



RIDGE

Energy Strategy Report
Fusion Students
Deansgate
16th December 2020

ENERGY STRATEGY FUSION STUDENTS, DEANSGATE SOUTH



DEANSGATE SOUTH MANCHESTER

16th December 2020

Prepared for

Fusion Manchester DevCo Ltd

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1. INTRODUCTION

Fusion Manchester Dev Co Ltd commissioned Ridge & Partners LLP to undertake an Energy Strategy Study and report to support the planning application for a 28-storey purpose-built student accommodation building (Sui Generis)

The purpose of the statement is to summarise the relevant policies both National and Local and demonstrate the ways Ridge & Partners have reviewed various options to promote policies set out in this report and subsequent design.

The report should be read in conjunction with the BREEAM pre-assessment.

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2. DEVELOPMENT PROPOSALS

2.1. Description of Development Site

The site is located in Manchester at the junction of the A56 and Deansgate and is an existing brown field site with previous uses.



There are existing developments surrounding the site with an 8-storey residential apartment block directly to the north east of the site.

The site has all major services (gas, water, telecoms and electricity) within the surrounding roads (refer to appendices) but none of these services presents any risk in terms of requiring diverting or disconnections to develop the project.

The proposed site is approximately 0.06ha and sits at the junction of Deansgate South, Bridgewater Viaduct (A56) and Chester Road.

Key Attributes:

- Site is currently vacant and being temporarily employed as works area for the adjacent Deansgate Square development
- Surrounding area is primarily made up of residential and commercial buildings, notably the Deansgate Square development, which is currently under construction
- Site sits less than a mile of Manchester Metropolitan University's main campus and 0.5 mile from the Edge Hill and Arden Universities
- Current Planning Policies highlight the area as somewhere where development is to be encouraged

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2.2. Development Proposals

The submission is for a 28 storey purpose built student accommodation build (Sui Generis)

The proposed design seeks to:

- Regenerate a prominent city plot, optimising its development potential
- Provide a provision for Student Accommodation and both internal and external amenity spaces
- Introduce a new scheme which benefits the surrounding areas and supports existing employment and amenities
- Improve the approach and experience of a key gateway site into Manchester City Centre
- Provide a proposal that is deliverable and responds to the site constraints
- Demonstrate a high-quality of design throughout all elements and scales of the scheme
- Take a considered approach to access and inclusivity including consideration of connectivity to surrounding areas
- Provide a positive contribution to the streetscape, activating the frontages to Deansgate South and the Bridgewater Viaduct, including improvements to the adjacent Public Realm

Key considerations:

The key considerations addressed and explored throughout the design process:

- Provide a design that address relevant National Regional and Local planning policies
- Develop a building design that address the interests of Local Stakeholders, reflecting the aspirations of both Fusion Students and the City of Manchester
- Minimise operational/running costs through good, sustainable design
- Provide a high-quality provision of amenity space, including external landscaped areas

3. GOVERNMENT POLICY

3.1. Energy Hierarchy

In line with the draft definition of zero carbon an energy hierarchy has been created (see figure 1 below). Under Policy EN4 developers will initially be expected to secure high levels of energy efficiency and low energy demand. This is followed by the incorporation of on-site measures where these exist, such as zero carbon energy technologies and directly connected heat (not necessarily on-site).

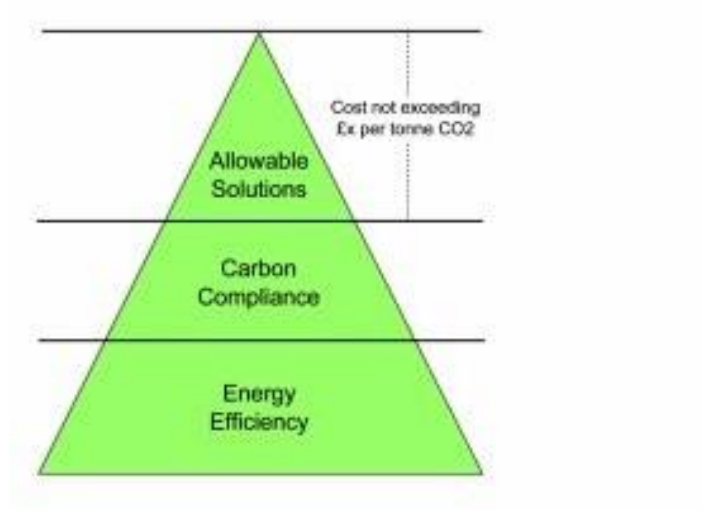


Figure 1.

However, in order to achieve the highest level of carbon reductions for the least cost it is intended that developers will be able to contribute to or co-ordinate investment in near or off-site infrastructure. This could include, for example, the connection of existing buildings to district heating networks and investment in low or zero carbon technologies on buildings owned by the City or by public and community institutions. Further guidance on these 'allowable solutions', possibly in the form of a Supplementary Planning Document (SPD), will be given following further national guidance on this matter expected from the Government.

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3.2. Decarbonisation of the Electricity Grid

The National Grid in the UK is decarbonising rapidly. This permits the electrification of heat and heralds the end to combustion of fossil fuels as the main source of heating. The attractive alternative to combustion is heat transfer using heat pumps linked to ground source energy.

The carbon factor of grid electricity was 495 grams of CO₂ for each kWh of electricity generated in 2014 according to Defra. This fell by 6.5% to 462 grams in 2015, and by a further 10.8% to 412 in 2016.

BEIS published its Energy and Emissions Projection (EEP) in January 2018 showing the projected Grid Carbon Factor falling dramatically from 212 grams in 2017 to just 66 grams in 2035. These projections, shown in the graph as a solid blue line, have fallen sharply from the BEIS predictions of a year ago, shown in a dotted blue line.

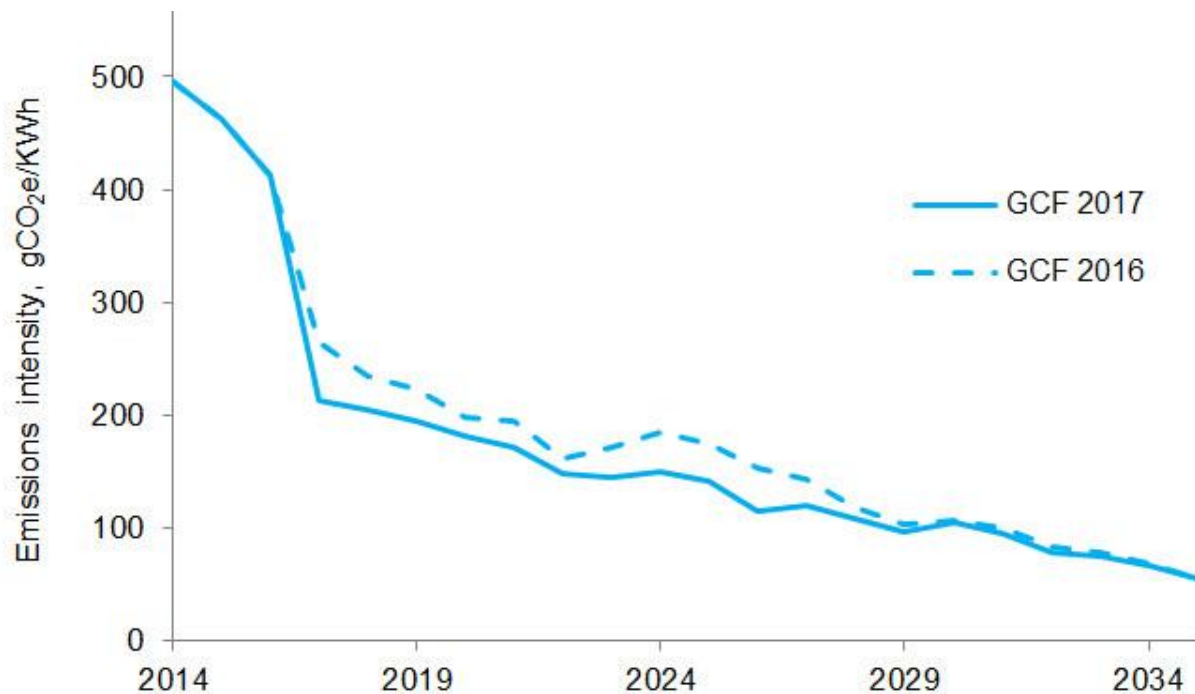


Figure 2. – Above indicates the predicted reduction in Carbon Emissions per kWh up to 2034.

Furthermore, the UK Government has passed laws that require the country to reduce all greenhouse gas emissions to net zero by 2050. And the phasing out of natural gas as a source of heating (gas heating to be banned from 2025).

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4. POLICY REVIEW

4.1. The Greater Manchester Combined Authority (GMCA)

The GMCA declared a climate Emergency in July 2019 and launched a plan in March 2020 following 12 months collaboration and consultation with representatives from areas across the city region. The plan omits the action needed to achieve a 50% reduction in CO₂ emission between 2020 and 2025 and actions to support the city zero carbon emissions by 2038.

4.2. Manchester Core Strategy

Policy EN 4

Reducing CO₂ Emissions by Enabling Low and Zero Carbon Development

The council will seek to reduce fuel poverty and decouple growth in the economy, growth in CO₂ emissions, and rising fossil fuel prices, through the following actions:

- All development must follow the principal of the Energy Hierarchy, being designed:
 - To reduce the need for energy through design features that provide passive heating, natural light and cooling
 - To reduce the need for energy through energy efficient features such as improved insulation and glazing
 - To meet residual energy requirements through the use of low or zero carbon energy generating technologies
- Wherever possible new development and retrofit projects, including energy generation plant, must be located and designed in a manner that allows advantage to be taken of opportunities for low and zero carbon energy supplies
- Where possible new development and retrofit projects will be used as a mechanism to help improve energy efficiency and provide low and zero carbon energy supplies to existing buildings
- Where appropriate new development and retrofit projects will be required to connect to and/or make contributions to low or zero carbon energy scheme and/or to incorporate provision to enable future connection to any existing/potential decentralised energy schemes
- The use of building material with low embodied carbon in new development and refurbishment schemes.

