coeff	91.6472	91.4393	91.2356	90.2787	90.0996	89.2662	89.2662	89.1118	89.5872	90.0996	90.4618	90.8405 (39)
Average = Sum(39)m / 12 =												90.2778
HLP	Jan 1.2027	Feb 1.2000	Mar 1.1973	Apr 1.1848	May 1.1824	Jun 1.1715	Jul 1.1715	Aug 1.1694	Sep 1.1757	Oct 1.1824	Nov 1.1872	Dec 1.1921 (40)
HLP (average)												1.1847
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3868 (42)											
Hot water usage for mixer showers	64.2386 63.2732 61.8665 59.1749 57.1886 54.9735 53.7144 55.1105 56.6409 59.0193 61.7686 63.9925 (42a)											
Hot water usage for baths	27.7479 27.3358 26.7555 25.6855 24.8843 23.9959 23.5160 24.0923 24.7197 25.6704 26.7624 27.6541 (42b)											
Hot water usage for other uses	39.0733 37.6524 36.2316 34.8108 33.3899 31.9691 31.9691 33.3899 34.8108 36.2316 37.6524 39.0733 (42c)											
Average daily hot water use (litres/day)	120.4737 (43)											
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	131.0598	128.2615	124.8536	119.6712	115.4628	110.9385	109.1995	112.5927	116.1714	120.9212	126.1835	130.7199 (44)
Energy content (annual)	207.5667	182.6427	191.8953	163.8239	155.4352	136.4118	132.0674	139.4133	143.2510	164.0890	179.7715	204.6758 (45)
Distribution loss (46)m = 0.15 x (45)m	31.1350 27.3964 28.7843 24.5736 23.3153 20.4618 19.8101 20.9120 21.4876 24.6133 26.9657 30.7014 (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	254.1616	224.7284	238.4902	208.9157	202.0301	181.5036	178.6623	186.0082	188.3428	210.6839	224.8633	251.2707 (62)

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WVHRS	-29.3672	-25.9726	-27.1970	-22.5202	-20.9880	-17.9596	-16.8343	-17.9015	-18.5817	-21.9058	-24.8166	-28.8234 (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	224.7944	198.7558	211.2932	186.3955	181.0420	163.5440	161.8280	168.1067	169.7611	188.7781	200.0468	222.4473 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2276.7929 (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)
Heat gains from water heating, kWh/month	106.2919	94.3973	101.0811	90.5449	88.9581	81.4304	81.1883	83.6308	83.7044	91.8355	95.8475	105.3306 (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	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404	119.3404 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	113.7916	125.9835	113.7916	117.5846	113.7916	117.5846	113.7916	113.7916	117.5846	113.7916	117.5846	113.7916 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	211.3159	213.5087	207.9829	196.2192	181.3696	167.4131	158.0892	155.8964	161.4222	173.1860	188.0356	201.9921 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340	34.9340 (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)	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723	-95.4723 (71)
Water heating gains (Table 5)	142.8654	140.4721	135.8617	125.7568	119.5674	113.0978	109.1241	112.4071	116.2561	123.4348	133.1215	141.5734 (72)
Total internal gains	529.7750	541.7665	519.4383	501.3627	476.5306	456.8976	439.8070	440.8972	454.0651	472.2145	500.5438	519.1592 (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	
Southeast				8.7300	36.7938	0.6300		0.7000		0.7700		98.1660 (77)	
Southwest				2.1800	36.7938	0.6300		0.7000		0.7700		24.5134 (79)	
Solar gains	122.6794	208.9684	285.9197	354.2683	396.8100	393.9405	379.8007	348.0627	309.5905	230.9546	146.9416	104.9880 (83)	
Total gains	652.4544	750.7349	805.3580	855.6311	873.3407	850.8381	819.6077	788.9599	763.6556	703.1691	647.4855	624.1472 (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	65.5832	65.7323	65.8791	66.5774	66.7097	67.3325	67.3325	67.4492	67.0913	66.7097	66.4426	66.1656
alpha	5.3722	5.3822	5.3919	5.4385	5.4473	5.4888	5.4888	5.4966	5.4728	5.4473	5.4295	5.4110
util living area	0.9941	0.9868	0.9719	0.9276	0.8269	0.6447	0.4748	0.5126	0.7444	0.9380	0.9866	0.9953 (86)
MIT	19.8893	20.0785	20.3191	20.6227	20.8537	20.9711	20.9954	20.9931	20.9371	20.6494	20.2189	19.8584 (87)
Th 2	19.9178	19.9200	19.9221	19.9322	19.9341	19.9429	19.9429	19.9445	19.9395	19.9341	19.9303	19.9263 (88)
util rest of house	0.9920	0.9821	0.9616	0.9011	0.7687	0.5500	0.3632	0.3988	0.6553	0.9097	0.9810	0.9936 (89)
MIT 2	18.6506	18.8915	19.1941	19.5676	19.8197	19.9284	19.9417	19.9425	19.9026	19.6077	19.0789	18.6175 (90)
Living area fraction	fLA = Living area / (4) =											0.3845 (91)
MIT	19.1269	19.3479	19.6266	19.9733	20.2173	20.3293	20.3469	20.3465	20.3004	20.0082	19.5172	19.0946 (92)
Temperature adjustment												0.0000
adjusted MIT	19.1269	19.3479	19.6266	19.9733	20.2173	20.3293	20.3469	20.3465	20.3004	20.0082	19.5172	19.0946 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9898	0.9788	0.9581	0.9023	0.7855	0.5859	0.4063	0.4428	0.6876	0.9121	0.9781	0.9918 (94)
Ext temp.	645.8047	734.8274	771.6393	772.0374	686.0299	498.4746	333.0171	349.3685	525.0734	641.3299	633.2995	619.0013 (95)
Heat loss rate W	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)
Space heating kWh	1358.8433	1321.1045	1197.6169	999.6827	767.4028	511.4341	334.4671	351.6770	555.4744	847.6787	1123.2864	1353.0367 (97)
Space heating requirement - total per year (kWh/year)	530.5008	393.9782	316.9273	163.9046	60.5414	0.0000	0.0000	0.0000	0.0000	153.5235	352.7905	546.1224 (98a)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98c)
Space heating kWh	530.5008	393.9782	316.9273	163.9046	60.5414	0.0000	0.0000	0.0000	0.0000	153.5235	352.7905	546.1224 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	(98c) / (4) =											2518.2887 (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											

