



UTILITIES, VENTILATION AND ENERGY/SUSTAINABILITY STATEMENTS

Tŷ CAMBRIA, CARDIFF - PBSA

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Project Revision Sheet

Tŷ Cambria, Cardiff – PBSA – Energy Statement. Including Utilities Statement, Ventilation and Extraction Statement.
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CONTENTS

Executive Summary	4
1.0 Introduction	4
1.1 Site Location	4
1.2 Development Proposal	5
2.0 Planning Policy Compliance & Analysis	6
2.1 Future Wales – The National Plan 2040	6
2.2 Planning Policy Wales	6
2.3 Technical Advice Note (TAN) 12	7
2.4 Cardiff Local Development Plan	8
2.5 Building Regulations – Approved Document L2A (Wales)	9
3.0 District Heat Appraisal	10
3.1 Site Heat Demand	10
3.2 Existing Heat Networks – Heat Map	10
4.0 Low & Zero Carbon Technology Assessment	13
4.1 Wind Turbines	13
4.2 Solar Photovoltaic Panels	13
4.3 Combined Heat and Power (CHP)	14
4.4 Solar Hot Water	15
4.5 Air Source Heat Pump	16
4.6 Ground/Water Source Heat Pump	17
4.7 Biomass Heating	19
4.8 Geothermal	19
4.9 Fuel Cells	19
4.10 Heat Recovery Systems	19
4.11 Micro Hydro/ Micro Wind	20
4.12 District Heating Network	20
4.13 Thermal Energy Storage	20
4.14 Battery Storage	20
5.0 Design Principals	23
5.1 Lean Measures	23
5.2 Clean Measures	24
5.3 Green Measures	24
6.0 Proposed Strategy	25
6.1 Part L Modelling Results	25
6.2 Commercial / Office Unit	25
7.0 Utilities Statement	26
8.0 Ventilation & Extraction Statement	27
8.1 Base Criteria of Design	27
8.2 Ventilation Systems	27
8.3 Noise Reduction	28
8.4 General Overview	28
Appendix A – Part L 2022 BRUKL Simulation	29

Executive Summary

This Energy Statement outlines the proposed energy strategy for the Ty Cambria development in Cardiff and demonstrates how the scheme has been designed to accord with the requirements of Building Regulations Approved Document Part L (Wales), Planning Policy Wales, Future Wales – The National Plan 2040 and Cardiff Council's planning policies. The proposed development comprises the construction of a purpose-built student accommodation (PBSA) building providing a range of student accommodation and associated communal facilities.

The proposed energy strategy follows the recognised energy hierarchy, beginning with the implementation of passive design measures to minimise energy demand. A fabric-first approach has been adopted, incorporating a high-performance building envelope with enhanced levels of insulation, thermally efficient glazing and improved airtightness to optimise the thermal performance of the building and reduce heating and cooling loads.

Energy-efficient building services have also been incorporated to further reduce operational energy consumption. These include high-efficiency lighting, ventilation systems with heat recovery where appropriate, and efficient electrical distribution systems, ensuring the development achieves a high standard of energy performance while maintaining occupant comfort and functionality.

Finally, low and zero carbon technologies were assessed to identify the most appropriate solution for the proposed development. Owing to the continued decarbonisation of the electricity network, an all-electric energy strategy was adopted. Air source heat pumps (ASHP) have been selected to provide low-temperature hot water for space heating and domestic hot water generation due to their high seasonal efficiencies, typically producing more than three units of heat for every unit of electricity consumed. In addition, roof-mounted photovoltaic (PV) panels will be installed to generate renewable electricity on-site, helping to offset the building's electrical demand, reduce regulated carbon emissions and support the overall low-carbon energy strategy.

Other technologies, including wind turbines, biomass heating, ground source heat pumps, and solar hot water systems, were considered during the assessment process in Section 4 of this report. However, these were deemed unsuitable due to site constraints, compatibility issues, or the superior effectiveness of the chosen solutions.

1.0 Introduction

This Energy Statement has been prepared for Elite Cask Ltd x MYS to support their planning application for the development of the site at 29 Newport Road, Cardiff. It has been developed by Amber Management and Engineering Services Ltd as a response to the local planning requirements. The statement is intended to respond to the issues raised in:

- Future Wales – Policies 16 & 17
- Planning Policy Wales – PPW 12
- Technical Advice Note – TAN 12
- Cardiff Local Development Plan – Policy EN12
- Cardiff Renewable Energy Assessment – REA
- Cardiff Planning obligations - SPG
- Supplementary Planning Guidance
- Welsh Government Approved Document Part L

1.1 Site Location

The proposed development site occupies a prominent location on Newport Road and bounded by East Grove to the East.

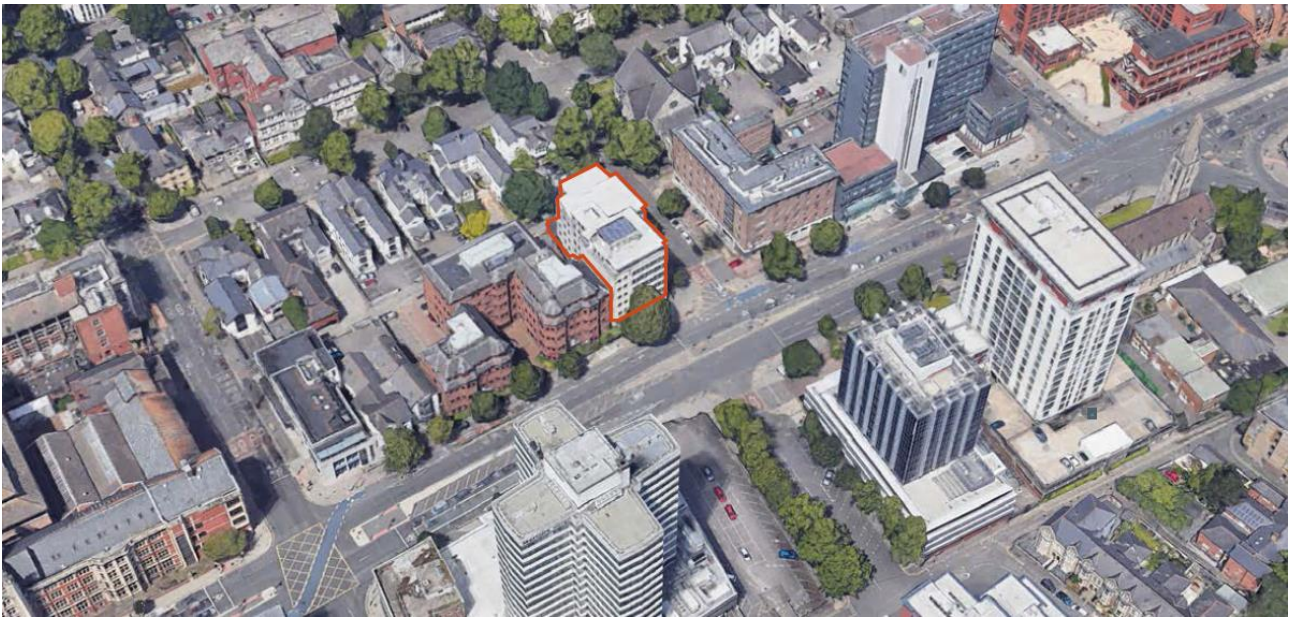


Figure 1: Site Location

1.2 Development Proposal

The proposed development involves the construction of circa 350 units of purpose built student accommodation (PBSA), arranged in a single tower of 23 floors with a typical floors seen in figure 2. The building allows for Ground, 1st and 23rd floor plant areas and amenity space spanning the Ground, 7th and 23rd floor. The bed spaces are arranged in a mix of en-suite rooms, studios and large studios.



Figure 2: Typical Floor Plans



Figure 3: 3D Massing View

2.0 Planning Policy Compliance & Analysis

Several planning policies are applicable to the proposed development. This section summarises the key carbon and sustainability policies relevant to the project.

At the national level, Planning Policy Wales (Edition 12) establishes the overarching objective of delivering net zero through climate-responsive development and requires developments to minimise energy demand, maximise energy efficiency and support the deployment of renewable and low-carbon energy. These principles are reinforced by Future Wales – The National Plan 2040, which promotes the integration of renewable and low-carbon energy technologies within new developments and encourages consideration of opportunities to connect to existing or planned heat networks where feasible.

Locally, the proposals have been developed with regard to the Cardiff Local Development Plan, particularly Policy EN12 (Renewable Energy and Low Carbon Technologies), which seeks to ensure that major developments maximise energy efficiency and incorporate renewable or low-carbon technologies where technically feasible and economically viable. In addition, the Cardiff Planning Obligations Supplementary Planning Guidance (SPG) provides further guidance on the information expected within an Energy Statement, including a demonstration that the energy hierarchy has been followed and that appropriate renewable and low-carbon technologies have been fully assessed.

