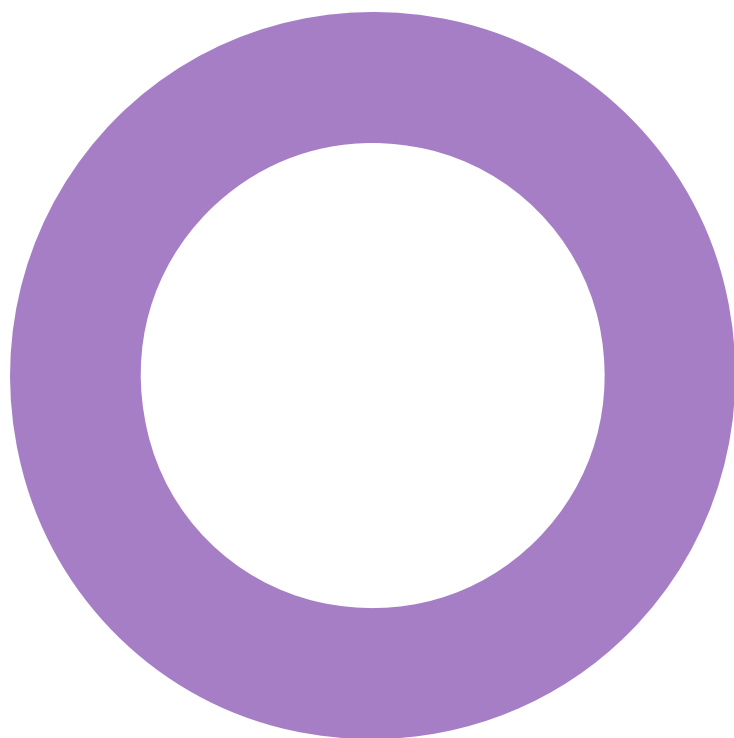


Rhydycar West Masterplan.
Merthyr Tydfil.
Marvel Limited.

SUSTAINABILITY
ENERGY STRATEGY

REVISION 09 – 06 MARCH 2023



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Project number: 23/24021
Document reference: REP-2324021-5A-RA-20211126-Rhydycar Energy Strategy-Rev09 FINAL.docx

Contents.

Executive summary	4
Applicant aspirations and approach.	4
Energy strategy summary.	5
1. Introduction.	6
Benchmarking.	6
Drivers.	6
Energy strategy summary.	6
2. Be Lean.	7
2.1 Passive design and energy efficiency features.	7
2.2 Site-wide energy requirement	8
2.3 Be Lean results.	8
3. Be Clean.	9
3.1 Development demand	9
3.2 Be clean: network and technologies	9
4. Be Green.	10
4.1 Low and zero carbon (LZC) technology assessment	10
4.2 Be green summary.	12
5. Conclusion.	13
5.1 The energy strategy.	13
5.2 Results.	13

Executive summary

The Energy Strategy provides recommendations regarding the approach to the reducing carbon dioxide (CO₂) emissions and optimising energy efficiency within the development. The Energy Strategy has been developed using a ‘fabric first’ approach, following the ‘Be Lean’, ‘Be Clean’, ‘Be Green’ energy hierarchy. This prioritises savings made to passive design and energy efficiency prior to consideration of low and zero carbon technologies.

The approach to Energy Strategy for the Proposed Development has been to provide an appraisal of the anticipated energy requirements and CO₂ emissions that could arise as a result of the Proposed Development through the use of energy data benchmarks of similar buildings. These building energy data benchmarks have been produced using Part L calculation methodology. The energy requirements for the Indoor Snow Centre component of the site have been estimated based on energy usage totals from similar existing facilities.

The emerging strategy for the Proposed Development will be determined at reserved matters and will be in line with the building regulations enforced at that time. Therefore, the final CO₂ emissions performance estimate for the Proposed Development will be completed at reserved matters once designs as well as fabric and systems performance details are available at building level.

However, occupants may operate their systems differently, and / or the weather may be different from the assumptions made by Part L approved calculation methods, leading to differing energy requirements.

Applicant aspirations and approach.

The Applicant, in response to the climate emergency, is seeking to achieve net zero carbon for the Proposed Development for embodied construction, operational emissions and transport emissions.

Suitable methodologies will be reviewed and adopted, where appropriate, to achieve this. An example, for the building emissions (i.e. not including transport emissions) is the UK Green Building Council (UKGBC) Net Zero Carbon (NZC) Framework that is an industry recognised approach to achieve NZC for the built environment. The framework aims to reduce, mitigate and offset emissions for construction and operational energy separately.

Below provides a summary of the direct and indirect measures that have been considered as part of the assessment, demonstrating that the Proposed Development will be designed, constructed and used to be a sustainable addition to the local area. Strategies and considerations that will be employed as well as projected outcomes are summarised below:

Embodied carbon during construction:

- The proposed development will adopt Circular Economy Principles during detailed design to ensure that the specification of low carbon technologies are prioritised.
- Preference for local suppliers (within Merthyr Tydfil or Wales, also see ES Chapter 5 Community & Socio-Economic) to shorten the supply chain and reduce its associated environmental footprint coupled with prioritisation of responsibly sourced goods and services where feasible whilst maximising the proportion of recycled content within materials used in construction.
- Detailed consideration on the placement of the Proposed Development in site to minimise its impact on the site’s ecology.
- Position of the building and structure so to minimise the number of trees that need to be felled.
- Key materials extracted as part of the enabling works to be re-used and/or recycled in accordance with the waste hierarchy giving priority to on-site uses where practical.
- Manage all waste materials during the construction phase in accordance with the construction waste management practices outlined in the Site Waste Management Plan. Facilitate this objective by providing training for site personnel regarding the correct disposal of materials.
- Procure energy efficient construction plant reflecting the latest technology advances.
- Monitor energy, water and waste data during the construction stage to encourage transparency and accountability.
- All waste generated during construction to be diverted from landfill (where technically feasible).

