



RIDGE

ENERGY STRATEGY REPORT
ONE MEDLOCK STREET
MANCHESTER
18.10.2022

**ONE MEDLOCK STREET MANCHESTER
STUDENT ACCOMMODATION AND COMMERCIAL OFFICE BLOCK
PREMIER INN HOTELS & DOMINVS GROUP**

18.10.2022

Prepared for

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1. INTRODUCTION

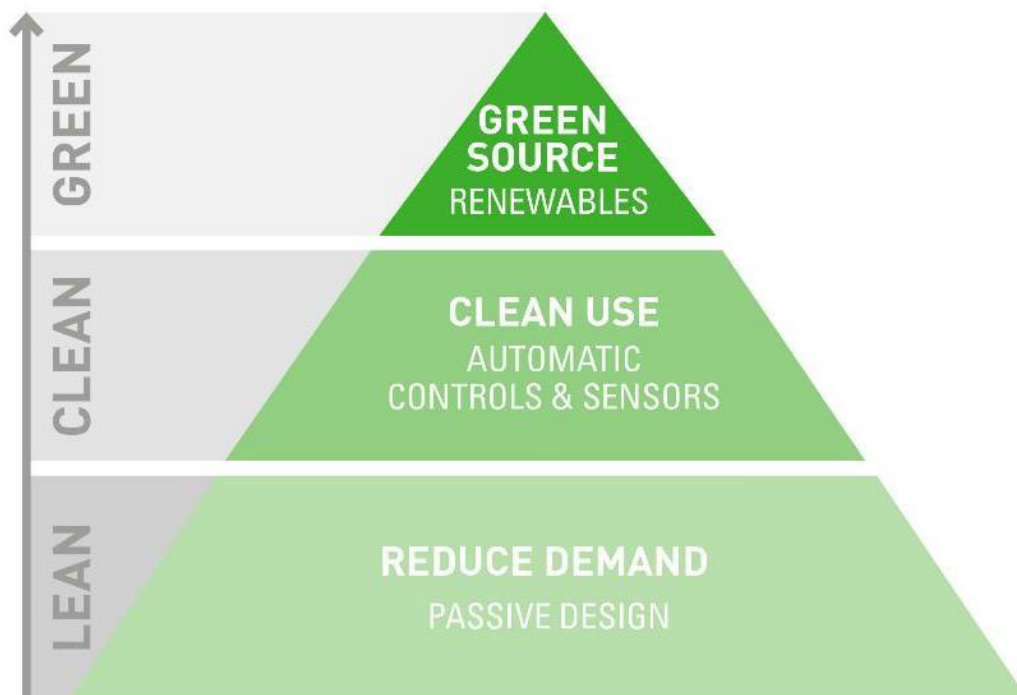
As Low Carbon Design Consultants Ridge and Partners have been appointed by Premier Inn Hotels and DOMINVS Group to provide early stage design advice on the redevelopment of the existing Premier Inn hotel site on Medlock Street in Manchester City Centre. The proposal comprises the demolition of the existing hotel building and structures and the development of the site for office uses (Use Class E), flexible office/community use (Use Class E/F1/F2) and purpose-built student accommodation (Sui Generis) comprising two separate buildings, along with associated ancillary internal and external amenity space, hard and soft landscaping and associated highway works.

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 document presented below outlines a preliminary low carbon design philosophy followed to develop an energy strategy for the proposed works. The “Energy Hierarchy” methodology provides a design framework which was used to develop the proposed low carbon energy strategy. The approach described by this methodology provides a stage process: LEAN, CLEAN and GREEN (Illustrated in below) to assess design measures.

Each stage would focus on the following:

- Lean – Main aim is to reduce the buildings energy demand through “passive measures”.
- Clean – Meet the reduced energy demand in the most efficient way possible using “active measures”
- Green – Assess the technical feasibility of incorporating a low or zero carbon technology to further reduce the CO₂ emissions.



2. DEVELOPMENT PROPOSALS

2.1 Description of Development Site

The site is located in Manchester at the junction of Medlock Street and River Street and is an existing brown field site with previous uses.



Figure 1 – View of the existing site and the surrounding area

There is an existing development on the site, the Premier Inn Hotel, which is to be demolished as part of the project.

There is a development of student accommodation currently to the West of the site, the Mancunian Way to the South of the site and to the North of the site are apartments. To the East is Medlock Street.

The site has all major services (gas, water, telecoms and electricity) within the surrounding roads which do not present any risk in terms of requiring diverting or disconnections to develop the project. However, Transco have indicated that there is a gas easement on site although trial holes confirm it is not there. The client is liaising with legal department of Transco to get easement removed.

The proposed site is approximately 0.94ha and sits at the junction of Medlock Street and the Mancunian Way (A57M).

2.2 Development Proposal

The proposed new build development is for two blocks and associated public realm, principally comprising office floorspace (Block A), and purpose built student accommodation floorspace with an element of community floorspace at ground floor (Block B).

The commercial block ('Block A') will be located on the eastern section of the Site fronting Medlock Street and the student accommodation block ('Block B') will sit on the western section of the Site adjacent to the Downing River Street development.

The commercial development will provide 36,494m² GIA of commercial space over 13 storeys (use class E).

The proposed purpose built student accommodation development will provide 1014 purpose built student accommodation units comprising a mix of studios, WCA studios, Premium/ Deluxe/ Superior studios, Twodio type A, Twodio type B, Threedio, 6 bed cluster type A and 7 bed cluster type A over 37 storeys. Ancillary uses will also be provided including community and amenity space, cycle store, FM store, gym, and roof terrace.

The development also includes a high-quality landscaping scheme and public realm pocket park, along with service space at ground level, amenity space, car parking, cycle parking, and works to the junction of Medlock Street and River Street.

3. GOVERNMENT POLICY

3.1. Energy Hierarchy

In line with the draft definition of zero carbon an energy hierarchy has been created (see figure 3 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).

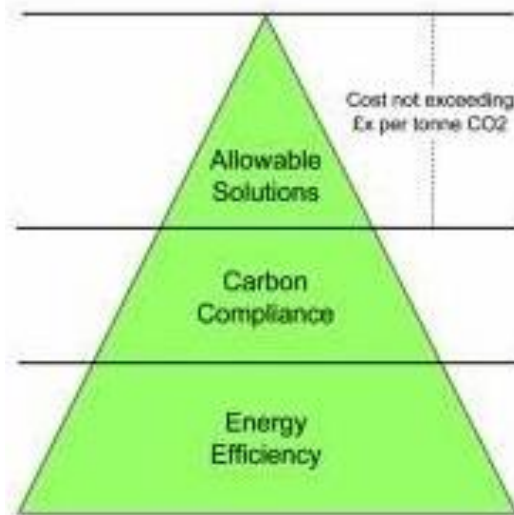


Figure 2 – Energy Hierarchy

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.

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 October 2020 showing the projected Grid Carbon Factor falling dramatically from 156 grams in 2019 to just 67 grams in 2040.

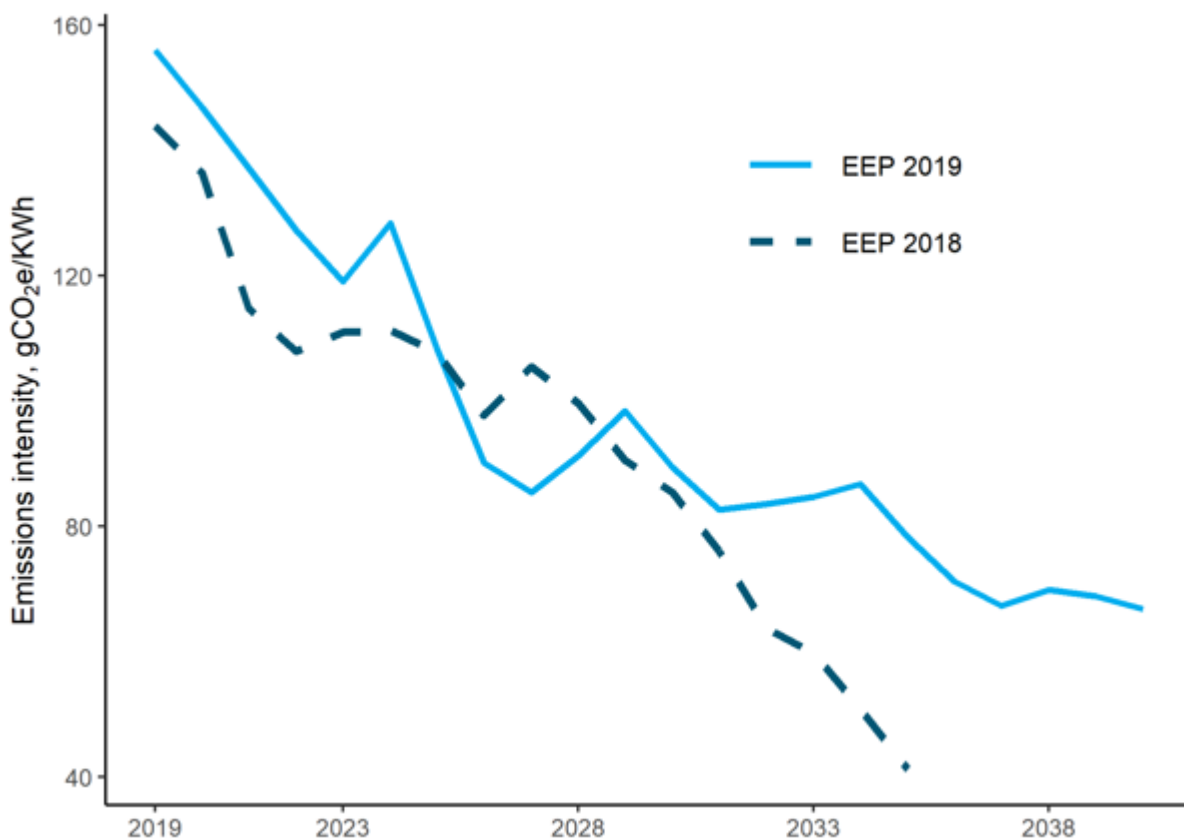


Figure 3 – Predicted Reduction in Grid Carbon Factor

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 with gas heating to be banned from 2025.

4. POLICY REVIEW

4.1. National Policy Framework

A revised National Planning Policy Framework (NPPF) was updated and published in July 2021 which sets out the Government's planning policies for England and how they are expected to be applied. This framework replaces that published in February 2019. This framework states the purpose of Sustainable development that:

'The purpose of the planning system is to contribute to the achievement of sustainable development.'