The following sections of this report describe the proposed energy strategy, demonstrate compliance with the relevant planning policy framework and Building Regulations, and assess the contribution of passive design measures, energy-efficient building fabric and renewable energy technologies towards reducing the operational carbon emissions of the proposed development.

2.1 Future Wales – The National Plan 2040

Future Wales provides the national spatial strategy for Wales and identifies renewable and low-carbon energy as fundamental to achieving a net zero economy.

2.1.1 Policy 16 – Heat Networks

Policy 16 encourages major developments to consider opportunities for connection to existing or planned heat networks where these are available or anticipated. Where no suitable network exists, developments should demonstrate that opportunities have been considered and that proposed heating systems do not prejudice future connection should district heating infrastructure become available.

Accordingly, the proposed heating strategy has considered the potential for heat network connection alongside individual low-carbon heating technologies.

2.1.1 Policy 17 – Renewable and Low Carbon Energy

Policy 17 supports the delivery of renewable and low-carbon energy generation throughout Wales and encourages developments to maximise opportunities for on-site renewable energy generation where it is technically feasible and environmentally appropriate.

In accordance with this policy, this Energy Statement assesses the feasibility of renewable technologies, including solar photovoltaic (PV) systems and electrically driven heat pump technologies, to reduce operational energy consumption and carbon emissions.

2.2 Planning Policy Wales

The government has outlined planning policy guidance in the Planning Policy Wales (PPW), serving as a framework for planning authorities to formulate and implement their development plans. Central to this guidance is the drive to achieve sustainable development goals.

The Planning Policy Wales addresses various planning issues, ranging from promoting sustainable transport to facilitating the responsible utilization of minerals. Section 14 of the framework, titled 'Meeting the challenge of climate change, flooding, and coastal change,' specifically focuses on climate change. In essence, the framework recommends

the following:

1. Plans should adopt a proactive stance in mitigating and adapting to climate change, considering the long-term implications for flood risk, coastal change, water supply, biodiversity, and landscapes. Policies should support measures ensuring the future resilience of communities and infrastructure to climate change impacts.
2. New developments should be planned to avoid increased vulnerability to climate change impacts, particularly in vulnerable areas. Care should be taken to manage risks through suitable adaptation measures, including green infrastructure planning. Additionally, developments should aim to reduce greenhouse gas emissions through thoughtful location, orientation, and design.
3. Local requirements for the sustainability of buildings should align with national technical standards.
4. Plans should have a positive strategy for renewable and low carbon energy, maximizing development potential while addressing adverse impacts. Identifying suitable areas for such energy sources and supporting infrastructure is crucial. Moreover, plans should explore opportunities for drawing energy supply from decentralized, renewable, or low carbon systems and consider co-locating potential heat customers and suppliers.
5. Local planning authorities should endorse community-led initiatives for renewable and low carbon energy, even beyond areas specified in local plans or strategic policies.

When evaluating planning applications, authorities should expect new development to comply with decentralised energy supply policies, unless the applicant demonstrates, considering the type of development and its design, that this is not feasible or viable. Additionally, authorities should consider factors such as landform, layout, building orientation, massing, and landscaping to minimize energy consumption.

For renewable and low carbon development applications, authorities should not demand an overall demonstration of the need for such energy but recognize the valuable contribution of even small-scale projects to reducing greenhouse gas emissions. Approvals should be granted if the impacts are acceptable, and subsequent applications for commercial-scale projects outside identified suitable areas should meet specific criteria used in identifying those areas.

This Energy Statement demonstrates how the proposed development has adopted a fabric-first approach to minimise energy demand, before assessing the feasibility of renewable and low-carbon technologies to further reduce operational carbon emissions.

2.3 Technical Advice Note (TAN) 12

TAN 12 aims to equip all those involved in the design of development with advice on how 'Promoting sustainability through good design'. A key aim of TAN 12 is the necessity to engage with the energy hierarchy.

The energy hierarchy promotes the reduction in energy demand. Future developments must consider the energy hierarchy:

1. Energy Reduction – Reduce the amount of energy used ('smart' heating and lighting, behavioural changes), use of passive design measures,
2. Energy Efficiency – Using energy efficient systems (better insulation, efficient appliances and lighting),
3. Renewable Energy – Generate heat and electricity from renewable sources (solar PV and thermal, wind, biomass, hydro, geothermal),
4. Minimise carbon impact of other energy generation – Using low carbon technologies to reduce residual CO₂ emissions (heat pumps, CHP and CCHP systems).

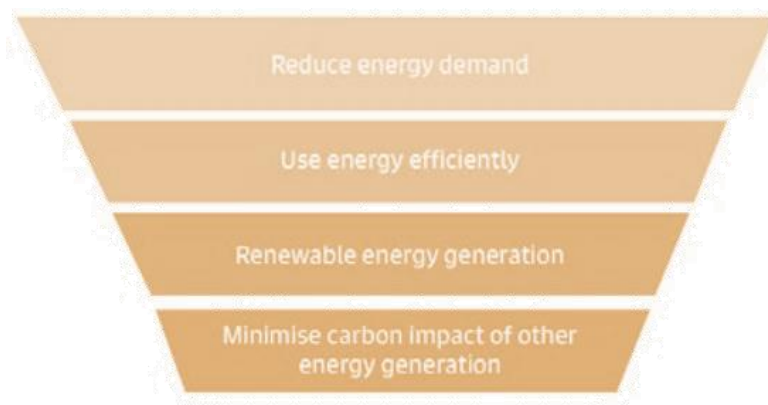


Fig 2.1 TAN 12 Energy Hierarchy

This report will outline how the development has reacted to each step of the Energy Hierarchy. It will do this through the creation of a Low/Zero Carbon technologies feasibility report assessing the possible inclusion of a wide range of technologies.

2.4 Cardiff Local Development Plan

2.4.1 Policy EN12 – Renewable Energy and Low Carbon Technologies

Policy EN12 seeks to ensure that new developments contribute towards reducing greenhouse gas emissions through the incorporation of renewable and low-carbon energy technologies.

The policy requires major developments to consider the technical and economic feasibility of renewable energy generation and low-carbon heating systems, having regard to the site's characteristics, building design and operational requirements. The policy also promotes the efficient use of energy and supports measures that reduce reliance on fossil fuels.

The proposed PBSA development has therefore been designed using a fabric-first approach and incorporates an assessment of suitable renewable and low-carbon technologies to minimise operational carbon emissions whilst maintaining high standards of occupant comfort.

2.4.1 Cardiff Planning Obligations Supplementary Planning Guidance (SPG)

Supplementary Planning Guidance (SPG) is generated to give details on the specific policies and proposals in the Cardiff Development Plan. In doing so, SPG's give contractors a greater understanding of policies and how to apply them effectively. It states that energy assessments are expected to provide the following details:

- Carbon footprint: Anticipated total energy demand / carbon dioxide emissions associated with the development (both regulated and unregulated loads should be identified),
- Assessment of options to reduce energy demand and emissions at each stage of the energy hierarchy,
- Measures of mitigation and proposed CO₂ reductions at each stage of the energy hierarchy, expressed in relation to compliance with Part L of the Building Regulations as the benchmark.

Carbon footprint reductions are important in Wales due to climate change. This is because of the urban heat island effect which is projected to become a more pressing issue in the future. As figure 2.2 indicates, the annual average temperatures in Wales are projected to increase by 1.3°C by the 2020s, 2.0°C by the 2040s and 3.3°C by the 2080s.

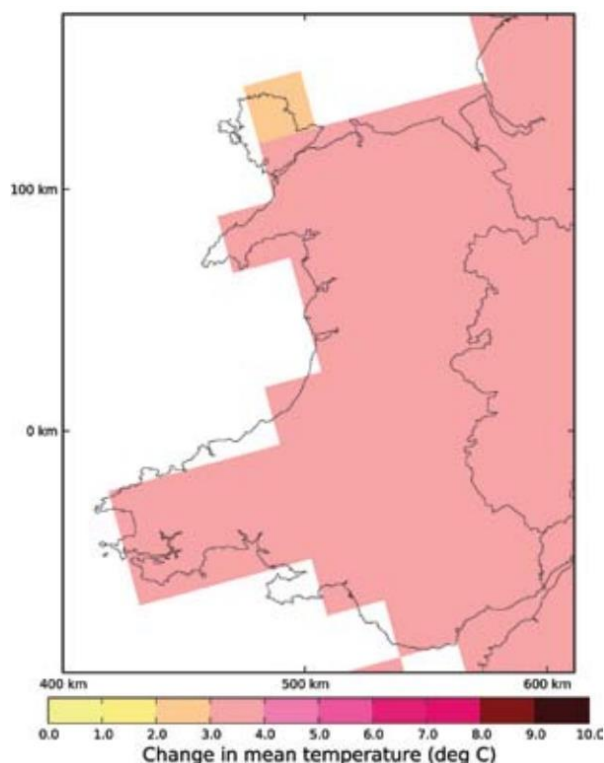


Figure 2.2 Change in mean temperature in wales by 2080. (<https://www.gov.wales/sites/default/files/publications/2024-02/atn20252doc1.pdf>)

Therefore, the Cardiff Renewable Energy Assessments Supplementary Planning Guidance, along with the first tier of the TAN 12 energy hierarchy can help to enable the development of Tŷ Cambria to meet future needs.