Policy EN5

Strategic Areas for low and zero carbon decentralised energy infrastructure

Within Manchester it is considered that the following strategic areas, indicated on the key diagram, will have a major role to play in achieving an increase in the level of decentralised, low and zero carbon energy supplies available.

- The Regional Centre, which also includes the Oxford Road Corridor and Eastlands
- District Centres and associated major development sites
- Airport Strategic Site
- Strategic housing location
- Strategic employment locations

Within these areas new development, regeneration and retrofit projects, will be expected to take place in the context of more detailed proposals for decentralised low and zero carbon energy infrastructure in the form of

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energy proposals plans. The Council will work with all relevant stakeholders, which may include developers, landowners, residents, community groups, private sector partners, utilities companies, neighbouring authorities and other public sector bodies, as appropriate, to bring forward such plans.

Where investment or development is being undertaken into or adjacent to a public building / asset or district heating network, full consideration shall be given to the potential role that these can have in providing an anchor load within a decentralised energy network or in creating opportunities for CO² reduction funded by contributions.

Policy EN 6

Target Framework for CO₂ reduction from low or zero carbon energy supplies

Application for residential development of 10 or more units and all other development over 1,000 sq m will be expected as a minimum to meet the target shown in Tables 12.1 or 12.2, unless this can be shown not to be viable. This should be demonstrated through an energy statement, submitted as part of the Design and Access Statement. Such a statement will be expected to set out the projected regulated energy demand and associated CO₂ emissions for all phases of the development.

Developments smaller than the above threshold, but involving the erection of a building or substantial improvement to an existing building will also be expected to meet the minimum target, where viable, but will not be expected to submit an energy statement.

The target framework relates to three broad development locations and their potential for low and zero carbon, decentralised energy. The areas are defined as follows:

- Target 1 Network development areas: locations where the proximity of new and existing buildings, the mix of uses and density of development provide the right conditions to support district heating (and cooling)
- Target 2 Electricity intense areas: location where predominant building type has an all-electric fit-out such as retail units and leisure complexes
- Target 3 Micro-generation areas: locations where lower densities and a fragmented mix of uses tend to mean that only building scale solutions are practical

Domestic CO₂ emissions reduction targets

Table 12.1

Target	% Minimum Requirement
Target 1: Network development area	CHP/district heating anchor or connection or where not feasible a 15% increase on Part L 2010
Target 2: Electricity intense buildings	+15% increase on Part L 2010
Target 3: Micro generation area	+ 15% increase on Part L 2010

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Non-domestic CO₂ emissions reduction targets

Table 12.2

Target	% Minimum Requirement
Target 1: Network development area	CHP/district heating anchor or connection or where not feasible a 15% increase on Part L 2010
Target 2: Electricity intense buildings (Applies to commercial uses with high proportion of emissions from electricity use (>45 kg CO ₂ /m ²)	10% increase on Part L 2010
Target 3: Micro generation area	+ 15% increase on Part L 2010

Where the CO₂ emissions reduction required under any future revision to Part L of the building regulations becomes greater than the '% Minimum requirement', the reduction required under building regulations would apply.

Where the Council identifies an 'allowable solution', for example within an energy proposals plan, that would produce higher carbon reductions at no extra cost than that of achieving the '% Minimum requirement' (or required under building regulations if greater) the higher percentage reduction will be required. The cost comparison is based on the cost of incorporating the 'allowable solution' at design stage.

The energy statement will be required to be submitted at the outset of any proposed development (outline application or before). Developers will be permitted to use green infrastructure elements such as green roofs, green walls, street trees and waterways to contribute to compliance with CO₂ mitigation, subject to the energy statement incorporating evidence such as modelling to demonstrate compliance.

Guidance on what the energy statement should contain and how to decide which target applies to a development proposal is given in Appendix A.

Policy EN8

Adaptation to Climate Change

All new development will be expected to be adaptable to climate change in terms of the design, layout, sitting and function of both buildings and associated external spaces. In achieving developments which are adaptable to climate change developers should have regard to the following, although this is not an exhaustive list:

- Minimisation of flood risk by appropriate siting, drainage, and treatment of surface areas to ensure rain water permeability
- Reduction in urban heat island effect through the use of Green Infrastructure such as green roofs, green walls, increased tree cover and waterways
- The need to control overheating of buildings through passive design
- The opportunity to provide linked and diverse green space to enhance natural habitats which will assist species adaptation.

Developers will be permitted to use green infrastructure elements such as green roofs, green walls, street trees and waterways to contribute to compliance with CO₂ mitigation under Policy EN6, subject to evidence to quantify their contribution to compliance.

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4.3. Regulatory Framework

4.3.1 Building Regulations

Building Regulation, Part L – Conservation of fuel and Power sets the compliance standards for energy demand and carbon dioxide emissions from buildings.

Part L2A of the government's 2010 building regulations applies to all non-domestic buildings in England and Wales. These regulations refer to new and existing commercial buildings including offices, restaurants, bars, storage spaces, industrial units, schools and conference facilities.

The aim of Part L2A is to conserve fuel and power in all buildings, apart from dwellings where L1A / L1B applies instead. Typically, commercial buildings use more energy through lighting and auxiliary power than domestic properties, which is why greater emphasis is placed on reducing carbon emissions during the non-domestic building process.

Part L2A compliance involves bringing CO₂ emissions below a specific target based on the size and scope of your building. In the UK, being compliant in this area is a key factor in the design and building stages of any commercial building or outlet.

Building Regulations Part L2A and L2B apply to all new and existing commercial buildings in England and Wales. These regulations outline the current target CO₂ emission rate (TER) for businesses.

CO₂ emissions are calculated using a number of factors, including:

- Building size
- Fabric energy efficiency
- Use of energy such as heating, cooling, ventilation and lighting

To be compliant with Part L2A, your target CO₂ emissions (based on 2010 regulations) should result in an aggregate 9% reduction in England, and a 20% reduction in Wales. A Target Primary Energy Consumption has also been introduced in Wales, setting a maximum kWh demand per m².

4.3.2 BREEAM

BREEAM (Building Establishment's Environmental Assessment Method) is the world's leading and most widely used environmental assessment method for buildings.

BREEAM UK New Construction scheme is a performance based assessment method and certification scheme for new non-domestic buildings. The primary aim of BREEAM UK New Construction is to mitigate the life cycle impact of new buildings on the environment in a robust and cost effective manner. This is achieved through integration and the use of the scheme by clients and their project team at key stages in the design and construction process.

The building's performance is assessed under a number of categories, including:

- Energy
 - Water
 - Transport
 - Materials
 - Land use
 - Pollution
- Health and wellbeing; and Management

5. APPRAISAL OF SOLUTIONS

5.1. Summary

The strategic approach outlined, follows a specific appraisal of technologies at each stage of design and to achieve the overall goal of CO₂ reduction.

As on the whole it becomes more expensive to implement carbon reduction measures the further along the design process as the opportunities to reduce demand diminish.

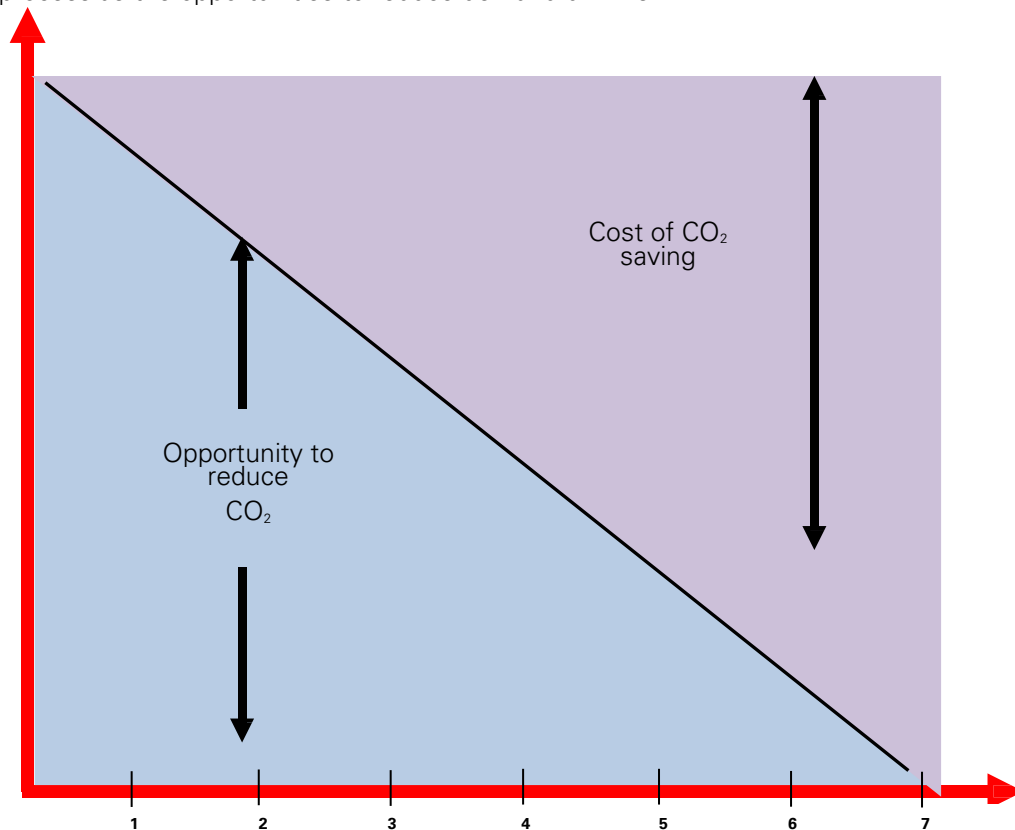


Figure 3

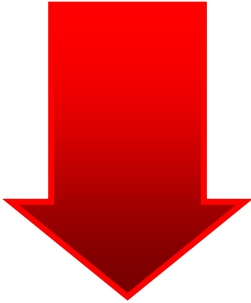
In this first instance it is therefore essential that the buildings 'passive measures' are optimised and the design team work in close collaboration with the user team to consider the future fit out demands.

