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engineering sustainable buildings

Energy Statement
Ref: Z59608

Proposed 14No. New Build Dwellings

at

Winston Road, Moston
Manchester

for

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Executive Summary

This Energy Statement has been developed in support of the planning application for the proposed development of 14No. residential dwellings at Winston Road, Moston, Manchester. The statement will evaluate the technical and economic feasibility of using both passive and low and zero carbon technologies and will assess the practical levels of CO_2 reduction possible for this development to comply with the following planning requirements:

- National Planning Policy Framework (2021)
- Manchester City Council's Core Strategy 2012 - 2027 (2012) policies EN4 - EN7
- Principles of The Guide to Development in Manchester SPD 2007

The following low and zero carbon technologies have been evaluated:

- Biomass
- Wind
- Biogas
- Air Source Heat Pumps & Exhaust Air Heat Pumps
- Geothermal
- Combined Heat & Power (CHP)
- Solar Hot Water
- Solar Photovoltaic

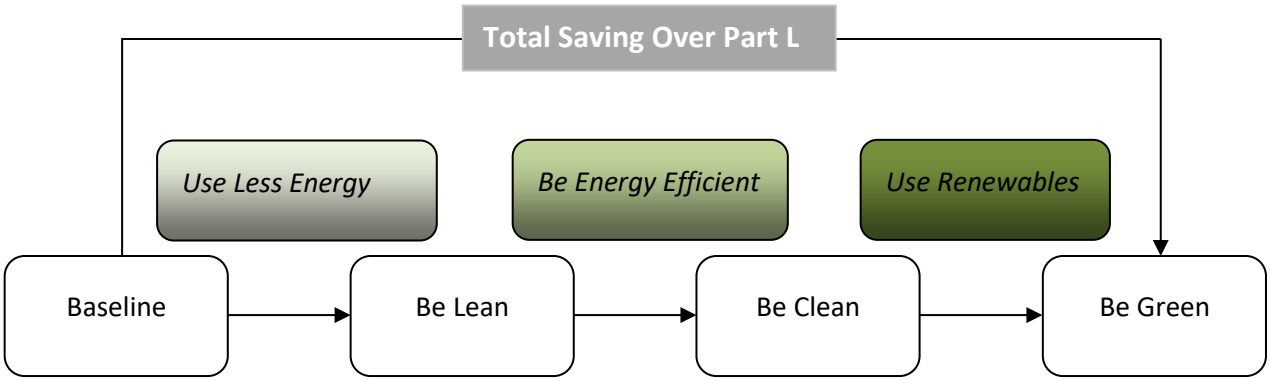
The approach for the Winston Road residential development is to embed sustainability into the heart of the development through a range of design measures based on the 'Be Lean, Be Clean, Be Green' design hierarchy. Measures will include:

1) Enhanced building fabric to meet the new Building Regulation ADL1 2021 (15/06/2021).
2) Enhanced air tightness and thermal bridging.
3) Efficient continuous extract ventilation system using System 3 MEV will be provided to all houses.
4) Efficient continuous mechanical ventilation with heat recovery system will be provided to all apartments.
5) Heating and hot water to all houses will be provided by highly efficient air source heat pumps.
6) Heating to all apartments will be provided by efficient direct electric panel heaters.
7) Hot water to all apartments will be provided by highly efficient heat pumps.
8) Efficient lighting strategy primarily using LED type fittings.

For the purpose of the assessment, we have evaluated a selection of dwelling types in SAP 10 (Standard Assessment Procedure) to provide an accurate estimate of predicted energy/ CO2 emissions. We have completed SAP calculations based on a representative dwelling type to provide an estimation of the worst-case total energy/emissions on site.

Summary

The development has been provided with energy savings through the use of passive improvement measures such as improved energy efficiency. This passive approach to compliance will complement the integrated approach to the sustainable energy objectives of the national and local policies. The use of air source heat pumps for heating and hot water in the house type dwellings, and the use of heat pumps for hot water in the apartment type dwellings achieves the necessary levels of carbon reduction.



The principles of a Be Lean, Be Clean, Be Green philosophy have been applied, resulting in a **60%** carbon emissions improvement and a **20%** primary energy improvement over Building Regulations Part L1 2021, as indicated in Table 1. A full design specification that confirms inputs used within the SAP calculations is provided within the appendices of this report.

Table 1 - Proposed development CO_2 emissions against Building Regulations Part L1 2021

	Total CO_2 Emissions ($kgCO_2/yr$)	Total Primary Energy (kWh/yr)
Target Dwelling Performance	**11,472**	**60,123**
Proposed Dwelling Performance	**4,583**	**48,061**
Total Reduction	**6,889**	**12,062**
Percentage Improvement (above ADL1 2021)	**60.05%**	**20.06%**

A fabric-first approach to meeting Manchester City Core Strategy energy policy has been undertaken for the Winston Road residential development, defined within the 'Be Lean, Be Clean, Be Green' energy hierarchy. The proposed design provides compliance with Building Regulations ADL1 2021, and with the application of air source heat pumps for heating and hot water for the house type dwellings, and with the application of heat pumps for hot water for the apartment type dwellings, ensures reductions which exceed Manchester City Council's Core Strategy 2012.

1. Introduction

The proposed development consists of 14No. residential dwellings located at Winston Road, Moston, Manchester. The development is required to achieve compliance under Building Regulations Approved Document Part L1 (2021) and meet MCC's planning policies.

Supporting information is provided within this report for the proposed energy strategy to be considered on site in accordance with the following planning policies:

- Manchester City Council's Core Strategy 2012 - 2027 (2012) policies EN4 - EN7
- Principles of The Guide to Development in Manchester SPD
- National Planning Policy Framework (2021)

Throughout this report, passive design techniques, energy efficient equipment and appropriate low carbon technologies will be appraised in line with the 'Be Lean, Be Clean, Be Green' philosophy of relevant planning documents and the Energy Hierarchy.

An assessment of CO_2 emissions will be made based on the calculation methodology dictated by the Standard Assessment Procedure (SAP) and in line with the requirements of Manchester City Council's planning policy.

1.1. Location

The proposed development Winston Road, Moston, in Manchester is highlighted by the red line boundary shown in Figure 1.

Figure 1 - Location of proposed Winston Road residential development

The site will be accessed off Winston Road, Manchester. Existing residential development exists on 2 sides of the development. The site is a typical suburban site.

Figure 2 – Site plan for the proposed Winston Road residential development

A site plan in Figure 2 shows the arrangement of the proposed dwellings on site.

