



ENERGY STATEMENT

PROJECT:

35 FOUNATIN STREET, MANCHESTER

PROJECT NUMBER:

P2223

DOCUMENT REF:

P2223-ENE-02

Revision	Date	Details	Authored	Checked
R1	01.12.2022	Issued for comment	C. Armstrong	S. Richardson
R2	14.12.2022	Revised after design team comments	C. Armstrong	S. Richardson

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1.0 EXECUTIVE SUMMARY

QuinnRoss Energy was commissioned to develop an energy statement for the proposed *35 Fountain Street* refurbishment that will outline how it intends to provide heating and power and meet the energy and carbon emission targets set by national and local policy. The development is commercial only, intended for office use, and will involve a major refurbishment of all HVAC, lighting, and constructions with the addition of renewable energy technologies.

This strategy was prepared directly in line with the *Manchester City Council* guidance on energy statements.

This development will be subject to the following requirements:

Requirement	Description / Summary
National Planning Policy Framework (2021)	The National Planning Policy Framework (NPPF) introduced a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities. The framework states that the purpose of planning is to help achieve sustainable development.
Building Regulations Part ADL2 2021	All existing commercial space must be refurbished to the standards of a new build where feasible.
Manchester's Local Development Framework Core Strategy Development Plan (2012)	Policy EN 4 states all development must follow the Energy hierarchy, utilise low and zero carbon energy supplies and use materials with low embodied carbon.
	Policy EN 6 states refurbishments that are offering substantial improvement must achieve energy reduction in line with current Building Regulations.

Table 01: Summary of energy and sustainability targets

To achieve the above targets, the following energy reduction methods will be required, using the Manchester Core Strategy's Energy Hierarchy:

Method	Description / Summary
Passive heating, natural lighting, and cooling	
Daylight strategy	The buildings new façade will be highly glazed to maximise daylight in the spaces and reduce the need for lighting demand.
Lighting controls	All lighting will be automated with occupancy and daylight sensing.
Natural ventilation	It is currently being investigated for the building to utilise a mixed mode/natural vent strategy, with opening windows, to avoid mechanical ventilation and cooling for a proportion of the year.

Highly efficient lighting	LED lighting installed throughout.
Highly efficient HVAC systems	Only specifying high efficiency air source heat pumps for heating and hot water, no gas installations on site.
Unregulated Energy Use	Efforts will be made to reduce the unregulated emissions by providing "best in class" ("A" rated or equivalent) white goods in the building where applicable.
Energy efficient features	
High performing building thermal envelope	Construction U-values performing substantially above the current building regulations.
Low infiltration	Air tightness no higher than 10.0 m ³ /m ² h, well below the default value for existing buildings of 25.0 m ³ /m ² h (as stipulated in the EPC conventions).
Insulated pipe work	All Internal heating pipework will be insulated to a standard beyond building regulation requirements.
Local energy resources	
District Heating	The Civic Quarter Heat Network is currently not up and running. There are no other networks planned in the Manchester area. Despite this the development will have a space allowance in the basement plant area to incorporate future equipment to allow for connection to any upcoming networks.
Combined Heat and Power (CHP)	The CO ₂ savings from the proposed heat pump system will be significantly improved over an equivalent CHP system, therefore CHP is not considered.
Low or zero carbon energy generating technologies	
Air source heat pumps	A highly efficient heat pump VRF system for space heating and cooling will be installed.
Solar panels	A photovoltaic (PV) array will be installed on all available roof space for use in the building (i.e., not sent to the grid).

Table 02: Summary of energy hierarchy methods

Thermal and Energy Modelling Results

The whole development has been analysed for its energy use using current 2021 Building Regulations in *IES VE Compliance* approved energy modelling software. The predicted CO₂ emissions, saved CO₂ emissions over the existing building is shown below:

Part L 2021 Results						
	Commercial (includes major refurbishments assessed under Part L2A)		Residential (includes major refurbishments assessed under Part L1A)		Overall area weighted reductions	
	Total tCO ₂	% Reduction at each stage	Total tCO ₂	% Reduction at each stage	Total tCO ₂	% Reduction at each stage
Existing Building	124	N/A	0	N/A	124	N/A
Passive and energy efficiency measures	72	42%	0	N/A	72	42%
Local energy sources	72	0%	0	N/A	72	0%
LZC Technology	47	21%	0	N/A	47	21%
TOTAL	78	62.5%	0	N/A	78	62%