The next stage is to adopt 'efficient technologies' such as heat recovery and variable speed drives etc to meet the demand efficiency with the final approach of applying 'renewable and low carbon' technologies accordingly.

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Our approach has followed the following route:-

Reduce Demand



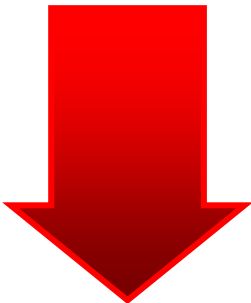
Passive design

- Thermal insulation
- Natural ventilation
- Natural daylight
- Thermal mass
- Air tightness
- Solar shading/Glass Specification
- Low energy fit out

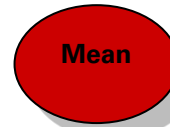


Reduce Energy Demand

Meet demand efficiently

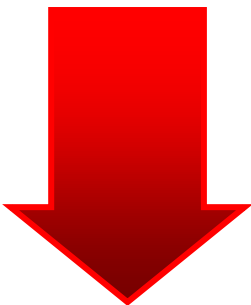


- Heat recovery
- Mixed mode ventilation
- Low energy lighting (LED)
- Power management
- Variable speed drives
- Demand Operated Systems
- Low Specific Fan Power

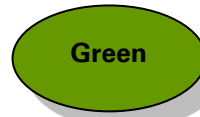


Supply Energy Cleanly and Efficiently

Supply energy from low and zero carbon technology



- Combined heat power/tri-generation
- Biomass/biofuels
- Solar thermal hot water
- Ground source heat pumps (GSHP)
 - Open loop
 - Closed loop
- Photovoltaics
- Fuel cells
- Air source heat pumps (ASHP)
- Wind
- Hydro



Incorporate Renewable Energy

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5.2. Low to Zero Carbon Technologies – Considered

Options have been reviewed for the use of on-site Low or Zero Carbon Technology (LZT) in line with the Manchester City Council's policy aspirations.

This LZC energy statement/strategy reviews the technical and economic feasibility of the following technologies –

- Biomass
- Wind
- Biogas/ Anaerobic Digestion
- Geothermal
- Ground Source Heat Pump
- Air Source Heat Pumps
- Combined Heat & Power (CHP) [Natural gas and Biomass]
- Solar Hot Water
- Solar Photo-voltaic

Biomass

Biomass is a generic name for any fuel produced from organic sources and falls into mainly two categories:

- Woody biomass- forest products, untreated wood products, energy crops and wood pellets
- Non-wood biomass – liquid biofuels (such as biodiesel, bioethanol) or animal waste industrial municipal products and high energy crops such as rape seed, sugar cane and maize.

For domestic properties, the fuel used is normally wood pellets, wood chips or wood logs. For larger applications, biomass boilers replace conventional fossil fuel boilers and come with an automated feed by screw drives from hoppers.

Biomass systems require more cleaning than gas or oil boilers and they must be capable of being taken out of service for cooling and cleaning whilst maintaining the building heating supply particularly in communal heating systems. Centralised gas boilers are therefore still required to support the biomass boiler, which would be the lead boiler. The size of the dedicated plant rooms is substantial. Fuel availability, delivery and storage are also important issues to consider.

Air quality issues are also an important factor when looking to install biomass, especially in the Manchester area.

The cost of the fuel depends on the type, delivery distances and whether it is obtained as simple waste product or from another organisation.

There is noise, transportation and delivery of fuel and air quality issues associated with biomass technology which could be problematic for a city centre development and for this reason biomass is discounted.

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Wind Power

Wind power is one of the cleanest and safest methods of generating electricity. However, wind power is unfeasible due to the fact the development is in an urban area and local wind conditions would not be sufficient to provide enough power.

Furthermore, as this development is in an urban area with numerous tall buildings in close proximity there will be obstacles which reduce wind speed. The average wind speed in this area is 2.4 m/s which is much less than the 6 m/s required. Therefore, wind is not a viable technology for this development.

Biogas/ Anaerobic Digestion (AD)

Anaerobic Digestion (AD) is a collection of processes by which microorganisms break down biodegradable material in the absence of oxygen. The process is used for industrial or domestic purposes to manage waste and/or to produce fuels. Anaerobic digestion is widely used as a source of renewable energy. The process produces a biogas, consisting of methane, carbon dioxide and traces of other 'contaminant' gases. This biogas can be used directly as fuel, in combined heat and power gas engines or upgraded to natural gas-quality biomethane. The nutrient-rich digestate also produced can be used as fertilizer.

Biogas typically refers to a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. It is a renewable energy source and in many cases exerts a very small carbon footprint.

Biogas can be produced by anaerobic digestion with anaerobic bacteria, which digest material inside a closed system, or fermentation of biodegradable materials.

As the site is extremely efficient in terms of available space the AD solution is not deemed practical and discounted.

Geothermal

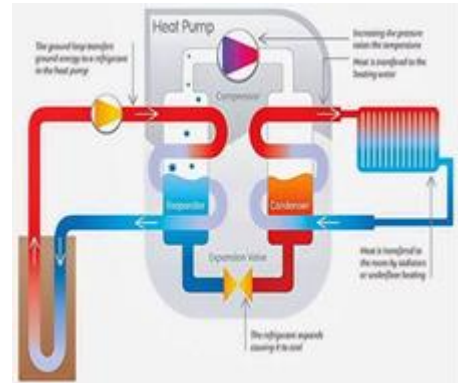
Geothermal energy is thermal energy generated and stored in the Earth. The geothermal energy of the Earth's crust originates from the original formation of the planet and from radioactive decay of materials. The geothermal gradient, which is the difference in temperature between the core of the planet and its surface, drives a continuous conduction of thermal energy in the form of heat from the core to the surface. Geothermal power is cost effective, reliable, sustainable, and environmentally friendly, but has historically been limited to areas near tectonic plate boundaries. Recent technological advances have dramatically expanded the range and size of viable resources, especially for applications such as home heating. As a result, geothermal power has the potential to help mitigate global warming if widely deployed in place of fossil fuels. The geothermal energy can be used to heat homes directly or can be used to drive steam turbines to generate electricity.

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Ground Source Heat Pump (GSHP)

GSHP's have been developed specifically for the housing market and are now considered to be an established reliable technology. The GSHP would be sized to cater for the heating and domestic hot water requirements. Typically, they are more suited to a centralised system with multiple bore holes to a depth of up to 150-250 metres depending on the ground conditions. GSHP's use a heat exchanger to extract heat from the earth.

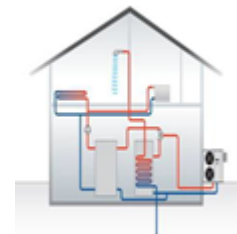
The efficiency of ground source heat pumps is measured by Co-efficient of Performance (CoP), this is the ratio of units of heat output for each unit of electricity used to drive the compressor and pump for the ground loop. Average CoP is around 3-5 although some systems may produce a greater rate of efficiency. This means that for every unit of electricity used to pump the heat, 3-5 units of heat are produced, making it an efficient way of heating a building. If grid electricity is used for the compressor and pump, then there is the opportunity to consider a range of energy suppliers to benefit from the lowest running costs, for example by choosing an economy 10 or economy 7 tariff.



Although they reduce CO2 emissions they rely directly on electricity for power and therefore are not fuel or energy efficient. The cost and practicalities to install GSHP's on this type of scheme is also prohibitive. GSHP are typically £20-30k per borehole. There is insufficient space at ground level to accommodate the number of boreholes to service the development, which makes this option unviable. GSHP's are not considered appropriate for this scheme.

Air Source Heat Pump (ASHP)

Air source heat pumps work in a similar way to GSHP. Air source heat pumps can be fitted, on the external façade or in the roof space. An air source heat pump uses small amounts of electricity to take in large quantities of air and extract heat. The efficiency of ASHP is measured by Coefficient of Performance (CoP); this is the ratio of units of heat output for each unit of electricity used to drive the system. Average CoP is around 2-4 although some systems may produce a greater rate of efficiency.



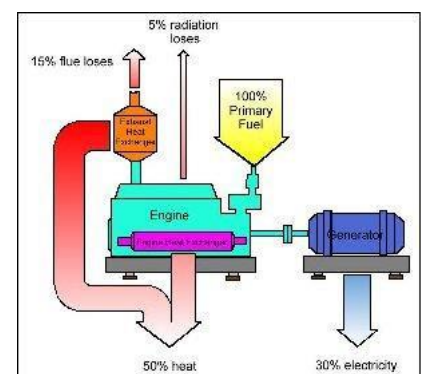
The ASHP system does offer an attractive solution in terms of the de-carbonisation of the grid and the omission of natural gas to the site. The main limitation to the development is the available roof space in relation to the size of the development.

Combined Heat & Power (CHP)

Combined heat and power (CHP) is a highly efficient process that captures and utilises the heat that is a by-product of the electricity generation process from an engine. By generating heat and power simultaneously (co-generation) CHP can reduce carbon emissions by up to 30% compared to the separate means of conventional generation via a boiler and power station. Typically a CHP would use natural gas as the main fuel source, although other forms of fuel can also be considered.

The main components of a typical system are:

- the engine which drives the generator.
- the generator which produces electricity.
- the heat recovery system that recovers the waste heat from both the engine water cooling jacket and exhaust gases.



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- the exhaust system to take away the products of combustion.
- the control panel to monitor the operation.

The heat generated during this process is supplied to an appropriately matched heat demand that would otherwise be met by a conventional boiler. CHP systems are highly efficient, making use of the heat which would otherwise be wasted when generating electrical or mechanical power. This allows heat requirements to be met that would otherwise require additional fuel to be burnt.

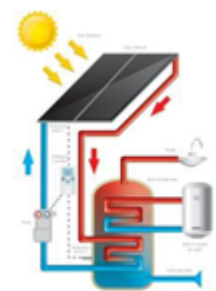
For many developments CHP is the measure that offers the most significant single opportunity to reduce energy costs and to improve environmental performance with existing users of CHP typically saving around 20% of their energy costs. Advantages of CHP include:

- CHP typically has an efficiency of 80-90%
- Operators typically saving around 20% on energy bills
- Significant carbon dioxide emission savings can be made
- Transmission and distribution losses are reduced
- Increases fuel supply security

However as the design intent and client brief is to have a strategy non reliant on fossil fuel and embrace the decarbonisation of the Electricity Grid then CHP is discounted.