Dwelling Type	Description	Number of Units
HT5 1B2P GF Apt	1 Bed 2 Person Ground Floor Apartment	2
HT5 1B2P TF Apt	1 Bed 2 Person Top Floor Apartment	2
HT7 1B2P GF Apt	1 Bed 2 Person Ground Floor Apartment	3
HT7 1B2P TF Apt	1 Bed 2 Person Top Floor Apartment	3
HT8 2B 3P	2 Bed 3 Person House	2
HT8 3B 5P	3 Bed 5 Person House	2
		14

Floor Plans

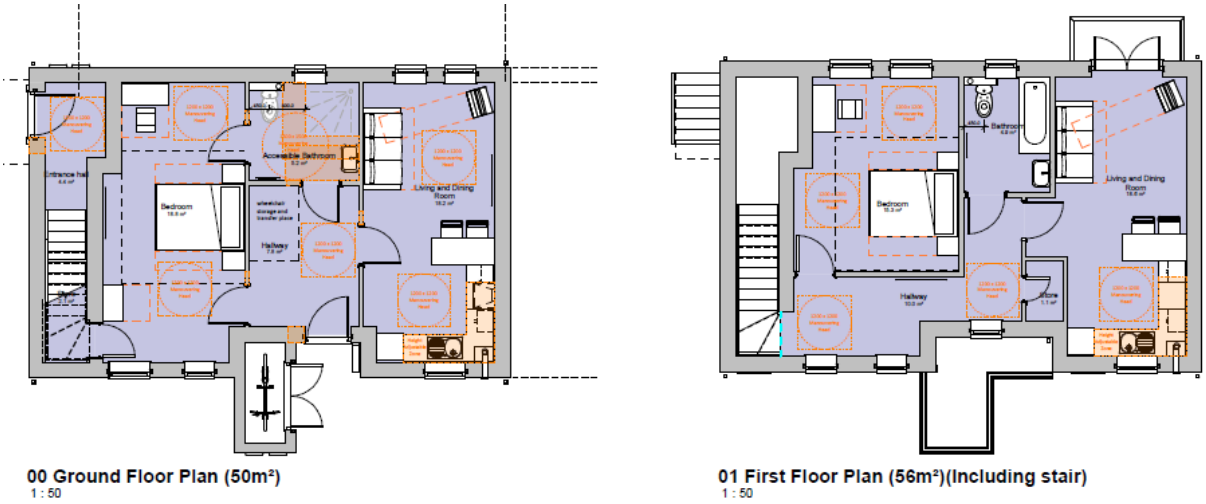


Figure 3 - House Type 5 – 1B2P End/Mid Terrace Apartment

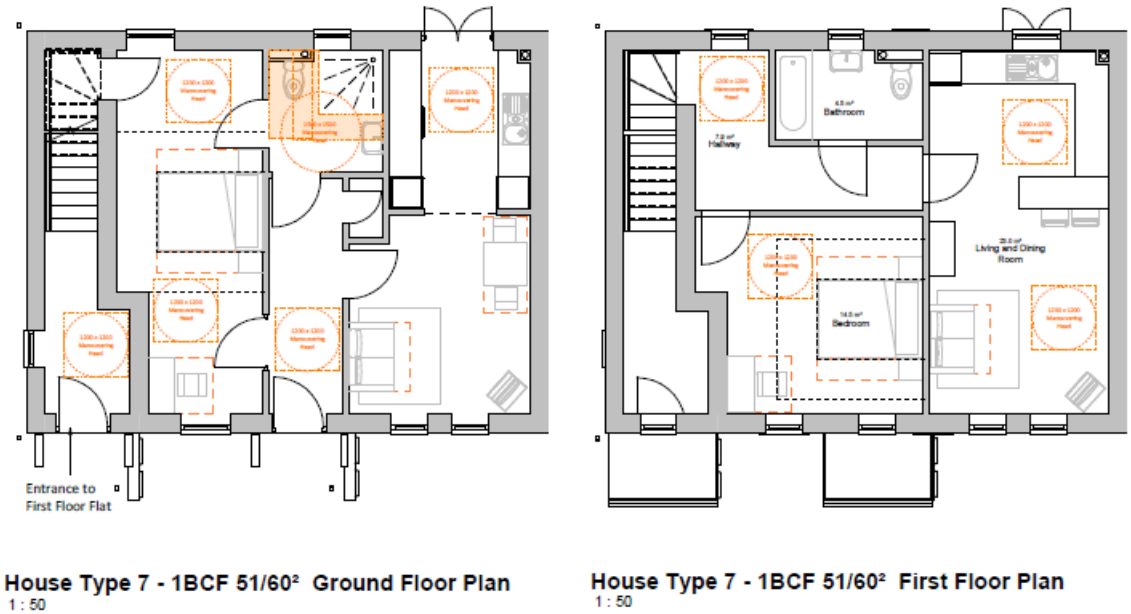
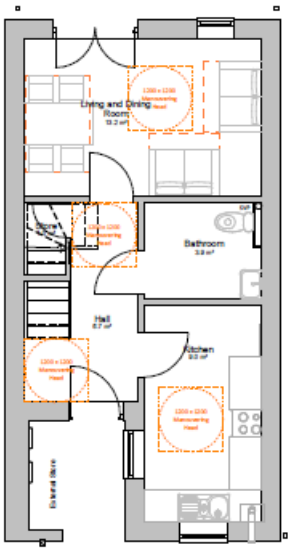
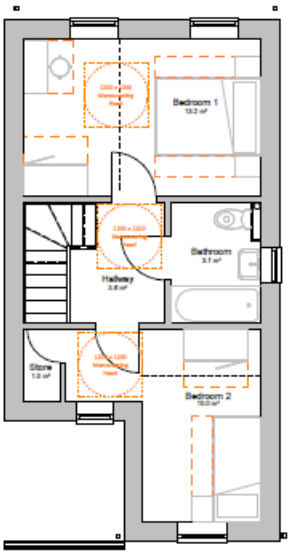


Figure 4- House Type 7 – 1B2P End/Mid Terrace Apartment

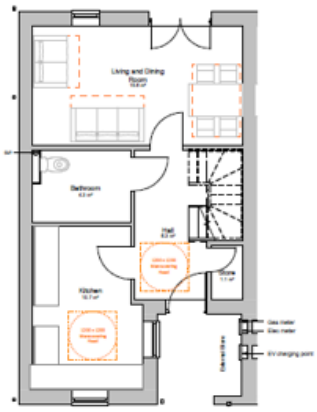


House Type 10 - 2BH 70m² Ground Floor Plan
1 : 50

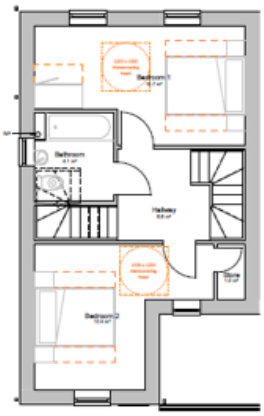


House Type 10 - 2BH 70m² First Floor Plan
1 : 50

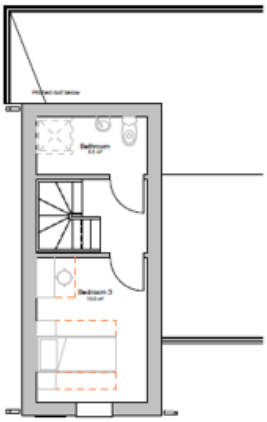
Figure 5 - House Type 8 – 2B3P Semi-Detached House



House Type 8 - 3BH 102m² Ground Floor Plan
1 : 50



House Type 8 - 3BH 102m² First Floor Plan
1 : 50



House Type 8 - 3BH 102m² Second Floor Plan
1 : 50

Figure 6 - House Type 8 – 3B5P Semi-Detached House

2. Policy Drivers for Energy Efficiency and Renewable Energy

This section presents a range of planning policy that is applicable to the Winston Road residential development, at both a national and a local level.

2.1. National Policy

The National Planning Policy Framework was published in July 2021 and sets out the government's planning policies for England and they should be applied. Table 2 sets out the relevant energy standards for new developments and provides an indication of the design response to be provided.

