energycouncil
engineering sustainable buildings

Energy Statement Ref: 67379.2

Proposed 14No. New Build Dwellings

at

Yewtree Lane,
Northenden,
Manchester,
M23 0EE

for

Bowker Sadler Architecture





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Document Status – Final

Reference: 67379.2			Date:
Produced by:		Tony Turner	12 March 2018
Checked by:		Matthew Adams	12 March 2018
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Executive Summary

This Energy Statement has been developed in support of the planning application for the proposed development of residential dwellings on Yewtree Lane, Northenden. The proposed development consists of fourteen four-bedroom detached dwellings designed by Bowker Sadler Architecture. 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 Manchester City Council planning requirements:

- 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

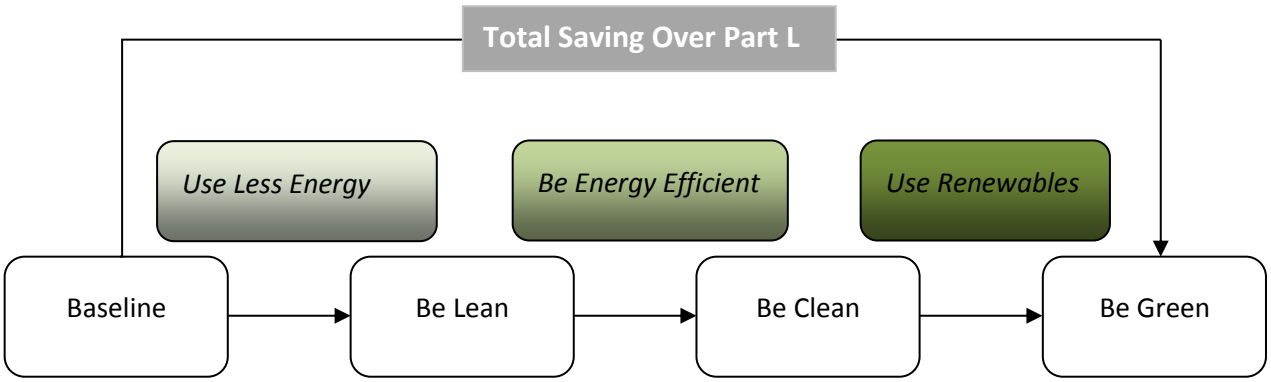
The approach for the Yewtree Lane development is to embed sustainability into the heart of the development through a range of design measures based on the 'Be Lean, Be Clean, Be Green' design hierarchy. Measures will include:

1. Enhanced building fabric to meet Building Regulation ADL1A 2016
2. Enhanced air tightness and thermal bridging.
3. Efficient extract ventilation system
4. Heating and hot water will be provided a highly efficient combi gas system
5. Efficient lighting strategy primarily using CFL or LED type fittings
6. A rooftop photovoltaic panel array (totalling 6kWp) on Blocks 3, 5 and 6

For the purpose of the assessment we have evaluated a selection of dwelling types in SAP 2012 (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. In addition, a photovoltaic panel array has been provided to dwellings to achieve the necessary levels of carbon reduction.



The principles of a Be Lean, Be Clean, Be Green design philosophy have been applied, which results in a 11.00% improvement over Building Regulations Part L1A 2016, 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 L1A 2016

	Total CO2 Emissions ($KgCO_2/Yr$)
	Total
Baseline Emissions of Development (pre improvement)	**26,567**
Be Lean, Be Clean & Be Green	**23,645**
Total Reduction in Energy ($KgCO_2/yr$)	**2,923**
Percentage Improvement in Carbon Emissions (above Bldg Regs ADL1A 2016)	**11.00%**

1. Introduction

The proposal consists of fourteen four-bedroom detached dwellings designed by Bowker Sadler Architecture. The development is required to achieve compliance under Building Regulations Approved Document Part L1A (2016).

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 (2007)
- National Planning Policy Framework (2012)

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 planning policy.

1.1. Location

The area for the proposed development at Yewtree Lane, Northenden, M23 0EE is highlighted by the red line boundary shown in Figure 1. Manchester city centre is roughly five miles to the north of the site.