Solar Thermal HW Panels

Solar panel heating uses the radiant energy from the sun to heat hot water, most commonly for domestic hot water needs. There are two types of collectors used for solar water heating – flat plate collectors and evacuated tubes collectors. The systems function successfully in all parts of the UK, as they can work in diffuse light conditions. The collector should be mounted on a 10-60 degrees pitch facing south, although other variations can be used, south is the most efficient.



The cost of installing the system is dependent on the distance between the solar collector and the hot water storage. The closer the collectors are to the hot water storage, the less pipe work is required. Annual maintenance checks are recommended. The solar collectors are connected to a condensing boiler via a HW cylinder with twin coil. A typical installation in the UK has a panel size of 3-5m² which is used in conjunction with a HW storage tank of 180-300litres, of which a minimum of 90-150 litres must be dedicated to solar hot water storage. For the reasons aforementioned this is not an appropriate option for this scheme.

They are a 'simple' and guaranteed technology which will act as a pre-heat for the Hot Water and Heating usage. Payback between capital cost and energy saving can normally be achieved within 12– 20 years, subject to usage and dwelling type. They work best on individual singular dwellings with a small HW cylinder. As the available roofspace for solar panels is limited and the use of photovoltaic panels is considered more effective in reducing carbon emissions than solar thermal panels are discounted.

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Photovoltaic Panels (PV)

Photovoltaic panels use cells to convert light into electricity. A PV cell normally consists of 1 or 2 layers of a semi conducting material such as silicon. When light shines on a cell it generates energy causing electricity to flow, the higher the light intensity is, the more electricity flows.

The amount of energy PV cells generate is referred to as Kilowatt Peak (KWp). PV arrays now come in a variety of shapes and colours, ranging from grey 'solar tiles' that look like roof tiles to panels and transparent cells that you can use on conservatories and glass to provide shading as well as generating electricity. Panels can be mounted flat or on A-frames to give the optimum angle. The optimum panel inclination for solar

collection is 35°, oriented due south; however panels that are inclined between 35° and 45° and oriented south of west or east are also generally suitable. If solar collectors are oriented away from due south then a larger surface area will be required to generate a set amount of energy.



The use of photovoltaic panels is considered attractive as this system offers an effective method of offsetting carbon emissions.

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Low/Zero Carbon Technologies (LZT) Discounted (Summary)

- Biomass has been discounted as it poses problems in terms of air quality, delivery of fuel, storage and transportation for deliveries etc. It would require a larger plant space for storing fuel, which is not currently included and is not conducive to city centre developments.
- Wind turbines are not seen to work particularly well on this type of development due to problems with wind turbulence and mounting of the units. The wind speeds in the area are not conducive to wind power electricity generation and there would be issues with shading, noise and air traffic.
- Ground Source Heat Pump's (GSHP) are not viable for site because of spatial constraints and financial costs. There is insufficient space to install GSHP vertical bores, and the systems are very costly. Typically, a singular borehole would cost £25-30k per bore and therefore there would need to be in the region of 60-100No. boreholes to serve the development.
- Geothermal. Availability of suitable location poses serious problem in adopting a geothermal solution. Extensive research is required prior to investing to ensure the location is suitable and sites do not 'run out of power' over a period of time. It may release harmful gases from deep within the Earth. High installation and investigation costs make the technology unviable.
- Biogas/ Anaerobic Digestion (AD). Emissions are likely to cause local air pollution and compliance with the Clean Air Act is problematic. Finding a secure supply of fuel can be difficult. The environmental impact of fuel transportation can be expensive. AD used to generate gas for heat or electricity requires pollution prevention and a control permit or waste management license. Digester, storage areas and delivery areas can cause problems via escape of odour and liquids. High installation costs make the technology unviable.
- Biomass CHP. As with standard biomass, this technology problems in terms of air quality, delivery of fuel, storage and transportation for deliveries etc. It would require a larger plant space for storing fuel, which is not currently included, and it is not conducive to city centre developments.
- Gas Fired CHP – Although a variable knowledge in terms of cost and carbon reductions the system is discounted on the basis of the move towards the decarbonisation of the Electrical Grid and the phasing out of Fossil fuels.
- Solar Thermal – Although a viable solution the system is discounted in favour of the adoption of Photovoltaics and the use of ASHP at roof level which after a more reliable cost-effective method of carbon emissions reduction.

ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

5.3. Summary of Technologies & Measures Considered & Adopted

Key:

Y – **Yes could be incorporated**

P – **Possible**

N – **Not appropriate**

REDUCE DEMAND	SUITABLE FOR CONSIDERATION	COMMENTARY
Natural ventilation	Y	Site mostly suitable to adopt natural ventilation for purge ventilation.
Good Natural daylight	Y	Essential to reduce the reliance on artificial lighting.
Thermal mass	Y	High rise lightweight structure, but concrete roof
Air tightness	Y	Essential to minimise air leakage with the condition of the exposed site and reduce heat losses and exceed the minimum requirements of Part L 2013.
Solar shading/Low G Value Glass	P	Specific solar shading not adopted but low 'G' value glass adopted to reduce unwanted solar gain on specific elevations
Thermal Insulation That Exceeds Minimum Standards	Y	Essential to minimise heat losses. Minimum standards Building Regulation U Values exceeded
Low 'G Value' glass specification	Y	Important to limit summertime overheating. TM59 compliance and current targets G Value 0.4 - 0.5 on appropriate elevations
'A' Rated White Goods & Appliances	Y	Will be an integral part of the fit-out requirements to reduce electricity demand.
ENERGY EFFICIENCY		
Ventilation Heat recovery	Y	MVHR adopted on ventilation systems local, both residential and communal spaces
Low energy lighting	Y	Extensively adopted LED fittings throughout the scheme
Variable speed drive	Y	Variable speed drives can be adopted on all fan and pump motors where possible to reduce energy consumption (Central Plant)
Demand Operated Systems	Y	The use of passive infra-red (PIR) for lighting, heating, ventilation where feasible (typically corridors)
Electric heating and hot water generation	Y	Lot 20 compliant, fast response system heating
RENEWABLE AND LOW CARBON TECHNOLOGY		
Solar		
Solar hot water	P	Feasible but not as robust or effective as Photovoltaics
Photovoltaics (PV's)	Y	Can be used to offset electrical demand subject to financial appraisal. - but minimal roof space available

ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

RENEWABLE AND LUT	SUITABLE FOR CONSIDERATION	COMMENTARY
Water		
Small scale hydro power	N	Not feasible as no significant water source available
Tidal power	N	Not Applicable
Wave power	N	Not Applicable
Wind		
Wind turbines	N	Not suitable for city centre environment
Biomass		
Biomass single room heaters/stoves	N	Not appropriate for Application
Biomass boilers	P	Could be adopted to offset heating and hot water but high No _x levels a concern in city centre environment.
Biomass community heating schemes	N	Could be adopted to offset heating and hot water but high No _x levels a concern in urban environment/city centre.
Combined Heat and Power (CHP) for use with the following fuels:		
Biofuel	N	Gasification process too large for scale of site. Biodiesel considered immature feedstock and unreliable.
Gas Fired CHP	P	Feasible but not in line with government strategy for decarbonisation of electricity grid
Sewerage gas and other biogases	N	Scale of site too small.
Heat Pumps		
Ground source heat pumps	P	Extensive underground pipework difficult to install due to availability of land.
Water source heat pumps	N	No significant water sources to reject / absorb heat.
Geothermal heating systems	N	Not considered.
Air source heat pumps	Y	This technology is feasible to generate hot water & for heating but available roof space restricts extent of plant
For heat pumps to comply, the heat source (ground or water) must be from a renewable source, for example soil, outside air, ground water, or a river.		
Other		
Fuel cells using hydrogen generated from any of the above 'renewable' sources.	N	Technologies not yet mature enough for application.
Rainwater recycling	N	Rainwater collection system could be adopted to recycle rainwater for toilet flushing purposes but minimal space to provide below ground tanks.
Green roofs	P	Could be adopted

ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

5.4. Detailed Option Appraisal

Please see next page

OPTION 1 – ELECTRIC HEATING & HOT WATER DELIVERED BY AIR SOURCE HEAT PUMP

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided by electric heating and hot water delivered from an air source heat pump (ASHP) Space heating shall be provided by electric panel heaters fed from the electric grid. The ASHP shall be a high efficiency, high temperature system. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat from the extract air, using it to pre-heat the incoming air.	<u>Pro's</u> ASHP offer highly efficient method of generating hot water – typically COP's 3:1 Low capex Does not require gas supply to the building Electric panel heaters offer fast response Aligned with government strategy to phase out fossil fuels Lower risk of leaks in building No heating pipework in corridors & therefore lower risk to overheating Improves on Part L by 9%	Main space heat source	Electric panel heaters	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Air source heat pump	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

	<u>Con's</u> More aligned to battery storage technologies Rooftop plant required and future access & maintenance requirements ASHP have lower life cycle than gas fired boilers (typical 15 years) Electric panel heaters have higher running costs than wet systems			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

OPTION 2 - ELECTRIC HEATING & HOT WATER DELIVERED BY GROUND SOURCE HEAT PUMP

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided by electric heating and hot water delivered from a ground source heat pump (GSHP). Ground Source Heat Pumps (GSHP) can be used to extract heat from the ground by circulating a fluid through a system of pipes buried underground to a heat exchanger which transfers the energy to the distribution network. This can provide space heating and/or domestic hot water. Ground source heat pumps have the advantage that they can act as a source of both heating and cooling for the buildings. Ground source heat pumps are either open-loop (abstracting and rejecting water to the aquifer below the site) or closed-loop (using boreholes and energy piles). Space heating shall be provided by electric panel heaters fed from the electric grid.	<u>Pro's</u> Does not require gas supply to the building Electric panel heaters offer fast response Aligned with government strategy to phase out fossil fuels Lower risk of leaks in building No heating pipework in corridors & therefore lower risk to overheating Improves on Part L by 26% More aligned to battery storage technologies <u>Con's</u> Electric panel heaters have higher running costs than wet systems	Main space heat source	Electric panel heaters	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Ground source heat pump	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