Full SAP Calculation Printout



Space heating efficiency (main heating system 1)	530.5008	393.9782	316.9273	163.9046	60.5414	0.0000	0.0000	0.0000	0.0000	153.5235	352.7905	546.1224 (98)
Space heating fuel (main heating system)	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 efficiency (main heating system 2)	574.7571	426.8452	343.3665	177.5782	65.5920	0.0000	0.0000	0.0000	0.0000	166.3310	382.2216	591.6819 (211)
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 (212)
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 (213)
Water heating requirement	224.7944	198.7558	211.2932	186.3955	181.0420	163.5440	161.8280	168.1067	169.7611	188.7781	200.0468	222.4473 (64)
Efficiency of water heater (217)m	85.9161	85.5641	84.9668	83.7727	81.8797	79.8000	79.8000	79.8000	79.8000	83.6002	85.3181	79.8000 (216)
Fuel for water heating, kWh/month	261.6442	232.2887	248.6773	222.5016	221.1075	204.9424	202.7920	210.6600	212.7332	225.8107	234.4717	85.9930 (217)
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	258.6808 (219)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	0.0000 (221)
Lighting	23.6436	18.9678	17.0784	12.5124	9.6649	7.8963	8.8167	11.4602	14.8857	19.5309	22.0601	7.0685 (231)
Electricity generated by PVs (Appendix M) (negative quantity)	-25.8396	-37.5567	-55.6316	-64.5173	-71.2649	-67.1308	-66.3120	-61.7745	-54.0388	-43.8311	-28.8077	24.3008 (232)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-22.2103 (233a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-43.8311 (233a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-28.8077 (233b)
Electricity generated by PVs (Appendix M) (negative quantity)	-11.3510	-24.1919	-48.6707	-73.9642	-98.6445	-99.4254	-98.2518	-82.7967	-60.1745	-34.8753	-15.2449	-24.3008 (233c)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-8.9524 (233b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-8.9524 (233b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-8.9524 (233b)
Annual totals kWh/year												
Space heating fuel - main system 1												2728.3735 (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												2736.3099 (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)												190.8177 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1255.4586 (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												4486.0425 (238)

