Energy and Carbon Statement

Plot H, Charles Street

25-011

December 2025

Rev 3

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0 INTRODUCTION

This Energy and Carbon Statement has been prepared by HGCE Ltd on behalf of RGRE Ltd, ID Manchester Ltd and The University of Manchester ('the Applicants') in support of an application for full planning permission for the redevelopment of the multi storey car park located on Charles Street, Manchester, M1 7AR ('the Site').

The proposed development comprises Purpose Built Student Accommodation (PBSA) with ground floor flexible commercial floorspace across three buildings of 8, 10 and 38 storeys, with a two-storey podium.

This 0.742 hectare site in Manchester City Centre is bounded by Charles Street (south), the Manchester South Junction and Altrincham Railway Viaduct and Granby Row (north), Sackville Street (east), and Princess Street (west). The site currently comprises a vacant multi-storey car park (closed October 2024) and three vacant retail units (last occupied June 2025). The car park and retail units are no longer fit for purpose and are subject to a planning application for demolition.

This statement has been produced to detail the strategy employed for the management of energy use and carbon dioxide emissions for the proposed development and describes how the strategy has been incorporated into the design of the building. The strategy follows the principles set out in the energy hierarchy, prioritising passive design measures, demonstrated by exceptional building fabric performance, optimised glazing specification and external shading. This allows the mitigation of overheating without the need for mechanical cooling in residential areas in tandem with the reduction in heating and cooling demands in communal and amenity areas of the building.

Following the maximisation of passive measures, high efficiency building services have been selected to ensure that the development makes optimal use of the energy it uses, followed by and appraisal of LZC technologies showing that photovoltaics and air source heat pumps can provide further energy and CO_2 emissions reductions.

Dynamic thermal modelling has been undertaken to quantify operational energy and carbon dioxide emissions and provide expected performance against the key metrics set out in the policies identified below.

The development comprises two uses, purpose-built student accommodation (sui generis) and ground floor commercial space across three separate units (Flexible Use Class E Commercial, Business and Service, excluding hot food). Although student accommodation is suggested to be reported against the residential KPIs, it is suggested in this case, as the building is assessed, not as individual dwelling units, but as a single managed building, the non-residential KPIs are more appropriate. This type of large-scale student accommodation includes significant amenity area and 24h managed accommodation. Although it may be appropriate for the inclusion of smaller scale, non-managed student accommodations in the "residential" definition, this development would be closer in nature to an aparthotel or serviced accommodation.

Furthermore, in respect of benchmarks, the UK Net Zero Carbon Building Standard (pilot) EUI limit for student residences, for a new building constructed in 2030 is 67kWh/m2 GIA. This standard is expected to be achievable by the top 5% of buildings and given the results from the pilot buildings,

which found that it was actually very difficult to meet the limit, fewer buildings are likely to meet the standard.

Due to the floor area of the PBSA element being above 1000m2, the “major developments” pro-forma applies.

In the case of the commercial units, the floor area of these is combined and falls within the “minor developments” bracket, so this pro forma will be used.

0.1 Applicable Policy Summary

0.1.1 Building Regulations

The Proposed Development will need to comply with Building Regulations AD Part L: Vol 2 England and Wales 2010 (2021 edition). These regulations (Conservation of fuel and power) are focused on limiting the carbon dioxide emissions and establish that the Building Emission Rate (BER) and Building Primary Energy Target (BPER) must not be greater than the Target Emissions Rate (TER) and Target Primary Energy Rate (TPER) set through the National Calculation Methodology (NCM)

0.1.2 National Planning Policy Framework (NPPF)

The Government’s National Planning Policy Framework (NPPF) (Dec 2024) covers a wide range of planning issues from promoting sustainable transport to facilitating the sustainable use of minerals. Climate change is covered in section 14 ‘Meeting the challenge of climate change, flooding and coastal change’.

New development should be planned for in ways that:

- Avoid increased vulnerability to the range of impacts arising from climate change. When new development is 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 standards.
- To help increase the use and supply of renewable and low carbon energy and heat, plans should:
    - Provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts).
    - Consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development.
    - Identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.”

Sustainable Development is achieved through the three pillars of sustainability integrated into the national planning framework:

Environmental: Addresses pollution control, habitat preservation, and responsible resource management.

Social: Promotes social equity, community well-being, and inclusive development.

Economic: Encourages responsible business practices, job creation, and long-term economic resilience.

Refer to: National Planning Policy Framework (2024) for further details.

0.1.3 Manchester Core Strategy -Adopted 2012-2027

The Manchester Core Strategy is the city's main planning document, guiding development until 2027. It sets out policies for sustainable growth, influencing decisions on housing, transport, employment, and the environment. Its purpose in planning applications is to ensure developments align with Manchester's long-term vision for economic and social growth while promoting sustainability and high-quality design. Proposals should support carbon reduction, well-connected communities, and the protection of green spaces and heritage assets. Developers must demonstrate how their plans meet these policies to secure approval.

Policy EN4

Policy EN4 of Manchester's Core Strategy focuses on reducing CO_2 emissions by enabling low and zero carbon development. Beyond the emphasis on the energy hierarchy, the policy encourages developments to integrate on-site renewable energy generation, such as solar panels or wind turbines, to supply a portion of their energy needs. It supports the development and connection to district heating networks, which distribute heat generated from a central source to multiple buildings, improving energy efficiency. The policy also promotes the use of low-carbon technologies, including combined heat and power systems and heat pumps. Additionally, it advocates for retrofitting existing buildings with energy-efficient measures to reduce their carbon footprint. These initiatives aim to facilitate the transition to a low-carbon city by integrating sustainable energy solutions into both new and existing developments.

The development adheres to the energy hierarchy by integrating highly efficient thermal elements, which reduces the heating demand of the building and therefore lowing the energy consumption. The use of renewable technologies has been incorporated into the design and an LZC feasibility study forms as part of this energy strategy. Air Source Heat Pumps have been included for the domestic hot water, and photovoltaic panels have been included into the roof plan, utilising space where possible. The development cannot connect to an existing district network due to practical constraints, however sustainability is at the forefront of the design with low energy lighting and highly efficiency heat recovery systems integrated, meeting the policy requirements.

Policy EN5

Policy EN5 of Manchester's Core Strategy focuses on promoting renewable energy within the city. It encourages the integration of renewable energy technologies, such as solar panels and wind turbines, into new developments and existing structures. The policy also supports the establishment of district heating networks and other decentralised energy systems to enhance energy efficiency and reduce carbon emissions. Additionally, EN5 advocates for retrofitting existing buildings with energy-efficient measures to improve their environmental performance. These initiatives aim to

transition Manchester towards a more sustainable, low-carbon future by incorporating renewable energy solutions into urban planning and development.

As referenced in the previous section, renewable technologies have been incorporated where feasible, and this has been especially utilised in place of district heating to show that the design has fully considered carbon reduction.

The development achieves a reduction over Approved Document L 2021 ensuring compliance with the current building regulations and improving upon them.

Policy EN6

Policy EN6 of Manchester's Core Strategy sets out a framework for reducing CO_2 emissions through the use of low or zero carbon energy supplies in new developments. It establishes a series of targets for CO_2 reduction relative to Building Regulations, encouraging developers to adopt measures that contribute to a more energy-efficient built environment. The policy supports the integration of renewable energy technologies, such as solar panels and heat pumps, alongside improvements to building design to minimise energy demand. Additionally, it promotes the development of decentralised energy networks, including district heating systems, to enhance energy efficiency and reduce reliance on fossil fuels. By implementing these measures through the incorporation of the energy hierarchy, Policy EN6 aims to facilitate Manchester's transition to a low-carbon future, ensuring that new developments contribute to the city's sustainability and emissions reduction goals.