Table 2 – Key National Planning Policy Requirements and Design Responses

Section	Policy Requirements	Design Response
14. Meeting the challenge of climate change, flooding and coastal change	The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: Shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.	This development will follow the principles set out in Manchester City Council's Core Strategy 2012 – 2027 (2012), using a 'Be Lean, Be Clean, Be Green' approach in reducing operational carbon emissions. An overview of current decentralised energy schemes in Manchester and an assessment on the potential for future schemes in relation to this development is provided in Section 6 of this report. This sustainability and renewable energy statement appraises site specific information to determine the most appropriate approach to minimise energy consumption.

2.2. Local Policy

The adopted Manchester Core Strategy 2012-2027 (2012) and the Supplementary Panning Document and Planning Guidance (2007) provide a set of guidelines for new development within Manchester. All relevant energy policy within these documents is provided within this section together with a design response.

Table 3 – Key Local Planning Policy Requirements and Design Responses

Manchester Core Strategy 2012 – 2027 (2012)		
Section	**Policy Requirements**	**Design Response**
EN 4 - Reducing CO_2 Emissions by Enabling Low and Zero Carbon Development	All development must follow the principle of the Energy Hierarchy, being designed: • to reduce the need for energy through design features that provide passive heating, natural lighting and cooling • to reduce the need for energy through energy efficient features such as improved insulation and glazing • to meet residual energy requirements through the use of low or zero carbon energy generating technologies Wherever possible new development and retrofit projects, including energy generation plant, must be located and designed in a manner that allows advantage to be taken of opportunities for low and zero carbon energy supplies. Where possible new development and retrofit projects will be used as a mechanism to help improve energy efficiency and provide low and zero carbon energy supplies to existing buildings. Where appropriate new development and retrofit projects will be required to connect to and/or make contributions to low or zero carbon energy schemes and/or to incorporate provision to enable future connection to any existing / potential decentralised energy schemes. The use of building materials with low embodied carbon in new development and refurbishment schemes.	The proposed Winston Road development will follow the principles of the Energy Hierarchy by adopting a passive fabric-first approach to design rather than adopting the use of renewable technologies. A full energy strategy is provided in Section 8 of this report, following an appraisal of a range of site-specific measures in line with the 'Be Lean, Be Clean, Be Green' approach. A review of district heating opportunities is provided in Section 6 of this report, in line with current local development.
Policy EN 5 – Strategic	Within Manchester it is considered that the following strategic areas, indicated on the key diagram, will have a major role to play in	The proposed Winston Road development

Areas for low and zero carbon	achieving an increase in the level of decentralised, low and zero carbon energy supplies available: • The Regional Centre, which also includes the Oxford Road Corridor and Eastlands • District Centres and associated major development sites • Airport Strategic Site • Strategic housing location • Strategic employment locations Within these areas new development, regeneration and retrofit projects, will be expected to take place in the context of more detailed proposals for decentralised low and zero carbon energy infrastructure in the form of energy proposals plans. The Council will work with all relevant stakeholders, which may include developers, landowners, residents, community groups, private sector partners, utilities companies, neighbouring authorities and other public sector bodies, as appropriate, to bring forward such plans. Where investment or development is being undertaken into or adjacent to a public building/asset or district heating network, full consideration shall be given to the potential role that these can have in providing an anchor load within a decentralised energy network or in creating opportunities for CO2 reduction funded by contributions.	does not fall within a Strategic Area for decentralised development, as defined within the Manchester City Council Core Strategy 2012 – 2027. The proximity of the site to current decentralised energy networks is illustrated within Section 6.1 of this report.
Policy EN 6 - Target Framework for CO2 reductions from low or zero carbon energy supplies	Developments smaller than 10 units but involving the erection of a building or substantial improvement to an existing building will be expected to meet the minimum targets for the defined areas below, where viable. The target framework relates to three broad development locations and their potential for low and zero carbon, decentralised energy. The areas are defined as follows: • Target 1 Network development areas: Locations where the proximity of new and existing buildings, the mix of uses and density of development provide the right conditions to support district heating (and cooling). • Target 2 Electricity intense areas: Locations where the predominant building type has an all-electric fit-out such as retail units and leisure complexes	The proposed development consists of 14No. units and is therefore within the threshold of a major development. The site does not sit within an area defined for development of low and zero carbon, decentralised energy. An overview of the site in relation to current decentralised networks in the region is provided in Section 6.1.

<table>
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<td>
Target 3 Micro-generation areas: Locations where lower densities and a fragmented mix of uses tend to mean that only building scale solutions are practical.
<table>
<tr><th>Target</th><th>% Minimum Requirement</th></tr>
<tr><td>Target 1: Network development area</td><td>CHP/district heating anchor or connection or where not feasible a 15% increase on Part L 2010.</td></tr>
<tr><td>Target 2: Electricity intense buildings</td><td>+15% increase on Part L 2010</td></tr>
<tr><td>Target 3: Micro generation area</td><td>+15% increase on Part L 2010</td></tr>
</table>
</td>
<td>A fabric first approach is proposed for this development.
Renewable technologies have not been specified for this development due to financial viability and ongoing maintenance issues. A +15% increase on Part L 2010 has been achieved within the design</td>
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<tr>
<td>Policy EN 7 – Energy Infrastructure opportunities</td>
<td>There will be a general presumption in favour of low and zero carbon decentralised energy schemes, subject to the following considerations:
That any new generating plant capable of producing heat and cooling as well as electricity should be located in a way that facilitates future connection to a local distributed energy system.

That any energy centre, including generating plant, standby/boiler plant and substations, shall be located and designed to a high quality so as to integrate with and contribute to the townscape.
Biofuels should be obtained from sustainable sources and processes and in a way that minimises transport impacts, following a sequential approach in order to minimise CO2 emissions – firstly prioritising local and regional sources, followed by national, European and international.
Consideration should be given to biofuel delivery by rail and waterways where possible. Where large-scale fuel or feedstock delivery is required by road the energy centre must be located in or adjacent to light industrial, industrial or leisure uses with any impact on local residential amenity minimised.
The cumulative impact of energy schemes will be taken into account when considering applications, to include modelled impacts on air quality and landscape character, with reference to Policy EN16.

</td>
<td>An overview of the site in relation to current decentralised networks in the region is provided in Section 6.1.

Due to the relatively small scale of the development, the development of an energy centre would not be a feasible design solution.

A fabric first approach to the development is a preferable method with the use of highly efficient heat pumps to provide hot water to the apartments, and highly efficient air source heat pumps to provide heating and</td>
</tr>
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	• Flood risk, through the Manchester-Salford-Trafford Strategic Flood Risk Assessment. In determining proposals for development, consideration will be given to the need to safeguard strategic energy sites and network routes, both proposed or existing, where these have been identified as having strategic significance for the delivery of low or zero carbon energy infrastructure or, would be required in order to achieve the successful regeneration of an area in line with targets for reducing carbon emissions.	hot water to the houses.
Supplementary Planning Document and Planning Guidance (2007)		
Section	**Policy Requirements**	**Design Response**
4.5 – Energy Efficiency	Part 1 Policy E1.5 encourages high standards of energy efficiency in new development. In the Environmental Standards Statement, developers should show how they have considered the steps necessary to reduce energy demand at the earliest stages of design. Developers should aim to reduce CO2 emissions by at least 25% more than the requirements of the current Building Regulations, which at present are Building Regulations: Approved Document L (2006) – 'Conservation of Fuel and Power.' The following design principles will assist developers in achieving energy efficiency targets: • Minimise reliance on energy-using equipment for heating, cooling, lighting and natural ventilation • Position trees and soft landscaping on and around the development and within buildings to provide natural shading, insulation and air conditioning • Integrate energy efficient micro-generation and community heating schemes, such as combined heat and power (CHP) • Site layout and building design principles should maximise the capture and use of daylight and passive solar energy, whilst avoiding excessive solar gain in summer Specify energy and water efficient appliances and systems	In line with the principles of the Be Lean, Be Clean, Be Green design philosophy, the Winston Road development seeks to provide a sufficient design solution that provides compliance with Building Regulations Part L1A. An early-stage overview of these calculations is provided in Section 8.
4.6 – Renewable Energy	To reduce energy demand and the harmful impact of using energy from non-renewables, in line with UDP Part 1 Policy E1.5, developers should aim for at least 20% of final site energy demand to be met by on-site renewable energy technologies. Renewable energy targets can be achieved more readily by undertaking the measures suggested above reducing the total energy demand of the building. It is possible	A full appraisal of low and zero carbon technologies is provided in Section 7 of this report.

