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Land North and East of Stakehill Industrial Estate – Rochdale

241288

**Energy and Climate Change
Adaptation Statement for Planning**



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Document Revision History

Ref

241288

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Energy and Climate Change Adaptation Statement for Planning



1.0 Introduction

In accordance with the requirements of the Rochdale Borough Council Core Strategy and the Places for Everyone Joint Development Plan, Couch Perry Wilkes (CPW) has produced an Energy and Climate Change Adaptation Statement to support an outline planning application for the proposed development of Land North and East of Stakehill Industrial Estate including:

- *Outline details for employment development including flexible Class E(g)/B2 general industrial/B8 storage and distribution uses along with residential dwellings – providing a mix of 2, 3 and 4 bed houses, including associated development, accesses, earthworks and infrastructure.*

The outline proposal seeks approval for up to 12,515m² GIA of flexible E(g)(iii) light industrial, B2 general industrial and B8 storage and distribution uses together with ancillary office floorspace, along with 314 residential dwellings as scheduled below:

2-bed houses = **80**

3-bed houses = **205**

4-bed houses = **29**

Total = 314

Unit E1 = **8,232m²**

Unit E2 = **2,044m²**

Unit E3A = **1,254m²**

Unit E3B = **985m²**

Total = 12,515m²

The illustrative masterplan is shown below:

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Figure 1. Illustrative Masterplan

1.1 Legislation and Planning Policy

Relevant local (Rochdale Borough Council Core Strategy), regional (Places for Everyone Joint Development Plan 2022 to 2039 – Adopted 21st March 2024) and national planning policy pertaining to sustainability and energy have been considered in the preparation of this report.

The National Planning Policy Framework (NPPF) document, revised in December 2024, sets out the overarching policies for development in England. At the heart of the NPPF is a presumption in favour of sustainable development encompassing three interdependent areas of planning policy: social, economic and environmental.

The NPPF supports a reduction in greenhouse gas emissions and the delivery of renewable and low carbon energy. To support the move to a low carbon future, local planning authorities should:

- plan for new development in locations and ways which reduce greenhouse gas emissions;

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- actively support energy efficiency improvements to existing buildings; and
- when setting any local requirement for a building's sustainability, do so by adopting nationally described standards.

In determining planning applications, local planning authorities should expect new development to:

- comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

The document also makes it clear that good design is a key aspect of sustainable development.

In terms of climate change, the NPPF states within Section 14 that plans should take a proactive approach to mitigating and adapting to climate change; minimising vulnerability and improving resilience.

At a local level, Rochdale Borough Council's Core Strategy Policy G1 – Tackling and Adapting to Climate Change, states that new developments will be expected to:

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

Furthermore, it is noted in Policy G3 – Renewable and Low Carbon Energy Development, that the Council will promote renewable, low and zero carbon energy generating developments, including wind power, biomass, Combined Heat and Power (CHP), hydro and heat pumps in order to help meet CO₂ reduction targets and contribute towards energy security for Greater Manchester and the North West.

At a regional level, the Places for Everyone Joint Development Plan Policies JP-S2: Carbon and Energy and JP-S3: Heat and Energy Networks are relevant. The primary aim is to deliver a carbon neutral Greater Manchester no later than 2038, with a dramatic reduction in greenhouse gas emissions in both construction and operation.

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1.2 Approach to Addressing Planning Policy Requirements

With reference to the key requirements of the Rochdale Borough Council Core Strategy and the Places for Everyone Joint Development Plan, this Energy and Climate Change Adaptation Statement serves to demonstrate how the proposed scheme will:

- Incorporate energy efficiency measures and best practice design to reduce the inherent energy demand and carbon dioxide (CO₂) emissions of the development against Building Regulations Part L 2013 standards in line with the energy hierarchy.
- Incorporate Low and Zero Carbon (LZC) technology solutions to decarbonise the energy supply and provide a further CO₂ reduction.
- Seek to measure both embodied (construction) and operational carbon emissions with a view to transitioning to a net zero carbon state.
- Target a BREEAM 'Excellent' rating for ENE01 credits under the New Construction criteria.
- Explore opportunities for decentralised energy production (energy networks).
- Address the impacts of climate change by incorporating comprehensive adaptation measures.

This report has been compiled to address the specific requirements of the Rochdale Borough Council Core Strategy and the Places for Everyone Joint Development Plan, in terms of demonstrating an exemplar Energy and Climate Change Adaptation strategy for the proposed development.

2.0 Net Zero Carbon and Environmental Impact Assessments

With reference to the requirements of the Places for Everyone Joint Development Plan; in order to align the development of a built asset to a Net Zero Carbon pathway, both operational carbon and embodied carbon must be taken into account over the life-cycle of the development. The diagram below shows how carbon is released to the atmosphere over the course of a typical buildings' life.

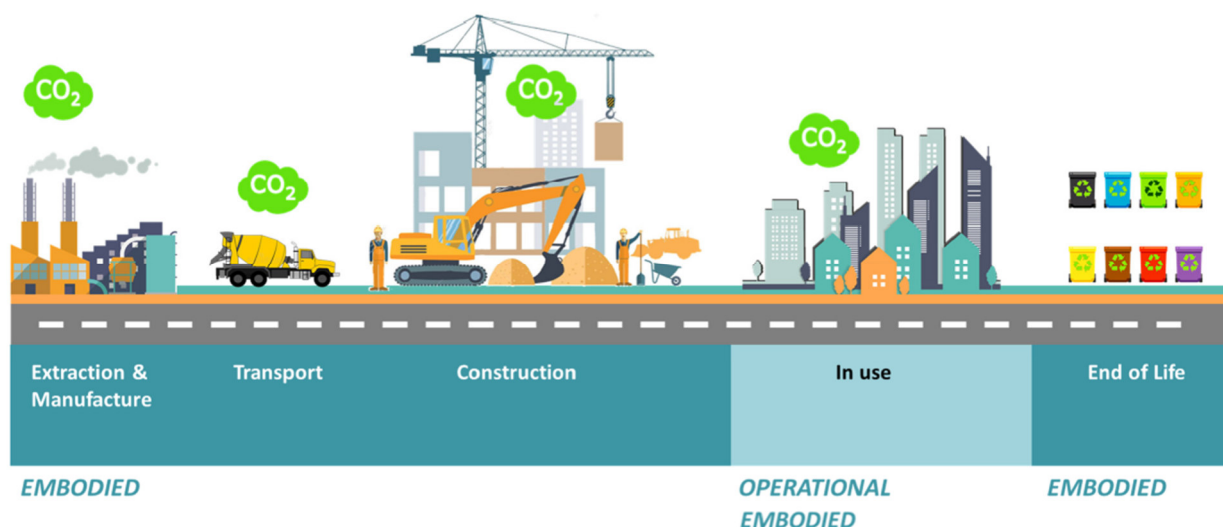


Figure 2. Operational and Embodied Carbon

In the UK, the framework for appraising the environmental impacts of the built environment is provided by BS EN 15978: 2011: (Sustainability of construction works — Assessment of environmental performance of buildings - Calculation method). It sets out the principles and calculation method for whole life assessment of the environmental impacts from built projects based on life-cycle assessment. See Figure 3 below.