Table 03: Summary carbon reductions calculations

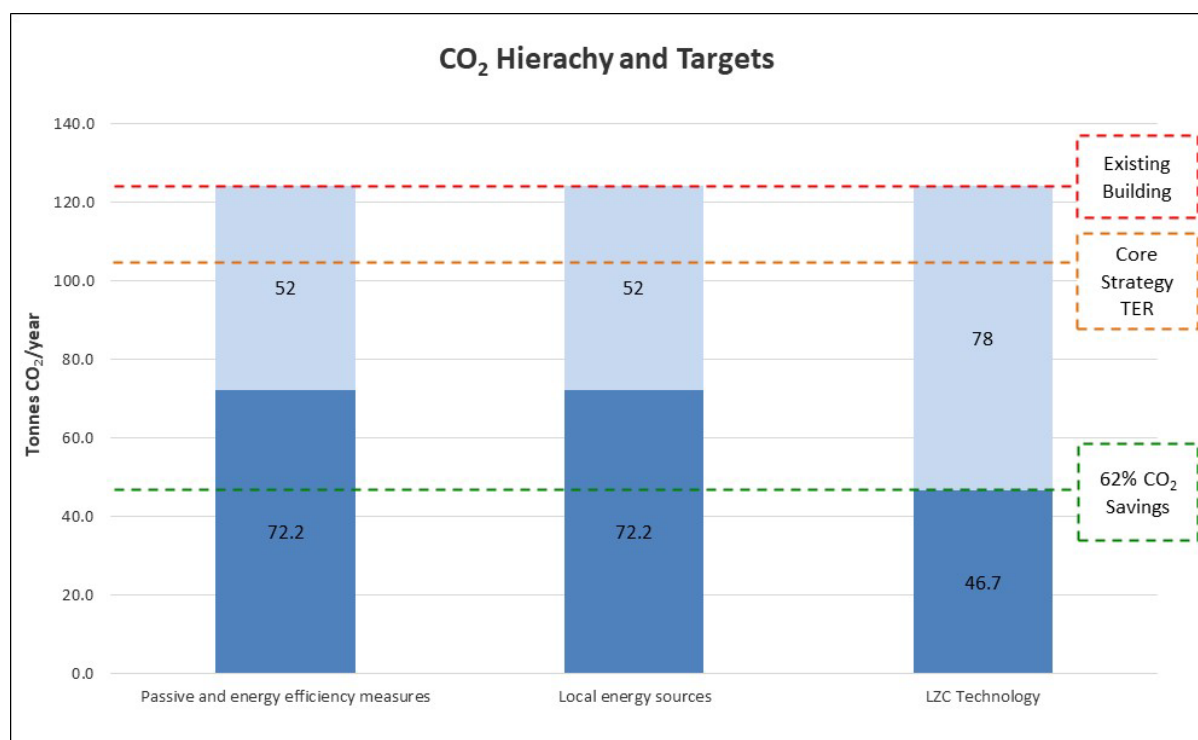


Figure 01: Summary carbon reductions calculations

All inputs and BRUKL's can be found in the appendices.

2.0 INTRODUCTION

QuinnRoss Energy was commissioned to develop an energy statement for the proposed 35 Fountain Street refurbishment that will outline how it intends to provide heating and power and meet the energy and carbon emission targets set by national and local policy. The development is commercial only, intended for office use, and will involve a major refurbishment of all HVAC, lighting, and constructions with the addition of renewable energy technologies.

The site is located in central Manchester. See image below:

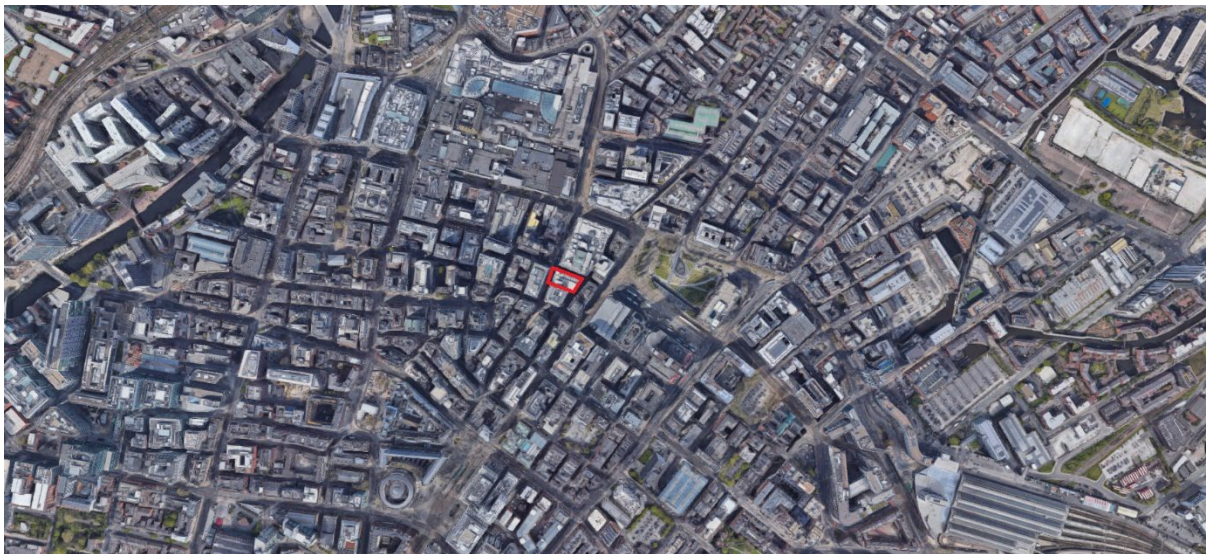


Figure 02: Google Map image of site

3.0 PLANNING POLICY AND LEGISLATION

This section describes the planning policies and regulations that will affect the proposed development. These are outlined below:

- National Planning Policy Framework (2021).
- Building Regulations Part ADL2, non-dwellings.
- Manchester's Local Development Framework Core Strategy



Figure 03: Document front cover images of applicable policies

3.01 National Planning Policy Framework (NPPF) 2021

The NPPF sets out government planning policy for England. It was first published by the Department for Communities and Local Government (now the Ministry of Housing, Communities and Local Government (MHCLG)) on 27 March 2012.

The NPPF followed a commitment made in the 2010 Coalition Agreement to 'publish and present to Parliament a simple and consolidated national planning framework covering all forms of development and setting out national economic, environmental and social priorities'.

The NPPF introduces a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities. The framework states that the purpose of planning is to help achieve sustainable development.