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The GSHP shall be a high efficiency, high temperature system. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat from the extract air, using it to pre-heat the incoming air.	Large amount of land required for number of boreholes There is insufficient land to develop a sufficient ground source heat pump scheme.			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

OPTION 3 - GAS FIRED BOILER FOR HEATING & HOT WATER

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided by gas fired boilers that will provide heating and domestic hot water. Space heating shall be provided by LTHW radiators and the domestic hot water system shall utilise a buffer vessel to provide storage for periods of high demand. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat from the extract air, using it to pre-heat the incoming air.	<u>Pro's</u> Known system to client in terms of operation and maintenance Part L betterment typically - 11% Life cycle of boilers typically 20-25 years Lower running costs than electric heating system <u>Con's</u> High capex of systems Extensive hot water pipework in corridors increases risk of overheating Gas required to building routing to rooftop boiler plant Higher risk of leaks in building	Main space heat source	LTHW radiators served via gas fired boiler, sessional efficiency 95%	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Gas fired boiler, sessional efficiency 95%	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

	Not aligned with government strategy to phase out fossil fuels Slower response time of LTHW radiators			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

OPTION 4 - GAS FIRED BOILER FOR HEATING & GAS FIRED BOILER WITH COMBINED HEATING POWER FOR HOT WATER

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided by gas fired boilers, supplemented by a combined heating and power (CHP) boiler, that will provide heating and domestic hot water. Space heating shall be provided by LTHW radiators and the domestic hot water system shall utilise a buffer vessel to provide storage for periods of high demand. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat from the extract air, using it to pre-heat the incoming air.	<u>Pro's</u> Known system to client in terms of operation and maintenance Part L betterment typically - 16% Life cycle of boilers typically 20-25 years Lower running costs than electric heating system CHP reduces energy and CO2 cost compared with an all-gas solution <u>Con's</u> High capex of systems Extensive hot water pipework in corridors increases risk of overheating	Main space heat source	LTHW radiators served via gas fired boiler, seasonal efficiency 95%	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Gas fired boiler, seasonal efficiency 95% with CHP	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

ENERGY STRATEGY FUSION STUDENTS, DEANSGATE SOUTH

	Gas required to building routing to rooftop boiler plant Higher risk of leaks in building Not aligned with government strategy to phase out fossil fuels Slower response time of LTHW radiators For maximum efficiency, there needs to be a need for both electricity and hot water on site Not long term sustainable when based on fossil fuel technology Combined Heating and Power units have a high maintenance cost.			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

OPTION 5 – ELECTRIC HEATING & GAS FIRED BOILER WITH COMBINED HEATING POWER FOR HOT WATER

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided by electric heating and hot water delivered from a gas fired boiler supplemented by a Combined Heating and Power (CHP) boiler Space heating shall be provided by electric panel heaters fed from the electric grid. The domestic hot water system shall utilise a buffer vessel to provide storage for periods of high demand. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat from the extract air, using it to pre-heat the incoming air.	<u>Pro's</u> Electric panel heaters offer fast response time Improves on Part L by 11% CHP reduces energy and CO2 cost compared with an all-gas solution Lower risk of leaks in building No heating pipework in corridors & therefore lower risk to overheating <u>Con's</u> Higher running cost Higher electrical point of connection required to site Electric panel heaters have higher running costs than wet systems	Main space heat source	Electric panel heaters	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Gas fired boiler, seasonal efficiency 95% with CHP	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

	Rooftop plant required and future access & maintenance requirements High capex of systems Extensive hot water pipework in corridors increases risk of overheating Gas required to building routing to rooftop boiler plant Higher risk of leaks in building For maximum efficiency, there needs to be a need for both electricity and hot water on site Not long term sustainable when based on fossil fuel technology			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

OPTION 6 – ELECTRIC HEATING WITH 100M² OF PHOTOVOLTAIC PANEL & HOT WATER DELIVERED BY GAS FIRED BOILER WITH COMBINED HEATING AND POWER

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided by electric heating and hot water delivered from a gas fired boiler supplemented by a Combined Heating and Power (CHP) boiler Space heating shall be provided by electric panel heaters fed from the electric grid and supplemented by 100m² of Photovoltaic panels. The domestic hot water system shall utilise a buffer vessel to provide storage for periods of high demand. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat from the extract air, using it to pre-heat the incoming air.	<u>Pro's</u> Electric panel heaters offer fast response time Improves on Part L by 11% CHP reduces energy and CO₂ cost compared with an all-gas solution Lower risk of leaks in building No heating pipework in corridors & therefore lower risk to overheating <u>Con's</u> Higher running cost Higher electrical point of connection required to site Rooftop plant required and future access & maintenance requirements	Main space heat source	Electric panel heaters	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Gas fired boiler, seasonal efficiency 95% with CHP	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

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	Electric panel heaters have higher running costs than wet systems. Gas required to building routing to rooftop boiler plant Not aligned with government strategy to phase out fossil fuels Higher risk of leaks in building. For maximum efficiency, there needs to be a need for both electricity and hot water on site. Not long term sustainable when based on fossil fuel technology Solar power is a variable energy source, with energy production dependent on the sun.			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

OPTION 7 – GAS FIRED BOILER FOR HEATING & HOT WATER DELIVERED BY AIR SOURCE HEAT PUMP WITH BATTERY STORAGE

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided by gas fired boilers that will provide heating and by an Air Source Heat Pump supplemented by battery storage. Space heating shall be provided by LTHW radiators. The ASHP shall be a high efficiency, high temperature system. The domestic hot water shall be provided by electric immersion heaters. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat from the extract air, using it to pre-heat the incoming air.	<u>Pro's</u> Known system to client in terms of operation and maintenance Life cycle of boilers typically 20-25 years (heaters only) ASHP offer highly efficient method of generating hot water – typically COP's 3:1 Lower capex Does not require gas supply to the building Electric panel heaters offer fast response Aligned with government strategy to phase out fossil fuels	Main space heat source	Electric panel heaters	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Gas fired boiler, seasonal efficiency 95%	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

	Lower risk of leaks in building No heating pipework in corridors & therefore lower risk to overheating Battery storage is not recognised by Part L. <u>Con's</u> Extensive hot water pipework in corridors increases risk of overheating Gas required to building routing to rooftop boiler plant Slower response time of LTHW radiators Rooftop plant required and future access & maintenance requirements ASHP have lower life cycle than gas fired boilers (typical 15 years) Electric panel heaters have higher running costs than wet systems			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

OPTION 8 – ELECTRIC HEATING & HOT WATER DELIVERED BY ELECTRIC IMMERSION HEATERS

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided with grid electricity for the heating and hot water. Space heating shall be provided by electric panel heaters. The domestic hot water shall be provided by electric immersion heaters. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat from the extract air, using it to pre-heat the incoming air.	<u>Pro's</u> Lower capex Does not require gas supply to the building Electric panel heaters offer fast response time Aligned with government strategy to phase out fossil fuels Lower risk of leaks in building No heating pipework in corridors & therefore lower risk to overheating <u>Con's</u> Higher running cost	Main space heat source	Electric panel heaters	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Electric immersion heater	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

	Does not pass Part L and planning requirements – not suitable Higher carbon emissions than fossil fuel option Higher electrical point of connection required to site			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

OPTION 9 – ELECTRIC HEATING & HOT WATER DELIVERED BY AIR SOURCE HEAT PUMP & GROUND SOURCE HEAT PUMP

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided with grid electricity for the heating, and hot water shall be provided by a split Air Source Heat Pump and Ground Source Heat Pump system. Space heating shall be provided by electric panel heaters. The domestic hot water shall be provided by electric immersion heaters. Ground Source Heat Pumps (GSHP) can be used to extract heat from the ground by circulating a fluid through a system of pipes buried underground to a heat exchanger which transfers the energy to the distribution network. This can provide space heating and/or domestic hot water. Ground source heat pumps have the advantage that they can act as a source of both heating and cooling for the buildings. Ground source heat pumps are either open-loop (abstracting and rejecting water to the aquifer below	<u>Pro's</u> Does not require gas supply to the building Electric panel heaters offer fast response time Aligned with government strategy to phase out fossil fuels Lower risk of leaks in building No heating pipework in corridors & therefore lower risk to overheating Part L betterment typically - 15% <u>Con's</u> Higher running cost	Main space heat source	Electric panel heaters	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Air source heat pump & ground source heat pump	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

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the site) or closed-loop. aquifer below the site) or closed-loop using boreholes and energy piles. The ASHP shall be a high efficiency, high temperature system. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat from the extract air, using it to pre-heat the incoming air.	Higher electrical point of connection required to site Rooftop plant required and future access & maintenance requirements Electric panel heaters have higher running costs than wet systems High capex of systems Higher carbon emissions than fossil fuel option			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

OPTION 10 – HEATING FROM AIR SOURCE HEAT PUMP & HOT WATER DELIVERED BY GAS BOILER WITH COMBINED HEATING AND POWER

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided with an Air Source Heat Pump for the heating, and hot water shall be provided by a gas fired boiler, supplemented by a Combined Heating and Power (CHP) boiler. Space heating shall be provided by electric panel heaters. The ASHP shall be a high efficiency, high temperature system. The domestic hot water shall be provided by gas fired boilers and shall utilise a buffer vessel to provide storage for periods of high demand. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat	<u>Pro's</u> Electric panel heaters offer fast response time Does not require gas supply to the building Aligned with government strategy to phase out fossil fuels No heating pipework in corridors & therefore lower risk to overheating Lower risk of leaks in building Life cycle of boilers typically 20-25 years Improves on Part L by 15%	Main space heat source	Air source heat pump	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Gas fired boiler, seasonal efficiency of 95% with CHP	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