The BS EN 15978: 2011 standard is used as a basis for the latest Royal Institute of Chartered Surveyors (RICS) – Whole life Carbon Assessment for the Built Environment (July 2024) guidance and the Pilot version of the UK Net Zero Carbon Buildings Standard (UK NZCBS) published in September 2024.

In terms of establishing the carbon footprint, it is important to identify the modules (A1-A5, B1-B7, C1-C4) that are included in the assessment such that comparisons can be made with industry benchmarks. Generally, Operational Energy Use (B6) and Operational Water Use (B7) are calculated separately to the Embodied Carbon elements (A1-A5, B1-B5 and C1-C4) and then combined to establish the overall carbon footprint for the building – this is also known as Cradle-to-Grave.

Benchmarks for the 'Upfront' carbon emissions (A1-A5), are well established for different building types and are tabulated within the UK NZCBS document, and act as minimum standards for Net Zero Carbon aligned assets.

The Whole Life Carbon, or Cradle-to-Cradle assessment takes this much further and accounts for the reuse or recycling of materials (module D). Due to the high level of uncertainty associated with recycling potential at end

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of life, this module is generally not included in benchmarks, but so-called Circular Economy principles should be considered as part of the decision making process nonetheless.

When dealing with Operational Energy it is often the case that this is broken down further into Regulated and Unregulated energy. For the avoidance of doubt, the definitions are as follows:

Regulated Energy [Heating, cooling, lighting and domestic hot water loads].

Unregulated Energy [Process, equipment and plug-in loads].

The Reference Study Period (RSP) for any exercise is normally 60 years (RICS) and the functional unit for the assessment is kgCO₂e.

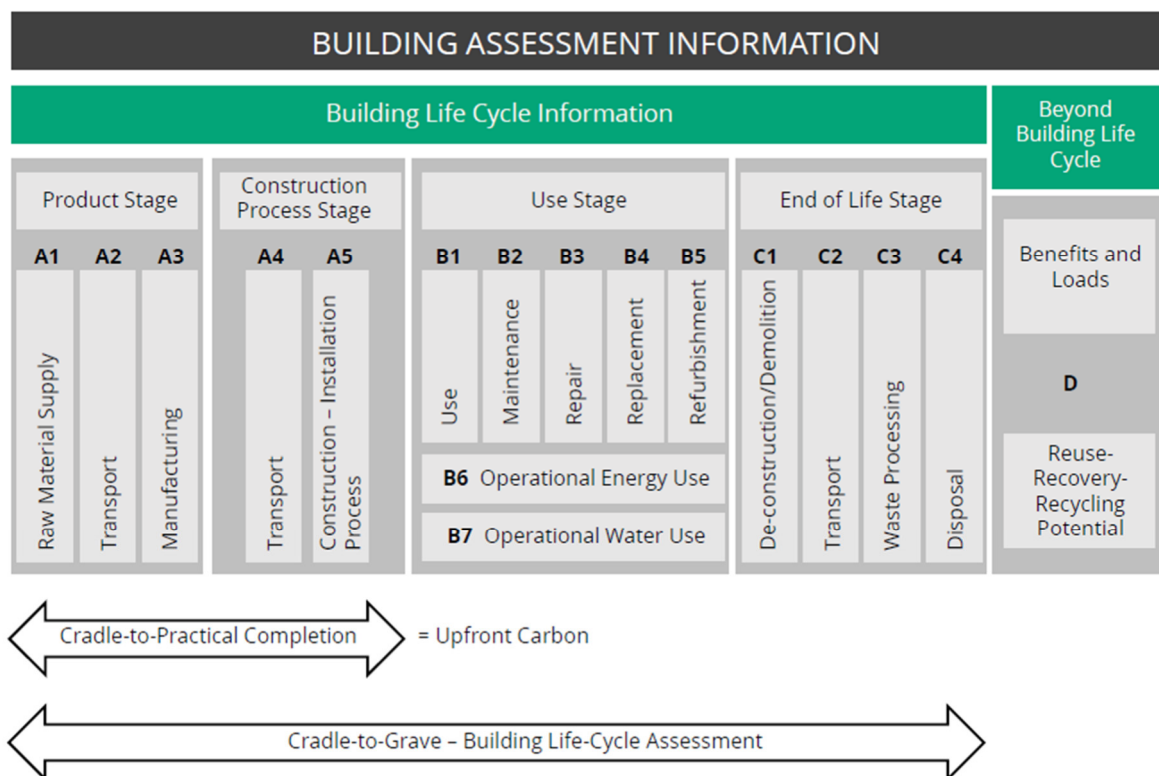


Figure 3. Assessment of Environmental Performance of Buildings - Calculation Method

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2.1 Estimated Energy Demands and CO₂ Emissions

To assist with the formulation of an energy strategy, the estimated regulated and unregulated (operational) energy consumption and CO₂ emissions for the development, along with the estimated upfront embodied (construction) carbon have been determined. This data is indicative only at this stage, but provides targets to align with the UK NZCBS and represents industry best practice:

Residential Development (314 dwelling c. 28,260m²) – based on a target energy consumption = 45kWhr/m²

The total predicted operational energy consumption is: **1,271,700kWhr per year**

The total predicted operational CO₂ emissions are: **172,951kgCO₂ per year**

Non-domestic Industrial Units (12,515m²) – based on a target energy consumption = 35kWhr/m²

The total predicted operational energy consumption is: **438,025kWhr per year**

The total predicted operational CO₂ emissions are: **59,571kgCO₂ per year**

For 'Upfront' Embodied Carbon (A1-A5), the target emissions are as follows:

Residential Development (28,260m²) – based on 430kgCO₂/m²

The total predicted upfront (A1-A5) CO₂ emissions are: **12,151,800kgCO₂**

Non-domestic Industrial Units (12,515m²) – based on 635kgCO₂/m²

The total predicted upfront (A1-A5) CO₂ emissions are: **7,947,025kgCO₂**

Note 1. CO₂ emission factors of 0.210 for Gas and an annual average of 0.136 for Electricity have been used to calculate the above (operational emissions) and are taken from Building Regulations Approved Documents.

3.0 Energy and Resource Efficiency

In order to deliver environmentally responsible building stock, an exemplar approach is being proposed based on low energy design principles, as illustrated below within the 'Fundamentals' element of the Low Energy Roadmap.

