
Banidev Limited C/O Capital & Centric and Kamani Property

Environmental Standards Statement

Ancoats Works, Pollard Street, Manchester

22 November 2021

Watt Energy & Consulting Engineers Ltd
40 King Street, Manchester, M2 6BA

t. 0161 43 43 103
w. www.wece.co.uk
e. office@wece.co.uk

watt 
Energy & Consulting Engineers

Issue Control

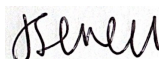
Director

Daniel Watt



Consultant

Jack Sewell



First Issue Date	Revision Issue Date	Issue Revision	Issued By
1 st September 21	-	-	JS
	22 October. 21	A	BS
	16 November. 21	B	DW
	22 November. 21	C	JD

Document Disclaimer

© Watt Energy & Consulting Engineers Ltd (WE&CE) own the copyright in this report and it has been written for the sole and confidential use of the client showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. It is not intended for and should not be relied upon by any third party. Any such party relies on this report at their own risk. No part of this report may be copied or duplicated without the express permission of WE&CE and the party for whom it was prepared.

Index

1	Executive Summary	5
2	Environmental Standards Statement	Error! Bookmark not defined.
2.1	The Site	8
2.2	Proposed Development	9
2.3	Demolition	9
2.4	Relevant Policies and Guidance	10
2.4.1	Local Planning Policy	10
2.4.1.1	Manchester Core Strategy	10
2.4.1.2	Guide to Development in Manchester, Supplementary Planning Document 2007	11
2.4.1.3	Manchester Residential Quality Guide 2017	11
2.4.1.4	Manchester's Great Outdoors 2015-25	12
2.4.1.5	Manchester Climate Change Framework 2020-25	12
2.4.2	Manchester City Council's Planning Document Targets	13
2.4.3	National Planning Policy	14
2.5	Sustainable Design Strategy	15
2.5.1	Energy and Carbon Emissions	15
2.5.2	Choice and Impact of Renewable Technology	18
2.5.3	Energy and CO ₂ Reduction Summary	19
2.5.4	Manchester City Council' Policy and Targets Summary	23
2.6	Adaptation to Climate Change	24
2.6.1	Flood Risk Zone	25
2.6.2	Green Blue Infrastructure	25
2.6.2.1	Sustainable Drainage Systems (SUDs)	25
2.6.2.2	Biodiversity	28
2.6.3	Internal Water Efficiency	28
2.6.4	Waste Management	28
2.6.4.1	Occupational Waste	28
2.6.4.2	Construction Waste	29
2.6.5	Materials	29

2.6.6	Pollution Control	30
2.6.7	Health and Wellbeing	30
2.6.8	Sustainable Transport	31
3	Feasibility Assessment of Renewable Energy and Low Carbon Technologies	32
4	Conclusion	35

1 Executive Summary

This report has been prepared by Watt Energy & Consulting Engineers on behalf of Banidev Limited, to support a full planning application for a residential-led development to provide 183 no. apartments and 10 no. duplex apartments (Use Class C3) and flexible commercial space (Use Class E/ sui generis) at the site of Ancoats Works on Pollard Street, Manchester.

The demolition and partial demolition of existing buildings is proposed, but the scheme includes retention of the southern area of the former industrial building together with its Pollard Street elevation. Two new build residential blocks are proposed to the north of the retained building, with a central courtyard providing amenity space for use by residents. A ground floor commercial unit is proposed on the corner of Pollard Street and Carruthers Street.

The Applicant is a development partnership between Capital & Centric and Kamani Property Group. Capital & Centric is a Manchester-based social impact developer and regeneration specialist. They have completed over 500,000 sq. ft. of development projects in the last 5 years and currently have a £450m development pipeline across the commercial, residential, hotel and leisure sectors in a number of UK regional cities. Kamani Property Group is a global leader in the ownership and development of commercial, residential and industrial buildings. They have completed and are currently working on a number of projects in Manchester City Centre from office and retail buildings in Manchester's Northern Quarter, to residential and industrial projects further afield. Banidev Limited is a subsidiary of Kamani Property Group.

This statement specifically addresses the following Manchester City Council approved climate change action plans in addition to planning policies, as stipulated in the Manchester Core Strategy (July 2012):

- Guide to Development in Manchester SPD (2007)
- Our Manchester Strategy 2016-2025
- Manchester: A Certain Future (2013)
- Manchester Climate Change Board – The Zero Carbon Framework 2020-2038
- Climate Change and Low Emissions Implementation Plan 2016-2020
- Meeting Our Objectives and Targets – Manchester Climate Change Framework – 2020-25
- Manchester Residential Quality Guidance 2017
- Core Strategy Policy DM 1 - Development Management
- Core Strategy Policy EN 4 - Reducing CO2 Emissions by Enabling Low and Zero Carbon Development
- Core Strategy Policy EN 6 - Target Framework for CO2 Reductions from Low or Zero Carbon Energy Supplies
- Core Strategy Policy EN 8 – Adaptation to Climate Change
- Core Strategy Policy EN 9 – Green Infrastructure
- Core Strategy Policy EN 14 – Flood Risk
- Core Strategy Policy EN 15 – Biodiversity and Geological Conservation
- Core Strategy Policy T 1 – Sustainable Transport

The statement details how the development will incorporate sustainable design and resource efficiency in line with the Energy Hierarchy, so to meet the policy requirements and council targets whilst reducing its overall environmental impact. The methodology and calculations are consistent with the MCC Appendix A EN6 Energy Target Explanation and all figures used within this report have been based on the most recent issue of drawings and modelled using SAP 2012 to accurately predict Energy Usage and CO₂ reductions.

In relation to the planning documents and policies outlined above, the development is required to achieve a **10%** reduction in carbon emissions over Part L 2013 of the Building Regulations.

In order to achieve compliance the development has been designed with a holistic low energy design concept involving a fabric first approach. The U-values, design air permeability and ventilation targets all aspire to Passive House design standards along with the consideration and application of low zero carbon renewable technologies.

Following the LZC feasibility assessment, it is proposed that the development will also benefit from a **50kWp PV array** that will be implemented on the main flat roof areas.

As a result of the above the predicted site wide reduction in CO₂ over Part L 2013 of the Building Regulations can be summarised as:

- **16.6%** with SAP 9 carbon factors (current Building Regulations)
- **38.1%** with SAP 10 carbon factors
- **62.4%** with SAP 10.1 carbon factors (proposed improvements to Part L)

This statement also examines how the design, specification and characteristics of the proposal will contribute to sustainability and meet the relevant objectives outlined within the National Planning Policy Framework (NPPF) 2021, in addition to the Manchester City Council approved climate change action plans and core strategy planning policies outlined above. The sustainability measures assessed included:

- Flood Risk Zone
- Green and Blue Infrastructure
- Sustainable Drainage Systems (SUDs)
- Biodiversity / Ecology
- Internal Water Efficiency
- Waste Management
- Materials
- Pollution Control
- Health and Wellbeing
- Sustainable Transport

The development therefore complies with all Manchester City Council's current and future policy requirements relating to creating a sustainable development.

In relation to the planning target centred around carbon emissions reduction, the proposed development is achieving a **16.6%** reduction in these emissions, over the Part L1A 2013 of the Building Regulations. This surpasses all of Manchester City Council's planning targets and therefore allows compliance to be reached.

2 Environmental Standards Statement

The following statement relates to the proposed development at Ancoats Works, Pollard Street, Manchester, M4 7AS.