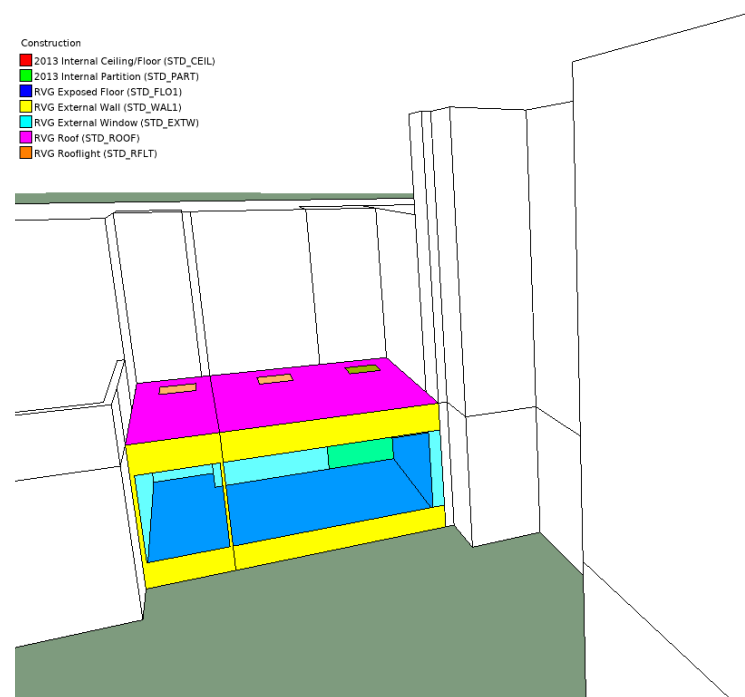
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2728.3735	0.2100	572.9584 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2736.3099	0.2100	574.6251 (264)
Space and water heating			1147.5835 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	190.8177	0.1443	27.5409 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-598.9153	0.1339	-80.2246
PV Unit electricity exported	-656.5433	0.1256	-82.4306
Total			-162.6552 (269)
Total CO2, kg/year			1024.3984 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.4400 (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	2728.3735	1.1300	3083.0620 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2736.3099	1.1300	3092.0302 (278)
Space and water heating			6175.0922 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	190.8177	1.5338	292.6826 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-598.9153	1.4950	-895.3903
PV Unit electricity exported	-656.5433	0.4608	-302.5665
Total			-1197.9568 (283)
Total Primary energy kWh/year			5399.9189 (286)
Target Primary Energy Rate (TPER)			70.8700 (287)

Appendix B: Part L2 Calculation extents for Communal Residential Areas and associated BRUKL Report.



BRUKL Output Document

Compliance with England Building Regulations Part L 2021



Project name

RVG Thamesfield Part L2A-JM-Rev0 As designed

Date: Wed Sep 13 13:12:40 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

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

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 105.31

The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m²annum	0.33
Building CO ₂ emission rate (BER), kgCO ₂ /m²annum	-3.27
Target primary energy rate (TPER), kWh _{pe} /m²annum	1.59
Building primary energy rate (BPER), kWh _{pe} /m²annum	-45.59
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 _{o-Limit}	U _{o-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.14	0.14	DJ000001:Surf[4]
Floors	0.18	0.18	0.18	DJ000001:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.18	0.18	DJ000001:Surf[2]
Windows** and roof windows	1.6	0.82	0.82	DJ000001:Surf[3]
Rooflights***	2.2	1.21	1.21	DJ000001:Surf[1]
Personnel doors [^]	1.6	-	-	No personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building
U_{o-Limit} = Limiting area-weighted average U-values [W/(m²K)] U_{o-Calc} = Calculated area-weighted average U-values [W/(m²K)] U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)] * Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. ** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position. [^] For fire doors, limiting U-value is 1.8 W/m²K NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

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- CIRCULATION

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

2- LAUNDRY

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

3- VRF SYSTEM

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	4.5	0	1.6	0.8
Standard value	2.5*	N/A	N/A	2^	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.

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

1- DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	0.91	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

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
L00-Corridor	110	-	-
L00-Laundry	55	-	-
L00-Toilet	110	-	-
L00-Store	110	-	-
L00-Multifunction Room	110	-	-

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?
L00-Multifunction Room	NO (-76.8%)	YES

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

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] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	20.5	72.8	1.8	6.5	3.2	3.08	3.11	3	4.5
Notional	27.5	44.7	2.8	2.7	6.9	2.78	4.63	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	0.4	0	0.1	0	0	0.8	0	1	0
Notional	1.5	0	0.3	0	0	1.41	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	129.4	0	44.9	0	0	0.8	0	1	0
Notional	133.7	0	26.3	0	0	1.41	0	----	----