This highlights sustainability as a critical issue that runs throughout all the planning policies. The National Planning Policy Framework (NPPF) defines sustainable development in agreement with the U.N. definition of "meeting the needs of the present without compromising the ability of future generations to meet their own needs." The NPPF outlines how three overarching objectives need to be pursued in mutually supportive ways to achieve sustainable development. These objectives are outlined below.

The environmental objective of this framework is to:

- Contribute to protecting and enhancing our natural, built, and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

At the heart of the Framework is a 'presumption in favour of sustainable development.' Section 14 of the National Planning Policy Framework (NPPF) specifically addresses the challenge of climate change. It states that: 'New development should be planned for in ways that:

- Avoid increased vulnerability to the range of impacts arising from climate change. When new developments are brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and can help to reduce greenhouse gas emissions, such as through its location, orientation, and design. Any local requirements for the sustainability of buildings should reflect the government's policy for national technical standard Local Plan and supplementary guidance.'

4.2. 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 actions needed to achieve a 50% reduction in CO₂ emissions between 2020 and 2025 and actions to support the city to be carbon neutral by 2038.

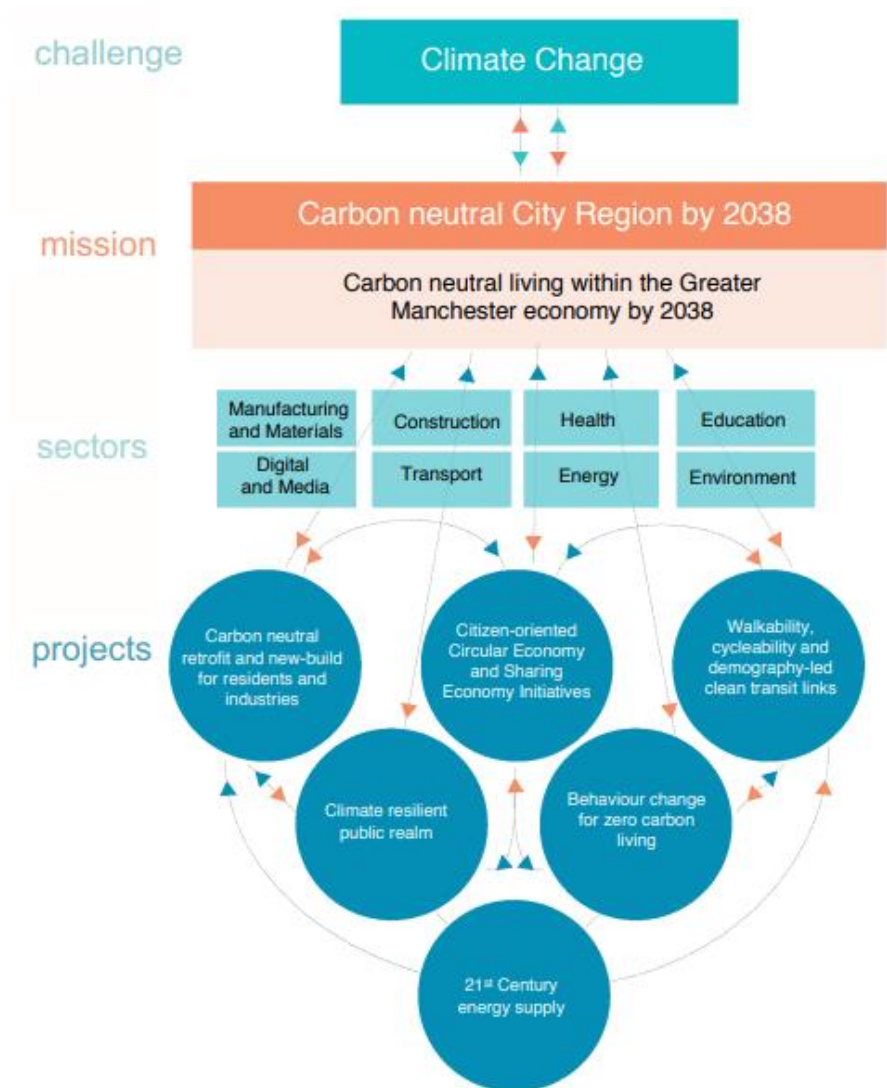


Figure 4 - Potential components of a Greater Manchester Clean Growth Mission

4.3. 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



Figure 5 - Key Diagram

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 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

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 CO₂/m²))	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 of 'Manchester's Local Development Framework, Core Strategy Development Plan Document, Adopted 11th July 2012'.

Policy EN8

Adaptation to Climate Change

All new development will be expected to be adaptable to climate change in terms of the design, layout, siting 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 rainwater 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.

4.4. The Emerging Places for Everyone Joint Development Plan

The emerging places for everyone joint development plan states:

- The Places for Everyone Joint Development Plan of Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan Councils is at the heart of our proposals to improve employment opportunities for our communities, build the right homes in the right places, rejuvenate green spaces and reshape town centres. As a long-term plan for jobs, new homes, and sustainable growth it will enable us to build back from the COVID-19 pandemic in a way that brings everyone with us and tackles the inequality experienced by so many of our communities.

Relevant policies from this document include:

Policy JP-S- 1

Sustainable development

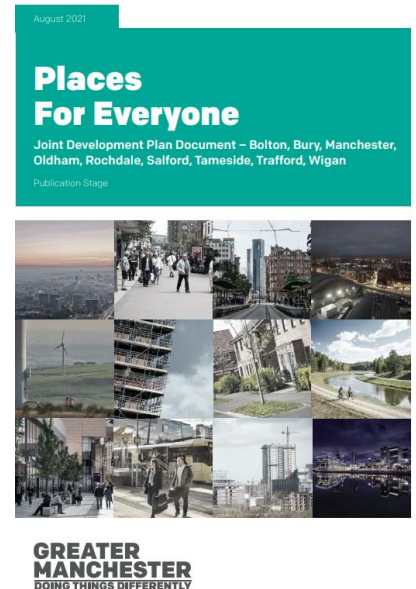
To help tackle climate change, development should aim to maximise its economic, social and environmental benefits simultaneously, minimise its adverse impacts, utilise sustainable construction techniques and actively seek opportunities to secure net gains across each of the different objectives. Preference will be given to using previously-developed (brownfield) land and vacant buildings to meet development needs. In bringing forward previously developed sites for development, particular attention will be paid to tackling land contamination and stability issues, ensuring that appropriate mitigation and remediation is implemented to enable sites to be brought back into use effectively

Policy JP-S- 2

Carbon and Energy

The aim of delivering a carbon neutral Greater Manchester no later than 2038, with a dramatic reduction in greenhouse gas emissions, will be supported through a range of measures including:

1. Promoting the retrofitting of existing buildings with measures to improve energy efficiency and generate renewable and low carbon energy, heating and cooling;
2. Promoting the use of life cycle cost and carbon assessment tools to ensure the long term impacts from development can be captured;
3. Taking a positive approach to renewable and low carbon energy schemes, particularly schemes that are led by, or meet the needs of local communities;
4. Keeping fossil fuels in the ground;
5. Planning for a balanced and smart electricity grid by identifying geographical locations which could support energy assets;
6. Increasing the range of nature based solutions including carbon sequestration through the restoration of peat-based habitats, woodland management, tree-planting and natural flood management techniques;
7. Development of Local Area Energy plans to develop cost effective pathways to achieve carbon targets;
8. An expectation that new development will:



- a. Be net zero carbon from 2028 by following the energy hierarchy (with any residual carbon emissions offset), which in order of importance seeks to:
 - i. Minimise energy demand;
 - ii. Maximise energy efficiency;
 - iii. Utilise renewable energy;
 - iv. Utilise low carbon energy; and
 - v. Utilise other energy sources.

With an interim requirement that all new dwellings should seek a minimum 19% carbon reduction against Part L of the 2013 Building Regulations.(Or until such time that this level is superseded by changes to national building regulations)

- b. Incorporate adequate electric vehicle charging points to future proof for the likely long-term demand, taking account of the potential maximum energy demand for the site;
- c. Where practicable, prioritise connection to a renewable energy/heating/cooling network in the first instance or a low carbon energy/heating/cooling network that is adaptable to non-fossil fuels at a later date;
- d. Achieve energy demand reductions for residential development in terms of space heat demand; hot water energy demand and the delivery of on-site renewable energy generation.

For renewable energy generation priority should be given to PV installation where technically feasible, alternative technologies will be appropriate where the equivalent generation is evidenced.

- e. For non-residential developments, achieve at least BREEAM excellent standard (or equivalent) for the 'Ene 01 – reduction of energy use and carbon emissions' category rising to 'BREEAM outstanding' equivalent for ENE 01 from 2028.
- f. Include a detailed energy statement to demonstrate via site relevant evidence how the development has sought to maximize reductions in carbon emissions in line with relevant policy targets, including the minimisation of overheating risks and appropriate measures for post occupancy evaluation. Whole life cycle emissions should be considered where possible.

District Local Plans may set out specific carbon emission reduction targets, particularly if carbon neutral targets have been set sooner than 2038, or promote other measures through which energy efficiency of buildings and renewable energy generation can be achieved

Policy JP-S- 3

Heat and Energy Networks

The provision of decentralised energy infrastructure is critical to the delivery of our objectives for low carbon growth, carbon reductions and an increase in local energy generation. The following measures will help to achieve this:

1. Delivery of renewable and low carbon energy schemes will be supported with particular emphasis on the use of decentralised energy networks in areas identified as "Heat and Energy Network Opportunity Areas". These will be identified where:
 - a. Existing heat/energy networks are operational or have been commissioned;
 - b. Proposals for new heat networks/energy networks are being progressed, or future opportunities have been identified in city-region master planning;
 - c. Sufficient density of existing heat demand occurs; and
 - d. Significant future development is proposed at the strategic development locations.