2.5 Building Regulations – Approved Document L2A (Wales)

Whilst Building Regulations are separate from planning policy, compliance with Approved Document L2A forms an important component of the overall energy strategy.

Approved Document L2A establishes minimum standards for the conservation of fuel and power in new buildings other than dwellings, including limiting fabric U-values, air permeability requirements and minimum efficiencies for fixed building services. Compliance is demonstrated through National Calculation Methodology (NCM) modelling using SBEM or Dynamic Simulation Modelling (DSM), comparing the proposed building against a notional building to demonstrate compliance with the Target Primary Energy Rate (TPER), Target Emission Rate (TER) and Building Primary Energy Rate (BPER), as applicable.

The proposed development has been designed to satisfy these requirements to satisfy compliance with Approved Document Part L2A 2022 Edition, while also delivering additional improvements in operational energy performance through enhanced fabric specifications and the integration of renewable energy technologies.

3.0 District Heat Appraisal

This district heating analysis will be completed in accordance with TAN 12 and Future Wales Policy 16.

3.1 Site Heat Demand

The Cardiff Heat Map illustrates that this development is not within an area of high heat demand. An area of high heat demand is classified as being greater than 625,000kWh/year. This area has a demand of less than 25,000kWh/year. Figure 3.1 clearly depicts this with information from the DataMapWales database:

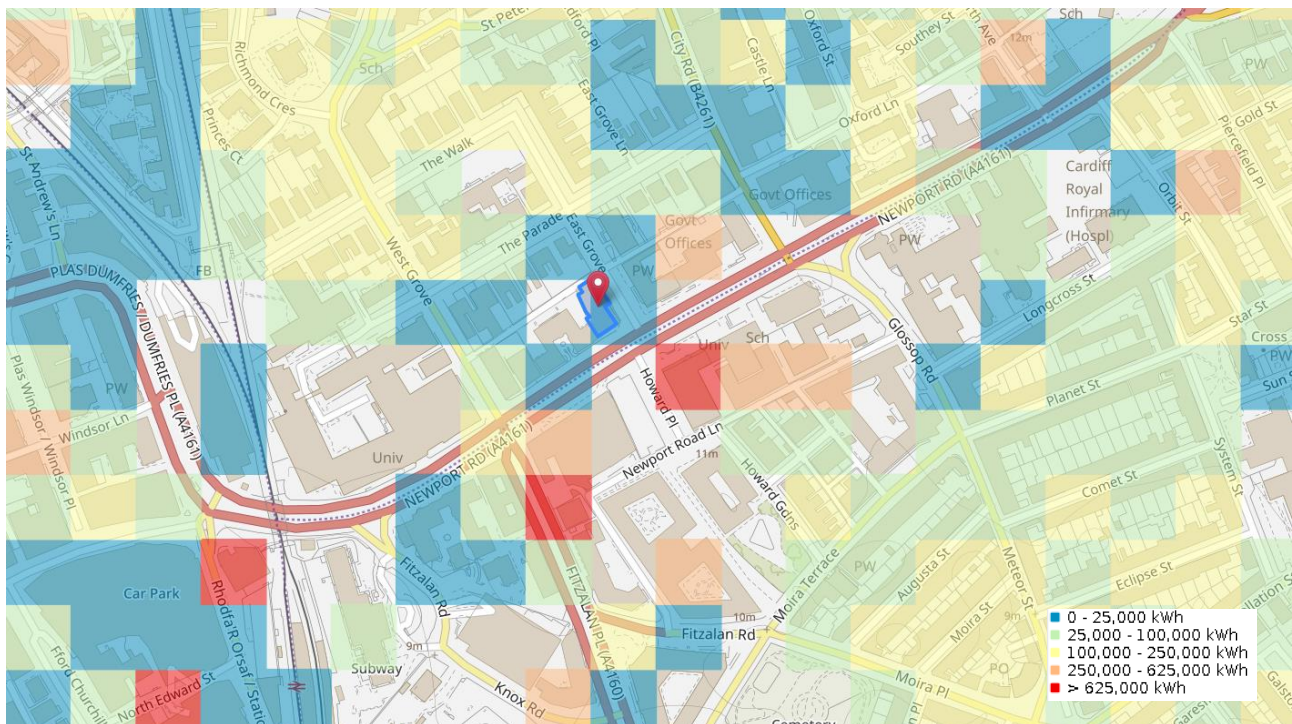


Figure 3.1 - Priority Areas for District Heat Networks – Heat Demand 50m Grid kWh
 (Proposed Development shown with red pin) (gov.wales)

3.2 Existing Heat Networks – Heat Map

There is currently an active and operational District Heat Network (DHN) in Cardiff which uses recovered heat from the Viridor Energy Recovery Facility at Trident Park to provide low-carbon heating and hot water.

Currently, Phase 1 has been completed, incorporating 4.9 kilometres of pipework which connects to six major public buildings and over 100 residential apartments.

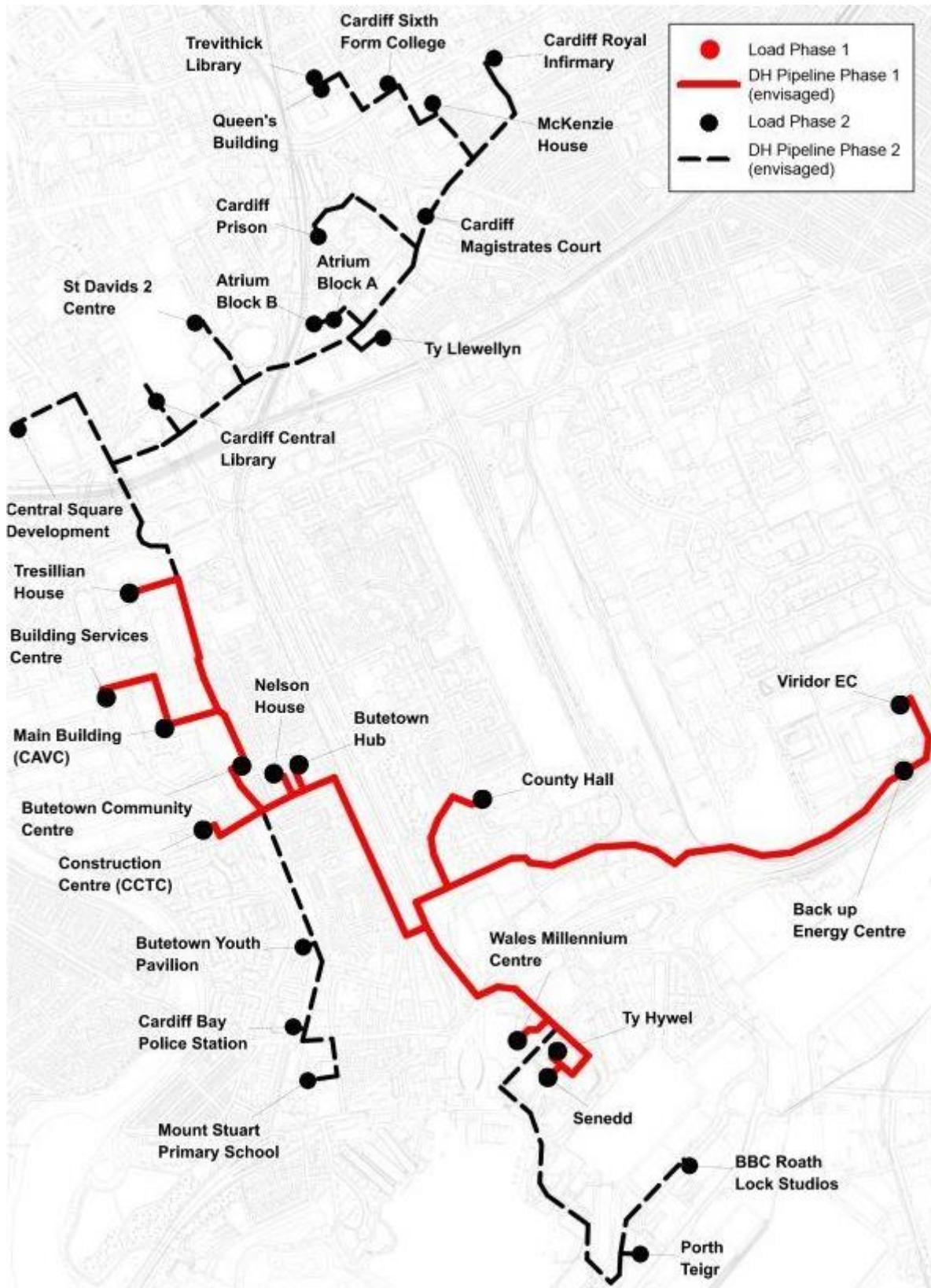


Figure 3.2 – Proposed Cardiff Heat Networks

There are plans to extend the network in a subsequent phase but the planning, financing and design of this project has yet to be confirmed. From early proposals, it appears that the DHN is planned to extend to be within the proximity of the planned Tŷ Cambria development with the adjacent Cardiff Sixth Form College one of the planned heat users.

