CGP | MEP

JOHN COTTON GROUP PROPOSED DEVELOPMENT

Low Carbon Energy Approach

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DOCUMENT CONTENT

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SECTION A - EXECUTIVE SUMMARY

A.1 Executive Summary

This report reflects the sustainable design and construction philosophy to support a planning application for the proposed warehouse construction at Leeds Road, Mirfield, WF14 0BT.

Above: Proposed Site

This high-quality development has placed strategic importance on its sustainable design and energy efficient features, and will aim to reduce impact upon the existing environment, it will also help to meet the strong growth in demand for this type of building, with strong collaboration between both client and project team sharing a collective long-term strategy in sustainable, responsible and efficient design standards for the benefit of building users and the local community.

This report establishes how the proposed development will achieve compliance with Building Regulations and Local Authority requirements. This has been achieved by following best practice procedures of the Energy Hierarchy: reduced energy use and improved building performance, centralised heating and cooling systems and use of low or zero carbon technologies.

We are adopting a fabric first approach to significantly reduce the energy consumption adopting better than notional fabric performance as highlighted further in this report. This coupled with use of LZC technology Air Source Heat Pumps to provide the heating and hot water needs. These measures ensure we meet Building Regulations.

Based on the robust energy hierarchy approach, the development will exceed the required CO2 reduction against the Target Emission Rate (TER) hence complying with Building Regulations and planning policies:

- Kirklees Council Policy LP24 – Design
- Kirklees Council Policy LP26 – Renewable and Low Carbon Energy
- Kirklees Council Policy LP34 – Conserving and enhancing the water environment

A1.1 Reducing carbon emissions through energy efficiency measures

To maximise the energy efficiency of the development and thus reduce the energy demands, the following design principles and features have been incorporated:

- Building fabric elements and glazing specifications improved over and above Building Regulation requirements;
- Reduced air permeability;
- Specification of efficient heating services and control systems;
- Energy efficient lighting and controls throughout the development;
- Water efficient sanitary fittings.

A1.2 Reducing carbon emissions through district heating measures

The inclusion of a site wide heating system was investigated. Potential options at the site included either connection to an area wide low carbon heat distribution network, a site wide heat network or a Combined Heat and Power (CHP) system. It is considered that the installation of either of these options is not practicable for this development and there isn't a current network available for connection.

A.1.3 Reducing carbon emissions through LZC measures

A low or zero carbon (LZC) technology feasibility study has been carried out as part of this Sustainability Assessment. This study compares the feasibility of different technologies. Based on this, it was identified that the most appropriate technology for the development to assure the sustainability and energy efficiency is the installation of an air source heat pump system to achieve a reasonable reduction in regulated CO_2 emissions from on-site renewable sources.

Based on the robust approach to the energy hierarchy, the development will exceed the required sustainability and energy targets required by Kirklees Council for the planning application.

Additionally, the adaptation measures for wider sustainable design and energy efficiency issues have been investigated, including water stress, extreme temperatures and district heating.

SECTION B – POLICY OBJECTIVES

B.1 POLICY OBJECTIVES

The relevant authority for this site is Kirklees Council. The requirements of this Council and other relevant authorities have been taken into account within the preparation of this Sustainability Statement. The key planning framework applicable to the energy aspects of the development is outlined below:

B.1.1 National Level Policies

There are a number of national policies and regulations related to energy; those most relevant to the energy assessment of new developments are detailed below.

National Planning Policy Framework – NPPF

The National Planning Policy Framework (NPPF) was published in March 2019, and superseded the former planning policy statements (PPS) documents. The NPPF is designed to make the planning system less complex and more accessible; to protect the environment and promote sustainable growth. It provides a framework within which local people and their respective councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

At the heart of the National Planning Policy Framework is a presumption in favour of sustainable development. The three dimensions of sustainable development can be defined as the economic, social and environmental.

There are twelve core planning principles in the NPPF. Within these, there is a strong support for the transition to a low carbon future in a climate change context, taking full account of a number of different factors. There is also an aim to contribute to conserving and enhancing the natural environment and reducing pollution.

The NPPF aims to strengthen local decision making, with the use of decision-taking in a positive way, as a means of fostering the delivery of sustainable development.