Similar to that of the other policies referenced under the core strategy, this development adheres to the energy hierarchy to ensure passive design considerations to reduce energy consumption through lower demand. Furthermore, the development has adopted two types of renewable technologies to ensure carbon reduction and utilise the technologies available to support Manchester's goals to push towards a more sustainable city.

An addendum to the Core Strategy was published in 2024 identifying the policies which have been partially replaced by the Places for Everyone policies.

0.1.4 Manchester City Council Local Plan

Manchester City Council published a draft Regulation 18 Local Plan for consultation in September 2025. Given the early stages of preparation, this carries limited weight.

0.1.5 Places for Everyone joint development plan – adopted 2024-2039

Places for Everyone is a joint development plan for nine Greater Manchester boroughs, and forms part of the development plan for Manchester City Council, alongside the Manchester Core Strategy. It sets out a strategic framework for housing, employment, infrastructure, and the environment up to 2039, with a focus on sustainable growth and reducing carbon emissions.

It provides a broader, region-wide approach to development, ensuring consistency across Greater Manchester. While the Core Strategy focusses specifically on Manchester, Places for Everyone introduces a unified vision for the wider city-region, shaping future planning decisions and policies at a higher level.

JS – S1 Sustainable Growth

This policy focuses on ensuring that Greater Manchester's growth is balanced, sustainable, and inclusive. It encourages developments that provide a mix of homes, jobs, and community amenities, while prioritising environmental protection and social wellbeing. Specific to energy efficiency, it is expected that the development will apply a Net Zero approach to the carbon emissions as laid out under the UK Green Building Council. Unregulated energy should be reported with regulated energy and new developments must follow the energy hierarchy, with any carbon emissions remaining after this has been demonstrated, offset through payment.

The development has been shown to adhere to the UK Green Buildings council with a yearly energy consumption of 55kWh/sqm/yr. The energy consumption is based off a baseline operational model produced with guidance from Unite Students, the Cumming group and historic data. A full CIBSE TM54 analysis will be undertaken at a later stage to ensure the development remains in line with the results produced in this report and that the operation of the building does not exceed the target.

JS – S2 Carbon and Energy

This policy sets a clear ambition for Greater Manchester to become a zero-carbon city-region by 2038. It requires new developments to contribute to reducing carbon emissions through energy efficiency measures, the integration of renewable energy sources, and the use of low-carbon technologies. The aim is to drastically reduce the city's overall carbon footprint by ensuring that all new developments meet high environmental standards. From adoption of this plan, new developments must be ‘Net Zero’ as defined by the UK Net Zero Carbon Buildings Standard, if technically feasible. All non-residential developments must achieve BREEAM ‘Excellent’ for ENE01 and demonstrate how the site has reduced carbon emissions, along with overheating risks.

As mentioned regarding the previous development, there is a target to be Net Zero where feasible and this development shows achievement of this through a low heating demand and good management of energy consumption. The development also achieves BREEAM ‘Excellent’ as required and complies with Approved Document O to mitigate overheating through daytime natural ventilation and boosted ventilation at night when needed.

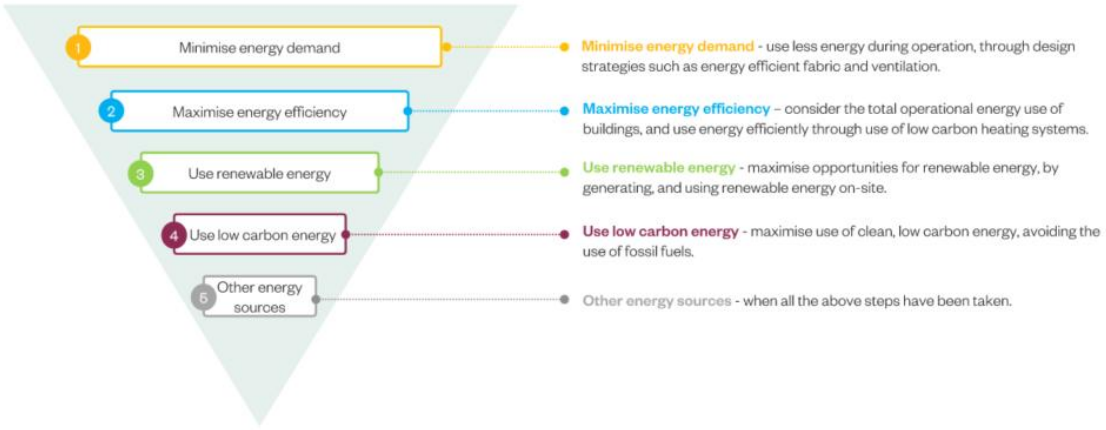
JS – S3 Heat and Energy Networks

This policy promotes the use of district heating systems and local energy networks to provide sustainable energy solutions across the region. It encourages new developments to connect to existing or planned heat networks, which can significantly reduce carbon emissions and improve energy efficiency. The policy supports the development of resilient, low-carbon energy infrastructure to help meet the region’s long-term energy needs and ensure that growth is supported by sustainable energy systems. New residential schemes that exceed 1000m2 must connect to existing or planned network if 500m within network unless able to provide effective alternative to reducing carbon emissions or if not financially/practically viable.

This development is over 500m away from any existing or proposed network and would also require major infrastructure works in order to reach the Proposed Site. With this in mind, the development is not required to provide viability to connect in the future to new District Heat Networks.

0.2 Energy Hierarchy

The image below shows the Places for Everyone energy hierarchy with each section of the report, focused on a specific level of the pyramid. The energy and carbon proforma, shown in the next section, reports against the KPIS of each stage of the hierarchy.



0.3 Energy and Carbon Proforma

Energy and Carbon Proforma
Non-residential
Major development *(+1,000m²)*

GMCA GREATER MANCHESTER COMBINED AUTHORITY

Version 1.0

Project Name: Plot H, Charles Street
Application ref:
Date:

		Ref. name	PBSA	Commercial Units
		Area (m²GIA)	33,949	612
		Target values	**Building 1**	**Building 2**
Minimise energy demand	**Space heating demand (kWh/m²GIA/yr)**	***≤ 15***	16.6	20
	Space cooling demand (kWh/m²GIA/yr)	***≤ 15***	2.8	31.2
	Calculation methodology used to calculate space heating demand and confirmation that this covers all homes/blocks	*Predictive energy model*	TM54 Predictive Energy Modelling	TM54 Predictive Energy Modelling

	Form factor per building	*≤ 2*	0.65	1.72
	Average external wall U-value (W/m²K)	*≤ 0.15*	0.14	0.14
	Average window U-value (W/m²K)	*≤ 1 (triple)*	1.00	1.00
	Air permeability rate (m³/h/m² @ 50 Pa)	*≤ 1*	3.0	3.0
Maximise energy efficiency	**BREEAM Ene 01 rating**	***Excellent***	Excellent	Very Good
	Energy use intensity (kWh/m²GIA/yr)	-	85	173
	Calculation methodology used to calculate energy use intensity and confirmation that this covers all homes/blocks	*Predictive energy model*	TM54 Predictive Energy Modelling	TM54 Predictive Energy Modelling
Use renewable energy	**PV footprint area (% of ground floor space)**	**-**	23%	0%
	Annual renewable energy generation (kWh/m² building footprint/yr)	-	50.7	0
	Renewable energy balance (%)	-	4.88	0
	Total energy used (kWh/yr)	-	1,763,952	25,666
	Total energy generated on-site (kWh/yr)	-	86,068	0
Use low carbon energy	**Fossil fuel free (yes/no)**	***Yes***	Yes	Yes
	Heat source	*Electric*	Electric	Electric
	Low Carbon Heat Appraisal completed	*Yes*	Yes	Not required
	Heat network suitability	-	No	
	Exemption requested	-	Yes	
	Efficiency of heating system (SCOP)	*≥ 3.5*	1.0	
	Carbon content of heat (gCO_2/kWh)	*≤ 100*	139	
Reduce overheating risk	**Has CIBSE TM52 been used to calculate overheating and does the building pass?**	***Yes***	No, TM59 has been used due to residential nature of the habitable areas	N/A – no naturally ventilated spaces
	What percentage of spaces are cooled? (% of GIA)	-	4%	100%