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m²]	105.3	105.3		Retail/Financial and Professional Services
External area [m²]	192.6	192.6		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	LON	LON		Offices and Workshop Businesses
Infiltration [m³/hm²@ 50Pa]	3	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	45.53	50.96		Storage or Distribution
Average U-value [W/m²K]	0.24	0.26		Hotels
Alpha value* [%]	25	10		Residential Institutions: Hospitals and Care Homes
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging				
				Residential Institutions: Residential Schools
				Residential Institutions: Universities and Colleges
				Secure Residential Institutions
				Residential Spaces
			100	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/m²]

	Actual	Notional
Heating	9.27	6.5
Cooling	3.98	1.64
Auxiliary	1.97	4.2
Lighting	16.33	7.4
Hot water	2.84	2.57
Equipment*	44	44
TOTAL**	34.39	22.3

* 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/m²]

	Actual	Notional
Photovoltaic systems	65.48	21.44
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	65.48	21.44

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	80.56	68.68
Primary energy [kWh _{PE} /m²]	-45.59	1.59
Total emissions [kg/m²]	-3.27	0.33

Appendix C: Detailed Part O Criteria and Results.

The geometry used to assess proposed dwellings was determined by drawings received from the project architect:

CIBSE TM59 overview

Overheating in all spaces was previously quantified by the number of occupied hours annually that the internal temperature exceeds a maximum temperature irrespective of external temperature.

The CIBSE TM59 criteria for predominantly naturally ventilated spaces use both an adaptive comfort and a fixed threshold approach:

Adaptive comfort:

Adaptive comfort is where the overheating threshold is dynamic. It is based on the comparison of the anticipated internal conditions against criteria which establishes a maximum acceptable room temperature calculated from the running ‘mean’ outdoor temperature. Research has shown that comfortable room temperatures vary with the external temperature conditions and occupants are generally more accepting of warmer room temperatures if the weather is also warm outside.

Fixed threshold:

CIBSE TM59 criterion B, used to assess bedrooms only, uses a static measurement where the threshold is fixed. The risk of overheating is quantified by the number of occupied hours annually that the internal conditions exceed a maximum temperature, irrespective of external temperature. It therefore does not vary in line with the external conditions like the adaptive comfort approach. This criterion is required to be satisfied within bedrooms only.

CIBSE TM59 criteria

CIBSE TM59 considers the risk of overheating by assessing occupied spaces against two criteria detailed in the table below.

Table 4: TM59 Criteria Summary

Criterion A	<u>For Living Rooms, Kitchens and Bedrooms:</u> Criteria sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature. To satisfy Criterion 1, the following must not occur for more than 3% of occupied hours: The difference between the actual operative temperature, and the maximum acceptable temperature* is equal to or greater than 1 degree during May to September.
Criterion B	<u>For Bedrooms Only:</u> Criteria states that peak bedroom temperatures should not exceed an absolute threshold of 26 °C. To satisfy Criterion 2, the operative temperature in the bedrooms from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours (33 Hours).

* Maximum acceptable temperature: CIBSE sets a maximum acceptable temperature of 3°C above the comfort temperature (for new buildings).

Mitigation strategy.

Minimising internal heat gains

The following mitigation methods will be implemented to minimise the internal heat generation through energy efficient design at the Proposed Development:

- Energy efficient lighting (i.e. LED) with low heat output.
- Insulation to heating and hot water pipework and minimisation of dead-legs to avoid standing heat loss.
- Energy efficient equipment with low heat output to reduce unnecessary heat gain.

Reducing the amount of heat entering the building in summer

The following mitigation methods will be implemented to reduce the amount of heat entering the building in summer within the Proposed Development:

- Passive shading measures, with particular focus on west, east and south facing orientations.
- Suitable g-values will be specified to further control solar heat gains as required; and
- Buildings will have the capability for internal blinds to be installed to improve occupant comfort.

Manage heat gains

- Opportunities to expose thermal mass to help to further regulate internal temperatures will be explored where possible.

Passive ventilation

The potential for passive ventilation via opening facades to facilitate a mixed-mode ventilation strategy has been considered within the facade design and will be evaluated further during the next stage of design.

Mechanical ventilation

Mechanical ventilation is an important element of building services, to maintain good indoor air quality throughout the day by providing fresh air and extracting vitiated air. Providing fresh air minimises the risk of stale and stagnant air and limits the risk of condensation and mould growth as well as benefitting the occupants’ physical and mental wellbeing. Heat recovery mechanisms will be provided to save heating energy.

Mechanical ventilation plant will be located away from pollution sources, typically at roof level. It is anticipated that the design flow rates specified will aid the regulation of internal temperatures in summer months.