	to produce developments that use 50% and even 100% energy from renewable sources. To achieve this, developers should: • Assess opportunities for integrating small and large scale renewable energy generation systems to improve the energy security of occupants and the neighbourhood, including siting of energy generation businesses on-site and export of surplus energy • Use a mix of technologies to help generation patterns match demand • Investigate energy generation opportunities before designing building envelopes or fixing their location, to optimise utilisation of wind, solar and geothermal resources • Consider final energy demand rather than building energy consumption in the selection and sizing of generation equipment • Explore opportunities to tackle waste and energy issues collectively through use of anaerobic digesters linked to CHPs (Combined Heat and Power devices) Consider private wire networks as an alternative to grid connection and availability charges on larger developments.	Achieving compliance with Building Regulations Part L1A will be demonstrated through a passive fabric-first approach. This ensures that the highest standards of fabric efficiency and energy efficiency are achieved, rather than applying renewable technologies to the development.

3. Methodology

The first step of the full energy strategy assessment has been to undertake a baseline energy assessment. The baseline energy assessment consists of calculating the total CO_2 emissions of the development to meet Building Regulations and then compare the proposed improvement measures against this baseline. Building Regulations Part L1 2021 (SAP) applies to each of the 14No. dwellings and provides carbon emissions from regulated energy.

The building can then be benchmarked/ thermally modelled using the energy hierarchy:

1. Be Lean *A reduction in energy use as a result of passive design and energy efficiency*
Thermal performance of envelope (U values) Glazing design Airtight construction Efficient mechanical ventilation Variable speed fans and pumps Efficient lighting
2. Be Clean *A focus on supplying energy to the development through efficient means*
Connect to low carbon heat networks Develop site wide heat network from single energy centre On site district heating network Provide energy efficient individual heating
3. Be Green *The installation of renewable technologies to meet energy demand where possible*
Consider the feasibility of renewable energy technologies Assess the integration of renewable technologies based on the above measures

The development must be provided with energy savings through the use of thermal improvements to fabric (a 'fabric first' approach), followed by other clean energy solutions (energy efficiency improvements, district heating, etc.) and finally the use of renewable energy technologies, where

practical. This hierarchy complements the integrated approach to the sustainable energy objectives of Manchester City Council's Planning Policies.

The planning policies require a full review of the technical and economic feasibility of the following renewable technologies:

- Biomass heating
- Biomass combined heat and power
- Solar hot water
- Solar photovoltaic
- Ground source heat pumps
- Air source heat pumps / exhaust air heat pumps
- Wind power

To achieve the targets set the development must achieve a balance between fabric, heating and control, ventilation and air leakage improvements, the amount of zero or low carbon technology installed and the capital, life cycle and running costs, maintenance, and operation, etc.

Feasible renewable energy technologies have been considered during the assessment to ensure the most suitable renewable energy is chosen for the demands of this scheme. The pros and cons of each technology with respect to this site are considered as part of this statement.

4. Baseline Energy Assessment

Energy Counsel have based the analysis on current Building Regulations ADL1 2021 (SAP 10), taking into account solutions that must not only be energy efficient but also practical, reliable and user friendly. Energy Counsel have carried out preliminary SAP 10 calculations for the dwellings. Under Building Regulations Part L1 2021, dwellings must comply with all three metrics set by the notional building shown below.

- Dwelling Emissions Rate (DER) must be lower than or equal to the Target Emissions Rate (TER)
- Dwelling Primary Energy Rate (DPER) must be lower than or equal to the Target Primary Energy Rate (TPER)
- Dwelling Fabric Energy Efficiency Rate (DFEE) must be lower or equal to the Target Fabric Energy Efficiency Rate (TFEE)

SAP 10 is the Governments Standard Assessment Procedure (SAP) for calculating the energy aspects of a dwelling. SAP is a measure of fuel costs for heating, hot water and lighting for a dwelling. SAP 10 can also be used to ascertain the energy requirements of a development.

To assess the baseline carbon emissions, we must make an estimation of the energy demands through Building Regulations in order to set a target upon which the actual development can be compared.

4.1. Predicted Baseline Energy Requirements

The predicted baseline CO_2 emission and primary energy demands for the development:

Table 4 - Baseline dwelling carbon emissions and primary energy

Our Ref	Dwelling Type	No. of Type	Floor Area m²	TER (Kg CO_2/ yr/m²)	TPER (kWh/yr/m²)	Total Target Carbon Emissions (Kg CO_2/yr)	Total Target Primary Energy (kWh/yr)
Z59608.1	HT5 1B2P GF Apt	2	54	11.98	62.68	1,294	6,769
Z59608.2	HT5 1B2P TF Apt	2	61	12.14	63.46	1,481	7,742
Z59608.3	HT7 1B2P GF Apt	3	53	12.38	64.83	1,968	10,308
Z59608.4	HT7 1B2P TF Apt	3	62	12.45	65.13	2,316	12,114
Z59608.5	HT8 2B 3P	2	70	13.29	69.63	1,861	9,748
Z59608.6	HT8 3B 5P	2	104	12.27	64.62	2,552	13,441
Total		**14**				**11,472**	**60,123**

The baseline carbon emissions rate for the development is **11,472 KgCO_2/yr** and the baseline primary energy rate is **60,123 kWh/yr**.

5. Passive Design and Energy Efficiency

The approach of the development is to embed sustainability into the heart of the design from the outset of the project design process. The design will be developed with sustainable solutions, taking into account the relevant policies and strategies of Manchester City Council. The development will seek to consider all aspects and principles of sustainable development, taking into account environmental, social and economic impacts.

5.1. Passive Design Measures

The philosophy for the site is to achieve as much of the necessary reduction in carbon emissions through the use of passive design techniques and energy efficient measures as possible, before resorting to the use of LZCs. This ensures that the highest standards of building fabric and energy efficiency are achieved, rather than offsetting a poorer performance with LZC contributions.

This will be undertaken through a fabric first energy efficient design approach with high levels of thermal efficiency and a reduction in energy demand through efficient lighting design.

5.2. Energy Efficient Systems

Options have been reviewed for improving the energy efficiency of the development by installing an efficient hot water and heating system. The dwellings will benefit from high efficiency air source heat pump to deliver hot water.

Dwellings will also be provided with a metering scheme based on their electricity usage.