In accordance with the Core Strategy and Joint Development Plan Policy, this approach follows the energy hierarchy and involves energy demand minimisation through effective building form and orientation, good envelope design and proficient use of services; such that the buildings themselves are being used as the primary environmental modifier.

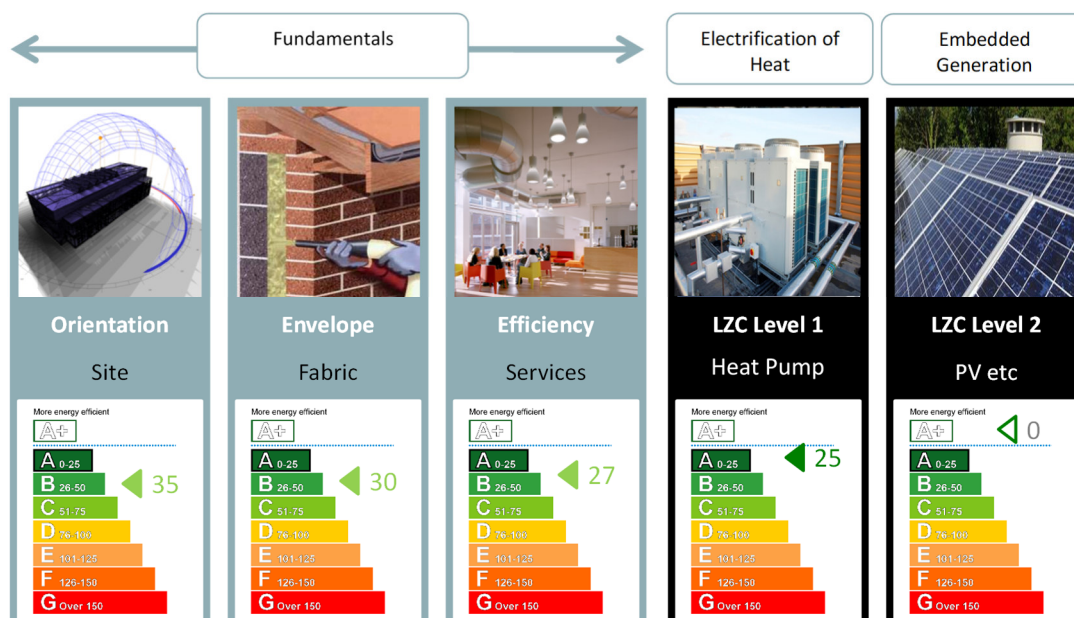


Figure 4. Low Energy Roadmap

Long term energy benefits are best realised by reducing the inherent energy demand of the buildings in the first instance before incorporating Low and Zero Carbon (LZC) technologies to decarbonise the energy supply. These benefits are described and quantified for the development as follows:

3.1 Building Design – Energy Efficiency

The general construction design standards to be adopted must exceed the requirements of the current (2021 Edition) Part L Building Regulations which stipulate an improvement on the CO₂ emissions of an aggregated 27% against 2013 standards.

The building envelope will be designed to ensure that the fabric and form of the development encompasses low energy sustainability principles.

The following table (Table 1) describes the proposed minimum building envelope thermal performance criteria for the residential elements.

Element	Part L 2021 Building Regulations U-Value (W/m ² K)	Target U-Value (W/m ² K)	Notes
General Glazing (including frame)	U = 1.60	U = 0.85	Glass to achieve a total light transmission of 0.70 (g = 0.40)
Roof Lights (including frame)	U = 2.20	U = 0.85	Glass to achieve a total light transmission of 0.58 (g = 0.55)
External Wall	U = 0.26	U = 0.15	
Party Wall	U = 0.20	U = 0.00	
Roof	U = 0.16	U = 0.12	
Ground Floor	U = 0.18	U = 0.15	
Thermal Bridging ψ Value	Default = 0.15W/mK	0.01W/mK	

Table 1. Summary of Building Envelope Thermal Performance Criteria for the Residential Elements

In accordance with the requirements of a low energy building, the air tightness characteristics will be addressed. With robust design, the target proposed for the residential dwellings is 1.0m³/m²/hr @ 50Pa. This compares to the current Part L Building Regulations standard of 8m³/m²/hr @ 50Pa and hence represents an improvement of 88%.

High levels of natural daylight will be provided, wherever possible, through effective window design and the introduction of roof lights. The glazing specification will be optimised to ensure that the glazed elements provide excellent thermal performance combined with optimum solar reflectance to minimise summer solar heat gains along with high daylight transmittance factors to maximise daylight factors. Encouraging the correct quality and quantity of daylight to penetrate the building is key to reducing the amount of light required from artificial sources and hence energy requirements.

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It is imperative that the lighting design philosophy provides the correct quality of lighting with minimum energy input and hence reduce internal heat gains. The latest LED low energy lighting technology will be employed throughout. External lighting will be designed with consideration to security requirements and minimising nuisance glare and light pollution to the surrounding area.

The dwellings could be ventilated via a 'mixed-mode' approach. Mechanical Ventilation Heat Recovery (MVHR) could be used during winter months to minimise heat losses and ensure good indoor air quality. If taken forward, the MVHR system would have a minimum heat exchange efficiency of 92%.

Natural ventilation, via means of openable windows, will also be possible where conditions allow for use outside of the heating season and for enhanced summer ventilation to prevent the risk of overheating.

Reducing demand to a minimum after applying the foregoing passive measures means that the duty and energy consumption of the heating system will be also minimised.

Heating will be provided via Air Source Heat Pump (ASHP) technology to take advantage of grid decarbonisation. Distribution will be via underfloor heating and radiators. Appropriate controls will include the use of a programmer and room thermostats to ensure best practice energy efficiency in operation.

Domestic Hot Water (DHW) will likely be via electric immersion 300 litre cylinder with 60mm insulation in conjunction with solar thermal evacuated tubes on the roof, where appropriate.

The following table (Table 2) describes the proposed minimum building envelope thermal performance criteria for the office and warehouse spaces of the Industrial elements; aligned with low energy sustainability principles necessary to target a BREEAM 'Excellent' rating for ENE01 credits.

Element	Part L 2021 Building Regulations U-Value (W/m ² K)	Target U-Value (W/m ² K)	Notes
General Glazing (including frame)	U = 1.60	U = 1.50	Glass to achieve a total light transmission of 0.70 (g = 0.40)
Roof Lights (including frame)	U = 2.20	U = 1.30	Glass to achieve a total light transmission of 0.58 (g = 0.55)
External Walls	U = 0.26	U = 0.26	
Roof	U = 0.18	U = 0.18	
Ground Floor	U = 0.18	U = 0.18	
Thermal Bridging ψ Value	Default = 0.15W/mK	0.01W/mK	

Table 2. Summary of Building Envelope Thermal Performance Criteria for the Industrial Elements

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The air tightness target proposed for the industrial buildings is $1.5\text{m}^3/\text{m}^2/\text{hr}$ @ 50Pa. This compares to the current Part L Building Regulations standard of $8\text{m}^3/\text{m}^2/\text{hr}$ @ 50Pa and hence represents an improvement of 81%.

