

Oxenwood Real Estate

Rhodes Business Park

Energy & Sustainability Statement

Last Updated 01/11/2023

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1 INTRODUCTION

The following Energy, Sustainability and Climate Change Report has been prepared for Rhodes Business Park.

The illustrative development comprises a 0.59 ha area on the park's southeastern edge that is currently un-used, into a new commercial/industrial unit (Use Classes E(g)/B2/B8).

Each LZC design principle and technology, as well as climate change considerations, have been assessed to determine the feasibility for inclusion within the development and are discussed across the subsequent sections.

The findings within this report are subject to review at the next stages of design.



1.1 LOCAL PLANNING REQUIREMENTS

The following planning policies have been considered during the production of this report:

DOCUMENT	POLICY	INFORMATION
Rochdale Adopted Core Strategy	T1 Delivering Sustainable Transport	1. Increased use of intelligent transport systems and advancing technology (vehicle charging points etc).
Rochdale Adopted Core Strategy	G1 Tackling and Adapting to Climate Change	1. New developments will be expected to: - Be zero carbon in line with national targets and definitions. - Adhere to the 'energy hierarchy' to minimise operational energy over their lifetime. 2. 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.
Rochdale Adopted Core Strategy	G2 Energy and New Development	1. All new development will be expected to adhere to the following energy hierarchy. 2. Demand Reduction – Achieve the maximum possible reduction in demand for energy through building design (i.e., the use of passive systems). 3. Energy efficiency and low / zero carbon technologies and networks – Design to maximize energy efficiency and use on-site or linked low or zero carbon technologies or direct connection to a low or zero carbon heat source. 4. 'Allowable solutions' – use wider energy efficiency / CO2 reduction measures, which could include developer contributions, to compensate for 'residual emissions'.
Rochdale Adopted Core Strategy	G3 Renewable and Low Carbon Energy Developments	1. Promoting renewable, low and zero carbon energy generating developments, including wind power, Biomass Combined Heat and Power (CHP), hydro and heat pumps
Places for Everyone	JP-S 2 Carbon and Energy	1. A carbon neutral Greater Manchester no later than 2038, with a dramatic reduction in greenhouse gas emissions. 2. Promoting the use of life cycle cost and carbon assessment tools to ensure the long-term impacts from development can be captured. 3. Positive approach to renewable and low carbon energy schemes including eliminating use of fossil fuels. 4. New development will: - Be net zero carbon from 2028 by following the energy hierarchy (with any residual carbon emissions offset) - Incorporate adequate electric vehicle charging points to future proof for the likely long-term demand, taking account of the potential maximum energy demand for the site; - Where practicable, prioritise connection to a renewable energy/heating/cooling network in the first instance or a low carbon energy/heating/cooling network that is adaptable to non-fossil fuels at a later date - For non-residential developments, achieve at least BREEAM excellent standard (or equivalent) for the 'Ene 01 – reduction of energy use and carbon emissions' category. - Include a detailed energy statement to demonstrate via site relevant evidence how the development has sought to maximize reductions in carbon emissions in line with relevant policy targets, including the minimisation of overheating risks and appropriate measures for post occupancy evaluation.
Places for Everyone	JP-S 3 Heat and Energy Networks	1. The provision of decentralised energy infrastructure is critical to the delivery of our objectives for low carbon growth. 2. Delivery of renewable and low carbon energy schemes will be supported with particular emphasis on the use of decentralised energy.

1.2 BREEAM UK NEW CONSTRUCTION V6

BREEAM is a sustainability certification scheme that is broken down into the topics categorised below:



By obtaining credits across the BREEAM categories, as well as mandatory credits, the following ratings can be achieved:



The proposed development is targeting a minimum standard of BREEAM 'Very Good'.

To achieve BREEAM 'Very Good' a score of 55% much be achieved.

Under the BREEAM Assessment, many aspects of sustainable best practice design will be assessed.

In line with the Manchester Places for Everyone document, the minimum requirements for 'Excellent' will be achieved under ENE 01.

The BREEAM sustainability measures will also aid in supporting other various policies within the Rochdale Adopted Core Strategy and Manchester Places for Everyone documents.

2 LOW CARBON DESIGN PRINCIPLES

2.1 EXECUTIVE SUMMARY

In line with Policies covered in Section 1.1, the following have been considered in the design of the development:

- Passive Measures.
 - Exploration of orientation on performance.
 - Building fabric
 - Reduced air permeability.
 - Maximising daylighting.
- High Efficiency Systems.
 - Energy efficient lighting.
 - Energy efficient vertical transportation including use of regenerative drive and variable speed drivers.
 - Use of heat recovery systems.
 - Reducing the volume of water used in sanitaryware.
- Electric Vehicle Charging (EVC).
- Cycle Storage.

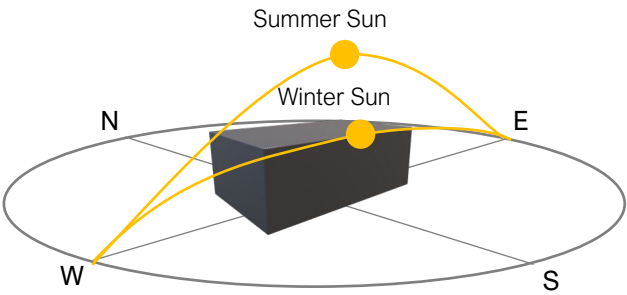
The table below summarises the LZC design principles viability. Each LZC principle has been considered in the subsequent sections of this report to determine suitability and allow an informed decision as to whether they would be beneficial to the development. The findings within the report are subject to review at the next stages of design.

LOW CARBON DESIGN PRINCIPLES			
	PASSIVE MEASURES	HIGH EFFICIENCY SYSTEMS	LOW CARBON TRANSPORTATION MEASURES
	Building Orientation	Energy Efficient Lighting	Electric Vehicle Charging
	Building Fabric	Water Consumption	
	Air Permeability	Vertical Transportation	Cycle Storage
	Daylighting	Heat Recovery	
VIABLE	YES	YES	YES

2.2 PASSIVE MEASURES

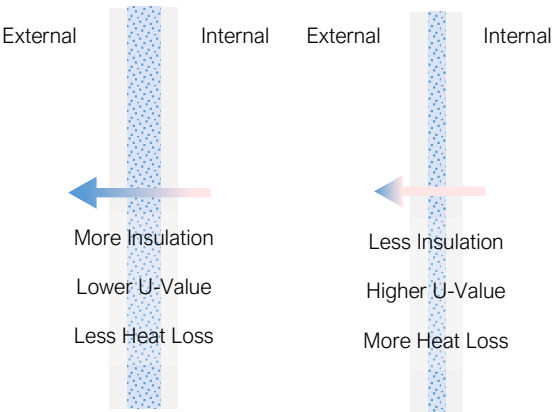
2.2.1 BUILDING ORIENTATION

- Building and room orientation can have an impact on the energy consumption of a building.
- For example, rooms that are used more regularly, and thus require more heating, should be located on the south side of the building where possible. By doing so, these rooms benefit from increased solar heat gains thus minimising heating demand.