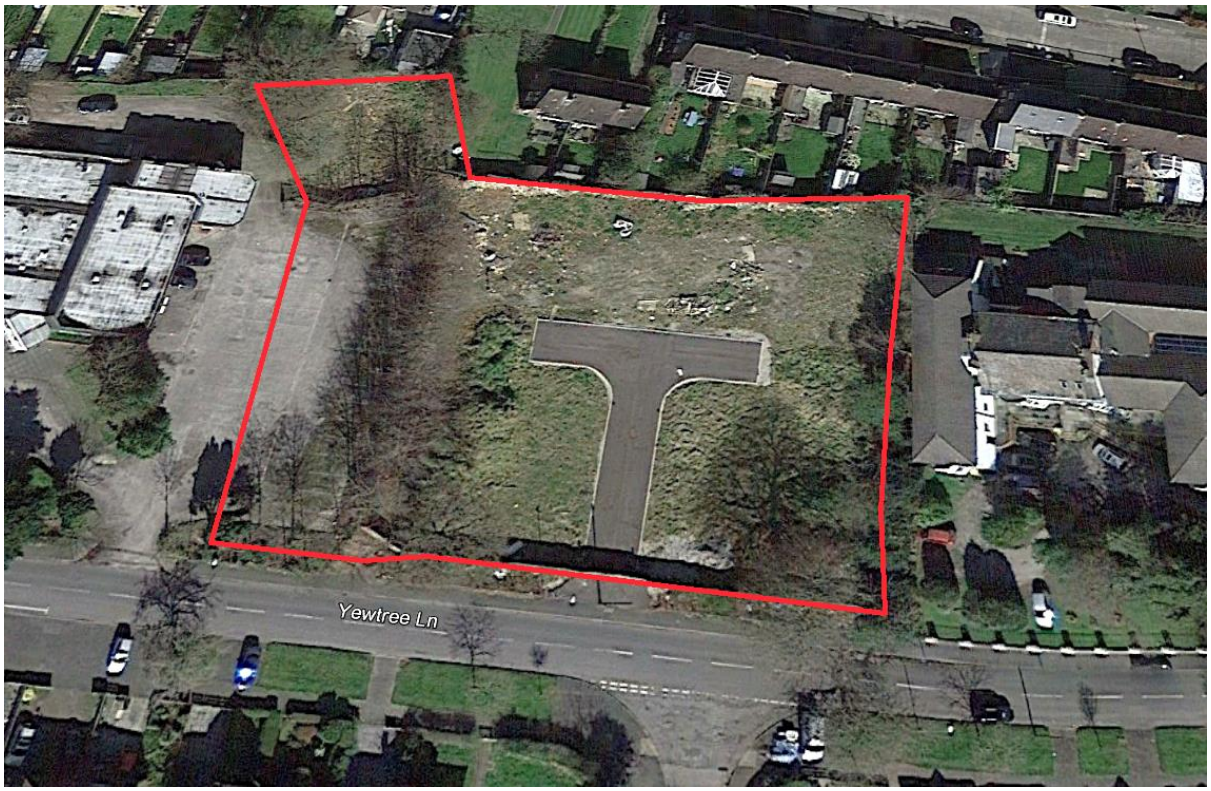


Figure 1 - Location and surrounding area of proposed Yewtree Lane residential development

The site is accessed by Yewtree Lane to the south, with the GMB Cringlewood Social Club to the west and Beech House nursing home to the east. The site sits within an urban area, with existing development surrounding all aspects. The M60 is located around 200m north of the site.

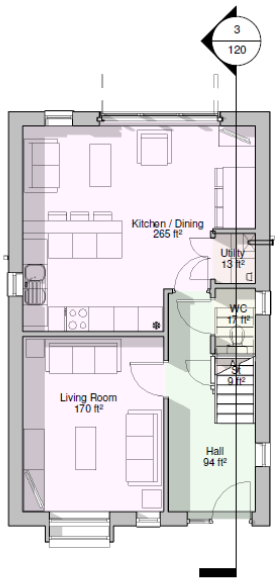


Figure 2 - Site plan for the proposed Yewtree Lane development

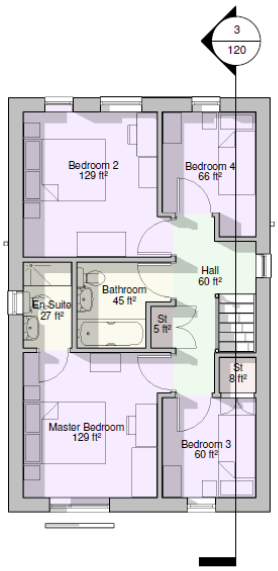
The proposed development consists of fourteen two-storey four-bedroom detached dwellings, as indicated in Figure 2 above. The follow dwelling types have been defined across the site:

- Block 1 – 8No. south facing
- Block 1 – 1No. north facing
- Block 2 – 1 No. south facing
- Block 3 – 1 No. north facing
- Block 4 – 1 No. east facing
- Block 5 – 1 No. west facing
- Block 6 – 1 No. north facing