High levels of natural daylight will be provided, wherever possible, through effective window design and c. 15% roof lights to the warehouse areas. The glazing specifications for the new buildings will be optimised to ensure that the glazed elements provide excellent thermal performance combined with optimum solar reflectance to minimise summer solar heat gains along with high daylight transmittance factors to maximise daylight factors. Encouraging the correct quality and quantity of daylight to penetrate the buildings is key to reducing the amount of light required from artificial sources and hence energy requirements.

It is imperative that the lighting design philosophy provides the correct quality of lighting with minimum energy input and hence reduce internal heat gains. In the buildings, energy efficient lighting (including LEDs with an efficacy of 120 lumens per circuit Watt) will be deployed throughout and lighting schemes will be appropriately zoned to allow control of luminaires via switches/absence detection and daylight sensors. Output performance or Light Output Ratios (LORs) will exceed 85%.

To complement the significant improvements in envelope design and lighting provision, the building services heating and ventilation systems being proposed will also drastically reduce the inherent energy consumption of the site.

The provision of an effective control and metering philosophy is fundamental to the efficient operation of the building's environmental services. The following provides an overview of the plant efficiency and control measures that are proposed:

- Air-source heat pump (ASHP) heating/cooling (VRV/VRF) to office/meeting room areas and electric panel heaters to ancillary areas.
- High efficiency hybrid heat recovery ventilation with automatic control strategy to the office spaces.
- Zoning of mechanical ventilation systems.
- Modular open architecture controls systems and associated network.
- High efficiency low energy motors to be used to drive mechanical ventilation systems.
- Variable speed pumps and fans to be used to promote lower operating costs and help match energy usage with the operating profile and occupancy of the building.
- Sub-metering to be provided such that approximately 90% of the input energy from each utility service may be accounted for at end use. The Building Management System (BMS) will be interfaced to provide automatic monitoring and targeting of all sub-meters to promote energy management and deliver lower consumption.

The incorporation of the aforementioned best practice measures into the design of the proposed development, will help achieve the energy consumption targets identified in Section 2.1 and the BREEAM 'Excellent' standards for ENE01 credits.

3.2 Building Design – Life Cycle Assessment and Embodied Carbon

A Life Cycle Assessment (LCA) will be conducted for the residential and industrial elements of the development, to quantify the embodied carbon associated with the materials of construction and, in turn, seek ways to limit the environmental impacts, underpinned by Circular Economy principles. Focus will be on construction product efficiency, responsible sourcing, product durability and building resilience.

The design intention is to use locally sourced A and A+ rated construction materials (as defined by the Green Guide to Specification), wherever possible, with associated low embodied carbon impact. Timber will be from certified and renewable FSC approved sources.

Construction product efficiency (off-site pre-fabrication) will be promoted along with the utilisation of a local workforce to reduce the environmental impact over the construction life cycle.

Opportunities to mitigate embodied carbon emissions on new build projects should concentrate on appropriate selection of materials of construction, not least for the concrete substructure that can account for over 40% of the total 'cradle-to-grave' emissions. The design could allow for the specification of concrete with up to 30 - 40% Pulverised Fuel Ash (PFA) or Ground Granulated Blast Furnace Slag (GGBS) content which can reduce the embodied carbon impact of concrete by as much as 80% when compared to that containing 100% Portland Cement.

A further environmental benefit of using PFA or GGBS is that they are both derived from waste streams and readily available in the UK at little or no cost uplift.

3.3 Building Design – Water Conservation

In order to minimise the environmental impact on water resources as a result of the development, water consumption will be reduced through the use of practical and hygienic water saving measures. For the residential elements, these measures will include dual flush WCs, low flow taps and shower heads and white goods selected for best practice with respect to both water use and energy efficiency.

An illustrative strategy to achieve the water efficiency standard target of 110 litres per person per day would include the following:

- Dual flush WCs (4/2.6 l/flush)
- Shower flow rates of 8 l/min
- Bath capacity of up to 170 litres
- Basin tap flows of 5 l/min
- Sink tap flows of 6 l/min
- Dishwasher 1.25 l/place setting
- Washing machine 8.17 l/kg

These measures will be supplemented by the incorporation of rainwater collection; water butts or tanks.

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Rainwater harvesting does provide a means of conserving water and is a recognised Sustainable Drainage Systems (SuDS) measure to provide for the disposal of surface water. SuDS will be discussed later in the document.

Similarly for the industrial units, it is proposed that all toilets will be low water capacity, taps will be push button type and water consumption will be tightly monitored. These measures will be supplemented by the incorporation of rainwater harvesting to the office accommodation.

3.4 Building Design – Operational Waste Management

For the industrial units, the final tenant will be encouraged to provide dedicated storage facilities for the building's operational related recyclable waste streams, so that waste can be diverted from landfill or incineration. The waste management strategy will be dependent on the tenant's business activities, but may include for e.g. compactors or balers to deal with large amounts of packaging, or vessels for composting suitable organic waste. Facilities should be clearly labelled to assist with the segregation, storage and collection of the recyclable waste streams.

3.5 Landscape and Sustainable Groundworks

The design strategy is to assimilate the proposed development within the site landscape and topology with particular attention given to the groundworks and earth modelling. Wherever possible, materials from site will be recycled and reused in the formation of the new landscaped areas. The reprofiling works will be designed to achieve an earthworks cut to fill balance, thus minimising the need for off-site disposal and import of materials. This has the added benefit of reducing HGV movements to and from the site. Where materials are required to be imported, the intention is to utilise recycled aggregates and soils sourced locally.

3.6 Sustainable Transport

A green travel plan will be developed as part of the process to consider all types of travel relevant to the various building types and users; encouraging the reduction of user reliance on forms of travel that have the highest environmental impact.

The green travel plan could include measures to minimise car-based travel patterns:

- Providing electric vehicle (EV) charging infrastructure across the site and conveniently located EV charging stations for user of the industrial units
- Providing parking priority spaces for car sharers
- Providing dedicated and convenient cycle storage and changing facilities
- Lighting, landscaping and shelter to make pedestrian and public transport waiting areas accessible
- Negotiating improved bus services, i.e. altering bus routes or offering discounts
- Providing lobby areas where information about public transport or car sharing can be made available
- Providing a pedestrian and cycle friendly site through the provision of e.g. cycle lanes and safe crossing points

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The plan will be further tailored to minimise the impacts of operational related transport e.g. deliveries of supplies, equipment and support services to and from the site.

4.0 Grid Decarbonisation and Electrification of Heat

An area of progress that will be exploited on this scheme to help meet emissions targets is that of UK grid electricity decarbonisation.

