

BUILDINGS AND BUILT ENVIRONMENT

Wilson Bowden Developments Ltd
Plot L, Kingsway
Rochdale

Energy Statement

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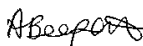
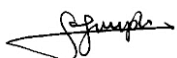
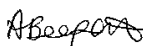
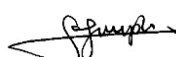
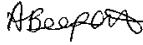
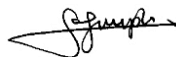
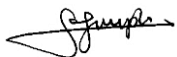
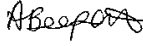
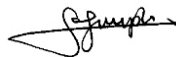
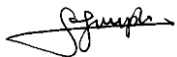
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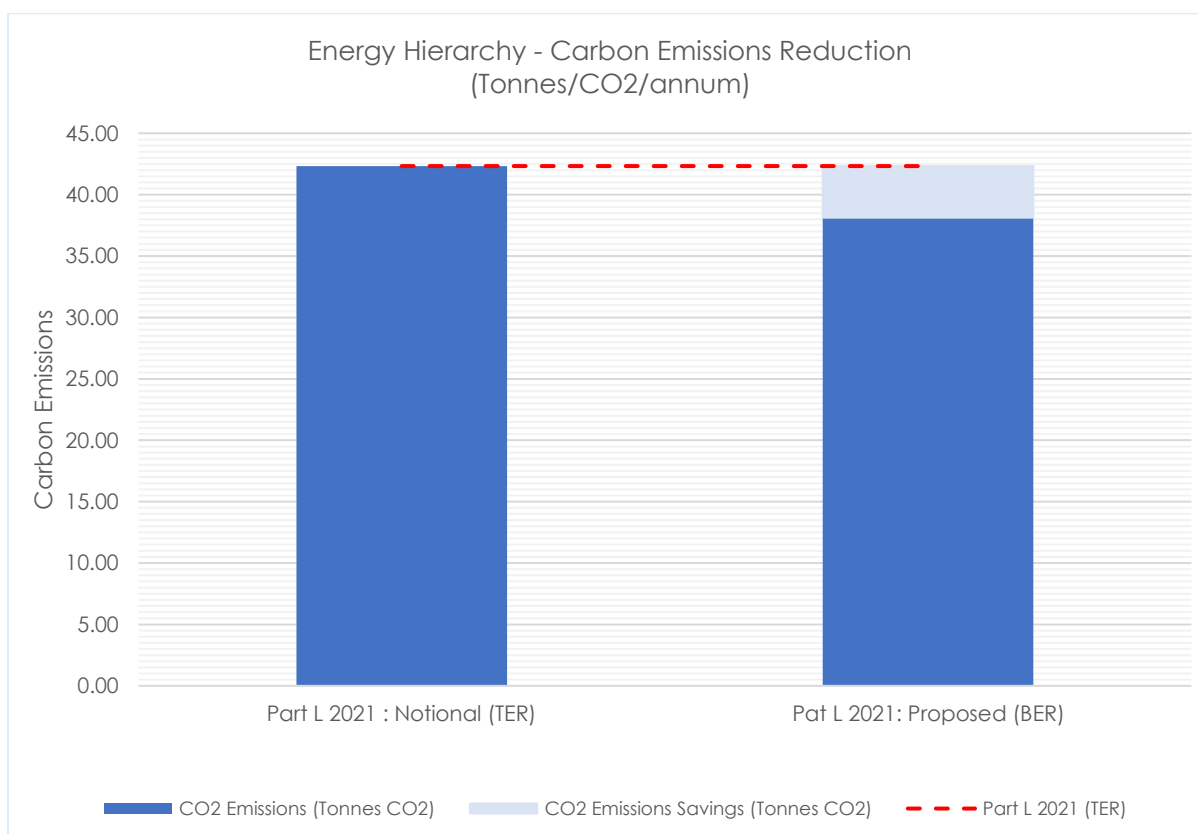
EXECUTIVE SUMMARY

This Energy Statement has been produced in support of a Planning Application for the Proposed Plot L Development at John Milne Avenue, Kingsway Business Park, Rochdale in accordance with Rochdale Borough Council's Core Strategy (2016) Policies G1 – G3.

This Energy Statement outlines the Proposed Development's approach to energy efficiency and renewable energy strategies using Dynamic Thermal Modelling (DSM). The Proposed Development will adopt the use of an energy hierarchy in order to meet current National best practice standard and Rochdale Borough Council's objectives for energy, carbon dioxide and the adaptability to the likely effects of Climate Change.

The Proposed Development envelope and services will be specified to exceed the minimum standards set in Part L (Volume 2) to ensure energy consumption via space heating/cooling is reduced. In addition, passive solar considerations have formed an integral part of the Proposed Development design. Analysis has been carried out on the facades to ensure solar gains and heating loads are reduced, hence providing a more comfortable internal environment for occupants.

This Energy Statement proposes to reduce the regulated energy and carbon dioxide emissions of the Proposed Development by a total of **46.57%** and **9.17%** respectively via ASHP (**VRF**) and PV (**281.25 kWp**) when compared with Part L 2021 (Volume 2) of the Building Regulations Target Emissions Rate Baseline. This complies with the National target to exceed the Part L 2021 TER Baseline, and thus demonstrate compliance with Rochdale Borough Council's requirement of adhering to the energy hierarchy that reflects national policy, targets, and requirements.



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1. INTRODUCTION

Instruction

- 1.1 BWB Consulting (BWB) was instructed by Wilson Bowden Developments Ltd (the Client) to carry out an Energy Statement in support of a Planning Application for the Proposed Plot L Development at John Milne Avenue, Kingsway Business Park, Rochdale.

Development Description

- 1.2 The Proposed Development (**Figure 1.1**) involves the erection of four employment buildings (Classes E(g)(iii), B2 and B8) with ancillary office space, new access, car parking, servicing, boundary treatments, hard and soft landscaping, and other associated works.

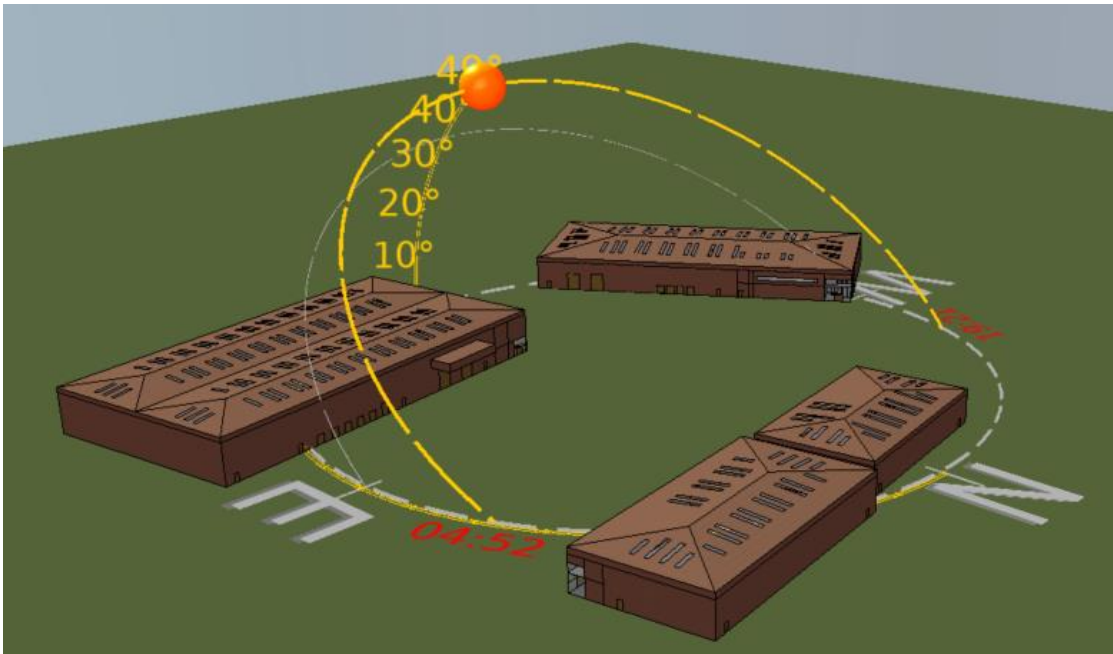


Figure 1.1: Proposed Development Thermal Model in IES VE

Purpose of the document

- 1.3 The purpose of this Energy Statement is to demonstrate that climate change mitigation measures will be integrated into the scheme's design and that the proposed measures are appropriate to the site environment and energy demands of the development.
- 1.4 This document will describe the policy context to which the Energy Statement responds before presenting the baseline carbon dioxide emissions and demonstrating how it is proposed to reduce these through a: lean energy efficient design; clean energy supply; and green on-site renewable energy generation.
- 1.5 This document also identifies and highlight the key sustainable practices to be incorporated into the design and construction of the development in accordance with the current national best practice, regional and local policy guidance.

Modelling Methodology (Apache DSM)

- 1.6 Energy models using the ApacheSim Dynamic Simulation Modelling (DSM) National Calculation Methodology (NCM) have been produced to predict the carbon dioxide emissions from the Proposed Development.
- 1.7 DSM is one of the Government adopted methodologies for calculating the energy performance of non-domestic buildings within the UK. Unlike SBEM (Simplified Building Energy Model), DSM is a much more accurate tool providing full annual simulation performed multiple times per hour using real hourly weather data.
- 1.8 Performing the DSM calculation involves creating a three-dimensional model of the proposed non-domestic development and then populating the model with the fabric and services specification.
- 1.9 The DSM calculation is then run to simulate the Proposed Development energy consumption and resultant carbon dioxide emissions due to the predicted operation of the development over a typical year.
- 1.10 The DSM calculations have been performed to inform this Energy Statement and to produce the most accurate estimate of the site carbon dioxide emissions. Consequently, this report details the thermal element, controlled fittings and building services specification upon which the calculations have been performed.
- 1.11 Criterion 1 of Building Regulations Approved Document Part L (Volume 2) 2021 requires calculation of the Building Emission Rate (BER) using Energy Model to demonstrate that the building will have a Carbon Dioxide Emissions Rate of no more than the Target Emission Rate (TER), which is also calculated within DSM using the building and a notional specification.
- 1.12 The baseline CO₂ emissions are equivalent to the Building Regulations Approved Document Part L worst allowable Target Emissions Rate (TER) calculated within the DSM assessments of the Proposed Development.

Information Used

- 1.13 The analysis detailed in this report is based solely on the following architectural drawings received in correspondence with DLA Architecture:
 - i. 2022-147_KPL-DLA-LS-XX- DR-A-90002_RevP07_SITE PLAN PLOT L
 - ii. 2022-147_KPL-DLA-L1-01-DR-A-20000_RevP03_UNIT L1 PROPOSED GROUND & FIRST FLOOR PLANS
 - iii. 2022-147_KPL-DLA-L1-RF-DR-A-20002_ RevP03_UNIT L1 PROPOSED ROOF PLAN
 - iv. 2022-147_KPL-DLA-L1-XX-DR-A-20010_ RevP03_UNIT L1 PROPOSED ELEVATIONS & SECTION
 - v. 2022-147_KPL-DLA-L2-01-DR-A-20000_Rev P03_UNIT L2 PROPOSED GROUND & FIRST FLOOR PLANS
 - vi. 2022-147_KPL-DLA-L2-RF-DR-A-20002_RevP P03_UNIT L2 PROPOSED ROOF PLAN

- vii. 2022-147_KPL-DLA-L2-XX-DR-A-20010_RevP03_UNIT L2 PROPOSED ELEVATIONS & SECTION
- viii. 2022-147_KPL-DLA-L3-01-DR-A-20000_RevP03_UNIT L3 PROPOSED GROUND & FIRST FLOOR PLANS
- ix. 2022-147_KPL-DLA-L3-RF-DR-A-20002_RevP03_UNIT L3 PROPOSED ROOF PLAN
- x. 2022-147_KPL-DLA-L4-XX-DR-A-20010_RevP03_UNIT L4 PROPOSED ELEVATIONS & SECTION
- xi. 2022-147_KPL-DLA-L5-01-DR-A-20000_RevP03_UNIT L5 PROPOSED GROUND & FIRST FLOOR PLANS
- xii. 2022-147_KPL-DLA-L5-RF-DR-A-20002_RevP03_UNIT L5 PROPOSED ROOF PLAN
- xiii. 2022-147_KPL-DLA-L5-XX-DR-A-20010_RevP03_UNIT L5 PROPOSED ELEVATIONS & SECTION

2. POLICY CONTEXT

Introduction

- 2.1 This section of the Energy Statement reviews relevant policy at the international, national, regional, and local levels and then discusses key issues for the Statement.

Climate Change

- 2.2 Climate change is a long-term change in the average weather patterns that have come to define Earth's local, regional, and global climates. These changes have a broad range of observed effects that are synonymous with the term.
- 2.3 Changes observed in Earth's climate since the early 20th century are primarily driven by human activities, particularly fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth's atmosphere, raising Earth's average surface temperature. These human-produced temperature increases are commonly referred to as global warming. Natural processes can also contribute to climate change, including internal variability (e.g., cyclical ocean patterns like El Niño, La Niña, and the Pacific Decadal Oscillation) and external forcing (e.g., volcanic activity, changes in the Sun's energy output, variations in Earth's orbit).
- 2.4 Scientists use observations from the ground, air, and space, along with theoretical models, to monitor and study past, present and future climate change. Climate data records provide evidence of climate change key indicators, such as global land and ocean temperature increases; rising sea levels; ice loss at Earth's poles and in mountain glaciers; frequency and severe changes in extreme weather such as hurricanes, heatwaves, wildfires, droughts, floods, and precipitation; and cloud and vegetation cover changes, to name but a few.