- Explore the potential for low carbon construction materials and techniques, such as timber frame and offsite manufacture, which can help reduce the embodied impact of construction.
- To be considered a zero-carbon development, in line with the UKGBC approach previously mentioned, residual emissions from the construction stages can be offset via recognised initiatives.

Transport emissions during construction:

- Identifying materials that can be procured and sourced locally.
- Coordinating movement of products to reduce number of trips to site.
- Employment of local workforce, where possible.
- Producing and implementing a site waste management plan that follows circular economy principles to reduce the need for movement of waste from the site wherever possible.

Emissions from operational energy demand:

- The Applicant will adopt a verified green tariff so that zero emissions are achieved from day-1 of operation.
- An “all-electric” approach to the Energy Strategy will be adopted to enable the development’s operational emissions to continue to decarbonise over its lifetime through decarbonisation of the National Grid.
- Optimisation of photovoltaic (PV) panels throughout the site, in combination with biodiverse roof and plant space will provide green energy to supply the “all electric” approach. It is estimated that the indicative PV area identified (approx. 18,000m² panel area) could provide 2,700 MWh/yr. of green energy alone which is approximately 10% of the annual regulated energy demand for the site.
- Waste heat will be captured from cooling systems so it can be used to offset heating demand throughout the site via an ambient heat-sharing loop network, utilising Air Source Heat Pumps to supply the buildings’ demands. In particular, this heat exchange system will enable excess heat from cooling the Indoor Snow Centre to be used to heat the Indoor Water Park.
- For all energy that is required for the operations of the development, the Energy Strategy is projected to achieve a ~92% reduction in energy demand and therefore a ~92% reduction in regulated emissions compared to the Part L 2022 Wales notional building.
- The approach to Energy Strategy for the Proposed Development has been to provide an appraisal of the anticipated energy requirements and CO₂ emissions that could arise as a result of the Proposed Development through the use of energy data benchmarks of similar buildings. These building energy data benchmarks have been produced using Part L calculation methodology. The energy requirements for the Indoor Snow Centre component of the site have been estimated based on energy usage totals from similar existing facilities.
- The proposed Energy Strategy that has been developed for the site follows the Energy Hierarchy approach (i.e. Be Lean, Be Clean, Be Green).
- Following a fabric first approach, energy demand will be reduced from high specification of building fabric, high efficiency mechanical ventilation with heat recovery, and reduce the need for artificial lighting through appropriate glazing sizing and location.

Transport emissions in operation:

- The transport emissions in operation contribute to the majority of the overall emissions of the Proposed Development due to the anticipated travel patterns and distances travelled of visitors of the site.
- Estimated emissions have been based on current and predicated travel patterns which also consider modes of transport.
- As the Proposed Development consists of a world-class leisure resort attraction, it is expected that visitors will be travelling from national locations in addition to local movement that would be expected for developments such as residential or offices.
- Considering this, the level of direct mitigation measures that can be applied as a result of the proposed design as the resultant emissions will depend on behaviour patterns of the visitors for how they choose to travel.
- It is expected that should all measures, including secondary (e.g. the forecasted increase of uptake of EV cars by ~43% by 2030) are implemented, the expected impact from transport during operations could be reduced to low over the development lifetime.

- To support positive behaviours in relation to sustainable travel, the following measures will be implemented:
 - Extensive provision of electric vehicle (EV) charging bays, which can be partially offset by the onsite PV array, to support visitors using EV private vehicles. The proposed offerings have also considered the expected increased uptake of EV use by the general public over the building's lifetime by including passive charging bays (i.e. infrastructure available from day-1 with the exception to the physical chargers) to enable 100% of parking to be EV charging should demand increase.
 - Ensure public realm strategy incorporates existing and proposed cycling and pedestrian routes to the site.
 - Provide safe and secure cycle storage provision for site users.
 - Provide appropriate signage and information on local public transport, cycle and pedestrian routes to encourage the use of sustainable modes of transport.
 - Implement dedicated sustainable transport modes, specifically by running a shuttle bus from the Proposed Development to key destinations in Merthyr including the rail station, bus station and town centre.
- Additional measures are measures that have not been included within the assessment as they are planned outside of the Proposed Development design. However, if implemented they will also have a positive impact on transport emissions and reduce such emissions. The Additional measures considered are as follows:
 - The proposed South Wales Metro will provide an integrated network of bus, rail and active travel to make sustainable travel easier across South Wales. The works will include electrification of railway infrastructure, replacement of trains and improving facilities at existing station.
 - Increased uptake in use of EV vehicles for private travel (forecast to be 43% increase by 2030).
 - Increased uptake in use of public transport modes to travel to and from the site.

Please refer to Chapter 6 of the Environmental Assessment (ES) for full detail on the proposed Green House Gas (GHG) Emissions which have been assessed.

Energy strategy summary.

Passive design and energy efficiency measures will provide the cornerstone to the energy demand and CO₂ emission reduction achieved for the Proposed Development. An on-site heat sharing network will make use of the waste heat generated cooling the Indoor Snow Centre to heat the hotel accommodation and site wide hot water (including heating the Indoor Water Park). This will significantly reduce heat waste and operational energy emissions of the Proposed Development.

Efficient thermal envelopes, on-site heat sharing networks and the implementation of low and zero carbon (LZC) technologies will minimise the energy usage of the Proposed Development.

This strategy has been prepared to demonstrate that at the planning stage, the Applicant and design team have given due consideration to the principles of sustainable energy principles, and how these could be implemented for the Proposed Development.

The following table provides a summary of the energy strategy for the Proposed Development, utilising Part L 2022 carbon factors.

Through the measures outlined in this Energy Strategy, it is anticipated that overall, approximately a ~92% reduction in CO₂ emissions could be achieved beyond the 'gas boiler baseline', inclusive of all measures. The decarbonisation of the UK grid is anticipated to mean that all-electric strategies will continue to provide increased benefit and further reductions as the grid electricity carbon factor improves.