A high efficiency mechanical ventilation system with heat recovery (MVHR) will serve the apartments. Supply will be provided to living and bedroom areas with extract from kitchen and bathroom areas. The MVHR should have a maximum specific fan power (SFP) of 0.70W/l/s and a heat recovery rate of at least 90% to enable Part L compliance. The MVHR will operate on a constant trickle rate with a boost setting for thermal comfort or to remove high concentrations of pollutants and water vapour, as required. A summer by-pass setting should also be included. Ventilation is also provided throughout the dwellings by openable windows. A system 3 mechanical extract system will serve the kitchen and bathroom areas for the remaining houses. The extract systems will run with an overall specific fan power (SFP) of 0.18W/l/s, in line with the requirements of Building Regulations Part F (2021). This system operates constantly on low extract and provides a boost when the wet room is in use. Ventilation will be provided throughout the rest of the dwelling by openable windows in all other spaces.

6. District & Communal Heating Networks

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

6.1. Decentralised Heating Networks

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

One of priorities for reducing CO_2 emissions is to reduce the reliance on centralised power stations. This means increasing the use of local, low-carbon energy supplies through de-centralised energy systems.

Decentralised plant generally means any heating and hot water and/or electricity generation provided on a district wide (DHN) or site wide (CHN) basis. DHN and CHN can typically include combined heat and power equipment (CHP). CHP is an engine which, when running, generates electricity and heats water which can then be distributed around a development.

A number of heat network opportunities across the region are at various stages of development. Benefits of district heating networks can include:

- Provision of low carbon / lower cost heat to domestic and commercial customers
- Diversification of the energy mix
- Reductions in region-wide carbon emissions
- Targeting and reduction of fuel poverty
- Potential long-term revenue streams for local authorities
- Alignment with regeneration programmes
- Driving the growth of the low carbon services sector

There are currently no existing district heating networks within proximity to the site. The nearest district heating network is located at North Manchester General Hospital just over 1.5 miles west of the site.

6.2. New Heating Networks – Options

Consideration has been given to adopting a centralised or decentralised energy strategy. A de-centralised energy option would typically be an energy centre distributing heat, hot water and electricity to the development from a single source either as a DHN or CHN. This typically would include boilers and a CHP type unit or district heat pumps, sized to provide the whole development. Sometimes multiple energy centres are used to split the loads, provide resilience and to serve different buildings.

The proposed heating and hot water demand from the development of 14No. dwellings is not sufficient to justify a DHN or CHN. The existing site is spatially constrained, there is insufficient space to locate the equipment and associated plant, and connection to a DHN would be cost prohibitive.

7. Renewable Energy Technologies

Energy Counsel have reviewed options for the use of on-site renewable energy/ Low or Zero Carbon Technology (LZT) in line with Manchester City Council policy aspirations.

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

- Solar Photovoltaic
- Solar Hot Water
- Ground Source Heat Pumps
- Air Source Heat Pumps / Exhaust Air Heat Pumps
- Micro Wind Power
- Biomass

7.1. Photovoltaics (PV)

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

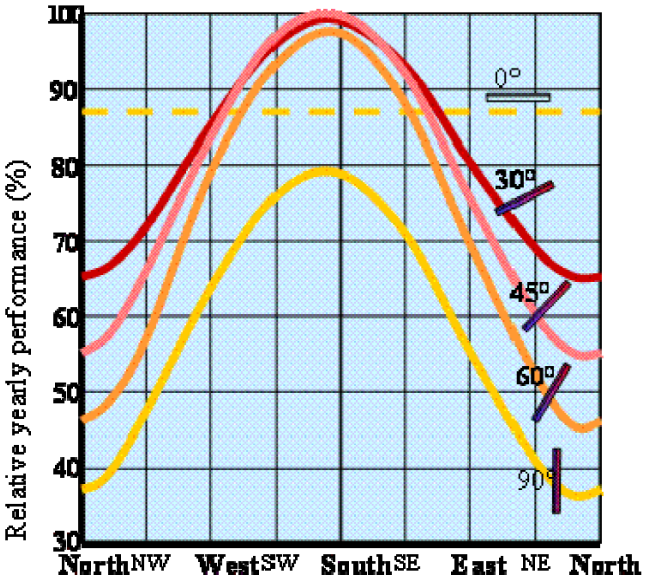

Figure 7 - Performance of photovoltaic panel orientation

The amount of energy PV cells generate is referred to as Kilowatt Peak (KWp). PV arrays now come in a variety of shapes and colours, ranging from grey 'solar tiles' that look like roof tiles to panels and transparent cells that you can use on conservatories and glass to provide shading as well as generating electricity. The roof must be strong enough to take the weight of the panels, especially if the panel is placed on top of existing tiles. For flat roofs the panels can be mounted on A-frames to give the optimum angle.

The optimum panel inclination for solar collection is 35°, oriented due south; however panels that are inclined between 35° and 45° and oriented south of west or east are generally suitable. If solar

collectors are oriented away from due south then a larger surface area will be required to generate a set amount of energy. The effect of non-optimal orientation is illustrated by the graph to the right:

The cost to install PV is typically £1,500 – 2,000 per kWp for 'on-roof' panel systems.

Although photovoltaic panels are a viable option they have not been proposed on these dwellings. Reasons are set out in Section 9.1.

Figure 8 - Photovoltaic array on a pitched roof

7.2. Solar Thermal HW Panels

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

The cost of installing the system is dependent on the distance between the solar collector and the hot water storage and therefore costs vary. The closer the collectors are to the hot water storage; the less pipe work is required. Annual maintenance checks are recommended. The solar collectors are connected to a condensing boiler via a HW cylinder with twin coil.

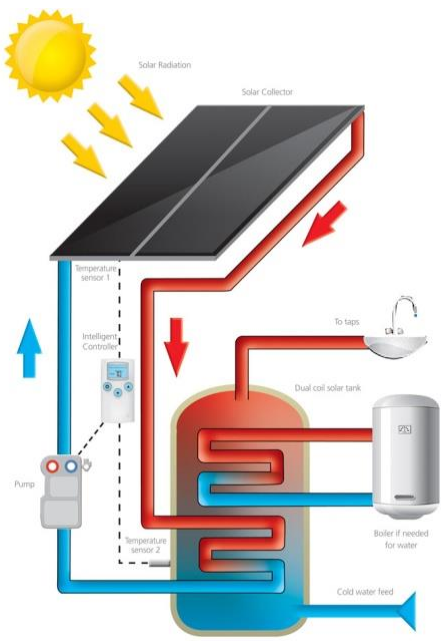

Figure 9 - The principles of a solar thermal system

A typical installation in the UK has a panel size of 3-5m^2 which is used in conjunction with a HW storage tank of 180-300litres, of which a minimum of 90-150 litres must be dedicated to solar hot water storage.

They are a 'simple' and guaranteed technology which will act as a pre-heat for the Hot Water and Heating usage. Payback between capital cost and energy saving can normally be achieved within 12 – 20 years, subject to usage and dwelling type.

The use of solar thermal panels are applied best in conjunction with individual heating systems for each dwelling. The orientation of the development is fine for the utilisation of solar water heating to provide domestic hot water however it will not achieve significant carbon savings. Carbon savings of approximately 4-5% are achievable with this technology. The dwellings are unlikely to require sufficient hot water storage to deem solar thermal a feasible technology for this site. For the reasons aforementioned we do not consider this a viable option for this scheme.

7.3. Ground Source Heat Pump (GSHP)

GSHPs have been developed specifically for the housing market and are now considered to be an established reliable technology. The GSHP would be sized to cater for the heating and domestic hot water requirements. Typically, they are more suited to apartments as a centralised system would be installed with multiple bore holes to a depth of up to 125 metres depending on the ground conditions. GSHPs use a heat exchanger to extract heat from the earth.