1.2. Floor Plans

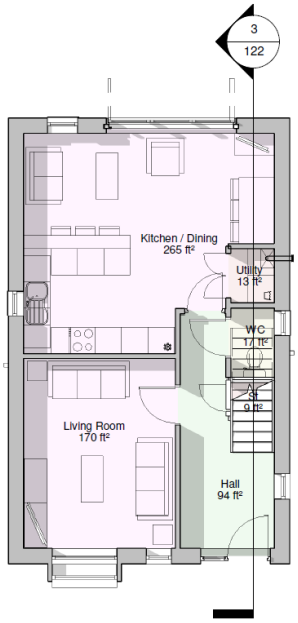


Ground Floor Plan
1 : 100

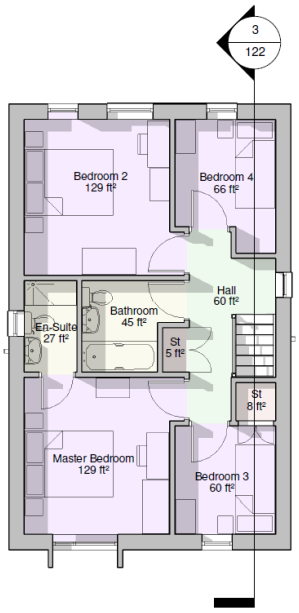


First Floor Plan
1 : 100

Block 1

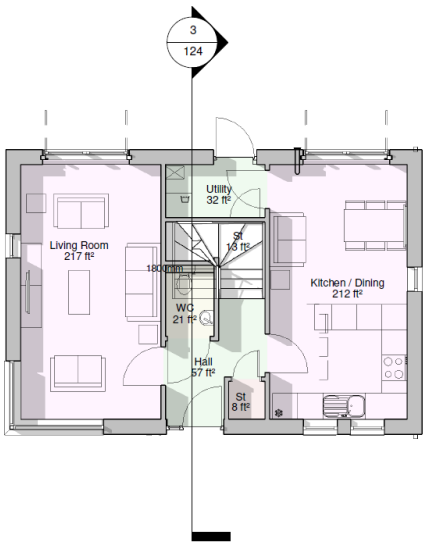


Ground Floor Plan
1 : 100

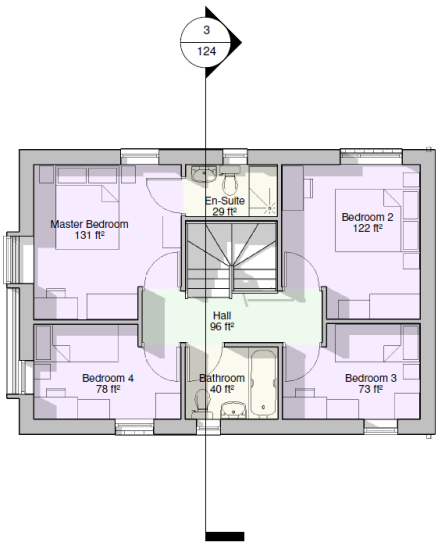


First Floor Plan
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Block 2

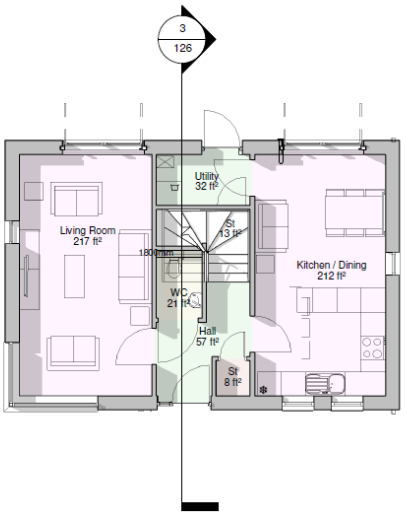


Ground Floor Plan
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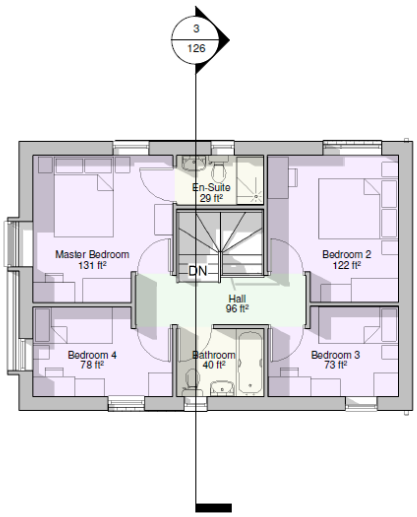