Figure 1: Approach to energy.

Table 1: Energy strategy summary (site-wide).

Be lean	Target of ~9% regulated carbon emission reduction against Part L baseline. High energy efficient building fabric and building services will be utilised to reduce carbon emissions and energy demand through good practice passive design measures.
Be clean	The benefit heat sharing is combined with the implementation of heat pumps at the Be Green stage of this Energy Strategy. Incorporation of a CHP system has been deemed to be unsuitable as it would offer no benefit to the Proposed Development. The implementation of a site-wide heat network is recommended, this should be assessed in detail at later design stages.
Be green	Target of ~83% sitewide regulated carbon emission reduction against Part L baseline via heat pumps and rooftop PV. Utilisation of high efficiency air source heat pumps with heat recovery is anticipated to significantly reduce energy consumption and carbon emissions for the Proposed Development. Rooftop PV is anticipated to further reduce emissions. Further LZC technologies are discussed and could be explored at later design stages

1. Introduction.

This report has been produced in support of the early-stage design development of Rhydycar West, Merthyr Tydfil in Wales, hereafter referred to as the Proposed Development.

This Energy Strategy provides recommendations regarding the approach to the reducing carbon dioxide (CO₂) emissions and optimising energy efficiency within the development. The Energy Strategy has been developed using a ‘fabric first’ approach, following the ‘Be Lean’, ‘Be Clean’, ‘Be Green’ energy hierarchy. This prioritises savings made to passive design and energy efficiency prior to consideration of low and zero carbon technologies.

Benchmarking.

The calculations presented in this Energy Strategy have been benchmarked using existing gas boiler baseline project energy use data for similar buildings where available. However, occupants may operate their systems differently, and / or the weather may be different from the assumptions made by Part L approved calculation methods. The energy requirements for the Indoor Snow-Centre component of the site have been estimated based on energy usage totals from similar existing facilities having consulted with existing operators. The final CO₂ emissions performance of the Proposed Development is subject to amendment once Part L modelling has been completed.

Drivers.

A policy review has been undertaken and is outlined in the preceding chapter. As a summary, planning policy applicable to the Proposed Development include:

National drivers; Approved Document Part L of the Building Regulations

Part L of the Building Regulations is the mechanism by which the Welsh Government is driving reductions in the regulated CO₂ emissions from new buildings. The policy relevant to energy contained in Planning Policy Wales and Future Wales – The National Plan 2040.

Local drivers; Merthyr Tydfil Local Development Plan 2016 - 2031

The Local development plan represents the local planning policies currently applied by the Council to inform the determination of planning applications in the Borough and enforce planning control. It was adopted by the council in January 2020, superseding the previously adopted 2016 Development Plan.

Energy strategy summary.

A passive design approach is based on all those passive measures that can bring a real benefit to the energy consumption without requiring active actions. Such measures include high performance for the façade (high u-values and optimised g-values), heat recovery from the mechanical ventilation system, bespoke external shading elements to reduce the solar gains during summer, bespoke fenestration design balancing thermal needs and daylighting opportunities. In conjunction with a passive design approach, energy efficiency measures will provide the cornerstone to the energy demand and CO₂ emission reduction achieved for the Proposed Development. An all-electric on-site strategy is also proposed with an embedded energy sharing network so to recover the waste heat (generated cooling the Indoor Snow Centre) to provide heat to the facilities located on the Site (including the Indoor Water Park). This will significantly reduce the heat waste and operational energy emissions of the Proposed Development.

An important factor to consider for the Energy Strategy is the decarbonisation of the UK grid. In the Future Energy subsection, the UK grid is projected to continue to decarbonise in coming years, resulting in an improvement in grid electricity carbon factors which leads to less carbon emitted during the electricity generation process. An all-electric strategy, such as the one proposed here, will capitalise on this continue improvement and will help to continue to reduce the real-life operational emissions.

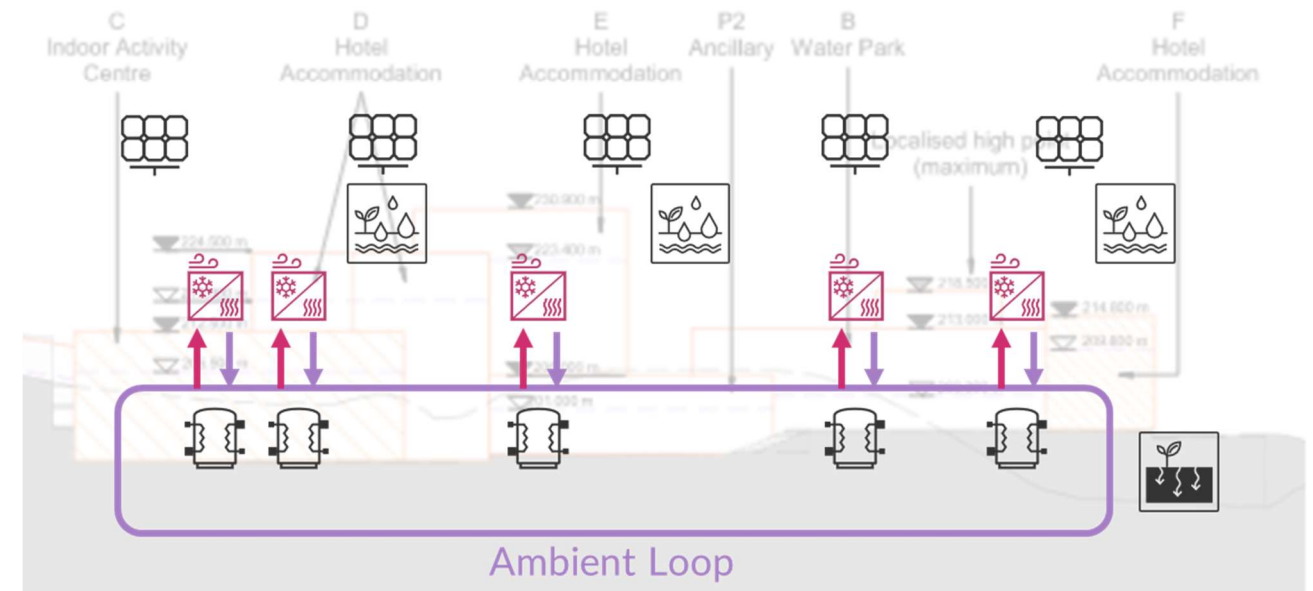


Figure 2: Proposed energy strategy.