2.2.2 BUILDING FABRIC

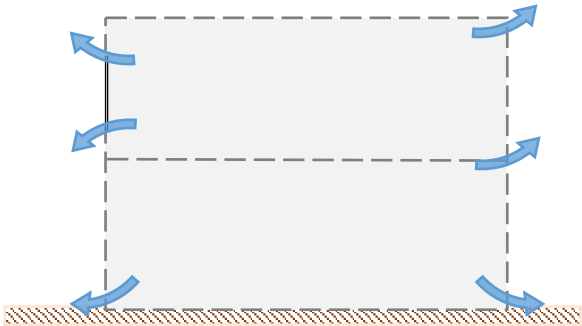
- U-values show the rate of heat transfer through a structure; the lower the U-value, the less heat that is lost through the structure.
- Building fabric choice determines the U-value of the building element, for example using more insulation will reduce heat loss through the element.
- Part L of the Building Regulations sets limiting values for U-values.
- An update to Part L of the building regulations came into effect on the 15th of June 2022 and it is the U-values from the updated Building Regulations that will be targeted for this development.



U-VALUES (W/m²K)	
	Minimum Part L
External Wall	0.26
Roof	0.18
Floor	0.18
Glazing	1.60

2.2.3 AIR PERMEABILITY

- Building airtightness is the resistance to air leakage through the external building envelope.
- Air leakage in buildings tends to be located at junctions between building elements, the wall and window and door frames, electrical equipment, and other building penetrations.
- The air leakage can be reduced through use of airtightness tapes and grommets.
- Reducing the air leakage in a building also improves the energy performance by reducing heating demand.
- Part L of the building regulations sets limiting values for air permeability. The lower the air permeability, the more airtight the building.



AIRTIGHTNESS (m³/hm²)

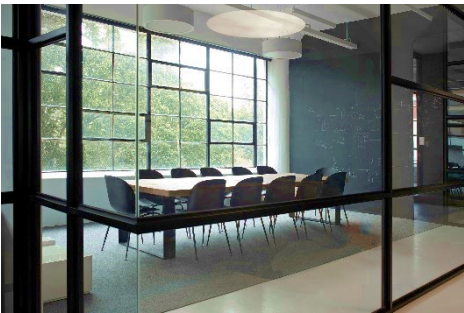
Minimum Part L

Air Permeability

8

2.2.4 DAYLIGHTING

- By providing natural daylighting to a building, use of artificial lighting can be minimised, thus reducing lighting loads and energy consumption.
- However, there is a balance to be found between maximising daylighting but not providing so many glazed areas that summer overheating and glare risks increase and building fabric u-values and airtightness are compromised.



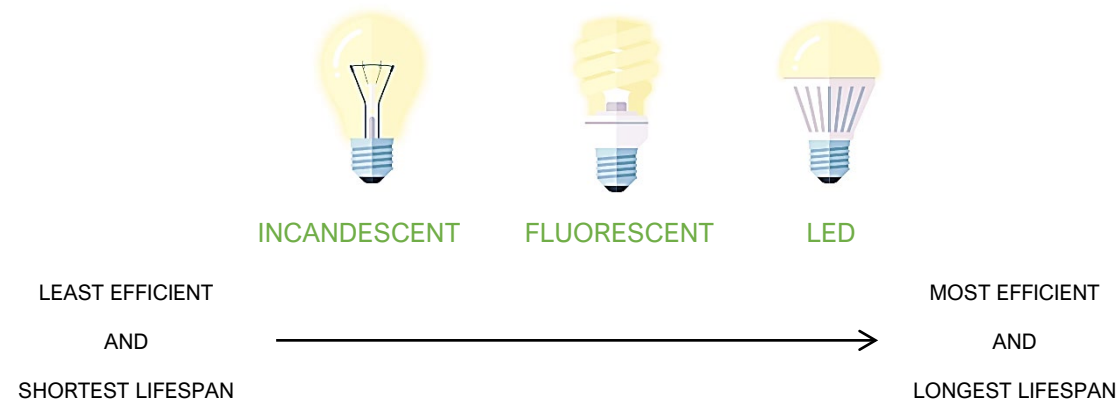
PASSIVE MEASURES CONSIDERED VIABLE

TO BE INCORPORATED INTO THE DEVELOPMENT WHERE POSSIBLE

2.3 HIGH EFFICIENCY SYSTEMS

2.3.1 ENERGY EFFICIENT LIGHTING

- LED lighting is highly efficient, they use around 75% less energy than incandescent bulbs.
- When compared to fluorescent lighting, LED lighting is more efficient, provides full brightness instantly and lasts longer.
- As such, LED lighting will be incorporated into the design where possible.



- Automatic lighting controls will be utilised in areas such as corridors to prevent unnecessary light usage during unoccupied periods.

2.3.2 WATER CONSUMPTION

- It takes a large amount of energy for water companies to treat and distribute potable water to developments accompanied by the energy required to heat the water at a proposed development.
- As such, it is important to reduce water consumption where possible through metering, leak detection, flow control and sanitaryware specification.



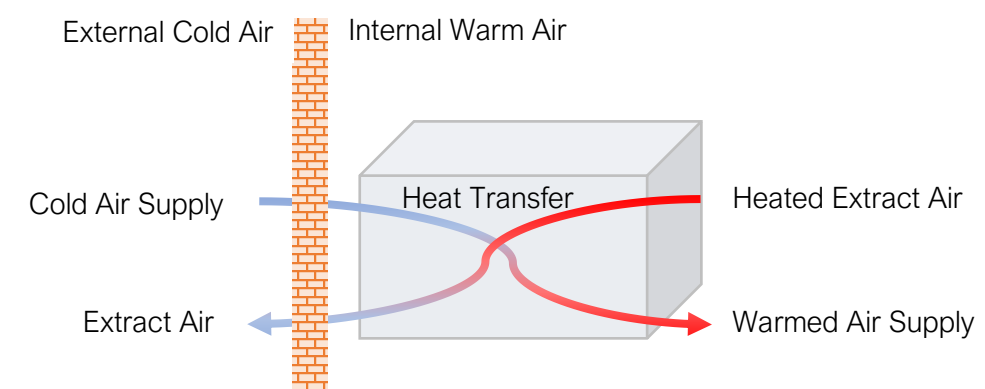
2.3.3 VERTICAL TRANSPORTATION

- Lift traffic analysis should be undertaken to ensure the correct number of lifts are specified for the development needs.
- Regenerative drives capture wasted energy associated with lift use and divert this back to the supply network, which can result in energy savings. As such regenerative drives should be considered.