United Nations Framework Convention on Climate Change

- 2.5 The international mechanism for addressing climate change is the United Nations Framework Convention on Climate Change (UNFCCC). Signed in 1992 at the United Nations Conference on Environment and Development, the Convention constitutes the foundational climate agreement that has provided the platform for most subsequent international climate agreements.
- 2.6 The Kyoto Protocol, which was signed in 1997 and which entered into force in 2005, was the first implementation of measures under the UNFCCC until 31 December 2020. The protocol was superseded by the Paris Agreement. Its supreme decision-making body, the Conference of the Parties (COP), meets annually to assess progress in dealing with climate change.

The Paris Agreement

- 2.7 The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at the United Nations Climate Change Conference in 2015 and entered into force in 2016. The 196 Parties to the UNFCCC reached a landmark

agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future.

- 2.8 The Paris Agreement builds upon the Convention and for the first time brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.
- 2.9 To achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a climate neutral world by mid-century. The Paris Agreement works on a 5-year cycle of increasingly ambitious climate action carried out by countries. Countries are required to submit their plans for climate action known as nationally determined contributions (NDCs).

The Paris Agreement and Nationally Determined Contributions

- 2.10 Through the Paris Agreement, Parties also agreed to a long-term goal for adaptation – to increase the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production.
- 2.11 Nationally determined contributions (NDCs) are at the heart of the Paris Agreement and the achievement of these long-term goals. NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change. The Paris Agreement (Article 4, paragraph 2) requires each Party to prepare, communicate and maintain successive nationally determined contributions (NDCs) that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions.

United Kingdom's (UK's) Nationally Determined Contributions

- 2.12 The UK's target under the Paris Agreement of 2015, when it shared a common plan on emissions with the EU, was for a 53% cut by 2030. However, that was widely regarded as not stretching, and the UK also had a domestic carbon budget under the Climate Change Act requiring a 57% reduction on average from 2028 to 2032.
- 2.13 In December 2020, the UK announced that it will cut its carbon emissions by 68% compared with 1990 levels before 2030, a significant increase on the current target of about 57% reductions. This represents the UK's nationally determined contribution towards meeting the Paris Agreement.
- 2.14 The UK was already committed to reducing carbon emissions to zero by 2050, with an interim target of 53%. The ambitious target would see the UK cutting emissions faster than any major economy so far and follows the advice of the government's statutory advisers, the committee on climate change, which found the costs of cutting emissions had fallen rapidly in the past few years.
- 2.15 In April 2021 at the climate summit, the U.K. government confirmed its plan to put the U.K. on course to meet its target of reaching net zero carbon emissions by 2050.

Climate Change Act

- 2.16 The Climate Change Act (2008) sets a legally binding target for reducing UK CO₂ emissions by at least 80% on 1990 levels by 2050. It established the Committee on Climate Change, which is responsible for setting binding interim carbon budgets for the Government over successive five-year periods.
- 2.17 To meet these targets, the government has set five-yearly carbon budgets which currently run until 2032. The carbon budgets restrict the amount of greenhouse gas the UK can legally emit in a five-year period. The UK is currently in the fifth carbon budget period (2028 to 2032).
- 2.18 The Climate Change Committee (CCC) has published its recommendation on the level of the Sixth Carbon Budget in December 2020. It sets the path to the UK's Net Zero emissions target in 2050, as the first carbon budget to be set into law following that commitment.
- 2.19 For the first time, this Carbon Budget will incorporate the UK's share of international aviation and shipping emissions – an important part of the government's decarbonisation efforts that will allow for these emissions to be accounted for consistently.

Planning and Energy Act

- 2.20 The Planning and Energy Act (2008) allows local planning authorities' policies to impose reasonable requirements for a proportion of energy used in developments to be from renewable and low carbon sources in the locality of the development.
- 2.21 This means local planning authorities have the power to set local energy efficiency standards for new homes that go beyond the minimum standards set through the Building Regulations.
- 2.22 For example, the local council could require developers to source at least 10 per cent of any new building's energy from renewable sources, implementing the so-called 'Merton Rule', named after the sustainable planning policy, first adopted by the London Borough of Merton.
- 2.23 It is however expected that the new planning reforms (expected to come into force in 2025) will clarify the longer-term role of local planning authorities in determining local energy efficiency standards.

UK Sustainable Development Strategy

- 2.24 The UK Sustainable Development Strategy recognises that everybody has the right to a healthy, clean, and safe environment. In 2005, the government published an updated strategy for implementing sustainable development across the UK.
- 2.25 This strategy acts as an overarching document from which a range of specific policies and legislation was derived. Although published in 2005, the strategy has taken a

recently renewed focus in light of the government's definition of Sustainable Development in the National Planning Policy Framework (NPPF).

- 2.26 One of the keys aims of this strategy is to recognise the threats of climate change and ensure that the UK develops a strategy to mitigate and adapt to this phenomenon. The document established five key principles that will underpin the national sustainable development strategy:
- i. Living within Environmental Limits;
 - ii. Ensuring a Strong, Healthy and Just Society;
 - iii. Achieving a Sustainable Economy;
 - iv. Promoting Good Governance; and
 - v. Using sound science responsibly
- 2.27 The strategy will be implemented at a national level through the development of more specific strategies at a government department or sector level.
- 2.28 With regards to planning and the built environment, this document set the basis for the development of plans and policies that promote development that mitigates and adapts to climate change.

Directive 2009/28/EC of the European Parliament and of the Council

- 2.29 The Directive 2009/28/EC of the European Parliament and of the Council on renewable energy, implemented by Member States by December 2010, sets ambitious targets for all Member States.
- 2.30 The directive, which amends and repeals earlier Directives 2001/77/EC and 2003/30/EC, creates a common set of rules for the use of renewable energy in the EU so as to limit greenhouse gas (GHG) emissions.
- 2.31 The European Union Renewable Energy Directive (Directive 2009/28/EC) sets an overall target for 20% of the energy consumed in the European Union to come from renewable sources by 2020. This overall target is divided by country, with the UK's target being 15% by 2020.
- 2.32 The UK's departure from the European Union may have major implications for future UK and EU climate policy. Although the UK Government has signalled its intention to stick to its existing carbon reduction commitments, it remains to be seen how the withdrawal of the United Kingdom from the European Union (Brexit) may impact on this.

Building Regulations

- 2.33 Whilst not planning policy, the Building Regulations and specifically Approved Document Part L: Conservation of Fuel and Power has relevance to the requirements for energy efficiency and carbon emissions of new buildings.
- 2.34 The primary mechanism for reducing carbon emissions in new commercial development is progressive changes to Part L aiming to deliver zero carbon buildings.

On this basis, a minimum requirement for the reduction in carbon emissions to be delivered by new buildings' is set within the Building Regulations, with each update requiring lower carbon emissions than the previous version to achieve compliance.

- 2.35 The update in June 2022 required new buildings other than dwellings to achieve 27% reduction in carbon emissions over the 2013 (with 2016 amendments) Regulations. This uplift is regarded as a first step towards making all buildings 'net zero ready' from 2025 when the Future Buildings Standard comes into effect, mandating a 75% reduction in emissions.

Approved Document L Volume 2: Buildings other than dwellings 2021

- 2.36 This approved document takes effect on 15 June 2022 for use in England. It does not apply to work subject to a building notice, full plans application or initial notice submitted before that date, provided the work for each building is started before 15 June 2023.
- 2.37 Part L amendments introduce a new principal performance metric measuring energy efficiency. 'Primary energy' will be used in combination with CO₂ metrics to assess compliance with Part L. Primary energy calculations take into account factors such as the efficiency of the building's heating system; power station efficiency for electricity; and energy used to produce fuel and deliver it to the building.
- 2.38 This change aims to strike a balance between the commitment to reducing carbon emissions and improving energy efficiency and ensuring that the overall effect of regulation does not stifle growth. These changing national regulations will drive energy efficiency and carbon reduction improvements in new buildings. The government has stated that developers will continue to have flexibility in how they meet carbon reduction targets; but that the emphasis is on using a fabric first approach.
- 2.39 The government also published its updated Building Regulations for England which includes amendments to Approved Documents Part F (ventilation), as well as the release of a new Approved Document for overheating (Part O). They are all viewed as a part of the country's journey towards net zero and are aimed at driving energy efficiency up and carbon emissions down in residential buildings.
- 2.40 The scope of the new regulations will affect both existing and new build properties and will change how heating and ventilation is specified.
- 2.41 All new residential buildings, including care and children's homes, and student accommodation, will have to be designed to reduce overheating under changes to Part F, and with the introduction of Part O. Higher standards of ventilation will be introduced to improve IAQ and reduce the spread of airborne viruses in new non-residential buildings, including additional standards for recirculating ventilation systems in new offices, along with the compulsory installation of CO₂ monitors.
- 2.42 Amendments to Part L are focused on measures that enable a building to produce less carbon emissions and will act as an interim uplift before the stricter demands of the Future Building Standard come into force in 2025.

- 2.43 The new edition raises the threshold for efficiency with new requirements for insulation, thermal bridging, primary energy targets and air leakage testing requirements. In addition, there has been a change in carbon factor of electricity, meaning the use of electrically powered heating systems (especially heat pumps) is especially incentivised.

The Future Buildings Standard

- 2.44 In the 2019 Spring Statement, the UK Government's made a commitment that by 2025 they will introduce a Future Buildings Standard for new buildings to be future-proofed with low carbon heating and world-leading levels of energy efficiency. The introduction of the Future Buildings Standard will achieve a considerable improvement in energy efficiency standards for new buildings.
- 2.45 The Future Buildings Standard consultation, launched in October 2019, represented a first step in incentivising these changes by providing a clear vision for implementation and setting an ambitious uplift to the energy performance requirements in the Building Regulations for new buildings.
- 2.46 On 19 January 2021, the government published the outcome of its 2019 consultation on the Future Buildings Standard. This consultation set out the government's plans for a new green Future Buildings Standard and sought views on changes to building regulations in England to improve energy efficiency and cut carbon emissions in new build buildings.
- 2.47 The government has confirmed that it will change building regulations so that from 2025 the Future Buildings Standard will deliver buildings that are zero-carbon ready. Buildings built under the Future Buildings Standard should produce 75-80% less carbon emissions compared with current levels and become net zero as the electricity grid continues to decarbonise.
- 2.48 The intention is that buildings built to the Future Buildings Standard will not need to be retrofitted with any additional measures or technology to become net zero. The Future Buildings Standard should see buildings fitted with low carbon forms of heating. The expectation is that heat pumps will become the main source of heating system for most new building.
- 2.49 A full technical specification for the Future Buildings Standard will be consulted on in 2023. Legislation will be introduced in 2024, ahead of implementation in 2025.
- 2.50 The government confirmed that once a new build has been built, no refurbishment will be necessary to reach zero-carbon as the electricity grid continues to decarbonise – and no new build built under the Future Buildings Standard will be reliant on fossil fuels.

Clean Growth Strategy

- 2.51 Clean Growth means growing the UK national income while cutting greenhouse gas emissions. The Clean Growth Strategy sets out the Governments proposals for decarbonising all sectors of the UK economy through the 2020s. It provides a route for the UK to take advantage of low carbon opportunities, while meeting national and international commitments to tackle climate change.

National Design Guide (2019)

- 2.52** Published in October 2019 the National Design Guide prepared by the Government sets out the characteristics of well-designed places and demonstrates what good design means in practice.
- 2.53** Sustainability is a key theme running through the Guide and Section 7, Resources in particular provides guidance on the delivery of efficient and resilient development. This includes development, which is designed in accordance with the energy hierarchy, utilises sustainable materials and maximise resilient to climate change.

National Planning Policy Framework

- 2.54** The updated National Planning Policy Framework (NPPF) published 2021 sets out the Government's planning policies for England and how these should be applied. The National Planning Policy Framework (NPPF) introduced the presumption in favour of sustainable development. It states that:

"[...] The purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs.

Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

- i. an economic objective: to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;*
 - ii. a social objective: to support strong, vibrant, and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and*
 - iii. an environmental objective: to contribute to protecting and enhancing our natural, built, and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy. [...]"*
- 2.55** The NPPF supports the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It helps to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy & associated infrastructure.

2.56 For the NPPF to support the move to a low carbon future, the local planning authorities should ensure new building developments are planned for in ways that:

- i. *“[...] Avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and*
- ii. *Can help to reduce greenhouse gas emissions, such as through its location, orientation, and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards. [...]”*

2.57 For the NPPF to support the move to a low carbon future, the local planning authorities should ensure new development are planned to help increase the use and supply of renewable and low carbon energy and heat by:

- i. *“[...] Provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);*
- ii. *Consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and*
- iii. *Identify opportunities for development to draw its energy supply from decentralised, renewable, or low carbon energy supply. [...]”*

2.58 For the NPPF to support the move to a low carbon future, the local planning authorities should ensure new development:

- i. *“[...] Comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable); and*
- ii. *Take account of landform, layout, building orientation, massing, and landscaping to minimise energy consumption. [...]”*

2.59 The key focus of the National Planning Policy Framework (NPPF) is to support local and regional planning authorities.

Planning Practice Guidance (The Guidance)

2.60 The National Planning Practice Guidance (NPPG) published 2012 and as revised from time to time provides further advice on various planning issues associated with development, including those linked to sustainability and renewable energy and underpins the policies within the NPPF.

2.61 The PPG Guidance is an important material consideration in planning decisions and should generally be followed unless there are clear reasons not to. It sets out how local authorities should include policies that protect the local environment and strategies to mitigate and adapt to climate change and supports developments that are functional and adaptable for the future.