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from the extract air, using it to pre-heat the incoming air.	CHP reduces energy and CO2 cost compared with an all-gas solution <u>Con's</u> Higher running cost Higher electrical point of connection required to site Electric panel heaters have higher running costs than wet systems Rooftop plant required and future access & maintenance requirements High capex of systems Extensive hot water pipework in corridors increases risk of overheating Gas required to building routing to rooftop boiler plant Higher risk of leaks in building			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

	ASHP have lower life cycle than gas fired boilers (typical 15 years) For maximum efficiency, there needs to be a need for both electricity and hot water on site. Not long term sustainable when based on fossil fuel technology			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

OPTION 11 – HEATING FROM AIR SOURCE HEAT PUMP & HOT WATER FROM AIR SOURCE HEAT PUMP

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided with an Air Source Heat Pump for the heating and hot water. Space heating shall be provided by electric panel heaters. The domestic hot water shall be provided by electric immersion heaters. The ASHP shall be a high efficiency, high temperature system. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat from the extract air, using it to pre-heat the incoming air.	<u>Pro's</u> ASHP offer highly efficient method of generating hot water – typically COP's 3:1 Lower capex Does not require gas supply to the building Electric panel heaters offer fast response Aligned with government strategy to phase out fossil fuels Lower risk of leaks in building No heating pipework in corridors & therefore lower risk to overheating Improves on Part L by 13%	Main space heat source	Air source heat pump	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Air source heat pump	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

ENERGY STRATEGY FUSION STUDENTS, DEANSGATE SOUTH

	More aligned to battery storage technologies <u>Con's</u> Rooftop plant required and future access & maintenance requirements ASHP have lower life cycle than gas fired boilers (typical 15 years) Electric panel heaters have higher running costs than wet systems Higher carbon emissions than fossil fuel option Higher electrical point of connection required to site			
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ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

OPTION 12 – ELECTRIC HEATING & HOT WATER FROM AIR SOURCE HEAT PUMP WITH 48M² OF PHOTOVOLTAIC PANELS

Insert the full description of the building services without abbreviation	Pros & Cons of this option	System	Insert the full description of the system without abbreviation	Rules of thumb loads W/m ²
The student accommodation shall be provided by electric heating and hot water delivered from an Air Source Heat Pump, with 48m² of photovoltaic panels. Space heating shall be provided by electronic panel heaters fed from electric grid. The domestic hot water shall be provided by electric immersion heaters. The ventilation shall be predominately provided by operable windows, with Mechanical Ventilation Heat Recovery (MVHR). The units shall incorporate a fan, supply and extract filters and a heat recovery device to recover heat from the extract air, using it to pre-heat the incoming air.	<u>Pro's</u> ASHP offer highly efficient method of generating hot water – typically COP's 3:1 Lower capex Does not require gas supply to the building Electric panel heaters offer fast response Aligned with government strategy to phase out fossil fuels Lower risk of leaks in building No heating pipework in corridors & therefore lower risk to overheating	Main space heat source	Air source heat pump	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Hot water heat source	Air source heat pump	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.
		Main ventilation system	Natural ventilation with mechanical supply & extract with heat recovery	N/A – Energy model developed utilising National Calculation Methodology (NCM) templates.

ENERGY STRATEGY FUSION STUDENTS, DEANSGATE SOUTH

	Improves on Part L by 9% More aligned to battery storage technologies <u>Con's</u> Rooftop plant required and future access & maintenance requirements ASHP have lower life cycle than gas fired boilers (typical 15 years) Electric panel heaters have higher running costs than wet systems Solar power is a variable energy source, with energy production dependent on the sun.			
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5.5. District Heating Network

This section outlines how consideration of energy supplied efficiently from a district heating network can be provided to the dwellings in line with the Energy Hierarchy.

De-Centralised/ District Heating Networks (DHN)

The energy policy reaffirms the view that energy generated by centralised power stations and transmitted through the national grid is highly inefficient and wasteful.

One of priorities for reducing CO2 emissions is to reduce the city's reliance on centralised power stations. This means increasing the use of local, low-carbon energy supplies through de-centralised energy systems.

Decentralised plant generally means any heating and hot water and/or electricity generation provided on a site or district wide basis. District heating is generally provided from Combined Heat and Power equipment (CHP). CHP is an engine which, when running, generates electricity and heats water which can then be distributed around a development.

Manchester City Council are working in partnership with Vital Energi to create the Manchester Civic Quarter Heat Network.

The network will provide heat and power solution for a number of buildings, making a significant carbon reductions.

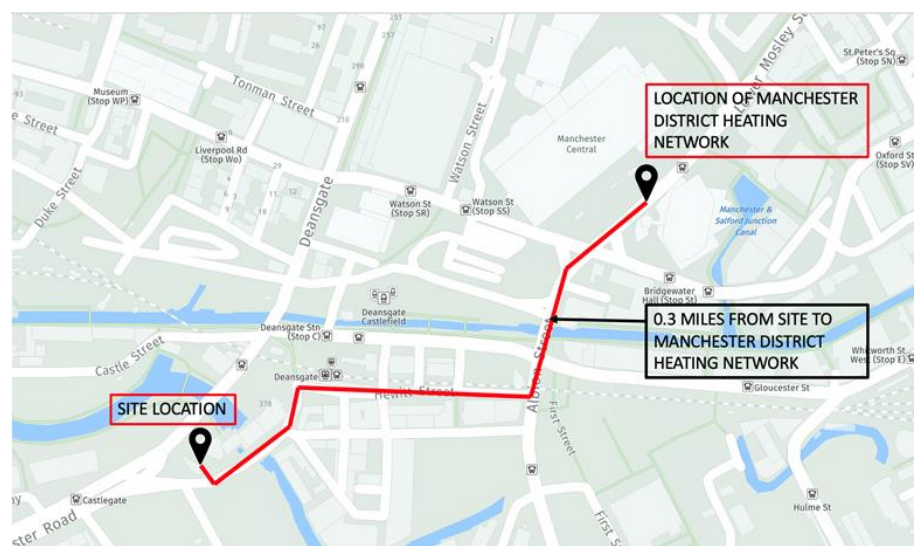
The first buildings to be connected are:

- Town Hall
- Town Hall Extension and Central Library
- Manchester Central Convention Centre
- The Bridgewater Hall
- Heron House

The network will contain power cables to distribute the electricity generated and underground pipes that deliver heat and hot water to connected buildings – one of the most cost-effective ways of reducing carbon emissions from heating. The network has been designed to enable future expansion, with efficiency and carbon savings increasing as more buildings join.

Heat will be generated from an energy centre, which is being built near to Manchester Central Convention Centre, at the junction of Great Bridgewater Street and Lower Mosley Street.

The distance of the proposed district heating neutralised this development site are considered to remote to be economically viable and therefore discounted.



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6. CARBON EMISSION CALCULATION

An energy model has been developed using IES software to establish the particular energy performance of the proposed development and the subsequent carbon emissions.

The specific inputs being: -

Element	Target Values			Surface where the maximum occurs
	Ua-Limit	Ua-Calc	Ui-calc	
Wall	0.35	0.25	0.26	
Floor	0.25	0.22	0.22	
Roof	0.25	0.18	0.18	
Windows, roof windows and rooflights	2.2	1.6	1.6	
Personnel doors	2.2	-	-	No personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No vehicle access doors in building
High usage entrance doors	3.5	-	-	No high usage entrance doors in building

Air Permeability	Worst acceptable standard	This building
M ³ /(h.m ²) at 50 Pa	10	3

The building services parameters listed below are expected to be checked by the BCO against guidance. No automatic checking is performed by the tool.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	Yes
Whole building electric power factor achieved by power factor correction	>0.95

1 – MVHR

Heating efficiency seasonal	Cooling nominal efficiency	SFP (W/(l/s))	HR seasonal efficiency
1	-	0	0.92
Automatic monitoring & targeting with alarms for out of range values for this HVAC system			Yes

2 – Heat Emitter + NV

Heating efficiency seasonal	Cooling nominal efficiency	SFP (W/(l/s))	HR seasonal efficiency
1	-	0	-
Automatic monitoring & targeting with alarms for out of range values for this HVAC system			Yes

3 – Electric Heating

Heating efficiency seasonal	Cooling nominal efficiency	SFP (W/(l/s))	HR seasonal efficiency
1	-	0	0.92
Automatic monitoring & targeting with alarms for out of range values for this HVAC system			Yes

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Local mechanical ventilation and exhaust

Zone	Supply/extract SFP (W/(l/s))	HR seasonal efficiency	Exhaust SFP (W/(l/s))
Bedrooms	1.1	-	-

The results of the model after various option appraisals (refer to section 5.4) are as follows: -

ASHP HWS & direct electrical

Energy Consumption by End Use (kWh/m²)

	Actual	Notional	% Improvement
Heating	46.49	53.02	+12
Cooling	0	0	N/A to bedrooms
Auxiliary	7.56	5.49	-37
Lighting	10.17	13.3	+24
Hot Water	42.13	44.47	+5
Equipment	11.64	11.64	N/A
TOTAL	86.24	116.28	+25

Energy Production by Technology (kWh/m²)

	Actual	Notional
Photovoltaic Systems	0.72	0

The subsequent carbon emissions saving:

Criterion 1: The Calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² . annum	47.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² . annum	47.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² . annum	43.1
Are emission from the building less than or equal to the target?	BER=<TER

The proposed option provides a 9.5% improvement on Part L2A baseline calculation.

ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

7. CONCLUSION

This report has set out the methodology in which the Fusion Team have approached the design of the proposed development in line with the requirements of Manchester City Council and the Government guidelines.