However, as the existing DHN does not yet extend to this site, the proposed development must design an independent energy strategy to meet its energy needs. However, it is crucial that this strategy remains adaptable to allow for a potential future connection to a DHN, once the network expands and more information on timelines and commercial considerations becomes available. This is dependent on plant space on the primary side to accommodate any arrangement involving DHN connection.

Given this situation, the development plans to incorporate a variety of low carbon and renewable energy technologies to ensure a sustainable and reliable energy supply for the building. These technologies will provide immediate benefits by reducing carbon emissions. However, due to spatial constraints on the primary side it is unlikely that the development will be able to integrate with a DHN in the future. This approach ensures that the development remains forward-thinking and environmentally responsible, aligning with long-term sustainability goals independently, without relying on the uncertain feasibility of a future DHN connection.

4.0 Low & Zero Carbon Technology Assessment

Each of the following Low and Zero Carbon Technologies (LZCT) will be assessed for potential integration within the development. Incorporating low and zero carbon technologies into a new building design is essential for reducing energy demand, lowering running costs, and minimising environmental impact. By generating renewable energy on-site, these systems decrease reliance on fossil fuels, reduce greenhouse gas emissions, and provide long-term savings on utility bills, while also insulating the building from fluctuating energy prices. Additionally, these technologies enhance energy efficiency by minimising transmission losses and increase energy resilience, offering independence from the nation-wide energy grid.

4.1 Wind Turbines

Wind turbines in city centre locations experience poor yields for electricity generation as the obstruction caused by similar height buildings, and natural variations in topography, inevitably lead to turbulent air flow around the building.

In reaction to this, the invention and development of Vertical-Axis Wind Turbines (VAWTs) has arisen. They require far less space than their horizontal-axis (HAWTs) counterparts, are unaffected by changes in wind direction and are much more quiet making them perfect for residential/urban areas. VAWTs are also cheaper and easier to maintain as they only have 2 main components, HAWTs have 4. The drawback is that the technology is still relatively new and commercial availability is currently scarce. On average, wind turbines harness 60% of the energy that passes through them, a far greater efficiency than solar panels, which average 18-22% energy capture.

HAWTs are less expensive (circa £20,000 for a 6kW turbine) but produce vibration, VAWTs are approximately 10% more expensive but are almost vibration free.

The British Wind Energy Association recommends that a site be monitored over the course of a year to assess the potential efficacy of a wind turbine.

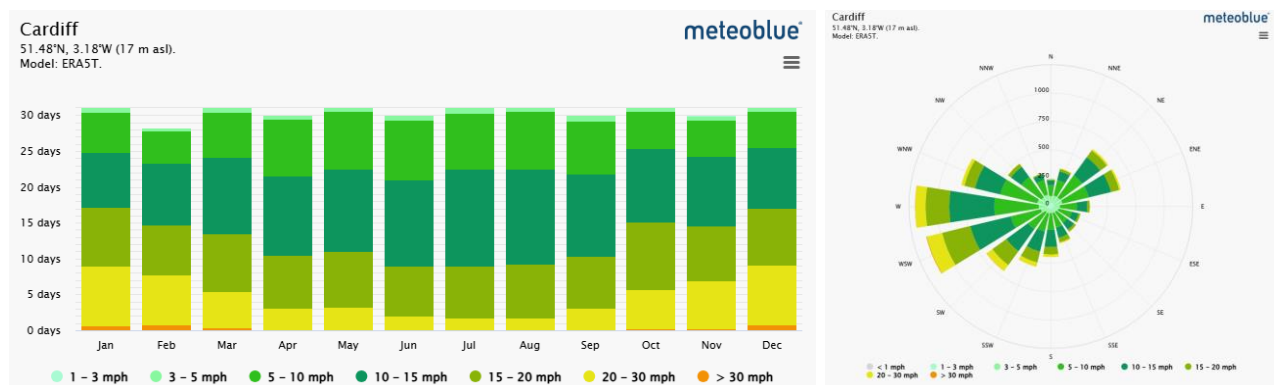


Figure 4.1 – Data for Average Wind Speed in Cardiff

(https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/cardiff_united-kingdom_2653822)

Wind turbines are generally considered to have a negative visual impact, and therefore wind turbines are not considered to be viable for this development.

Selected: **No**

4.2 Solar Photovoltaic Panels

Roof mounted photovoltaic panels (PV) have been identified as a possible means of generating zero carbon electrical energy. Due to the wide variation in occupancy of student accommodation, the electrical base load is generally constant throughout the day. This can be, in part, covered by the output of the photovoltaic system.

Once the photovoltaic panels are installed, there are minimal maintenance requirements. However, access and a water supply will be needed to roof level for annual cleaning of the panels and to enable panel replacement should any fail. Installation of technology is subject to approval for embedded generators by the Distribution Network Operator (DNO).

A blue and/or green roof can be installed in addition to the Solar PV present on the roof, in a similar fashion to Figure 4.2, with the PV panels being securely suspended above the vegetation at a pitch angle of 10 degrees. Meaning that the lower section of the panel is approximately 500-550mm above the soil, and the higher section 800-850mm above.



Figure 4.2 Example of PV being used in alignment with a living roof (Roofland.com)

Installing a blue roof alongside solar photovoltaic (PV) panels offers synergistic benefits that enhance the performance and sustainability of both systems. The vegetation on a living roof helps to regulate the temperature around the PV panels, keeping them cooler and thereby improving their efficiency, as solar panels operate more effectively at lower temperatures. Additionally, the blue roof reduces the building's overall energy consumption by providing natural insulation, which complements the energy generated by the solar panels.

Some of the lower roof areas on this project shall be assigned as amenity terraces for occupants of the building to use. However, the upper roof level will not be overshadowed and is deemed suitable for the installation of a photovoltaic array. This shall be further developed with the applicable project team members to assess the maximum size that can be accommodated.

Selected: **Yes**

4.3 Combined Heat and Power (CHP)

A CHP unit generates electricity on-site, and recovers the waste heat from this process to be used for heating or domestic hot water generation.

To ensure that a CHP is running as efficiently as possible, a steady, continuous heat demand is required. The large quantity of domestic hot water required for high density residential developments satisfies this requirement. The electricity generated will also contribute to the building base load.

However, due to the ongoing decarbonisation of the UK electricity generating network, the carbon factor for electricity is now less than natural gas and therefore the carbon impact of using gas as an energy source is far higher, especially when using heat pumps with a Coefficient of Performance in the region of 300%. Therefore, CHP machines are not deemed to be a viable technology for this development as per the TAN 12 Energy hierarchy.

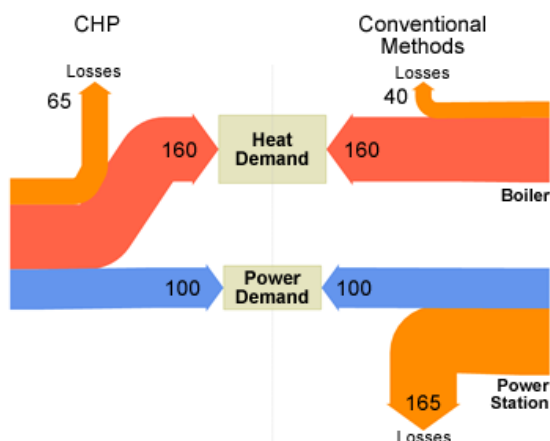


Figure 4.3 – Sankey diagram illustrating CHP energy flows

Selected: **No**

4.4 Solar Hot Water

Roof mounted solar thermal collectors are used to provide a pre-heat to the domestic hot water requirements from solar energy. The proposed development will have a high domestic hot water demand and so a solar hot water system has the potential to provide a significant reduction in CO₂ emissions.

However, a solar hot water system would reduce the roof space available for photovoltaic panels.

Additionally, when the building may be experiencing periods of low occupancy due to student summer holidays, this aligns with the highest yields which are very difficult to manage once all hot water storage requirements are satisfied and therefore complicated and expensive heat rejection plant is required which in theory ‘wastes’ the energy.

For these reasons, solar hot water is not deemed suitable for this development and instead photovoltaic systems shall be optimised instead.

Selected: **No**

4.5 Air Source Heat Pump

An Air Source Heat Pump (ASHP) extracts heat energy from the ambient air and uses this to provide space heating and/or domestic hot water, via either an air system or a wet system with radiators/underfloor heating and calorifiers for domestic hot water generation.