2. Within the identified “Heat and Energy Network Opportunity Areas”, there will be:
 - a. A requirement that new residential developments that are '10 dwellings or more' or other developments over 1,000 m² floorspace should evaluate the viability of:
 - i. Connecting to an existing or planned heat/energy network (where such a network has been identified within the Heat Network Opportunity Areas); and/or
 - ii. Installing a site-wide or communal heat/energy network solution.
 - b. A requirement, where unviable to connect to an existing network or install a site-wide or communal heat/energy network, for new development to incorporate appropriate capability to enable future connection (e.g. adequate space in plant-room for plate heat exchangers, capped-off flow/return connections);
 - c. A ‘presumption in favour of network connection’ where new residential developments over 10 dwellings and other developments over 1,000 sq m floor space are within 500m of an existing heat network, or where a network is being delivered;
 - d. An expectation that new industrial development will demonstrate that opportunities for using waste heat locally have been fully examined, and included in proposals unless proven to not be viable;
 - e. An expectation that where publicly-owned buildings and assets adjoin new major development sites, opportunities for these buildings and assets to connect to site-wide proposals will be considered; and
 - f. An expectation that any site-wide networks will be designed so as to enable future expansion to adjoining buildings or assets as appropriate.
3. In support of the above, all decentralised heat/energy network viability assessments are required to demonstrate consideration and analysis of:
 - a. Identification of existing and proposed heat/energy loads;
 - b. Identification of heat/energy supply sources;
 - c. Identification of opportunities to utilise renewable and low carbon energy sources;
 - d. Identification of opportunities to utilise waste and secondary heat sources;
 - e. Impact of proposals and technology choices on local air quality;
 - f. Design according to national best practice in relation to efficient heat network design (e.g. CIBSE CP1 Heat Networks: Code of Practice for the UK(42), or equivalent); and
 - g. Adopting appropriate consumer protection standards (e.g. HeatTrust(, or equivalent).

5. REGULATORY FRAMEWORK

5.1. Building Regulations

Part L 2021 came into effect in June 2022 with a transitional period of 12 months and will acts as an uplift to help the construction industry adapt to changing regulations and low carbon heating. Figure 7 shows the timeline for the new Part L regulations and displays that the new regulations will require a 31% and 27% reduction in CO₂ emissions compared to the previous 2013 regulations for domestic buildings and non-domestic buildings respectively.

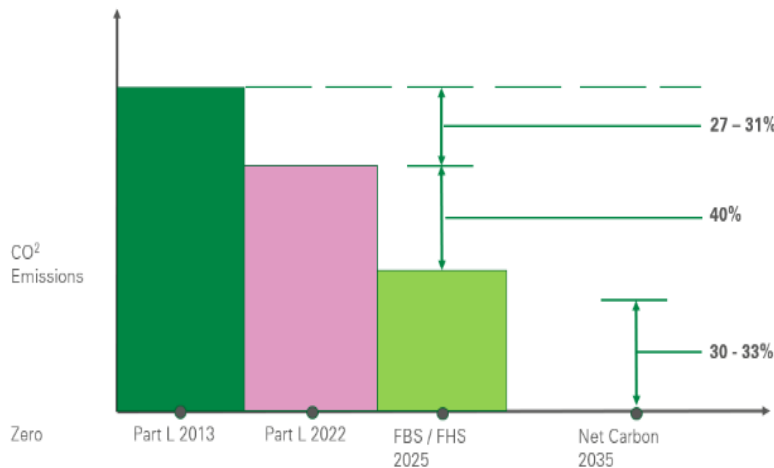


Figure 6 - Part L 2022 Changes

The future building standards which will come into effect in 2025 will require CO₂ emissions to be further decreased by 40% in comparison to current figures. The timeline for the future buildings standards is displayed in figure 8:

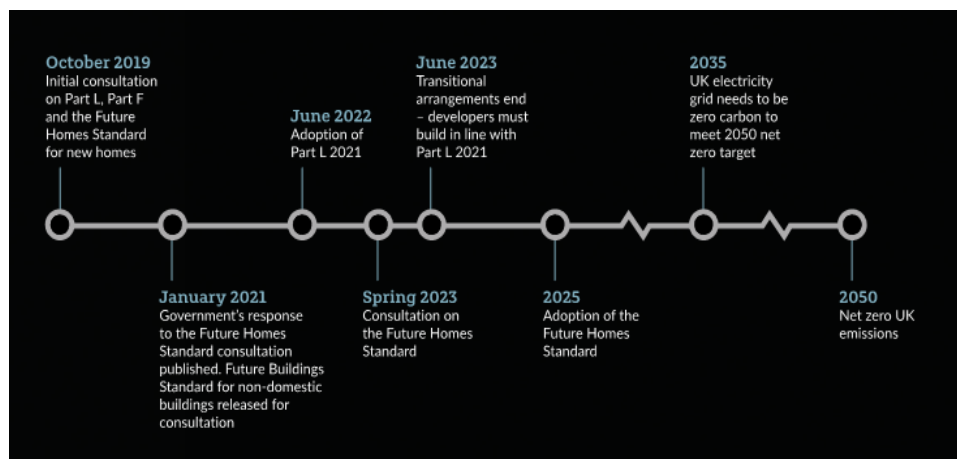


Figure 7 - Future Homes Standard

Part L volume 1 Key Changes (Domestic buildings)

- 31 % less CO₂ reduction compared to current regulations.
- No ban on use of gas boilers.
- Local planning authorities will retain powers to set higher energy efficiency targets than building regulations.
- All new builds to be air tightness tested and reducing unwanted air infiltration in existing dwellings.
- Improve accuracy of as built energy calculations

- Uplift in the efficiencies of building services in dwellings.
- Maximum flow temperature of 55°C in wet space heating systems.

Part L volume 2 Key Changes (Non-Domestic buildings)

- New non-domestic buildings to be 27% less CO₂ than current regulations.
- Encourage use of low carbon systems and high levels of building fabric.
- Uplift in the efficiencies of building services.
- Update to SBEM and NCM modelling guide.
- Uplift to limiting U-values and air permeability.
- Air tightness in existing buildings – reducing unwanted air filtration.
- Maximum flow temperature of 55°C in wet space heating systems.

A new performance metric has also been ushered in, primary energy will become the principle measure replacing CO₂ emissions as the main metric. CO₂ emissions will become less effective as a measure of energy performance as the electricity grid becomes decarbonised. If not addressed, this could result in a dwelling with low CO₂ emissions complying with regulations, despite having excessively high energy consumption. Consequently, the Primary Energy metric has been introduced to ensure that energy efficiency is directly measured rather than assuming it is linked to CO₂ emissions. Any plans/notices submitted after June 2022 must adhere to the new part L standards.

5.2. BREEAM

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

The assessment process provides in a report that covers the areas assessed, along with a formal certification on a scale of UNCLASSIFIED, PASS, GOOD, VERY GOOD, EXCELLENT and OUTSTANDING.

The assessment process provides in a report that covers the areas assessed, along with a formal certification on a scale of UNCLASSIFIED, PASS, GOOD, VERY GOOD, EXCELLENT and OUTSTANDING.

The diagram below shows how the BREEAM assessment scores and rates a building:

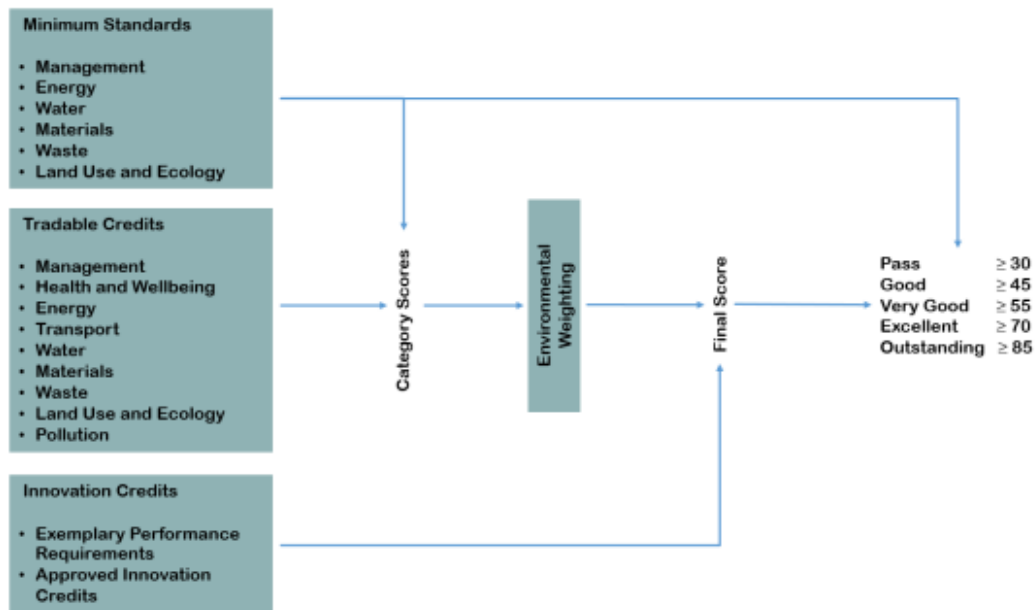


Figure 8 Process for Awarding BREEAM Ratings

The BREEAM categories include a number of environmental elements that reflect the different options available when designing, procuring and constructing a building. Each environmental element has credits available that are awarded when compliance has been demonstrated.

For the building to meet a specific BREEAM rating, there are a series of minimum standards that must be achieved for that rating to be awarded.

In addition to the credits, there are also innovation credits available that provide additional recognition of sustainable performance that goes beyond what is currently recognised and rewarded by the standard BREEAM credits.

The innovation credits are awarded for either meeting the BREEAM exemplary level requirements or by an application to BRE to have a specific feature, system or process recognised as 'innovative'.

Each different BREEAM section has an environmental weighting applied to the scores which calculates the final BREEAM score. These factors have been derived from consensus based research with groups such as the government, suppliers and lobbyists.

The weightings are:

Environmental section	Weighting			
	Fully fitted out	Simple building	Shell and core only	Shell only
Transport	10%	11.5%	11.5%	14.5%
Water	7%	7.5%	7%	2%
Materials	15%	17.5%	17.5%	22%
Waste	6%	7%	7%	8%
Land Use and Ecology	13%	15%	15%	19%
Pollution	8%	6%	9%	6%
Total	100%	100%	100%	100%
Innovation (additional)	10%	10%	10%	10%

Environmental section	Weighting			
	Fully fitted out	Simple building	Shell and core only	Shell only
Management	11%	7.5%	11%	12%
Health and Wellbeing	14%	16.5%	8%	7%
Energy	16%	11.5%	14%	9.5%

Once the weightings have been applied, the score is then assigned a BREEAM rating as follows:

BREEAM RATING	SCORE (%)
UNCLASSIFIED	<30
PASS	≥30
GOOD	≥45
VERY GOOD	≥55
EXCELLENT	≥70
OUTSTANDING	≥85

At this stage it is difficult to predict the exact number of BREEAM credits achievable by each Low and Zero Carbon Technology. These technologies will have an influence over the following:

- Ene 01 – Energy Performance – Up to 9 credits are available
- Ene 01 – Predicting Operation Energy use – Up to 4 credits are available
- Ene 04 – Low and Zero Carbon Technologies – Up to 3 (+1 innovation) credits are available
- Pol 02 – Local Air Quality – Up to 2 credits are available.