- 2.62 The PPG confirms Local Authorities have the option to set technical requirements exceeding the minimum requirements of the Building Regulations in respect of access, water, and space where sufficient evidence is produced to justify the target.
- 2.63 The Guidance also states that Local Authorities can set carbon reduction targets equivalent to a 19% reduction beyond the 2013 Building Regulations and renewable energy policies for non-domestic buildings. However, Local Authorities have the power to include policies imposing excess of the 19% requirements at their discretion.
- 2.64 The Guidance states that the distribution and design of new development, and the potential for servicing sites through sustainable transport solutions, are particularly important considerations and that good design is an integral part of sustainable development to deliver a wide range of planning objectives.

Net Zero Strategy: Build Back Greener

- 2.65 Published in October 2021, this document sets out clear policies and proposals for the decarbonisation of all sectors of the UK economy to meet our net zero target by 2050, building on from the Prime Minister's Ten Point Plan for a Green Industrial Revolution.
- 2.66 The strategy follows a systems approach and sets out HMG plans for reducing emissions from each sector of our economy whilst absorbing any remaining emissions with greenhouse gas removals – either natural, like trees or technological, using carbon capture approaches. Being the first major economy to create a legally binding target to bring down greenhouse gas emissions to net zero by 2050, this strategy demonstrates how the UK is leading by example, with a clear plan for the future.

Heat and Buildings strategy

- 2.67 Published in October 2021, this strategy sets out the Government's plans to cut emissions from the UK's 30 million homes and workplaces whilst ensuring that prices remain fair and affordable for households across the country. It will be a gradual transition which will start by incentivising consumers and driving down costs.
- 2.68 As well as allowing for the saving of money on energy bills and improving health standards through the reduction of carbon emissions, this strategy aims to boost the economic recovery by supporting up to 240,000 skilled green jobs by 2035.
- 2.69 In addition to clean heat, the strategy compiles the Government's work on energy efficiency and the requirement for better and smarter energy performance. Both will be paramount to the journey of a net zero future in the UK.

Rochdale Adopted Core Strategy Development Plan (RDP) 2016

- 2.70 The Rochdale Core Strategy Development Plan (RDP) 2028 was adopted by Rochdale Borough Council on 10 November 2016. The RDP sets out a spatial vision and strategy for the sustainable growth of Rochdale for the period 2016 to 2028, and is used to guide decisions on planning, development and regeneration in Rochdale. The RDP replaced the policies in the Unitary Development Plan (UDP) June 2006.

2.71 The Core strategy is the lead document of the Council's Local Plan, the other documents that make up the Borough's Local Plan are as followed:

- i. Site Allocations Development Plan Document
- ii. Greater Manchester Joint Minerals Plan (Currently in preparation)
- iii. Greater Manchester Joint Waste Plan (Adopted)
- iv. Area and Neighbourhood Plans.

2.72 The Rochdale's Core strategy sets out a framework that will guide future development across the Borough, in particular how climate change is addressed, quality of life, delivery of infrastructure, creation of an inclusive economy and Rochdale's national/international role. The key policies of the RDP in terms of Sustainable Development policies and targets are as follows:

- i. Policy G1: Tackling and adapting to climate change
- ii. Policy G2: Energy and new development
- iii. Policy G3: Renewable and low carbon energy developments

2.73 Policy G1: This policy addresses climate change and ensures growth does not increase CO2 emissions by:

- i. Requiring new developments to reduce CO2 emissions and water consumption;
- ii. Promoting and supporting the use of low and zero carbon energy sources and technologies;
- iii. Promoting the use of CHP schemes and district heating;
- iv. Encouraging the use of waste as a resource;
- v. Promoting sustainable transport systems including cycling and walking.;
- vi. Supporting the development of new low carbon technologies; and
- vii. Encouraging developers to take account of the natural features of a site (e.g. orientation and landscape features) to minimise energy use.

2.74 New developments will be expected to:

- i. Be zero carbon in line with national targets and definitions;
- ii. Adhere to the 'energy hierarchy' as outlined in policy G2, being designed in such a way
- iii. that ensures that buildings require the minimum amount of energy to function over their lifetime;
- iv. Reduce CO2 emissions through the use of renewable and low carbon decentralised energy technologies and networks. This will be through both on-site provision in new developments and through connection to local networks;
- v. Address the impacts of climate change by incorporating comprehensive adaptation measures.

2.75 Policy G2: This policy expects all new developments to adhere to the above energy hierarchy reflecting national policy, targets and requirements. These include:

- 2.76 Demand Reduction: Achieving the maximum possible reduction in demand for energy through building design throughout their lifetime with considerations to its orientation, layout, construction and landscaping. The of natural passive systems such as solar gain, natural lighting, shading, ventilation and cooling to minimise heating. Green roofs and green walls should also be incorporated into development wherever feasible.
- 2.77 Energy efficiency and LZC technologies and networks: The use of low or zero carbon technologies to maximize energy efficiency.
- 2.78 Allowable Solutions: The use of wider energy/CO2 reduction measures to compensate for residual emissions, these include the following:
- i. On site measures such as heat networks
 - ii. Retrofitting existing buildings
 - iii. Contributions towards strategic infrastructure projects via a Greater Manchester fund.
 - iv. Contributions towards connecting existing buildings to district heating networks (network development areas)
 - v. Contributions towards tree planting or other measures to reduce CO2 through natural systems.
- 2.79 Policy G3: This policy requires new development to incorporate the provision for low & zero carbon forms of energy generation or to connect into low & zero carbon energy generation networks where they exist. This shall be achieved wherever practicable & unless it can be demonstrated that the cost of achieving this would make the proposed development unviable.

Climate Emergency

- 2.80 In July 2019, the Rochdale Borough Council declared a climate emergency with the aim of becoming a carbon neutral Borough by 2050 in line with the Mayor and Government's targets. The Draft Climate Change Strategy Plan mentions Rochdale Borough Council hopes it can achieve this target earlier by 2038 in alignment with the sustainable Development Goals and Greater Manchester Environmental Plan.

Planning Policy Summary

- 2.81 Both local and national policy aims to ensure the delivery of sustainable development and well-designed buildings which mitigate and adapt to the potential impacts of climate change. Recent policy changes have confirmed the UK's commitment to a legally binding target of net zero emissions by 2050 and reiterates the importance of low carbon new buildings in ensuring this target is met.
- 2.82 The Rochdale's Core Plan confirms the Council's commitment to the creation of sustainable new developments. The Applicant is committed to the delivery of sustainable development and the following sections of this report set out the sustainable design measures included for the Proposed Development to ensure the delivery of a sustainable development providing economic, social & environmental benefits & address the requirements of local policy.

3. BASELINE: TARGET ENERGY AND CO₂ EMISSIONS

- 3.1 The baseline energy demand and CO₂ emissions due to end-uses by Building Regulations have been calculated using the National Calculation Methodology (NCM) ApacheSim Dynamic Simulation Modelling (DSM) 2021.
- 3.2 Unlike SBEM (Simplified Building Energy Model), DSM is a much more accurate tool providing full annual simulation performed multiple times per hour using real hourly weather data.

Baseline Energy and Carbon Dioxide Emissions (TER)

- 3.3 DSM calculations have been performed to generate the energy demand and resultant CO₂ emissions of the Proposed Development.
- 3.4 Please note that all total figures include regulated consumption assessed within Building Regulations only, equipment energy (appliances, including equipment and small power) is not calculated within Building Regulations as the developer is unable to directly influence this end-use.
- 3.5 The baseline regulated energy and CO₂ emissions are equivalent to the Building Regulations Approved Document Part L worst allowable Target Emissions Rate (TER) calculated within the DSM assessment of the Proposed Development.
- 3.6 **Table 3.1** and **3.2** shows the baseline energy demand and carbon emissions. Refer to **Appendix 1** for the baseline BRUKL document:

Table 3.1: Baseline Energy Demand (TER)

BASELINE (TER): ENERGY DEMAND				
	Energy Demand (kWh/year)			
	Unit 1	Unit 2	Unit 3	Unit 4
Heating	90,203.36	62,669.23	25,593.60	35,673.48
Cooling	502.18	242.90	275.20	222.82
Auxiliary	15,002.51	9,635.19	3,973.20	5,258.55
Lighting	27,368.59	15,991.18	7,963.60	9,581.26
Hot Water	24,418.31	15,626.82	6,467.20	8,511.72
TOTAL PART L BASELINE (TER)				365,180.92

Table 3.2: Baseline Carbon Dioxide Emissions (TER)

BASELINE (TER): CARBON DIOXIDE EMISSIONS				
	CO ₂ Emissions (Tonnes/CO ₂ /year)			
	Unit 1	Unit 2	Unit 3	Unit 4
Part L Baseline (TER) CO ₂	19.40	10.93	4.70	7.31
TOTAL PART L BASELINE (TER)				42.33

4. ENERGY AND CO₂ REDUCTION STRATEGY METHODOLOGY

- 4.1 The design of the Proposed Development has been developed to reduce its annual energy consumption, provide energy in an environmentally friendly way, and to minimise its annual CO₂ footprint.
- 4.2 To achieve this, the Proposed Development will adopt an energy hierarchy (**Figure 4.1**) approach to meet Rochdale Borough Council's Development Plan (RDP) 2016 Policies G1-G3 objectives for energy / carbon emissions reduction and sustainable design.
- Use Less Energy (**Be Lean**); then
 - Supply Energy Efficiently (**Be Clean**); and finally
 - Use Renewable Energy (**Be Green**).



Figure 4.1: Energy Hierarchy

- 4.3 Energy saving measures following the Fabric First Approach is encouraged. This will reduce energy demand and consequently the energy bills by investing in improving the building fabric's thermal properties and using efficient building services. This is often referred to as 'Be Lean'.
- 4.4 The Fabric First approach provides protection against fluctuations in both gas and electricity supply tariffs by inherently reducing energy consumption and expands the number of suitable energy generation and delivery options.
- 4.5 Further improvements in building services, over and above the minimum requirements to comply with Building Regulations Part L, can reduce energy demand further and shall be described within the 'Be Clean' section. This includes identifying the proposed development site heat/cooling demand, investigating existing/planned decentralised energy and heat network, and the potential for a new heat district network as part of the Proposed Development.
- 4.6 An investigation into a combined heat and power (CHP) system shall also be conducted based on the Proposed Development estimated annual baseload. CHP systems generate electricity from burning fossil fuels and capture the heat generated in the process for heating purposes. In order for CHP technology to be appropriate the site needs to have a suitable base-load heat demand.
- 4.7 Finally, the use of on-site renewable technologies will be assessed to offset the development's residual energy demand and CO₂ emissions. The use of the energy hierarchy will help to reduce the size of any on-site renewable technologies required by ensuring that energy consumption and CO₂ emissions is driven out of the scheme by the Fabric First approach.

5. BE LEAN: ENERGY EFFICIENT DESIGN MEASURES

- 5.1 Energy demand and CO₂ reduction has been considered in three stages: layout and orientation; building fabric; and building services. The proposals to reduce energy at each of these stages are described within this section.

Layout and Orientation Analysis

- 5.2 The opportunities for orientation and layout of this site have been maximised. The offices are orientated such that the glazing shall be on either the north-east, south-east or south-west façade.
- 5.3 These orientations are ideal for office areas as they provide an optimum balance between beneficial solar gains, diffuse/natural lighting whilst avoiding the risks of overheating.
- 5.4 Furthermore, the site is expected to be sheltered by similar industrial/commercial units. These are likely to provide considerable protection from winds, including prevailing winds, hence passively reducing the proposed development heating demand.
- 5.5 Shelter from wind is especially important in industrial warehouse buildings with vehicle access loading doors, as this can significantly reduce the ingress of cold external air when the loading doors are opened.
- 5.6 It is also proposed that the warehouse areas shall have roof lights in order to maximise the availability of natural daylight.
- 5.7 This strategy will help reduce the demand for artificial lighting and saves energy. It will also help to create a visually stimulating and productive environment for building occupants.

Building Fabric Analysis

- 5.8 In order to reduce the demand for heating and cooling energy, it is proposed to construct the development with a highly thermal efficient building envelope.
- 5.9 To meet Building Regulations Approved Document Part 2021 (Volume 2) Standard and to ensure the development is future proofed for the longer term and ready to meet the Future Building Standard from 2025, the Proposed Development shall be well insulated with measures taken to achieve a high degree of air tightness.
- 5.10 The development fabric elements making up the envelope shall therefore be specified to exceed the minimum standards set in Part 2 (Volume 2) to ensure energy consumption via space heating and cooling is reduced.
- 5.11 **Table 5.1** shows the proposed level of performance in comparison with the worst allowable standards for each element, with the floor u-value calculation based on the perimeter to area (P/A) ratio as detailed in **Appendix 2**.

Table 5.1: Proposed Fabric Specification

PROPOSED FABRIC SPECIFICATION			
Element	Proposed U-values	Part L 2021 Worst Allowable U-values	Percentage Improvement (%)
Ground Floor (L1)*	0.14 W/m ² .K	0.18 W/m ² .K	22.89 %
Ground Floor (L2)*	0.17 W/m ² .K	0.18 W/m ² .K	5.56 %
Ground Floor (L3)*	0.18 W/m ² .K	0.18 W/m ² .K	00.00 %
Ground Floor (L4)*	0.17 W/m ² .K	0.18 W/m ² .K	5.56 %
External Wall	0.26 W/m ² .K	0.26 W/m ² .K	00.00 %
Roof	0.18 W/m ² .K	0.18 W/m ² .K	00.00 %
Glazed Windows (inc. frame)	1.40 W/m ² .K	1.60 W/m ² .K	12.50 %
Rooflights	1.80 W/m ² .K	2.20 W/m ² .K	18.18 %
Solid Pedestrian Door	1.60 W/m ² .K	1.60 W/m ² .K	00.00 %
Vehicle Access Door	1.30 W/m ² .K	1.30 W/m ² .K	00.00 %
Air Permeability	3.00 m ³ /(hr.m ²)	8.00 m ³ /(hr.m ²)	62.50 %

*Refer to Appendix 2 for the ground floor u-value calculations using the perimeter area (PA) ratio methodology

- 5.12 Light and Solar Transmittance (g-values) are factors that measure the amount of light and solar energy that pass through glazed openings. They are important as they affect the control of solar gains and availability of natural light into the building.
- 5.13 **Table 5.2** shows the proposed light and solar transmittance values recommended for the Proposed Development.