2.1 The Site

The application site extends to approximately 0.55 hectares and is located approximately 1.5km to the east of Manchester City Centre. It is currently occupied by a range of industrial buildings associated with the former Ancoats Works industrial site, and also includes the former Bank of England pub, both of which are now vacant. The main Ancoats Works building is of three storey height and occupies the north eastern half of the site, with car parking toward the Carruthers Street boundary. The existing building is a traditional and substantial industrial unit with a double-gabled roof.

The site is bound to the north by the Ashton Canal, to the east by Hope Mill, a grade II* listed 7-storey former mill building which comprises a theatre and a range of other business uses, to the south by Pollard Street and to the west by Carruthers Street. There are dwellings opposite the site on Pollard Street, Carruthers Street and to the northwest beyond the canal on Piercy Street.

The extent of the application site is shown on the Site Location Plan submitted with the planning application and in the image below:



Figure 1: Ground Floor Plan

2.2 Proposed Development

Full planning application for a residential-led development to provide 183 no. apartments and 10 no. duplex apartments (Use Class C3) and flexible commercial space (Use Class E/ sui generis) across two new development blocks and refurbishment of the southern part of the Ancoats Works building including its Pollard Street façade, together with landscaping, parking, cycle parking, supporting infrastructure and associated works, following the demolition and partial demolition of existing buildings on site.

The quantum of development is summarised below:

Residential Units

- 183 no. residential apartments (Use Class C3)
- 10 no. duplex apartments (Use Class C3)

The development comprises the following mix of units:

- 61 no. 1 beds (32%)
- 118 no. 2 beds (61%)
- 4 no. 3 beds (2%)

Amenity and Commercial GIA

- 219.6 sqm (116.9 sqm amenity and 102.7 sqm commercial)

2.3 Demolition

The proposals include the retention and refurbishment of part of the Ancoats Works building fronting onto Pollard Street including its historic façade. The warehouses to the rear of the main Ancoats works building will be demolished.

2.4 Relevant Policies and Guidance

2.4.1 Local Planning Policy

2.4.1.1 Manchester Core Strategy

Manchester's Core Strategy (CS) was adopted on 11th July 2012 and is the key Development Plan Document (DPD) guiding the measures assessed in this report.

CS Policy DM 1 - Development Management: Stipulates that all new development should have regard for several development principles relevant to sustainability, including: waste management, designing for health, flood risk, green infrastructure, biodiversity. Additionally, subject to scheme viability, developers will be required to demonstrate that new non-domestic development will achieve a BREEAM Rating of 'Very Good' or for domestic development to achieve the Code for Sustainable Homes standard.

CS Policy EN 4 – Reducing CO2 Emissions: This policy targets the reducing of CO2 emissions through the following of the energy hierarchy; firstly reducing the need for energy through efficient design measures, followed by clean energy and lastly, the application of renewable or LDC technologies. In addition to this point, MCC state within this policy all new development is required to use building materials that have low embodied carbon.

CS Policy EN 6 - Target Framework for CO2 Reductions from Low or Zero Carbon Energy Supplies: This Policy requires electricity intense residential development of 10 or more units to meet, as a minimum, a 15% reduction in domestic CO2 emissions over Part L of the 2010 Building Regulations, unless proven to be unviable. As Part L 2013 of the Building Regulations represents a 6% improvement on 2010 levels, this target is subsequently equivalent to a 9% improvement in CO2 emissions over Part L 2013. Section 2.3 provides evidence of how this target is achieved.

CS Policy EN 8 – Adaptation to Climate Change: Expects all new development to be adaptable to climate change in terms of its design, layout, siting, and function of both building associated external spaces.

CS Policy EN 9 – Green Infrastructure: Requires new developments to maintain existing green infrastructure whilst using every opportunity, in accordance with current Green Infrastructure Strategies, to enhance the quality and quantity of green infrastructure, improve the performance of its functions and create and improve linkages to and between area of green infrastructure.

CS Policy EN 14 – Flood Risk: This policy expects all new developments to minimise surface water run-off through the use of SUDs and Green Infrastructure.

CS Policy EN 15 – Biodiversity and Geological Enhancement: Developers will be expected to identify and implement reasonable opportunities to enhance, restore or create new biodiversity, either on or adjacent to the proposed site.

CS Policy T 1 – Sustainable Transport: Policy aims to deliver sustainable, high quality, integrated transport systems to encourage a shift away from car travel to public transport, cycling and walking.

2.4.1.2 Guide to Development in Manchester, Supplementary Planning Document 2007

The Development Guide in Manchester Supplementary Planning Documents (SPD) establish and set out the ongoing generation of the City by providing a set of set principles which will guide developers, architects, and residents in the design of the city. The MCC Core Strategy stipulates that all new residential developments should comply with the design guidance set out in the SPDs. These principles include the following environmental standards relevant to this report: energy strategy, water consumption, drainage management, weather resilience, waste management, construction management, biodiversity, and waterways.

2.4.1.3 Manchester Residential Quality Guide 2017

The Manchester Residential Quality Guide has been developed to help shape the creation of new homes and communities across the Greater Manchester city region, beginning with the Centre and its immediate surroundings. This document outlines the considerations, qualities, and opportunities that will help to deliver high quality residential development as part of successful and sustainable neighbourhoods across Manchester. The guidance includes the following nine components:

Make it Manchester – developers must understand the city’s unique character, heritage old and new, density and scale in various parts of the city and appreciate how new homes will fit in to what is already there.

Make it bring people together – new homes must encourage a sense of community and neighbourliness, offering a mix of tenures to promote a mix of people.

Make it animate streets and spaces – understand the relationship between new homes and its environment and create public space.

Make it easy to get around – make sure developments have good transport links, along with good walking and cycling provision.

Make work with the landscape – development should improve the connection with the local environment with improved biodiversity, as well as greening and water schemes.

Make it practical – dealing with waste, car parking, bike storage and visitors should be made as easy as possible.

Make it future proof – design must anticipate the impacts of climate change and extreme weather with efficient design and adaptability.

Make it a home – sufficient space, natural light, privacy and storage are essential for people to settle down and flourish.

Make it happen – ensuring proposals are delivered, to a high quality, with high design standards and high sustainability.

2.4.1.4 Manchester's Great Outdoors- A green and blue infrastructure strategy 2015-25

The Green and Blue Infrastructure Strategy for Manchester aims to invest to date in the city's Green and Blue infrastructure over the next 10 years (by 2025). Four objectives have been established to enable the vision to be achieved:

1. Improve the quality and function of existing green and blue Infrastructure, to maximize the benefits it delivers.
2. Use appropriate green and blue infrastructure as a key component of new developments to help create successful neighbourhoods and support the city's growth.
3. Improve connectivity and accessibility to green and blue infrastructure within the city and beyond.
4. Improve and promote a wider understanding and awareness of the benefits that green and blue infrastructure provides to residents, the economy, and the local environment.

2.4.1.5 Manchester Climate Change Framework 2020-25

Following the declaration of a climate emergency by MCC in July 2019, this framework was adopted and is an in-depth strategy to accompany the Draft Manchester Zero Carbon Framework 2020-38, which was published in February 2019. It is a framework that will continue to develop over the next five years, in line with changes in policy, climate science, rate of progress and other factors. The framework has set out four objectives to facilitate this:

Objective 1 – Staying within our carbon budgets.

- Direct CO2 emissions: staying within our 15-million-ton carbon budget for 2018-2100, including reducing the CO2 emitted from our homes, workplaces and ground transport by at least 50% during 2020-25.
- Indirect CO2 emissions: understanding and taking action on the things that we consume, and which generate greenhouse gases through their production, transportation and disposal.