The heat pumps operate by cool refrigerant entering the compressor which decreases the volume, thus raising the temperature. The hot refrigerant is then circulated through the internal heat exchanger for space heating, as seen in Figure 4.4. The process can also be reversed during summer months to remove heat from the building by certain heat pumps that have ‘reverse cycle’ capability.

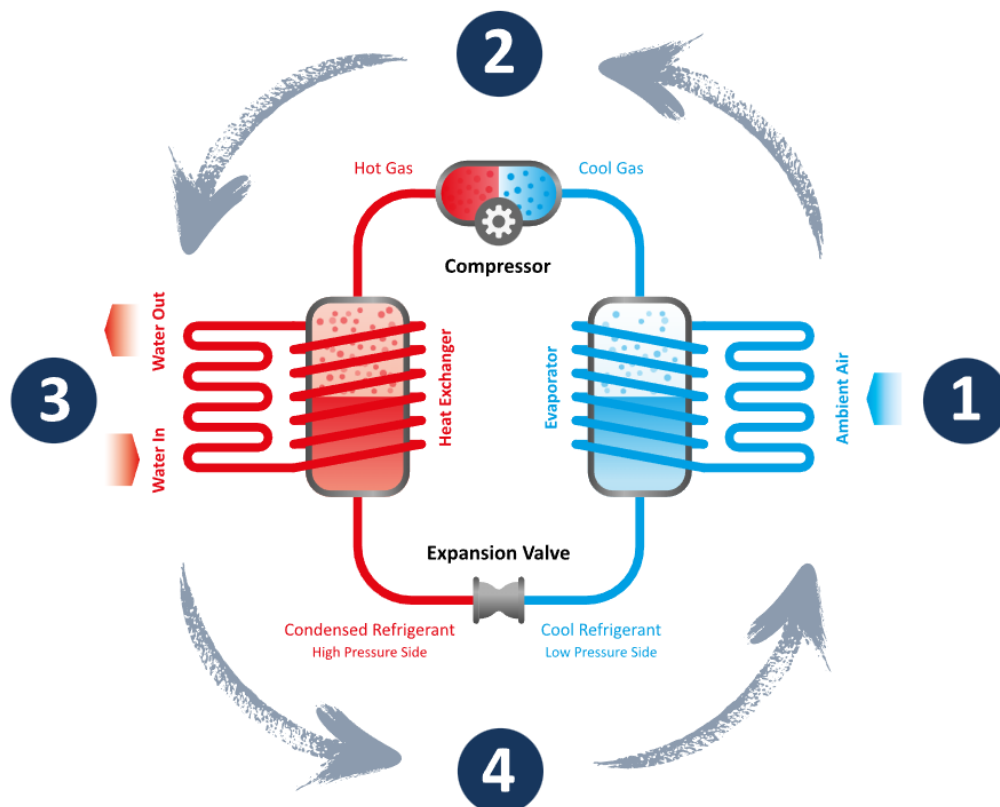


Figure 4.4 – Air Source Heat Pump Functionality Diagram

The heat pumps operate on grid-supplied electricity and often have seasonal coefficients of performance (SCoP) in excess of 3. This efficiency coupled with the decarbonised electricity grid means that ASHP can provide a highly energy efficient means of supplying heat energy.

Further recent developments with ASHP technology has optimised designs to better suit the higher temperature requirements of domestic hot water generation which generally requires storing water over 60°C. Additionally, the refrigerant used in modern heat pumps have lower a Global Warming Potential (GWP) than they have previously. With the rise in commercial availability of the refrigerant known as R32, heat pumps have become even more of an eco-friendly option. R32 is now the most used refrigerant with a GWP of 675 replacing the former most popular refrigerant of R410A which had a GWP of 2088. Another benefit of R32 is that it can deliver improved efficiency, meaning the heat pump is able to recharge and recycle heat more with less losses, saving energy and making the heat pump greener in its operation.

Furthermore, the UK make is seeing increasing availability of natural refrigerants such as CO₂ & Propane. CO₂/propane heat pumps are incredibly versatile, with a wider range of ambient temperature applications. In response to environmental regulations and the phase-out of high GWP refrigerants, CO₂/propane heat pumps are becoming a

much more attractive option but require further coordination to consider the increased flammability or higher pressures of these systems.

As an air source heat pump is an LZCT, it helps to meet the aspiration laid out in TAN 12 by the Welsh Government to ensure that all new buildings achieve a zero carbon and nearly zero energy standard for regulated emissions.

Therefore, it is proposed that ASHP technology, in addition to large volumes of thermal energy storage, would be extremely suitable for space heating and domestic hot water production on this development. It is also proposed that Variable Refrigerant Flow heat pump or comfort cooling and heating systems would be provided to social and amenity spaces.

Selected: **Yes**

4.6 Ground/Water Source Heat Pump

Due to the fact that the ground remains at a stable temperature of between 10-12°C, a ground source heat pump (GSHP) can be used to extract heat energy from the ground in winter and reject unwanted heat energy into the ground during summer.

The proposed development site has a large footprint with the potential to provide the required space to install a closed loop ground collector for a GSHP. However, due to the high cost of installation and internal plant space requirements, this system has been deemed inappropriate for the development.

With the city being above a shallow urban aquifer, water source heat pumps (WSHP's) can be a potential LZCT that allows for the supply of water at a more stable and consistent temperature than ASHP's.

WSHP's work by extracting energy from the water whilst allowing unwanted heat to dissipate into a river or aquifer to be removed by the flowing water. There are two types of WSHP's. Firstly, a closed loop WSHP works by utilising a heat exchanger or coil in the river that allows for the energy exchange between the water in the system and the water in the river without the cross contamination of the two water sources. Figure 4.5 depicts this.

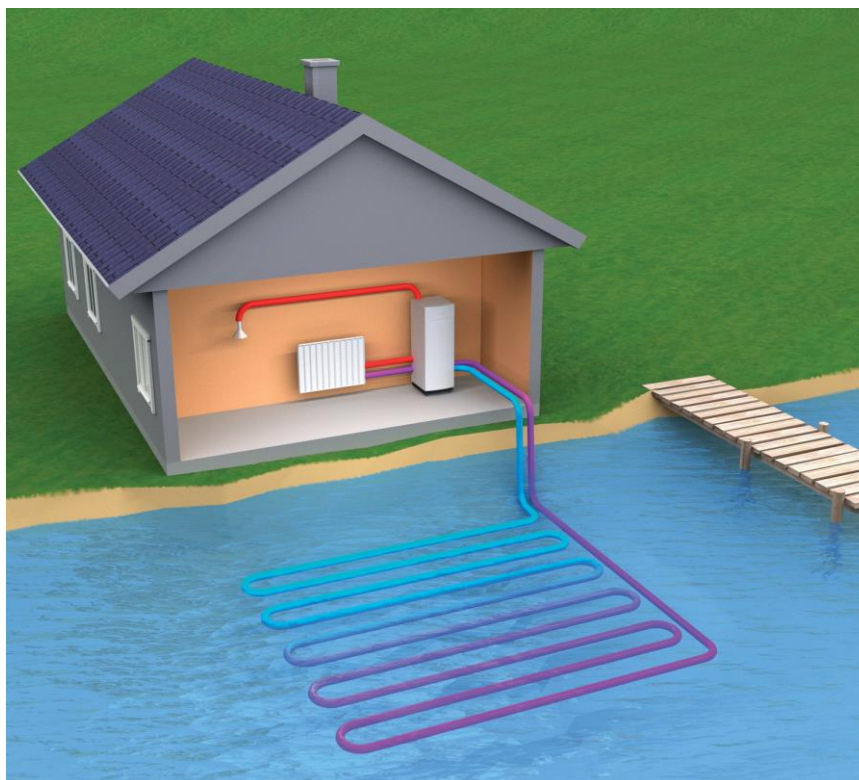


Figure 4.5 – Example of a closed loop WSHP. (<https://senergyheating.co.uk/heat-pumps/>)

The benefit of utilising a closed loop WSHP on this site is that it would not require an Abstraction licence because it will not extract any water from the aquifer. An Abstraction licence is required if the development plans to remove more than 20m³ per day.

However, as the aquifer water is “usually much cleaner than the water of reservoirs at the earth's surface” (SDWF, 2024), there is not necessarily a clear reason to use an open loop WSHP in an aquifer.

Alternatively, open loop WSHP's do not require a heat exchanger to be situated in the aquifer. This is because they operate by extracting water. This water is then transferred to a plate heat exchanger in the plant room of the building. Once the heat transfer has taken place, the water is re-deposited in the aquifer resulting in a net extraction of 0m³/s. Figure 4.6 Depicts this.