However, the NPPF also highlights that pursuing sustainable development requires careful attention to the viability and costs in plan-making and decision-taking. Plans should be deliverable. Therefore, the sites and the scale of development identified in the plan should not be subject to such a scale of obligations and policy burdens, that their ability to be developed viably is threatened.

Climate Change Act 2008

The Government has introduced legislation and a number of policies during recent years focusing on the reduction of CO_2 emissions. The Climate Change Act (2008) sets a legally binding target for the reduction in UK carbon dioxide emissions. Upon ratification of the Kyoto Protocol, the UK committed to a reduction in its CO_2 emissions by 80% compared to 1990 levels (by 2050). In addition, under the Climate Change Act an interim target of a 34% reduction by 2020 was set.

In order to enforce these targets, the Government is using the Building Regulations: Part L 2021 – (Conservation of fuel and power) which set the standards to which all new and existing buildings must comply.

Building Regulations 2021 Part L

Building Regulations are statutory instruments that seek to ensure that the policies set out within any relevant UK legislation are carried out. Building regulations approval is required for the majority of building work carried out in the United Kingdom.

Part L of these regulations covers the requirements with respect to the conservation of fuel and power in all building types. It controls the insulation values of building fabric elements and openings, the air permeability of the structure, the heating efficiency of heating, ventilation and air conditioning systems together with hot water storage and lighting efficiency. It also sets out the requirements for calculating the carbon dioxide emissions and the Carbon Emission Targets for each building type.

Part L is split into four sections:

- L1 Dwellings;
- L2 Buildings other than Dwellings;

Due to the development being of a commercial type the proposed development needs to comply with Part L2.

B.1.2 Regional Level Policies

LP24 – Design

Good design should be at the core of all proposals in the district and should be considered at the outset of the development process, ensuring that design forms part of pre-application consultation of a proposal.

Development briefs, design codes and masterplans should be used to secure high quality, green, accessible, inclusive and safe design, where applicable.

Where appropriate and in agreement with the developer schemes will be submitted for design review.

LP26 – Renewable and Low Carbon Energy

Renewable and low carbon energy proposals (excluding wind) will be supported and planning permission granted where the following criteria are met:

a. the proposal would not have an unacceptable impact on landscape character and visual appearance of the local area, including the urban environment;

b. the proposal would not have either individually or cumulatively an unacceptable impact on protected species, designated sites of importance for biodiversity or heritage assets;

c. the statutory protection of any area would not be compromised by the development;

d. any noise, odour, traffic or other impact of development is mitigated so as not to cause unacceptable detriment to local amenity;

e. any significant adverse effects of the proposal are mitigated by wider environmental, social and economic benefits.

Where the above criteria are met, the council encourages dialogue with local community groups promoting community renewable and low carbon energy schemes.

B.1.3 General Guidance

Climate Change Adaptation

All developments should be fit for purpose and remain so into the future. Proposals for major development are required to set out in a sustainability statement how they have incorporated adaptations for a changing climate and changing weather patterns in order to avoid increased vulnerability and offer high levels of resilience to the full range of expected impacts.

Climate change mitigation, decentralised, renewable and low carbon energy

The development of low and zero carbon and decentralised energy, including (C)CHP distribution networks, is strongly supported and encouraged.

New buildings must achieve a reasonable reduction in carbon emissions measured against the relevant Target Emission Rate (TER) set out in the Building Regulations 2021) (Part L). This should be achieved through the provision of appropriate renewable and low carbon energy technologies on site and/or in the locality of the development and improvements to the energy performance of the building.

Where it can clearly be shown that this is not possible, offsite offsetting measures in line with the energy hierarchy should be delivered.

The energy hierarchy	**The waste hierarchy**
Step 1: Eliminate energy need Developments should be designed to eliminate the need for energy through measures including: ▪ design of the scheme layout ▪ thermally efficient construction methods and materials • design features that eliminate the need for appliances • making optimal use of passive heating and cooling systems **Step 2: Use energy efficiently** Developments should incorporate energy efficient systems, equipment and appliances to reduce the remaining energy demand. Energy storage devices may improve efficiency. **Step 3: Supply energy from renewable and low carbon sources** The remaining energy need should be met from renewable and low carbon sources. **Step 4: Offset carbon emissions** As a final step, remaining emissions should be offset, for example through off-site measures that reduce carbon emissions or remove carbon from the atmosphere.	**Step 1: Eliminate waste** Construction practice and design should reduce waste wherever possible through measures including: • efficient procurement avoiding oversupply and excessive packaging • eliminating waste at the design stage. **Step 2: Reuse waste materials** Reuse waste materials, ideally in its current location, avoiding the energy costs associated with transport and recycling. **Step 3: Recycle/compost waste materials** Recover materials through recycling and substitute for primary materials. Compost organic material to produce rich soils that replace fertilisers, ideally in a closed system to avoid the emissions released by organic material in landfill. **Step 4: Recover energy** If it cannot be reused or recycled, use waste instead of fossil fuels in energy generation to recover embodied energy. **Step 5: Disposal to landfill** Usually the last resort. Disposal to landfill wastes materials and embodied energy.