First Floor Plan
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Block 3

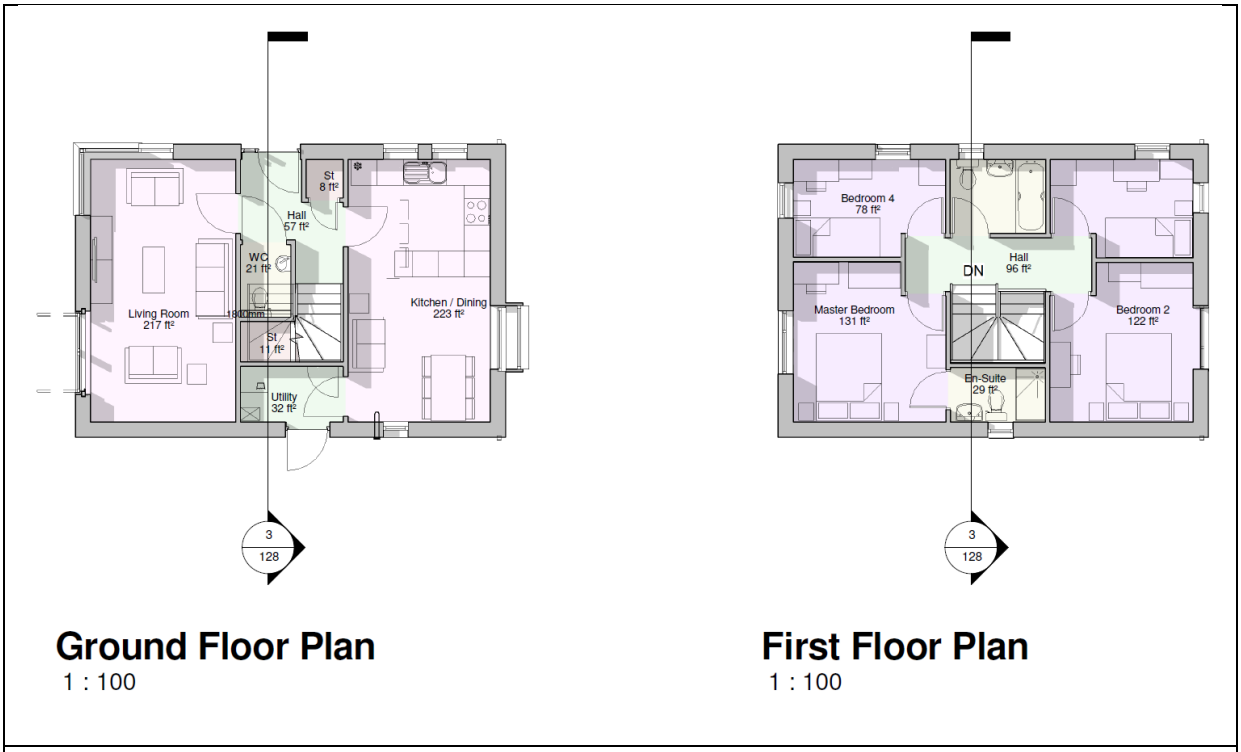


Ground Floor Plan
1 : 100

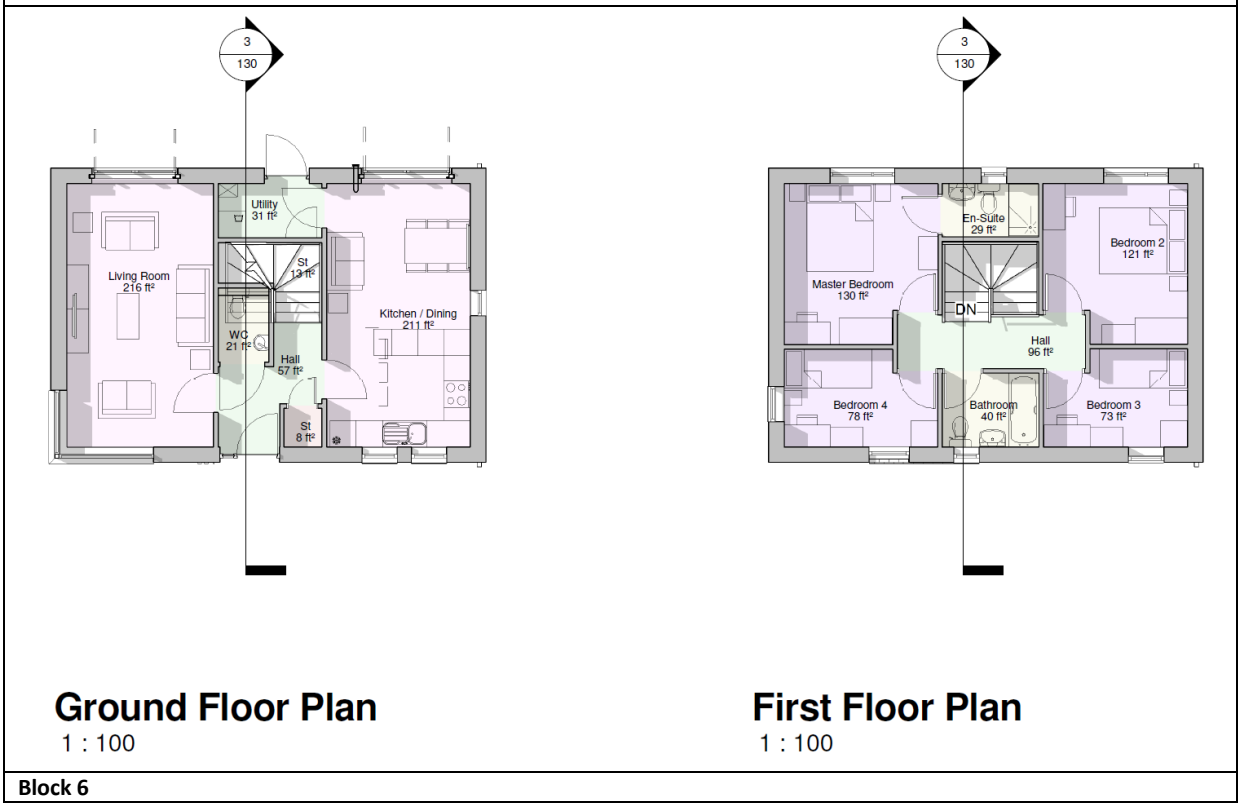


First Floor Plan
1 : 100

Block 4



Block 5



Block 6

Figure 3 – Floor plans by block type for the proposed Yewtree Lane development

The proposed development consists of fourteen dwelling arranged as per the floor plans in Figure 3 and the site plan provided in Figure 2.