	Has a CIBSE TM52 assessment been carried out using DSY2 and DSY3 weather files? Have any additional passive measures been included as a result?	*Yes*	TM59	Not required
Minimise embodied carbon	**Upfront embodied carbon ($kgCO_2e/m^2GIA$)**	**-**	765	
	List top three materials with the highest upfront embodied carbon emissions ($kgCO_2e/m^2GIA$): Material 1	-	Ready-mix concrete (14%)	Included in building 1 figures
	Material 2	-	Furniture (11%)	
	Material 3		Electrical appliances (9%)	
	Lifecycle embodied carbon ($kgCO_2e/m^2GIA$) - *for large major developments only*	-	1,273	
Offsets	**Offset contribution (£)**	**-**	-	-

1 BUILDING FABRIC AND VENTILATION

The building form has been designed to optimise thermal performance and reduce heat loss through a compact envelope, efficient glazing strategy and efficient ventilation incorporating heat recovery. Local shading from façade articulation and decorative panels are modelled to ensure accurate representation of solar gains.

1.1 BUILDING FORM FACTOR

Form factor in building refers to the ratio of a building's external surface area to its internal heated floor area, which is a key metric for energy efficiency. A lower form factor indicates a more compact building shape, which is more energy-efficient because it has less surface area for heat to escape.

The calculated form factors for each area of the building are calculated below:

	Student Accommodation	**Commercial Units**	**Combined**
GIFA (m2)	33,949	612	34,561
External SA (m2)	22,216	1,051	23,267
Form Factor	0.65	1.72	0.67

1.2 BUILDING FABRIC STANDARDS

The table below details the proposed building fabric standards and compares these against the Part L notional building properties from the National Calculation Methodology (NCM).

Building Fabric		**Units**	**Proposed Building**	**Notional Building**
External Walls		$W/m^2.K$	0.14	0.18
Ground floor		$W/m^2.K$	0.15	0.15
Roof		$W/m^2.K$	0.10	0.15
Glazing (inc. frame)	u-Value	$W/m^2.K$	1.00	1.40
	g-value (generally)	$W/m^2.K$	0.32	0.29
	g-value (North elevation)	$W/m^2.K$	0.42	0.29
	g-value (amenity spaces)	$W/m^2.K$	0.25	0.29
Air tightness		$m^3/m^2.h$ @ 50 Pa	3.0	3.0

1.3 VENTILATION DESIGN

Reference should be made to the HGCE ventilation and extraction statement for full details of the ventilation proposals for the development. The Ventilation Statement has been prepared to illustrate the proposed ventilation designs. It addresses the building regulation requirements described within Approved Document Part F, 2021 for ventilation to the various elements of the proposed development.

The statement also highlights the provision of a complete, energy efficient, fully working and balanced ventilation systems that will:

- Deliver sufficient outdoor fresh air to occupants;
- Deliver good indoor air quality;
- Ensure acceptable internal noise levels are not exceeded;
- Assist in the removal of heat gains;
- Remove odours, contaminants and moisture;
- Assist in avoidance of summertime overheating;
- Provide summertime night time cooling of the building fabric when required;
- Provide an easily controlled and maintainable system;
- To recover heat from the exhaust air stream for re-use in the fresh air supply.

The ventilation statement demonstrates how the proposed systems aid in providing an efficient envelope and contain intelligent building services reducing the environmental impact of the proposed development whilst providing comfortable living and working accommodation.

2 MAXIMISE ENERGY EFFICIENCY

The proposed servicing strategy for the development takes full advantage of the ongoing decarbonisation of the UK electrical distribution network. The energy efficiency measures and servicing strategy for each area of the building is set out in the table below:

Energy Use	PBSA		Commercial Units
	Residential Areas	Amenity Areas	
Heating	Electric panel heaters	Variable refrigerant flow systems	Variable refrigerant flow systems
Cooling	None	Variable refrigerant flow systems	Variable refrigerant flow systems
Hot Water	CO_2 air source heat pumps	Point of use electric heaters	Point of use electric heaters
Ventilation	MVHR units	Central AHU with heat recovery and demand-controlled ventilation	MVHR units
Lighting	High efficacy luminaires up to 135 lm/c.W	High efficacy luminaires up to 115 lm/c.W	High efficacy luminaires up to 115 lm/c.W
Lighting controls	Absence detection to residential corridors	Presence/absence detection to all areas	Presence/absence detection to all areas

The assumed system efficiencies of each energy use class are detailed in the following tables:

2.1 HEATING AND COOLING

Heating/Cooling System	Heating SCoP	Cooling SEER
Electric Panel Heaters	1.00	n/a
Variable refrigerant flow	6.00	11.00

2.2 VENTILATION

Ventilation System	SFP (W/l/s)	Heat recovery efficiency (%)
Studio MVHR	0.78	91%
Cluster MVHR	0.90	85%
Residential purge fans	0.20	n/a

Amenity Space AHU	1.50	80%
Commercial Unit MVHR	1.50	80%

2.3 DOMESTIC HOT WATER

DHW System	SCoP	Storage volume (litres)	Storage losses (kWh/l/day)	Secondary circulation loop length (m)	Secondary circulation losses (W/m)
CO_2 heat pump (PBSA)	3.8	0	0	4000	6
POU water heaters (Amenity)	1.0	0.05	n/a	n/a	n/a
POU water heaters (Commercial)	1.0	0.05	n/a	n/a	n/a

2.4 ENERGY AND CARBON EMISSIONS – RESULTS

Compliance methodology

A Part L2A model has been created using approved software package IES VE 2025 by an experienced Energy Assessor. In terms of Part L2A assessment methodology, testing compliance translates into comparing Actual and Notional building carbon emissions represented by calculating the Building Emission Rating (BER) and Target Emission Rating (TER). To achieve minimum compliance, the BER for the proposed building must be lower than its relevant TER in line with Part L of Building Regulations. The CO_2 emission factors and primary energy factors for the electricity used from the building and the grid-displaced electricity by generation from PV systems, are defined in Table 30 and 31 of the NCM modelling guide respectively.

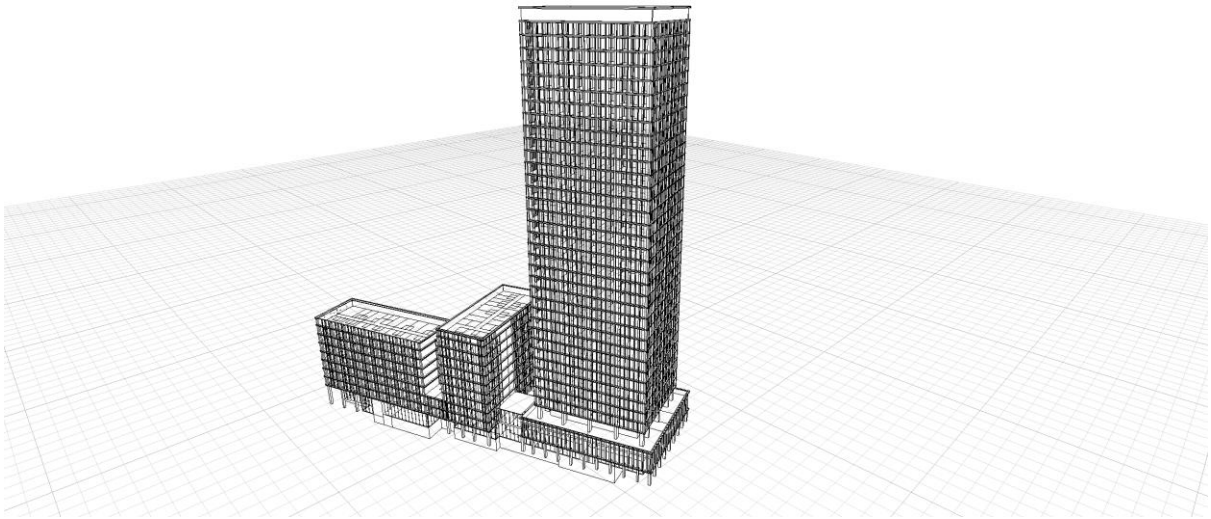
Table 30 CO_2 emission and primary energy factors for grid-supplied electricity and grid-displaced electricity EXCEPT that generated by PV systems