Please note the NPPF does not state any specific energy or CO₂ targets, it outlines that local councils should produce their own (as outlined below).

3.02 Building Regulations Part ADL2 2021

The building will be subject to the Building Regulations Conservation of Fuel and Power in buildings other than dwellings Part ADL2. As this building is not being extended extensively enough, not providing a building service for the first time, and not significantly increasing the capacity of the current building services there is no specific requirement or target CO₂ rating. In these cases, the regulation only states the building is expected to improve its energy efficiency to a new-build standard where feasibly possible.

The Part L calculations are based on regulated loads of the building. Regulated loads refer to heating, cooling, auxiliary, lighting and DHW energy consumption, end uses related to the quality of the building construction and design. Unregulated loads are energy consuming end uses related to tenant's behaviour, such as computers, lifts, or escalators.

3.03 Manchester's Local Development Framework Core Strategy

The Manchester Local Development Plan outlines a number of policies to underpin the city's response to climate change. These policies cover adaptation, waste, aggregates, contaminated land, hazardous substances and most applicable to this development climate change mitigation. The key policies within the strategy relating to energy consumption and CO₂ emissions include the following:

3.03.01 Policy EN 4 Reducing CO₂ Emissions by Enabling Low and Zero Carbon Development

Policy EN 6 requires all new and retrofit developments to use the energy hierarchy as follows:

- Reduce the need for energy through passive design measures.
- Reduce the need for energy through energy efficient features.
- Meet energy requirements through the use of low or zero carbon technologies.

3.04.02 Policy EN 6 Target Framework for CO₂ reductions from low or zero carbon energy supplies

Policy EN 6 requires all buildings which are classed as “electricity intense buildings” to achieve the following:

- 10% CO₂ reduction over Part L 2010.
- OR
- Future Building Regulations Part L compliance if more onerous than above.

4.0 ENERGY HIERARCHY

As part of our aims to provide a sustainable development we will be following the energy hierarchy outlined in the Manchester Core Strategy. The hierarchy shown below guides our approach to minimising the energy use within the building and to create a comfortable internal environment. This consists of three best practice criteria: Energy efficiency, low energy demand and zero carbon energy technologies to achieve low energy and carbon design.

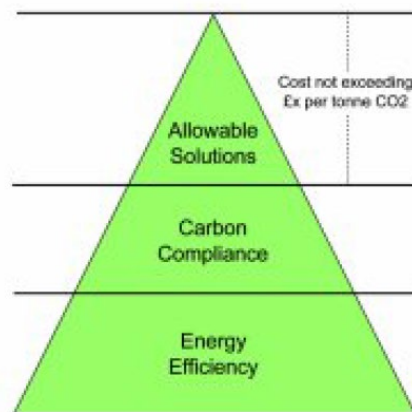


Figure 04: Manchester Core Strategy's energy hierarchy

Although not outlined above, an appraisal of local heat networks for incorporation into the building will be conducted in this report.

4.01 Passive Design Measures

4.01.01 Building Form

The first thing to consider under passive design measures is how the building form can be best optimised and influenced to help limit any unnecessary energy use. The building form design includes the following to reduce energy use:

- Generous floor to ceiling heights to help optimise daylight penetration into spaces.
- Dual aspect glazing was available to optimise daylight and uniformity, which limits the need for artificial lighting.

4.01.02 Daylight strategy

The provision of artificial lighting accounts for a considerable proportion of most building's primary energy consumption. The maximisation of daylight within a building can reduce this demand

significantly. The below items will be considered during the design development period throughout the contract:

- Generous floor to ceiling heights.
- Dual aspect glazing in areas where possible.

4.01.03 Natural ventilation

The building is currently being investigated for an optional natural ventilation strategy, through opening windows, that also aligns with several BREEAM credits. This will run as a mixed mode system along with the central ventilation strategy, to allow natural ventilation for a proportion of the year.

4.01.04 Energy efficient services

A number of energy efficient HVAC and lighting strategies are proposed for the development:

- Lighting – LED lighting will be installed throughout and be chosen to minimise over-illumination.
- Lighting controls – all lighting will have daylight and occupancy controls installed throughout.
- Energy meters – energy meters will be installed for all major energy uses including water.
- User controls – Efficient and user-friendly controls will be specified throughout all buildings.
- Heating & hot water – The building will be highly insulated for low space heating requirements. Heating will be provided by a high efficiency communal heat pump system with a 450% heating generator seasonal efficiency.
- Mechanical ventilation – All air handling units will utilise highly efficient heat recovery systems and low specific fan powers (SFP's).
- Cooling – Efficient mechanical equipment (lighting, fans etc) will be specified to minimise internal gains. Solar control glazing with a 0.40 g-value will also be installed to reduce solar gains.
- Air conditioning – All air conditioning will use high efficiency heat pumps with a Seasonal Energy Efficiency Rating (SEER) of 550%.

4.02 Energy Efficient Features

4.02.01 Building Envelope Thermal Performance

The most effective way of keeping heating energy consumption to a minimum is to ensure the building uses high performing fabric properties. It is proposed the building has constructions upgraded beyond the current existing building. As a result, the following construction U-values (W/m².K) are proposed:

Envelope Element	U-Value W/m ² .K	
	Existing building	Proposed
Wall	0.35	0.26
Roof	0.25	0.18
Floor	Not being refurbished	Not being refurbished
Glazing	3.30	1.60

Table 04: Proposed U-values

The above figures will be achieved by adding substantial high performing insulation into the constructions and only using manufacturer is that have well insulated glazing products with deep air gaps between frames.