Objective 2 – Climate adaptation and resilience

- Increase the amount of urban green infrastructure cover, aiming for a 10% increase by 2038 from 2018 levels, in line with the Greater Manchester aim.
- Respond to these risks by incorporating adaptation and resilience within our plans and strategies, and acting to make necessary changes to our buildings, infrastructure and our natural environment.

Objective 3 – Health and wellbeing

- Adapt the city's built and natural environment and prepare our residents to become more resilient to these changes. Increasing the amount and quality of green space to enable residents to benefit from the improved physical and mental health that will come as a result.
- Improving the energy efficiency of the city's homes and providing access to affordable, secure supplies of renewable energy are essential help get 38,000 Manchester households out of fuel poverty.

Objective 4 – Inclusive, zero carbon and climate resilient economy

- Ensure that Manchester establishes an inclusive, zero carbon and climate resilient economy where everyone can benefit from playing an active role in decarbonising and adapting the city to the changing climate.

2.4.2 Manchester City Council's Planning Document Targets

Manchester City Council's Planning Policy currently uses the following documents to look to establish the carbon reduction targets to be achieved in new developments across the City.

These documents use different terminology to describe achieving the various reduced carbon emissions.

Please see below a summary of the terminology and targets set out within the current Manchester Planning Policy documents:

Planning Document:	Time of Production or Adoption:	Low Carbon Target:	Sustainable Design Definition:
Manchester Council's Core Strategy 2012-2027	Adopted 2012	Targets a 9% reduction in carbon emissions over Part L Building Regulations.	Low Carbon (9% over Part L 2013)
Climate Change and Low Emission Strategies 2016-2020	Adopted 2016	Targets a 48% reduction in carbon emissions from 1990 - 2020	Low Carbon (48% over 1990 emissions)
Manchester: A Certain Future	Produced in 2009, updated in 2013	Targets emitting 41% less CO ₂ in 2020 than in 2005 – Equates to 10% over Part L 2013 (if going by Part L requirements)	Low Carbon (10% over Part L 2013)

Table 1: Overview of Manchester Planning Documents Carbon Targets

2.4.3 National Planning Policy

The NPPF (August 2021) sets out the Government's planning policies for England and how these are expected to be applied. The overall emphasis of the NPPF is to reiterate the Government's key objectives, including securing sustainable development.

The NPPF defines the purpose of the planning system as being to contribute to the achievement of sustainable development. It explains at Paragraph 8 that there are three dimensions to sustainable development. These are economic, social and environmental and should be pursued simultaneously through the planning system.

Paragraph 10 states that at the heart of the Framework is a presumption in favour of sustainable development.

2.5 Sustainable Design Strategy

2.5.1 Energy and Carbon Emissions

Building Services Strategy

In response to the policy requirements and climate change plan targets set out in section 2.2, developments should aim to assist and achieve the following carbon reduction targets:

1. Achieve a minimum of 10% CO₂ reduction over the Part L 2013 Target Emission Rate (TER), as per Target 2 (Electricity intense buildings) in Table 12.1 of Policy EN6.
2. Assist in achieving carbon neutrality by 2038.

To achieve the most accurate calculations and estimates, the proposed units have been modelled using *SAP 2012*, the Government's Standard Assessment Procedure for residential dwellings.

The proposed strategy for minimising energy use and carbon emissions is based on the energy hierarchy described in CIBSE Guide F 2012 (Energy efficiency in buildings). The energy hierarchy has been adopted for the development to ensure that the correct approach to design is taken to promote an energy-efficient low carbon solution (see figure 2). This has ensured that the benefits of effective methods of energy use reduction have been maximised first. The approach adopted is as follows:

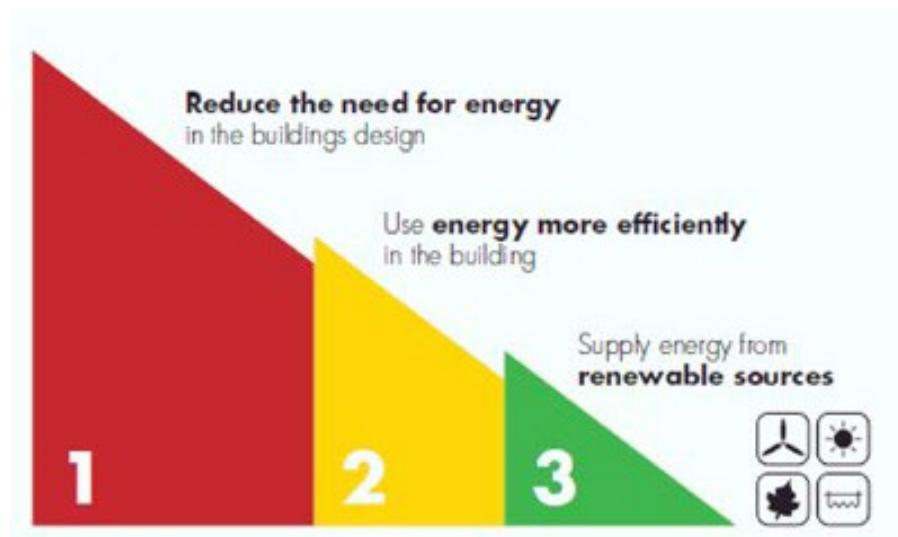


Fig 2: Energy Hierarchy

Minimise energy demand – Implement passive design measures and optimise the building envelope in terms of orientation, air tightness, and insulation. For example, the proposal is targeting a low carbon classification through a holistic low energy design concept as it will be designed with a fabric first approach whereby Passive House design standards are aspired to for all fabric U-values and air permeability targets.

Meet demands efficiently – Specification of energy efficient decentralised plant, heating, ventilation, lighting, and system controls to facilitate efficient operation. For example, each dwelling will include highly efficient gas boilers to provide the main heating and hot water requirements.

Particular attention is being paid to the wellbeing of occupants. The ventilation strategy has been developed to minimise noise ingress from the proposed location as far as possible while minimising the risk of overheating.

Additional Renewable Energy Measures

Opportunities for incorporating low and zero carbon technologies (LZCT) have been considered for this development. The viability of several separate technologies was examined in a LZCT study (see section 3) which helped to identify potential opportunities for the inclusion of PV panels.

Efficient and Sustainable Design Measures

In line with the above Sustainable Design Strategy, the following Energy Efficient design measures are specified.

- High levels of insulation throughout with minimal thermal bridges
- Passive solar gains and internal heat sources
- Excellent level of airtightness
- Good indoor air quality by openable windows

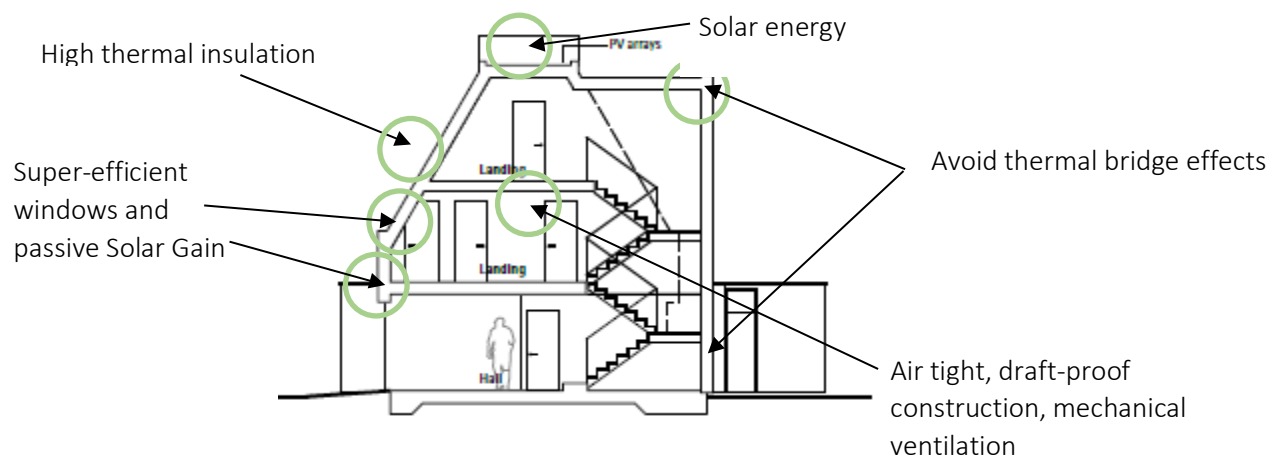


Fig 3. Efficient Design Measure examples

The Proposed specifications and key energy efficient design measures are as follows:

Residential Units:

- Ground floor U-values of 0.10 W/m²K
- External Wall U-values of 0.20 W/m²K
- Flat Roof U-values of 0.10 W/m²K
- Pitched Roof U-values of 0.10 W/m²K
- Low Double Glazed Window U-values of 1.3 W/m²K
- 100% low energy lighting throughout
- 100% efficient electric panel heaters to each flat
- 120/150L electric immersion cylinders to each flat
- MVHR – Vent Axia Sentinel Kinetic FH to each flat
- Air Permeability Rate of 3m³/hm² in all houses

2.5.2 Choice and Impact of Renewable Technology

All reasonable technologies were investigated for their suitability to the site and development; please refer to section 3 for details.

In addition to energy efficiency measures, it is proposed that the development will feature the following Low/Zero carbon Technologies:

- **50kWp Site Wide PV Array (Approx. 148no. 340W Panels) implemented onto the roof of the apartment block**

The above LZC contribution has provided an **8.5%** reduction in CO₂ following Energy Efficiency Measures.

- Energy Saving from onsite LZC Technologies = **43170.2 kWh/Yr**
- CO₂ Saving from onsite LZC Technologies = **22405.4 kgCO₂/Yr**

2.5.3 Energy and CO₂ Reduction Summary

A summary of all stages of the energy demand assessment from baseline figures to final carbon reduction are shown in Figures 1 & 2 below:

	SAP 9.0	SAP 10.0	SAP 10.1
Summary of CO₂ Emission Reductions	Total CO₂ emissions (kgCO₂/year)		
Baseline emissions	288756.5	174613.5	167793.7
Improved emissions (after application of energy efficiency measures)	263294.0	118203.3	68994.2
Improved emissions (after incorporation of efficient energy supply)	263294.0	118203.3	68994.2
Improved emissions (after incorporation of renewable energy technology) % CO ₂ displaced in total	240888.7	108144.6	63123.0
% CO ₂ displaced in total	16.6%	38.1%	62.4%
% CO ₂ displaced by energy efficiency measures	8.8%	32.3%	58.9%
% CO ₂ displaced by efficient supply of energy	0.00%	0.00%	0.00%
% CO ₂ displaced by renewable energy	8.5%	8.5%	8.5%

Table 2: Summary of CO₂ Reductions



	Energy demand (kWh pa)	Energy saving achieved (%)	Regulated CO ₂ emissions (kg pa)	Saving achieved on residual CO ₂ emissions (%)
Building Regulations Part L compliance ("Baseline" energy demand & emissions)	823792.7		288756.5	
Proposed scheme after energy efficiency measures and CHP ("Residual" energy demand & emissions)	507310.3	38.4%	263294.0	8.8%
Proposed scheme after on-site renewables	464140.0	43.7%	240888.7	8.5%
Proposed scheme offset for financial contribution or other "allowable solution"			0	0
Total savings on residual emissions				8.5%

Table 3. Total Energy and Carbon Emissions Savings Based on SAP 9.0 Carbon Factors



For a full Breakdown of the figures and calculations please see Appendix A – Energy Demand Assessment Spreadsheet.

Baseline energy demand

‘Standard Assessment Procedure - SAP 2012’ was used to produce example SAP reports to generate the figures used within the calculations.

Baseline energy demand (kWh pa)	823792.7
Regulated emissions (kg pa)	288756.5

Heating

The heating and cooling hierarchy has been applied to the design process of the development. It has resulted in large focus on energy efficiency measures and as can be seen in Figure 1.

Energy savings from the use of CHP systems (kWh pa)	-
Emission savings from the use of CHP systems (kg pa)	-
Total regulated emissions after CHP savings (kg pa)	288756.5

Energy efficiency

The following table demonstrates how the development achieves the reduction in carbon dioxide emissions from energy efficiency measures.

Energy savings from energy efficiency measures (kWh pa)	316482.4
Emission savings from energy efficiency measures (kg pa)	25462.4
Total regulated emissions after CHP savings and energy efficiency measures (kg pa) (“residual emissions”)	263294.0

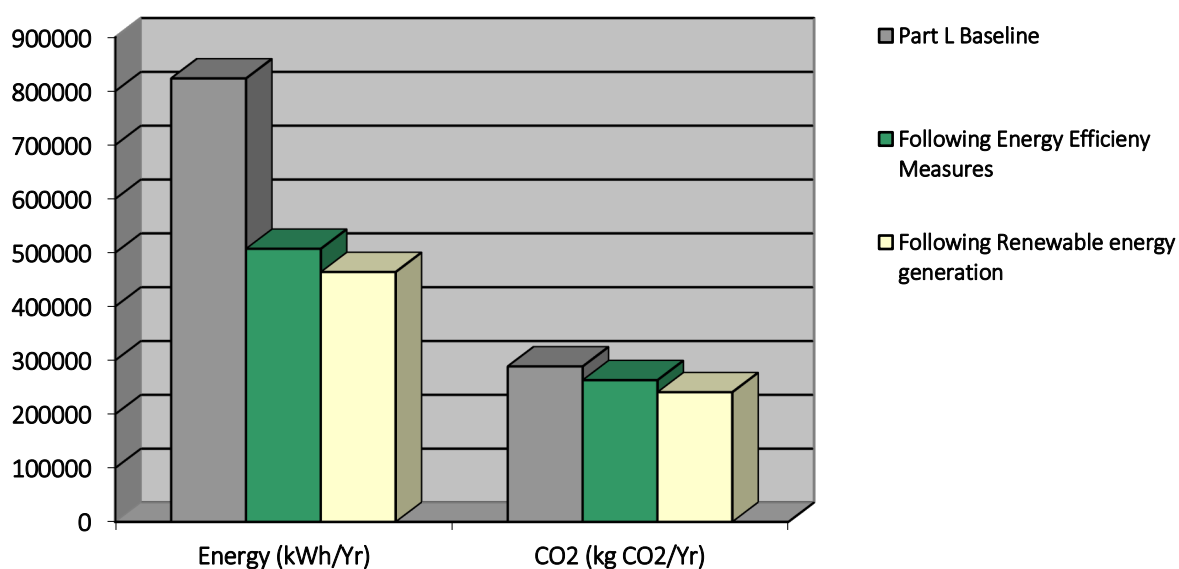


On-site renewables

The following table demonstrates how the development achieves the reduction in carbon dioxide emissions from LZC technologies.