SECTION C – ENERGY EFFICIENCY

C.1 Energy Efficiency

Eliminating energy need and minimising energy use through design has been factored in from the beginning of the design process. A number of architectural and building fabric measures (passive design) and energy efficient services (active design) have been explored and further explanations have been provided below clarifying which measures will be adopted and integrated into the design, and why it is not feasible to incorporate certain measures into the proposed development.

C.2 Building Fabric

New buildings are currently subject to Building Regulations requirements on energy efficiency which are set out in the 2021 edition approved document L2. This requires that new buildings meet a minimum Target Emission Rate (TER) for CO_2 emissions.

For the proposed building, improvements on the minimum values have been proposed to minimise operational energy use and carbon dioxide emissions, as well as further exceed Part L requirements. The table below demonstrates that fabric elements for the proposed building will surpass both the minimum Building Regulation standards and the Notional Building values. The final U-values are still subject to further energy modelling results and might be improved, if required, to comply with Building Regulations and Local Policies.

U-values (W/(m^{2}K))	Building Regulations Part L (max)	Notional Building
Roof	0.18	0.15
Wall	0.26	0.18
Curtain wall	2.2	1.6
Floor	0.18	0.15
Doors	1.6	1.6
Glazing elements/rooflight (including frame)	1.6	Windows U-Value=1.4; G-Value=0.4

Table 1: Comparison of building fabric parameters for Part L 2021 and the proposed design standards.

It should be noted that in buildings with high internal heat gains and long occupancy hours, similar to the proposed building, the effect of insulation on total energy use and occupant comfort should be carefully evaluated. It is recognised that low U-values are beneficial for winter periods as they prevent heat loss, however it's a delicate balance as increased thermal performance and air tightness can also lead to internal overheating issues which is currently a wide spread problem in the UK construction industry. In many cases over-insulation of the building retains high amounts of warm air, limits air extraction and leads to higher internal temperatures – in most cases creating an increased need for mechanical cooling systems.

C.3.1 Glazing

Low U-values for glazing are as important as low U-values for fabric elements. Building design will utilise low U-value glazing in order to diminish heat losses over the winter period.

The proposed building design will include glazing with a U-value lower than the Building Regulation minimum value of 2.2 W/(m^2K), and lower than the Notional Building value of 1.6 W/(m^2K).

A low g-value glazing (0.4) will be utilised for the glazing elements to reduce solar gains.

C.3.2 Thermal bridging

As per minimum Building Regs requirements, the building fabric will be constructed so that there are no reasonably avoided thermal bridges in the insulation layers caused by gaps within the various elements, at the joints between elements and at the edges of elements such as those around window and door openings. Non-repeating thermal bridge heat losses for each element will be allowed for by a method that satisfies BS EN 14683 and Part L Building Regulations.

C.4 Air Permeability

The air tightness of a building impacts on its energy consumption and hence the CO_2 emissions. The lower the air tightness, the more heated warm air is retained within the occupied spaces of the building, therefore less energy is required to heat the building in winter. Part L of Building Regulations identifies that air permeability of less than 10m^3/hr per m^2 @ 50Pa should be achieved. However, as 'a rule of thumb' it is usually necessary to make improvements on the statutory limit to achieve CO_2 emissions compliance. A new build should generally target a value no higher than 5m^3/hr per m^2 @ 50Pa.