2.3.4 HEAT RECOVERY

- Heat recovery systems utilise heat extracted from the inside heated space to warm the incoming external air, thus minimising the heating requirement and reducing carbon impact.
- Ventilation units should include heat recovery.



HIGH EFFICIENCY SYSTEMS CONSIDERED VIABLE

TO BE INCORPORATED INTO THE DEVELOPMENT WHERE POSSIBLE

2.4 LOW CARBON TRANSPORTATION MEASURES

2.4.1 ELECTRIC VEHICLE CHARGING (EVC)

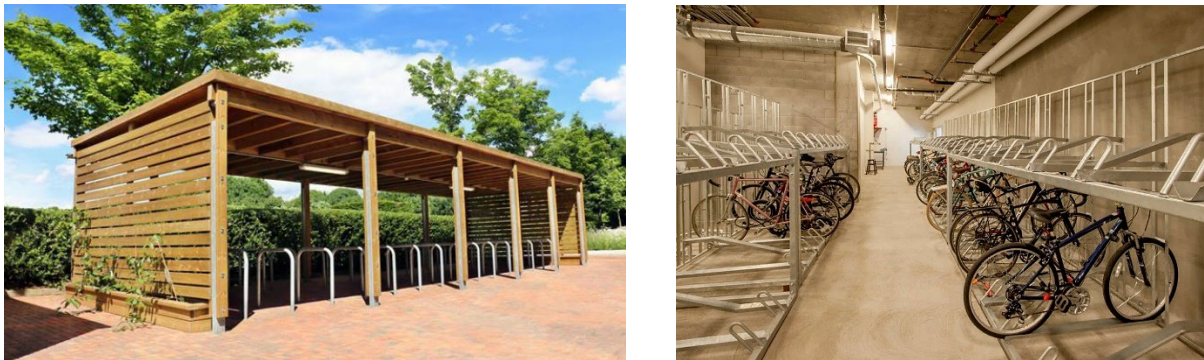
- Electric recharging stations of a minimum of 3kW for at least 10% of the total car parking capacity will be provided in line with BREEAM criteria.
- Electric vehicle charge points provide the facility for building users to charge their vehicles whilst parked at work.
- The facility of EV charge points will encourage building users to consider alternative low carbon fuelled vehicles, thus encouraging low carbon emission transport, and minimising the impact of the development on local air quality.
- EV Fast and Superfast charge points may be installed to provide sufficient charge for shorter term users.



EVC – SUMMARY TABLE	
Appropriateness of technology to the site/ system viability	Relatively easy to incorporate. Consideration is needed to the availability of electricity supply capacity is sufficient to meet the expected long-term demand.
Lifetime & Payback	Lifetime: 20 years. Payback: N/A.
Land Use	Minimum space required to accommodate the EV Charge Posts.
Noise	No noise issues
Grant	OLEV Grant available under the Workplace Charging Scheme.
Carbon Savings	Relative to miles travelled by Building Users.

2.4.2 CYCLE STORAGE

- Cycle spaces will be provided across the development site, within each development plot, to provide building users with sustainable transport options whilst helping to reduce the carbon footprint associated with travel to and from the site.
- This will encourage users to choose active travel, contribute to improving local air quality and reducing local congestion.
- Cycle spaces will be BREEAM compliant and therefore meeting the following criteria:
 - Number of cycle spaces provided to be based on 1 per 10 staff.
 - Cycles will be able to be secured within spaces in racks with overhead covering. The cycle racks are set in or fixed to a permanent structure (building or hardstanding) or alternatively, will be located in a locked structure fixed to, or part of, a permanent structure with appropriate surveillance
 - The distance between each cycle rack, and the cycle racks and other obstructions, e.g., a wall, allows appropriate access to the cycle storage space for easy storage and access to bikes
 - The storage facility or entrance to the facility will be in a prominent site location visible to potential users from either an occupied building or a main access to a building
 - The cycle storage facility has adequate lighting
 - The lighting will be controlled to avoid out-of-hours use and operation during daylight hours, where there is sufficient daylight in or around the facility.



LOW CARBON TRANSPORTATION MEASURES CONSIDERED VIABLE
TO BE INCORPORATED INTO THE DEVELOPMENT WHERE POSSIBLE

3 LOW AND ZERO CARBON TECHNOLOGIES

3.1 EXECUTIVE SUMMARY

In line with Policies covered in Section 1.1, the following low or zero carbon technologies have been considered for use within the development:

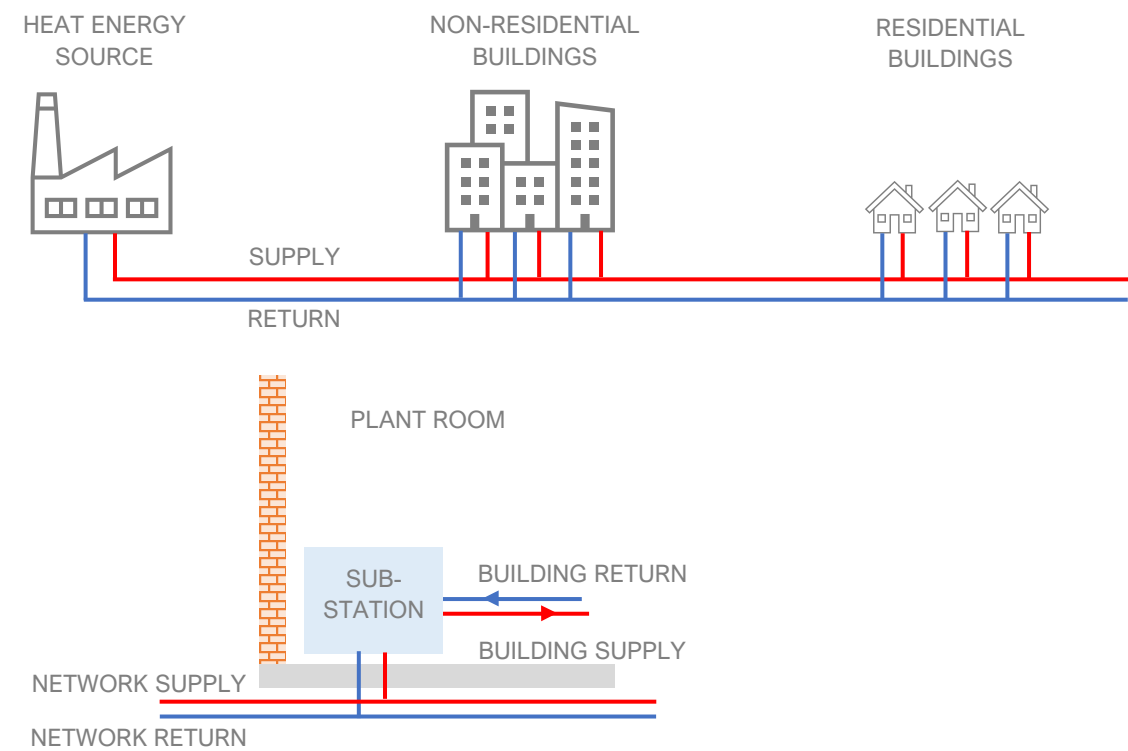
- District Heat Network.
- Air Source Heat Pumps (ASHPs).
- Ground Source Heat Pumps (GSHPs).
- Biomass Heating.
- Combined Heat and Power (CHP).
- Wind Power.
- Photovoltaics and Battery Storage.
- Solar Water Heating.