Table 5.2: Proposed Light and Solar Transmittance Specification

PROPOSED GLAZING SPECIFICATION			
Element	Description/ Notes	Proposed Solar Transmittance	Proposed Light Transmission
Window	Proposed specification	0.29	0.60
Roof lights	Proposed specification	0.38	0.71

- 5.14 In addition to the Proposed Development improved envelope u-values, a key area of construction which could result in a significant reduction in heating demand are junction details where two elements of the development envelop meet (thermal bridging).
- 5.15 The proposed development has been modelled using ApacheSim Dynamic Simulation Modelling (DSM). For DSM software, the non-repeating thermal bridge [Psi (Ψ)] heat losses for each element (including windows etc) is automatically allowed for by adding 25% to the standard area weighted average U-values. Consequently, for the proposed development DSM analysis, an additional 25% heat loss is automatically added to make

an allowance for the extra conduction via non-repeating thermal bridges in accordance with BS EN ISO 14683. Thus, an Alpha value of 25% within the BRUKL document can be observed.

- 5.16 The proposed development will be designed to make use of best practice design (such as construction joint details calculated by a suitably competent person following the guidance detailed in BR 497 or from a reputable non-government database containing independently assessed thermal junction details) to minimise thermal bridging, energy losses, and reducing CO₂ emissions.
- 5.17 Therefore, it is proposed that the details between different envelope elements should be carefully designed in order to maintain continuity of insulation.

Building Services Analysis

- 5.18 The following services are proposed for the development in order to reduce energy consumption and carbon dioxide emissions through energy efficient equipment and services strategy.

Space Heating and/or Cooling:

- 5.19 Space heating/cooling to the office and reception area is provided via a Variable Refrigerant Flow (VRF) system with a minimum seasonal efficiency of 340% in heating mode and 510% in cooling mode – Refer to chapter 7 for further details.
- 5.20 Space heating to all other areas within the proposed development (WCs and circulation areas) are provided via electric panel heaters with a seasonal efficiency of 100%. In order to further reduce the energy demand, all heating system would be provided with central time, local time and local temperature etc (i.e., BMS Control).
- 5.21 The calculation assumes space heating shall also be provided to the warehouse area (shell) via an Air Source Heat Pump with a heating efficiency of 250% in accordance with the Non-Domestic Building Services Compliance Guide (NDBSCG) and in line with the ongoing decarbonisation of the UK electricity grid.

Domestic Hot Water:

- 5.22 Domestic hot water to the core areas is provided via a stand-alone electric water heater with a 10 litres storage and a storage loss of 0.0710 kWh/l/day assumed. Domestic hot water to the warehouse area (shell) is assumed to be provided via an Instantaneous Electric Water Heater in accordance with the NDBSCG.

Ventilation:

- 5.23 Ventilation to the office and reception areas are provided via a Mechanical Ventilation Unit with 85.00% efficient heat recovery. Such Mechanical Ventilation Unit with heat recovery system can significantly reduce the winter heat demand by pre-heating supply air with extract air. The system shall therefore be selected to have a specific fan power (SFP) of no greater than 1.50 Watt/litres/second [W/(l/s)].

- 5.24 Extract ventilation to the WCs area shall be selected to have a specific fan power (SFP) of no greater than 0.30 W/(l/s) with a flow rate of 6 l/s assumed per WC.

Lighting:

- 5.25 All areas within the proposed development are proposed to be served by energy efficient LED lightings to reduce electricity consumption.
- 5.26 Lighting to the office areas is proposed to be served by LED lightings with efficacy of no less than 120 lumens per circuit Watt.
- 5.27 Lighting to the WCs, circulation and store areas are proposed to be served by LED lightings with efficacy of no less than 100 lumens per circuit Watt.
- 5.28 Lighting to the lifts and warehouse is proposed to be served by LED lightings with efficacy of no less than 95 lumens per circuit Watt in accordance with the NDBSCG.
- 5.29 It is proposed that lighting to the office area shall be provided with photoelectric dimming and PIR (passive infra-red) sensors to provide auto-on-off control with a parasitic power of no greater than 0.10 W/m². This is to ensure that artificial lightings shall not be fully utilised when there is sufficient natural light or space is unoccupied.
- 5.30 It is proposed that lighting to the WCs, circulation and store areas shall be provided with PIR (passive infra-red) sensors to provide auto on-off control with a parasitic power of no greater than 0.10 W/m². This is to ensure that artificial lightings shall not be utilised when spaces are unoccupied.
- 5.31 It is assumed that lighting to the warehouse area (shell) shall be provided with photoelectric dimming and PIR sensors to provide auto-on-off control with a parasitic power of no greater than 0.30 W/m². This is to ensure that artificial lightings shall not be fully utilised when there is sufficient natural light or space is unoccupied in accordance with the NDBSCG and the Building Regulations.

Metering:

- 5.32 It is proposed that all Proposed Development's services shall be fitted with metering which will communicate meaningful information, enabling the building occupier to address and adjust the system to satisfy the requirements of paragraph 5.17 of ADL2.

Power Factor Correction:

- 5.33 A power factor correction device can adjust the wavelength of the electricity supply to ensure that minimal electrical energy is wasted within the building. However, no power factor correction system has been assumed/proposed for the Proposed Development.

6. BE CLEAN: SUPPLYING ENERGY EFFICIENCY

6.1 The clean energy supply hierarchy is followed as such:

- i. Connection to existing or planned district heat networks, and
- ii. Site wide Combined Heat and Power (CHP) network.

Connection to existing or planned district heat networks

6.2 District heating is an alternative method of supplying heat to buildings, using a network of super insulated pipes to deliver heat to multiple buildings from a central heat source.

6.3 Heat is generated in an energy centre and then pumped through underground pipes to the building (**Figure 6.1**). Building systems are usually connected to the network via a heat exchanger, which replaces individual boilers for space heating and hot water.

6.4 Desktop study was undertaken to investigate whether an existing distribution network was in place close to the proposed development site. However, there are no existing district heating networks within 500m of the site, therefore, connection to an existing network is not feasible/recommended.

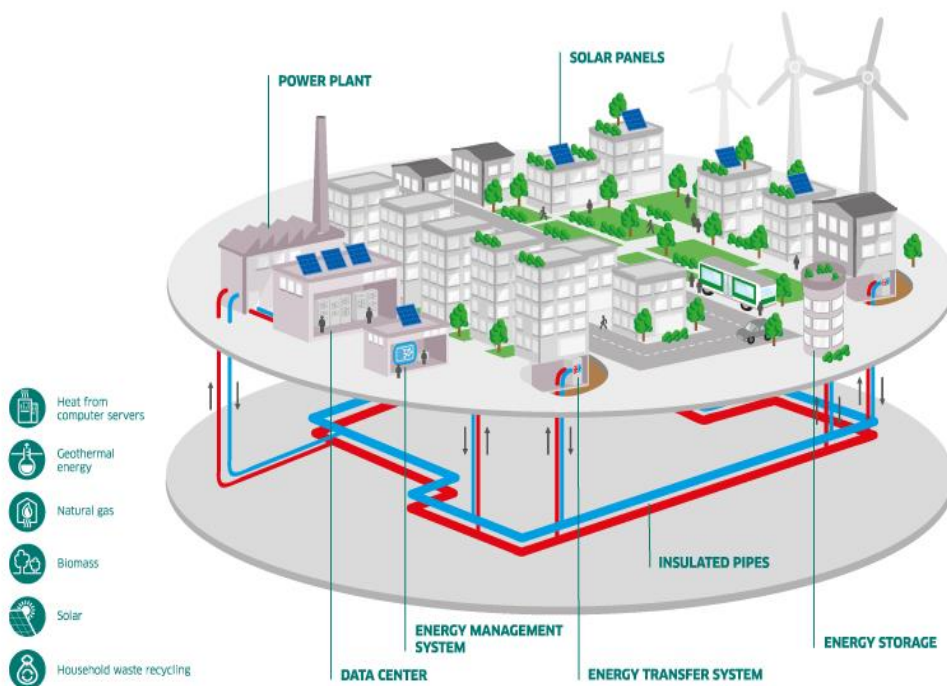


Figure 6.1: District Heating and Cooling Systems Schematic

6.5 Whilst the Proposed Development will not rely on third parties to meet their heat or power requirement, some flexibility may be included to allow third party energy connection. It is therefore recommended that the proposed development be left with spare valve connections, capable for connection into any future heat network, should the applicant/tenant wish.

- 6.6 New network (such as a Centralised Air Source Heat Pump Energy) could be considered for the Proposed Development Site and if applicable will incorporate good practice design and specification standards. Poorly designed heat network infrastructure within a scheme can contribute towards internal overheating problems, especially in communal areas, and high service charges.
- 6.7 To avoid this, the applicant will work with their chosen heat network operator from pre-design and commit to designing and delivering communal heating systems in compliance with the relevant CIBSE/ADE Heat Networks Code of Practice for the UK and in partnership with energy services companies registered with the Heat Trust scheme. This will support the development of good quality networks whilst helping network operators prepare for regulation / ensuring that customers are offered a reliable and cost-competitive service.
- 6.8 The administrative burden of managing a new heat network at this small scale based on the proposed development energy profile, however, means it is generally uneconomic for developers to pursue.

Site Wide Combined Heat and Power (CHP) network

- 6.9 Combined Heat and Power systems generate electricity from burning fossil fuels and capture the heat generated in the process for heating purposes. CHP can be used where there is a significant year-round need for heating, in addition to the electricity generated.
- 6.10 For Combined Heat and Power (CHP) technology to be appropriate the site needs to have a suitable base-load heat demand. CHP works most effectively when it is operating consistently for long periods of the day throughout the year; therefore, a consistent year-round heat demand is required in order to avoid heat rejections during CHP operation.
- 6.11 CHP requires significant capital investment in plant and resources. Gas-engine CHP has been the primary technology for facilitating the development of district heat networks due to its high efficiency and better carbon performance compared to electrical systems utilising grid electricity. However, the rapid decarbonisation of the UK electricity grid means that technologies generating onsite electricity will not achieve the carbon savings they have to date.
- 6.12 The annual predicted space heating and domestic hot water demands of the Proposed Development based upon the DSM calculations performed for this analysis suggest the domestic hot water demands during the summer are significant and could potentially be sufficient a base-load demand for a CHP system.
- 6.13 However, considering the Proposed Development is situated in an Air Quality Management Area (AQMA), CHP is not a suitable option for the Proposed Development site due to the adverse impacts on air pollution.
- 6.14 Moreover, the National Grid in the UK is decarbonising rapidly, thus communal low-temperature heating system such as CHP will not be proposed in favour of a low carbon renewable energy solution.

7. BE GREEN: PROPOSALS FOR RENEWABLE ENERGY GENERATION

Low and Zero Carbon Feasibility Study

- 7.1 The next stage in the energy hierarchy is investigating opportunities for producing, storing, and using renewable energy on-site. Generating low carbon energy onsite can reduce reliance on fossil fuels & minimises energy lost through transmission, contributing to security of supply and better connections between energy demand and generation.
- 7.2 An initial renewable energy options assessment has been undertaken using the Renewable Energy Sources Estimation Tool (RESET) – Figure 7.1 which accompanies the CIBSE TM38 'Renewable Energy for Buildings' guidance document. This toolkit is intended for use at the earliest stages of design, when ideas are being considered and the outline direction of the design is developed, to identify the most promising renewable technology options for a given development or building. This is the key stage for some of the most important decisions relating to overall appearance, orientation, building mass and ventilation strategy, which can also influence decisions about renewable energy sources.

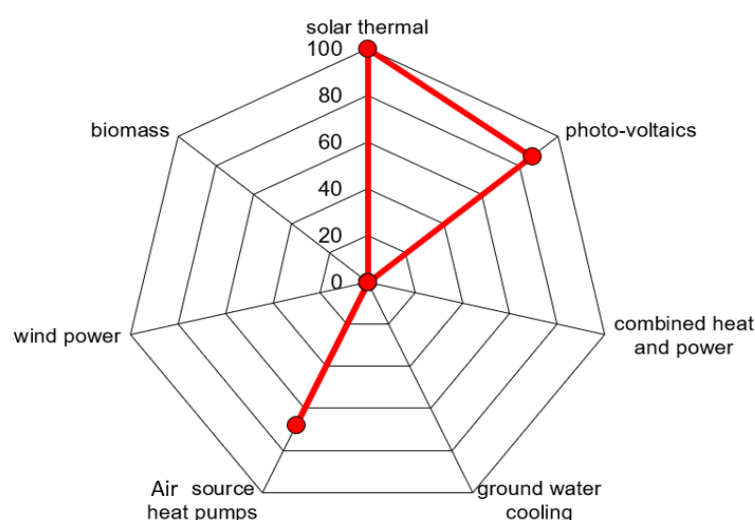


Figure 7.1: Initial Renewable Energy Feasibility

- 7.3 The initial assessment has been undertaken to judge the feasibility of renewable energy technologies from the outset, enabling viable technologies to be promoted and others to be ruled out from further consideration. The initial assessment demonstrates that Solar Thermal; Photovoltaic Panels; and Air Source Heat Pumps (ASHP) are all feasible technologies for the Proposed Development Site.
- 7.4 A further detailed review (**Table 7.1**) of potential low carbon renewable energy technologies has also been carried out to determine potential technologies which could be incorporated into the Proposed Development Site.
- 7.5 The detailed assessment further demonstrates that renewable technologies with a high opportunity include PV and ASHP. Technologies such as Solar Thermal, GSHP, WSHP, Waste Heat, Wind Turbine etc have been discounted at this stage based on a balanced consideration of the policy requirements, financial viability, and technical feasibility.