The Manchester City Council set as a minimum student halls and commercial developments to achieve BREEAM Very Good for new developments therefore this is what will be targeted.

6. APPRAISAL OF SOLUTIONS

6.1. 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.

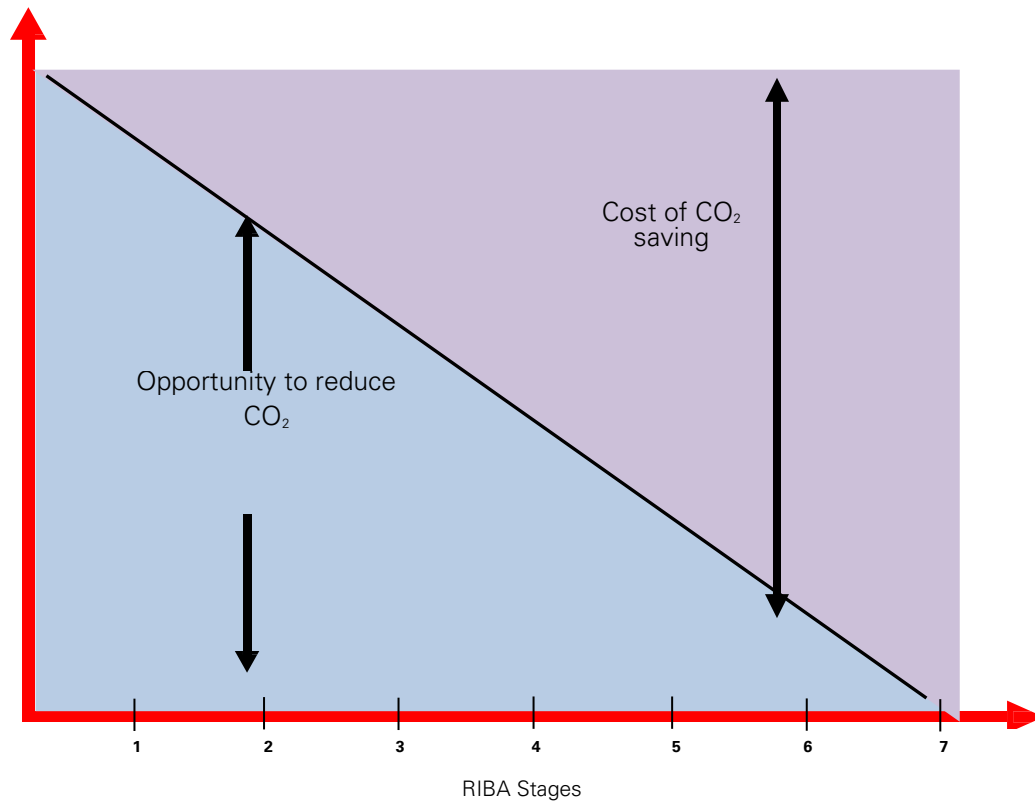


Figure 9 - Costs of implementing design measures at each RIBA Stage

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

Our approach has followed the following route:

Reduce Demand



- Passive design
 - Thermal insulation
 - Natural ventilation / mixed mode
 - Natural daylight
 - Thermal mass
 - Air tightness
 - Solar shading / glass specification

LEAN

Meet demand efficiently



- Mechanical Ventilation with heat recovery
- Mixed mode ventilation
- Low energy lighting (LED)
- Power management
- Variable Speed Drives
- Demand Operated Systems (PIR)
- Low Specific Fan Power

CLEAN

Supply energy from low and zero carbon technology



- Combined heat power/tri-generation
- Solar thermal hot water
- Ground source heat pumps
 - Open Loop
 - Closed Loop
- Photovoltaics
- Air source heat pumps
- Wind

GREEN

6.2. Passive Design Measures - (Reduce Demand – Be Lean)

This section looks at the proposed measures that will ensure the initial demand for energy in the building is low from the outset using passive measures.

The **site location** is in central Manchester, with **weather** typical of the North-west. Mild conditions are present throughout the year, with relatively high rainfall and cloud cover expected throughout the year. The **microclimate** in the centre of Manchester tends towards higher temperatures than typical in the North-west generally, due to the urban heat island effect.

In terms of expected **building occupancy**, these are expected to be typical of buildings of this type, with significant usage of the commercial space during 9-5 on weekdays, with more variable usage in the PBSA generally but high occupancy in the weekday evenings and weekends.

The following measures are to be incorporated in the design:

- Passive Design
 - Thermal Insulation and Thermal Bridging
 - Natural Ventilation / Mixed mode
 - Natural Daylight
 - Thermal Mass
 - Air tightness
 - Solar Shading
 - Low Energy Fit Out
 - Sub-metering
 - Adaption to climate change

These measures promote the reduction of Energy use and carbon emission in the first instance.

The passive design features at One Medlock Student Accommodation mean that the building is well adapted to these risks.

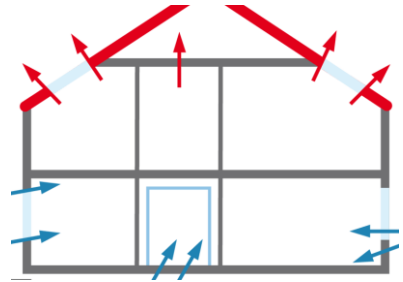
Firstly, the energy demand has been reduced and therefore the building will be less affected by the decreased availability of energy.

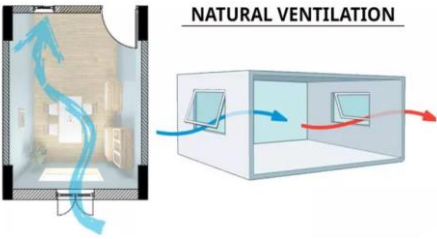
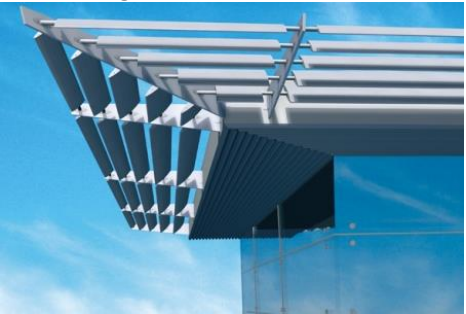
Secondly, the building will have a lower carbon footprint helping to stop the effects of climate change from increasing any further.

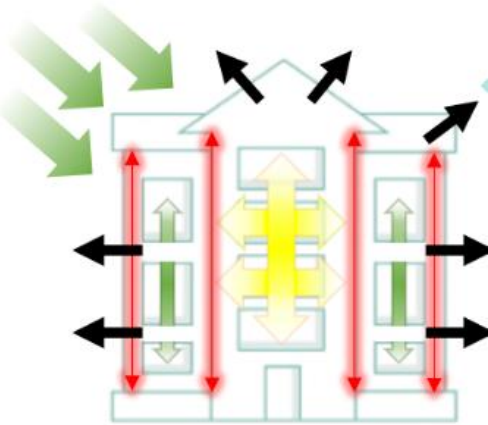
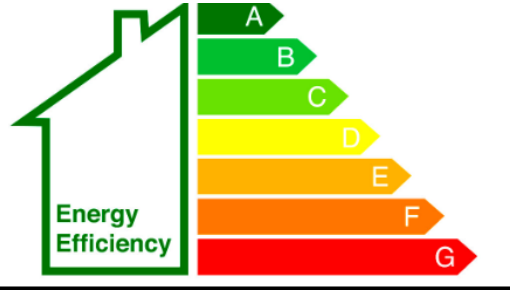
The expected increase in external temperatures could result in future overheating problems. Whilst the building cannot be relocated, by having low g-value glass, there is less solar heat gain entering the rooms.

The demand for cooling has also been reduced through the adoption of efficient building services and by exceeding the u-values stated in the Building Regulations.

This combination of passive design measures act to stabilise the temperatures within the building and enable it to adapt to the likely extremes of both high and low temperatures.