The table below summarises the LZC technologies viability and whether there are any available funding schemes. Each technology has been considered in the subsequent pages to determine the suitability to allow an informed decision as to whether they would be beneficial to the development.

LOW AND ZERO CARBON TECHNOLOGIES		VIABLE	AVAILABLE FUNDING SCHEMES
District Heat Network		No	Non-Domestic Renewable Heat Incentive (RHI) ended in March 2021.
Heat Pumps	Air Source (ASHP)	YES	Non-Domestic Renewable Heat Incentive (RHI) ended in March 2021.
	Ground Source (GSHP)	No	
Biomass Heating		No	Non-Domestic Renewable Heat Incentive (RHI) ended in March 2021.
Combined Heat and Power		No	The Feed-in Tariff ended in April 2019. Smart Export Scheme available as of January 2020. Rate not guaranteed
Wind Power		No	The Feed-in Tariff ended in April 2019. Smart Export Scheme available as of January 2020. Rate not guaranteed
Photovoltaics and Battery Storage	Photovoltaics	Yes	The Feed-in Tariff ended in April 2019. Smart Export Scheme available as of January 2020. Rate not guaranteed
	Battery Storage	No	
Solar Thermal Water Heating		No	Non-Domestic Renewable Heat Incentive (RHI) ended in March 2021.

3.2 DISTRICT HEAT NETWORK

- District heat networks use the heat energy from a centralised energy centre and distributes it to buildings via a network of pipes.
- The heating network is comprised of the following components:
 - Heat energy sources.
 - Primary pipeline network that distributes the heat.
 - Heat exchanger substations located within the building.
 - A secondary pipeline network that utilises the heat to provide hot water and heating to building users.



- The heat energy sources can be power stations, energy from waste, geothermal, or CHP.
- As district heat networks operate off waste energy they can be seen as a sustainable technology.
- Both hot water and heating can be supplied through district heating networks.

ADVANTAGES	DISADVANTAGES
Utilises heat energy that would typically be wasted.	Heat energy may come from sources using fossil fuels.
Tends to be more efficient than using individual boilers.	Works best in densely populated areas.
	Availability of connections to a district heat network.

DISTRICT HEAT NETWORK – SUMMARY TABLE	
Appropriateness of Technology to the Site/ System Viability.	There is no district heat network within close proximity to the proposed development site and there will be minimal heat requirements for the development. Heating and comfort cooling is to be provided via ASHP for the office areas. The warehouse aspect of the development has been considered as untreated at this stage of the design. As such a heat network is not deemed viable.
Lifetime and Payback.	Lifetime: 30 Years Payback: Not calculated as the system is not viable.
Land Use.	Plant containing substation would be located internally. However, this does not need to be considered further, as the system is not deemed viable.
Noise.	Plant noise attenuation requirements would have to be reviewed by the acoustic consultant and attenuation included within the design and installation as necessary to prevent noise egress. However, this does not need to be considered further, as the system is not deemed viable.
Carbon Savings.	0.35kgCO2e/m2 @ 0.225kgCO2e/kWh carbon factor for electricity and 0.3180kgCO2e/kWh carbon factor for heat and steam from a district heat network.

DISTRICT HEAT NETWORK NOT CONSIDERED VIABLE

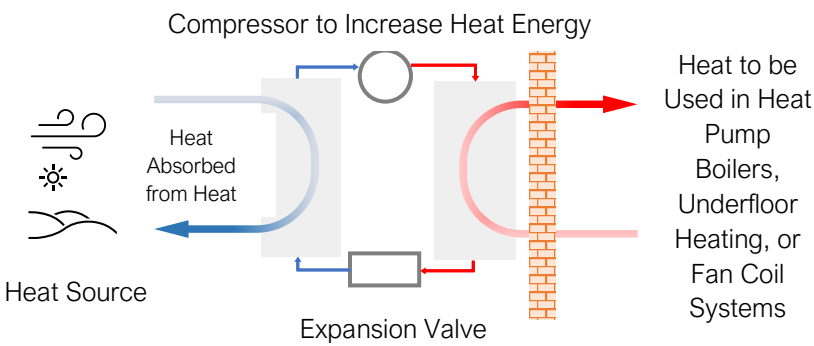
NOT PROPOSED TO BE INCORPORATED INTO THE DEVELOPMENT

3.3 HEAT PUMPS

- Heat pumps extract thermal energy from a variety of renewable sources, including the air, earth, or water. If the heat source for the system is the air, it is known as an air source heat pump and if the source is the ground, it is a ground source heat pump.
- The thermal energy is then upgraded to a higher, more useful temperature. Therefore, heat pumps supply more useful energy than they consume. As such, use of heat pumps can lead to reduced use of fossil fuels and subsequently, a reduction in the emission of greenhouse gases.

3.3.1 AIR SOURCE HEAT PUMP (ASHP)

- By using an air source heat pump, it is possible to extract considerable heat from the air, even at temperatures as low as minus 15°C.
- The air source heat pump system consists of a compressor and a carefully matched evaporator coil and heat exchanger.
- There is a refrigerant liquid that circulates within the system; it has a boiling point as low as minus 40°C and evaporates into gas when absorbing heat from the outside air. This gas is then compressed, increasing its heat energy, and raising its temperature to around 75°C. This is used to heat internal spaces.
- Space heating using an air source heat pump is usually provided through underfloor heating, utilising heat pump boilers located internally, or by heating the air using fan coil systems.
- This heat pump cycle is also reversible, allowing for the provision of space cooling i.e., the circulating refrigerant liquid evaporates when absorbing heat from the air within the building, and expels it into the atmosphere via air-cooled condensers.
- Consideration would have to be given to noise generation from the roof mounted condensing units.
- The final plant and equipment selection will need to incorporate noise attenuation where necessary to ensure any planning conditions stipulating external noise levels are not exceeded and the system operation does not cause nuisance to adjacent buildings.



ADVANTAGES	DISADVANTAGES
Low capital cost.	Increased use of refrigerant gas.
Increased cooling output.	Increased plant space requirements.
High efficiency.	Medium/ high running costs.
Proven technology.	Medium high maintenance costs.
	Only considered renewable in heating mode.