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
$kgCO_2/kWh$	0.163	0.160	0.153	0.143	0.132	0.120	0.111	0.112	0.122	0.136	0.151	0.163
kWh_{PE}/kWh	1.602	1.593	1.568	1.530	1.487	1.441	1.410	1.413	1.449	1.504	1.558	1.604

Table 31 CO_2 emission and primary energy factors for grid-displaced electricity by generation from PV systems

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
$kgCO_2/kWh$	0.196	0.190	0.175	0.153	0.129	0.106	0.092	0.093	0.110	0.138	0.169	0.197
kWh_{PE}/kWh	1.715	1.697	1.645	1.567	1.478	1.389	1.330	1.336	1.405	1.513	1.623	1.718

The energy assessment has been split to separate PBSA and commercial units. The image below shows the compliance model built for the energy assessment:



Student accommodation areas

The following table and graph show the calculated modelling results for student accommodation areas and how the proposed development performs against the various energy and CO2 emissions targets. This includes both regulated and unregulated energy use. Please refer to the BRUKL document at the end of this document for details.

Part L2 2021	Result	Comments
TER ($kgCO_2/m^2/annum$)	3.14	The building achieves a reduction in carbon emissions associated with regulated energy when compared to the Building Regulations notional building. This also in part demonstrates compliance with Part L2 of the Building Regulations.
BER ($kgCO_2/m^2/annum$)	2.85	
TPER ($kWh/m^2/annum$)	33.47	
BPER ($kWh/m^2/annum$)	30.05	
Heating energy use (kWh/m^2)	6.4	
Total energy use, EUI (kWh/m^2)	49.8	
BREEAM Ene01 rating	Excellent	7 No. credits achieved

Commercial units

The following table and graph show the calculated modelling results for the commercial units and how the proposed development performs against the various energy and CO2 emissions targets. This includes both regulated and unregulated energy use. Please refer to the BRUKL document at the end of this document for details. Note that the commercial units are to be delivered as “Shell and Core” subject to fit-out by incoming tenants.

Part L2 2021	Result	Comments
TER ($kgCO_2/m^2/annum$)	3.67	

BER ($kgCO_2/m^2$/annum)	2.82	The building achieves a reduction in carbon emissions associated with regulated energy when compared to the Building Regulations notional building. This also in part demonstrates compliance with Part L2 of the Building Regulations.
TPER (kWh/m^2/annum)	39.63	
BPER (kWh/m^2/annum)	30.2	
Heating energy use (kWh/m^2)	4.4	
Total energy use, EUI (kWh/m^2)	40.5	
BREEAM Ene01 rating	Very Good	0 No. credits achieved

2.5 PREDICTIVE ENERGY MODELLING

A further energy model has been produced by Buro Happold following the CIBSE TM54 methodology for predictive energy use and to establish the EUI figures presented in the proforma.

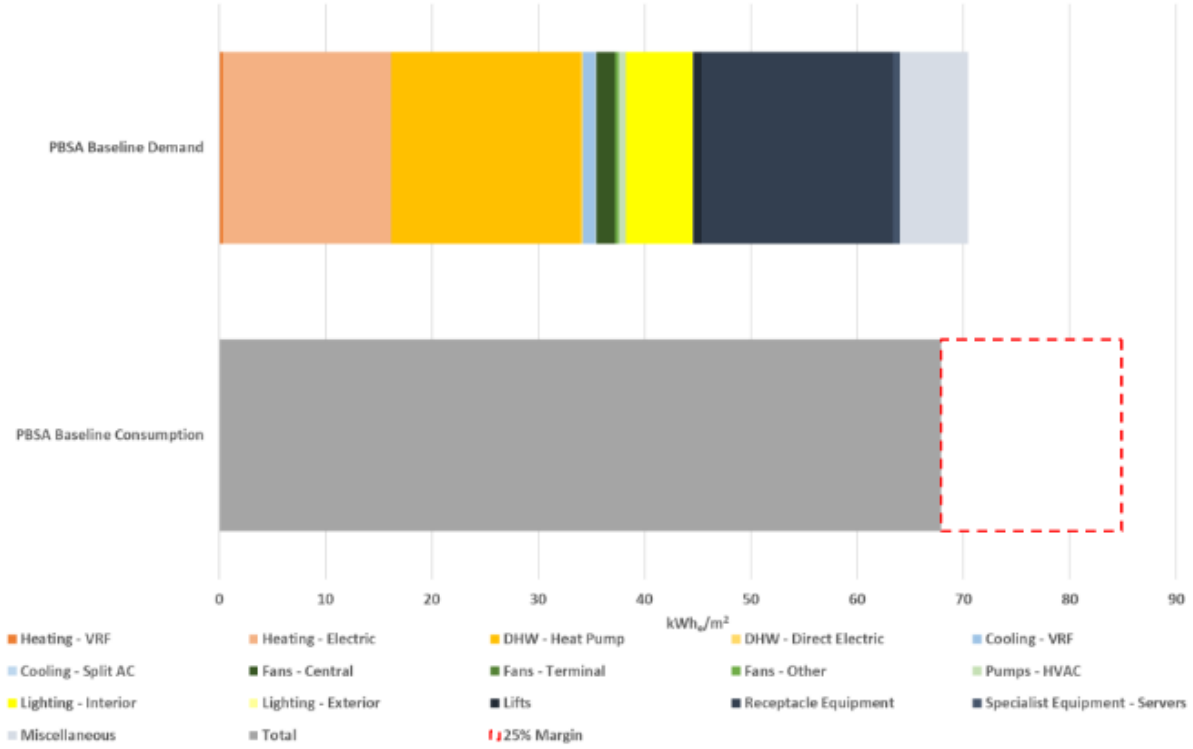
Full details of the model and the results can be found in the TM54 report, however a summary of the results are given below.

2.5.1 Student Accommodation (PBSA)

The estimate of the operational energy consumption of the PBSA based on RIBA Stage 2 design information predicts:

- An EUI of between 71 and 88 kWh/m2 GIA representing the range that could be expected when operating the building varying usage. This is without the benefit from the PV.
- When including the benefit from the on-site energy generation from PV, the EUI reduces between 68 and 85 kWh/m2 GIA representing the range that could be expected when operating the building varying usage.
- Space heating and domestic hot water along with the small power equipment were predicted to contribute ¾ of the energy use.
- The use of mechanical ventilation with heat recovery for fresh air in the heating season with opening windows for purge ventilation only was a key feature.