The efficiency of ground source heat pumps is measured by Co-efficient of Performance (CoP), this is the ratio of units of heat output for each unit of electricity used to drive the compressor and pump for the ground loop. Average CoP is around 2-4 although some systems may produce a greater rate of efficiency. This means that for every unit of electricity used to pump the heat, 2-4 units of heat are produced, making it an efficient way of heating a building. If grid electricity is used for the compressor and pump, then there is the opportunity to consider a range of energy suppliers to benefit from the lowest running costs, for example by choosing an economy 10 or economy 7 tariff.

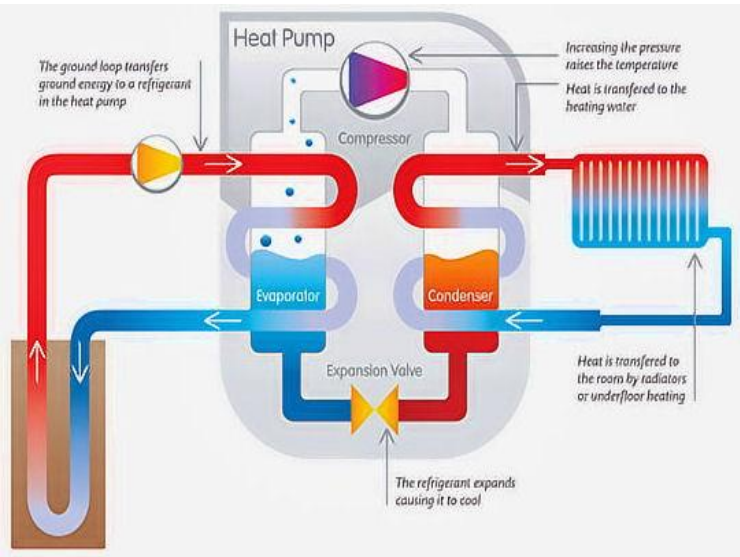

Figure 10 - Principles of a GSHP system

Due to the scale of these dwelling units, GSHPs are not considered an appropriate design solution.

7.4. Air Source Heat Pump/Exhaust Air Heat Pump

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

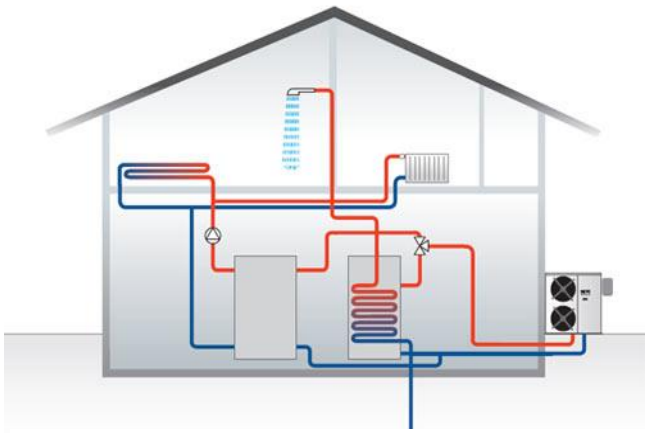

Figure 11 - Principles of an ASHP system

Exhaust air heat pumps such as the NIBE F370 work in a similar manner to ASHP units but have only indoor units (no outdoor compressors) and in addition they also recover heat from their integral exhaust air ventilation system. These units work well on apartment blocks and dwellings where mains gas is unavailable or unsuitable for a development. They are expensive in terms of capital cost of the equipment, installation and the enhanced structural requirements.

Hot Water Heat Pumps are considered the most appropriate technology for this scheme and can be utilised to deliver efficient hot water throughout the dwellings. The introduction of this technology ensures that carbon emissions reductions can be provided in line with Manchester City Council's Core Strategy.

7.5. Micro Wind Power

Wind power is one of the cleanest and safest methods of generating electricity. However, wind power is unfeasible due to the fact the development is in an urban area and local wind conditions would not be sufficient to provide enough power. Most small wind turbines generate Direct Current (DC) electricity. Systems that are not connected to the national grid require battery storage and an inverter to convert DC electricity into Alternating Current (AC) which is mains electricity.

There are two types of wind turbine available:

- Roof mounted – These are mounted on the roof of dwellings
- Mast mounted – Which are free standing

Important issues to consider when using wind turbines are:

- Wind speed increases with height so it's best to have the turbine high on a mast or tower.
- The ideal site is a smooth top hill with a flat, clear exposure, free from excessive turbulence and obstructions such as large trees, dwellings or other buildings.
- Small scale wind power is particularly suitable for remote off grid locations where conventional methods of supply are expensive or impractical.
- Where the local annual average wind speed is 6 m/s or more.
- Where there are no significant nearby obstacles such as buildings, trees or hills that are likely to reduce the wind speed or increase turbulence

Figure 12 - Mounted wind turbine

As this development is in an urban area there will be obstacles which reduce wind speed. The average wind speed in this area is 4.7 m/s at a height of 10 metres, which is less than the 6 m/s required. Therefore, micro wind is not a viable technology for this development. Please refer to section 9.1 for more details.

7.6. Biomass

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

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

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

Biomass systems require more cleaning than gas or oil boilers and they must be capable of being taken out of service for cooling and cleaning whilst maintaining the building heating supply particularly in

communal heating systems. Centralised gas boilers are therefore still required to support the biomass boiler, which would be the lead boiler. The size of the dedicated plant rooms is substantial. Fuel availability, delivery and storage are also important issues to consider.

Air quality issues re also an important factor when looking to install biomass. The cost of the fuel depends on the type, delivery distances and whether it is obtained as simple waste product or from another organisation. The cost of wood pellets is currently a little more expensive than mains gas, and woodchip is approx. 30% cheaper, however prices are fluctuating rapidly in the bio-fuel market at the present time creating uncertainty over their take up.

Figure 13 - Biomass boiler and hopper

Biomass CHP is still relatively new to the UK market and is more suitable to large developments where energy demand does not require significant modulation. There are technical issues with small scale Biomass CHP and until these can be resolved and proven the take up of these systems in the UK and Europe has been slow.

Overall carbon savings of 40%+ are achievable with biomass technology. Biomass is more suited to a communal heating system; there is insufficient space to accommodate the equipment and fuel storage to facilitate a biomass boiler. Furthermore, there are noise and air quality issues associated with this type of technology. For this reason, biomass is discounted.

8. Energy Assessment of Proposed Scheme

The Winston Road residential development has adopted the principles of the 'Be Lean, Be Clean, Be Green' approach. The most practical and economically feasible solution for the development is a good quality thermally insulated fabric, air-tight envelope, passive improvements and the use of highly efficient heat pumps supported by efficient ventilation extract system.

Table 5 - Proposed carbon emissions from Winston Road residential development

Ref	Dwelling Type	No. of Type	TER	DER	TPER	DPER	Total Carbon Emissions (Kg CO_2/yr)	Total Primary Energy (kWh/yr)
Z59608.1	HT5 1B2P GF Apt	2	11.98	4.90	62.68	50.90	**529**	**5,497**
			59%		19%			
Z59608.2	HT5 1B2P TF Apt	2	12.14	5.45	63.46	56.41	**665**	**6,882**
			55%		11%			
Z59608.3	HT7 1B2P GF Apt	3	12.38	5.12	64.83	53.14	**814**	**8,449**
			59%		18%			
Z59608.4	HT7 1B2P TF Apt	3	12.45	5.48	65.13	56.69	**1,019**	**10,544**
			56%		13%			
Z59608.5	HT8 2B3P	2	13.29	4.71	69.63	49.60	**664**	**7,341**
			65%		29%			
Z59608.6	HT8 3B5P	2	12.27	4.29	64.24	44.94	**892**	**9,348**
			65%		30%			
Total		**14**					**4,583**	**48,061**

The predicted carbon emissions for the proposed development is **4,583** kgCO_2/yr. This is a total carbon reduction of **6,886** kgCO_2/yr from the baseline emissions of **11,472** kgCO_2/yr. This equates to a **60**% carbon reduction.