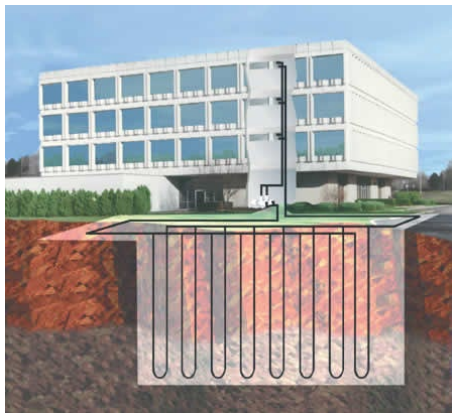
AIR SOURCE HEAT PUMP – SUMMARY TABLE	
Appropriateness of Technology to the Site/ System Viability.	System provides heating and comfort cooling to the office areas.
Lifetime and Payback.	Lifetime:15 – 20 years. Payback: No Payback.
Land Use.	External plant enclosure local to the office area to house external condensers.
Noise.	Plant noise attenuation requirements to be reviewed by the acoustic consultant and attenuation included within the design and installation as necessary to prevent noise egress.
Carbon Savings.	0.77kgCO2e/m2 @ 0.225kgCO2e/kWh carbon factor for electricity.

AIR SOURCE HEAT PUMP CONSIDERED VIABLE

TO BE INCORPORATED INTO THE DEVELOPMENT WHERE POSSIBLE

3.3.2 GROUND SOURCE HEAT PUMPS (GSHP)

- Ground source heat pumps can provide spatial heating and hot water through heat absorption. It is achieved by circulating water mixed with antifreeze through a closed collector pipework system.
- The temperature of the earth at one metre below ground level remains consistent, approximately 9 - 12°C throughout the year, depending on geographical location and soil type.
- Heart pumps are highly efficient; for every kW used to power the heat pump 3 to 4kW of energy is extracted from the ground.
- A ground source heat pump installation typically consists of a heat pump, ground collector (either a bore hole or array), a manifold, circulation pumps to move the energy around the system, various automatic and manual valves, an expansion vessel, a buffer tank to store the energy, a hot water cylinder for heating domestic hot water, and a control system.
- As heat is provided at a lower temperature than other forms of heating, it is best suited to underfloor heating applications.



ADVANTAGES	DISADVANTAGES
	Space required for the closed collector pipework system.
High efficiency.	Suitability of internal heat emitters.
	High capital cost.
	Piling or bores would be required on site.

GROUND SOURCE HEAT PUMP – SUMMARY TABLE

Appropriateness of Technology to the Site/ System Viability.	A GSHP is better suited to underfloor heating applications. Underfloor heating is not proposed for the development and would require a re-design of the heating strategy. Comparative to an ASHP there are significantly more costs associated with a GSHP. For these reasons, an ASHP is deemed preferable over a GSHP and therefore a GSHP is not considered further.
Lifetime and Payback.	Lifetime: 20 years. Payback: Not calculated as the system is not viable.
Land Use.	Minimal land use is required for geothermal bore holes. Horizontal arrays require external space for installation.
Noise.	No noise issues.
Carbon Savings.	0.77kgCO2e/m2 @ 0.225kgCO2e/kWh carbon factor for electricity.

GROUND SOURCE HEAT PUMP NOT CONSIDERED VIABLE

NOT PROPOSED TO BE INCORPORATED INTO THE DEVELOPMENT

3.4 BIOMASS HEATING

- Biomass is also known as biofuel or bioenergy; it is obtained from organic matter, either directly from plants or indirectly from industrial, commercial, domestic, or agricultural products such as logs, wood chips, pellets, etc.
- For safety and cost reasons, biomass boilers should be sized to meet a base load, with gas or oil boilers as a back-up.
- To achieve the desired output, the biomass boiler must be left running for some time.
- Heat storage provision enables the boiler to operate at a higher efficiency, as use at lower temperatures over a longer burning time is more sustainable.
- The use of biomass is generally classed as a 'carbon-neutral' process because the carbon dioxide released during the generation of energy is balanced by that absorbed by plants during their growth.
- Other factors impact upon the sustainability of biomass such as, use of fertiliser, and carbon consumed in harvesting and transportation.
- Biomass fuel prices vary depending on availability and the quantity of fuel purchased.
- Outside access to the plant room and storage is important for handling the delivered fuel, which should be appropriate to its means of transportation.
- Flues arrangements are more onerous than those for gas or oil boilers; access will also be required for ash removal.
- Sufficient fuel storage is required to cover the time between deliveries, this amount depends upon the size of the boiler and the cost and reliability of fuel supply. The fuel type also needs to be considered as logs and wood chips take up more space than pellets, for the same heat output.



ADVANTAGES	DISADVANTAGES
	Although deemed 'carbon neutral', there are still other emissions associated with biofuel such as, particulates, sulphur dioxide and nitrogen oxides.
It is a carbon neutral energy source.	Biomass is cheaper than gas, however, there are generally higher running costs.
	High capital cost.
Fuel costs are cheaper than gas.	Increased plant space requirements for storage of biomass fuel.
	Noise issues associated with biomass fuel delivery.
	Reliability of biomass heating plant.
	Availability of biomass fuel local to the development is currently unknown. Increased CO ₂ if the fuel is not sourced locally.
	Possible higher insurance premium.

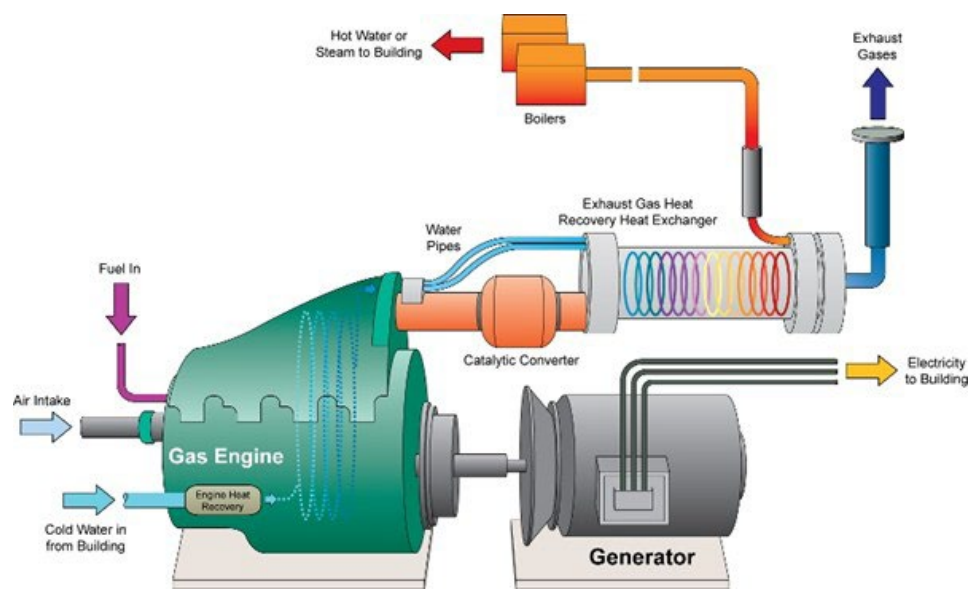
BIOMASS – SUMMARY TABLE	
Appropriateness of Technology to the Site/ System Viability.	Biomass boilers could be utilised to heat the buildings. However, although biomass can be deemed carbon neutral, there are other particulates associated with burning biomass. As such, an ASHP is deemed preferable over biomass heating and therefore a biomass heating is not considered further.
Lifetime and Payback.	Lifetime: 15 – 20 years. Payback: Not calculated as the system is not viable.
Land Use.	Biomass boiler plant and the associated fuel storage can be accommodated internally or externally depending on the availability of space.
Noise.	Possible issues associated with the delivery of the biomass fuel.
Carbon Savings.	1.66kgCO ₂ e/m ² @ 0.225kgCO ₂ e/kWh carbon factor for electricity and 0.011kgCO ₂ e/kWh carbon factor for biomass from wood pellets.