Over the past decade, there has been a significant shift in the way electricity is being generated in the UK with the proliferation of embedded generation from renewable sources and the managed phase out of the use of coal-fired power stations.

In 2012, the average carbon intensity of the National Grid was 531gCO₂e/kWh. This dropped to 275gCO₂e/kWh in 2017 with projections showing a continued downward trajectory to c. 110gCO₂e/kWh in 2030 and c. 65gCO₂e/kWh in 2035 as shown below:

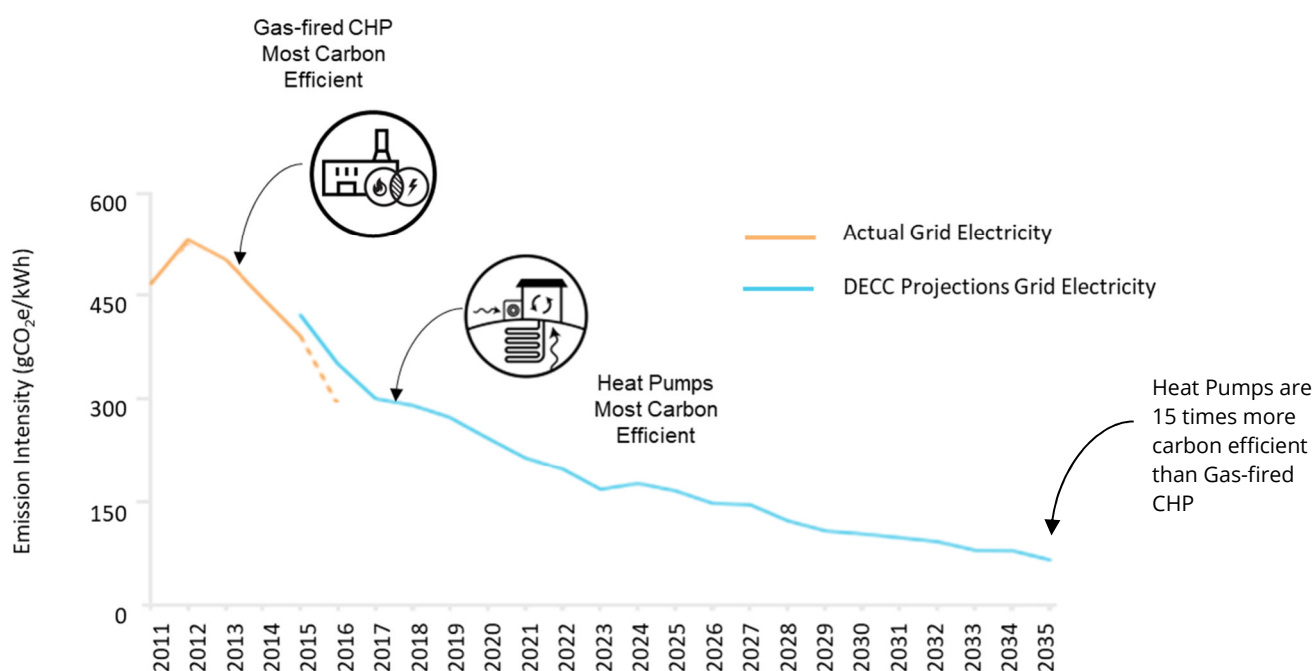


Figure 5. Grid Emission Carbon Intensity

The trend towards decarbonisation of the grid leads to opportunities to shift space heating and hot water generation from gas to electric with all-electric solutions including heat pumps replacing gas-fired boilers and/or combined heat and power (CHP) plant.

By 2035, it is estimated that every unit of heat energy delivered from a heat pump will be at least 15 times more carbon efficient than that being delivered from CHP plant.

The UK government, through the amended Climate Change Act, commits to a reduction in CO₂ and other greenhouse gas emissions of 100% by 2050. In other words, 'zero carbon' by 2050.

On that basis, it is reasonable to assume that grid supplied electricity will therefore be zero carbon by 2050.

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Recent announcements have brought that date forward to 2035, with the grid being decarbonised by up to 95% by 2030; further encouraging an acceleration towards the use of heat pump technology.

Heat pump technology will be used on this project to support the transition to net zero carbon.

5.0 Decentralised Energy Networks

In accordance with the Core Strategy and Joint Development Plan Policy, opportunities to connect the proposed development to existing or future decentralised heat distribution networks have been considered.

It has long been the case that estates with reliable year-round base heat loads (e.g. hospital sites) lend themselves to district heating network solutions, traditionally featuring gas-fired prime movers like CHP plant, where waste heat is produced in abundance.

As shown in the previous section, the use of gas-fired infrastructure does nothing to support the transition to net zero carbon, and the use of fossil fuels on new build projects does not accord with the requirements of the UK NZBS.

Furthermore, with reference to the target energy consumption figures in Section 2.1, the proposed buildings will be low energy in operation with respect to space heating and domestic hot water (DHW) demands. For residential properties, space heating would likely be c. 15kWh/m² per annum and for unconditioned warehouse based schemes c. 5kWh/m² per annum and limited to winter periods only. Domestic hot water loads are sporadic throughout the year, extremely low and best dealt with locally.

Given the lack of base heat load coupled with the fact that the proposed buildings will be inherently low energy in operation (and, therefore, present no opportunities for waste heat distribution around the site), leads to the conclusion that a decentralised energy network (district heating) is not viable on this project.

6.0 Adaptation to Climate Change

The proposed scheme has the potential to be impacted upon by a changing climate and, in particular, more frequent severe weather events, in the medium to longer-term. These impacts are identified and addressed by the mitigation measures shown in the next Section. Potential impacts on the proposed scheme could include:

- Material and asset deterioration due to higher temperatures
- Building/property overheating due to higher temperatures
- Health and safety risks to road users
- Damage to roads from periods of heavy rainfall
- Flood risk (surface, groundwater, fluvial and snow/ice melt) on the network and damage to drainage systems with the potential for increased runoff from adjacent land contributing to surface water flooding

6.1 Resilience of Buildings and Building Materials to Extreme Weather Events

The buildings and surrounding landscaped areas will be designed to mitigate the impact of more extreme weather conditions arising from climate change over the lifespan of the development.

Thermal modelling of the project's various building types will be undertaken as the scheme progresses using 2030 and 2050 weather data files, to ensure that the buildings will or can be adapted to withstand the effects of climate change, particularly with regard to minimising the risk of overheating.

To that end, the glazing specification will be chosen to ensure excellent performance criteria for light transmission to promote daylighting, combined with a low solar transmission to protect against solar gain and summertime overheating. The robust envelope design, including the exemplar air tightness characteristics, will further help with the control of the internal environmental conditions.