2. Policy Drivers for Energy Efficiency and Renewable Energy

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

2.1. National Policy

The National Planning Policy Framework was published in March 2012 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
10. Meeting the challenge of climate change, flooding and coastal change	When setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards.	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.
	Comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable.	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.
	Take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.	This 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 Planning Document and Planning Guidance (2007) provide a set of guidelines for new development. 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 Yewtree Lane development will follow the principles of the Energy Hierarchy by adopting a passive fabric-first approach to design. 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 Areas for low and	Within Manchester it is considered that the following strategic areas, indicated on the key diagram, will have a major role to play in achieving an increase in the level of decentralised, low	The proposed Yewtree Lane development does not fall within a Strategic

zero carbon decentralised energy infrastructure	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.	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 of this report.

<table>
<tr>
<td>Policy EN 6 - Target Framework for CO2 reductions from low or zero carbon energy supplies</td>
<td>Applications for residential development of 10 or more units and all other development over 1,000 sq m will be expected as a minimum to meet the target shown in Tables 12.1 or 12.2, unless this can be shown not to be viable. This should be demonstrated through an energy statement, submitted as part of the Design and Access Statement. Such a statement will be expected to set out the projected regulated energy demand and associated CO_2 emissions for all phases of the development.
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.
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>An assessment of CO_2 emissions as a result of the Yewtree Lane development is provided in Section 8 of this report. A requirement for compliance with Manchester City Council policy states that developments should provide a 15% improvement on Part L 2010, equivalent to a 9% increase on Part L 2013.

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.</td>
</tr>
<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</td>
<td>An overview of the site in relation to current decentralised networks in the region is provided in Section 6. There are currently no existing</td>
</tr>
</table>

	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 CO_2 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. • 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.	district heating networks within reach of the proposed development, therefore connection to an existing network is not possible. Due to the relatively small scale of the development, the construction of an energy centre would not be a feasible design solution. Microgeneration in individual dwellings is preferred, with a highly efficient fabric providing a reduction in heat demand from the outset.
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.	In line with the principles of the Be Lean, Be Clean, Be Green design philosophy, the Yewtree Lane development seeks

	Developers should aim to reduce CO_2 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	to provide a sufficient design solution that provides compliance with Building Regulations Part L1A 2013, which ensures an emissions rate greater than 25% over Approved Document L (2006). 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 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	A full appraisal of low and zero carbon technologies is provided in Section 7 of this report. 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

	• 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.	offsetting a poorer performing design through the contribution of low and zero carbon technologies.

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 L1A 2016 (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 and heat recovery 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 CHP 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 Council have based the analysis on current Building Regulations ADL1A 2016 (SAP 2012), taking into account solutions that must not only be energy efficient but also practical, reliable and user friendly.

Energy Council have carried out preliminary SAP 2012 calculations for the dwellings. To meet compliance with Building Regulations Part L1 2013, the Dwelling Emissions Rate (DER) must be lower than or equal to the Target Emissions Rate (TER). SAP 2012 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 2012 can also be used to ascertain the energy requirements of a development.

To assess the baseline energy we must make an estimation of the energy demands based on current 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 demands for the development:

Table 4 - Baseline dwelling carbon emissions

Ref	Dwelling Type	No. of Type	TER	Regulated Carbon Emissions Per Type (Kg CO_2/yr)	Total Carbon Emissions (Kg CO_2/yr)
67379	Block 1S	8	18.20	1,921	15,367
67387	Block 1N	1	17.64	1,862	1,862
67388	Block 2	1	18.20	1,921	1,921
67989	Block 3	1	17.78	1,850	1,850
67990	Block 4	1	17.98	1,871	1,871
67991	Block 5	1	17.73	1,874	1,874
67992	Block 6	1	17.61	1,823	1,823
Total		**14**			**26,567**

The baseline carbon emissions are **26,567 KgCO_2/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.



Figure 4 - Architectural representations of proposed Yewtree Lane dwelling types

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 heating system. The scheme will benefit from high efficiency gas boilers within each dwelling.

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

A low energy high efficiency decentralised whole house extract system will serve the kitchen and bathroom, with an overall specific fan power (SPF) of 0.24W/l/s, in line with the requirements of Building Regulations Part F (2016). 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 city's reliance on centralised power stations. This means increasing the use of local, low-carbon energy supplies through de- centralised energy systems.

Decentralised plant generally means any heating and hot water and/or electricity generation provided on a 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 city 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, as indicated in Figure 5.