COMBINED HEAT AND POWER NOT CONSIDERED VIABLE

NOT PROPOSED TO BE INCORPORATED INTO THE DEVELOPMENT

3.5 COMBINED HEAT AND POWER (CHP)

- The principal of CHP is that a gas or oil-fired engine drives a generator which produces electricity; the heat from the engine block, oil cooler and exhaust are absorbed into a coolant which is then used as a heat source within the building.
- CHP is not considered a “sustainable energy”, but it is highly energy efficient system that makes use of waste heat from the production of electricity, and as such reduces the production of CO₂.
- The ratio of electricity to heat production is in the region of 1 unit of electricity to 2 units of heat, though this may vary between different manufacturers of combined heat and power units.
- In order to maintain its efficiency, there must be a constant requirement for the heat produced, throughout the year.
- The CHP plant should be sized to supply not less than 45% of the annual total heating demand.
- Noise associated with the operation of the CHP unit can cause nuisance; the final location of the CHP plant and the construction of the plantroom enclosure would have to be carefully considered and incorporate the necessary specification of noise attenuation to minimise noise breakout.



ADVANTAGES	DISADVANTAGES
High efficiency.	Constant heat load requirement.
	Plant location (noise and vibration).
	High capital cost.
	Increased maintenance requirements.

COMBINED HEAT AND POWER – SUMMARY TABLE

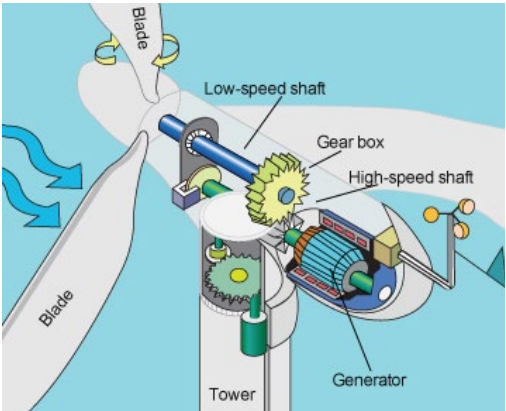
Appropriateness of Technology to the Site/ System Viability.	Heat produced by the CHP unit could be utilised to meet a proportion of the domestic hot water demand however the warehouse and office will not have a large DHW requirement and therefore the benefit of installing a CHP will be small.
Lifetime and Payback.	Lifetime: 15 years. Payback: In excess of 20 years due to lack of constant heat demand and reduced operating period.
Land Use.	CHP plant can be accommodated internally or externally depending on the availability of space.
Noise.	Plant noise attenuation requirements to be reviewed by the acoustic consultant and attenuation included within the design and installation as necessary to prevent noise egress.
Carbon Savings.	0.22kgCO ₂ e/m ² @ 0.225kgCO ₂ e/kWh carbon factor for electricity.

COMBINED HEAT AND POWER NOT CONSIDERED VIABLE

NOT PROPOSED TO BE INCORPORATED INTO THE DEVELOPMENT

3.6 WIND POWER

- Wind power can be harnessed and converted into electricity using wind turbines
- Wind turbines are commercially available in various sizes and outputs from a few hundred Watts (battery charging systems for boats and homes) to 2-3 Megawatts (wind farm turbines connected to the National Grid). However, this output is only achieved for the time that the wind is at its optimum level. As an approximate guide a good wind site will provide an average of 30% of the rated capacity of the turbine.
- Most small turbines generate a direct current (DC) and need to be connected to an inverter to convert the direct current to alternating current (AC).
- There are two main types of wind turbine systems, grid connected systems and off grid systems.
- Off grid systems incorporate batteries to store the energy produced by the turbine, an extra controller is required to ensure the batteries do not become over or under-charged. The controller diverts the electricity produced by the turbine to other electrical appliances when the batteries are fully charged (for example space and or water heaters).
- Grid connected systems do not incorporate batteries and require a controller and inverter to ensure that electricity is produced at a quality acceptable to the grid. Surplus electricity can be exported back to the electricity grid via an export meter and sold back to the electricity supply company.
- Small variations in wind speed can produce large changes in energy output. Wind speed increases with height and it is essential that the knowledge of the local wind resource is comprehensive to maximise the potential of the turbine.
- Turbines should not be located in areas where the annual mean wind speed is less than 6.5 m/s when measured at 40 m above ground level.



ADVANTAGES	DISADVANTAGES
Electricity generated without producing greenhouse emissions.	Visual impacts so require planning approval
	Noise generation.
	Small variations in wind speed can produce large changes in energy output

COMBINED HEAT AND POWER – SUMMARY TABLE	
Appropriateness of Technology to the Site/ System Viability.	Whilst the electricity generated by wind turbines could be utilised within the building to reduce the consumption of grid electricity, the wind speeds do not meet the minimum required annual wind speed and as such are not deemed viable. Wind Speeds <i>estimates from NOABL data</i> • At 10m above ground level 4.5 m/s • At 25m above ground level 5.3 m/s • At 45m above ground level 5.8 m/s Wind speed data for Rhodes Business Park (53.5432, -2.2205). (Source: NOABL wind map)
Lifetime and Payback.	Lifetime: 20 years. Payback: Not calculated as system is not viable
Land Use.	Wind turbine(s) would have to be roof mounted due to the restricted development site area.
Noise.	Noise is less likely to be an issue on this site, as the development plots lie within close proximity to the A580 dual carriageway.
Carbon Savings.	0.04kgCO ₂ e/m ² @ 0.225kgCO ₂ e/kWh carbon factor for electricity.