C.5 Building Services

In addition to upgrading the insulation and air tightness standards, it is important that the energy used within the building is efficient. Therefore, the building services systems should be designed to optimise the efficiency of the systems by matching installed capacity to anticipated building demand. Items of equipment, which make up the building's building services installation, will be specified to achieve high annual energy efficiency in operation and will be regularly serviced to maintain their performance. Please note that all systems have efficiencies and controls which will meet or exceed the requirements of Non-Domestic Building Services Compliance Guide.

C.5.1 Internal lighting systems

The project team will incorporate energy-efficient LED lighting for the proposed building. According to the non-domestic building services compliance guide, the average initial efficacy should be not less than 110 luminaire lumens per circuit watt. Currently, the proposed lighting represents an improvement over and above the 2021 Part L Building Regulations with 120 luminaire lumens per circuit watt (Lm/W) as a minimum.

Energy efficient LED lighting in combination with lighting controls will be used throughout the proposed buildings, as opposed to merely standalone LED lighting. Lighting control systems will include daylight sensing and PIR (passive infrared sensors) detection to assure that the energy use and associated carbon emissions of the building lighting installation are as low as possible.

C.6 Responsive Heating Controls

One of the most cost-effective ways to reduce fuel is to use responsive heating / weather controls. These controls are an electronic energy management system that utilises a computer chip to balance heating system water temperature with outdoor temperature. By constantly measuring outside temperature, controls determine the optimum temperature needed to heat the building. The controls possess a sensor on the north side of the building and a sensor mounted at the boiler/heating system to sense water temperature. Additional sensors can also be incorporated into the system to detect internal heat gains from solar or extreme heat losses.

These systems are still to be to fully investigated during the detail design stage but the potential advantages of these technologies could lead to further efficiencies within the energy strategy.

C.7 Building Management Systems

Energy metering systems will be installed enabling at least 90% of the estimated annual energy consumption of each fuel type to be assigned to the various end-use categories of energy consuming systems. The energy consuming systems will be monitored using an appropriate energy monitoring system, such as a Building Management System (BMS) as feasible.

C.8 Energy Storage

Energy storage works by capturing electricity produced by both renewable and non-renewable resources and storing it for discharge when required. The solution allows users to come off the grid and switch to stored electricity, at a time most beneficial, giving greater flexibility and control of electrical usage.

Energy storage can efficiently smooth out the supply from the energy sources to provide a more reliable supply that matches demand. This allows organisations to maximise renewable generation, therefore energy storage can play an integral role in a business' journey towards carbon neutrality.

At times of unexpected increases in demand on the grid, energy storage can be used to discharge power back to the electrical supply network very quickly to provide additional supply to help meet demand. By businesses contributing to this process of balancing the demand it alleviates the pressure from the grid and for this assistance contracts are offered.

Energy storage can also provide flexibility in electricity supply and opportunities for significant cost savings by enabling a switch to stored electricity during peak-tariff periods. It eliminates the risk of network interruption by providing full UPS capabilities, reducing the likelihood of energy related failures which can total as much as 17% of annual revenues and maximises the investment into renewable generation.

The design team will investigate the potential of this technology at further design stages.

C.9 Water Efficiency

In England the average person uses about 150 litres of water a day for a range of uses including sanitation, where significant savings are possible. Given that climate projections forecast half as much rainfall in summer in the South East of England by 2080, it is important to build water efficiency in to our building stock and minimise the need for major infrastructure enhancements to meet these pressures as well as growing demands. Under these scenarios and with the expected high population growth, deficits are expected to be already widespread by the 2050s. The UK is expected to be in deficit by up to 16% of the total water demand in the 2050s and of up to 29% in the 2080s leading to major impacts on cost and resource levels.

As per the local planning policies, the fittings below (Table 3) will be procured to meet a water consumption figure of no more than 110 litres/person/day:

WATER FITTING	MAXIMUM CONSUMPTION
WC	4/2.6 litre dual flush
Shower	8 litres/min
Bath	170 litres
Wash hand basin taps	5 litres/min
Sink taps	6 litres/min
Dishwasher	1.25 litres/place setting
Washing machine	8.17 litres/kilogram

Table 3: Proposed water efficient fittings.

Rainwater harvesting or greywater recycling is not proposed as part of this development, as the required level can be achieved through efficient fittings. There are no major water consuming external areas with simple planting, which reduce the need for potable water to be used externally.