Table 5: TM59 Criteria Summary

Fixed Comfort Criterion	<u>For Living Rooms, Kitchens and Bedrooms:</u> Criteria sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature. Fixed comfort criterion All living rooms, kitchens and bedrooms must not exceed the maximum operative temperature threshold of 26 degrees for 3% of the total annual occupied hours.
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Active cooling

As the final step active cooling is specified, in order to keep internal temperatures within acceptable limits. The façade and building services have the ability to enable a fan coil unit cooling solution.

Table 6 - Natural ventilation iteration - occupied rooms

Room analysed	Criterion A		Criterion B		Pass/fail
	Target < 3%	Pass/fail	Target≤32	Pass/fail	
02-Unit16-2B3P-Living kitchen	1.3	Pass	N/A	N/A	Pass
02-Unit16-2B3P-single bedroom	0.9	Pass	17	Pass	Pass
02-Unit16-2B3P-double bedroom	0.7	Pass	10	Pass	Pass
02-Unit15-1B2P-Double bedroom	0.4	Pass	12	Pass	Pass
02-Unit14-1B2P-Double bedroom	0.7	Pass	13	Pass	Pass
02-Unit14-1B2P-Living/kitchen	1.4	Pass	N/A	N/A	Pass
02-Unit15-1B2P-Living/kitchen	1	Pass	N/A	N/A	Pass
01-Unit10-2B4P-Double bedroom 01	0.8	Pass	11	Pass	Pass
01-Unit10-2B4P-Double bedroom 02	1.1	Pass	10	Pass	Pass
01-Unit10-2B4P-Living/kitchen	1.6	Pass	N/A	N/A	Pass
01-Unit09-2B4P-Double bedroom 01	0.7	Pass	12	Pass	Pass
01-Unit09-2B4P-Living/kitchen	1.4	Pass	N/A	N/A	Pass
01-Unit09-2B4P-Double bedroom 02	0.7	Pass	13	Pass	Pass

Table 7 - Natural ventilation iteration - communal corridors

Room analysed	No. of hours>28°	Failing overheating check?
	Target<3%	
02-communal corridor 01	0.6	No
02-Communal corridor 02	0.6	No
02-Communal corridor 03	0.5	No
01-communal corridor 01	0.9	No
01-communal corridor 02	0.6	No
01-communal corridor 03	0.6	No

Table 8 - Mechanical ventilation iteration - occupied rooms

Room analysed	Criterion A		Criterion B		Pass/fail
	Target < 3%	Pass/fail	Target≤32	Pass/fail	
02-Unit16-2B3P-Living kitchen	0.3	Pass	N/A	N/A	Pass
02-Unit16-2B3P-single bedroom	0.2	Pass	4	Pass	Pass
02-Unit16-2B3P-double bedroom	0.4	Pass	7	Pass	Pass
02-Unit15-1B2P-Double bedroom	0.3	Pass	19	Pass	Pass
02-Unit14-1B2P-Double bedroom	0.3	Pass	16	Pass	Pass
02-Unit14-1B2P-Living/kitchen	0.4	Pass	N/A	N/A	Pass
02-Unit15-1B2P-Living/kitchen	0.3	Pass	N/A	N/A	Pass
01-Unit10-2B4P-Double bedroom 01	0.5	Pass	12	Pass	Pass
01-Unit10-2B4P-Double bedroom 02	0.6	Pass	7	Pass	Pass
01-Unit10-2B4P-Living/kitchen	1.1	Pass	N/A	N/A	Pass
01-Unit09-2B4P-Double bedroom 01	0.5	Pass	15	Pass	Pass
01-Unit09-2B4P-Living/kitchen	0.9	Pass	N/A	N/A	Pass
01-Unit09-2B4P-Double bedroom 02	0.4	Pass	10	Pass	Pass

Table 9 - Mechanical ventilation iteration - communal corridors

Room analysed	No. of hours>28°	Failing overheating check?
	Target<3%	
02-communal corridor 01	1.1	No
02-Communal corridor 02	1	No
02-Communal corridor 03	1.1	No
01-communal corridor 01	1.2	No
01-communal corridor 02	1.1	No
01-communal corridor 03	1.1	No



MARCO TREGLIA

PRINCIPAL ENVIRONMENTAL DESIGNER

marcotreglia@hoarelea.com

HOARELEA.COM

Enterprise House
Old School Close
Ferndown
Bournemouth
BH22 9UN
England