Energy saving from the use of renewables (kWh)	43170.2
Saving on residual emissions from the use of renewables (kg)	22504.4
Saving on residual emissions from the use of renewables (%)	8.5%

The chart below illustrates the improvements over the Part L Compliant Baseline:



2.5.4 Manchester City Council' Policy and Targets Summary

With regards to the Manchester City Council's planning documents policy and targets (outlined in section 2.2.1 to 2.2.3) the table below details how the Sustainable Design Strategy (outlined in section 2.3.1) achieves the current planning policy requirements and targets.

Planning Document:	Sustainable Design Strategy
Manchester Council's Core Strategy 2012-2027	The Sustainable Design Strategy achieves a 16.3% reduction in carbon emissions over Part L 2013 - exceeding the EN6 documents Low Carbon target of 9% over Part L 2013.
Climate Change and Low Emission Strategies 2016-2020	The Sustainable Design Strategy achieves a 16.6% reduction in carbon emissions over Part L 2013 – exceeding the documents Low Carbon target of 48% over 1990 Emissions.
Manchester: A Certain Future	The Sustainable Design Strategy achieves a 16.6% reduction in carbon emissions over Part L 2013 – exceeding the documents Low Carbon target of 10% over Part L 2013.

Table 4. Summary of MCC and Planning Targets

As a result of the sustainable design parameters outlined within section 2.3.1 and the energy and CO2 reduction figures summarised above, the proposed development achieves a total reduction of **16.6%** in carbon emissions over Part L 2013.

The low carbon classification for the development can be derived from its prioritisation of fabric first carbon reduction through exceeding Building Regulation design standards, before the incorporation of on-site renewable technologies.

2.6 Adaptation to Climate Change

In addition to the primary building design and fabric, many other issues that will influence creating a sustainable development, including flood prevention, material use, waste minimisation and transport. All these issues feature regularly within the separate climate change action plans, outlined within section 2.2, as areas that Manchester is aiming to significantly improve on in order to become a more carbon neutral and clean city.

All the sections of creating a sustainable development should be taken into consideration from the start of the development and promoted throughout the building construction on site in order to maximise their benefits. Additionally, features which enable more efficient usage should also be specified to encourage the building users to maintain efficient use once construction has been completed.

2.6.1 Flood Risk Zone

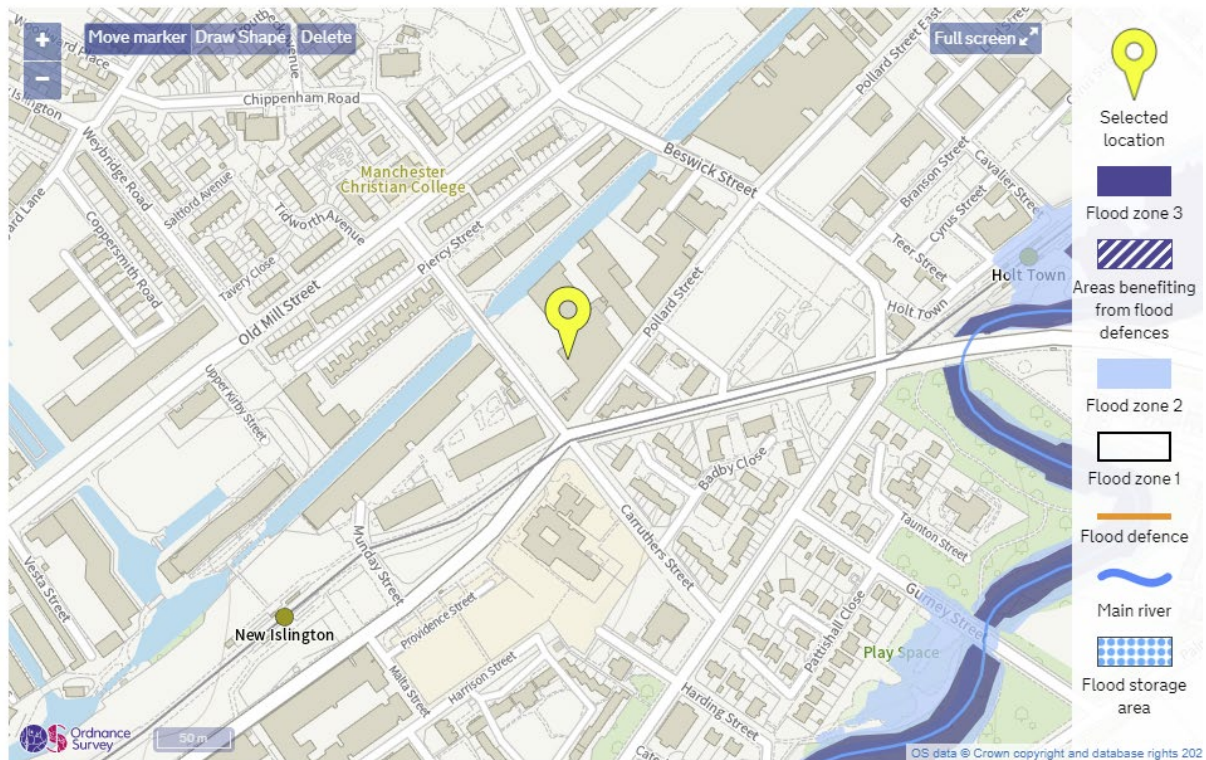


Fig 4: Flood Risk Map

The above map and snippet have been taken from a Government licences flood risk map for Manchester. It can be seen that the site is just located within flood risk zone 1 and therefore has minimal to no risk of flooding.

2.6.2 Green Blue Infrastructure

2.6.2.1 Sustainable Drainage Systems (SUDs)

Even though it has been shown that the proposed scheme is located on a site with a low to zero flood risk, it is adjacent to the canal and therefore it should be ensured that the levels of surface water run-off do not increase from the existing development to the proposed, especially due to the new scheme having a different footprint and potentially resulting in new areas of impermeable surfacing. Therefore, a drainage strategy assessment should be undertaken, by a suitably qualified professional, to assess the feasibility of introducing on-site SUDs measures, that will reduce surface water run-off and any flood risks associated.

By incorporating SuDs, flood risk can be managed and mitigated. Section 1.1 of the SuDs Manual (Ciria C753) states the following:

“Sustainable drainage systems (SuDs) can deliver multiple benefits.

Surface water is a valuable resource, and this should be reflected in the way it is managed and used in the built environment. It can add to and enhance biodiversity, beauty, tranquillity and the natural aesthetic of buildings, places and landscapes and it can help make them more resilient to the changing climate.”

The general concept of SUDs is to manage the flood and pollution risks in developed areas. This is done by efficiently managing surface water run-off by either slowing down the surface water run-off, or by reducing the quantity of surface water run-off. There are different methods to achieve this such as:

- Harvesting – capturing rainwater and facilitate its use within the development
- Infiltrating – rainwater infiltrates into the ground
- Storing – capturing rainwater and control the flow through the means of storing and releasing it slowly i.e. attenuation
- Conveying & treating – capturing rainwater and removing any contaminants, then convey the flow towards a downstream system

The SuDS Manual describes the four pillars of SuDS design as Water Quality, Water Quantity, Amenity and Biodiversity as illustrated in Figure 3 below:

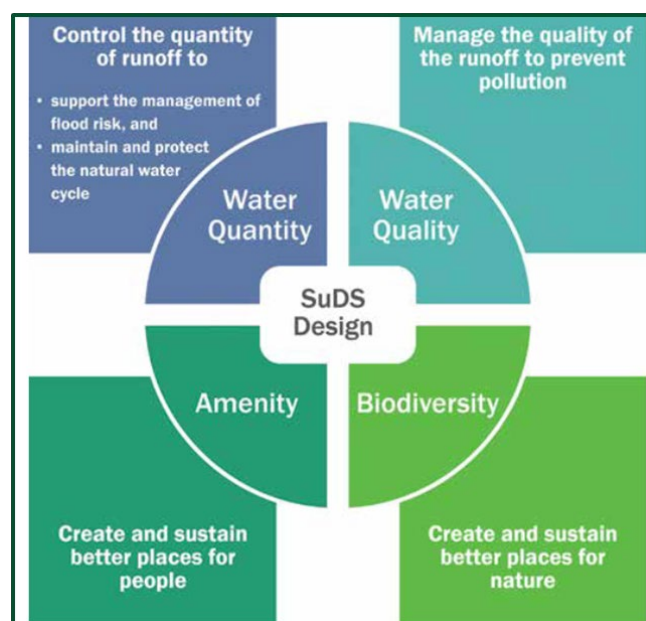


Fig 5. Representation of figure 2.1 of the SUDs Manual

SuDS are increasingly gaining popularity as a holistic solution to a wide range of pressing issues including flood risk, water pollution, groundwater depletion, biodiversity loss and urban decline.