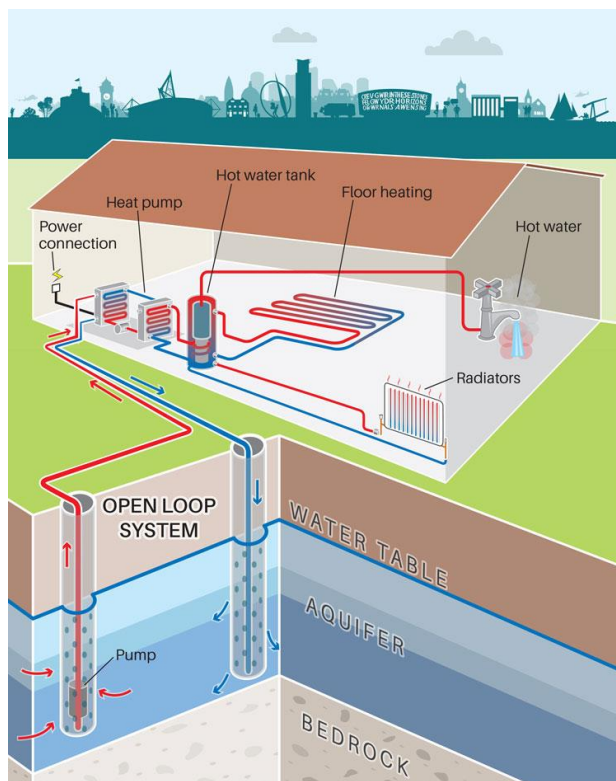


Figure 4.6 – Example of an open loop WSHP. (Boon, et al, 2019. Groundwater heat pump feasibility in shallow urban aquifers: Experience from Cardiff, UK. Science of the Total Environment, 697, p.133847.)

However, it will still need an Abstraction licence as it does remove water from the aquifer temporarily. Furthermore, the application charge to remove water depends on how many megalitres per year (ML/yr) of water the development is applying for. Annually, this development will likely be placed within the highest band of payment for water abstraction.

Alongside an Abstraction licence, for most open loop installations, a groundwater or surface water point source discharge activity environmental permit is required under the Environmental Permitting (England and Wales) Regulations 2010.

Furthermore, an open loop system will require regular maintenance to clean filters due to the high level of sand and silt that are prevalent in many aquifers. This would place a higher financial cost of maintenance compared to ASHP's.

Due to the complications associated with WSHP installation in this particular instance, coupled with the high efficiency and practicality of an ASHP it is likely to be both financially and technically more appropriate to use an ASHP.

Selected: **No**

4.7 Biomass Heating

Biomass in the form of logs, wood pellets or wood chips is classified as a renewable energy source because the CO₂ emitted during burning has been taken out of the atmosphere by the plant while it was growing. Therefore, locally sourced biomass fuel has the potential to significantly reduce the CO₂ emissions related to heating and hot water generation.

Due to the complicated feeding mechanisms and reduced availability, the cost of an automated biomass heating system is far greater than that of a more conventional heating system. The use of a biomass heating system also invites debate about how sustainable the fuel used truly is and because of this, such systems should only be selected following caution.

The UK sources only 18% of its consumed liquid biofuels domestically, with 30% originating from Brazil, sparking a broader discussion on the sustainability of their production due to the resulting deforestation. This information is made readily available by the Renewables Fuels Agency.

However, due to the location of the development site, a number of difficulties exist in relation to the delivery and storage of the fuels and operation of the boiler. Biomass heating can result in air quality problems, especially in city centre locations such as this development.

A large fuel store will be needed, requiring regular deliveries to keep the building operational. The Clean Air Act would also require a detailed analysis of the dispersal of the flue emissions to be carried out to ensure there are no air quality issues. Therefore, this technology is not proposed to form part of the development.

Selected: **No**

4.8 Geothermal

Geothermal technology uses deep geothermal boreholes in the Earth's surface, along with a thermodynamic refrigeration cycle to generate hot water. This technology requires a lot of capital expenditure, time and space to drill the boreholes. Space is not a commodity in this development due to its location in the city centre and thus this technology is not recommended for the development.

Selected: **No**

4.9 Fuel Cells

A fuel cell is an electrochemical device that converts chemical energy directly into electrical energy through a reaction between a fuel (such as hydrogen) and an oxidizing agent (usually oxygen). It produces electricity, water, and heat as by-products, offering a clean and efficient power generation method.

This technology is only appropriate for inclusion in developments that have continuous access to chemical energy and as such is not suitable for this development.

Selected: **No**

4.10 Heat Recovery Systems

A heat recovery system captures and reuses waste heat from industrial processes to enhance energy efficiency. By identifying and utilizing sources of waste heat, such as exhaust gases or hot water runoff, the system aims to reduce carbon emissions.

This technology is only appropriate for inclusion in developments that either directly or indirectly come into contact with industrial waste and as such is not suitable for this development.

Selected: **No**

4.11 Micro Hydro/ Micro Wind

Micro hydro refers to small-scale hydroelectric power systems that generate electricity from flowing water, typically streams or rivers. Micro wind refers to small-scale wind turbine systems that harness wind energy to generate electricity. Both micro hydro and micro wind are decentralized, renewable energy solutions suitable for smaller-scale applications.

These technologies are more suitable to small scale residential developments so have been ruled out of this development.

Selected: **No**

4.12 District Heating Network

Covered in section 3 above.

Selected: **No**

4.13 Thermal Energy Storage

Thermal Energy Storage (TES) provides a means of storing thermal energy for use at a later time, allowing the operation of heating plant to be decoupled from periods of peak heat demand. Within a Purpose-Built Student Accommodation (PBSA) development, TES is typically provided in the form of insulated hot water storage vessels connected to the domestic hot water (DHW) and/or space heating system. The stored thermal energy can be generated during periods of lower electrical demand or when renewable electricity generation is available, before being utilised during periods of peak occupancy. This approach improves the operational flexibility of the heating system and can reduce the required peak capacity of heat generation equipment.

Where electrically driven air source heat pumps are proposed, thermal energy storage can provide significant operational benefits by enabling the heat pumps to operate for longer periods at lower output, where their efficiency is generally higher. Heat can be stored when external temperatures are more favourable or when on-site photovoltaic (PV) generation is available, reducing reliance on electricity imported during peak demand periods and increasing the utilisation of renewable energy generated on-site. In a PBSA development, where domestic hot water demand typically exhibits predictable morning and evening peaks, appropriately sized thermal storage can improve system efficiency, reduce operating costs, enhance occupant comfort and support the overall decarbonisation strategy by reducing operational carbon emissions.

Thermal Energy Storage is proposed to be used on this project by utilising primary LTHW storage along with DHW storage within calorifiers.

Selected: **Yes**

4.14 Battery Storage

Battery Energy Storage Systems (BESS) enable electrical energy to be stored for use at a later time, providing greater flexibility in the operation of building electrical systems. In conjunction with on-site renewable generation, such as solar photovoltaic (PV) panels, battery storage can capture surplus electricity generated during periods of high solar output and discharge it during periods of increased building demand or when renewable generation is unavailable. This can reduce peak electricity imports from the grid, improve the utilisation of renewable energy generated on-site and enhance the resilience of the building's energy infrastructure.

For the proposed Purpose-Built Student Accommodation (PBSA) development, the feasibility of incorporating battery storage has been considered as part of the overall energy strategy. Student accommodation typically exhibits a relatively consistent electrical demand throughout the day and evening due to the continuous operation of communal services, mechanical ventilation, lighting, lifts, domestic hot water systems and occupancy-related plug loads. An assessment of the proposed photovoltaic (PV) system indicates that the anticipated on-site generation will remain below the building's daytime electrical base load for the majority of operating hours. Consequently, the electricity generated by the PV array

is expected to be consumed directly by the building as it is produced, leaving little or no surplus energy available for storage.

As a result, the installation of a battery energy storage system would provide minimal additional benefit in terms of increasing on-site renewable energy utilisation or reducing grid electricity imports. Given the limited opportunity to charge the battery from surplus PV generation, the additional capital cost, maintenance requirements and replacement costs associated with battery storage would not be justified by the operational savings achievable. It is therefore concluded that the inclusion of battery energy storage would not be a technically or economically viable measure for the proposed development and has not been taken forward as part of the proposed energy strategy.