C.10 Orientation and Layout

Visual comfort is an important part of ensuring building occupant health, comfort and wellbeing. Maximising exposure to natural daylight and providing an external view out provides users with a connection to nature. This can in turn support mental wellbeing, for example by improving people's mood and reducing the symptoms of depression. Increasing the level of daylight within the building also reduces the need for artificial lighting, which can reduce operational costs and environmental impacts of the building. Further to this, naturally lit environments increase occupant productivity and support the regulation of circadian rhythms. For these reasons, a good level of daylight through the windows will be provided.

Wherever appropriate within the development, buildings should be oriented facing south to allow best exploitation of sunlight while allowing effective control of solar gains in summer. For this reason, the areas with largest glazing should be facing east, south and west to receive beneficial sunlight and heat gains, which will help reduce the heating energy in the winter.

C.11 Use of Materials

The use of construction products leads to a wide range of environmental and social impacts across the life cycle through initial procurement, wastage, maintenance and replacement. Taken together, construction products make a significant contribution to the overall life cycle impacts of a building. In some cases, they may even outweigh operational impacts (such as energy consumption).

Surface materials that are often used for landscaping and paving, and even the external finishes of surrounding buildings can affect the temperature of the surrounding air. Hard and dark coloured materials like concrete, brick and macadam have the tendency to absorb the sun's energy and heat generated during the day and re-radiate this at night. As a result of this, the night-time air temperature remains high. The building's finishes colour will be selected so as not to significantly contribute to urban heat island effect.

All materials specified will be of a robust and durable nature. A detailed assessment of the maintenance and end of life strategies will be considered for material components at risk of damage, heavy use and exposure to weather conditions.

C.12 Climate Change Adaptation

The proposed development will be fit for purpose and will remain so into the future due to the measures denoted below.

An increase of hotter summers/heat waves could lead to increases in internal temperature of the building and potentially have an impact on thermal comfort of the occupants. The technical control measure for this risk will be in place with ventilation units in most areas.

Additionally, the risk of overheating will be controlled through a number of passive and active design measures. Passive: the proposed building will incorporate effective low G-Value glazing, which will considerably decrease solar radiation. Active: as mentioned, ventilation units to be incorporated, ensuring the building temperature remains comfortable from January, right through to December.

The overheating model, will cover Current and Future Climate comfort modelling. This will be further evidenced by TM52 analysis to be carried out.

An increase of droughts and reduced water availability could lead to restrictions on water availability and usage. The technical control measure for this risk will be in place through a specification of water efficient equipment including low flow sanitary fittings. Metering of incoming water supply will also be provided to quantify the amount of water used and means to reduce this usage. Water leak detection with automatic flow shutoff will be provided.

SECTION D – DECENTRALISED ENERGY

D.1 Decentralised Energy

Connection to a de-centralised energy network and the use of combined heat and power is a recognised method of generating energy more efficiently.

D.2 Heat Network

Consideration was given to the possible connection to an existing or proposed area wide decentralised energy network. The UK CHP Development Map is an interactive tool, using an interactive GIS system, which allows users to identify opportunities for decentralised energy projects in the UK. This tool details the existing heat loads and supplies within the UK as well as existing heat distribution networks.

Following a review of Heat Map, it has been established that there are currently no existing district heating networks located in the vicinity, that the proposed development could link to (see Figure 1 below).

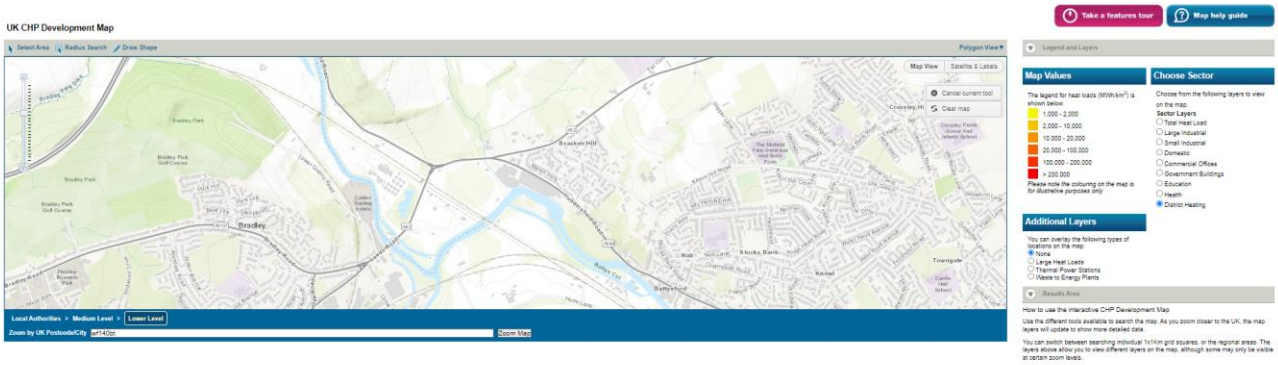

Figure 1: District Heating connections.