Drainage Hierarchy

To alleviate pressure on existing sewer networks and to address issues of climate change the following hierarchy has been developed and implemented from a planning perspective.

The Planning Practice Guidance, states that:

“generally, the aim should be to discharge surface run-off as high up the following hierarchy of drainage options as reasonable practicably:

1. *Into the ground (infiltration)*
2. *To a surface water body*
3. *To a surface water sewer*
4. *To a combined sewer”*

The “Building Regulations Approved Document H” refer to this discharge hierarchy.

Description	Benefit
Flood risk management	SuDS aim to have an attenuating affect by slowing down and storing surface water run-off
Drainage resilience	Future proofing designed to be resilient against climate change
Natural flow regime protection	Mimic natural drainage arrangements to emulate natural flow
Water quality	Filter out pollutants and discharge cleaner water
Water reuse	Can be strategically placed to clean and capture water for reuse
Biodiversity and ecology	SuDS use vegetation and natural landscape to support biodiversity and ecology
Amenity	Improve visual integrity and desirability of the site by implementing green and blue features
Carbon reduction	SuDS can reduce carbon use throughout the life cycle including construction, maintenance, and demolition
Microclimate	Aim in reducing heat island effects
Education	Educate and engage the general public about surface water management

Table 5. Outline of types of green/blue infrastructure and associated benefit

2.6.2.2 Biodiversity

Similarly, to the previous section on SUDs, the nature of the proposal: including the demolishing of an existing building and potential change in area of impermeable surface, there could be adverse impacts on the surrounding ecology as well potential for the enhancement. This has been addressed through an Ecology Scoping Report, submitted in support of the planning application.

2.6.3 Internal Water Efficiency

Part G of the Building Regulations requires all new dwellings to have an internal water consumption of no greater than 110 litres / person / day, unless specified to be less. Therefore, fittings proposed should have low flow rates, capacities, effective flush volumes etc. Example targets for these to achieve the required internal consumption are as follows:

Appliance	Unit of measure	Amount (litres)
WC (Dual flush)	Full flush volume	4
WC (Dual flush)	Part flush volume	2.6
Taps (excluding kitchen)	Flow rate l/min	5
Kitchen taps	Flow rate l/min	6
Bath	Capacity to Overflow	170
Shower	Flow rate l/min	8
Washing Machine	Litres / kg dry load	8.17
Dishwasher	Litres / place setting	1.25

Table 6. Internal Water Efficiency Flow Rates

The above rates will achieve a total internal water consumption of 106.31 with a bath present and 98.25 with only a shower present.

The specifying of 'A' rated appliances should be prioritised where possible.

2.6.4 Waste Management

2.6.4.1 Occupational Waste

Manchester City Council's Waste Storage and Collection Guidance for New Developments 2017 encourages all new developments to incorporate a waste management strategy into the build at the earliest stage possible.

2.6.4.2 Construction Waste

A target of at least 90% of waste generated on site, throughout the construction stage of the development, to be diverted from landfill' will be included as part of a Construction Environmental Management Plan (CEMP) to be agreed with MCC.

The proposal will also endeavour to maximise the use of recycled materials on site, whereby further promoting the minimising of waste production.

2.6.5 Materials

The construction of new buildings and building elements has a large environmental impact in terms of both, energy, and embodied carbon of new materials. Therefore, Manchester City Council promote the prioritising of environmentally friendly materials, where possible, and encourages the use of recycled building materials. This information should also be incorporated into the SWMP mentioned in the previous subsection (Waste Management) as a means of promoting the re-using and recycling of materials.

Where new materials are to be used, careful consideration of their environmental impact should be taken. This can be achieved by ensuring that only materials that score well under The Green Guide to Specification. This useful online tool can be used as a reference that provides guidance on the relative environmental impacts for a wide range of different building specifications. The BRE's Environmental Profile Methodology determines the Life Cycle Assessment (LCA) of materials, which is what the Guide's specifications are based on.

In order to take full advantage of low impact materials, elements key to the scheme should be specified to achieve ratings of between A+ and C under The Green Guide's ratings. Insulation materials that are specified will also have a global warming potential (GWP) of 5 or less, with an ODP of 0. Additionally, 100% of all timber used as part of the scheme will be responsibly sourced from suppliers that are either Forest Stewardship Council (FSC) accredited, Programme for the Endorsement of Forestry Certification accredited, or a similar recognised accreditation body.

To further promote embodied energy and carbon savings, the scheme will first prioritise the reusing of any demolished materials within the site, however if this is not possible secondary priority must be given to the redirecting from landfill, in line with the waste hierarchy.

Finally, in addition to the above policy points, the development is also recommended to register with the Considerate Constructors Scheme, or a similar approved scheme.

2.6.6 Pollution Control

To reduce emissions of gases with high global warming potential (GWP) and nitrogen oxide (NOx) into the atmosphere, new buildings will be specified with insulating materials that have a GWP of less than 5. This will follow throughout the development to reduce the impact that the construction phase has upon climate change.

Additionally, the following measures will be implemented:

- Pollution Prevention Guidance will be adhered to in respects of air (dust) and water (ground and surface) pollution during the demolition and construction phase.
- External light fittings will be controlled through a time switch, or daylight sensor, to prevent operation during daylight hours to limit the impact of artificial lighting for the development's residents and surrounding environment.
- Dust suppression measures will also be put in place as part of the Main Contractor's Environmental Management Plan, this will reduce the potential risk to local watercourses (River Irk) and neighbouring properties.

Sound insulation will be specified to achieve Building Regulation Part E compliance standard (this will be verified by pre-completion testing) in addition to meeting the requirements of the council. This will reduce the impact of sound pollution for the occupants within adjoining dwellings.

2.6.7 Health and Wellbeing

A full daylight and sunlight analysis assessment should be carried out for the proposed development to ensure that compliant levels of vertical sky component (VSC), no sky line (NSL) and annual probabal sunlight hours (APSH) are achieved.

In addition to having this assessment completed, the following measures will also be incorporated:

- Efficient MVHR Units are to be specified to each individual dwelling which will provide a continuous source of fresh, filtered air to maintain a healthy indoor environment.
- Enhancing the green infrastructure of the site by introducing planting wherever possible, therefore improving the physical and mental wellbeing of residents, visitors, and workers.
- Secure by Design accreditation will be sought which will incorporate the adoption of crime prevention measures to further prevent crime and promote a safe environment.

The above findings and technology will all help to promote healthy housing for residents which has been identified by the World Health Organisation (WHO) as an increasingly important factor in increasing quality of life, preventing disease and illness, and mitigating climate change.