The predicted primary energy rate for the proposed development is **48,061** kWh/yr. This is a primary energy reduction of **12,062** kWh/yr from the baseline primary energy rate of **60,123** kWh/yr. This equates to an **20**% primary energy reduction.

The development proposal achieves carbon efficiency reductions through a highly efficient thermal fabric, energy efficient lighting and ventilation, improved thermal bridging, low air leakage and highly efficient heat pumps for domestic hot water to reduce emissions in line with Manchester City Council's Core Strategy 2012 – 2027 Policy

9. Conclusion

Following the 'Be Lean, Be Clean, Be Green' hierarchy, the proposed design solutions on the Winston Road development are predicted to:

1) Reduce the total carbon emissions by 60% compared to new Building Regulations ADL 2021. New Building Regulations ADL 2021 are a 31% improvement on Building Regulation Part L 2013, which in turn were a 6% improvement on Building Regulations 2010 upon which the energy policies are based. Therefore the project significantly exceeds energy policy EN6 2010 regulations by 97%.
2) The heat pumps are the proposed renewables/ low carbon technology. Their contribution to the overall energy reduction under the 'be green' energy hierarchy is approx. 50%.
3) Reduce the total primary energy by 20% compared to new Building Regulations ADL 2021. This is a new metric under Building Regulations Part L 2021.

The approach for the Winston Road residential development is to embed sustainability into the heart of the development through a range of design measures based on the 'Be Lean, Be Clean, Be Green' design hierarchy. Measures will include:

1) Enhanced building fabric to meet the new Building Regulation ADL1 2021 (15/06/2021).
2) Enhanced air tightness and thermal bridging.
3) Efficient continuous extract ventilation system using System 3 MEV will be provided to all houses.
4) Efficient continuous mechanical ventilation with heat recovery system will be provided to all apartments.
5) Heating and hot water to all houses will be provided by highly efficient air source heat pumps.
6) Heating to all apartments will be provided by efficient direct electric panel heaters.
7) Hot water to all apartments will be provided by highly efficient heat pumps.
8) Efficient lighting strategy primarily using LED type fittings.

9.1. Low/ Zero Carbon Technologies (LZT) Chosen

- Hot Water Heat Pumps (HWHP) are viable and are considered most suitable for the apartments on this development for the following reasons:

a) The HWHP achieves a 50%+ reduction in CO2 emissions based on the SAP 10 ADL1 2021 standards, which confirms a highly efficient well performing solution.

b) Every apartment benefits directly from the HWHP performance.

c) The dwellings are small. The space heating load for these small m2 units means that when a good quality fabric and air tightness is proposed the load is significantly reduced and the hot water becomes the largest demand. The HWHP focusses on reducing the hot water load.

d) These units do not require an external condensing unit. This has a massive benefit in terms of security of the unit, which sits inside each apartment.

e) Because the units are located internally, there are no external noise pollution considerations which may affect adjacent properties.

f) Because the units are located internally within each flat within a HW cupboard there are no risky access concerns which are present on roof mounted equipment.

- Air Source Heat Pumps (ASHP) are viable and are considered most suitable for the houses on this development for the following reasons:

g) The ASHP achieves a 50%+ reduction in CO2 emissions based on the SAP 10 ADL1 2021 standards.

h) Every dwelling benefits directly from the heat pump performance.

i) The gross floor area and associated space heat load on a house is significantly more than apartment and the ASHP efficiency SCOP of circa 350% therefore contributes towards reducing CO2 and energy usage.

j) Heat pumps require annual standard maintenance and have a long service life.

9.2. Low/ Zero Carbon Technologies (LZT) Discounted

- Solar Thermal Hot Water is viable however it is discounted for the following reasons:

a) The dwellings will have a HW cylinder but solar thermal is not proposed as the hot water is being supplied from an efficient air source heat pump.

b) CO_2 savings from this technology are not significant enough to justify the cost of these systems.

c) Increased maintenance and operating costs. These include annual service, heat transfer fluid changes and filter changes.

d) Access to the roof will require RAMS and is high risk item.

- PV is viable option however it has been discounted for the following reasons:

a) A fabric first approach with efficient heat pump is the preferred solution in this instance and Photovoltaic solar panels have not been specified for this development.
b) CO_2 savings are beneficial and could be considered as a future retrofit solution to meet zero carbon.
c) Affordability issues related to CAPEX of PV.
d) Increased maintenance and operating costs. These including an annual service and cleaning – refer to access issues below.
e) Access to the roof will require RAMS and is high fire risk item with electric cabling passing through the dwelling.

- Biomass has been discounted for the following reasons:

a) It poses problems in terms of delivery of fuel.
b) It poses problems in terms of air quality issues.
c) Storage and transportation for deliveries would be required.
d) It would require a centralised larger plant space for storing fuel, which on this constrained site is not viable.

- Micro-wind has been discounted for the following reasons:

a) Turbines do not work on this type of development due to problems with wind turbulence and mounting of the units.
b) The wind speeds in the area are not conducive to wind power electricity generation and there would be issues with turbulence, wind shading, noise and air traffic.

- Ground Source Heat Pumps (GSHP) are not viable for site due to the following reasons:

a) The size of the development is very small for a GSHP system. Costs increase for smaller developments.
b) Ground conditions are unknown which is a large risk item.
c) Site spatial requirements are limited and unfeasible for vertical bore holes or horizontal slinky type units.

- Air Source Heat Pumps (ASHP) & Exhaust Air Heat Pumps (EAHP) are viable for the houses but are not considered viable for the apartments for the following reasons:

a) The dwellings are small for an ASHP/EAHP system. The space heating load for these small m2 units means that when a good quality fabric and air tightness is proposed the load is significantly reduced and the hot water becomes the largest demand.

b) ASHP/EAHP do not work as effectively as Hot Water Heat Pumps and therefore in SAP 10 we'd expect a drop in performance using ASHP/EAHP compared to a Hot Water Heat Pump.

c) Costs increase for smaller developments.

d) ASHP require external condensing units, which would need locating on the external gable or rear of each dwelling with security from malicious damage to the units mounted at low level a concern.

e) Large banks of ASHP external condensers would need locating external on the façade of the building or roof, which would increase the distribution runs and reduce efficiencies.

f) Nose issues of external condensers associated with each apartment and impact on adjacent apartments and associated habitable space.

g) Access to the heat pumps for the top floor flats which would be located in the ground floor domain.

A more detailed overview of LZT technologies is provided in the appendices of this report.

9.3. Summary Headlines

- A fabric-first approach to meeting Manchester City Council's Core Strategy 2012 - 2027 Policy has been undertaken for the Winston Road residential development, defined within the 'Be Lean, Be Clean, Be Green' energy hierarchy. The proposed design provides compliance with Building Regulations ADL1 2021, and with the application of heat pumps for hot water ensures reductions which exceed Manchester City Council's Core Strategy 2012 – 2027 Policy.
- The use of high-efficiency air source heat pumps reduces carbon emissions by 60% and provides a primary energy reduction of 20% when compared to new Building Regulations Part L 2021.