External solar shading devices will be used to provide additional protection measures to reduce solar gain within the occupied spaces of the industrial units, where glazing treatments are reaching saturation.

In order to ensure adequate ventilation for future climates, the dwellings could be ventilated via a 'mixed-mode' approach; a combination of MVHR systems during winter months and natural ventilation, via means of openable windows, outside of the heating season.

Mechanical ventilation solutions featuring heat recovery are proposed for the office elements of the industrial units. This opens up the opportunity for the buildings to benefit from 'free cooling' in summer where the outside air temperature is below that of the occupied spaces. With appropriate zoning, air can be drawn into the building in a controlled manner in response to CO₂ and temperature sensors to maintain good indoor air quality. Heat recovery techniques will be employed to lower the operating costs during the heating season.

Materials for construction will be chosen to offer structural and fabric resilience to the ever more extreme weather conditions expected over the lifespan of the development. Projected heat stress over the next 30 years will be factored into the detailed structural design of residential and industrial unit structures.

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Robust, low-carbon materials will be used for roads and pavements; selected to maintain structural stability and safety of road user. Durable road markings will be utilised; designed to resist changes in climatic conditions.

Landscaping and external planting will be such that it offers natural protection for the buildings and the external building areas occupied by users. With shading from trees and the large buildings as well as cooling effects from the various ponds, a microclimate will be established in and around the development to help influence temperatures at pedestrian level.

The landscaping plan will address potential changes in growing regimes due to changing climates.

6.2 Sustainable Drainage Systems (SuDS)

Sustainable drainage systems (SuDS) play an important role in positively addressing climate resilience. By mimicking natural drainage regimes, SuDS can help meet climate targets through their ability to improve water quality, while managing and mitigating both flood risk and surface water run-off created as a result of new development.

A flood risk assessment will be undertaken as part of the planning process and will include consideration of climate change projections within maintenance plans and drainage systems to protect against a return period of 1-in-100 years flood event.

Given that SuDS interventions are in essence a series of management practices, control structures, strategies, and design solutions to drain surface water both efficiently and sustainably from development sites, the following are deemed appropriate on this project.

Rainwater harvesting does provide a means of conserving water and is a recognised SuDS measure to provide for the disposal of surface water. Rainwater collection in the form of water butts or tanks will be provided for the residential elements. The large roofs of the industrial units will be used to collect water at scale for use in the office accommodation.

Permeable surface treatments to the car park and service areas will be encouraged to facilitate attenuation within the sub-structure; leading to an increase in the time of entry for the overflow into the carrier network. Infiltration techniques will be highly dependent upon the soil characteristics and the level of the water table.

The flow and run-off from soft landscaped areas will be reduced through strategic planting of locally occurring species of bushes and trees.

Finally, a series of ponds will be incorporated into the landscape to enlarge the developments' water storage capacity and enhance the habitat diversity for wildlife.

7.0 Appraisal of Renewable and Low Carbon Technology Energy Options

The technical feasibility and economic viability of installing each LZC technology at the Stakehill Estate development have been assessed in order to discount any unsuitable options at an early stage. A summary of the feasibility process is tabulated below and an overview of each viable technology is given subsequently.

Technology	Brief Description	Benefits	Issues/Limitations	Feasible for site
Solar Photovoltaic	Solar photovoltaic panels convert solar radiation into electrical energy through semiconductor cells. They are not to be confused with solar panels which use the sun's energy to heat water (or air) for water and space heating.	Low maintenance/no moving parts Easily integrated into building design	Any overshadowing reduces panel performance Panels ideally inclined at 30° to the horizontal facing a southerly direction	Yes
Solar Thermal	Solar thermal energy can be used to contribute towards space heating and hot water requirements. The two commonest forms of collector are panel and evacuated tube.	Low maintenance Little/no ongoing costs	Must be sized for the building hot water requirements Panels ideally inclined at 30° to the horizontal facing a southerly direction	Yes
Ground Source Heat Pump (GSHP)	GSHP systems tap into the earth's considerable energy store to provide both heating and cooling to buildings. A number of installation methods are possible including horizontal trench, vertical boreholes, piled foundations (energy piles) or plates/pipe work submerged in a large body of water. The design, installation and operation of GSHPs is well established.	Minimal maintenance Unobtrusive technology Flexible installation options to meet available site footprint	Large area required for horizontal pipes Full ground survey required to determine geology More beneficial to the development if cooling is required Integration with piled foundations must be done at an early stage	No, prohibitively expensive installation costs
Air Source Heat Pump	Electric or gas driven air source heat pumps extract thermal energy from the surrounding air and transfer it to the working fluid (air or water).	Efficient use of fuel Relatively low capital costs	Specialist maintenance More beneficial to the development if cooling is required	Yes

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Technology	Brief Description	Benefits	Issues/Limitations	Feasible for site
			Requires defrost cycle in extreme conditions Some additional plant space required	
Wind Turbine (Stand-alone column mounted)	Wind generation equipment operates on the basis of wind turning a propeller, which is used to drive an alternator to generate electricity. Small scale (1kW – 15kW) wind turbines can be pole or roof mounted.	Low maintenance/ongoing costs Minimum wind speed available Excess electricity can be exported to the grid	Planning issues Aesthetic impact and background noise Space limitations on site Wind survey to be undertaken to verify 'local' viability	No, not suitable on this site
Wind Turbine (Roof Mounted)	As above	Low maintenance/ongoing costs Minimum wind speed available Excess electricity can be exported to the grid	Planning issues Aesthetic impact and background noise Structural/vibration impact on building to be assessed Proximity of other buildings raises issues with downstream turbulence Wind survey to be undertaken to verify 'local' viability	No, not suitable on this site
Gas Fired Combined Heat and Power	A Combined Heat and Power (CHP) installation is effectively a mini on-site power plant providing both electrical power and useful heat. CHP is strictly an energy efficiency measure rather than a renewable energy technology.	Potential high CO ₂ saving available Efficient use of fuel Excess electricity can be exported to the grid Benefits from being part of an energy centre/district heating scheme	Maintenance intensive Sufficient base thermal and electrical demand required Some additional plant space required	No, limited domestic hot water requirements
Bio-fuel Fired Combined	As above.	Potential high CO ₂ saving available	Maintenance intensive	No, not suitable on this site