2.6.8 Sustainable Transport

A key message from all climate change adaptation plans (as mentioned in section 2.2), specifically Our Manchester Strategy 2016-2025, The Zero Carbon Framework (formulated by the Manchester Climate Change Board) and Manchester City Council's Core Strategy 2012-2027, is the need to increase the proportion of cycling, walking and public transport journeys. This is due to it providing both environmental and social benefits through the reducing of emissions, improving air quality, and promoting a more active lifestyle.

The proposed development acknowledges the benefits associated with these forms of sustainable transport and is therefore providing a large, central cycle store at ground floor level whilst also not including any car parking, thereby encouraging all residents to commute in a sustainable manner.

Further to providing cycle provision, the site is located within New Islington adjacent to both Pollard and Carruthers Streets, which both have multiple bus stops. Also, New Islington Tram Stop is a five-minute walk southeast from the site. This proximity to several transport nodes with such a range of travel possibilities further reduces the reliance on cars and the negative environmental impacts associated.

Transport Links

- **Train:** The closest train station to the site is Piccadilly Train Station, which is located approximately 0.9 miles southwest of the site. This station provides access to additional Manchester stations as well as regional and national destinations.
- **Bus:** The nearest bus stop is located on Pollard Street and is less than 0.1 miles from the site. These will provide frequent services to Stalybridge, Ashton-under-Lyne and Piccadilly Gardens; where further buses can be caught to more regional destinations.
- **Metrolink:** The closest Metrolink station to the site is the New Islington Tram Stop. This provides an additional means of public transport to locations within central Manchester, Manchester Airport and also further afield to Altrincham, Bury, Eccles, East Didsbury, Rochdale, Ashton-Under-Lyne and Manchester Airport.

Local Amenities

- North Ridge Recreation Area is situated 0.3 miles from site; providing a recreational space for residents.
- The site is also only 0.6 miles from Great Ancoats Street, and within a 20 minute walk to the centre of town, where a multitude of shops and amenities can be accessed.
- Manchester Metropolitan and Manchester University are both less than 1.5 miles from the proposed development providing good access to higher education via the transport nodes mentioned earlier in this subsection.
- Due to its proximity to Central Manchester, the site has good access to music, theatre and art venues, places of religion and Manchester's City Library.

3 Feasibility Assessment of Renewable Energy and Low Carbon Technologies

Solar Hot Water (Thermal)

Solar water heating systems are one of the more familiar renewable technologies used at the moment. They use the energy from the sun to heat water, most commonly for hot water needs. Solar heating systems use a heat collector that is usually mounted on a roof in which the sun heats a fluid. This fluid is used to heat water that is stored in either a separate hot water cylinder or in a twin-coil hot water cylinder (the second coil is used to provide additional heating from a boiler or other heat source).

Renewable Technology Not Chosen.

Solar hot water panels could be used however, PV will provide slightly better savings and avoid the need for water storage cylinders when compared.

Photovoltaic Panels (PV)

Photovoltaic modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases of silicon. Through a process called doping, very small amounts of impurities are added to the semiconductor, which creates two different layers called n-type and p-type layers.

Certain wavelengths of light are able to ionize the silicon atoms, which separates some of the positive charges (holes) from the negative charges (electrons). The holes move into the positive or p-layer and the electrons into the negative or n-layer. These opposite charges are attracted to each other, but most of them can only re-combine by the electrons passing through an external circuit, due to an internal potential energy barrier. This flow of electrons produces a DC current.

A PV array can be mounted on the suitable roof space. The amount proposed at this stage is **50.0kWp Site Wide PV Array (Approx. 148no. 340W Panels)** implemented onto the main flat roof areas.

Chosen Renewable Technology

Ground Source Heat pumps

A heat pump is a device that takes up heat at a certain temperature and releases it at a higher temperature. The essential components of a heat pump are heat exchangers (through which energy is extracted and emitted) and a means of pumping heat between the exchangers. The effectiveness of the heat pump is measured by the ratio of the heating capacity to the effective power input, usually known as the coefficient of performance (COP). Ground-source heat pumps (GSHP) extract heat from the ground. They are classified as either water-to-air or water-to-water units depending on whether the heat distribution system in the building uses air or water. Ground source heat pumps either use long shallow trenches or deep vertical boreholes to take low grade heat from the ground and then compress it to create higher temperatures.

Renewable Technology Not Viable

Ground source heat pumps would not be suitable due to the lack of land space around the properties and the associated costs.

Air Source Heat pumps

Air source heat pumps absorb heat from the outside air. This is usually used to heat radiators, underfloor heating systems, or warm air convectors and hot water in your home. An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside.

The system performs down to air temperatures of -20°C which means that they are more than suitable for installations within the UK. Hot water and Heating can be provided 365 days a year. The hot water is produced without the aid of electrical immersions and at 55°C is more than hot enough for baths and showers.

There are two main types of air source heat pump system:

- An air-to-water system distributes heat via your wet central heating system. Heat pumps work much more efficiently at a lower temperature than a standard boiler system would. So they are more suitable for under-floor heating systems or larger radiators, which give out heat at lower temperatures over longer periods of time.
- An air-to-air system produces warm air which is circulated by fans to heat your home. They are unlikely to provide you with hot water as well.

Renewable Technology Not Chosen

Air Source heat pumps are a good option to provide heating and cooling however, as previously mentioned the development is already achieving the required reduction through efficient design measures and PV.

Biomass Heating

Biomass is any plant-derived organic material that renews itself over a short period.

Biomass energy systems are based on either the direct or indirect combustion of fuels derived from those plant sources. The most common form of biomass is the direct combustion of wood in treated or untreated forms. The use of biomass is becoming increasingly common in some European countries.

The environmental benefits relate to the significantly lower amounts of energy used in biomass production and processing compared to the energy released when they are burnt. This can range from a four-fold return for biodiesel to an approximate 20-fold energy return for woody biomass. Biomass-fuels can be used to produce energy on a continuous basis (unlike renewables such as wind or solar energy) and it can be an economic alternative to fossil fuels as it is a potential source of both heat and electricity.

However, Biomass systems have particular design management and maintenance requirements associated with sourcing, transportation and storage and are therefore more commonly used in commercial developments rather than domestic installations. It can be less convenient to operate than mains-supplied fuels such as natural gas and are more management intensive and require expertise in facilities management. Sources of biomass can also fluctuate, so boilers should be specified to operate on a variety of fuels without risk of overheating or tripping out.

Renewable Technology Not Chosen

A communal biomass system would not be feasible for this development due to the expense associated with the necessary output to heat all dwellings on the site.

Wind

Wind turbines convert the kinetic energy in wind into mechanical energy that is then converted to electricity. Turbines are available in a range of sizes and designs and can either be free-standing, mounted on a building or integrated into a building structure.

Renewable Technology Not Viable

The wind speed in the area is under the advised minimum and the built-up area means that a wind turbine wouldn't be feasible.

4 Conclusion

This statement has assessed the proposed development at the Ancoats Works site against the relevant climate change and sustainability policies and targets, as outlined within: the Manchester City Council Core Strategy (July 2012), Our Manchester Strategy, Manchester: A Certain Future and The Zero Carbon Framework, through the following of the energy hierarchy, the modelling of apartments in the FSAP 2012 software and addressing all aspects of a sustainable development. In addition, the proposal has been assessed against national sustainable design definitions to determine how it can be classified.