2. Be Lean.

The initial stage of the analysis is mainly focused on the architectural layouts, façade composition and external thermal envelope. The scope of this stage is to optimise the shape of the new buildings based on internal parameters (i.e. daylighting requirement, function of the space, thermal characteristic of the space) but also external factors such as surrounding buildings, site morphology, and local weather data.

A second step within this analysis phase involves optimising the thermal performance of the building(s) envelope(s). This could be achieved through solutions such as targeting low U-values, air permeability and efficient glazing to minimise heat losses in winter and maximise cool air retention in summer months.

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

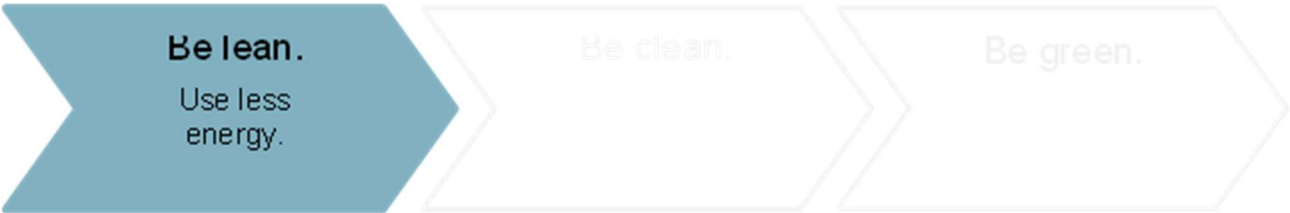


Figure 3: Be Lean stage of the hierarchy.

2.1 Passive design and energy efficiency features.

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

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

Recommended measures:

	Fabric performance A 'fabric first' approach will be taken in order to reduce the energy demand and CO2 emissions from the Development. The overriding objective for the façade design of each new building will be to achieve the optimum balance between providing natural daylighting benefits to reduce the use of artificial lighting, the provision of passive solar heating to limit the need for space heating in winter and limiting summertime solar gains to reduce space cooling demands.
	Thermal Insulation The Proposed Development will seek to utilise efficient thermal envelopes. Typically, demand for space heating can be dominant in dwellings, whilst space heating is less dominant in commercial spaces such as office and retail. Heat losses and gains will be controlled by the optimisation of the fabric of each building, i.e. ensuring appropriate levels of glazing to control winter heat loss and summer heat gain. Reducing the thermal transmittance of the building envelope where appropriate will help to reduce both heating requirement and result in lower energy requirements. Insulation will be critical to the energy efficiency of the indoor snow-centre. The Proposed Development is seeking to use Passivhaus U values in the building fabric and further explore the use of the Passivhaus air tightness standards to minimise energy wasted on cooling.

	Glazing Energy & Light Transmittance Elevations for newly constructed dwellings will be developed with a suitable approach to fenestration and glazing specification (light transmission and solar control) to ensure an appropriate balance between the benefits of passive solar heating in winter months whilst limiting the likelihood of high internal temperatures in summer, as applicable to each building type.
	Mechanical ventilation It is anticipated that high-efficiency mechanical ventilation with heat recovery will be adopted for all buildings. Mechanical ventilation is an important addition to the building services to maintain good indoor air quality by providing fresh air and extracting vitiated air. Providing fresh air minimises the risk of stale and stagnant air and limits the risk of condensation and mould. Coupled to a heat exchanger, the warmth in extracted air can be recovered and delivered to the supply air. In this mode, the ventilation system reduces space heating and cooling demand. To reduce the electrical energy associated with fan usage, plant and systems will be optimised to achieve low specific fan powers. In residential areas, any mechanical ventilation with heat recovery (MVHR) units will be provided with a bypass function to avoid returning hot air to the dwellings in summer months.
	Domestic hot water (DHW) system To limit the demand for hot water, all spaces will include the use of water-efficient fixtures and fittings including WCs with low flush volume, flow reducers in the taps of wash hand basins and aerated shower heads, to limit overall water consumption in line with Building Regulations Part G.
	Natural daylight and lighting strategy All buildings will be provided with low-energy, efficient light fittings throughout, and external lighting for amenity and communal areas will also be low-energy efficient fittings and will be linked to daylight sensors and / or presence detectors to prevent unnecessary use. The Proposed Development will be supplied by Light Emitting Diodes (LED) or similar low energy lamps. The lighting specification for the Proposed Development will be carried out in conjunction with lighting control systems incorporating daylight linkage and presence detection in suitable areas. As well as reduced energy requirement that will be achieved by implementing these strategies, the contribution to the cooling requirements and internal heat gains will be reduced. This will further reduce the total energy requirements and CO2 emissions of each building.
	Metering & controls Building management, daylight link, zonal control, etc will be implemented to minimise energy usage. Smart Building technology will also support an in-use energy management plan.

2.2 Site-wide energy requirement

The estimated regulated energy requirement and regulated CO2 emissions calculated for the gas boiler baseline (before any improvements) are presented in Table 2.