Selected: **No**

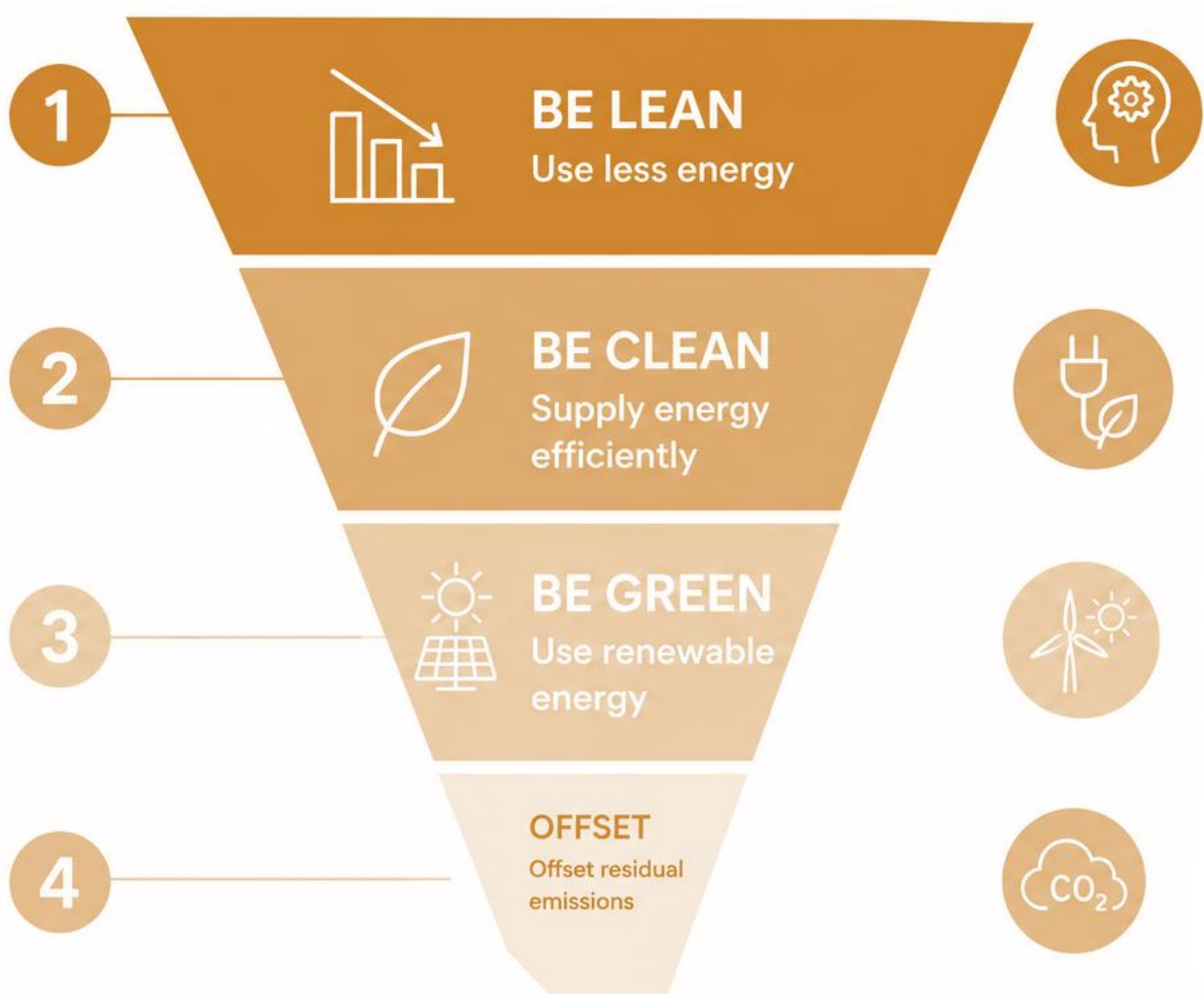
Table 4.1 LZCT Inclusion Table

Wind Turbine 	No	Considered to have a negative visual impact and limited yield within a city centre environment.
Solar PV 	Yes	Solar photovoltaic (PV) panels have been incorporated into the proposed development to generate renewable electricity on-site, reducing operational carbon emissions and grid electricity demand. The electricity generated will be used directly within the building, helping to improve overall energy performance and supporting compliance with national and local planning policies relating to renewable energy and decarbonisation.
CHP 	No	The carbon factor for electricity is now less than natural gas and therefore the carbon impact of using gas as an energy source is far higher, especially when using heat pumps with a Coefficient of Performance in the region of 300%.
Solar Hot Water 	No	The highest yields occur while the building is at lowest capacity, during the summer holidays. Once all hot water storages are satisfied it is complicated and expensive to build heat rejection plant to displace the excess yields.
Air Source Heat Pump 	Yes	Air source heat pumps (ASHPs) have been incorporated into the proposed development to provide an efficient, low-carbon heating and domestic hot water solution. By using electricity to extract heat from the outside air, ASHPs significantly reduce operational carbon emissions compared with conventional fossil fuel heating systems and support compliance with national and local planning policies promoting building decarbonisation.
Ground Source Heat Pump 	No	Ground source heat pumps (GSHPs) have not been incorporated into the proposed development as the site does not provide sufficient space to accommodate the borehole field or ground collector arrays required. In addition, the higher installation costs and construction complexity associated with GSHP systems would not provide sufficient benefit over the proposed air source heat pump solution, which offers a more practical and cost-effective low-carbon heating strategy for the development.
Biomass	No	A large fuel store will be needed, requiring regular deliveries to keep the building operational. The Clean Air Act would also require a detailed

		analysis of the dispersal of the flue emissions to be carried out to ensure there are no air quality issues.
Geothermal 	No	This technology requires a lot of capital expenditure, time and space to drill the boreholes. Space is not a commodity in this development due to its location in the city centre.
Fuel Cell 	No	Due to constant operation and high base load, fuel cells not deemed as necessary to store energy produced on site.
Heat Recovery 	No	No local industrial waste to take advantage of.
Micro Wind / Hydro 	No	Not a suitable technology for use on a development of this scale.
District Heating Network 	No	Connection to a district heating network has been considered; however, there is currently no local heat network available to serve the proposed development. Consequently, a connection is not considered technically feasible at this time. The building services design will, where practicable, be future-proofed to facilitate a connection to a district heat network should one become available in the area during the building's operational life.
Thermal Energy Storage 	Yes	Thermal energy storage has been incorporated into the proposed development to improve the efficiency and flexibility of the heating system by storing heat for use during periods of peak demand. This enables the air source heat pumps to operate more efficiently, reduces peak electrical demand and supports the effective utilisation of low-carbon heating.
Battery Storage 	No	Battery energy storage has not been incorporated into the proposed development as the electricity generated by the proposed solar PV system is expected to be consumed directly by the building, with generation remaining below the daytime electrical base load. As a result, there is insufficient surplus renewable electricity to justify the installation of battery storage, making it neither technically nor economically viable.

5.0 Design Principals

The design intent of the development is to reduce the annual energy consumption, whilst ensuring that the energy consumed is done so in the most efficient manner possible, minimising CO₂ emissions. The services strategy to achieve this and to comply with the Building Regulations has followed the following principles:



- **Lean:** Prioritise passive design strategies to reduce energy demand. This includes optimising building orientation, insulation and airtightness to minimise heating and cooling needs.
- **Clean:** After reducing demand, focus on improving energy efficiency through the use of high efficiency systems, such as LED lighting, energy-efficient heating, ventilation, and air conditioning (HVAC) systems.
- **Green:** Finally, meet the reduced energy demand through renewable energy sources and LCGT, such as PV, Wind turbines or heat pumps. This reduces the building's carbon footprint and contributes to net-zero goals by offsetting non- renewable energy use.

5.1 Lean Measures

5.1.1 Building Fabric

The thermal insulation standards will be specified to exceed the minimum standards contained within Approved Document L Volume 2 2022 to limit the heat loss through the building fabric. This will reduce the heat energy required to maintain internal comfort levels and so reducing the CO₂ emissions associated with space heating.

The building will also be designed to achieve air permeability standards in excess of the requirements of Approved Document L, targeting an air permeability of $2.5 \text{ m}^3/(\text{h} \cdot \text{m}^2)$ at 50 Pa. This will reduce the infiltration of external ambient air and so reduce the heating requirement of the building.

3.1.2 Solar Gain

Solar control glazing will be provided to the windows on the south elevation to limit summertime solar gains and overheating, so reducing the requirement for mechanical cooling systems and increased mechanical ventilation rates.

3.2 Clean Measures

3.2.1 Heating Plant

Heating and hot water will be provided by centralised high efficiency Air Source Heat Pumps (ASHP). These will be selected to have an efficiency that exceeds the minimum standards required by the NCM modelling guide for buildings other than dwellings in Wales. Heating will be supplied to each room via a central distribution network feeding high efficiency radiators. TRV's will be provided to each radiator, with weather compensated controls varying the ASHP flow temperatures. All central controls will be linked to the Building Management System to provide central monitoring and control.

3.2.2 Mechanical Ventilation

Due to acoustic and energy efficiency requirements all areas shall require Mechanical Ventilation with Heat Recovery (MVHR), these shall incorporate high efficiency heat exchangers to minimise the CO₂ emissions related to heating the incoming fresh air to the room temperature.

3.2.3 Internal Lighting

Internal lighting contributes to a significant proportion of the operational energy requirements of buildings of this type, and so offers significant scope for the reduction of annual CO₂ emissions. The energy consumption associated with internal lighting will be minimised by using efficient LED luminaires wherever possible, with high frequency fluorescent luminaires elsewhere.

Automatic lighting controls will be provided, via passive infra-red detectors (PIR's), throughout all communal and circulation spaces to ensure lighting is not left on unnecessarily. The use of automatic absence detection to student rooms shall be investigated to turn off lights in unoccupied rooms.