Measure	Description	Suitability for the Site																																																				
Thermal Insulation 	Thermal insulation is the reduction of heat transfer (i.e., the transfer of thermal energy between objects of differing temperature) between objects in thermal contact or in range of radiative influence.	Insulation is central to low energy construction to reduce unnecessary heat loss. The Part L building regulations set out limiting efficiencies for thermal insulation which we intend to improve on shown in the table below. This will reduce the energy required to heat the spaces in the proposed new building. <table><tr><th>Parameter</th><th>Part L 2013</th><th>Part L 2021</th><th>Indicative FHS</th></tr><tr><td>Floor U-value (W/m²K)</td><td>0.13</td><td>0.13</td><td>0.11</td></tr><tr><td>External Wall U-value (W/m²K)</td><td>0.18</td><td>0.18</td><td>0.18</td></tr><tr><td>Roof U-value (W/m²K)</td><td>0.13</td><td>0.11</td><td>0.11</td></tr><tr><td>Window U-value (W/m²K)</td><td>1.4</td><td>1.2</td><td>0.8</td></tr><tr><td>Door U-value (W/m²K)</td><td>1.0 (opaque) 1.2 (semi opaque)</td><td>1.0</td><td>1.0</td></tr><tr><td>Air permeability (m³/h m² at 50 Pa)</td><td>3</td><td>5</td><td>5</td></tr><tr><td>Heating appliance</td><td>Gas boiler</td><td>Gas boiler</td><td>Low carbon heating (eg heat pump)</td></tr><tr><td>Heat emitter type</td><td>Regular radiators</td><td>Low temperature heating</td><td>Low temperature heating</td></tr><tr><td>Ventilation system type</td><td>Natural (with extract fans)</td><td>Natural (with extract fans)</td><td>Natural (with extract fans)</td></tr><tr><td>PV (panel area as % of ground floor area)</td><td>0%</td><td>40%</td><td>0%</td></tr><tr><td>Wastewater Heat Recovery System (WWHRS)</td><td>None</td><td>Yes (36% eff)</td><td>None</td></tr><tr><td>Thermal bridging (ψ value W/m²K)</td><td>0.05</td><td>0.05</td><td>0.05</td></tr></table> = Part L 2021 improvement to 2013 edition = Proposed FHS improvement to interim Part L 2021 update	Parameter	Part L 2013	Part L 2021	Indicative FHS	Floor U-value (W/m ² K)	0.13	0.13	0.11	External Wall U-value (W/m ² K)	0.18	0.18	0.18	Roof U-value (W/m ² K)	0.13	0.11	0.11	Window U-value (W/m ² K)	1.4	1.2	0.8	Door U-value (W/m ² K)	1.0 (opaque) 1.2 (semi opaque)	1.0	1.0	Air permeability (m ³ /h m ² at 50 Pa)	3	5	5	Heating appliance	Gas boiler	Gas boiler	Low carbon heating (eg heat pump)	Heat emitter type	Regular radiators	Low temperature heating	Low temperature heating	Ventilation system type	Natural (with extract fans)	Natural (with extract fans)	Natural (with extract fans)	PV (panel area as % of ground floor area)	0%	40%	0%	Wastewater Heat Recovery System (WWHRS)	None	Yes (36% eff)	None	Thermal bridging (ψ value W/m ² K)	0.05	0.05	0.05
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Air Tightness 	Airtightness is the control of air leakage, i.e. the elimination of unwanted draughts through the external fabric of the building envelope. This may be achieved by the correct and proper installation of a vapour check or vapour barrier.	The future building standards will also need to be considered. This will come into effect in 2025 and will require CO₂ emissions to be further decreased by 40% in comparison to current figures (2020) therefore careful consideration of thermal insulation must be made at design stage. The development will adapt a high level of thermal insulation to reduce heat loss and thus reduce overall energy demand. The development will target an air tightness far greater than the requirement from building regulations to reduce air infiltration and unwanted draughts through the external fabric of the building envelope and so heating and cooling energy demand will be lowered.																																																				

Natural Ventilation 	Natural ventilation is a method of supplying fresh air to a building or room by means of passive forces, typically by wind speed or differences in pressure internally and externally. During design, natural ventilation is first considered before mechanical ventilation because this reduces carbon emissions.	The building will use natural ventilation where possible to reduce on site carbon emissions by the avoidance of operating electrically driven ventilation fans and cooling plant. The internal planning, building geometry and external topography will be optimised to take full advantage of natural ventilation. Careful attention to the placement of openable windows and interior partitions can greatly increase the natural flow of air through a building by capturing the prevailing winds. However, the building will utilise mixed mode ventilation
Natural Daylight 	Natural light is light that is generated naturally, the common source of which is the Sun. This is as opposed to artificial light, which is typically produced by electrical appliances such as lamps.	To reduce the energy used for artificial lighting the natural daylight entering occupied spaces will be maximised by optimising window size and orientation. Dimmable lighting with photocells will sense if the illuminance level of the space has been met and reduce lighting levels as required. North facing windows are particularly effective at providing useful daylight and will be incorporated on the building. The buildings orientation and fenestration strategy will take advantage of passive solar gains and natural daylight to reduce heating energy and the need for artificial lighting.
Solar Shading 	Solar shading is a method by which solar radiation in the form of heat and light can be mitigated in a building. While natural heat and light are essential in most buildings and modern architecture uses it more and more there are occasions when the levels are too high. This leads to overheating and too much light. Solar shading is a general term for a range of methods used to reduce the amount of solar gain.	Whilst maximising daylight care must be taken to ensure that direct sunlight does not cause glare in the spaces and does not cause excessive solar gains in summer which will cause spaces to overheat. This will be managed by solar shading on affected windows. Some examples of solar shading are: canopies, solar control glazing, balconies, internal blinds and curtains which could be adopted on this development.

Thermal Mass 	Thermal mass describes a materials capacity to absorb, store and release heat. For example, water and concrete have a high capacity to store heat and are referred to as 'high thermal mass' materials. Insulation foam, by contrast, has very little heat storage capacity and is referred to as having 'low thermal mass'. A common analogy is thermal mass as a kind of thermal battery. Though thermal mass has always been an aspect of buildings, only in recent years has it evolved as a tool to be deployed in the conservation of energy. However thermal mass does not offer a 'one size fits all' concept.	Thermal mass such as concrete can absorb large amounts of heat energy which prevents spaces from overheating. The thermal mas can be cooled overnight when the space is not occupied to further reduce energy needed for cooling when the space is occupied. The ground and roof will be concrete which is high thermal mass and therefore will reduce heat losses.
Low Energy Fit Out 	A low energy fit out is an interior development of a building that is low carbon in its design, operation, and entire lifecycle.	All goods and appliances will be highly energy efficient to reduce energy demand.

Sub-metering



Building submetering is a meter within your building or facility for specific energy measurements.

Power, lighting, plant and separate tenancy areas will be metered to allow energy consumption to be pinpointed and reviewed if it is excessive. Baselines and targets will also be set to help reduce energy use.

Adaption to climate change



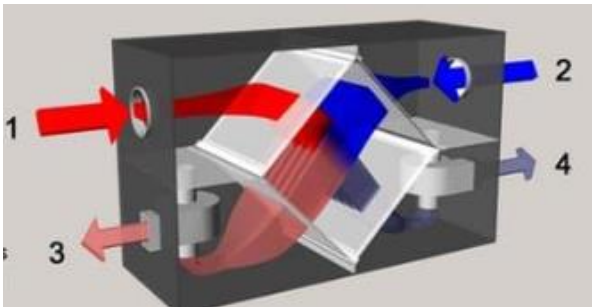
Average temperatures for central England have risen by approximately 1°C since the 1970s and this has resulted in higher temperatures, changing rain patterns, rising sea levels, in addition to unpredictable extreme weather events such as floods, droughts and freezing winters. Risks of climate change include the increased likelihood of increased external temperatures which could lead to staff illness and therefore lower productivity, damage to equipment due to the high internal building temperatures in addition to increased cooling demand.

An uplift in fabric improvements and solar shading on a development can maximise the retention of heat in winter and reduce solar gains in summer. These actions will help combat the extremes expected as a result of climate change.

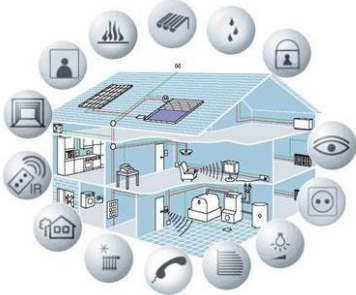
6.3. Meeting Demand Efficiently - (Be Clean)

This section looks at technologies that will be used to ensure that energy demand is further reduced and met efficiently

- Ventilation
- Heat recovery
- Demand Operated Systems
- Variable Speed Drives on fans and pumps
- Power Management
- LED Lighting
- Waste Water Heat Recovery
- BMS

Technology	Description	Suitability for site
Mechanical Ventilation Heat Recovery (MVHR) 	MVHR provides fresh filtered air into a building whilst retaining most of the energy that has already been used in heating the building. Heat Recovery Ventilation is the solution to the ventilation needs of energy efficient buildings.	Where fresh air is supplied, and stale warm air extracted by mechanical ventilation, heat recovery will be used to recycle up to 85% of the heat from the extracted air to warm the incoming air. The re-use of waste heat in the mechanical ventilation systems could provide a significant step towards reducing CO₂ emissions. This could be proposed on the mechanical ventilation units in the both blocks to reduce the energy required for heating by recovering waste heat from extracted air.
Demand Operated Systems 	The control of the heating, cooling, ventilation, and lighting systems is fundamental to the energy efficiency of buildings. The use of the following measures can reduce energy consumption: Zoned thermostatic control; Time control; Variable flow control; BMS (Building Management System) automated control; Lighting PIR (Passive Infra-Red	Where ventilation, heating and cooling is provided to a space that may not always be in use, occupancy sensors will be used, this will be fundamental to the energy efficiency of each building. These will shut down the systems serving the spaces when they are not required and turn them back on instantly when they are required. The use of the following measures will be encouraged: Zoned thermostatic control;

	Sensor) control; Daylight linked lighting control; CO ₂ detection; and Energy management control	Time control; Variable flow control; BMS (Building Management System) automated control; Lighting PIR (Passive Infra-Red Sensor) control; Daylight linked lighting control; CO₂ detection; and Energy management control. This may be used on the ventilation systems to reduce the speed or shut down ventilation to areas when they are not occupied. This includes occupied spaces and ancillary areas such as toilets.
Variable Speed Drives 	Variable speed drives and controls allow an energy system to modulate during periods of low demand. Using variable speed drive pumps therefore uses less energy than traditional pumps, which run at a constant speed.	All pumps and fans will may be provided with variable speed motors which will speed up and slow down as the demand increases or reduces to conserve energy. These can be used in conjunction with the demand operated systems to reduce the speed of pumps and fan motors to a minimum to conserve energy. Where appropriate variable speed drives will be utilised.
Power Management 	Power management is a computing device feature that allows users to control the amount of electrical power consumed by an underlying device, with minimal impact on performance. It enables the switching of devices in various power modes, each with different power usage characteristics related to device performance.	Power factor correction can be used on the electrical supplies of a building to improve energy efficiency. This is not wholly suitable to the site

LED Lighting 	An LED lamp or LED light bulb is an electric light that produces light using light-emitting diodes. LED lamps are significantly more energy-efficient than equivalent incandescent lamps and can be significantly more efficient than most fluorescent lamps	The use of energy efficient lighting will be encouraged throughout the development to limit the energy associated with internal and external lighting. LED lighting will be used throughout the development in areas with demand operated controls. Typically, this will be in the form of PIR sensors in small spaces and microwave sensors in larger areas.
BMS Optimisation 	A building management system is a computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems.	The buildings may be provided with an intelligent building management system that will learn how the building operates and optimise the function of the ventilation, heating, and cooling systems to minimise energy use.