Table 7.1: Renewable Energy Feasibility Matrix

TECHNOLOGY	PRE-FEASIBILITY	
TECHNOLOGY	OVERVIEW	FEASIBLE
Solar Photovoltaic	Solar Photovoltaic or Photovoltaic Panels (PV) utilise energy in the form of rays of light from the sun and are therefore required to be mounted on either a south facing unobstructed roof or wall to ensure energy output is maximised. Photovoltaic systems convert energy from the sun into electricity through semiconductor cells. Systems consist of semi-conductor cells connected and mounted into modules. Modules are connected to an inverter to turn their direct current (DC) output into alternating current (AC) electricity for use in buildings. Photovoltaics supply electricity to the building they are attached to or to any other load connected to the electricity grid. Excess electricity can be sold to the national grid when the generated power exceeds the local need. PV systems require only daylight, not sunlight to generate electricity (although more electricity is produced with more sunlight), so energy can still be produced in overcast or cloudy conditions. Ideally photovoltaics should face between south-east and south-west, at an elevation of about 30-40°. However, in the UK even flat roofs receive 90% of the energy of an optimum system. PV arrays do not create a nuisance from noise, vibration, odour, or fumes and do not impact on air quality. The effectiveness of PV can be maximised with battery technology at a community level and within an individual house. By storing the energy generated in the day rather than exporting unused electricity back to the national grid, the electricity can be used when it is needed, avoiding distribution losses. This technology is becoming more cost effective and considering there is suitable shade free roof space available and daytime electricity demand expected. This technology is therefore considered suitable for the Proposed Development site.	Yes
Solar Thermal	Solar Thermal or Solar Water Heating Systems use the energy from the sun to heat water, most commonly in the UK for domestic hot water needs. The systems use a heat collector, generally mounted on the roof in which a fluid is heated by the sun. This fluid is used to heat up water that is stored in either a separate hot water cylinder or a twin coil hot water cylinder inside the building. The systems work very successfully in all parts of the UK, as they can work in diffuse light conditions. Ideally the collectors should be mounted on a south-facing roof, although south-east/south-west will also function successfully, at an elevation of between 10 and 60°. The panels can be bolted onto the roof or integrated into the roof with lead flashings. Solar water heating systems are suitable for any building type that has sufficient year-round hot water needs (ideally during the day). They require small amount of maintenance & do not create a nuisance from noise, vibration, odour, or fumes and do not impact on air quality. The technology is becoming more cost effective and may be suitable for the Proposed Development site. However, considering the dominant energy requirement is for domestic hot water and space heating, this technology has therefore not been considered further due to the very large scale of Solar Thermal panels required to meet a portion of the domestic hot water demand.	Not Proposed

Ground Source Heat Pump (GSHP)	Ground source heat pumps are used to extract heat from the ground to provide space and water heating to either individual houses or any type of non-domestic building. Heat pumps take in heat at a certain temperature and release it at a higher temperature, using the same process as a refrigerator. As the ground stays at a fairly constant temperature throughout the year heat pumps can use the ground as the source of heat. The ground temperature is not necessarily much higher than ambient air temperature in winter, but it is more stable whereas air has a vast temperature range. This makes system design more robust. The measure of efficiency of a heat pump is given by the Coefficient of Performance (CoP), which is defined as the ratio of the heat output, divided by quantity of energy put in. A CoP of 4 or more should be achievable with ground source heat pump systems, giving good energy and running cost savings. For ground source systems, the ground pipe system can be horizontal or vertical. For horizontal systems, a coiled or linear pipe network is buried at around two metres depth below ground level, thus requiring a large area of open space depending on the size of the system. For vertical systems, the pipes are placed in holes bored straight into the ground to a depth of 80 to 150 metres depending on ground conditions and size of system. Vertical systems thus require very little ground space but do require access for the drilling rig at the construction stage, though this is unlikely to be greater than for normal construction vehicles. Ground source heat pump systems can be used in almost any size of building. A particular use is where natural gas is not available making the ground source heat pump more economic. Ground source heat pumps cannot be seen from the outside of the building, so aesthetic design is not an issue. Ground source heat pumps will be cost prohibitive for this scheme and will not be explored further at this stage. However, if deemed appropriate at a later detailed design stage, a full site survey will have to be undertaken to investigate the feasibility of a closed loop system, although vertical loops are subject to local consent and horizontal loops require the ground to be free of rock to a depth of approximately 3m.	Not Proposed
Air Source Heat Pump (ASHP) - Variable Refrigerant Flow (VRF)	Air source heat pumps (ASHP) operate in a similar manner to ground source heat pumps but use the heat in external air rather than the ground to release heat at a higher temperature. As ASHPs aren't as efficient at heating to the higher temperatures needed for domestic hot water, supplementary plant is often required. In addition, ASHP in the form of a Variable Refrigerant Flow (VRF) systems can also provide simultaneous heating & cooling to the Proposed Development at a very high efficiency. Furthermore, ASHP in the form of 'Air to water heat pumps' take heat from the outside air and transfer it to a water-based system. Reverse cycle heat pump chillers are a form of air-to-water heat pump technology. The created heat can be used for space heating and domestic hot water supply. This technology (in the form of a VRF system) will be most suited for the Proposed Development site as cooling is required. The VRF system can replace the boiler in the 'baseline lean' model to the office areas. Though, heat pumps can only be considered as a renewable technology when used in heating mode.	Yes

Water Source Heat Pump (WSHP)	Water source heat pumps (WSHPs) move heat from a source of water into a building in an extremely efficient manner, especially if the water temperature is around 5 to 8 degrees Celsius. As such, there are numerous advantages of installing heat pumps. Depending on the type of heat pump, either the water from a river or small stream is pumped through the heat pump, or a special refrigerant fluid is pumped through pipes laid in the body of water. While both have their own advantages, the latter type requires less maintenance and an easier application process, making it a cheaper option. Water source heat pumps have been in use since the late 1940s. They use a rather constant temperature of the water as an exchange medium instead of extracting the heat from the outdoor air temperature. Thus, water source heat pumps can reach reasonably high efficiencies (300% to 600%) even on the coldest winter nights, in comparison to 175% to 250% for air-source heat pumps on cool days. However, there are no potential enough water sources on or nearby the Proposed Development site. Hence, at this stage, this technology is not considered feasible. However, the suitability may be explored further at a later stage of the design, if required.	No
Geothermal	Geothermal energy is the heat that comes from the sub-surface of the earth. It is contained in the rocks and fluids beneath the earth's crust and can be found as far down to the earth's hot molten rock, magma. To produce power from geothermal energy, wells are dug a mile deep into underground reservoirs to access the steam & hot water there, which can then be used to drive turbines connected to electricity generators. There are three types of geothermal power plants: dry steam, flash & binary. Dry steam is the oldest form of geothermal technology and takes steam out of the ground and uses it to directly drive a turbine. Flash plants use high-pressure hot water into cool, low-pressure water whilst binary plants pass hot water through a secondary liquid with a lower boiling point, which turns to vapour to drive the turbine. Geothermal energy will be cost prohibitive for this scheme & will not be explored further at this stage. However, if deemed appropriate at a later design stage, a full site survey will have to be undertaken to investigate the feasibility of the technology.	No
Wind Turbine	Wind turbines are an established means of capturing wind energy and converting it into usable electricity. Wind turbines come in various sizes depending on requirements. A wind turbine usually consists of a nacelle containing a generator connected, sometimes via a gearbox, to a rotor consisting of three blades. Wind turbines harness the power of the wind and use it to generate electricity. For the Proposed development Site, this would be to use to offset the energy used in the energising of equipment and lighting. Excess electricity generated from the wind turbine could be exported to the grid or could be stored in batteries and used when there is no wind. Considering the site location and provided the average wind speed in the area of the development site is 4.4m/s at 10m hub height, this technology is therefore not feasible. Moreover, wind turbine will be cost prohibitive for this scheme and will not be explored further at this stage.	No

Small Scale Hydro Power	Small Scale Hydropower or hydroelectricity (typically 100 kW - 30 MW) refers to the conversion of energy from flowing water into electricity. It is considered a renewable energy source because the water cycle is constantly renewed by the sun. Historically, one of the first uses of hydro power was for mechanical milling, such as grinding grains. Today, modern hydro plants produce electricity using turbines and generators, where mechanical energy is created when moving water spins rotors on a turbine. This turbine is connected to an electromagnetic generator, which produce electricity when the turbine spins. However, there are no potential hydro resource on-site in the area of the development site. Moreover, this technology will be cost prohibitive for this scheme and will not be explored further at this stage.	No
Wave and Tidal Power	Wave and tidal energy harvesting have been around for a few decades. But it has only been in recent years that it has started to become more realistic due to advance in research and technology. Some speculates that wave and tidal energy can supply at least 10 percent of the world's energy consumption. How much power can be harvested is determined mainly on the wave activity. However, the Proposed Development site is not located within reasonable distance to a coastal location. Thus, this technology is not considered feasible and will not be explored further at this stage.	No
Biomass Boiler	Biomass can be burnt directly to provide heat in buildings. Wood from forests, urban tree pruning, farmed coppices or farm and factory waste, is the most common fuel and nowadays is used commercially in the form of wood chips or pellets, although traditional logs are also used. Biomass is normally considered a carbon neutral fuel, as the carbon dioxide emitted on burning has been (relatively) recently absorbed from the atmosphere by photosynthesis and no fossil fuel is involved. The wood is a by-product of other industries and the small quantity of energy for drying, sawing, pelleting and delivery are discounted. Biomass from coppicing is likely to have some external energy inputs, for fertiliser, cutting, drying etc. and these may need to be considered in the future. Biomass heating is theoretically applicable to any building requiring heat; however practical constraints suggest that it is currently most applicable to lower density situations due to fuel supply and storage issues. The most common application of biomass is as one or more boilers in a sequenced (multi-boiler) installation particularly where there is a communal i.e. block or district heating system. There must be a local and adequate supply of appropriate biomass fuel (normally wood chips or pellets) and room for delivery and storage. Biomass boilers can replace conventional boilers and have no aesthetic impact. However, given the scale of the Proposed Development including the potential adverse effect on local air quality, biomass boilers are not considered feasible due to the fuel deliveries issues and Air Quality Management Area (AQMA) for PM1 and Nitrogen Oxides (NOx) emissions.	No

Waste Heat	Waste heat is the unused heat given to the surrounding environment (in the form of thermal energy) by a heat engine in a thermodynamic process in which it converts heat to useful work. Waste heat is inevitable for any heat engine and the amount it produces compared to the amount of input heat are factors that make up its thermal efficiency. Waste heat is often dissipated into the atmosphere, or large bodies of water like rivers, lakes and even the ocean. Since waste heat is a necessary product of heat engines, efficiencies of power plants are limited and therefore must burn more fuels in order to achieve their desired energy output. This increases greenhouse gas emissions and contributes more to global warming. Harnessing Waste Heat is mostly seen in industrial processes where more than half of the input energy is turned into waste heat. Capturing waste heat enables it to be redirected to a function that would otherwise be using energy from the grid, and this in turn prevents consumption of power used to counteract the very effects of the waste heat itself. However, at this stage, it is assumed that the use of the Proposed Development site will not involve processes which generate waste heat to be utilised in reducing fossil fuel demand.	No
Transpired Solar Air Collectors	Transpired Solar Collectors (TSCs) are solar air heating systems made of pre-finished perforated steel skins. Treated to enhance its absorbance of solar energy, the steel skins are installed onto south-facing walls or roofs creating a cavity between the metal skin and the walls or roofs. The most common application of a TSC is for preheating ventilation air, where the ventilation air supply is heated as it passes through the TSC perforated sheet. The heated air is then generally heated further as it passes through the building's HVAC system to reach the desired delivery temperature. In summer, when there may be no requirement to heat the ventilation air supply, TSC systems have a means of bypassing the absorber. Transpired solar collectors are mostly used to pre-heat non-residential development (retail units). This technology is unsuitable for the proposed development type.	No
Hydrogen Fuel Cell	Hydrogen is an energy storage medium and environmental benefits are only found where hydrogen is generated from renewable energy sources. However, there is limited market available, high capital and maintenance costs and life expected from fuel stacks is less than 10 years. Hence, at this stage, the Proposed Development site is not expected to incorporate hydrogen fuel.	No

Low and Zero Carbon Feasibility Study Summary

- 7.6 From the site-specific renewable energy feasibility assessment, it was found that the potentially feasible technology for the Proposed Development are PV and Air Source Heat Pump (ASHP). Technologies such as GSHP and Solar Hot Water have been discounted at this stage based on a balanced consideration of the building energy profile, policy requirements, financial viability, and technical feasibility.

Air Source Heat Pump

- 7.7 Air source heat pumps absorb heat from the outside air. This exchange heat between the outside air and a building can be used to provide space heating in winter and cooling in the summer months.
- 7.8 The efficiency of these systems is inherently linked to the ambient air temperatures. The heat can be used to heat radiators, underfloor heating, or warm air convectors and hot water. Typically, there are two main types of ASHP, one which is refrigerant-based system (VRF) and one which is water-based system (air to water heat pumps).
- 7.9 Refrigerant-based system (VRF) (Table 7.2) will be most suited to the Proposed development as there are no technical feasibility restraints. The efficiency of the VRF system should be no less than 340% (SCOP) in heating mode and 550% (EER/SEER) in cooling mode.