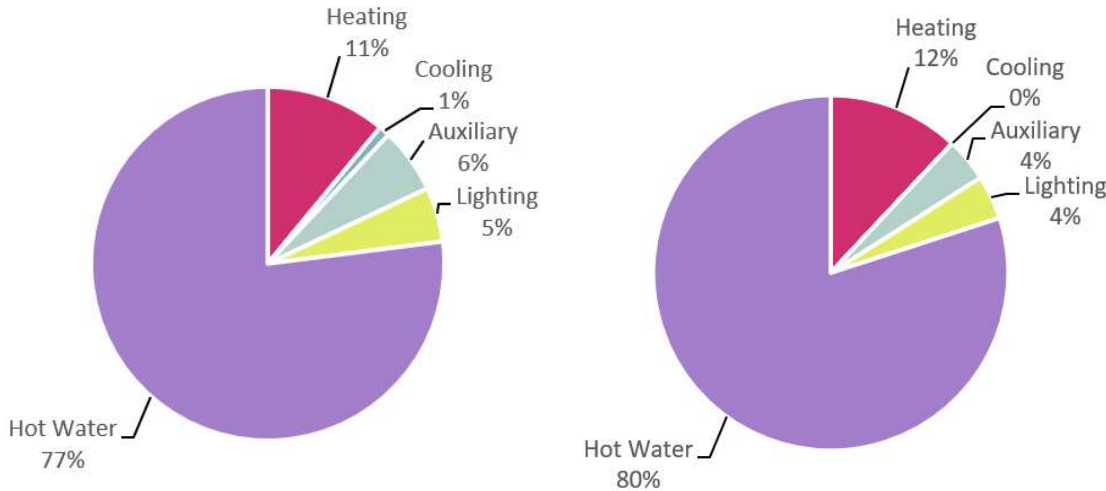
Table 2: Regulated Energy Demand and CO2 Emissions.

Stage	Regulated Energy Requirement (kWh/yr)	Regulated CO ₂ Emissions (kg CO ₂ per annum)
Part L 2022 Wales Baseline	18,883,377	3,899,916

Site-wide energy and carbon breakdown

The anticipated site-wide demand from each element are compared in the chart below. This shows that the dominant source of regulated energy demand is associated with cooling, hot water and space heating.

Figure 4: Sitewide regulated system side fuel requirement (left) and emissions breakdown (right).



2.3 Be Lean results.

Overall, the Proposed Development would be anticipated to approximately a ~9% reduction in annual regulated CO2 emissions via passive design and energy efficiency measures as described above (i.e. before any benefit from low or zero carbon technologies).

Table 3: 'Be lean' sitewide carbon performance.

Development baseline emission rate:	3,552,030
Target emission rate with Be Lean measures:	3,899,916
Percentage reduction:	8.9%

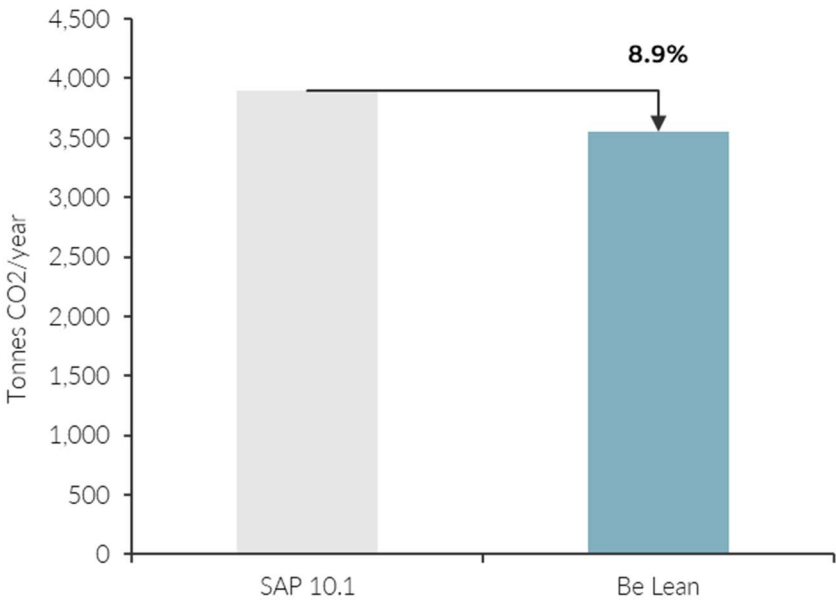


Figure 5: Sitewide regulated carbon emission reduction at the Be Lean stage.

3. Be Clean.

The second step on the optimisation process is focused on exploring the most sustainable way to dispatch energy across the site. This analysis is done through the evaluation of alternative technologies to deliver the required energy for the specific project.

This stage of the energy hierarchy includes consideration of connection to available district heat networks, or the use of on-site heat networks and decentralised energy production such as Combined Heat and Power (CHP) in order to provide energy and reducing consumption from the national grid and gas networks, through the generation of electricity, heating and cooling on-site.



Figure 6: Be Clean stage of the hierarchy.

3.1 Development demand

The Proposed Development's demand is anticipated to be dominated by thermal processes at 93% compared to 7% non-thermal energy demand.

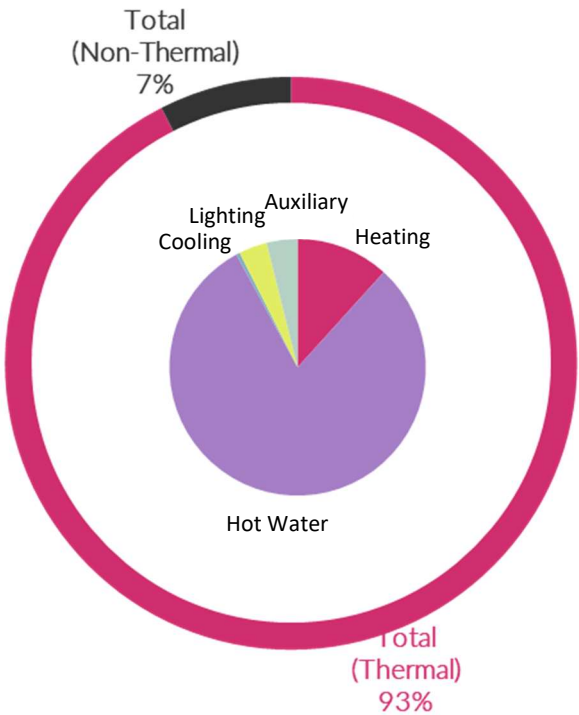
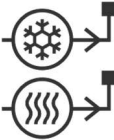


Figure 7: Sitewide emissions breakdown, showing the division between thermal and non-thermal.