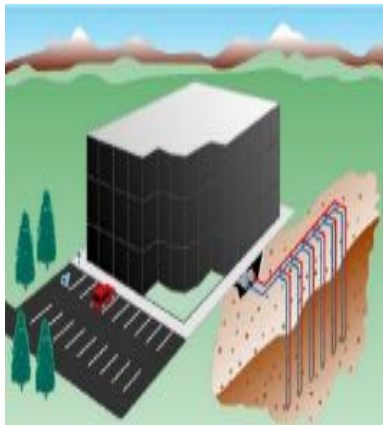
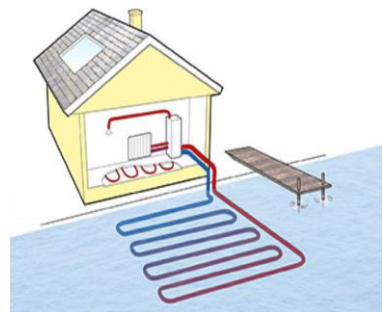
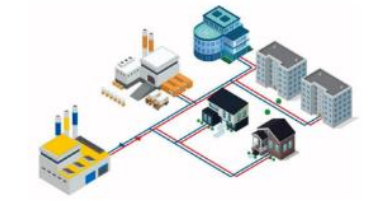
6.4. LZC Technology - (Be Green)

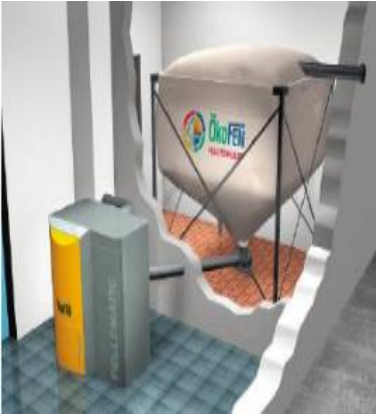
The following Low Zero Carbon (LZC) technologies have been identified and reviewed against their suitability on the One Medlock, Manchester site:

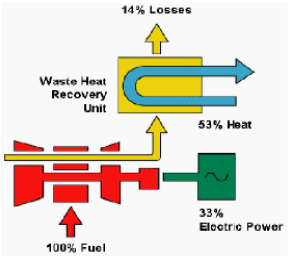
- Solar Water Heating
- Ground Source Heat Pumps
- Water Source Heat Pumps
- District Heating
- Biomass
- Wind Power
- Photovoltaic Electricity Generation
- Combined Heat and Power
- Air Source Heat Pumps
- Battery Storage

These services are described in more detail below and their suitability discussed.

Technology	Description	Suitability for site
Solar Thermal Water Heating 	Solar thermal water heating systems use heat from the sun to pre-heat domestic hot water. Solar thermal water heating systems are generally composed of solar thermal collectors and a fluid system to move the heat from the collector to a storage tank to store the heat for subsequent use. The system requires solar panels on the roof, ideally south facing, linked to hot water storage cylinders.	In the case of multi-dwelling, multi-storey blocks the available roof area, pitch and orientation is critical. The solar and pipework distribution strategy would centre on collecting and storing thermal energy in cylinders or tanks in plant rooms. Solar thermal alone will not meet the scheme's targets and would require large roof areas to make any meaningful contribution to the energy strategy. Additionally domestic hot water loads are relatively large. The roof space would be better utilised for PV panels and plant equipment and therefore there would be limited space to utilise this technology.

Ground Source Heat Pumps 	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).	Low grade heat generated, efficiency of system dependent on low distribution temperatures. Availability of 'free' or mechanical cooling, applicable to building. Compatible with future decarbonisation of the grid which would reduce emissions further. Average Co-efficient of Performance (CoP) of around 4-6 meaning that for every unit of electricity used to pump the heat, 4-6 units of heat are produced, making this an efficient way of heating a building.
Water Source Heat Pumps 	Water Source Heat Pumps (WSHP) work in a similar way to GSHP, with the exception that the pipes are submerged into a river, stream, lake or the sea. The fluid is pumped through the system and absorbs energy from the surrounding water. WSHP can be either an open-loop or closed-loop system.	No suitable water courses nearby. Low grade heat generated; efficiency of system dependent on low distribution temperatures. Availability of 'free' or mechanical cooling, applicable to buildings. Ability to share energy between blocks when heating or cooling is rejected by one building and required by another via an ambient loop.
District Heating 	Energy sources include heat from CHP and to a lesser extent, geothermal. Manchester City Council has a district heating scheme with the possibility of connection, however the feasibility and viability of connection to the district heating mains related to both the proximity of the network and the forecasted annual heat demand.	Low carbon emission factors. Potentially able to achieve renewable targets without other technologies. Reduced plant requirements within buildings. The distance of the proposed district heating mains to this development site are considered to be too far to be economically viable and are therefore discounted.

Biomass 	Biomass heating systems burn biomass material in a biomass boiler in order to heat water in the same way that gas boilers burn gas. Biomass materials include all land and water based vegetation, e.g. wood chips, wood pellets, wood waste and fast growing coppice trees such as willow. The carbon dioxide emitted from burning biomass is balanced by that absorbed during the fuel's production. Biomass heating therefore approaches a low carbon process. Biomass boilers require fuel storage for the fuel source.	Sourcing of materials, transporting large volumes into the site. Wood chips require a large storage area, usually equivalent to the plant room size. Maintenance requirements and reliability. Small systems fuelled by wood pellets, requiring less storage. Wood pellets typically more expensive than gas, although there is equivalence with heating oil and LPG. High capital and, potentially, operating (maintenance) cost. Plant usually supplemented by back-up (gas fired) boiler. Renewable Heat Incentive (RHI) payments are available. Can achieve high % renewables contribution. However, less advantageous under latest building regulations, as the Notional and Actual buildings are both fuelled by biomass. Deliveries, storage, maintenance and a substantial site electrical energy demand mean that biomass is not a favoured technology. Not applicable to site as it will not comply with the new Part L 2021 regulations.
Wind Power 	Wind power is one of the cleanest and safest methods of generating electricity. Wind turbines use the wind's forces to turn a rotor which in turn generates electricity. Wind power is used in large scale wind farms for national electrical grids as well as in small individual turbines or building integrated turbine.	Relatively high anticipated daytime electricity demand for the building. Therefore, no potential issues with utilisation, i.e. availability will match demand. As the UK is one of the windiest countries in Europe, wind power is one of the best sources of renewable energy – dependent upon location.

		Capital cost has dropped significantly in recent years. Economic viability potentially affected by recent proposed changes to feed in tariff. Turbine size and height requirements, potential turbulence and noise mean that this is not a preferred technology. 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.
Photovoltaic Electricity Generation 	Photovoltaic (PV) modules are devices or banks of devices that use the photovoltaic effect to generate electricity directly from sunlight. Until recently, their use has been limited due to high manufacturing costs. In buildings current applications include PV on the roof, PV curtain walling systems and PV louvred external shading devices. Typically, photovoltaics would be installed on a south facing roof.	Relatively high anticipated daytime electricity demand for the development. Therefore, no potential issues with utilisation, i.e. availability will match demand. The PV panels are used to generate electricity reducing CO₂ emissions. Capital cost has dropped significantly in recent years. The PV panels can also be integrated with proposed battery storage technology to utilise more energy generated on site. There is minimal roof space for PV panels as air source heat pumps will be installed on the roof.
Combined Heat and Power (CHP) 	A CHP unit provides heating as well as electrical power. The electricity generated by the CHP plant can be distributed around a development and into the electrical network if needed. The use of this co-generation improves the overall efficiency of the primary energy delivered to the site with a corresponding reduction in the development's CO₂ emissions.	Relatively low cost of CHP unit if integrated into a gas boiler and domestic water cylinder strategy High maintenance costs result in marginal returns on small to medium sized installations Best suited to community or district heating systems with significant thermal loads

	The amount of thermal energy provided by the CHP unit will be dependent on the calculated thermal base load for the buildings.	The application of CHP to the site will be dependent on establishing a heating baseload, which in this instance will essentially comprise the domestic hot water service (DHWS). Potentially a number of energy centres required located around the development. Not compatible with future de-carbonisation of the grid and reduction of use of fossil fuels Not applicable to site as it will not comply with the new Part L 2021 regulations.
Battery Storage 	Modern batteries can store large amounts of electrical energy in a development. Battery storage allows the low and zero carbon technology that can generate electricity, such as PV panels to charge batteries if there is not sufficient demand from the buildings to utilise the electrical energy. This is more efficient than exporting to the grid and saves the consumer more money.	In combination with a private wires electricity network across the site, battery storage can store energy generated on site smoothing out peaks and troughs in electrical demand and on site generation. The battery storage will be used to 'peak loop' the peaks in demand, where electricity is most expensive and use stored energy to overcome these. A Local Clean Energy Marketplace will be established. Using battery storage in the development would help store any excess electricity generated by the PV Panels which can be discharged at a later time when demand is high. This is more efficient than exporting to the grid and it is more cost effective to utilise energy on site than to export to the grid. This technology will be considered to remove peak demand with the ai source heat pumps.

7. SUMMARY OF TECHNOLOGIES

7.1. Commercial Office

Key:

- Y** – **Yes could be incorporated**
P – **Possible**
N – **Not appropriate**

REDUCE DEMAND	SUITABLE FOR CONSIDERATION	COMMENTARY
Natural ventilation	N	Not wholly suitable due to proximity of Mancunian Way.
Good natural daylight	Y	Essential to reduce the reliance on artificial lighting.
Thermal mass	Y	Medium lightweight structure but roof will be concrete.
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 2021.
Solar shading/Low G-value glass	Y	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. Part O compliance and current targets G Value 0.32 on appropriate elevations.
ENERGY EFFICIENCY		
Ventilation Heat recovery	Y	Central air handling unit adopted on ventilation systems at roof top level incorporating heat recovery.
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).
Daylight Dimming	Y	Use of photocells to dim office lights when there is sufficient daylight from outside
RENEWABLE AND LOW CARBON TECHNOLOGY		
Solar		
Solar thermal hot water	N	Feasible but not as robust or effective as photovoltaics.
Photovoltaics (PV's)	Y	Photovoltaics will be adopted at roof top level.

RENEWABLE AND LZC TECHNOLOGIES	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	N	Could be adopted to offset heating and hot water but high NO _x levels a concern in city centre environment and will not comply with new Part L 2021 building regulations therefore discounted.
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 and will not comply with new Part L 2021 building regulations therefore discounted.
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	N	Feasible but not in line with government strategy for decarbonisation of electricity grid.
Heat Pumps		
Ground source heat pumps	N	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 appropriate.
Air source heat pumps	Y	This technology is feasible to generate hot water & for heating and is the favored solution.
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 adaption.
Rainwater recycling	N	Insufficient space available to house rainwater recycling tank
Green roofs	N	Minimal roof space as photovoltaics will be proposed
Battery Storage	P	Feasible technology but lack of space for a battery storage system but should be considered for future adoption.