The figure below, courtesy of Buro Happold, illustrates the predicted energy breakdown for the PBSA element of the development:

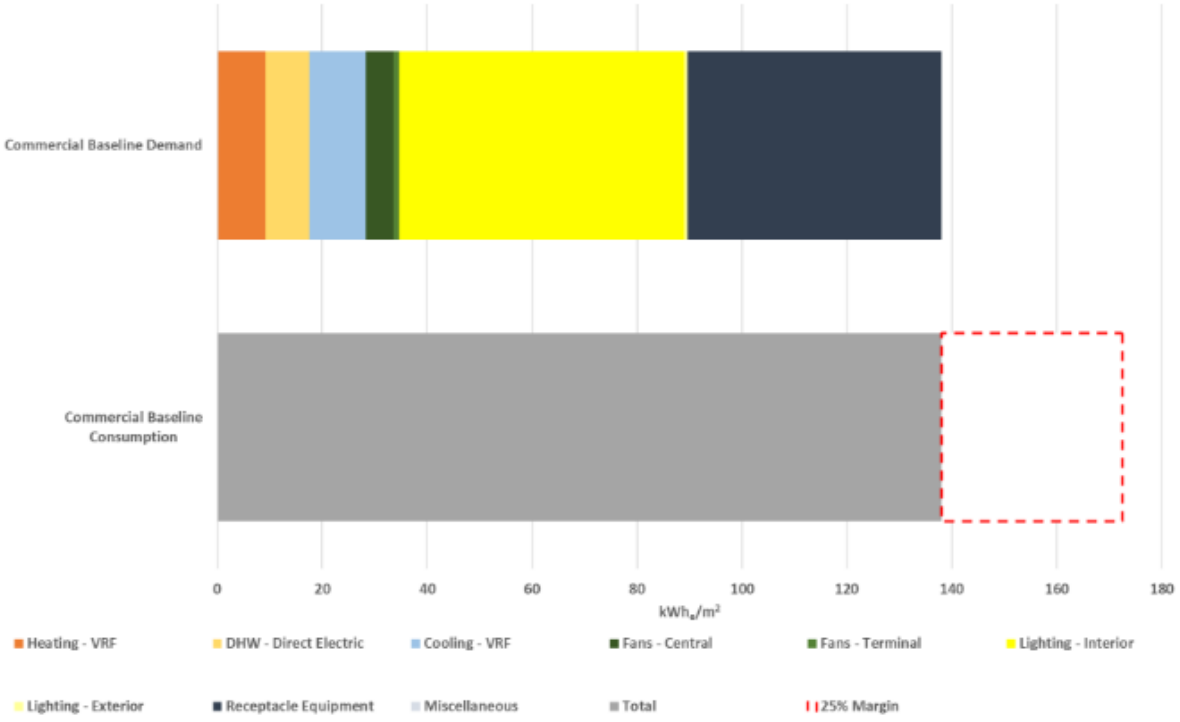


2.5.2 Commercial Units

The estimate of the operational energy consumption of the PBSA based on RIBA Stage 2 design information for a mix of sales typologies predicts:

- An EUI of between 138 and 173 kWh/m2 GIA representing the range that could be expected when operating the building varying usage.
- Small power equipment and lighting (including display lighting) to be the biggest energy consumers as they contribute ¾ of the total energy use.

The figure below, courtesy of Buro Happold, illustrates the predicted energy breakdown for the commercial element of the development:


Commercial Baseline Demand
Commercial Baseline Consumption
0
20
40
60
80
100
120
140
160
180
kWh$_e$/m^2
Heating - VRF
DHW - Direct Electric
Cooling - VRF
Fans - Central
Fans - Terminal
Lighting - Interior
Lighting - Exterior
Receptacle Equipment
Miscellaneous
Total
25% Margin

3 RENEWABLE ENERGY GENERATION

The proposed building is designed to be all-electric with no reliance on gas or fossil-fuels for any HVAC use. The use of heat pumps for hot water generation and direct electric panel heaters will take advantage of the decarbonisation of the grid. An appraisal of the most appropriate renewable energy technologies is presented in the following section and covers true renewable energy generating technologies only. LZC technologies assessed for heating are discussed in the low carbon heating appraisal section of this report.

3.1 Wind Turbines

System Description

Wind turbines are modern, high-technology descendants of the old technology windmills that have been around for centuries. The difference is that now the kinetic energy of the wind is used to turn a turbine to generate electricity as opposed to moving water or turning a grist mill wheel. There are two types of wind turbine, one being the horizontal-axis variety which faces up-stream or downstream of the wind and where the rotational movement of the blade is connected to a generator to create electricity. The other type is the vertical-axis design, which is the most flexible type of wind turbine and is best suited for the more urban sites as it operates in any wind direction.

Summary of Factors Affecting Wind Turbines	
Land Use	Foundation unless building mounted
Planning Issues	Potentially a problem with gaining planning permission
Noise	Problematic
Tariffs	Historic – FiT 8.46 (4.91 for export) pence/kWh. Current – Smart Export Guarantee (SEG) came into effect 1st January 2020, variable payment rate, contract length, etc.



Horizontal-axis wind turbine



Vertical Axis Wind Turbine

Technical Viability

One of the big issues with wind turbines is the available wind speed. Apart from the direction, approximately 4.0 m/s wind velocity is required as a minimum before the turbine will begin to generate electricity. Additionally, if this option were used for this development, the building would need wind turbines protruding from the roof. Wind turbines in urban centres can generate acoustic complaints from both the occupants and the surrounding commercial / residential units.

Commercial Viability

Depending on initial wind turbine costs, energy production, and maintenance costs, return on investment can vary widely from 12-20 years, as the suggested minimum payback period in Part L is 15 years it is not certain that the installation of building mounted wind turbines can be considered commercially viable.

Wind turbines are therefore not recommended for this development.

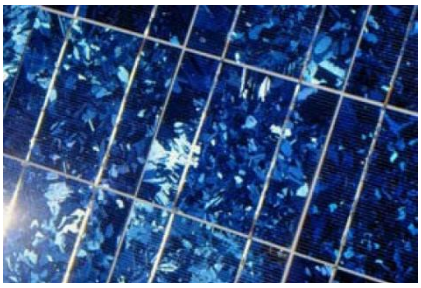
3.2 Solar Photovoltaic Panels

System Description

Solar photovoltaics panels (PVs) convert energy from daylight into electricity using a semiconductor material such as silicon. When light hits the semiconductor, the energy in the light is absorbed, 'exciting' the electrons in the semiconductor so that they break free from their atoms. This allows the electrons to flow through the semiconductor material producing electricity.

Summary of Factors Affecting Photovoltaics	
Land Use	No land use (roof mounted)
Planning Issues	Potential issue if located in visible position. Can be located in discrete position.
Noise	None
Tariffs	Historic – FiT 2.38 (4.91 for export) pence/kWh. Current – Smart Export Guarantee (SEG) came into effect 1st January 2020, variable payment rate, contract length, etc.


Rooftop Installation


PV Cells


Solar Glass

Technical Viability

Solar PV panels are best mounted at an incline with a southerly orientation, although orientations between south-east and south-west are viable. This technology can benefit from the SEG.

Due to the high-rise nature of the proposed development, the available roof space is limited and shared with external plant, however, significant roof area is still available for the installation of PVs

Commercial Viability

Return on investment for PV systems is around 6 to 10 years. As the suggested minimum payback period in Part L is 15 years the installation of photovoltaics is considered commercially viable.

Photovoltaics are therefore a viable solution for the Proposed Development.