An overall 60% improvement in CO_2 emissions and a 20% improvement in primary energy above the Building Regulations ADL 2021 baseline is proposed to support our application. The project significantly exceeds energy policy EN6 2010 regulations by 97%.

	Total CO_2 Emissions ($kgCO_2/yr$)	**Total Primary Energy (kWh/yr)**
Target Dwelling Performance	**11,472**	**60,123**
Proposed Dwelling Performance	**4,583**	**48,061**
Total Reduction	**6,889**	**12,062**
Percentage Improvement (above ADL1 2021)	**60.05%**	**20.06%**

10. Appendices

10.1. LZT Feasibility Table

Technology	Technical Feasibility	Carbon Savings	Estimated Costs	Financial Viability
Solar photovoltaics	A photovoltaic array is not required for the dwellings as carbon emissions reductions in line with BRegs Part L1 2021 are already achieved.	A 1kWp system could save around 213 kg of CO2 / year per dwelling	Average cost for such a system is around £1.5K per dwelling.	Current potential income generation is around £120 minimum per annum per dwelling with a fuel cost saving of around £40 / year per dwelling.
Wind	Average wind speeds on the site according to the NOABL Wind Speed Database are 4.7m/s. To be technically feasible a minimum of 6m/s is required, therefore this site is not considered feasible.	N/A	N/A	N/A
Micro Hydro	There is no capacity for micro hydro on this site since there are no local water courses available.	N/A	N/A	N/A
District Heating	There are no existing or planned district heating networks to facilitate connection at this stage.	N/A	N/A	N/A
Solar Hot Water	This technology has been discounted as the level of hot water usage in each dwelling does not merit a storage system, which poses space issues.	Around 270 kg of CO2 / year per dwelling.	£3-5K per dwelling	Income generation from RHI in a 4-person household would be in the region of £340 / year (per dwelling) with a fuel saving of around £65 / year per dwelling
Heat Pumps	GSHP: Ground conditions on site are unknown, and installation of coils are likely not economically viable for this project. ASHP: Provided to all dwellings for heating and hot water. HWHP: Provided to all dwellings for hot water	GSHP: 2,100 to 3,300 kg CO2 / year per dwelling ASHP: 1,700 to 2,700 kg CO2 / year per dwelling. HWHP: 1,700 to 2,700 kg CO2 / year per dwelling.	GSHP @ £13-20K per dwelling ASHP: £7-11K / dwelling ASHP: £3K / dwelling	GSHP: £2,590 minimum annual RHI income generation per dwelling with fuel saving of £440 / year minimum per dwelling ASHP: RHI removed. Fixed £5000 grant fund per property. HWHP: N/A
Biomass	The small scale of this development would not facilitate the installation of biomass boilers due to the space required for pellet storage.	N/A	N/A	N/A

10.2. Specification for Energy Assessments (ADL1 2021 – SAP 10)

Item	Brief Description	Notes	Confirm
	The following information is required for the design submission (as per requirements of AD L1).	Please note submission is in two stages. A) **Design**, B) As installed	
1. Dwelling Type			
1.1	Building Regulations Part L1 2021 apply.		
1.2	Post code of site will be provided at a later date.	Royal mail postcodes.	
1.3	Electricity is supplied by standard tariff rather than economy 7, 10 or 24.	Assumed Standard tariff.	
1.4	It is assumed that the dwellings have a Medium thermal mass parameter.	Masonry construction.	
2. Floor Construction Details			
2.1	Ground floor is insulated to achieve the U-value stated opposite. 150mm PIR insulation or equivalent.	U-Value = 0.12W/m²K	
3. Wall Construction Details			
3.1	Main external walls to achieve the U-value stated opposite.	U-Value = 0.18 W/m²K	
3.2	Party walls will be fully sealed to achieve the U-value stated opposite.	U-Value = 0.0 W/m²K	
4. Roof Construction Details			
4.1	Cold roofs are insulated to achieve the U-value indicated opposite. 500mm mineral wool quilt.	U-Value = 0.09 W/m²K	
5. Openings			
5.1	External doors/Doors to cold corridors are installed to achieve the U-value stated opposite.	U-Value = 1.2 W/m²K	
5.2	All double-glazed windows, rooflights and patio type doors/windows with Low-e glass hard coating to achieve the U-Value stated opposite.	U-value = 1.3 W/m²K G-value = 0.45 **BFRC**	
6. Ventilation			
6.1	Design stage SAP calculation presumes an air permeability of $4m^3/m^2/hr$ at 50pa will be achieved.	$4m^3/m^2/hr$ at 50pa	
6.2	Apartments (HT5 & HT7) : Balanced mechanical ventilation system with heat recovery is installed in wet areas. Houses (HT8): System 3 dMEV is installed in all wet areas incl. bathrooms, ensuites and kitchens.	MVHR : EnviroVent EnergiSava 200 Issue B or equal and approved. System 3 dMEV : Vent Axia Lo-carbon NBR 125 dMEV or Greenwood CV3 GIP dMEV Every dwelling part F tested and certificated.	
6.3	No open flues or fireplaces or flue-less gas fires are present anywhere.		
7. Space Heating			
7.1	There is only one main heating system installed.	No secondary heating.	
7.2	The pump and cylinder are inside the dwelling.	Within the heated space.	
7.3	Apartments Heating (HT5 & HT7) : is provided by individual direct electric panel heaters.	Panel heaters.	
7.4	Houses Heating (HT8) : is provided by air source heat pumps.	Daikin Altherma EDLA06EV3 used for calculation (106466).	
7.5	Heating is controlled by time and temperature zone control.		

8. Water Heating			
8.1	Apartments Hot Water (HT5 & HT7) : Hot water is provided by hot water heat pumps with cylinder storage to the apartments as indicated opposite.	Vaillant Arostor 200l VWL B 200/5 UK PCDB Ref: 10414 OR Dimplex Edel 170l.	
8.2	Houses (HT8) : Hot Water connected to air source heat pump - A hot water cylinder is installed.	200L pre-plumbed cylinder Heat loss 1.81 kWh/day Used for calculation.	
8.3	Independent time control is provided to the hot water cylinder.		
8.4	All showers will be supplied from the hot water cylinder via a pump. All showers to be flow regulated to <8litres/minute.	Flow regulated 8l/min@3bar.	
8.5	Houses (HT8) : Waste water heat recovery instantaneous system has been installed.	Recoup WWHR system B used for calculation (80192).	
8.6	Water usage per person per day is ≤125 Litres.	To meet or exceed Part G. Requires good specification of flow rates on all water consuming appliances – taps, showers, etc.	
9. Renewables			
9.1	The heat pump is considered a low carbon technology under the 'Be Green' Energy Hierarchy. There are no renewable technologies on the development.		
10. Other			
10.1	The Contractor will be responsible for undertaking thermal bridging calculations for each detail to provide a comprehensive set of calculations to meet building regs compliance ADL1 2021. They will be responsible for meeting a overall Y value of 0.04W/mK (summations of all the junctions).	Y Value target 0.04W/mK	
10.2	Split lintels or insulated thermally broken lintels will be used throughout.	Applicable for masonry construction.	
10.2	Low energy (LE) lights are installed throughout.	All lighting must be specified with efficacy of 80 lumens/circuit watt or more.	
10.3	Dwellings will require further analysis under part O.	Part O overheating assessment required for dwellings.	

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