7.2. Student Accommodation

Key:

Y – **Yes could be incorporated**

P – **Possible**

N – **Not appropriate**

REDUCE DEMAND	SUITABLE FOR CONSIDERATION	COMMENTARY
Natural ventilation	Y	Combined with mechanical vent for mixed mode solution.
Good natural daylight	Y	Essential to reduce the reliance on artificial lighting.
Thermal mass	Y	High rise lightweight structure but roof will be concrete.
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 2021.
Solar shading/Low G-value glass	Y	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. Part O 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 student clusters 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).
RENEWABLE AND LOW CARBON TECHNOLOGY		
Solar		
Solar thermal hot water	P	Feasible but minimal roof space available.
Photovoltaics (PV's)	P	Can be used to offset electrical demand subject to financial appraisal. - but minimal roof space available.

RENEWABLE AND LZC TECHNOLOGIES	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	N	Could be adopted to offset heating and hot water but high NO _x levels a concern in city centre environment and will not comply with new Part L 2021 building regulations therefore discounted.
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 and will not comply with new Part L 2021 building regulations therefore discounted.
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	N	Feasible but not in line with government strategy for decarbonisation of electricity grid.
Heat Pumps		
Ground source heat pumps	N	Extensive underground pipework is difficult to install due to availability of land. Insufficient land available to have ground source heat pumps
Water source heat pumps	N	No significant water sources to reject / absorb heat.
Geothermal heating systems	N	Not considered appropriate. This technology is feasible to generate hot water & for heating
Air source heat pumps	Y	This technology is feasible to generate hot water & for heating and is the favored solution
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 are not yet mature enough for adaption.
Rainwater recycling	N	Insufficient space available to house rainwater recycling tank
Green roofs	N	Minimal roof space available.
Battery Storage	P	Feasible technology but lack of space for a battery storage system but should be considered for future adoption.

7.3. 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 significant carbon reductions.

The buildings 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 situated near to Manchester Central Convention Centre, at the junction of Great Bridgewater Street and Lower Mosley Street. The distance of the proposed district heating mains to this development site are considered to be too far to be economically viable and are therefore discounted.

8. PREDICTED CARBON EMISSIONS

8.1. Commercial Office

The following BRUKL results relate to a RIBA stage 2 design and will be subject to a design development due to the next stages. The results produced are run off the new Part L 2021 building regulations.

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

Target Building Fabric U-Values: -

Element	Target Values			G-Value
	Ua-Limit	Ua-Calc	Ui-Calc	
Wall	0.26	0.21	0.3	
Floor	0.18	0.18	0.18	
Windows, roof windows	1.6	1.3	1.3	0.32
Personnel doors	1.6	1.6	1.6	

Target air permeability value:

Air Permeability	Worst acceptable standard	This building
M ₃ /(h.m ²) at 50 Pa	8	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	0.9 to 0.95

1 – AHU (S&E)

	Heating efficiency	Cooling efficiency	Radiant efficiency	S22PF [W/l/s]	HR efficiency
This system	3.55	6.13	0	1.5	0.83
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out of range values for this HVAC system					YES
* Standard shown is for all types of > 12 kW output, except absorption and gas engine heat pumps.					
^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.					

2 – 4-pipe FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SPF [W/l/s]	HR efficiency
This system	3.55	6.1	0	1.5	0.83
Standard value	2.5*	4.5**	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out of range values for this HVAC system					YES
* Standard shown is for all types of > 12 kW output, except absorption and gas engine heat pumps.					

**Standard shown is for air-cooled chillers ≥ 400 kW. For chillers < 400 kW, limiting SEER is 4.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

3-Toilets & Cleaners Extract

	Heating efficiency	Cooling efficiency	Radiant efficiency	SPF [W/l/s]	HR efficiency
This system	3.44	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out of range values for this HVAC system					YES
* Standard shown is for all types of > 12 kW output, except absorption and gas engine heat pumps.					

4- MVHR (Basement)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SPF [W/l/s]	HR efficiency
This system	3.55	-	0	1.5	0.83
Standard value	2.5*	N/A	N/A	1.9^	N/A
Automatic monitoring & targeting with alarms for out of range values for this HVAC system					YES
* Standard shown is for all types of > 12 kW output, except absorption and gas engine heat pumps.					
^Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.					

1- DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	3.44	-
Standard value	2*	N/A
*Standard shown is for all types except absorption and gas engine heat pumps		

The results of the model after various option appraisals are as follows: -

Energy Consumption by End Use (kWh/m²)

	Actual	Notional
Heating	2.12	1.73
Cooling	3.64	3.35
Auxiliary	8.54	8.98
Lighting	7.53	10.51
Hot Water	3.39	3.6
Equipment	34.6	34.6
TOTAL	25.21	28.17

Energy Production by Technology (kWh/m²)

	Actual	Notional
Photovoltaic Systems	2.53	0

The subsequent carbon emissions saving:

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

Target CO2 emission rate (TER), kgCO2/m2. annum	3.79	
Building CO2 emission rate (BER), kgCO2/m2. annum	3.11	
Target primary energy rate (TPER), kWh/m ² .	41.45	
Building primary energy rate (BPER), kWh/m2/yr	33.93	
Do the buildings emission and primary energy rates exceed the targets?	BER=<TER	BPER=<TPER

The proposed option provides a 17.94% improvement on Part L baseline calculation.

8.2. Student Accommodation

The following BRUKL results relate to a RIBA stage 2 design and will be subject to a design development due to the next stages. The results produced are run off the new Part L 2021 building regulations.

A BRUKL was developed to establish the energy use of the apartment block. The specific inputs being:

Target Building Fabric U-Values:

Building Fabric Element	Target U-Value (w/m2K)	Limiting U-Value (w/m2K)	G-Value
Windows	1.6	1.6	0.4
Exposed Floors	0.13	0.18	
Roof	0.15	0.18	

Target air permeability value:

Air Permeability	Worst acceptable standard	This building
M ₃ /(h.m ²) at 50 Pa	8	3

The results of the model after various option appraisals are as follows: -

Energy Consumption by End Use (kWh/m²)

	Actual	Notional
Heating	7.36	12.51
Cooling	0.32	0.21
Auxiliary	5.99	4.65
Lighting	7.7	8.56
Hot Water	5.63	6.11
Equipment	33.62	33.62
TOTAL	27.01	32.04

The subsequent carbon emissions saving:

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

Target CO ₂ emission rate (TER), kgCO ₂ /m ² . annum	4.39
Building CO ₂ emission rate (BER), kgCO ₂ /m ² . annum	3.82
Target primary energy rate (TPER), kWh/m ² .	46.8
Building primary energy rate (BPER), kWh/m ² /yr	40.85
Do the buildings emission and primary energy rates exceed the targets?	BER=<TER BPER=<TPER

The proposed option provides a 12.98% improvement on Part L baseline calculation.

9. CONCLUSION

9.1. Commercial Office

This report has set out the methodology in which the design team have approached the design of the proposed commercial office and have adopted the requirements of Manchester City Council and the Government guidelines.

9.1.1 Passive Measures – Lean

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

- Appropriate glass to wall ratio
- Target U-values that exceed minimum Building Regulation Standards as below

Element	Target Values			G-Value
	Ua-Limit	Ua-Calc	Ui-Calc	
Wall	0.26	0.21	0.3	
Floor	0.18	0.18	0.18	
Windows, roof windows	1.6	1.3	1.3	0.32
Personnel doors	1.6	1.6	1.6	

- Target Air leakage rates that exceed minimum Building Regulations

Air Permeability	Worst acceptable standard	This building
M ₃ /(h.m ₂) at 50 Pa	8	3

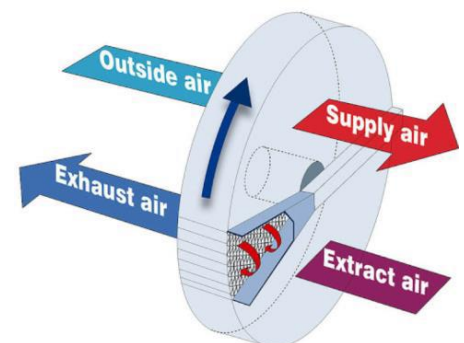
- Improved glazing specification (G Value) that limits the amount of unwanted solar gain to avoid overheating
- Solar shading to the south west elevations of the office
- Exposed slabs for night time cooling as shown in the image to the right



9.1.2 Energy Efficiency Measures – Mean

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

- Low specific fan power ratings to ventilation fans and fan coil units
- Lighting control systems such as PIR detection and daylight control
- High efficiency LED lighting throughout
- Demand operated services
- Variable speed drives
- Automatic monitoring and targeting with alarms for out-of-range values
- Heat recovery on the ventilation systems via a thermal wheel, illustrated in the figure to the right.



9.1.3 Renewable and Low Carbon Technologies – Green

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 the heating and hot water to the building being selected. This system was chosen to align with the government's 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.

The commercial office will adopt the following renewable and Low Carbon Technologies:

- Air Source Heat Pumps, as shown in the image on the right below
- Photovoltaic Panels, as shown in the image on the left below



9.1.4 Summary

In summary, the commercial office building emission rate is lower than the target emissions rate and passes criterion 1 as follows: **(The following BRUKL results relate to a RIBA stage 2 design and will be subject to a design development due to the next RIBA stages. The results produced are run off the new Part L 2021 building regulations).**

Target CO ₂ emission rate (TER), kgCO ₂ /m ² . annum	3.79	
Building CO ₂ emission rate (BER), kgCO ₂ /m ² . annum	3.11	
Target primary energy rate (TPER), kWh/m ² .	41.45	
Building primary energy rate (BPER), kWh/m ² /yr	33.93	
Do the buildings emission and primary energy rates exceed the targets?	BER=<TER	BPER=<TPER

The proposed option provides a 17.94% improvement over Part L 2021 baseline calculation. Based on heating and domestic hot water generation via air source heat pumps combined with photovoltaic panels for electricity on site generation.

The BRUKLS for the results are shown in appendix 1 of this report.

9.2. Student Accommodation

This report has set out the methodology in which the design team have approached the design of the proposed residential building and how the strategies of Manchester City Council and the Government guidelines have been adopted.