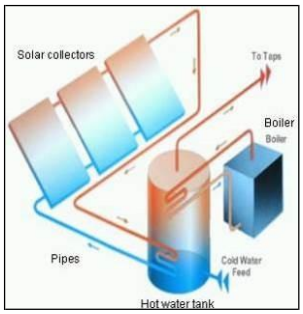
3.3 Solar Water Heating

System Description

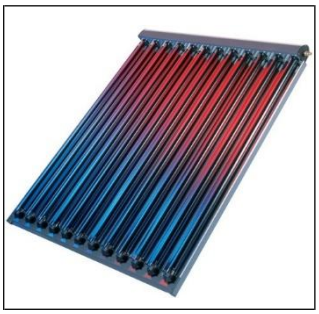
Solar Water Heating systems convert solar radiation to heat carried by water for use in space heating or the provision of domestic hot water. Solar water heating systems normally operate with a back-up source of heat, such as gas condensing boilers. The solar water heating pre-heats the incoming water, which is topped-up by the back-up heat source when there is insufficient solar energy to reach the target water temperature.

Solar collectors are best mounted at an incline with a southerly orientation, although orientations between south-east and south-west are acceptable. As solar radiation is greatest in the summer when demand is lowest, it is not possible to meet the entire annual demand by increasing the size of the system. It is therefore recommended that a solar hot water system meet no more than 75% of the domestic hot water demand.

Summary of Factors Affecting Solar Hot Water	
Land Use	No land use
Planning Issues	Potential issue if visible. Can be located in discrete location
Noise	None
Tariffs	Non-Domestic Renewable Heat Incentive 10.28 pence/kWh – Closed to new applicants on 31 March 2021.



System Diagram


Evacuated Tube Collector


Glazed Flat Panel Collector

Technical Viability

For a solar panel to perform efficiently, it should be positioned between a 15- and 60-degree incline. As solar radiation is greatest in the summer when demand is lowest, it is not efficient to try to meet the entire annual demand by increasing the size of the system. It is therefore recommended that a solar water heating system meet no more than 65% of the domestic hot water demand.

This technology can no longer benefit from the Renewable Heat Incentive.

Due to the high-rise nature of the proposed development, the available roof space is limited and is taken up by external plant and a more effective photovoltaic array.

Commercial Viability

Return on investment for solar thermal systems is around 5 to 10 years. As the suggested minimum payback period in Part L is 15 years the installation of solar thermal would be considered commercially viable.

Therefore, the installation of Solar Thermal panels is not a viable solution.

3.4 Battery storage

System Description

Battery storage systems are designed into schemes for several purposes including:

- Peak lopping
- Curtailment
- Optimising self-consumption
- Energy trading
- EV Charging
- Backup power

In relation to LZC technologies these storage systems allow on-site generated power to be stored for periods of time where the generation of power is low or not feasible due to environmental variables.



Containerised battery storage facility

Technical Viability

The scheme does generate power on-site, and as such, power storage could be useful, however, it is expected that the base demand of the site is close to or above the expected output of the photovoltaic array and as such, battery storage would not be required.

Battery storage is therefore not recommended for this development.

3.5 Proposed PV installation

The proposed development includes renewable energy generation from a photovoltaic array across each of the three roof areas. Please see appendix 2 for the proposed photovoltaic array arrangement. The table below shows the design parameters of the modelled PV array used in the thermal model.

Description	**Solar PV**
Azimuth	-21°
Slope	40°
Peak Output (kWp)	86.6
Array details	140No. 620 Wp bifacial 120 cell module (396 m^2)
PV area as percentage of ground floor area	23%

Expected annual renewable energy generation	86,068 kWh
Annual renewable energy generation per m^2 GIA	2.5 kWh/m^2
Annual renewable energy generation per m^2 building footprint	50.7 kWh/m^2
Balance between total energy use and renewable energy generation	4.9%
Shading constraints?	2m distance allowed between parapet for access and façade maintenance allows for minimal overshadowing
Data source	PVGIS

Lifecycle Cost

A lifecycle cost estimation for the PV array is presented below with the following inputs:

Estimated installation costs = £1,500 per kWp output

PV array size = 86.6 kWp

Installation cost = £129,900

Lifespan of installation = 20 years

Annual maintenance cost = £2,500

Lifetime maintenance cost = £50,000

Residual value = £0

End of life removal costs = £25,000

Annual energy generation = 86,068 kWh

Electrical import cost offset = 0.286 £/kWh

Lifetime energy savings = £492,309

Lifecycle cost = Installation cost + Lifetime maintenance cost + End of life costs – Lifetime energy savings – Residual value

= £129,900 + £50,000 + £25,000 - £492,309 - £0

= -£287,409

The lifecycle cost calculation therefore suggests an income of approximately £290k over the life of the PV installation.

4 LOW CARBON HEATING

The Plot H development will be an “all-electric” development and will have no reliance on fossil fuels. The following section of the report discusses the heating and hot water generation options considered and how the proposed solution of direct electric space heating and domestic hot water generated by air source heat pumps is derived. A justification is also given for the application for exemption for connection to a local low carbon heat network.

A low carbon heating appraisal is conducted for the student accommodation area of the building; however the commercial areas do not require the presentation of an appraisal as heat pumps are to be used.

The carbon intensity of electricity used in the following section is taken from the HM Treasury Green Book using an average carbon factor over the first 15 years from the anticipated 2030 building completion date (2030-2045) which represents the average carbon content of electricity over the heating system lifetime.

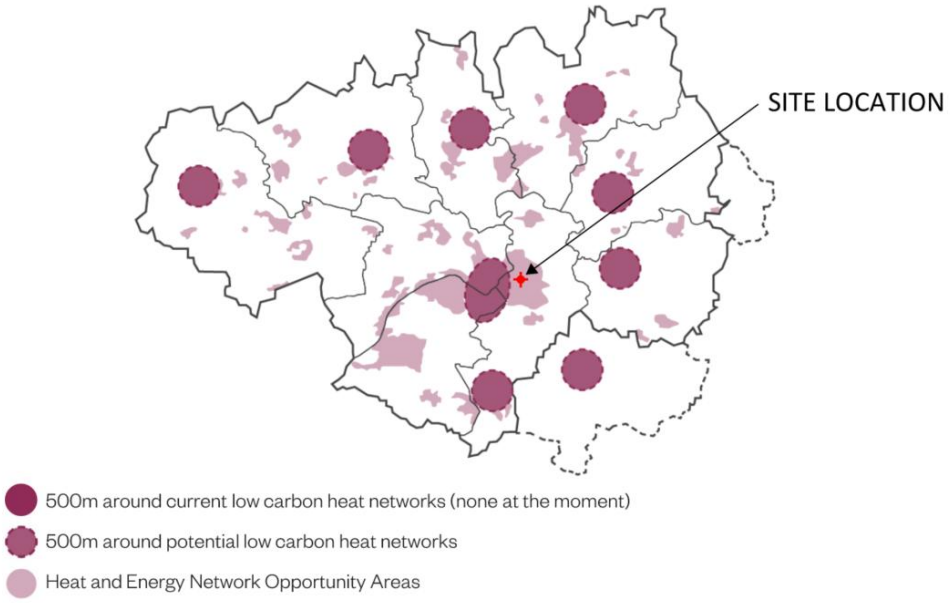
Grid-average, consumption-based factors for commercial/public sector is averaged over the timeframe to give an average carbon factor of 22 gCO2e/kWh.

4.1 LOW CARBON HEAT NETWORKS

The way in which Places for Everyone Policy JP-S3 is applied, depends on whether the proposed development site falls within a location defined by the following four cases:

- Case 1: the site is within 500m of an existing low carbon heat network
- Case 2: the site is within 500m of a planned low carbon heat network
- Case 3: the site is within a low carbon heat network opportunity area
- Case 4: any other location in Greater Manchester

The site location is overlaid onto the map Greater Manchester showing the three different types of heat network areas and shown below:



This illustrates that the site is within a heat network opportunity area but not within 500m of an existing or proposed low-carbon heat network. In this instance the low carbon heat appraisal will use case 3 as a basis for the assessment of the low carbon heat network option and the following steps should be taken:

1. As part of the low carbon heating appraisal, an option for a notional low carbon heat network with a carbon content of heat delivered of 100 gCO2/kWh is one of the options assessed as there may be such a network coming forward in the future.
2. Advice should be sought from MCC as to whether the site is now part of a formally designated heat network zone or not although it is recognised that designations are unlikely before 2027.