4.02.02 Air Infiltration

Uncontrolled air infiltration in a building can contribute to a sizeable proportion of heat losses particularly in well insulated modern buildings. An air permeability of no greater than 5.0 m³/m²h is proposed. This is done by ensuring all bridges, corners and air gaps in the façade or glazing are sealed as far as feasibly possible.

4.02.03 Insulated pipework

All Internal heating pipework, particularly those located in internal corridors, will be insulated to a standard beyond building regulation requirements. This will minimise issues of internal heat gain and avoid the need for any additional ventilation or cooling.

4.02.04 Unregulated energy use

In addition, efforts are being made to reduce the unregulated emissions by providing “best in class” (“A” rated or equivalent) white goods in each room to encourage energy consumption reduction.

Please note the benefits of high efficiency appliances cannot be included in any results shown in this report. These measures interact to some degree (e.g., more low energy lighting reduces the ancillary heat gains from lighting, so increases the space heating demand) so comparisons of individual results can produce apparent anomalies and are not provided as a result.

4.03 Local Energy Resources

4.03.01 District Heating (DH) Networks

Although not outlined in the hierarchy the next stage is to look at the availability of decentralised heat networks within the vicinity of the development. The Manchester Civic Quarter heat network has been approved for construction and will run within close proximity to this site. A completion date has yet to be determined. Despite this the development will be supplied with associated pipework leading off site to allow for a future connection.

4.03.02 Combined Heat and Power (CHP)

The recent change (June 2022) in Building Regulations now favours electrical systems over gas fuelled ones, such as CHP, in line with the government policy to move away from natural resource consumption such as gas. Therefore, the CO₂ savings from the proposed heat pump system will be significantly improved over an equivalent CHP system, therefore CHP is not considered.

4.04 Low or Zero Carbon Technologies

The final part of the hierarchy is to minimise carbon dioxide emissions using renewable / Low or Zero Carbon (LZC) technologies. An initial LZC technology feasibility study has been conducted, shown in appendix A, and the most appropriate products available are heat pumps and solar panels.

4.04.01 Air source heat pumps

A high efficiency communal heat pump system for space heating and hot water will be used for the whole development. The system offers a heating generator seasonal efficiency of 450%.

4.04.02 Solar panels

A 152 m² solar panel array will be installed at roof level for use in the building, i.e., not fed to the grid.

4.05 Maintenance & Management Strategy

This section outlines the proposed maintenance and management strategy for the renewable technology proposed:

- **User guide:** To use a heat pump efficiently, it must be used correctly, and said use will be different to a standard boiler system. Each dwelling will be provided with a user guide on how best to control the heating and hot water system.
- **Display information:** Each dwelling will have a full zone control system with a digital display showing system performance snapshot.
- **Maintenance and cleaning:** Heat exchanges, pipework and pumps can become clogged with deposits of material. Regular cleaning by FM teams is required.
- **Alarms:** The integrated zone control system will notify users of faults if occurring.
- **Spare parts:** A spare parts list will be provided with the installation and the asset owner will commit to an inventory of parts to ensure longevity of the system.
- **Record and log maintenance works:** Facilities management teams will have to log all heat pump & solar panel related maintenance in a central record.
- **Metering:** The individual heat pump system and solar array will be metered in line with the Be Seen criteria, with display information available for occupants.
- **End of life:** FM team should keep records demonstrating that the equipment has been decommissioned and disposed of in an appropriate manner. This includes evidence that the equipment has been sent to a competent party for the purposes of reuse, recycling, or disposal.

5.0 THERMAL & ENERGY MODELLING RESULTS

5.01 Part ADL2 Software Used

All Part ADL2 calculations will use the Dynamic Simulation Modelling (DSM) method. The software used is the *Integrated Environmental Suite (IES) software Virtual Environment (VE) Version 2022.0.0.0*. IESVE is one of the world leaders in developing DSM software and is used internationally for all manner of dynamic simulation calculations, including Part ADL2 and ASHRAE 90.1 calculations. IESVE is approved by the Department for Levelling-Up Housing and Communities (DLUHC) for performing Part L 2021 and EPC calculations and fulfils the requirements of CIBSE AM11 as a Building Energy and Environmental Modelling (BEEM) software. The software was used to create a 3-D model based on information provided by the design team as defined in the following section. Hourly simulations for a year were then run as part of the CO₂ emissions analysis using the relevant weather file for the location.

<https://www.iesve.com/>

The calculations were also conducted by an approved CIBSE Low Carbon Energy Assessor (LCEA) who is a fully accredited Level, 3, 4 and 5 user of IESVE.

5.02 Results

The Part ADL2 results under current Building Regulations 2021 are shown below:

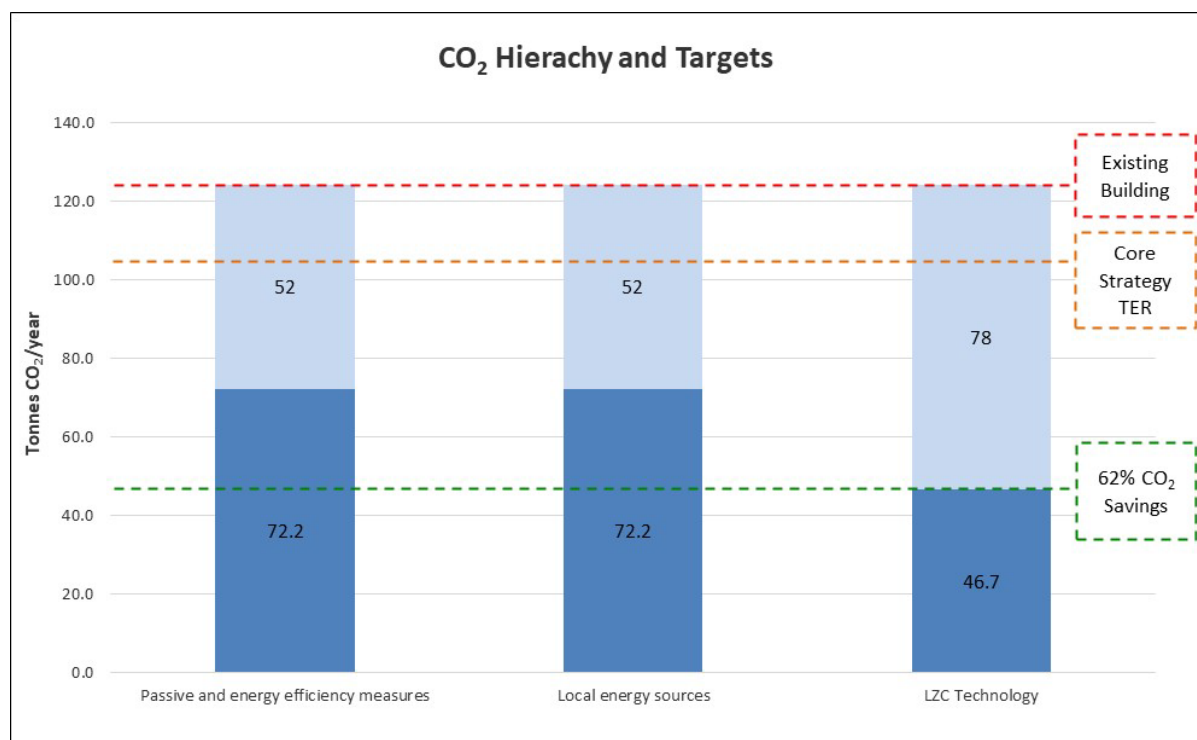


Figure 05: Results in Tonnes of CO₂

Using the input data outlined in this report the proposed building will offer a 62% carbon emissions reduction over the existing building.

A sample BRUKL document for the energy hierarchy scenarios as proof of the above calculations can be found in the appendices.

6.0 SUMMARY & CONCLUSION

The proposed development will achieve the following energy & sustainability targets:

Requirement	Description / Summary
National Planning Policy Framework (2021)	By conforming to the legal requirements of Part L 2021 and the local requirements of Manchester City Council, as outlined below, the development can be considered compliant with the NPPF.
Building Regulations Part ADL2 2021	Using the inputs outlined in this report the building will be compliant with Part ADL2 2021.
Manchester's Local Development Framework Core Strategy Development Plan (2012)	Policy EN 4: Using the inputs outlined in this report the building has reduced energy consumption as far as possible and utilised all feasible LZC technologies for maximum CO ₂ reduction.
	Policy EN 6: Using the inputs outlined in this report the building is compliant with Building Regulations and offers significant CO ₂ reductions compared to the existing building.

Table 05: Summary of energy and sustainability targets achieved

To achieve the above emissions, the following energy reduction methods will be required, using Manchester's Core Strategy energy hierarchy:

Passive heating, natural lighting, and cooling

- **Building Form** – The building form must be optimised to help limit any unnecessary energy use. This includes limiting solar gains on south facing facades and large floor to ceiling heights to help optimise daylight penetration.
- **Daylight Strategy** – The maximisation of daylight within a building can reduce lighting demand significantly by using generous floor to ceiling heights, dual aspect glazing and daylight dimmable sensors where possible.
- **Highly efficient lighting with controls** – LED lighting installed throughout.
- **Highly efficient HVAC systems** – Only specifying a high efficiency heat pump system and mech vent units with low SFP's and heat recovery.
- **Highly efficient hot water generator** - The hot water demand will be provided by the same heat pump used for space heating with highly insulated hot water storage tanks.
- **Unregulated Energy Use** - In addition, efforts are being made to reduce the unregulated emissions by providing "best in class" ("A" rated or equivalent) white goods in apartments.

Energy efficient features

- **High performing building thermal envelope** – Construction U-values performing above the current building regulations. The following construction U-values will be used

Envelope Element	U-Value W/m ² .K	
	Existing building	Commercial
Wall	0.35	0.26
Roof	0.25	0.18
Floor	Not being refurbished	Not being refurbished
Glazing	3.30	1.60

Table 06: Proposed U-values

- **Low Infiltration** – Air tightness no higher than 5.0 m³/m²h.
- **Insulated pipe work** - All Internal heating pipework will be insulated to a standard beyond building regulation requirements.

Local energy resources

- **District Heating (DH)** – The Manchester Civic Quarter heat network has been approved for construction and will run within close proximity to this site. A completion date has yet to be determined. Despite this the development will be supplied with associated pipework leading off site to allow for a future connection.
- **Combined Heat and Power (CHP)** – Although CHP is feasible, it would offer far inferior CO₂ savings over the proposed heat pumps and is not considered as a result.

Low or zero carbon energy generating technologies

- **Air Source Heat Pumps** – Highly efficient heat pump for space heating and hot water will be installed.
- **Solar Panels** – 152 m² of solar panels will be installed at roof level for feed-in to the national grid.