As a result of a comprehensive research, it can be concluded that at this stage no firm plans exist for this particular focus area to confirm the timescale for the potential network. Thus, as there is no heating network in the area to connect to and it is unclear when any potential networks will be completed, the proposed development will not be connected to the district heating network.

D.3 Combined Heat and Power (CHP)

The installation of a Combined Heat and Power (CHP) unit for the development has also been considered. CHP units can achieve considerable savings in CO_2 emissions when installed and utilised correctly. To maximise the performance of a CHP, long operating hours are required and the heating demand of the development needs to match the power generation. According to the 'rule of thumb' non-residential developments with simultaneous demand for heat and power of less than 5,000hrs/yr are not expected to install on-site CHP.

The use of CHP for the development will be considered further as the project develops.

SECTION E – LOW AND ZERO CARBON TECHNOLOGIES

E.1 Low and Zero Carbon Technologies

This section discusses the feasibility of using low and zero carbon (LZC) technologies for the proposed scheme.

In order to address the local planning requirement for the integration of LZC technologies on site, the installation of the technologies mentioned below has been investigated.

E.1.1 Biomass Boiler – Not Likely

A biomass system designed for this development would be fuelled by wood pellets due to their high energy content. Wood pellets also require less volume of storage than other biomass fuels, require less maintenance and produce considerably less ash residue.

A biomass system would not be an appropriate low-carbon technology for the site for the following reasons:

- The burning of wood pellets releases substantial amount of NOx emissions. This would significantly reduce the air quality of the site which is located in an urban environment.
- Storage and delivery of wood pellets would be difficult due to the site constraints and the lack of local biomass suppliers. Pellets would have to be transported from elsewhere in the UK.

E.1.2 Biomass CHP – Not Likely

For the size of system required for this development, a biomass CHP is still in its infancy and brings several financial and technological risks. Therefore, this option is not considered feasible.

For the reasons listed above, biomass is not considered feasible for this development.

E.1.3 Wind Energy – Not Likely

Due to the limited space on site, building-integrated turbines would be most suited to the development, as opposed to stand alone turbines.

Based on the current design of the development, any roof-mounted wind turbine would need to be located above the highest residential studios. Therefore, only one turbine could be installed on site. This results in very low CO_2 savings. In addition, a roof-mounted wind turbine would have a significant visual impact.

In urban areas the efficiency of wind turbines is limited due to reduced wind speeds (less than 5m/s), thereby reducing the ability of the wind turbines to operate efficiently.

For these reasons, wind turbines would not be feasible for this project.

E.1.4 Solar PV-T Panels – Not Likely

PV-T panels combine two well established renewable energy technologies, solar photovoltaics (PV) modules and solar thermal collectors, into one integrated component that removes generated heat from the Solar PV thereby improving electrical efficiencies.

Typically installed as a roof mounted technology, heat is extracted by either passing air or a liquid across the back of the panel, essentially drawing the heat away as it is generated and transferring it either indirectly (e.g., into a domestic hot water cylinder or space heating circuit) or directly (e.g., direct air space heating).

Combining solar photovoltaic and thermal energy generation into a single hybrid system offers many benefits. You can have a single solar system that delivers both electricity and hot water, that saves available roof space, if a solar PV system for electricity generation and a thermal system for hot water generation are considered. Furthermore, Solar PV panels are at their most efficient in cooler temperatures. When outdoor temperature begins to head over 25°C, the output system can drop by 0.5% for each degree. As solar thermal panels are designed to capture this heat, they act as a cooling circuit which increases the efficiency of the renewable electricity generation. Finally, Solar PV and solar thermal panels are very low maintenance and the same goes for solar PV-T systems too.