WIND POWER NOT CONSIDERED VIABLE

NOT PROPOSED TO BE INCORPORATED INTO THE DEVELOPMENT

3.7 PHOTOVOLTAICS (PV) AND BATTERY STORAGE

3.7.1 PHOTOVOLTAICS (PV)]

- Photovoltaics work by converting solar energy into electricity, which can then be used to power ordinary electrical equipment such as household appliances, computers, and lighting.
- PVs output in DC so, DC motors for plant and equipment need to be sourced to use the DC current, or an inverter and other equipment is needed to deliver the power to a building or the grid in AC form.
- Any number of modules can be connected together to give the desired electrical output.
- South facing PV panels, at a pitch of 35°, can produce around 150kWh/yr/m² PV of DC electrical energy or 110kWh/yr/m² PV of AC electrical energy. East or West facing panels provide approximately 80% of that yielded from a South facing panel.
- PV systems can be incorporated in various ways: on sloped roofs, on flat roofs, in facades, atria, and shading devices. Modules can be mounted using frames or incorporated into the building fabric; for example, PV roof tiles are available which can be fitted in place of standard tiles.



ADVANTAGES	DISADVANTAGES
Electricity generated without producing greenhouse emissions.	
Electricity can be sold back to the grid during periods of low demand within the building.	Large external area required to locate PV panels.
No moving parts so minimal maintenance and low maintenance costs.	PV panels will have a visual impact and would require planning approval.
Mature technology.	High capital expenditure.
Unlikely to create any noise nuisance	

PHOTOVOLTAICS – SUMMARY TABLE

Appropriateness of Technology to the Site/ System Viability.	Easily integrated and can be used alongside other LZCs. It is not influenced by the building services strategy. Requires installation of fixed building services to make best use of this technology.
Lifetime and Payback.	Lifetime: 25 years. Payback: Subject to calculation at next design stage.
Land Use.	Often installed at roof level at an incline of 15 - 45° and south facing. Structural loading may require uplift to accommodate the increased load.
Noise.	Not an issue with this type of system.
Carbon Savings.	Annual savings of 0.03kgCO ₂ e/m ² with an emission factor of 0.225kgCO ₂ e/kWh for electricity

PHOTOVOLTAICS CONSIDERED VIABLE
TO BE CONSIDERED FURTHER

3.7.2 BATTERY STORAGE

- Battery storage systems enable electricity to be released into the system when it is needed – this is often referred to as ‘load shifting’.
- Ideally, battery storage would be used to shift summer generation to the winter months. However, batteries benefit from a daily discharge cycle to aid in battery life.
- As such, a battery storage system could be used to capture excess load during the day and utilise this in the evenings.



- The main factors which impact upon the electrical consumption data are listed below:

REDUCING CONSUMPTION	INCREASING CONSUMPTION
More efficient lighting and lighting control.	Transfer office heating from gas fire to electric VRF/ ASHP with cooling provision.
Reduced area / more efficient use of space.	Provision of battery charging for staff cars.
More efficient equipment / plant / use of variable speed drives.	Increased demand / use of existing underutilised spaces.

BATTERY STORAGE – SUMMARY TABLE

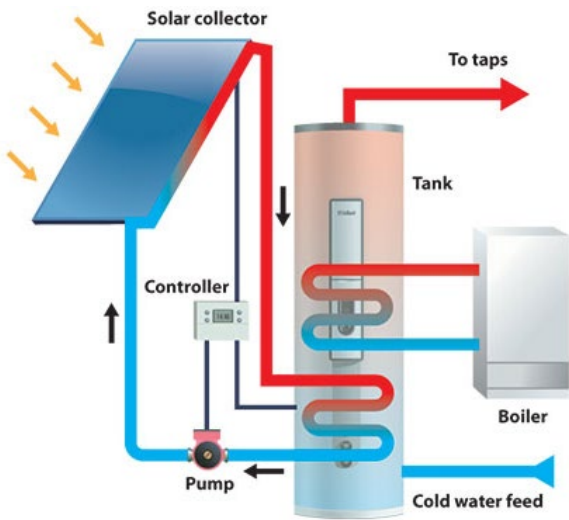
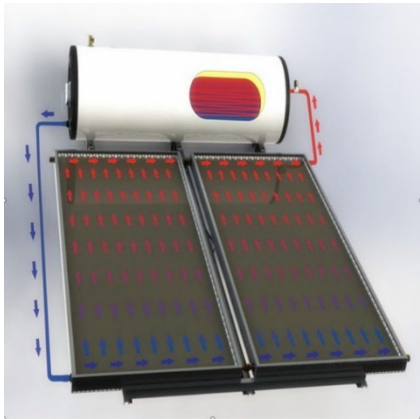
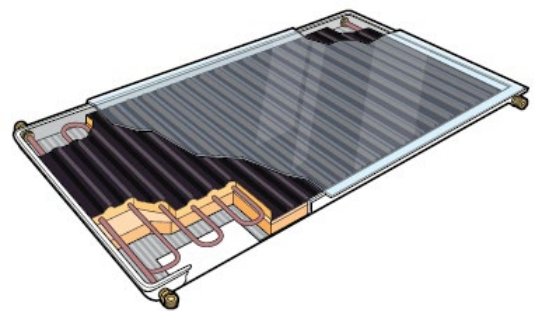
Appropriateness of Technology to the Site/ System Viability.	Although solar PV is being considered further, battery storage is not deemed to be a viable option as the amount of energy being produced by the PV is not sufficient to meet the peak load demands.
Lifetime and Payback.	Lifetime: Varies considerably depending upon how the technology is used (approx. 10 – 15 years based on lithium-ion batteries). Payback: TBC.
Land Use.	Space required to accommodate battery storage units and associated plant is dependent upon storage capacity.
Noise.	Low.
Carbon Savings.	Relative upon end usage. Energy storage systems do not produce any emissions during operation.

BATTERY STORAGE NOT CONSIDERED VIABLE

NOT PROPOSED TO BE INCORPORATED INTO THE DEVELOPMENT

3.8 SOLAR THERMAL WATER HEATING

- Solar thermal utilises heat from the sun to provide domestic hot water. It works by using thermal energy to heat an energy absorbing media, comprised of water or a water/glycol mixture, that is pumped through a solar absorbing panel usually located on the roof. The heated media is then pumped through a heat exchanger, typically to heat hot water within a storage cylinder.
- The hot water demand requirements of the building served, and size of the hot water storage vessel have a significant effect on the viability of a solar water heating system.
- The major applications for this type of system are associated with the generation of low-grade hot water, often in the range of 30°C – 50°C, dependant on the geographical location of the installation.
- There are two main options when considering solar water heating. These are either flat plate (approximately 30% efficient) or evacuated tube systems (approximately 40% efficient).
- The collector uses a refrigerant as the transfer media; this allows for higher-grade heat energy to be produced, typically 50°C – 70°C in summer.
- An evacuated solar heat pipe collector works throughout the day, but the heat it generates needs to be removed and used immediately, as long stagnation will damage collectors permanently
- Performance is directly related to the amount of light directed to the panel. Peak irradiation is achieved using South facing panels at 45 degrees inclination. Solar panels are not normally installed at less than 20 degrees inclination.
- It is possible to make the system independent by using photovoltaics to power the circulation pump or designing the manifold below the heat exchanger to eliminate the pump.