Energy Modelling Results

The whole development has been analysed for its energy use using approved energy modelling software. The predicted tonnes of CO₂ are shown below:

Part L 2021 Results						
	Commercial (includes major refurbishments assessed under Part L2A)		Residential (includes major refurbishments assessed under Part L1A)		Overall area weighted reductions	
	Total tCO ₂	% Reduction at each stage	Total tCO ₂	% Reduction at each stage	Total tCO ₂	% Reduction at each stage
Existing Building	124	N/A	0	N/A	124	N/A
Passive and energy efficiency measures	72	42%	0	N/A	72	42%
Local energy sources	72	0%	0	N/A	72	0%
LZC Technology	47	21%	0	N/A	47	21%
TOTAL	78	62.5%	0	N/A	78	62%

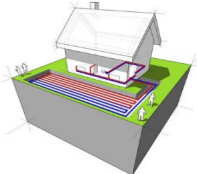
Table 07: Summary of CO₂ emissions and savings

As the results above show, when including all available energy reduction technologies and methods, the proposed refurbishment will achieve a 67% improvement over the existing building.

All BRUKL's as proof of the legitimacy of the above calculations can be found in the appendices.

7.0 APPENDICES

7.01 Appendix A – LZC Technology Feasibility Analysis

Technology		Feasibility	
Photovoltaic (PV) Panels		PV's use semiconductor technology to convert incident solar radiation into electrical power. The building is well suited for solar collection with a large flat roofs located several storeys above ground level. Any electricity that is generated and used on site is preferable as every kWh used is one that the development doesn't have to purchase. Any surplus electricity generated can be exported to the national grid, receiving a further export tariff in addition to the generation tariff. This development has lots of open roof ideal for solar panel placement.	High
Solar Thermal Panels		Solar thermal panels are a method of harvesting the sun's energy, commonly to provide a source of preheated water. As mentioned above, the building has a large area of roof providing an ideal location for solar thermal collection. The optimum size of a solar thermal array is to provide approximately a third of the daily stored demand, which would benefit the residential areas however it would be at the cost of PV panel area. Electricity demand reduction, from PV's, has a greater impact on CO ₂ savings than hot water consumption making this tech feasible but less effective than other options.	Medium
Ground Source Heat Pump (GSHP)		A GSHP takes low-grade heat from the ground and uses electricity to convert it to useful heat (at approximately 40°C) that can be used to heat a building. The ground can also be used as a heat sink to provide cooling. The bore holes and length of pipework into the ground required for this tech make this option difficult to justify considering the developments suburban location.	Low
Air Source Heat Pump (ASHP)		Similar to the GSHP, ASHP utilises the external environment as a heat source. A heat pump uses electricity or gas to run a refrigerant cycle, extracting heat from external air to convert it to useful heat for space heating. ASHPs offer high efficiencies and are suited to institutional and commercial properties. Although these systems are typically not silent-running, must be located externally and require an area of flat roof, their high efficiencies are too beneficial to rule out.	High
Wind Turbines		Wind energy can be converted to electricity by using wind turbines. This renewable technology is suited to exposed areas free from obstructions where the average wind speeds are high. On the site there are plenty of obstructions which would lead to the wind having a turbulent nature resulting in poor output for turbines, plus they have significant visual and noise impacts on neighbouring areas. Hence they are unsuitable for this development.	Low
Biomass		Biomass fuel is usually wood chips or wood pellets, and as it comes from plants it is considered a low-carbon source of high-grade heat that can be used for space heating, domestic hot water and, with absorption chillers, cooling (this last option is very rarely implemented due to high capital cost). A biomass boiler needs to operate under a reasonably constant load being a solid fuel boiler; it is unable to respond to load fluctuations as quickly as a gas or oil boiler. This limits the boilers to being suitable to operate for the provision of the base load. This could still be suitable for this development for its likely large base load however biomass also has the potential to have a significantly detrimental effect on air quality in the local vicinity, frequent fuel deliveries are required which could be disruptive to residents and there are significant maintenance costs. Unless a free source of wood can be found, such as waste from a factory or forestry management operation, the biomass fuel is often the same price or more expensive than gas. This means that the additional capital outlay on top of the increased fuel, maintenance costs, air quality, running costs and maintenance issues make biomass less viable than other tech available.	Low
Combined Heat and Power		CHP is the simultaneous generation of usable heat and power (usually electricity) in a single process, the heat being distributed in surrounding buildings instead of being wasted. CHP is best suited to buildings with large heating and DHW demands making it feasible for this development. Although CHP is feasible, it would not offer significantly better savings over the proposed heat pumps. It must also be noted that recently installed Building Regs have moved away from CHP and natural resource consumption, therefore CHP is not considered.	Medium
District Heating		DH tends to be large CHP units run by commercial energy firms supplying energy to local buildings through underground pipework. Though they offer the same benefits as an on site CHP, without maintenance costs (provided by the supplier), the limitations are the proposed site needs to be within reasonable distance of a network. The Manchester Civic Quarter heat network has been approved for construction and will run within close proximity to this site. A completion date has yet to be determined. Despite this the development will be supplied with associated pipework leading off site to allow for a future connection.	Medium

7.02 Appendix B – Input data used for Passive and Energy Efficiency Measures

Constructions U-values W/m2.K

Wall	0.26
Roof	0.18

Glazing

Overall U-value (including frame)	1.60 W/m ² K
g-value	0.40

Air Permeability

Air permeability	5.0 m ³ /m ² h
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HVAC Systems