9.2.1 Passive Measures – Lean

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

- Target U-values that exceed minimum Building Regulation Standards as below

Building Fabric Element	Target U-Value (w/m ² K)	Limiting U-Value (w/m ² K)	G-Value
Windows	1.6	1.6	0.4
Exposed Floors	0.13	0.18	
Roof	0.15	0.18	

- Target Air leakage rates that exceed minimum Building Regulations

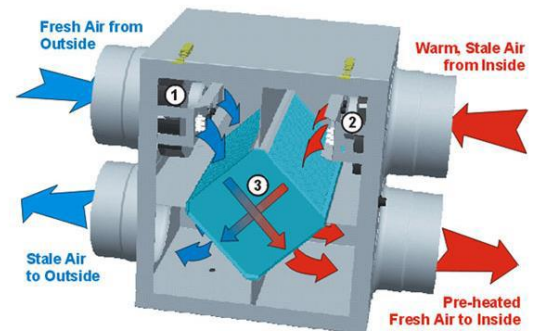
Air Permeability	Worst acceptable standard	This building
M ₃ /(h.m ²) at 50 Pa	8	3

- Improved glazing specification (G Value of 0.4) that limits the amount of unwanted solar gain to avoid overheating

9.2.2 Energy Efficiency Measures – Mean

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 student accommodation and amenity mechanical ventilation systems, as shown in the image to the right.
- Low specific fan power ratings to ventilation fans
- High efficiency LED lighting throughout
- Demand operated lighting
- Variable speed drives
- Air source heat pumps to generate low carbon heating and hot water for the development



9.2.3 Renewable and Low Carbon Technologies – Green

The final aspect of the design has been to establish what renewable and low carbon technologies can be adopted. Following the appraisal of the building and site rooftop air source heat pumps will be used to generate heating and hot water for the development.



9.2.4 Summary

In summary, the student accommodation building emission rate is lower than the target emissions rate using block compliance and the design fabric energy efficiency is better than the target fabric energy efficiency.

(The following BRUKL results relate to a RIBA stage 2 design and will be subject to a design development due to the next RIBA stages. The results produced are run off the new Part L 2021 building regulations).

Target CO2 emission rate (TER), kgCO2/m2. annum	4.39
Building CO2 emission rate (BER), kgCO2/m2. annum	3.82
Target primary energy rate (TPER), kWh/m ² .	46.8
Building primary energy rate (BPER), kWh/m2/yr	40.85
Do the buildings emission and primary energy rates exceed the targets?	BER=<TER BPER=<TPER

The proposed option provides a 12.98% improvement on current Part L target emission rate baseline calculation.

The BRUKLS for the results are shown in appendix 2 of this report.

10. OVERALL SUMMARY

This report has discussed the energy strategy for the and Commercial and Student Accommodation developments at One Medlock Street, reviewed and proposed low and zero carbon technologies, and presented the results from the thermal modelling.

Part L 2021 building regulations generally require a 27% reduction over the Part L 2013 CO₂ emissions for non-domestic buildings. Using modelling software we have shown that both buildings have passed Part L 2021 which demonstrates improvements over Part L 2013 as the notional CO₂ target emissions improved by 27% between the regulations.

These results show the commercial office building achieves a betterment of 17.94% over the notional building and the student accommodation building emission rate achieves a betterment of 12.98% over the notional building.

Our strategy has sought to reduce the carbon emissions for the buildings using a lean, mean green approach and these findings have been applied to each building.

The proposals presented also support the government's and local authorities' policy on phasing out fossil fuels and as the grid decarbonises further and will offer more carbon reduction towards net zero carbon.

11. APPENDIX 1

Commercial office BRUKL

The following BRUKL results relate to a RIBA stage 2 design and will be subject to a design development due to the next stages. The results produced are run off the new Part L 2021 building regulations.

Air Source Heat Pumps for Heating and Domestic Hot Water with Photovoltaics for Electricity Generation

BRUKL Output Document

 HM Government

Compliance with England Building Regulations Part L 2021

Project name

One Medlock Street Office - 100m2 pv

As designed

Date: Tue Oct 18 13:57:43 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache
Calculation engine version: 7.0.16
Interface to calculation engine: IES Virtual Environment
Interface to calculation engine version: 7.0.16
BRUKL compliance module version: v6.1.c.0

Certifier details

Name: TEST000000
Telephone number: Phone
Address: Street Address, City, Postcode

Foundation area [m²]: 2183.98

The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	3.79
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	3.11
Target primary energy rate (TPER), kWh/m ² annum	41.45
Building primary energy rate (BPER), kWh/m ² annum	33.93
Do the building's emission and primary energy rates exceed the targets?	BER <= TER BPER <= TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _{calc}	U _{calc}	U _{calc}	First surface with maximum value
Walls*	0.26	0.21	0.3	NR00001F:Surf[30]
Floors	0.18	0.18	0.18	NR00003E:Surf[17]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	0.18	0.18	00000331:Surf[0]
Windows** and roof windows	1.6	1.3	1.3	NR00005C:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors ⁴	1.6	1.6	1.6	NR00000C:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

U_{calc} = Limiting area-weighted average U-values [W/m²K]

U_{calc} = Calculated area-weighted average U-values [W/m²K]

U_{calc} = Calculated maximum individual element U-values [W/m²K]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

⁴ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	3

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m ²]	35534.4	35534.4		Retail/Financial and Professional Services
External area [m ²]	19919.9	31861.9		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	MAN	MAN	100	Offices and Workshop Businesses
Infiltration [m ³ /hm ² @ 50Pa]	3	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	11857.1	11314.6		Storage or Distribution
Average U-value [W/m ² K]	0.50	0.36		Hotels
Alpha value* [%]	24.38	10		Residential Institutions: Hospitals and Care Homes
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging				Residential Institutions: Residential Schools
				Residential Institutions: Universities and Colleges
				Secure Residential Institutions
				Residential Spaces
				Non-residential Institutions: Community/Day Centre
				Non-residential Institutions: Libraries, Museums, and Galleries
				Non-residential Institutions: Education
				Non-residential Institutions: Primary Health Care Building
				Non-residential Institutions: Crown and County Courts
				General Assembly and Leisure, Night Clubs, and Theatres
				Others: Passenger Terminals
				Others: Emergency Services
				Others: Miscellaneous 24hr Activities
				Others: Car Parks 24 hrs
				Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	2.12	1.73
Cooling	3.64	3.35
Auxiliary	8.54	8.98
Lighting	7.53	10.51
Hot water	3.39	3.6
Equipment*	34.6	34.6
TOTAL**	25.21	28.17

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
 ** Total is net of any electrical energy displaced by CHP generation, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	2.53	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	2.53	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	88.72	73.18
Primary energy [kWh/m ²]	33.93	41.45
Total emissions [kg/m ²]	3.11	3.79

12. APPENDIX 2

Student Accommodation BRUKL

The following BRUKL results relate to a RIBA stage 2 design and will be subject to a design development due to the next stages. The results produced are run off the new Part L 2021 building regulations.

Air Source Heat Pumps for Heating and Domestic Hot Water

BRUKL Output Document HM Government Compliance with England Building Regulations Part L 2021

Project name

One Medlock 2021 ASHP

As built

Date: Wed Sep 07 16:17:44 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

BRUKL compliance check version: v0.1.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 742.6

The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	4.39
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	3.82
Target primary energy rate (TPER), kWh/m ² annum	46.8
Building primary energy rate (BPER), kWh/m ² annum	40.85
Do the building's emission and primary energy rates exceed the targets?	BER =< TER BPER =< TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _{av} Limit	U _{av} Calc	U _{av} Calc	First surface with maximum value
Walls*	0.26	0.15	0.15	GM000000:Surf[3]
Floors	0.18	0.13	0.13	GF000002:Surf[0]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	0.15	0.15	GM000001:Surf[0]
Windows** and roof windows	1.6	1.6	1.6	GM000000:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors ^Δ	1.6	1.6	1.6	GM000001:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

U_{av} Limit = Limiting area-weighted average U-values [W/(m²K)]

U_{av} Calc = Calculated area-weighted average U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

^Δ For fire doors, limiting U-value is 1.8 W/(m²K).

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	3

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Technical Data Sheet (Actual vs. Notional Building)			
Building Global Parameters			Building Use
	Actual	Notional	% Area Building Type
Floor area [m²]	30439.3	30439.3	Retail/Financial and Professional Services
External area [m²]	17838.1	17838.1	Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	MAN	MAN	Offices and Workshop Businesses
Infiltration [m³/hm² @ 50Pa]	3	3	General Industrial and Special Industrial Groups
Average conductance [W/K]	15785.6	11302	Storage or Distribution
Average U-value [W/m²K]	0.88	0.63	Hotels
Alpha value* [%]	25.08	10	Residential Institutions: Hospitals and Care Homes
			Residential Institutions: Residential Schools
			100 Residential institutions: Universities and Colleges
			Secure Residential Institutions
			Residential Spaces
			Non-residential Institutions: Community/Day Centre
			Non-residential Institutions: Libraries, Museums, and Galleries
			Non-residential Institutions: Education
			Non-residential Institutions: Primary Health Care Building
			Non-residential Institutions: Crown and County Courts
			General Assembly and Leisure, Night Clubs, and Theatres
			Others: Passenger Terminals
			Others: Emergency Services
			Others: Miscellaneous 24hr Activities
			Others: Car Parks 24 hrs
			Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]		
	Actual	Notional
Heating	7.36	12.51
Cooling	0.32	0.21
Auxiliary	5.99	4.65
Lighting	7.7	8.56
Hot water	5.63	6.11
Equipment*	33.62	33.62
TOTAL**	27.01	32.04

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
 ** Total is net of any electrical energy displaced by CHP generation, if applicable.

Energy Production by Technology [kWh/m²]		
	Actual	Notional
Photovoltaic systems	0	0.69
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	0	0.69

Energy & CO ₂ Emissions Summary		
	Actual	Notional
Heating + cooling demand [MJ/m²]	95.41	69.4
Primary energy [kWh/m²]	40.85	46.8
Total emissions [kg/m²]	3.82	4.39

The analysis supporting this report was carried out by a competent person who is a Chartered Engineer with IMechE, Low Carbon Consultant (LCC) and Level 3,4 and 5 IES DSM qualified.

Name of Assessor: Adam Imrie



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