ADVANTAGES	DISADVANTAGES
More efficient than use of Solar PV.	Large external area required to locate solar panels.
Unlikely to create any noise nuisance.	Solar panels will have a visual impact and would require planning approval.
	Relatively high capital expenditure.
	Constant hot water demand is required throughout the year.
	Hot water storage plant space required local to the solar panels.

SOLAR THERMAL WATER HEATING – SUMMARY TABLE

Appropriateness of Technology to the Site/ System Viability.	The hot water generated by solar collectors could be utilised for domestic usage within the development, however the warehouse and office areas will have a low DHW demand and therefore the technology would have little impact in reducing CO ₂ emissions. Therefore, it is deemed to not be viable in this instance.
Lifetime and Payback.	Lifetime: 20 years. Payback: Not calculated as system is not viable.
Land Use.	Solar collectors generally installed at roof level, south facing at an incline of 30 - 45°.
Noise.	Not an issue with this type of system.
Carbon Savings.	Annual savings of 0.02kgCO ₂ e/m ² with an emission factor of 0.225kgCO ₂ e/kWh for electricity

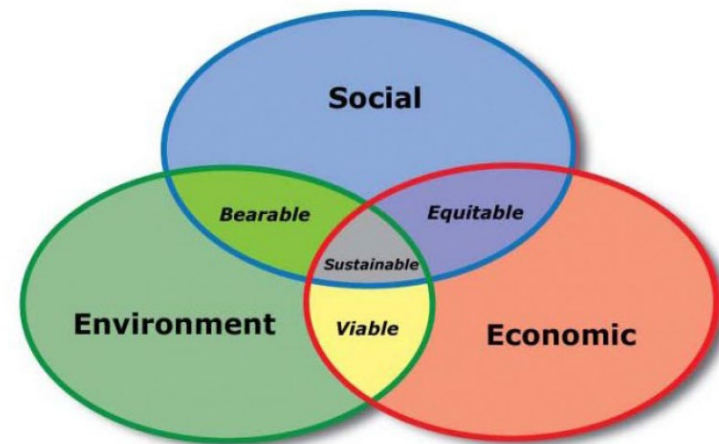
SOLAR THERMAL WATER HEATING NOT CONSIDERED VIABLE

NOT PROPOSED TO BE INCORPORATED INTO THE DEVELOPMENT

4 CLIMATE CHANGE

Climate change is the long-term shift in average weather patterns across the world. It is believed that the current, sudden, and extreme changes in global climate are a result of anthropogenic climate change in the form of industrialisation, intensive farming and fossil-based transportation.

The development will utilise the Three Pillars of Sustainability to maximise the interaction of environmental, social and economic performance thus creating a sustainable development.



Three Pillars of Sustainability

The Sustainable Development Goals (SDGs) provide a blueprint to foster a sustainable future on a global scale and are formed of 17 global goals set by the United Nations General Assembly.

The 17 SDGs contain 169 targets, many of which are both intertwined and independent of each other. This enables the goals to be achieved on a large scale and at a local level. The local level goals began in 2016 with a process often called "Localizing the SDGs."



17 Sustainable Development Goals

4.1.1 DESIGN FOR FUTURE THERMAL COMFORT

Dynamic thermal modelling will be undertaken using a future weather scenario in order that the developments is attenuated for the predicated temperature changes associated with climate change. The thermal model will be simulated to demonstrate that summer and winter operative temperature ranges in occupied spaces are in accordance with the criteria set out in CIBSE Guide A Environmental design. The projected climate change environment is assessed using external climatic conditions specific to the geographic location of the development and uses industry standard weather data for the UK which is provided by CIBSE.

4.1.2 ADAPTATION TO CLIMATE CHANGE

Consideration will be given to the production of a climate change adaptation strategy following a systematic risk assessment to identify the impact of expected extreme weather conditions arising from climate change on the building over its projected life cycle. The assessment will cover the installation of building services and renewable systems, as well as structural and fabric resilience aspects.

Following this assessment, a number of recommendations or solutions based on the climate change adaptation strategy appraisal will be developed.

4.1.3 SURFACE WATER MANAGEMENT

The development will aim to incorporate surface water management techniques that are attenuated for predicted climate change events. Where possible the drainage measures will be designed so that the peak rate of run-off from the site to the watercourses (natural or municipal) shows a 30% improvement for the developed site compared with the predeveloped site. This should comply with the climate change scenario of 1-year and 100-year return period events.

4.1.4 GREENHOUSE GAS EMISSIONS

To reduce the level of greenhouse gas emissions arising from the leakage of refrigerants from building systems, the incorporation of refrigerants with a low global warming potential (GWP) will be considered. Systems using refrigerants will be analysed to determine if a DELC of $\leq 1000\text{kgCO}_2\text{-eq/kW}$ cooling and heating capacity is practicable.

5 CONCLUSION

This report assessed the feasibility of incorporating both Low and Zero Carbon design principles and technologies for Rhodes Business Park.

5.1 BREEAM UK NEW CONSTRUCTION 2018

The proposed development is targeting a minimum standard of BREEAM 'Very Good'.

As such a minimum BREEAM score of 60% should be targeted to provide a 5% buffer above the minimum BREEAM 'Very Good' score of 55%.

5.2 LOCAL PLANNING REQUIREMENTS

The Policies covered in Section 1.1 were considered as part of the report.

5.3 LOW CARBON DESIGN PRINCIPLES

This report considered the following low carbon design principles:

- Passive Measures.
 - Exploration of orientation on performance.
 - Building Fabric
 - Reduced air permeability.
 - Maximising daylighting.
- High Efficiency Systems.
 - Energy efficient lighting.
 - Energy efficient vertical transportation including use of regenerative drive and variable speed drivers.
 - Use of heat recovery systems.
 - Reducing the volume of water used in sanitaryware.
- Electric Vehicle Charging (EVC).
- Cycle Storage.

It is considered that low carbon design principles are viable and to be implemented into the development where appropriate.

5.4 LOW AND ZERO CARBON TECHNOLOGIES

This report considered the following low or zero carbon technologies:

- District Heat Network.
- Air Source Heat Pumps (ASHPs).
- Ground Source Heat Pumps (GSHPs).
- Biomass Heating.
- Combined Heat and Power (CHP).
- Wind Power.
- Photovoltaics and Battery Storage.
- Solar Water Heating.

Of these, the most suitable LZO technology for possible incorporation into the proposed development would be Air Source Heat Pumps and Photovoltaics.

The other renewable energy technologies investigated are not considered to be viable options due to the development's location, space limitations, fiscal restraints, and technology payback period.

5.5 CLIMATE CHANGE

This report considered the following climate change design principles:

- Design for future thermal comfort
- Adaptation to climate change
- Surface water management
- Greenhouse gas emissions

It is considered that climate change design principles are viable and to be implemented into the development where appropriate.