Main system

System description	VRF heat pump heating & cooling with mech vent
NCM system type	Variable refrigerant flow
Heat source	Heat pump (electric): air source
Heating fuel type	Electricity
Heating generator seasonal efficiency	2.50
Cooling system	Heat pump (electric): air source
Cooling fuel type	Electricity
Cooling seasonal energy efficiency rating (SEER)	2.50
Cooling nominal energy efficiency rating (EER)	2.50
AHU Specific fan power (SFP)	1.80
AHU Pump type	-
Heat recovery efficiency	0.70

Secondary system

System description	Electric panel heaters
NCM system type	Other local room heater - unfanned
Heat source	Direct or storage electric heater
Heating fuel type	Electricity
Heating generator seasonal efficiency	1.00
Cooling system	-
Cooling fuel type	-
Cooling seasonal energy efficiency rating (SEER)	-
Cooling nominal energy efficiency rating (EER)	-
AHU Specific fan power (SFP)	-
AHU Pump type	-
Heat recovery efficiency	-

Ventilation

Extract vent

AHU Specific fan power (SFP)	0.30
Scope	Fan remote from zone

DHW

System description	Stand-alone water heater
Heating fuel type	Electricity
Delivery efficiency	100%
Storage volume (l)	600
Storage insulation (mm)	50

Lighting	
Lighting power densities	lm/W
Office	120
Reception	100
Circulation	100
WC's / showers / lockers	100
Power & Lighting controls	
Electric Power Factor	0.90 to 0.95
PIR's	Yes
Daylight sensors	Yes
Metering / Monitoring	Lighting systems have provision for metering
Lighting control parasitic power	0.10 W/m ²
Renewables	
None	
-	

7.03 Appendix C – Input data used for LZC Technology

Constructions U-values W/m ² .K		
	Wall	0.26
	Roof	0.18
Glazing		
	Overall U-value (including frame)	1.60 W/m ² K
	g-value	0.40
Air Permeability		
	Air permeability	5.0 m ³ /m ² h
HVAC Systems		
Main system		
	System description	VRF heat pump heating & cooling with mech vent
	NCM system type	Variable refrigerant flow
	Heat source	Heat pump (electric): air source
	Heating fuel type	Electricity
	Heating generator seasonal efficiency	4.50
	Cooling system	Heat pump (electric): air source
	Cooling fuel type	Electricity
	Cooling seasonal energy efficiency rating (SEER)	5.50
	Cooling nominal energy efficiency rating (EER)	3.50
	AHU Specific fan power (SFP)	1.80
	AHU Pump type	-
	Heat recovery efficiency	0.70
Secondary system		
	System description	Electric panel heaters
	NCM system type	Other local room heater - unfanned
	Heat source	Direct or storage electric heater
	Heating fuel type	Electricity
	Heating generator seasonal efficiency	1.00
	Cooling system	-
	Cooling fuel type	-
	Cooling seasonal energy efficiency rating (SEER)	-
	Cooling nominal energy efficiency rating (EER)	-
	AHU Specific fan power (SFP)	-
	AHU Pump type	-
	Heat recovery efficiency	-
Ventilation		
Extract vent		
	AHU Specific fan power (SFP)	0.30
	Scope	Fan remote from zone
DHW		
	System description	Stand-alone water heater
	Heating fuel type	Electricity
	Delivery efficiency	100%
	Storage volume (l)	600
	Storage insulation (mm)	50

Lighting	
Lighting power densities	lm/W
Office	120
Reception	100
Circulation	100
WC's / showers / lockers	100

Power & Lighting controls	
Electric Power Factor	0.90 to 0.95
PIR's	Yes
Daylight sensors	Yes
Metering / Monitoring	Lighting systems have provision for metering
Lighting control parasitic power	0.10 W/m ²

Renewables	
Solar photovoltaics (PV)	
Type	Monocrystalline
Panel efficiency	21%
Panel area	90 m ²
Orientation	Laid flat



7.04 Appendix D – BRUKL Output for Existing Building

Project name

EXISTING

As built

Date: Tue Nov 29 11:07:49 2022

Administrative information

Building Details

Address: 35 Fountain Street, MANCHESTER, M2 2AN

Certifier details

Name: Christopher Armstrong

Telephone number: 01795 841 035

Address: QuinnRoss Consultants Ltd, Unit 3, Bobbing Hill,
Bobbing, Kent, Sittingbourne, ME9 8NY

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.17

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.17

BRUKL compliance module version: v6.1.c.0

Foundation area [m²]: 730.27The CO₂ emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	7.49
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	16.83
Target primary energy rate (TPER), kWh/m ² annum	59.15
Building primary energy rate (BPER), kWh/m ² annum	150
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 _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.45	0.45	BS000001:Surf[2]
Floors	0.18	0.45	0.45	BS000001:Surf[0]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	0.25	0.25	BS000001:Surf[1]
Windows** and roof windows	1.6	3.29	3.29	00000001:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No Personnel doors in building
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_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]U_{a-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.

^ 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	10

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

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- ELEC HEATING

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.81	-	0.2	-	-
Standard value	0.93*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output and overall for multi-boiler systems. For single boiler systems >2 MW or any individual boiler in a multi-boiler system, limiting efficiency is 0.88.					

2- ELEC HEATING + EXTRACT

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.81	-	0.2	-	-
Standard value	0.93*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output and overall for multi-boiler systems. For single boiler systems >2 MW or any individual boiler in a multi-boiler system, limiting efficiency is 0.88.					

3- VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2	2	0	1.8	-
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					NO
* Standard shown is for all types >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.					