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Technology	Brief Description	Benefits	Issues/Limitations	Feasible for site
Heat and Power		Efficient use of fuel Excess electricity can be exported back to the grid Benefits from being part of an energy centre/district heating scheme	Sufficient base thermal and electrical demand required Significant plant space required Biomass fuelled systems are at early stages of commercialisation Large area needed for fuel delivery and storage Reliable biomass fuel supply chain required	
Bio-Renewable Energy Sources <i>(Automated feed – wood-fuel boiler plant)</i>	Modern wood-fuel boilers are highly efficient, clean and almost carbon neutral (the tree growing process effectively absorbs the CO ₂ that is emitted during combustion). Automated systems require mechanical fuel handling and a large storage silo.	Stable long term running costs Potential good CO₂ saving	Large area needed for fuel delivery and storage Reliable fuel supply chain required Regular maintenance required Significant plant space required	No, not suitable on this site
Fuel Cells and Fuel Cell Combined Heat and Power	Fuel cells convert the energy of a controlled chemical reaction, typically involving hydrogen and oxygen, into electricity, heat and water vapour. Fuel cell stacks operate in the temperature range 65°C – 800°C providing co-generation opportunities in the form of Combined Heat and Power (CHP) solutions.	Zero CO₂ emissions if fired on pure hydrogen and low CO₂ emissions if fired on other hydrocarbon fuels Virtually silent operation since no moving parts High electrical efficiency Excess electricity can be exported back to the grid Benefits from being part of an energy centre/district heating scheme	Expensive Pure hydrogen fuel supply and distribution infrastructure limited in the UK Sufficient base thermal and electrical demand required Some additional plant space required Reforming process, used to extract hydrogen from alternative fuels, requires energy; lowering overall system efficiency	No, expensive, emerging technology

Table 3. Summary of Renewable and Low Carbon Technology Energy Options

7.1 Solar Photovoltaic (PV) Panels

Solar photovoltaic panels convert solar radiation into electrical energy through semiconductor cells. They are not to be confused with solar panels which use the sun's energy to heat water (or air) for water and space heating.



Photovoltaic panels are available in a number of forms including mono-crystalline, polycrystalline, amorphous silicon (thin film) or hybrid panels. Polycrystalline products offer the best combination of performance and cost at present. They are fixed or integrated into a building's un-shaded south facing façade or pitched roof.

Distribution centre/warehouse roofs provide an ideal location for the installation of PV panels.

Figure 6. Solar PV Installation

It is essential that the panels remain un-shaded, as even a small shadow can significantly reduce output. This is not an issue on warehouse projects due to the uncluttered nature of the roof. The individual modules are connected to an inverter to convert their direct current (DC) into alternating current (AC) which is usable in buildings.

Photovoltaic technology may be feasibly incorporated into the building design with little/no maintenance or on-going costs. Installations are scaleable in terms of active area; size being restricted only by available façade and/or roof space.

It should be noted that the installation and connection of embedded generation equipment to the mains electrical utility grid (National Grid), including solar PV panels rated at more than 16A per phase, is subject to technical approval by the District Network Operator (DNO). This takes the form of a G99 agreement. The G99 is the regulation surrounding the connection of any form of generator device to run 'in parallel' or 'synchronised' with the grid.

The DNO are required (under the Connection and Use of System Code) to make a request for a Statement of Works (SoW) to National Grid Electricity Transmission plc (NGET) in relation to the potential impact of connection of embedded generation on the National Electricity Transmission System (NETS). As such, there is no guarantee that approval for the connection of embedded generation equipment will be granted.

For this project, roof mounted solar PV technology will be incorporated into both the residential and industrial elements.

7.2 Solar Thermal

Solar thermal energy can be used to contribute towards space heating and hot water requirements. In the UK, most applications focus on hot water installation as the solar availability during the space heating season is limited.



Figure 7. Solar Thermal Evacuated Tube Systems

The use of solar water heating installations is widespread throughout Europe. The systems use a heat collector, generally located at roof level on support frames, orientated in a southerly direction to maximise solar heat absorption.



A working fluid is used to heat water that is stored in either a separate hot water cylinder or more commonly a twin coil hot water cylinder with the second coil providing top-up heating from a conventional boiler.

The two most common forms of collector are panel and evacuated tube.

The panel type collectors are generally more robust and reliable while manufacturers claim that the evacuated tube versions offer better winter all-round performance.

Figure 8. Evacuated Tube Type Collectors

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The design of the flat plate panels is relatively straightforward; consisting of water tubes arranged behind solar glass and an absorber plate. The absorber plate absorbs the sun's rays and transfers energy to the water flowing through the tubes. In contrast, the evacuated tube type collectors are more complicated consisting of double wall glass tubes with a space in the centre containing a heat pipe and a liquid.

Coatings on the inner glass ensure that around 93% of the absorbed heat is retained within the system and the vacuum prevents loss of heat through conduction and convection. The circular design helps maximise the potential to collect solar energy all year round when the sun is at different angles.

The heat pipes are connected to a manifold containing circulating water. The liquid in the heat pipe is evaporated by the sun's energy and rises to a heat exchanger within the manifold where it condenses and gives up its latent heat energy to the water. This heated water is then pumped to a coil in the hot water cylinder sized to meet the demand of the installation. Evacuated tube systems deliver higher temperature water than flat plate types, with little decrease in efficiency, making them more effective with thermal storage solutions.

As a general rule, the evacuated tube collectors can deliver around 700kWhr/m²/yr when in optimum orientation (inclined at 30° to the horizontal facing a southerly direction). This compares to around 580kWhr/m²/yr for the flat plate collectors under similar conditions.

Solar thermal installations can be designed to fit the available roof space and/or building façade. Each evacuated tube is approximately 2m in length with an external diameter of 58mm. They weigh around 2kg each and can be spaced from 10mm to 500mm apart in an array. A typical panel array, 2.1m x 1.0m, will provide around 1.33m² of absorber area and weigh approximately 45kg. Bespoke mounting frames can be fashioned to provide the ideal inclination of 30° to the horizontal facing a southerly direction. Access to the roof mounted solar collectors will be necessary for occasional cleaning of the active tubes.

For this development, solar thermal technology will be sized to support the domestic hot water demands of the residential elements.

Solar thermal systems generally come with a 10-year warranty. Very little maintenance is required and a check by a professional installer of pumps, valves and anti-freeze mixture every 3 – 5 years is usually sufficient.

7.3 Air Source Heat Pumps

Electric driven air source heat pumps extract thermal energy from the surrounding air and transfer it to the working fluid (air or water). They can provide both heating and cooling to buildings and have an associated Coefficient of Performance (COP). This is typically around 3 to 4 for heat pumps driven by compressors powered by electric motors and incorporating Variable Refrigerant Flow (VRF) technology. With VRF technology, there is an opportunity to heat and cool separate spaces and recover the heat between them.



Care should be taken when mounting the units to avoid any acoustic problems associated with operating the fans. The outdoor units normally operate with sound levels typically in the range 55 - 60dB(A).

A downside of electric driven air source heat pumps is that they require a defrost cycle in extreme conditions which impacts on the system efficiency. Heating capacity also falls off as the ambient temperature drops below 5°C but still maintains 80% capacity at -5°C.

Figure 9. Air Source Heat Pumps

Air source heat pump systems are scaleable to meet the specific demands of the development and have the potential to offer good CO₂ reduction as the grid electricity supply is decarbonised.