In the first instance the team have maximised passive measures to reduce the initial load of the building in terms of heating, cooling, and anticipated lighting loads with the following measures: -

- Appropriate glass to wall ratio
- U values that exceed minimum Building Regulation Standards
- Air leakage rates that exceed minimum Building Regulations
- Glass specification (G Value) that limits the amount of unwanted solar gain to avoid overheating

The specific inputs being: -

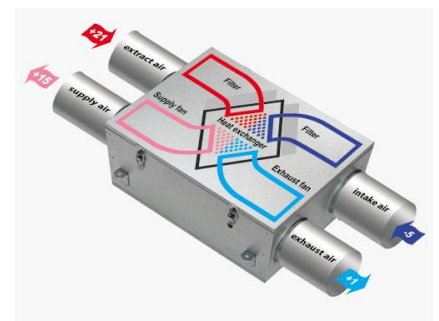
Element	Target Values		
	Ua-Limit	Ua-Calc	Ui-calc
Wall	0.35	0.25	0.26
Floor	0.25	0.22	0.22
Roof	0.25	0.18	0.18
Windows, roof windows and rooflights	2.2	1.6	1.6
Personnel doors	2.2	-	-
Vehicle access & similar large doors	1.5	-	-
High usage entrance doors	3.5	-	-

Air Permeability	Worst acceptable standard	This building
M ³ /(h.m ²) at 50 Pa	10	3

Typically, these measures have reduced the kWhr heating loads of the baseline notional building by circa 12% of the kWhr/m² demand.

The next stage of the design development was to establish energy efficiency measures to meet the demand of the building, these being: -

- Heat recovery on the ventilation systems (MVHR)
- Low specific fan power ratings to ventilation fans
- Lighting control systems such as PIR detection in corridors and en suite bathrooms
- High efficiency LED lighting throughout
- Direct electric heating with local control and occupancy sensing and set point temperature



ENERGY STRATEGY FUSION STUDENTS, DEANS GATE SOUTH

The final aspect of the design has been to establish what renewable and low carbon technologies can be adopted with air source heat pumps (ASHP) to generate hot water to the building being adopted. This system was chosen to align with the governments policy on the phasing out of fossil fuels and the subsequent decarbonisation of the National Grid.

The ASHP solution will generate hot water to the development with high efficiency system where the typical 1 kWh of electricity input will generate 3 kWh of heat output (known as the co-efficient) of performance COP).



To further supplement this system with renewable technology, rooftop photovoltaic panels will be provided to generate electricity. These panels will offset in the region of 1% of the overall estimated carbon emission from the building.



In Summary

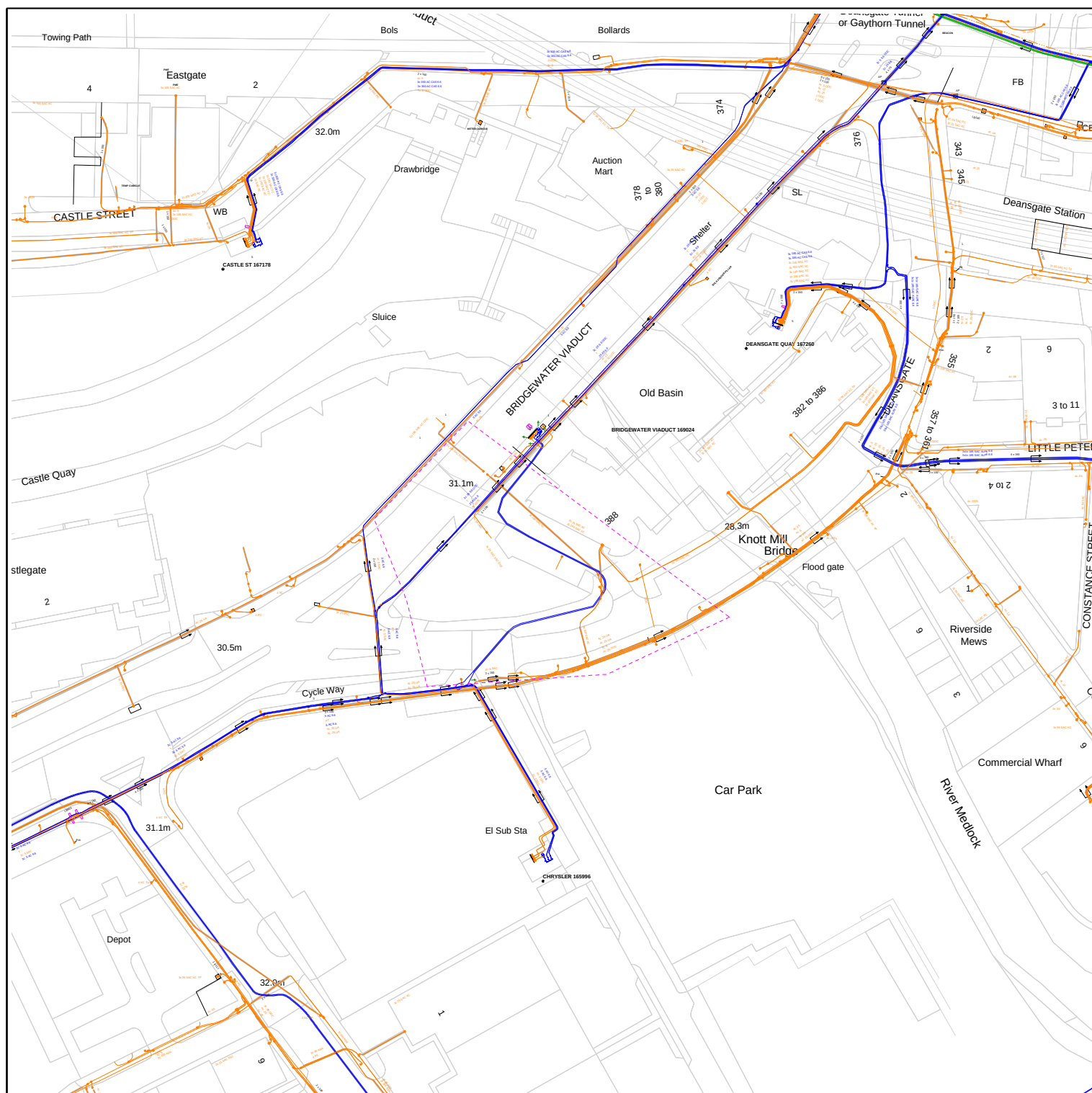
CO ₂ emission rate from the notional building, kgCO ₂ /m ² . annum	47.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² . annum	47.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² . annum	43.1
Are emission from the building less than or equal to the target?	BER=<TER

The proposed option provides a 9.5% improvement on Part L2A baseline calculation.

ENERGY STRATEGY FUSION STUDENTS, DEANSGATE SOUTH

8. APPENDIX

8.1. Utility drawings



Requested by: Lindsey Eccleston

Company: Ameen Utilities Ltd

Date Requested: 30/06/2020

Job Reference: 19249217

Your Scheme/Reference: Bridgewater Viaduct

Dig Sites:

Area □ Line ---

Operating Voltage	Colour Code	Line Colour
132kV	Black	—
33kV	Green	—
22kV-25kV	Yellow	—
11kV	Red	—
6kV-6.6kV	Blue	—
1kV-6kV	Violet	—
LV	Orange	—
Unknown Voltage	Brown	—

electricity
north west

Data Management
Electricity North West
Linley House
Dickinson Street
Manchester, M1 4LF
Phone: 0800 195 4141
Email: planrequest@enwl.co.uk

Scales on A4 paper:
1:1250 Area dig site
1:250 Line dig site

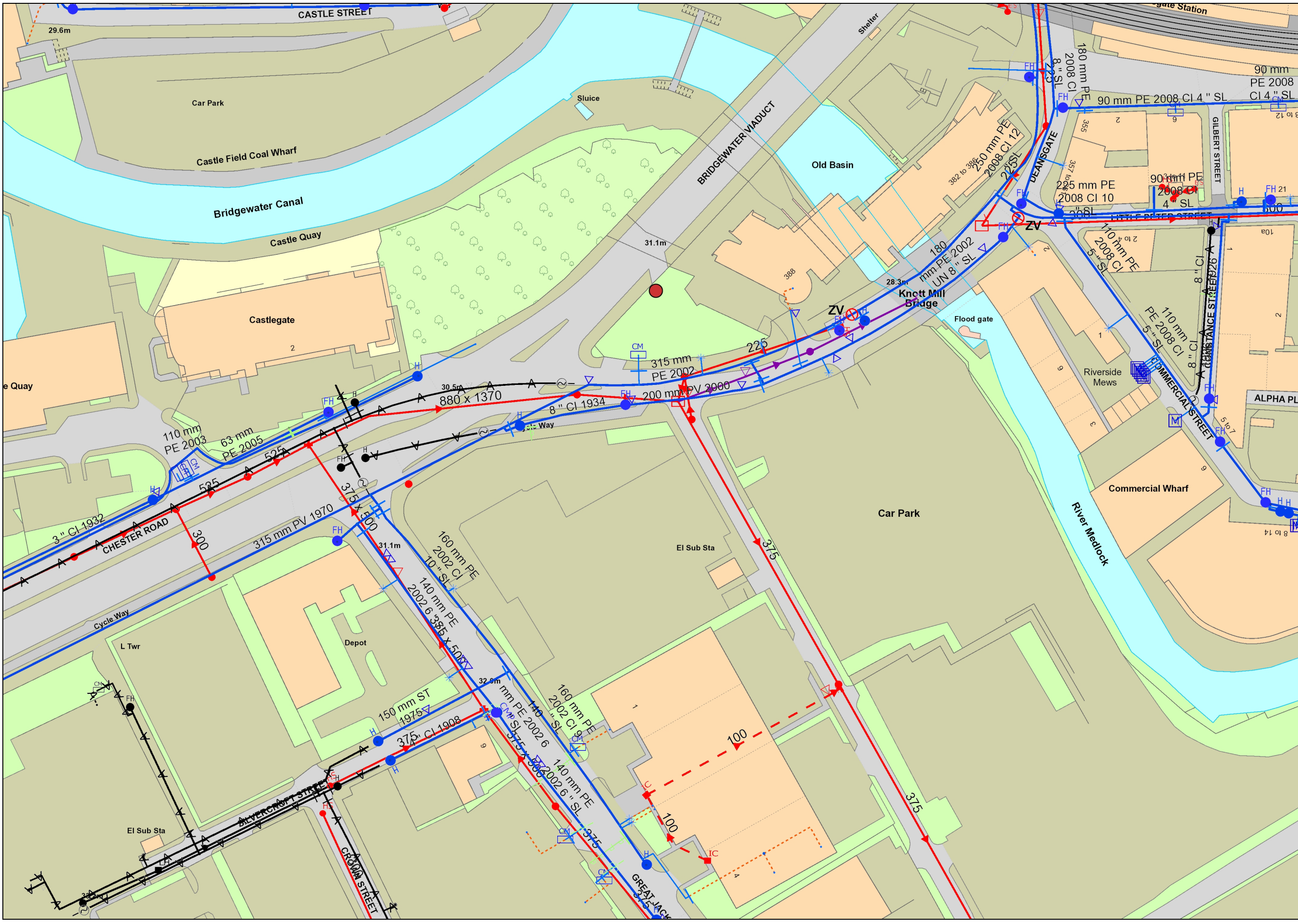
Unless otherwise indicated the depth of Electricity North West Limited cables are in accordance with NJUG (450mm for Low Voltage & 600mm for 11kV cables) 33kV and 132kV cables are laid at depths as marked. The depth and positions of Electricity North West Limited equipment was accurate as shown when the equipment was installed. However third parties may have altered the level & other reference data. Therefore Electricity North West Limited accept no responsibility for the position of Electricity North West Limited equipment being different from shown. No person, body or company, shall be relieved from liability for damage caused to Electricity North West Limited equipment by reason of being located differently to the indications on this drawing. Service cables are not necessarily shown but must be assumed to exist to all premises, streetlights and signs. There may be other Electricity North West Limited apparatus in the vicinity which is not indicated on the cable records. Other apparatus may also be present which is owned by a third party other than Electricity North West Limited.