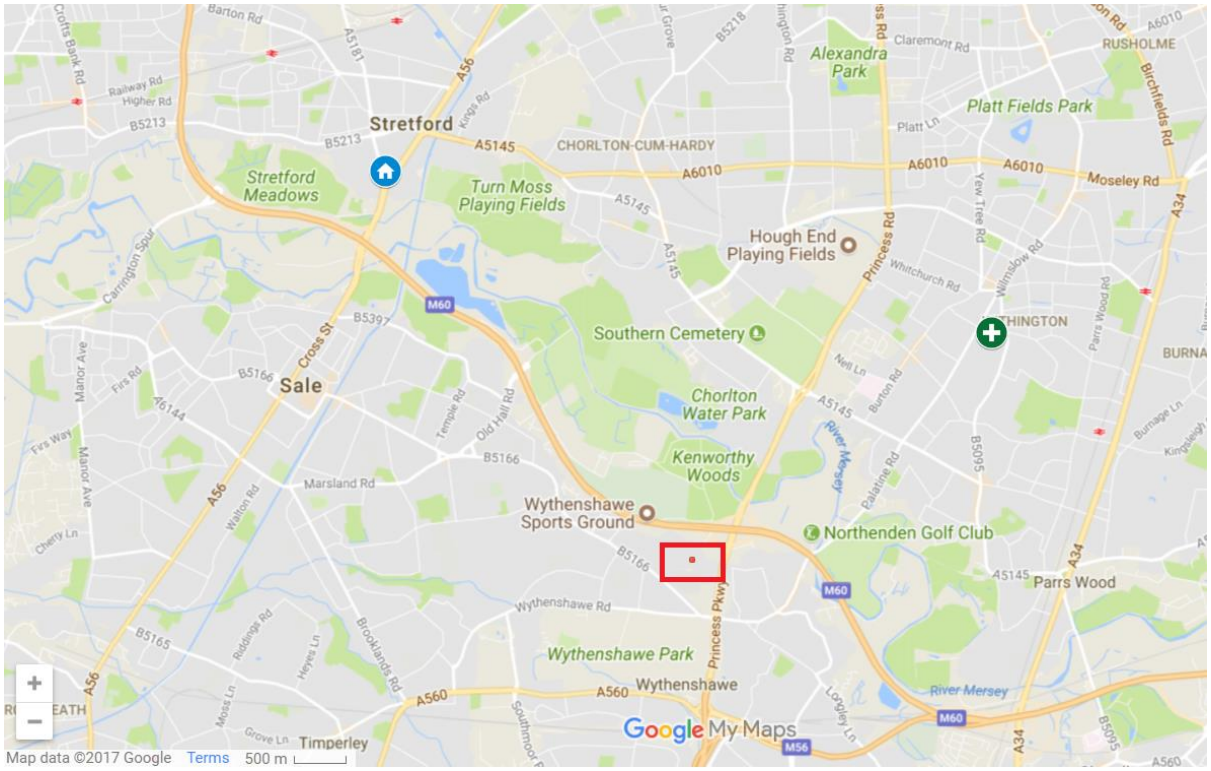


Figure 5 - Location of site in relation to current heat networks under development

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 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 development of 14 dwellings is relatively small scale and the heating and hot water demand is not sufficient to justify a DHN or CHN. The existing site is spatially constrained and there is insufficient space to locate a CHN plantroom - Communal Boiler or CHP units and associated HW store, pump sets etc.

7. Renewable Energy Technologies

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

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

- Solar Photo-voltaic
- 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.

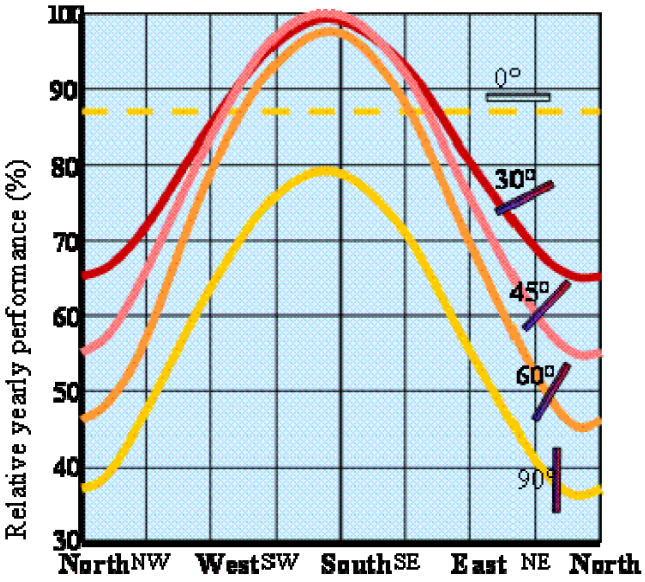


Figure 6 - Performance of photovoltaic panel orientation

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. Solar panels are not light and the roof must be strong enough to take their weight, 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 £1,000 - £1,500 per kWp for 'on-roof' panel systems.

The roof could support the addition of photovoltaic panels. A 6kWp array has been included in the SAP calculations split between Blocks 3, 5 and 6. Panels should be installed on the most southerly facing roof pitch.



Figure 7 - 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.