Table 7.2: ASHP (Air to Air Heat Pump) Details

ASHP (AIR TO AIR HEAT PUMP) DETAILS	
System Description	Air to Air System
Capacity (kW)	TBC at the detailed design stage

- 7.10 In accordance with Ofgem, heat pumps that are designed for cooling are not eligible for the Renewable Heat Incentive (RHI) scheme. Hence, no government financial incentive is applicable for this renewable technology.

Solar Photovoltaic (PV)

- 7.11 Photovoltaics (PV), also known as Solar panel electricity system captures the sun's energy using photovoltaic cells. These cells convert the sunlight into electricity, which can then be used to run buildings appliances and lighting.
- 7.12 A total of **281.25 kWp** (requiring 1270 m² roof space and 625 panels) solar PV capacity is proposed for the four units comprising Plot L. The analysis is based on Q.PEAK DUO-G8 (360W) monocrystalline panel (**Appendix 3**) mounted flush on the roof and orientated due south (Unit L1, L3, L4) and south-west (Unit L2). This is detailed in **Table 7.3** with the output document (BRUKL document) documented as **Appendix 1**.

Table 7.3: Solar PV Details

SOLAR PV DETAILS					
	Unit L1	Unit L2	Unit L3	Unit L4	Total
PV Orientation	South	South-West	South	South	-
Number of Panels	245	205	85	90	625
Area (m ²)	497.59	416.35	172.63	182.79	1269.37
Capacity (kWp)	110.25	92.25	38.25	40.50	281.25

Be Green (Renewable Energy) Results

7.13 **Table 7.4** and **Table 7.5** shows the reduction summary of energy demand and CO₂ emissions due to the proposals for on-site renewable energy generation (ASHP) for the Proposed Development and this is compared to the baseline, lean and clean scenario. Refer to **Appendix 1** for the BRUKL output:

Table 7.4: Individual Unit Be Green Energy Demand Breakdown (BER)

BE-GREEN (BER): RENEWABLE ENERGY								
	Unit L1		Unit L2		Unit L3		Unit L4	
	Baseline Energy kWh/yr	Be-Lean – Be-Green Energy kWh/yr	Baseline Energy kWh/yr	Be-Lean – Be-Green Energy kWh/ yr	Baseline Energy kWh/ yr	Be-Lean – Be-Green Energy kWh/ yr	Baseline Energy kWh/ yr	Be-Lean – Be-Green Energy kWh/ yr
Heating	90,203.36	89,387.33	62,669.23	68,944.25	25,593.60	30,134.40	35,673.48	39,060.35
Cooling	502.18	1,820.39	242.90	769.20	275.20	791.20	222.82	623.90
Auxiliary	15,002.51	31,260.46	9,635.19	19,756.19	3,973.20	8,376.40	5,258.55	10,873.62
Lighting	27,368.59	38,793.10	15,991.18	24,128.46	7,963.60	10,664.00	9,581.26	13,814.84
Hot Water	24,418.31	25,987.61	15,626.82	16,719.89	6,467.20	7,069.20	8,511.72	9,224.75
Renewables (PV + ASHP)	-105,770.82	-159,378.11	-86,311.89	-120,925.71	-34,778.40	-52,890.00	-41,310.83	-63,169.47
Total Energy Consumption per Unit	51,724.13	27,870.77	17,853.44	9,392.29	9,494.40	4,145.20	17,937.01	10,427.98
Part L 2021 Reduction (%)		46%		47%		56%		42%
Total Energy Consumption							97,008.98	51,836.23
Total Savings (Against Baseline)								46.57%

Table 7.5: Be Green Carbon Dioxide Emissions (BER)

BE-GREEN (BER): CARBON DIOXIDE EMISSIONS								
	Unit L1		Unit L2		Unit L3		Unit L4	
	Baseline Emissions TonneCO ₂ /yr	Be-Lean – Be-Green Emissions TonneCO ₂ /yr	Baseline Emissions TonneCO ₂ /yr	Be-Lean – Be-Green Emissions TonneCO ₂ /yr	Baseline Emissions TonneCO ₂ /yr	Be-Lean – Be-Green Emissions TonneCO ₂ /yr	Baseline Emissions TonneCO ₂ /yr	Be-Lean – Be-Green Emissions TonneCO ₂ /yr
CO ₂ Emissions	19.40	16.38	10.93	10.73	4.70	4.54	7.31	6.80
Total CO ₂ Emissions							42.33	38.45
Total CO ₂ Reduction (%)								9.17%

- 7.14 **Table 7.4-7.5** shows the total energy /CO₂ emissions of the Proposed Development has been reduced by **46.57% / 9.17%** when compared with Building Regulations Part L Baseline.
- 7.15 This complies with the National target to exceed the Part L 2021 TER Baseline, and thus demonstrate compliance with Rochdale Borough Council's requirement of adhering to the energy hierarchy that reflects national policy, targets, and requirements.

8. CONCLUSION

- 8.1 This Energy Statement has been produced in support of a Planning Application for the Proposed Plot L Development at John Milne Avenue, Kingsway Business Park, Rochdale in accordance with Rochdale Borough Council's Core Strategy (2016) Policies G1 – G3.
- 8.2 This Energy Statement outlines the Proposed Development's approach to energy efficiency and renewable energy strategies using Dynamic Thermal Modelling (DSM). The Proposed Development will adopt the use of an energy hierarchy in order to meet current National best practice standard and Rochdale Borough Council's objectives for energy, carbon dioxide and the adaptability to the likely effects of Climate Change.
- 8.3 The Proposed Development envelope and services will be specified to exceed the minimum standards set in Part L (Volume 2) to ensure energy consumption via space heating/cooling is reduced. In addition, passive solar considerations have formed an integral part of the Proposed Development design. Analysis has been carried out on the facades to ensure solar gains and heating loads are reduced, hence providing a more comfortable internal environment for occupants.
- 8.4 This Energy Statement proposes to reduce the regulated energy and carbon dioxide emissions of the Proposed Development by a total of **46.57%** and **9.17%** respectively via ASHP (**VRF**) and PV (**281.25 kWp**) when compared with Building Regulations Approved Document Part L (Volume 2) Target Emissions Rate (TER) Baseline. This complies with the National target to exceed the Part L V2 2021 TER Baseline, and thus demonstrate compliance with Rochdale Borough Council's requirement of adhering to the energy hierarchy that reflects national policy, targets, and requirements.

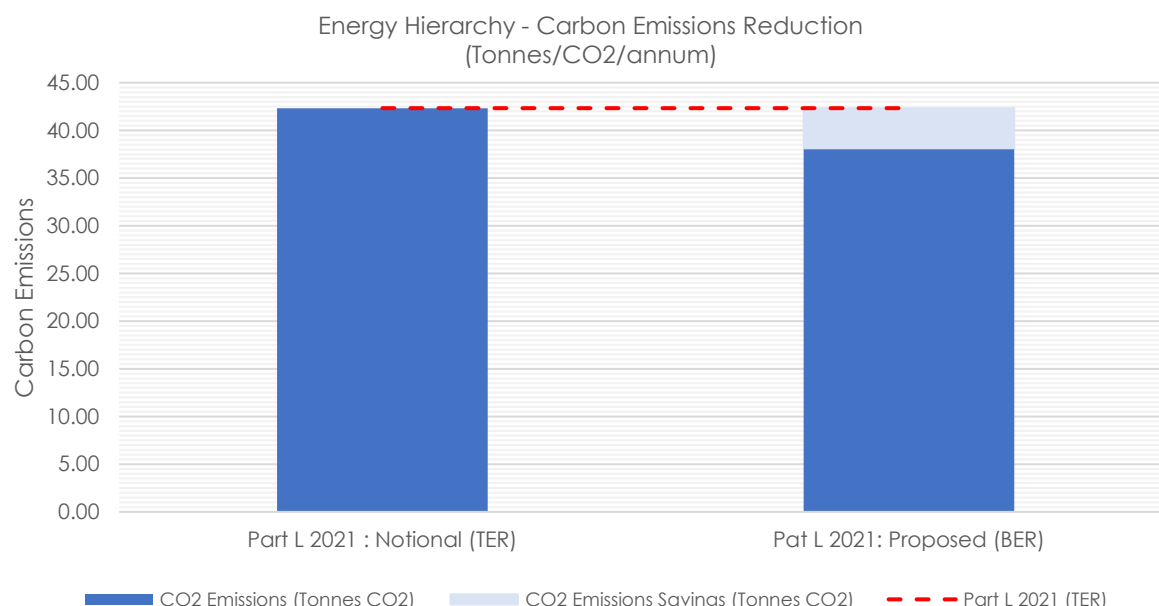


Figure 8.1: Proposed Development CO₂ Reduction Hierarchy

- 8.5 The measures and commitment outlined shall ensure the Proposed Plot L Development at John Milne Avenue, Kingsway Business Park, Rochdale will deliver a low carbon and a sustainable resource efficient development.

APPENDICES

APPENDIX 1: BRUKL Document

Project name

Shell and Core

222009 Plot L Kingsway_Plot L1

As designed

Date: Thu Sep 07 17:52:05 2023

Administrative information

Building Details

Address: Plot L1, Greater Manchester,

Certifier details

Name: Ariana Beepath

Telephone number:

Address: BWB Consulting Limited, Whitehall Waterfront, 2
Riverside Way, Leeds, LS1 4EH

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

Foundation area [m²]: 5508.43The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	3.09
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	2.61
Target primary energy rate (TPER), kWh _{PE} /m ² annum	31.71
Building primary energy rate (BPER), kWh _{PE} /m ² annum	25.41
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

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

Fabric element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.26	0.26	00000008:Surf[1]
Floors	0.18	0.14	0.14	00000008:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.18	0.18	00000030:Surf[25]
Windows** and roof windows	1.6	1.4	1.4	00000023:Surf[1]
Rooflights***	2.2	1.8	1.8	00000030:Surf[22]
Personnel doors^	1.6	1.6	1.6	00000023:Surf[4]
Vehicle access & similar large doors	1.3	1.3	1.3	00000030:Surf[8]
High usage entrance doors	3	-	-	No high usage entrance doors in building

U_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

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

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

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

^ For fire doors, limiting U-value is 1.8 W/m²K

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

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	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	<0.9

1- 02_222009_Electric Panel Heater

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.67	-	-
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					YES

2- 01_222009 ASHP VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.4	5.1	0	-	0.85
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

3- 01_222009 MVHR (ASHP VRF)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.4	5.1	0	-	0.85
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

4- 04_222009 ASHP VRF (SHELL)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- 03_222009_stand alone Water Heater

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.071
Standard value	1	N/A

2- 05_222009_ Instantaneous Water Heater (SHELL)

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

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1		Zone	Standard
00_GF_Unit 1_Acc_WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
00_1F_Unit 1_Offices	-	-	-	1.5	-	-	-	-	-	-	-	N/A
00_1F_Unit 1_Male WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
00_1F_Unit 1_Acc WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
00_1F_Unit 1_Female WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
00_GF_Unit 1_Acc_WC	NO
00_GF_Unit 1_Stairs 01	NO
00_GF_Unit 1_Lobby	NO
00_GF_Unit 1_Riser	NO
00_GF_Unit 1_Stair 02	NO
00_1F_Unit 1_Stair 01	NO
00_1F_Unit 1_Riser	NO
00_1F_Unit 1_Stair 02	NO
00_1F_Unit 1_Offices	NO
00_1F_Unit 1_Circulation	NO
00_1F_Unit 1_Male WC	NO
00_1F_Unit 1_Acc WC	NO
00_1F_Unit 1_Female WC	NO
00_1F_Unit 1_Warehouse	YES
00_GF_Unit 1_Lift	NO
00_1F_Unit 1_lift	NO

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
00_GF_Unit 1_Acc_WC	100	-	-
00_GF_Unit 1_Stairs 01	100	-	-

General lighting and display lighting		General luminaire		Display light source	
Zone name		Efficacy [lm/W]		Efficacy [lm/W]	Power density [W/m²]
	Standard value	95		80	0.3
00_GF_Unit 1_Lobby		120		-	-
00_GF_Unit 1_Riser		100		-	-
00_GF_Unit 1_Stair 02		100		-	-
00_1F_Unit 1_Stair 01		100		-	-
00_1F_Unit 1_Riser		100		-	-
00_1F_Unit 1_Stair 02		100		-	-
00_1F_Unit 1_Offices		120		-	-
00_1F_Unit 1_Circulation		100		-	-
00_1F_Unit 1_Male WC		100		-	-
00_1F_Unit 1_Acc WC		100		-	-
00_1F_Unit 1_Female WC		100		-	-
00_1F_Unit 1_Warehousesee		95		-	-
00_GF_Unit 1_Lift		95		-	-
00_1F_Unit 1_lift		95		-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00_GF_Unit 1_Lobby	YES (+61.5%)	NO
00_1F_Unit 1_Offices	NO (-44.7%)	NO
00_1F_Unit 1_Warehousesee	NO (-2.6%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	6277.2	6277.2
External area [m ²]	13933.5	13933.5
Weather	MAN	MAN
Infiltration [m ³ /hm ² @ 50Pa]	3	5
Average conductance [W/K]	3613.22	4409.2
Average U-value [W/m ² K]	0.26	0.32
Alpha value* [%]	25	10

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

Building Use

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	14.24	14.37
Cooling	0.29	0.08
Auxiliary	4.98	2.39
Lighting	6.18	4.36
Hot water	4.14	3.89
Equipment*	30.75	30.75
TOTAL**	29.83	25.1