3.2 Be clean: network and technologies

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

Recommended:	
	Connection to or creation of a heat network There is not currently an established heat network within the vicinity of the Site. However, since heat networks can be beneficial where there is a source of waste heat present which can be uplifted at greater efficiency than generating heat locally, an on-site heat sharing system will be implemented. With this system the excess heat generated by cooling the Indoor Snow Centre could be used to heat hotel rooms and the Indoor Water Park etc., thereby minimising wasted heat and energy and improving the coefficient of performance for all linked facilities. Distribution losses can be high in heat network systems, however the Proposed Development is intentionally designed around a single plaza, so all the buildings will be very close which drastically reduces the distribution system length and losses. Furthermore, the distribution system will work with a low temperature to further reduce the energy losses throughout the distribution system. The estimated benefit of such a system has been modelled as an uplift in the efficiency of the heat pumps on site and as such will be presented as a compound benefit in the following Be Green section.
Not recommended:	
	Combined heat and power (CHP) Changes to the carbon factor of grid electricity have meant that previously favoured systems such as Combined Heat and Power (CHP) are becoming much less carbon efficient. In fact, CHP systems are now expected to lead to greater carbon emissions than conventional gas-fired boilers due to their lower efficiency. Due to the decarbonisation of the electricity grid, schemes using CHP engines for the delivery of heating energy at the Proposed Development leads to net increase carbon emissions (over the gas boiler baseline), In contrast, electric systems are far more likely to achieve substantial carbon emission savings with future carbon factors. Further, CHP engines are an on-site source of particulate pollutants which will adversely affect local air quality. In light of grid decarbonisation and increased focus on air quality, CHP is not proposed.

Be Clean summary

CHP is not proposed due to poor carbon reduction and adverse air quality impacts. An on-site heat sharing system will make use of waste heat generated due to the high cooling demand of the Indoor Snow Centre and balance the energy needs across the various facilities, as illustrated in Figure 8.

The estimated benefit of implementing such a system in conjunction with air source and water to water heat pumps is presented as a compound benefit in the Be Green section.

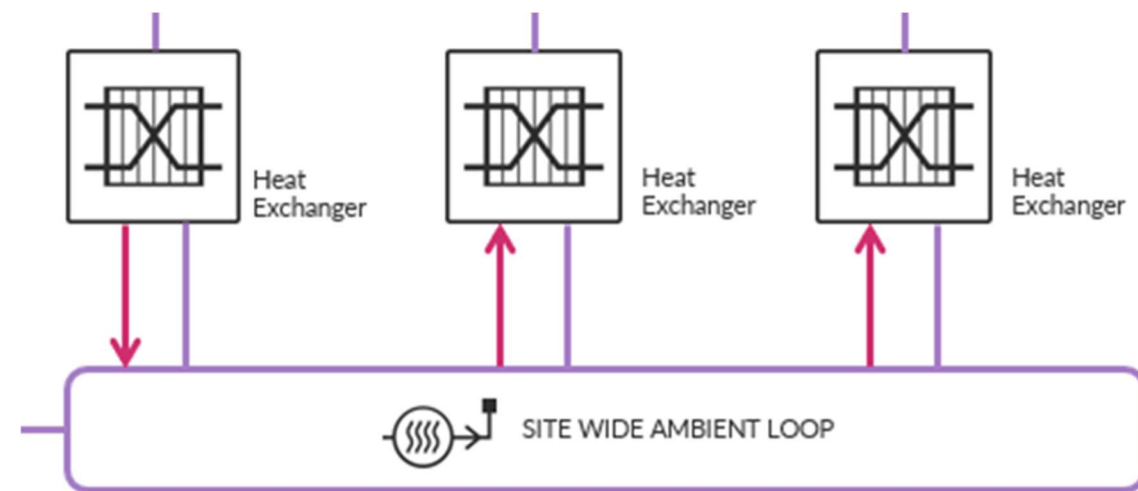
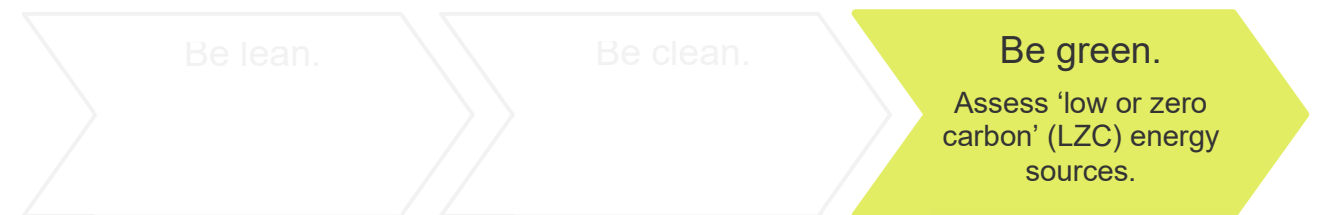


Figure 8: Schematic illustrating site wide energy sharing scheme.

4. Be Green.

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



4.1 Low and zero carbon (LZC) technology assessment

A number of technologies were considered for feasibility to contribute towards offsetting carbon emissions of the Proposed Development. The following technologies are recommended in this section due to potential benefit and feasibility. A summary of the potential savings, if installed, is discussed in the table below.

- **Photovoltaic panels:** Generate renewable energy on site.
- **Air Source Heat Pumps:** Practical solution for the Proposed Site and increasingly beneficial to heating and cooling efficiency in the long term, with grid decarbonation.