There aren't as many solar PV-T panels available on the market as there are solar PV and solar thermal but there are several options available. Some of the leading Solar PV-T panels include the following:

<u>PowerTherm</u>

- Prioritising thermal output, a PowerTherm solar panel can produce around 80% of a conventional flat plate solar thermal panel but also generate electricity.
    - Thermal output of 680W
    - Electricity output of 180W
    - Panels measure 870 x 1640 x 105mm and weigh 34.4 kg
    - Mono-Crystalline technology

<u>PowerVolt</u>

- PowerVolt panels focus on electricity generation while also producing hot water. In its optimal position, PowerTherm panels are capable of producing up to 25% more electricity each year than a conventional solar PV panel thanks to cooled PV cells.
    - Electricity output of 200W
    - Thermal output of 630W
    - Panels measure 828 x 1601 x 90mm and weigh 24.4 kg
    - Mono-Crystalline technology

<u>SolarAngel</u>

- SolarAngel PV-T panels are slimline and can be integrated into the roof so they won't detract from the rest of the development. SolarAngel panels focus on electricity generation and can produce up to 20% more electricity than Solar PV panels while also contributing to the hot water generation.

This technology is not currently considered for inclusion within the scheme but will be reviewed as the design of the domestic hot water system is developed.

E.1.5 Photovoltaic Panels – Likely

Four types of solar cells are available at present; these are mono-crystalline, poly-crystalline, thin film and hybrid panels. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

This technology is considered to be installed in the proposed development's roof to contribute to the energy generation from renewable energy sources and aid the council's carbon reduction commitment.

E.1.6 Solar Thermal Panels – Not Likely

Solar thermal arrays include evacuated tubes and flat plate collectors. Evacuated tubes are more efficient, produce higher temperatures and are more suited to the UK climate when compared to flat plate collectors. Evacuated tubes tend to be more costly than flat plate collectors.

The use of solar thermal for this development would be limited to domestic hot water only. The use of solar thermal for space heating would not be practical as it is not required when solar thermal is most effective (during the summer months).

Solar thermal arrays would require additional plumbing which is likely to incur additional financial costs and solar PV would likely offer greater CO_2 emission reductions with the same area. Solar thermal technology and PV panels are in direct competition for the same roof space.

For these reasons, solar thermal technology would not be the most feasible option for the proposed development.

E.1.7 Ground Source Heat Pumps (GSHP) - Not Likely

A ground source heat pump system for the site would include a closed ground loop where a liquid passes through the system, absorbing heat from the ground and relaying this heat via an electrically run heat pump within the building.

A ground source heat pump system would deliver space heating through a low temperature efficient distribution network such as underfloor heating. The installation of ground source loops significantly increases the construction time and adds to the capital cost of the project.

The site is constrained with little room for a shallow ground source heat pump. Deep bore hole ground source heat pumps require a long-term balance of heating and cooling to avoid a long-term altering of the ground temperature and a resulting long-term decline in system efficiency. As the development is predominantly domestic, the demand for heating and cooling are not balanced. Demand for space heating and water heating is predicted to be an order of magnitude higher than demand for cooling.

A GSHP system on this site would not deliver substantial carbon savings per unit of cost in comparison to other renewable strategies, such as ASHP

For this reason, GSHPs would not be feasible for this development.

E.1.8 Air Source Heat Pumps (ASHP) – Likely

Air source heat pumps (ASHPs) employ the same technology as ground source heat pump (GSHPs). However, instead of using heat exchangers buried in the ground, heat is extracted from the external ambient air.

Air source heat pumps use fuel efficiently compared to the gas-powered systems and have a relatively low capital cost. Additionally, this type of system is beneficial for this type of development as this technology can provide both heating and cooling, depending on the indoor conditions required.

For these reasons, this technology will be considered for this development.

SECTION F – CONCLUSION

F.1 Conclusion

This report reflects the sustainable design and construction philosophy for the proposed site at Leeds Road, Mirfield.

This report denotes how the proposed development will achieve compliance with Building Regulations, and National and Local Authority requirements. This has been achieved by following best practice procedures of the Energy Hierarchy: improved building performance and the use of low or zero carbon technologies.

Based on the robust approach to the energy hierarchy, the development will exceed the required sustainability and energy targets.

Additionally, the adaptation measures for wider sustainable design and energy efficiency issues have been investigated, including water stress, extreme temperatures and district heating.