* 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	14.14	4.21
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>14.14</i>	<i>4.21</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	111.57	136.66
Primary energy [kWh _{PE} /m ²]	25.41	31.71
Total emissions [kg/m ²]	2.61	3.09

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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	285.1	0	94.1	0	0.5	0.84	0	1	0
	Notional	291.7	0	57.4	0	1.1	1.41	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	414.2	70.7	34.5	5.2	0	3.33	3.81	3.4	5.1
	Notional	331.6	12.7	33.1	0.8	0	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	100.5	0	11.9	0	5	2.35	0	2.5	0
	Notional	131.9	0	13.2	0	2.5	2.78	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	82.9	58.5	6.9	4.3	7.9	3.33	3.81	3.4	5.1
	Notional	81.8	22.4	8.2	1.3	1.8	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	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

Project name

Shell and Core

222009 Plot L Kingsway_Plot L2

As designed

Date: Thu Sep 07 18:01:13 2023

Administrative information

Building Details

Address: Plot L2, Greater Manchester,

Certifier details

Name: Ariana Beepath

Telephone number:

Address: BWB Consulting Limited, Whitehall Waterfront, 2
Riverside Way, Leeds, LS1 4EH

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

Foundation area [m²]: 5434.53The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	2.7
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	2.65
Target primary energy rate (TPER), kWh _{PE} /m ² annum	27.17
Building primary energy rate (BPER), kWh _{PE} /m ² annum	25.06
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

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

Fabric element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.26	0.26	0000001A:Surf[2]
Floors	0.18	0.17	0.17	0000001A:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.18	0.18	00000031:Surf[43]
Windows** and roof windows	1.6	1.4	1.4	0100000E:Surf[2]
Rooflights***	2.2	1.8	1.8	00000031:Surf[25]
Personnel doors [^]	1.6	1.6	1.6	0000001A:Surf[1]
Vehicle access & similar large doors	1.3	1.3	1.3	00000031:Surf[6]
High usage entrance doors	3	-	-	No high usage entrance doors in building

U_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

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

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

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

[^] For fire doors, limiting U-value is 1.8 W/m²K

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

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	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	<0.9

1- 02_222009_Electric Panel Heater

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.67	-	-
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					YES

2- 01_222009 MVHR (ASHP VRF)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.4	5.1	0	-	0.85
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

3- 01_222009 ASHP VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.4	5.1	0	-	0.85
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

4- 04_222009 ASHP VRF (SHELL)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- 03_222009_stand alone Water Heater

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.071
Standard value	1	N/A

2- 05_222009_ Instantaneous Water Heater (SHELL)

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

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1		Zone	Standard
01_FF_Unit L2_Female WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
01_FF_Unit L2_Male WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
01_FF_Unit L2_Offices	-	-	-	1.5	-	-	-	-	-	-	-	N/A
00_GF_Unit L2_WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
00_GF_Unit L2_Stairs	NO
01_FF_Unit L2_Female WC	NO
01_FF_Unit L2_Male WC	NO
01_FF_Unit L2_Offices	NO
00_GF_Unit L2_WC	NO
00_GF_Unit L2_Reception	NO
00_FF_Unit L2_Circulation	NO
00_GF_Unit L2_Stairs	NO
00_GF_Unit 2_Stairs_lift	NO
01_FF_Unit L2_Stairs	NO
01_FF_Unit L2_Riser	NO
01_FF_Unit L2_Stairs	NO
01_FF_Unit L2_lift	NO
00_Unit L2_Warehouse	YES

General lighting and display lighting		General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3	
00_GF_Unit L2_Stairs	100	-	-	
01_FF_Unit L2_Female WC	100	-	-	
01_FF_Unit L2_Male WC	100	-	-	
01_FF_Unit L2_Offices	120	-	-	
00_GF_Unit L2_WC	100	-	-	

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m ²]
	Standard value	95	80	0.3
00_GF_Unit L2_Reception		120	-	-
00_FF_Unit L2_Circulation		100	-	-
00_GF_Unit L2_Stairs		100	-	-
00_GF_Unit 2_Stairs_lift		95	-	-
01_FF_Unit L2_Stairs		100	-	-
01_FF_Unit L2_Riser		100	-	-
01_FF_Unit L2_Stairs		100	-	-
01_FF_Unit L2_lift		95	-	-
00_Unit L2_Warehouse		95	-	-

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?
01_FF_Unit L2_Offices	NO (-56.6%)	NO
00_GF_Unit L2_Reception	YES (+64.5%)	NO
00_Unit L2_Warehouse	NO (-3.6%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	4048.4	4048.4
External area [m ²]	9489.8	9489.8
Weather	MAN	MAN
Infiltration [m ³ /hm ² @ 50Pa]	3	5
Average conductance [W/K]	2596.04	3027.07
Average U-value [W/m ² K]	0.27	0.32
Alpha value* [%]	25	10

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

Building Use

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	17.03	15.48
Cooling	0.19	0.06
Auxiliary	4.88	2.38
Lighting	5.96	3.95
Hot water	4.13	3.86
Equipment*	30.2	30.2
TOTAL**	32.18	25.73

* 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	17.02	7.96
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>17.02</i>	<i>7.96</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	127.24	145.43
Primary energy [kWh _{PE} /m ²]	25.06	27.17
Total emissions [kg/m ²]	2.65	2.7

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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	343.7	0	113.4	0	0.4	0.84	0	1	0
	Notional	304.3	0	59.9	0	0.8	1.41	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	549.3	76.7	45.8	5.6	0	3.33	3.81	3.4	5.1
	Notional	381.9	12.2	38.2	0.7	0	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	113.9	0	13.5	0	5	2.35	0	2.5	0
	Notional	138.9	0	13.9	0	2.5	2.78	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	85.7	50.4	7.1	3.7	7.9	3.33	3.81	3.4	5.1
	Notional	78.7	23.3	7.9	1.4	1.8	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	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

Project name

Shell and Core

222009 Plot L Kingsway_Plot L3

As designed

Date: Thu Sep 07 18:10:21 2023

Administrative information

Building Details

Address: Plot L3, Greater Manchester,

Certifier details

Name: Ariana Beepath

Telephone number:

Address: BWB Consulting Limited, Whitehall Waterfront, 2
Riverside Way, Leeds, LS1 4EH

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

Foundation area [m²]: 2098.46The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	2.73
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	2.64
Target primary energy rate (TPER), kWh _{PE} /m ² annum	27.61
Building primary energy rate (BPER), kWh _{PE} /m ² annum	25.1
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

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

Fabric element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.26	0.26	00000005:Surf[6]
Floors	0.18	0.18	0.18	00000005:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.18	0.18	00000010:Surf[8]
Windows** and roof windows	1.6	1.4	1.4	00000005:Surf[2]
Rooflights***	2.2	1.8	1.8	00000010:Surf[0]
Personnel doors^	1.6	1.6	1.6	00000005:Surf[1]
Vehicle access & similar large doors	1.3	1.3	1.3	00000010:Surf[30]
High usage entrance doors	3	-	-	No high usage entrance doors in building

U_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

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

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

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

^ For fire doors, limiting U-value is 1.8 W/m²K

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

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	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	<0.9

1- 01_222009 ASHP VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.4	5.1	0	-	0.85
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

2- 02_222009_Electric Panel Heater

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.67	-	-
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					YES

3- 01_222009 MVHR (ASHP VRF)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.4	5.1	0	-	0.85
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

4- 04_222009 ASHP VRF (SHELL)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- 03_222009_stand alone Water Heater

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.071
Standard value	1	N/A

2- 05_222009_Instantaneous Water Heater (SHELL)

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

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1		Zone	Standard
00_GF_Unit L3_WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
00_FF_Unit L3_WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
00_FF_Unit L3_Office	-	-	-	1.5	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
00_GF_Unit L3_Reception	NO
00_GF_Unit L3_WC	NO
00_FF_Unit L3_Circulation	NO
00_FF_Unit L3_WC	NO
00_FF_Unit L3_Office	NO
00_GF_Unit L3_Stairs	NO
00_GF_Unit L3_lift	NO
00_FF_Unit L3_Stairs	NO
00_FF_Unit L3_lift	NO
00_Unit L3_Warehouse	YES

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value		95	80	0.3
00_GF_Unit L3_Reception		120	-	-
00_GF_Unit L3_WC		100	-	-
00_FF_Unit L3_Circulation		100	-	-
00_FF_Unit L3_WC		100	-	-
00_FF_Unit L3_Office		120	-	-
00_GF_Unit L3_Stairs		100	-	-
00_GF_Unit L3_lift		95	-	-
00_FF_Unit L3_Stairs		100	-	-
00_FF_Unit L3_lift		95	-	-
00_Unit L3_Warehouse		95	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00_GF_Unit L3_Reception	YES (+92.5%)	NO
00_FF_Unit L3_Office	NO (-47.2%)	NO
00_Unit L3_Warehouse	NO (-2.7%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	1720	1720
External area [m ²]	3924	3924
Weather	MAN	MAN
Infiltration [m ³ /hm ² @ 50Pa]	3	5
Average conductance [W/K]	1169.22	1278.97
Average U-value [W/m ² K]	0.3	0.33
Alpha value* [%]	25	10

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

Building Use

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	17.52	14.88
Cooling	0.46	0.16
Auxiliary	4.87	2.31
Lighting	6.2	4.63
Hot water	4.11	3.76
Equipment*	30.68	30.68
TOTAL**	33.16	25.75

* 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	17.91	7.65
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>17.91</i>	<i>7.65</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	134.44	140.22
Primary energy [kWh _{PE} /m ²]	25.1	27.61
Total emissions [kg/m ²]	2.64	2.73

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] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	297.3	0	98.1	0	0.6	0.84	0	1	0
	Notional	254.7	0	50.2	0	1.1	1.41	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	438.5	98.7	36.5	7.2	0	3.33	3.81	3.4	5.1
	Notional	332.5	18.9	33.2	1.1	0	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	116.3	0	13.8	0	5	2.35	0	2.5	0
	Notional	133.4	0	13.3	0	2.5	2.78	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	69.6	52.8	5.8	3.8	7.9	3.33	3.81	3.4	5.1
	Notional	58.3	30.4	5.8	1.8	1.8	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	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

Project name

Shell and Core

222009 Plot L Kingsway_Plot L4

As designed

Date: Thu Sep 07 18:16:52 2023

Administrative information

Building Details

Address: Plot L4, Greater Manchester,

Certifier details

Name: Ariana Beepath

Telephone number:

Address: BWB Consulting Limited, Whitehall Waterfront, 2
Riverside Way, Leeds, LS1 4EH

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

Foundation area [m²]: 1963.83The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	3.28
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	3.05
Target primary energy rate (TPER), kWh _{PE} /m ² annum	33.63
Building primary energy rate (BPER), kWh _{PE} /m ² annum	29.72
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

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

Fabric element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.26	0.26	00000011:Surf[1]
Floors	0.18	0.17	0.17	00000011:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.18	0.18	00000032:Surf[26]
Windows** and roof windows	1.6	1.4	1.4	0000000B:Surf[1]
Rooflights***	2.2	1.8	1.8	00000032:Surf[16]
Personnel doors [^]	1.6	1.6	1.6	0000000B:Surf[2]
Vehicle access & similar large doors	1.3	1.3	1.3	00000032:Surf[5]
High usage entrance doors	3	-	-	No high usage entrance doors in building

U_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

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

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

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

[^] For fire doors, limiting U-value is 1.8 W/m²K

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

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	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	<0.9

1- 02_222009_Electric Panel Heater

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.67	-	-
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					YES

2- 01_222009 ASHP VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.4	5.1	0	-	0.85
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

3- 01_222009 MVHR (ASHP VRF)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.4	5.1	0	-	0.85
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

4- 04_222009 ASHP VRF (SHELL)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- 03_222009_stand alone Water Heater

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.071
Standard value	1	N/A

2- 05_222009_ Instantaneous Water Heater (SHELL)

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

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1		Zone	Standard
00_Unit 4_GF_Acc Wc	-	-	0.3	-	-	-	-	-	-	-	-	N/A
00_FF_Unit 4_Offices	-	-	-	1.5	-	-	-	-	-	-	-	N/A
00_Unit 4_FF_WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
00_Unit 4_FF_WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A
00_Unit 4_FF_WC	-	-	0.3	-	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
00_GF_Unit 4_Stairs	NO
00_GF_Unit 4_Lift	NO
00_Unit 4_GF_Lobby	NO
00_Unit 4_GF_Acc Wc	NO
00_FF_Unit 4_Stairs	NO
00_FF_Unit 4_Lift	NO
00_FF_Unit 4_Offices	NO
00_Unit 4_FF_Circ	NO
00_Unit 4_FF_WC	NO
00_Unit 4_FF_WC	NO
00_Unit 4_FF_WC	NO
00_GF_Unit 4_Warehouse	YES

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value		95	80	0.3
00_GF_Unit 4_Stairs		100	-	-
00_GF_Unit 4_Lift		95	-	-
00_Unit 4_GF_Lobby		120	-	-
00_Unit 4_GF_Acc Wc		100	-	-
00_FF_Unit 4_Stairs		100	-	-
00_FF_Unit 4_Lift		95	-	-

General lighting and display lighting		General luminaire		Display light source	
Zone name		Efficacy [lm/W]		Efficacy [lm/W] Power density [W/m²]	
Standard value		95		80 0.3	
00_FF_Unit 4_Offices		120		-	
00_Unit 4_FF_Circ		100		-	
00_Unit 4_FF_WC		100		-	
00_Unit 4_FF_WC		100		-	
00_Unit 4_FF_WC		100		-	
00_GF_Unit 4_Warehouse		95		-	