As part of this process, the development was designed with a fabric first approach; with U-values, design air permeability and ventilation targets all aspiring to Passive House design standards and therefore significantly exceeding Building Regulations Part L 2013 standards. Following on from this, efficient MVHR systems are proposed for each apartment and house, to further reduce the total energy demands whilst simultaneously providing each dwelling with healthy internal environments. This approach demonstrates a holistic low energy design concept, involving very low limiting values and thus led to high-energy performance targets and being defined as a low carbon development.

Furthermore, an LZC feasibility assessment was carried out, with all suitable technologies investigated for their suitability to the site and development. The assessment determined that a 50.0kWp system can be proposed at this stage, which would equate to 148No panels and would provide an additional 8.5% reduction in carbon emissions over the residual emissions: bringing the total carbon reduction to **16.6%**, when using SAP 9.0 carbon factors. However, this reduction rises further to **38.1%** and **62.4%** when using SAP 10 and 10.1 carbon factors. In addition to this renewable technology provision, the development can also be defined as carbon neutral because it will have net zero carbon emissions. This is to be achieved by obtaining all the energy used on site from a 100% renewable energy electricity supply provider.

The development will also be adapting to climate change by incorporating sustainable drainage measures into the design, protecting existing ecology, enhancing biodiversity where possible and providing cycle storage provision to residents.

In addition to the following of the energy hierarchy through the efficient design and renewable technology measures mentioned and meeting all relevant Manchester City Council carbon targets the proposal will include a large number of sustainability measures throughout construction and once completed, which will contribute heavily to the development's sustainability performance and accord with the requirements of the NPPF. The key measures to be included:

- The proposal sits within Flood Risk Zone 1 and therefore has minimal to no risk of flooding.
- A SUDs strategy will be produced to outline all measures to be incorporated that will ensure any additional surface water is collected, treated and removed.
- The development will incorporate green infrastructure in the form of extensive planting involving hedges, trees, sedum/green roofs and ornamental planting that will instil a sense of wellbeing whilst also assisting with offsetting carbon dioxide and balancing local temperatures through evapotranspiration.

- Internal water efficiency will be prioritised by ensuring that efficient water fixtures are proposed so that each dwelling achieves less than 110L per person per day and 'A' rated appliances will be specified where possible.
- Waste minimisation will be targeted from throughout construction and occupational phase. It is targeted that at least 90% of construction waste will be diverted from landfill. Whilst tri-separator refuse shoots will be installed on each floor to promote recycling.
- In addition to targeting Secure by Design accreditation through adoption crime prevention measures, the site layout promotes busy spaces and routes and facilitates natural surveillance. These will therefore reduce the fear of crime and subsequently improving mental health of residents, visitors and workers.
- Prioritising reusing existing materials and locally sourced materials for construction to reduce waste and transportation to landfill in addition and promote a low embodied carbon development.
- When new materials are specified that are not locally attainable then only those that score well on the BRE: The Green Guide to Specification are to be used; to further encourage the use of sustainable materials and reductions in embodied carbon.
- The buildings will have a daylight and sunlight analysis carried out and will aim to achieve high pass rates. Additionally, highly efficient MVHR systems are being proposed to each flat individually to provide a continuous source of fresh air and maintain healthy indoor environments. These will promote healthy housing and subsequently boost physical and mental wellbeing of residents.
- The proximity of the Manchester City Centre to the proposed site is highly sustainable in terms of transport and local amenities as it is near a number of public transport nodes including Manchester Deansgate Train Station and Cornbrook Metrolink Station, multiple bus stops and additional Metrolink stations, as well as a multitude of shops and other local amenities.
- The development will also include significant cycle storage provision.

As a result of all the above, the proposed sustainable design and energy strategy allows the development to comply with Manchester City Council's planning policy requirement and is in line with all targets put forward in their planning documents.

House Type	GF Duplex x10	GF End Terrace x4	GF Mid Terrace x11	MidF Exposed Floor x3	MidF End Terrace x44	MidF Mid Terrace x93	TopF End Terrace x8
Frequency	10	4	11	3	44	93	8
BASELINE Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)
Main Heating Fuel Requirement (DER)	1621.05	2250.14	1881.57	3528.5	1596.08	1440.65	2117.65
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0	0	0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0	0	0
Water Fuel Requirement (DER)	2320.96	2265.27	2194.37	2361.91	2283.72	2207.99	2268.57
Electricity Pumps Fans Requirement (DER)	75	75	75	75	75	75	75
Electricity Lighting Requirement (DER)	311.22	298.7	277.55	370.61	298.7	277.55	298.7
TOTAL PER DEVELOPMENT							
AFTER ENERGY SAVING MEASURES Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)
Main Heating Fuel Requirement (DER)	459.24	1101.01	752.79	2027.95	745.69	455.74	991.97
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0	0	0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0	0	0
Water Fuel Requirement (DER)	1625.81	1594.96	1531.34	1696.5	1594.96	1531.34	1594.96
Electricity Pumps Fans Requirement (DER)	169.97	132.28	119.8	183.63	132.28	124.69	132.28
Electricity Lighting Requirement (DER)	311.22	298.7	277.55	370.61	298.7	277.55	298.7
TOTAL PER DEVELOPMENT							
FINAL Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)
Main Heating Fuel Requirement (DER)	459.24	1101.01	752.79	2027.95	745.69	455.74	991.97
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0	0	0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0	0	0
Water Fuel Requirement (DER)	1625.81	1594.96	1531.34	1696.5	1594.96	1531.34	1594.96
Electricity Pumps Fans Requirement (DER)	169.97	132.28	119.8	183.63	132.28	124.69	132.28
Electricity Lighting Requirement (DER)	311.22	298.7	277.55	370.61	298.7	277.55	298.7
PV Energy Produced (DER)	-223.7	-223.7	-223.7	-223.7	-223.7	-223.7	-223.7
TOTAL PER DEVELOPMENT							



TopF Mid Terrace x15	TopF Pitched Roof x5	TOTAL (kWh/yr)		TOTAL (kgCO2/yr)	SAP 10.0	TOTAL (kgCO2/yr)	SAP 10.1	TOTAL (kgCO2/yr)
15	5	193						
Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
1924.05	2951.28	321260.2	0.216	107557.9	0.210	67464.6	0.210	67464.6
0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
0	0	0.0	0.216	0.0	0.210	0.0	0.136	0.0
2193.22	2371.34	432224.8	0.216	144708.9	0.210	90767.2	0.210	90767.2
75	75	14475.0	0.519	7512.5	0.233	3372.7	0.136	1968.6
277.55	370.61	55832.7	0.519	28977.2	0.233	13009.0	0.136	7593.3
		823792.7		288756.5		174613.5		167793.7
Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
722.67	1481.7	124739.5	0.519	64739.8	0.233	29064.3	0.136	16964.6
0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
1531.34	1696.5	301377.3	0.519	156414.8	0.233	70220.9	0.136	40987.3
124.69	183.63	25360.7	0.519	13162.2	0.233	5909.1	0.136	3449.1
277.55	370.61	55832.7	0.519	28977.2	0.233	13009.0	0.136	7593.3
		507310.3		263294.0		118203.3		68994.2
Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
722.67	1481.7	124739.5	0.519	64739.8	0.233	29064.3	0.136	16964.6
0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
1531.34	1696.5	301377.3	0.519	156414.8	0.233	70220.9	0.136	40987.3
124.69	183.63	25360.7	0.519	13162.2	0.233	5909.1	0.136	3449.1
277.55	370.61	55832.7	0.519	28977.2	0.233	13009.0	0.136	7593.3
-223.7	-223.7	-43170.2	0.519	-22405.4	0.233	-10058.7	0.136	-5871.2
		464140.0		240888.7		108144.6		63123.0