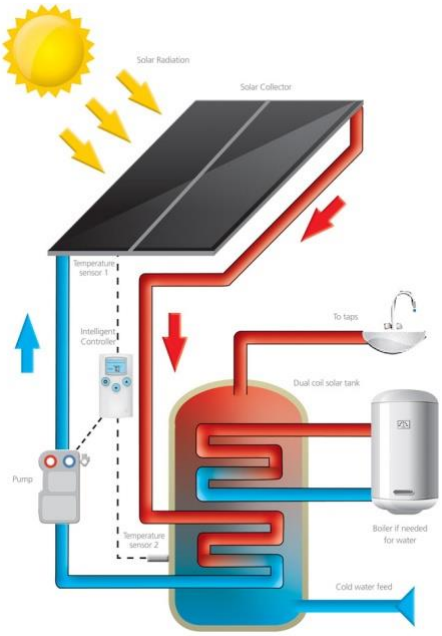


Figure 8 - The principles of a solar thermal system

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, work 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 this is not an appropriate 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.

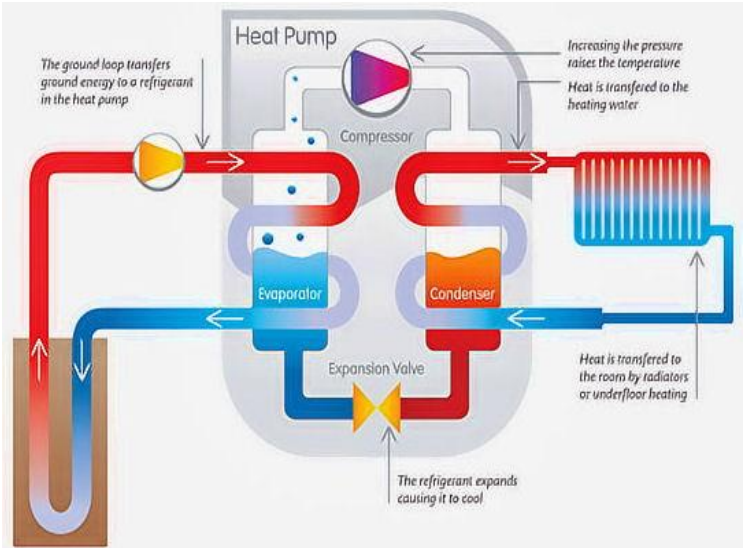


Figure 9 - Principles of a GSHP system

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.

Due to the relatively small scale of this development, 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.

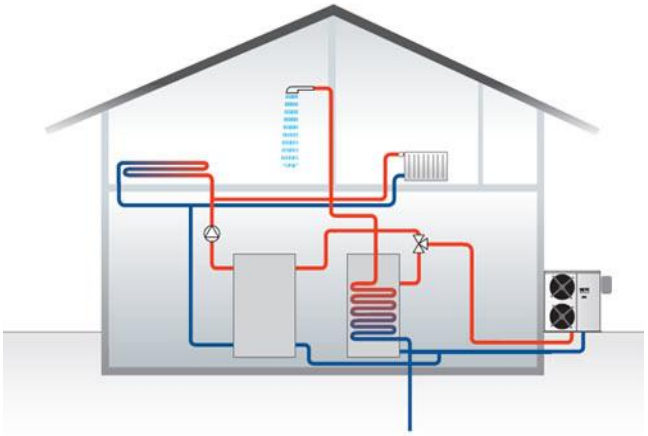


Figure 10 - Principles of an ASHP system

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.

ASHPs are not considered appropriate for this scheme as the energy savings with mains electric ASHP are negligible when compared to the baseline energy analysis which uses gas as the main fuel source. This is due to the fuel factors apportioned to mains electric and mains gas. The carbon emissions are significantly higher using mains electricity compared to mains gas.

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.
- Generally speaking 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 11 - 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 4.5 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.

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, especially in the Manchester area. 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 12 - 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 Yewtree Lane 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 combi gas boilers supported by efficient ventilation extract system.

Table 5 - Proposed carbon emissions from the Yewtree Lane development

Ref	Dwelling Type	No. of Type	TER	DER	Improvement Factor (%)	Regulated Carbon Emissions Per Type (Kg CO_2/yr)	Total Carbon Emissions (Kg CO_2/yr)
67379	Block 1S	8	18.20	18.10	0.55	1,910	15,282
67387	Block 1N	1	17.64	17.4	1.36	1,836	1,836
67388	Block 2	1	18.20	18.10	0.55	1,910	1,910
67989	Block 3	1	17.78	8.49	52.25	883	883
67990	Block 4	1	17.98	17.43	3.06	1,814	1,814
67991	Block 5	1	17.73	10.09	43.09	1,067	1,067
67992	Block 6	1	17.61	8.23	53.27	852	852
Total		**14**			**11.00**		**23,645**

The carbon emissions are 23,645 Kg/CO_2/yr. This is a total carbon reduction of 2,923 Kg/CO_2/yr from the baseline emissions of 26,567 Kg/CO_2/yr this equates to an 11.00% carbon reduction.

The development proposal meets local policy through a highly efficient thermal fabric, energy efficient lighting and ventilation, improved thermal bridging, low air leakage, a photovoltaic array and a highly efficient gas boiler for space and water heating.

9. Conclusion

Following the 'Be Lean, Be Clean, Be Green' hierarchy, the proposed design solutions are predicted to reduce the total carbon emissions by 2,923 Kg/CO_2/yr from the baseline emissions of 26,567 Kg/CO_2/yr. This equates to an 11.00% carbon reduction from the calculated baseline regulated energy emissions.