For this scheme, ASHP technology will be used to provide space heating for the residential elements of the development and heating/cooling for the office areas of the industrial units.

8.0 Summary and Conclusions

An Energy and Climate Change Adaptation Statement has been produced at outline planning stage for the Stakehill Estate development to address the requirements of the Rochdale Borough Council Core Strategy and the regional Places for Everyone Joint Development Plan in relation to sustainability and wider Net Zero Carbon aspirations.

In order to deliver environmentally responsible building stock, an exemplar approach is being proposed based on low energy design principles. In summary, this approach involves energy demand minimisation through effective building form and orientation to promote high levels of daylight, good envelope design and proficient use of building services such that the buildings themselves are being used as the primary environmental modifier.

It is worthy of note, that long term energy benefits are best realised by reducing the inherent energy demand of the buildings in the first instance before incorporating Low and Zero Carbon (LZC) technologies to decarbonise the energy supply.

To align the development with a Net Zero Carbon pathway, both operational energy/carbon and embodied (upfront) carbon targets have been proposed in-line with the UK NZCBS.

Furthermore, to accord with the UK NZCBS, the development will be fossil-fuel free and take advantage of grid decarbonisation. Deploying electrification of heat principles, in the form of heat pump technology throughout, supports the transition to a Net Zero Carbon state.

Opportunities to connect the planned development to existing or future decentralised heat distribution networks have been considered. Traditionally, these networks have featured gas-fired prime movers like CHP plant, where waste heat is produced in abundance. Due to the design standards being proposed, the space heating and DHW demands of the buildings within the development will be very low, and as such, will not yield a suitable base-load for a heat network. The design intention is to pursue local electrification of heat solutions, including heat pump technology, on this project.

Having reviewed the feasibility of installing each LZC technology solution, the following is proposed for inclusion on the scheme.

To help decarbonise the energy supply, roof mounted solar PV technology will be incorporated into both the residential and industrial elements across the development. Solar thermal systems will be sized to support the DHW demands on the residential buildings.

Other LZC technology solutions have been discounted on the grounds that they are not technically feasible or economically viable for the development, as described in Table 3 of this report.

The incorporation of the aforementioned best practice measures into the design of the proposed development, will help achieve the BREEAM 'Excellent' standards for ENE01 credits.

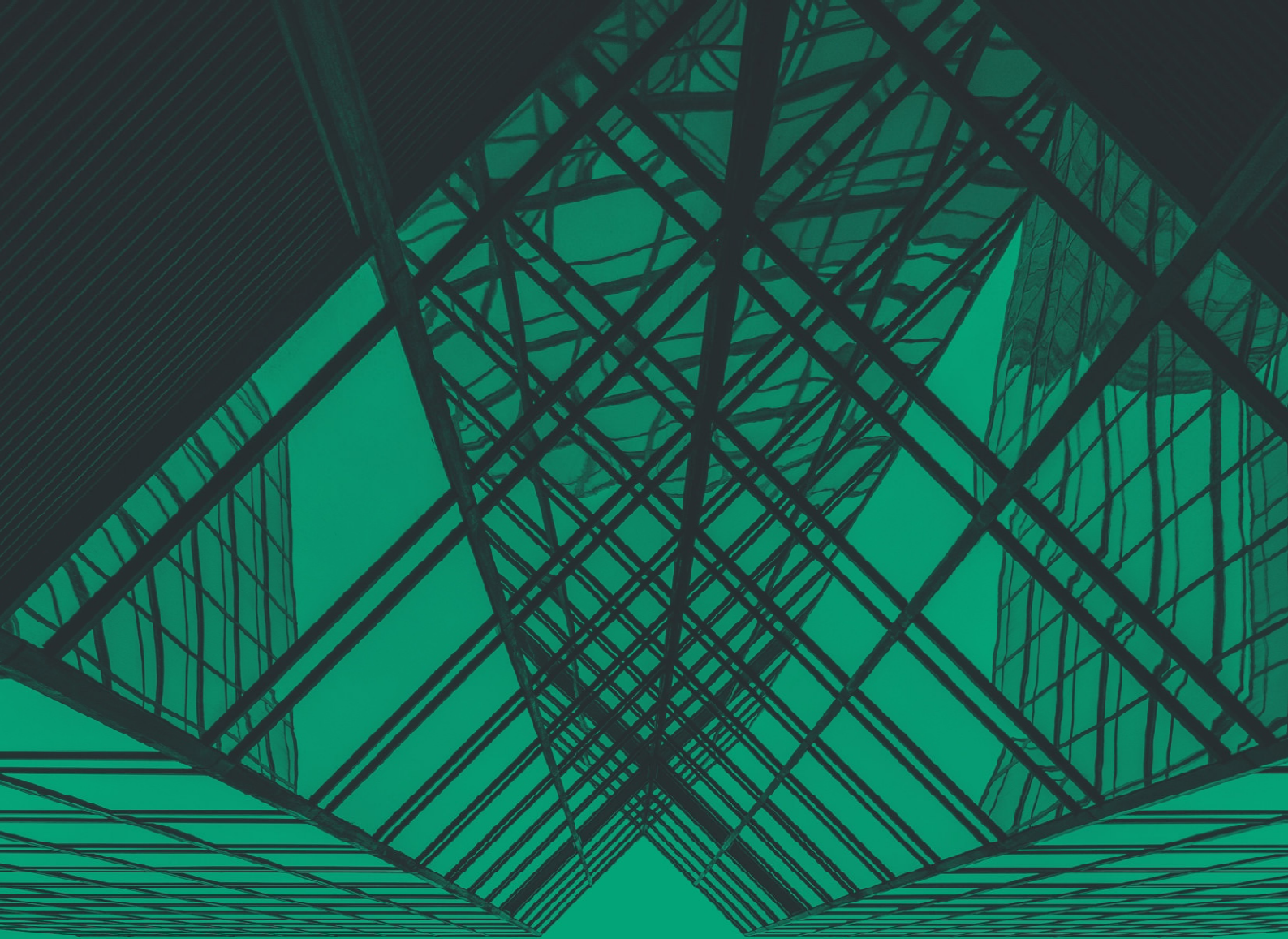
The proposed scheme has the potential to be impacted upon by a changing climate and, in particular, more frequent severe weather events, in the medium to longer-term. The potential impacts have been identified and include the resilience of buildings to overheating, structural and fabric resilience across the site and increased

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flood risk/surface water run-off created as a result of the new development. Practical mitigation measures have been proposed to combat the effects of a changing climate.

The design strategies outlined within this Energy and Climate Change Adaptation Statement, will be further developed at the full planning application stage, with detailed energy and carbon modelling undertaken to demonstrate how the residential dwellings and industrial units perform.



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