"No HWS in project, or hot water is provided by HVAC system"

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]										HR efficiency	
	ID of system type	A	B	C	D	E	F	G	H	I	Zone	Standard
-01 MALE SHOWERS		0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	-	N/A

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	7302.7	7302.7
External area [m ²]	5505.1	5505.1
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	10	3
Average conductance [W/K]	6512.37	0
Average U-value [W/m ² K]	1.18	0
Alpha value* [%]	28.76	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
100	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	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	24.13	3.78
Cooling	21.34	4.5
Auxiliary	7.19	6.97
Lighting	31.58	10.75
Hot water	23.47	19.25
Equipment*	36.74	36.74
TOTAL**	107.71	45.25

* 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 generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0.37
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>0</i>	<i>0.37</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	235.04	94.75
Primary energy [kWh/m ²]	150	59.15
Total emissions [kg/m ²]	16.83	7.49



7.05 Appendix E – BRUKL Output for Passive and Energy Efficiency Measures

Project name

PASSIVE AND ENERGY EFFICIENCY MEASURES

Date: Tue Nov 29 10:44:27 2022

Administrative information

Building Details

Address: 35 Fountain Street, MANCHESTER, M2 2AN

Certifier details

Name: Christopher Armstrong

Telephone number: 01795 841 035

Address: QuinnRoss Consultants Ltd, Unit 3, Bobbing Hill,
Bobbing, Kent, Sittingbourne, ME9 8NY

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.17

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.17

BRUKL compliance module version: v6.1.c.0

Foundation area [m²]: 730.27

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

The building does not comply with England Building Regulations Part L 2021

Target CO ₂ emission rate (TER), kgCO ₂ /m ² ·annum	5.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² ·annum	9.71
Target primary energy rate (TPER), kWh/m ² ·annum	61.17
Building primary energy rate (BPER), kWh/m ² ·annum	106.53
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 _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.26	0.26	BS000001:Surf[2]
Floors	0.18	0.75	0.75	BS000001:Surf[0]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	0.18	0.18	BS000001:Surf[1]
Windows** and roof windows	1.6	1.6	1.6	00000001:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No Personnel doors in building
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_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]U_{i-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.

^ 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
m³/(h.m²) at 50 Pa	8	5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

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- ELEC HEATING

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- ELEC HEATING + EXTRACT

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

3- VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	2.5	0	1.8	0.72
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					NO

* Standard shown is for all types >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- ELEC DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1			
-01 MALE SHOWERS	0.3	-	-	-	-	-	-	-	-	-	-	N/A
-01 DIS SHOWER	0.3	-	-	-	-	-	-	-	-	-	-	N/A

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	7302.7	7302.7
External area [m ²]	5505.1	5505.1
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	10	3
Average conductance [W/K]	3768.69	2405.92
Average U-value [W/m ² K]	0.68	0.44
Alpha value* [%]	26.62	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
100	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	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	10.13	2.82
Cooling	14.2	4.5
Auxiliary	6.42	6.7
Lighting	21.46	10.75
Hot water	19.15	17.63
Equipment*	36.74	36.74
TOTAL**	71.35	42.4

* 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 generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0.87
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>0</i>	<i>0.87</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	137.05	94.75
Primary energy [kWh/m ²]	106.53	61.17
Total emissions [kg/m ²]	9.71	5.6



7.06 Appendix F – BRUKL Output for LZC Technology

Project name

LZC TECHNOLOGY

As Designed

Date: Tue Nov 29 11:47:16 2022

Administrative information

Building Details

Address: 35 Fountain Street, MANCHESTER, M2 2AN

Certifier details

Name: Christopher Armstrong

Telephone number: 01795 841 035

Address: QuinnRoss Consultants Ltd, Unit 3, Bobbing Hill,
Bobbing, Kent, Sittingbourne, ME9 8NY

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.17

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.17

BRUKL compliance module version: v6.1.c.0

Foundation area [m²]: 730.27The CO₂ emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	5.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	6.42
Target primary energy rate (TPER), kWh/m ² .annum	61.19
Building primary energy rate (BPER), kWh/m ² .annum	69.37
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 _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.26	0.26	BS000001:Surf[2]
Floors	0.18	0.75	0.75	BS000001:Surf[0]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	0.18	0.18	BS000001:Surf[1]
Windows** and roof windows	1.6	1.6	1.6	00000001:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No Personnel doors in building
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_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]U_{i-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.

^ 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	5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

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- ELEC HEATING

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- ELEC HEATING + EXTRACT

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

3- VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	5.5	0	1.8	0.72
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					NO

* Standard shown is for all types >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- ELEC DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1			
-01 MALE SHOWERS	0.3	-	-	-	-	-	-	-	-	-	-	N/A
-01 DIS SHOWER	0.3	-	-	-	-	-	-	-	-	-	-	N/A

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	7302.7	7302.7
External area [m ²]	5505.1	5505.1
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	10	3
Average conductance [W/K]	3768.69	0
Average U-value [W/m ² K]	0.68	0
Alpha value* [%]	26.62	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
100	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	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	9.66	2.82
Cooling	4.87	4.5
Auxiliary	6.42	6.7
Lighting	8.03	10.75
Hot water	19.15	17.63
Equipment*	36.74	36.74
TOTAL**	48.12	42.4

* 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 generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	2.01	0.86
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>2.01</i>	<i>0.86</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	130.11	94.75
Primary energy [kWh/m ²]	69.37	61.19
Total emissions [kg/m ²]	6.42	5.6