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00_Unit 4_GF_Lobby	YES (+83.8%)	NO
00_FF_Unit 4_Offices	NO (-50.3%)	NO
00_GF_Unit 4_Warehouse	NO (-16.6%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	2228.2	2228.2
External area [m ²]	5486	5486
Weather	MAN	MAN
Infiltration [m ³ /hm ² @ 50Pa]	3	5
Average conductance [W/K]	1506.62	1757.8
Average U-value [W/m ² K]	0.27	0.32
Alpha value* [%]	25	10

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

Building Use

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	17.53	16.01
Cooling	0.28	0.1
Auxiliary	4.88	2.36
Lighting	6.2	4.3
Hot water	4.14	3.82
Equipment*	30.28	30.28
TOTAL**	33.03	26.59

* 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	14.64	4.46
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>14.64</i>	<i>4.46</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	135.91	152.31
Primary energy [kWh _{PE} /m ²]	29.72	33.63
Total emissions [kg/m ²]	3.05	3.28

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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	317.9	0	104.9	0	0.6	0.84	0	1	0
	Notional	280.5	0	55.2	0	1.2	1.41	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	443.8	83.1	37	6.1	0	3.33	3.81	3.4	5.1
	Notional	335.8	15.4	33.6	0.9	0	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	121.4	0	14.4	0	5	2.35	0	2.5	0
	Notional	146.3	0	14.6	0	2.5	2.78	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	89.6	47.9	7.5	3.5	7.9	3.33	3.81	3.4	5.1
	Notional	80.9	27.4	8.1	1.6	1.8	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	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

APPENDIX 2: Ground Floor U-Value Calculations

U Value Calculation

Software: Stroma U-value Calculator - Version 0.92
 Date Printed: 28/03/2023 15:56
 Construction Type: Floor - 222009_Plot L Kingsway WBD - Unit L1
 Calculation Method: BS EN ISO 6946 / BS EN ISO 13370

Floor Construction

No	Description	Main Element			Bridging Element		
		Thickness	λ	R-value	λ	R-value	Fraction
-	Internal Surface Resistance	-	-	0.17	-	-	-
1	Reinforced Concrete (2% Steel)	200	2.5	0.08	-	-	-
		$\Sigma=200\text{mm}$		$\Sigma=0.25$			

Resistances

Lower Limit	Upper Limit	Average
0.25	0.25	0.25 m ² K/W

Soil Properties

Perimeter	312.528m
Area	5488.77m ²
Wall Thickness	199mm
Ground Type - Default $\lambda=$	2W/mK

Floor U-value Corrections

No Correction Values	
Floor U-value	
U-value	0.179
U-value rounded	0.18 W/m ² K

U Value Calculation

Software: Stroma U-value Calculator - Version 0.92
 Date Printed: 29/03/2023 15:46
 Construction Type: Floor - 222009_Plot L Kingsway WBD - Unit L2
 Calculation Method: BS EN ISO 6946 / BS EN ISO 13370

Floor Construction

No	Description	Main Element			Bridging Element		
		Thickness	λ	R-value	λ	R-value	Fraction
-	Internal Surface Resistance	-	-	0.17	-	-	-
1	Reinforced Concrete (2% Steel)	200	2.5	0.08	-	-	-
		$\Sigma=200\text{mm}$		$\Sigma=0.25$			

Resistances

Lower Limit	Upper Limit	Average
0.25	0.25	0.25 m ² K/W

Soil Properties

Perimeter	259.804m
Area	3539.83m ²
Wall Thickness	199mm
Ground Type - Clay or Silt $\lambda=$	1.5W/mK

Floor U-value Corrections

No Correction Values	
Floor U-value	
U-value	0.171
U-value rounded	0.17 W/m ² K

U Value Calculation

Software: Stroma U-value Calculator - Version 0.92
 Date Printed: 29/03/2023 15:46
 Construction Type: Floor - 222009_Plot L Kingsway WBD - Unit L3
 Calculation Method: BS EN ISO 6946 / BS EN ISO 13370

Floor Construction

No	Description	Main Element			Bridging Element		
		Thickness	λ	R-value	λ	R-value	Fraction
-	Internal Surface Resistance	-	-	0.17	-	-	-
1	Reinforced Concrete (2% Steel)	200	2.5	0.08	-	-	-
		$\Sigma=200\text{mm}$		$\Sigma=0.25$			

Resistances

Lower Limit	Upper Limit	Average
0.25	0.25	0.25 m ² K/W

Soil Properties

Perimeter	152.716m
Area	1362.85m ²
Wall Thickness	199mm
Ground Type - Clay or Silt $\lambda=$	1.5W/mK

Floor U-value Corrections

Corrective Description	Correction Value
Horizontal Edge Insulation	-0.054
	$\Sigma=-0.054$

Floor U-value

U-value uncorrected	0.237
Total U-value Corrections	-0.054
U-value	0.183
U-value rounded	0.18 W/m ² K

U Value Calculation

Software: Stroma U-value Calculator - Version 0.92
 Date Printed: 29/03/2023 15:46
 Construction Type: Floor - 222009_Plot L Kingsway WBD - Unit L4
 Calculation Method: BS EN ISO 6946 / BS EN ISO 13370

Floor Construction

No	Description	Main Element			Bridging Element		
		Thickness	λ	R-value	λ	R-value	Fraction
-	Internal Surface Resistance	-	-	0.17	-	-	-
1	Reinforced Concrete (2% Steel)	200	2.5	0.08	-	-	-
		$\Sigma=200\text{mm}$		$\Sigma=0.25$			

Resistances

Lower Limit	Upper Limit	Average
0.25	0.25	0.25 m ² K/W

Soil Properties

Perimeter	186.446m
Area	1994.31m ²
Wall Thickness	199mm
Ground Type - Clay or Silt $\lambda=$	1.5W/mK

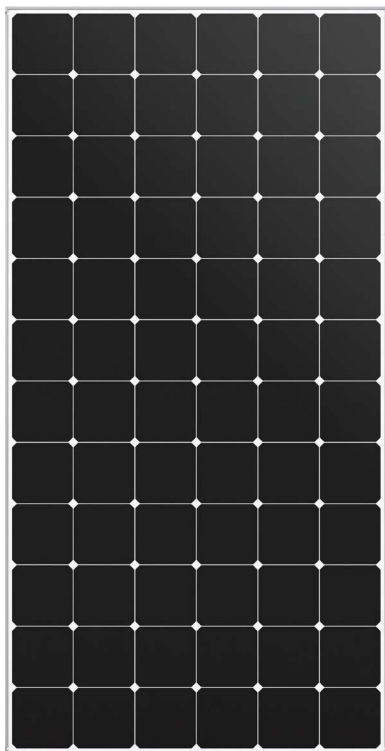
Floor U-value Corrections

Corrective Description	Correction Value
Horizontal Edge Insulation	-0.04
	$\Sigma=-0.04$

Floor U-value

U-value uncorrected	0.207
Total U-value Corrections	-0.04
U-value	0.167
U-value rounded	0.17 W/m ² K

APPENDIX 3: Indicative Solar PV Datasheet



MAXEON 5 COM

POWER RANGE: 430-450 W | EFFICIENCY: Up to 22.2%

Hundreds of patents, decades of design and five cell generations have led to the new Maxeon 5 solar panel. Part of the record-setting SunPower Maxeon product line, Maxeon 5 pushes the boundaries of solar innovation, reliability and sustainability.

SunPower Maxeon panels are world-renowned for their energy production and savings advantages that combine unmatched efficiency and reliability with an industry-leading warranty and an estimated 40-year useful life.^{1,2,3,4}

Sunpower Maxeon
Solar Cell Technology

- Proven technology across 3.5 billion cells shipped
- Most efficient cell in commercial solar¹
- Only solar cell with a solid-metal foundation, providing patented protection from breakage and corrosion



Maximum Lifetime Energy and Savings

The SunPower Maxeon 5 solar panel is designed to deliver 35% more energy in the same space over 25 years in real-world conditions such as partial shade and high temperatures.^{5,6,7}

A Better Product. A Better Warranty.

The 25-year SunPower Complete Confidence Panel Warranty is backed by testing and field data from more than 30 million SunPower Maxeon panels deployed—and a demonstrated warranty return rate of .005%.⁸



- | | |
|--|-------|
| • Year 1 Minimum Warranted Power Output | 98.0% |
| • Maximum Annual Degradation | 0.25% |
| • Year 25 Minimum Warranted Power Output | 92.0% |

Leadership in Sustainable Manufacturing

SunPower Maxeon panels—and the facilities in which they are produced—raise the bar for environmental and social responsibility. Included below are highlights of the certifications and recognition received by some of our products and manufacturing sites.



Declare.

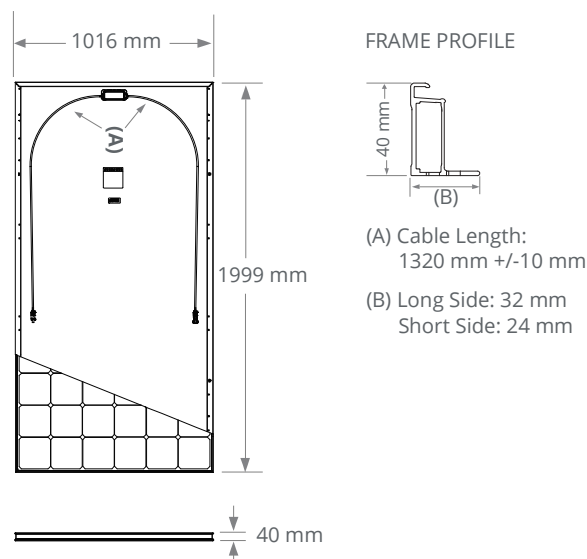
Landfill-Free Facility
NSF P445

Electrical Data			
	SPR-MAX5-450-COM	SPR-MAX5-440-COM	SPR-MAX5-430-COM
Nominal Power (P _{nom}) ¹⁰	450 W	440 W	430 W
Power Tolerance	+5/0%	+5/0%	+5/0%
Panel Efficiency	22.2%	21.7%	21.2%
Rated Voltage (V _{mpp})	44.0 V	43.4 V	42.7 V
Rated Current (I _{mpp})	10.2 A	10.2 A	10.1 A
Open-Circuit Voltage (V _{oc}) (+/-3%)	51.9 V	51.69 V	51.2 V
Short-Circuit Current (I _{sc}) (+/-3%)	11.0 A	10.9 A	10.9 A
Max. System Voltage	1000 V IEC		
Maximum Series Fuse	20 A		
Power Temp Coef.	-0.29% / ° C		
Voltage Temp Coef.	-136 mV / ° C		
Current Temp Coef.	5.7 mA / ° C		

Tests and Certifications	
Standard Tests ¹¹	IEC 61215, IEC 61730
Quality Management Certs	ISO 9001:2015, ISO 14001:2015
Ammonia Test	IEC 62716
Desert Test	IEC 60068-2-68, MIL-STD-810G
Salt Spray Test	IEC 61701 (maximum severity)
PID Test	1500 V: IEC 62804
Available Listing	TUV

Sustainability Tests and Certifications	
IFLI Declare Label	First solar panel labeled for ingredient transparency and LBC-compliance. ¹¹
Cradle to Cradle Certified™ Bronze	First solar panel line certified for material health, water stewardship, material reutilization, renewable energy & carbon management, and social fairness. ¹²
Green Building Certification Contribution	Panels can contribute additional points toward LEED and BREEAM certifications. ¹³
EHS Compliance	RoHS, OHSAS 18001:2007, REACH SVHC-201

Operating Condition and Mechanical Data	
Temperature	-40° C to +85° C
Impact Resistance	25 mm diameter hail at 23 m/s
Solar Cells	72 Monocrystalline Maxeon Gen 5
Glass	High-transmission tempered antireflective
Junction Box	IP-68, Stäubli (MC4), 3 bypass diodes
Weight	21.6 kg
Max. Load	Wind: 2400 Pa, 244 kg/m² front & back Snow: 5400 Pa, 550 kg/m² front
Frame	Class 2 silver anodized



Please read the safety and installation guide.

1 Based on datasheet review of websites of top 20 manufacturers per IHS, as of Jan, 2020.
2 Jordan, et. al. Robust PV Degradation Methodology and Application. PVSC 2018.
3 Based on Oct. 2019 review of warranties on manufacturer websites for top 20 manufacturers per IHS 2018.
4 "SunPower Module 40-Year Useful Life," Useful life is 99 out of 100 panels operating at more than 70% of rated power.
5 SunPower 450 W, 22.2% efficient, compared to a Conventional Panel on same-sized arrays (370 W mono PERC, 19% efficient, approx. 2 m²).
6 PV Evolution Labs "SunPower Shading Study," 2013. Compared to a conventional front contact panel.
7 Based on temperature coefficients provided in manufacturer datasheets 2019.
8 SunPower panels are less than 50 dppm, or 0.005%, on over 15 million panels shipped - Source: SunPower White Paper, 2019.
9 Standard Test Conditions (1000 W/m² irradiance, AM 1.5, 25° C). NREL calibration Standard: SOMS current, LACCS FF and Voltage.
10 Class C fire rating per IEC 61730.
11 SunPower Maxeon (DC) panels first received the International Living Future Institute Declare Label in 2016.
12 SunPower Maxeon (DC) panels are Cradle to Cradle Certified™ Bronze - www.c2ccertified.org/products/score-card/e-series_x-series_solar_panels_-_sunpower_corporation. Cradle to Cradle Certified™ Bronze. Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute.
13 Maxeon panels can contribute to LEED Materials and Resources categories and BREEAM certification.

Designed in U.S.A. by SunPower Corporation
Made in Malaysia (Cells)
Assembled in Mexico (Modules)

Specifications included in this datasheet are subject to change without notice.

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