It is noted that the enabling of a future connection to a low carbon heat network is not required as the site has not been formally designated as a heat network zone due to the level of uncertainty and applicants are not expected to be constrained to this solution until a more formal plan is established.

4.2 APPRAISAL OF OPTIONS – STUDENT ACCOMMODATION AREAS

Several options for heat generation solutions for the student accommodation areas of the development have been considered, however, any heat sources which are considered incompatible with net zero have automatically been discounted, these include:

- Gas boilers
- Gas fired CHP
- Combustion of biomass

Building scale electrified solutions are assessed which include direct electric heating as well as source heat pumps.

The following solutions are assessed at high level to determine suitability to take forward any options to a detailed appraisal.

Technology	Functionality	Cost Effectiveness	Potential CO_2 savings	Potential suitability
Ground Source Heat Pumps (GSHPs) – generation of heat from the ground	Can be a very efficient way of heating a building, using the ground as a heat source. An efficient system can produce 3 to 4 units of heat for every unit of electricity used. Closed loop horizontal or vertical pipework systems required within the ground to utilise the ground as a heat source.	A medium sized system with an overall COP of 3 could be expected to achieve a payback of about 20 years. The ground works are the most expensive part of the system, while the heat pumps can be of a comparable price to conventional boilers.	Medium/High – high COPs are dependent on relatively low supply temperatures.	**No** – there is insufficient accessible ground space around the building to install a closed loop system. Also, given the city centre location of the site, the ground is unlikely to be free from obstructions, such as sewers and other services
Air Source Heat Pumps (ASHPs) – generation of heat from external air	COPs are inferior to that of GSHPs due to varying air temperatures. Also generate low grade heat typically used to serve LTHW systems. ASHPs work best when serving a steady base load and at a constant output. The building has suitable external roof space to locate ASHPs.	Capital cost is lower when compared to GSHP installations with similar capacities. A medium sized system with an overall COP of 2.5 could be expected to achieve a reasonable payback period.	Medium/High – depends on the size of system and COPs that can be achieved	**Yes** – this technology would be feasible as there is suitable plant space and can offer reasonable carbon savings.
Direct electric heating – electric panel heaters for space heating	Direct electric panel heaters provide fast acting space heating with high levels of controllability	Eliminating central LTHW distribution and large plant items leads to a cost-effective solution	n/a – considered to be the baseline solution in terms of appraisal	**Yes** – given the ongoing decarbonisation of the grid and cost effectiveness, this option is considered feasible.

Three main heating options are considered for the development, described as follows:

1. Direct electric heating using panel heaters with hot water generated by high temperature heat pumps using CO_2 as a refrigerant
2. Air source heat pumps providing both heating and hot water generation
3. The notional low carbon heat network as discusses in the previous section

The following table details the energy use assumptions used in assessing the heating options taken from the energy model, the assumptions used as a basis to report on the KPIs of each assessed system.

		Heating options		
		1. Direct electric heating with AHSP for domestic hot water	**2. ASHP heating and domestic hot water**	**3. Notional low carbon heat network**
Heating	Energy use (kWh/annum)	216,595	238,254	238,254
	Fuel	Electricity	Electricity	Electricity
	Carbon factor (gCO_{2e}/kWh)	22	22	100
	System efficiency	1.00	3.24	1.00
	CO_2 emissions ($t.CO_2$/annum)	47.65	16.18	238.25
Hot water	Energy use (kWh/annum)	188,077	188,077	188,077
	Fuel	Electricity	Electricity	Electricity
	Carbon factor (gCO_{2e}/kWh)	22	22	100
	System efficiency	3.80	3.24	1.00
	CO_2 emissions ($t.CO_2$/annum)	10.89	12.77	188.08
Overall	CO_2 emissions ($t.CO_2$/annum)	58.54	28.95	426.33
	Eq. Carbon factor (gCO_{2e}/kWh)	14	7	100
	Emissions compared with benchmark low carbon heating system	-	49%	728%

4.3 LOW CARBON HEAT APPRAISAL OPTIONS KPIs

KPIs as described in the GMCA submission guidance are reported in the table below for each of the assessed options. The following clarifications are made which relate to the calculation of the KPIs:

1. Energy costs are based on electricity costs of 26.3p/kWh plus 214.1p/day standing charge

2. Capital costs of heating systems are based on SPONS rates and include heat emitters due to the different cost of emitters between the options.
3. Maintenance costs are bases around preventative maintenance only
4. Replacement costs are based on a 15-year lifespan of the heating systems
5. Options 1 is considered the baseline option

Performance Area	Key performance indicator	1. Direct electric heating with AHSP for domestic hot water	2. ASHP heating and domestic hot water	3. Notional low carbon heat network
Environmental performance	1. Fossil fuel use	No	No	No
	2. Carbon content of heat (gCO2/kWh)	14	7	100
	3. Local pollution	None	None	None
Impact of building users	4. Estimated energy costs for heating and hot water (£/yr)	£148,181	£112,807	£190,325
	5. Estimated maintenance costs (£/yr)	£12,500	£17,500	£5,000
	6. Estimated replacement costs (£/yr)	£198,000	£363,333	£286,000
	7. Operating costs compared with benchmark low carbon heating system	-	181%	138%
Impact on viability	8. Estimated capital cost of heating system	£2,970,000	£5,450,000	£4,290,000
	9. Cost compared with benchmark low carbon heating system	-	184%	144%
Infrastructure development	10. Connection to low carbon heat network	No	No	Yes
	11. Scale of application (m^2)	33,949	33,949	33,949

4.4 PROPOSED HEATING SOLUTION

The proposed heating solution for the building is based on direct electric panel heaters providing space heating and high temperature CO_2 heat pumps providing domestic hot water.

4.5 JUSTIFICATION FOR EXEMPTION FOR CONNECTION TO A LOW CARBON HEAT NETWORK

An exemption from the requirement to connect to a low carbon heat network is to be sought on the following basis:

- The site is not within 500m of an existing or proposed network
- Emissions are significantly higher than the baseline and ASHP options
- Capital and operating costs are significantly higher than the baseline option

5 OVERHEATING RISK

A thermal comfort report has been prepared by HGCE to assess the risk of overheating within the building. The report details the methodology carried out and the results obtained when considering the overheating criteria set out within the guidance.

The report also covers requirements under the BREEAM assessment to consider future weather scenarios with results published for all areas. It should be noted that in future weather scenarios, the use of internal blinds is used as allowed in TM59.

The building has been modelled utilising IES VE software with the results for each habitable room presented to demonstrate compliance.

Where no air quality issues are observed, the results show that compliance with the regulations is achieved by using opening windows during daytime hours. During the night, in areas designated for sleeping, high external noise levels mean that opening windows cannot be relied upon to control the internal environment.

A marginal increase in ventilation flowrates above those required for normal operation, coupled with the high-performance solar control glazing, local shading to the opening windows via external louvres and solar shading from façade articulation, ensures a passive approach to mitigating overheating.

Where air quality issues are expected the results show that compliance with the regulations is achieved by using an acoustic purge fan, capable of 4 air changes per hour, is sufficient to mitigate overheating without reliance on opening windows. These purge fans, coupled with the high-performance solar control glazing, local shading to the opening windows via external louvres and solar shading from façade articulation, ensures a low energy approach to mitigating overheating without the need for mechanical cooling.

Please refer to the thermal comfort report provided in the appendices for full details of the assessment.