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Reference should be made to HSE Guidance, HS(G)47 "Avoiding Danger from Underground Services" and GS6 "Avoidance of Danger from Overhead Power Lines".

Electricity North West Limited 304 Bridgewater Place, Birchwood Park, Warrington WA3 6XG. Registered in England and Wales. Registered No 02366949





United Utilities Maps
for SafeDig

Date : 30/06/2020 10:00:53

Centre X: 383287

Centre Y: 397391

Scale : 1000

UserName: A430NDU

Extract from maps of United Utilities'
Underground Assets

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. The actual positions may be different from those shown on the plan and private service pipes may be shown by a blue broken line. United Utilities Water will not accept liability for any damage caused by the actual position being different from those shown.

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Enquirer

Name	Mrs Lindsey Eccleston	Phone	07779975064
Company	Ameon Utilities Ltd	Mobile	07779975064
Address	Unit 8-10 Olympic Court, Boardmans Way Blackpool Lancashire FY4 5GU		
Email	leccleston@ameon.co.uk		

Enquiry Details

Scheme/Reference	Bridgewater Viaduct		
Enquiry type	Initial Enquiry	Work category	Development Projects
Start date	01/07/2020	Work type	Commercial/industrial
End date	01/07/2020	Site size	3179 metres square
Searched location	XY= 383289, 397439	Work type buffer*	25 metres
Confirmed location	383304 397434		
Site Contact Name	lindsey eccleston	Site Phone No	01253706160
Description of Works			

* The WORK TYPE BUFFER is a distance added to your search area based on the Work type you have chosen.

Site Map



Asset Owners

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Notes. Please ensure your contact details are correct and up to date on the system in case the LSBUD Members need to contact you.

Validity and search criteria. The results of this enquiry are based on the confirmed information you entered and are valid only as at the date of the enquiry. It is your responsibility to ensure that the Enquiry Details are correct, and LineasearchbeforeUdig accepts no responsibility for any errors or omissions in the Enquiry Details or any consequences thereof. LSBUD Members update their asset information on a regular basis so you are advised to consider this when undertaking any works. It is your responsibility to choose the period of time after which you need to resubmit any enquiry but the maximum time (after which your enquiry will no longer be dealt with by the LSBUD Helpdesk and LSBUD Members) is 28 days. If any details of the enquiry change, particularly including, but not limited to, the location of the work, then a further enquiry must be made.

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1. "LSBUD Members" who are asset owners who have registered their assets on the LSBUD service.
2. "Non LSBUD Members" are asset owners who have not registered their assets on the LSBUD service but LSBUD is aware of their existence. Please note that there could be other asset owners within your search area.

Below are three lists of asset owners:

1. LSBUD Members who have assets registered within your search area. ("Affected")
 - a. These LSBUD Members will either:
 - i. Ask for further information ("Email Additional Info" noted in status). The additional information includes: Site contact name and number, Location plan, Detailed plan (minimum scale 1:2500), Cross sectional drawings (if available), Work Specification.
 - ii. Respond directly to you ("Await Response"). In this response they may either send plans directly to you or ask for further information before being able to do so, particularly if any payments or authorisations are required.
2. LSBUD Members who do not have assets registered within your search area. ("Not Affected")
3. Non LSBUD Members who may have assets within your search area. Please note that this list is not exhaustive and all details are provided as a guide only. It is your responsibility to identify and consult with all asset owners before proceeding.

National Grid. Please note that the LSBUD service only contains information on National Grid's Gas above 7 bar asset, all National Grid Electricity Transmission assets and National Grid's Gas Distribution Limited above 2 bar asset.

For National Grid Gas Distribution Ltd below 2 bar asset information please go to www.beforeyoudig.nationalgrid.com

LSBUD Members who have assets registered on the LSBUD service within the vicinity of your search area.

List of affected LSBUD members

Asset Owner	Phone/Email	Emergency Only	Status
Electricity North West Limited	08001954141	08001954141	Await response

LSBUD Members who do not have assets registered on the LSBUD service within the vicinity of your search area. Please be aware that LSBUD Members make regular changes to their assets and this list may vary for new enquiries in the same area.

List of not affected LSBUD members

AWE Pipeline	Balfour Beatty Investments Limited	BOC Limited (A Member of the Linde Group)
BP Exploration Operating Company Limited	BPA	Carrington Gas Pipeline
CATS Pipeline c/o Wood Group PSN	Cemex	Centrica Storage Ltd
Chrysaor Production (UK) Limited	CLH Pipeline System Ltd	CNG Services Ltd
Concept Solutions People Ltd	ConocoPhillips (UK) Teesside Operator Ltd	Diamond Transmission Corporation
DIO (MOD Abandoned Pipelines)	Drax Group	E.ON UK CHP Limited
EirGrid	ENI & Himor c/o Penspen Ltd	EnQuest NNS Limited
EP Langage Limited	ESP Utilities Group	ESSAR
Esso Petroleum Company Limited	Fulcrum Pipelines Limited	Gamma
Gateshead Energy Company	Gigaclear Ltd	Gtt
Heathrow Airport LTD	Humbly Grove Energy	IGas Energy
INEOS FPS Pipelines	INEOS Manufacturing (Scotland and TSEP)	INOVYN Enterprises Limited
Intergen (Coryton Energy or Spalding Energy)	Jurassic Fibre Ltd	Mainline Pipelines Limited
Manchester Jetline Limited	Manx Cable Company	Marchwood Power Ltd (Gas Pipeline)
Melbourn Solar Limited	Murphy Utility Assets	National Grid Gas (Above 7 bar), National Grid Gas Distribution Limited (Above 2 bar) and National Grid Electricity Transmission
Northumbrian Water Group	NPower CHP Pipelines	Oikos Storage Limited
Ørsted	Perenco UK Limited (Purbeck Southampton Pipeline)	Petroineos
Phillips 66	Portsmouth Water	Premier Transmission Ltd (SNIP)
Redundant Pipelines - LPDA	RWE - Great Yarmouth Pipeline (Bacton to Great Yarmouth Power Station)	RWEnpower (Little Barford and South Haven)
SABIC UK Petrochemicals	Scottish and Southern Electricity Networks	Scottish Power Generation
Seabank Power Ltd	SES Water	SGN
Shell	Shell NOP	SSE (Peterhead Power Station)
SSE Enterprise Telecoms	SSE Utility Solutions Limited	Tata Communications (c/o JSM Construction Ltd)
Total (Colnbrook & Colwick Pipelines)	Total Finaline Pipelines	Transmission Capital
UK Power Networks	Uniper UK Ltd	Vattenfall
Veolia ES SELCHP Limited	Veolia ES Sheffield Ltd	Wales and West Utilities
West of Duddon Sands Transmission Ltd	Western Power Distribution	Westminster City Council

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Non-LSBUD members (Asset owners not registered on LSBUD)			
Asset Owner	Preferred contact method	Phone	Status
BT	https://www.swns.bt.com/pls/mbe/welcome.home	08009173993	Not Notified
Cadent Gas	plantprotection@cadentgas.com	0800688588	Not Notified
CenturyLink Communications UK Limited	plantenquiries@instalcom.co.uk	02087314613	Not Notified
CityFibre	asset.team@cityfibre.com	033 3150 7282	Not Notified
Colt	plantenquiries@catelecomuk.com	01227768427	Not Notified
Energetics Electricity	plantenquiries@lastmile-uk.com	01698404646	Not Notified
ENGIE	nrswa@cofely-gdfsuez.com	01293 549944	Not Notified
GTC	https://pe.gtc-uk.co.uk/PlantEnqMembership	01359240363	Not Notified
KPN (c/-Instalcom)	kpn.plantenquiries@instalcom.co.uk	n/a	Not Notified
Manchester City Council	medc@manchester.gov.uk	01614552250	Not Notified
Mobile Broadband Network Limited	mbnlplantenquiries@turntown.com	01212 621 100	Not Notified
Sky UK Limited	nrswa@sky.uk	02070323234	Not Notified
Sota	SOTA.plantenquiries@instalcom.co.uk		Not Notified
Teliasonera	telentelia.plantenquiries@telent.com	0800526015	Not Notified
United Utilities	WastewaterDeveloperServices@uuplc.co.uk	08707510101	Not Notified
Utility assets Ltd	assetrecords@utilityassets.co.uk		Not Notified
Verizon Business	osp-team@uk.verizonbusiness.com	01293611736	Not Notified
Virgin Media	http://www.digdat.co.uk	08708883116	Not Notified
Vodafone	osm.enquiries@atkinsglobal.com	01454662881	Not Notified

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