The following technologies were discounted in the current analysis prior to undertaking the calculations due to various constraints, including the nature and location of the Site. However, many could be explored further, and potentially implemented to deliver increased beneficial effect.

- **Solar thermal:** Could potentially be explored for the site but this would require consideration of how solar thermal would work practically with the current proposed strategy.
- **Ground source heat pumps:** Due to the imbalance between cooling and heating could have limited benefit.

The following technologies were considered unsuitable for the Proposed Development and have been ruled out.

- **Biomass boilers:** Due to the potential to use the excess rejected heat from cooling the Indoor Snow Centre for heating, there is a low need for biomass boilers, and they could result in an adverse effect on local air quality.
- **Wind turbines:** Considered acoustically and aesthetically inappropriate for the Proposed Development

Included in calculations:	
	Photovoltaic (PV) panels An appraisal of roof space available for photovoltaic (PV) panels has been undertaken. <u>Suitability to Proposed Development:</u> Provision has been made for PV system to be installed on-site. The system will be deployed across the site in order to maximise panels' exposition and efficiency.
	Air source heat pumps Air source heat pumps (ASHP) use thermodynamic principles to convert heat from the air into useable heat within the building. Unlike some other sources of renewable energy, heat pumps do require energy (typically electricity or gas) to pump and compress refrigerant through the system. However, under the Renewable Energy Directive 2009/28/EC they are classified as renewable technologies provided that the final energy output significantly exceeds the primary energy input required to drive the heat pump. ASHP need to be located externally with access to the ambient air, typically at roof level. <u>Suitability to Proposed Development:</u> Due to grid decarbonisation, it is expected that ASHP technology will offer significant carbon emission reductions over the gas boiler baseline scenario. A communal ASHP plant will be installed as part of the site-wide ambient loop to provide all space heating, cooling and hot water demand for the site. It is predicted that the use of ASHP in combination with an ambient loop distribution system for the entire site could provide an additional saving of ~41% at the Be Green stage.

Not included in calculations, could be explored:	
	Solar thermal Solar Thermal Panels are similar to PV Panels in that they harness energy from solar radiation. This technology however converts solar into thermal energy that can offset the demand on hot water generation systems. <u>Suitability to proposed development:</u> Solar thermal could potentially be explored for the Site, but this would require consideration of how this would work practically with the current proposed strategy. Since the proposed strategy utilises on-site heat sharing networks to redistribute waste heat & solar thermal technology also offsets heating demand, the benefit is assumed to be minimal.
	Ground source heat pumps (GSHP) Ground Source systems work to extract heat or cooling energy from the ground. They are generally more efficient than air source systems, as the ground temperature is more constant throughout the course of the year relative to air temperature. There are four common varieties of ground source systems: - Vertical, open loop, direct cooling (i.e. without heat pump) - Vertical, open loop, with heat pump - Horizontal, closed loop, with heat pump - Vertical, closed loop, with heat pump Due to grid decarbonisation, it is expected that in general GSHPs will offer significant carbon emission reductions over the gas boiler baseline scenario. GSHP plant can be located in basements, with several boreholes connected to ground water. Implementing heat-pump technology brings the additional benefit of a shift towards combustion-free development, with the associated benefit to local air quality. <u>Suitability to Proposed Development:</u> In the specific case of the Proposed Development, the cooling demand outweighs the heating demand, which would lead to an excess of rejected heat entering the GSHP system and reducing the efficiency of the system. In addition to this, to meet the thermal demand of the Proposed Development the area required for piling for GSHP could be large. Therefore, this technology is not currently considered appropriate for the Proposed Development but could be reconsidered once more detailed project information is available. The site has been used in the past as a mining area, which can create either benefits or issues for GSHPs. Surveys of the available underground areas would need to be undertaken to understand whether there were any suitable areas for the implementation of GSHPs.

Ruled out:	
	Biomass Biomass boilers burn wood fuel or other bio-fuel sources to generate heat. These boilers can operate at high efficiencies, comparable to condensing gas boilers. <u>Suitability to Proposed Development:</u> Biomass boilers require a large fuel store to maintain continuous operation during the winter months. As such, area take for such plant is high. Fuel deliveries in rural locations should be feasible but adverse impacts on local air quality and security of fuel supply are also important considerations. Due to the proposed use of the excess rejected heat from cooling the site and the potential adverse effects of biomass boilers or other fossil fuel burning technologies have on local air quality, biomass boilers are not considered suitable for the Proposed Development.
	Wind turbines Wind turbine could generate renewable energy on-site. <u>Suitability to Proposed Development:</u> The natural, rural location of the Site means that wind turbines would stand out in the landscape and are considered acoustically and aesthetically inappropriate for the Proposed Development.

4.2 Be green summary.

Through the measures outlined in the Be Green stage, it is anticipated that a further site wide reduction in CO2 emissions of approximately ~83% could be achieved beyond the Be Lean stage of the hierarchy. This is inclusive of the heat pump-based site-wide ambient loop and rooftop PV. This would result in an overall reduction of ~92% reduction over the Part L baseline.