3.2.4 Energy Metering

All main incoming utilities, major energy consuming plant, and individual electrical distribution boards will be metered to enable the end use to be identified. All meters will be linked to a Meter Management System (MMS) to provide central monitoring. While metering does not in itself reduce energy consumption, this will allow high energy consumption to be identified and targeted for improvements.

3.3 Green Measures

A variety of low/zero carbon technologies (LZCTs) were assessed for potential inclusion in the scheme in Section 4 of this report. Suitable technologies include Air Source Heat Pumps for primary heating and domestic hot water productions long with photovoltaic array electricity generation to reduce the buildings electrical demand.

6.0 Proposed Strategy

Following the design development process, Part L energy calculations will be undertaken to determine the amount of energy consumed by the proposed building, and the associated CO₂ emission, through the use of SBEM calculations and assessments of the passive design measures and energy efficiency design measures that will be employed to minimise the operational energy use as far as practically possible.

In addition to the measures employed to reduce energy consumption, this report has also analysed the feasibility of various renewable and low/zero carbon energy sources. A number of potential renewable and low/zero carbon energy sources, such as biomass, wind turbines, solar hot water and ground source heat pumps, have been shown to not be technically or financially feasible for this development.

Provision will be considered to include for district heat network connection to be introduced in the future, with routing through site from point of connection. Potential inclusion will be subject to carbon intensity of the local energy centre and its ability to decarbonise as effectively as high efficiency air source heat pumps following the reduction in the electricity grids carbon intensity.

6.1 Part L Modelling Results

Results to demonstrate compliance with Building Regulations Approved Document Part L, Volume 2 (Wales) shall be demonstrated here when available.

6.2 Commercial / Office Unit

There is a ground floor commercial space which will be modelled separately at this stage as a shell and core space.

For the simulation, heating and cooling will be assumed to be provided by VRF and ventilation is provided with MVHR due to closed windows on the ground floor. SFP and efficiencies of the equipment is modelled as being the same as in the amenity spaces.

Lighting in this space has been modelled to include Photocell control dimming to counter-act the high glazing to wall ratio in the space.

7.0 Utilities Statement

7.1 Electricity

The building is to be provided with LV electricity infrastructure with a connection from the local substation. To serve the new development, this infrastructure shall be reconfigured to suit the new requirements with a provision of a new substation within the development served from the local network at HV. Capacity demand will be assessed against the intent of this report with regards to systems and any other specific requirements due to building allowances to ensure as low as possible demand is applied for.

The intent at present is that the HV and substation will be adopted and form part of the local DNO (National Grid) network that will also still serve other neighbouring buildings as it does so already.

During construction works, the substation shall have to be temporarily relocated to allow the existing building to be demolished and the new one to be built. During this period the temporary substation shall be sited on a plot adjacent to the site with discussions ongoing with National Grid, the DNO, to progress this.

7.2 Potable Water

The proposed development shall utilise low flow water appliances and Sanitaryware across the scheme both for the accommodation and Laundry facilities. This is to assist with achieving BREEAM accreditation for which water conservation and sustainability are top priorities.

Impact to the Dŵr Cymru Welsh Water (DCWW) infrastructure will be minimised by employing large capacity potable water storage tank(s) that shall fill at a steady rate to remove high peaks and troughs on the water network reducing the impact on the network.

A pre-planning enquiry will be made to DCWW to ensure the available capacity in the adjacent infrastructure is available to service this development. This will require more in depth modelling by DCWW to assess what, if any, reinforcement works may be necessary. It should be noted that existing supplies to the building will be disconnected and their infrastructure allowances will be considered in the application.

It should be noted that the current development is already serviced by DCWW so this will help to mitigate any additional demand for the scheme.

7.3 Communications

Utilities searches show that both Openreach and Virgin Media service is available adjacent to this site that will be able to provide high speed connectivity to the development. As the project progresses the necessary disconnection and new connection applications shall be progressed in a timely manner. Multiple incoming media service providers shall either be brought into the building or cable duct networks provided at different locations to provide secure connections.

8.0 Ventilation & Extraction Statement

8.1 Base Criteria of Design

The following documents have been the primary basis for the ventilation strategy approach for the new development:

- Building Regulations Approved Document Part F, volumes 1 & 2 – 2022 editions
- Chartered Institution of Building Services Engineering (CIBSE) Guides and Technical Memoranda
- Building Research Establishment Environmental Assessment methodology (BREEAM) New Construction Version 7 – Multi Residential
- Building Research Establishment Environmental Assessment methodology (BREEAM) New Construction Version 7 – Commercial – Shell and Core

8.2 Ventilation Systems

The ventilation strategy has been developed to serve the following areas:

- Residential student accommodation
- Student accommodation social and amenity areas
- Student accommodation “Back of House” – i.e. cycle store, plant rooms, bin store etc.
- Commercial area

8.2.1 Residential Student Accommodation

Each student room, Studio, Social Studio, Apartment Bedroom and Communal Kitchens will be provided with its own Mechanical Ventilation Heat Recovery (MVHR) unit.

This unit will be located within a bulkhead feature within the room and provide fresh air together with extract from the room served, including the sanitary “Pod” facility.

Ductwork will be routed from the MVHR unit to the external façade, which will have integrated within, purpose designed features, allowing the air – fresh or exhaust – to exit the building to atmosphere.

Each MVHR unit shall incorporate a 100% full summer bypass facility to offer the occupant a free cooling mode should temperatures allow.

Operation of these units shall be in accordance with Part F of the Building Regulations to provide continuous background ventilation with an occupier boost facility for purge and overheating.

Within each Studio, Social Studio and Communal Kitchen, a kitchen cooker hood, with integral charcoal filters shall be provided which will recirculate the air when in operation.

8.2.2 Student Accommodation Social & Amenity Areas

The student accommodation social and amenity areas will be located throughout the development and will be provided with dedicated mechanical supply and extract ventilation systems incorporating heat recovery, selected to suit the size, occupancy and function of each space.

Where appropriate, the social space areas will be served by local mechanical ventilation with heat recovery (MVHR) units. All heat recovery systems will incorporate a 100% summer bypass facility to provide free cooling during suitable external conditions.

Ventilation ductwork will be routed to suitably located external façade louvres or other approved intake and discharge positions to provide fresh air supply and exhaust air discharge.

Where toilet facilities are provided, dedicated mechanical extract ventilation systems will be installed and controlled via occupancy detection to minimise energy consumption while maintaining the required ventilation rates.

All ventilation systems will be integrated with the Building Energy Management System (BEMS) to enable efficient operation, monitoring and control.

8.2.3 Student Accommodation “Back of House”

Back-of-house and ancillary areas, including plant rooms, cycle storage, refuse stores and other service areas, will be provided with dedicated mechanical ventilation systems comprising either supply and extract ventilation or mechanical extract ventilation, as appropriate to the intended use and occupancy of each space.

External air intake and exhaust will be provided via suitably located louvres or other approved façade ventilation terminals to meet the operational requirements of each system.

All ventilation systems will be integrated with the Building Energy Management System (BEMS) to enable efficient control, monitoring and operation.

8.2.4 Commercial Area

The commercial units will be designed to accommodate suitable mechanical ventilation systems as part of the future tenant fit-out. Provision will be made within the base building to facilitate the installation of supply and extract ventilation systems, with external air intake and exhaust provided via suitably located façade louvres or other approved ventilation terminals.

8.3 Noise Reduction

Where required all fans and MVHR units will be provided with noise attenuation to meet the requirements of the external noise report provided by the project acoustician.

All plant will be selected to meet the noise limits and additional noise attenuation measures will be provided to ensure these limits are met where required.

The following noise control techniques will be implemented as part of the inherent design of the development:

- Plant will be appropriately selected to meet the specified noise criteria.
- Air intake and discharge louvres are kept away from noise sensitive receptors such as nearby windows
- Noise attenuation of air intake/discharge louvres with duct-mounted attenuators and/or acoustic louvres provided where required.
- Internal plant rooms will include appropriate sound insulating measures.
- Anti-vibration mounts to control structural-borne noise and vibration.

8.4 General Overview

The proposed ventilation strategy incorporates a range of measures to minimise the potential impacts associated with noise, vibration and odour. These include:

- The control of noise and vibration through the use of appropriately selected plant, ductwork attenuation and anti-vibration mounts where required.
- Provision within the commercial areas for future odour abatement and grease filtration systems, where required as part of tenant fit-out kitchen ventilation systems.
- The reduction of external pollutants through the provision of filtration within mechanical ventilation systems and the appropriate location of external air intake terminals.
- The maintenance of suitable separation distances between air intake and exhaust terminals, where practicable, to minimise the risk of exhaust air re-entrainment.
- The selection and specification of all mechanical plant and ventilation systems to comply with the recommendations of the project acoustic assessment and relevant planning requirements.

Appendix A – Part L 2022 BRUKL Simulation

To be appended when available.