6 MATERIALS

A separate Whole Life Carbon Assessment (WLCA) report has been produced by Buro Happold which details a whole life carbon assessment of construction materials, as well as site works and expected operational demands of the proposed building.

One Click LCA was used to produce the assessment, assuming industry standard carbon factors in line with RICS 2nd edition and its referenced discipline specific documents.

Betterment of material carbon performance will continue to be explored in future stages.

The Buro Happold report shows an upfront embodied carbon intensity, for the whole development, of 765 kgCO2e/m2. Life cycle embodied carbon, (A-C excluding B6 & B7) is 1,273 kgCO2e/m2 for a decarbonised scenario.

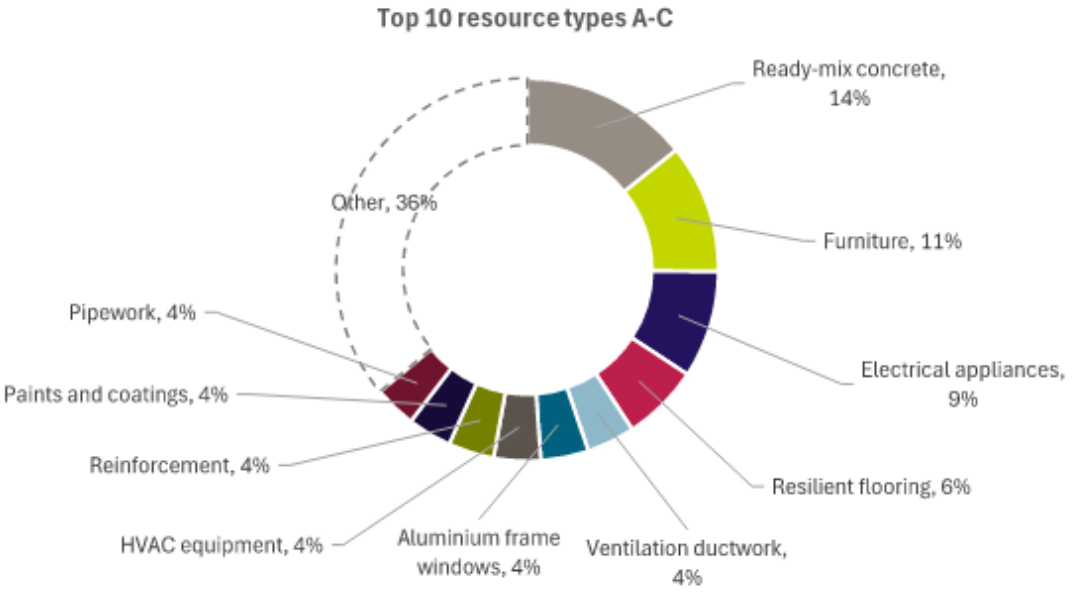
For the decarbonised scenario, the following apply:

- Grid decarbonisation: Represents a scenario in which there is a gradual reduction in the energy and carbon intensity of electricity production.
- Material decarbonisation: Accounts for the expected decarbonisation transition related to the extraction, transportation and manufacturing processes of materials.

The following table, taken from the executive summary of the WLCA report, shows the breakdown across the various WLCA modules for each scenario, including a 15% contingency in-line with ROCS 2nd edition guidelines for early stage design:

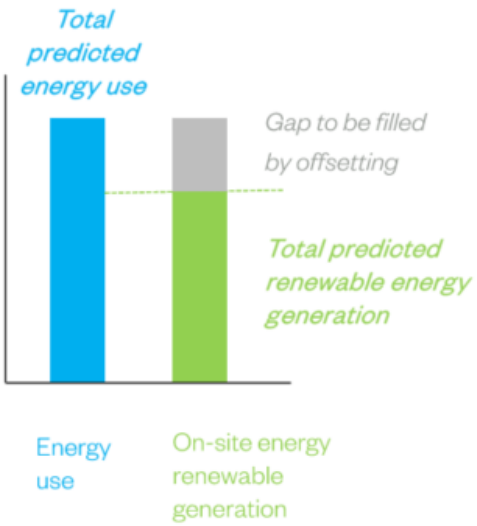
	WLCA Module	Non-decarbonised scenario		Decarbonised scenario	
		Total ($kgCO_2e$)	**Embodied carbon intensity** ($kgCO_2e/m^2$)	**Total** ($kgCO_2e$)	**Embodied carbon intensity** ($kgCo_2e/m^2$)
Plot H	**Upfront embodied carbon (A1-A5)**	**26,488,460**	**765**	**26,488,460**	**765**
	Module B1-B5	31,588,950	912	15,821,115	457
	Module B6-B7 *(operational energy + water)*	59,066,231	1,706	12,989,210	375
	Module C1-C4	2,604,425	75	1,753,377	51
	Module D	-15,252,465	-441	-7,645,291	-221
	Cradle-to-grave (A-C) *excluding B6&B7*	**60,681,835**	**1,753**	**44,062,951**	**1,273**

In terms of the most contribution materials, the following chart, taken from the WCLA report breaks down the lifecycle emissions into each category:


Top 10 resource types A-C
Ready-mix concrete, 14%
Furniture, 11%
Electrical appliances, 9%
Resilient flooring, 6%
Ventilation ductwork, 4%
Aluminium frame windows, 4%
HVAC equipment, 4%
Reinforcement, 4%
Paints and coatings, 4%
Pipework, 4%
Other, 36%

7 OFFSETTING

Due to the limited scope for on-site generation for a development of this scale, a negative operational energy balance remains. To be deemed “net zero compliant” it is expected that in the future, an offset mechanism will be introduced, with the decision to include offsetting determined by Manchester City Council. The graph below illustrates the required offset:



Options for offsetting are under currently development so proposals for offsetting cannot be made at this time.

8 SUMMARY

Following a review of the relevant of National and Local Planning Policies. This Energy Assessment proposes a strategy that positively response to the relevant energy and sustainability policies of Manchester City Council.

An overheating assessment risk assessment has been undertaken to show compliance with Approved Document O, which is further detailed in the thermal comfort report included as part of this planning submission, which aligns with the assumption that windows must be closed at nighttime for noise pollution.

The KPIs presented in the proforma at the beginning of this report, compare favourably with the GMCA planning guidance and are summarised below in an abridged format:

		Target values	**Building 1**	**Building 2**
Minimise energy demand	**Space heating demand (kWh/m²GIA/yr)**	***≤ 15***	16.6	20
	Space cooling demand (kWh/m²GIA/yr)	***≤ 15***	2.8	31.2
Maximise energy efficiency	**BREEAM Ene 01 rating**	***Excellent***	Excellent	Very Good
Use renewable energy	**PV footprint area (% of ground floor space)**	**-**	23%	0%
Use low carbon energy	**Fossil fuel free (yes/no)**	***Yes***	Yes	Yes
Reduce overheating risk	**Has CIBSE TM52 been used to calculate overheating and does the building pass?**	***Yes***	No, TM59 has been used due to residential nature of the habitable areas	N/A – no naturally ventilated spaces
Minimise embodied carbon	**Upfront embodied carbon ($kgCO_2e/m^2GIA$)**	**-**	765	
Offsets	**Offset contribution (£)**	**-**	-	-

The building boasts highly efficient thermal elements, and a combination of energy efficient measures such as photovoltaic panels and low energy lighting.

APPENDIX 1 – THERMAL LINE STRATEGY

APPENDIX 2 – PHOTOVOLTAIC ARRAY LAYOUT

APPENDIX 3 – EMBODIED CARBON STATEMENT

Refer to separate report produced by Buro Happold.

APPENDIX 4 – PREDICTIVE ENERGY REPORT

Refer to separate report produced by Buro Happold.