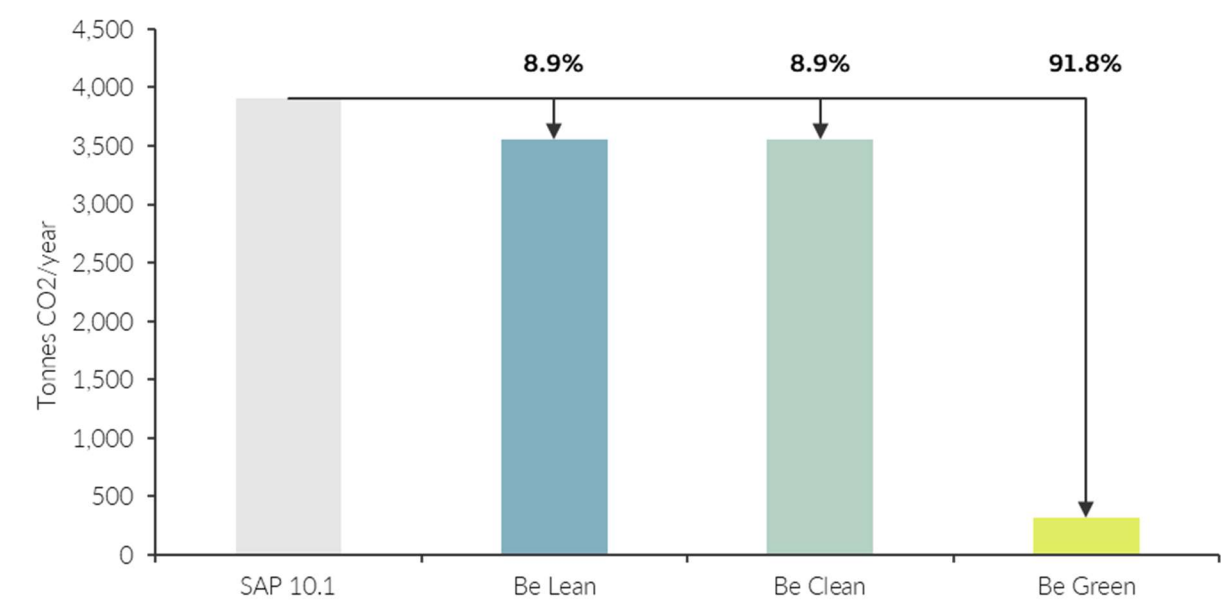


Figure 9: Sitewide regulated carbon emissions summary.

5. Conclusion.

This strategy has shown that the Proposed Development would benefit from a highly energy efficient, combustion free, low-carbon scheme which utilises minimises waste energy and heat on-site.

Efficient thermal envelopes, on-site heat sharing networks and the implementation of low and zero carbon (LZC) technologies will minimise the energy usage of the Proposed Development.

This strategy has been prepared to demonstrate that at the planning stage, the Applicant and design team have given due consideration to the principles of sustainable energy principles, and how these could be implemented for the Proposed Development.

5.1 The energy strategy.

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

The following table provides a summary of the energy strategy for the Proposed Development, utilising Part L 2022 carbon factors.

Table 4: Energy strategy summary (site-wide).

Be lean	~9% regulated carbon emission reduction against Part L baseline. High energy efficient building fabric and building services will be utilised to reduce carbon emissions and energy demand through good practice passive design measures.
Be clean	The benefit heat sharing is combined with the implementation of heat pumps at the Be Green stage of this Energy Strategy. Incorporation of a CHP system has been deemed to be unsuitable as it would offer no benefit to the Proposed Development. An on-site heat sharing system will be implemented.
Be green	~83% sitewide regulated carbon emission reduction against Part L baseline via heat pumps and rooftop PV. Utilisation of high efficiency air source heat pumps with heat recovery will significantly reduce energy consumption and carbon emissions for the Proposed Development. Rooftop PV will further reduce emissions. Further LZC technologies are discussed and could be explored at later design stages

5.2 Results.

The following provides details on the percentage carbon reduction seen from the baseline case.

Through the measures outlined in this Energy Strategy a ~92% reduction in CO2 emissions could be achieved beyond the ‘gas boiler baseline’, without further consideration of other technologies.

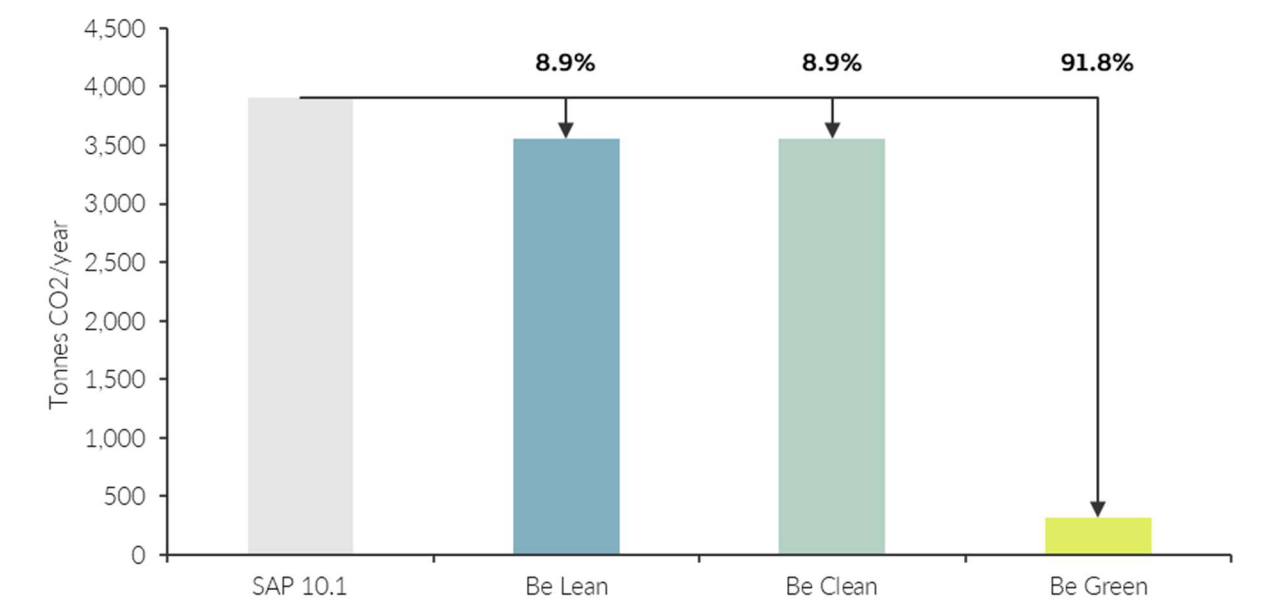


Figure 10: Sitewide regulated carbon emissions summary compared to the Part L 2022 baseline.



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