The approach for the Yewtree Lane 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 Building Regulation ADL1A 2016
2) Enhanced air tightness and thermal bridging
3) Efficient extract ventilation system
4) Heating and hot water will be provided a highly efficient combi gas system
5) Efficient lighting strategy primarily using CFL or LED type fittings
6) A rooftop photovoltaic panel array on each dwelling

9.1. Low/ Zero Carbon Technologies (LZT) Discounted

- Solar Thermal Hot Water is not a viable option as combi boilers are typically proposed and hot water demand will be limited with storage kept to a minimum.
- PV - The dwellings could potentially support the addition of photovoltaic panels on the roof. A 2kWp array has been modelled on the most southern pitch of Block 3 (South), Block 5 (West) and Block 6 (South). This provides a significant reduction in carbon emissions, necessary to meet the 9% improvement on Building Regulations Part L1A 2013, as defined by the Manchester City Council Core Strategy 2012 - 2027 (2012).
- Biomass has been discounted as it poses problems in terms of air quality, delivery of fuel, storage and transportation for deliveries etc. It would require a centralised larger plant space for storing fuel, which on this constrained site is not viable.
- Micro-wind turbines do not work on this type of development due to problems with wind turbulence and mounting of the units. 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.

- GSHPs are not viable for site because of spatial and financial costs. There is no room to accommodate a GSHP vertical bore and associated communal plant room, ground conditions are unknown and systems are very costly.
- ASHP and/or NIBE units have been discounted due to fuel efficiency issues, with a gas fired boiler system preferred in this instance.

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

9.2. Summary Headlines

- A fabric-first approach to meeting Manchester City Council's energy policy has been undertaken for the Yewtree Lane development, defined within the 'Be Lean, Be Clean, Be Green' energy hierarchy. The use of a 6kWp photovoltaic array spread across three unit types (2kWp each) is provided to further reduce carbon emissions to levels dictated by local planning policy.
- Site constraints and viability for District Heating Network (DHN) and Communal Heating Network (CHN) have been reviewed. Existing DHN is not sufficiently close to connect into. In addition to this, the scheme's heating and hot water (HW) demand is too small to justify connection to DHN or CHN.

An overall 11.00% improvement in CO_2 emissions above the Building Regulations baseline is proposed to support our application and to meet policy requirements. It is hoped that this will be reviewed favourably.

	Total CO2 Emissions ($KgCO_2/Yr$)
	Total
Baseline Emissions of Development (pre improvement)	**26,567**
Be Lean, Be Clean & Be Green	**23,645**
Total Reduction in Energy ($KgCO_2/yr$)	**2,923**
Percentage Improvement in Carbon Emissions (above Bldg Regs ADL1A 2016)	**11.00%**

10. Appendices

10.1. LZT Feasibility Table

Technology	Technical Feasibility	Carbon Savings	Estimated Costs	Financial Viability
Solar photovoltaics	South facing aspects of the roofs between east and west have been utilised for solar photovoltaic panels, with a 2kWp on Blocks 3, 5 and 6.	A 0.5kWp 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 4.5m/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	Manchester City Council documents suggest 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: A gas heating system is preferred due to the lower fuel emissions.	GSHP: 2,100 to 3,300 kg CO2 / year per dwelling ASHP: 1,700 to 2,700 kg CO2 / year per dwelling.	GSHP @ £13-20K per dwelling ASHP: £7-11K / dwelling	GSHP: £2,590 minimum annual RHI income generation per dwelling with fuel saving of £440 / year minimum per dwelling ASHP: £920 minimum annual RHI income generation per dwelling with fuel saving of £335 / year minimum per dwelling
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 (ADL1A 2016 - SAP)

Item	Brief description	Notes.	Confirm
	The following information is required for the design submission (as per requirements of approved doc L1A).	Please note submission is now in two stages. A) **Design**, B) As installed	
1. Dwelling Type			
1.1	Building Regulations Part L1A 2013 apply.		
1.2	Post code of site is M23 0EE		
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.		
2. Floor Construction Details			
2.1	Ground floor includes for 150mm of PIR-type insulation to achieve the U-value stated opposite.	U-Value = 0.13 W/m²K	
2.2	Upper heat loss floors are insulated to achieve the U-value stated opposite.	n/a	
3. Wall Construction Details			
3.1	Main external walls to achieve the U-value stated opposite.	U-Value = 0.20 W/m²K	
3.2	Party walls are fully filled and sealed to achieve the U-value stated opposite.	U-Value = 0.0 W/m²K	
4. Roof Construction Details			
4.1	Conventional timber roofs are insulated with 400mm of mineral wool insulation to achieve the U-value indicated opposite.	U-Value = 0.14 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 and patio type doors/windows with Low-e glass hard coating to achieve the U-Value stated opposite.	U-value = 1.2 W/m²K. Non-specialist double glazed window.	
6. Ventilation			
6.1	Design stage SAP calculation presumes an air permeability of 5m3/m2/hr at 50pa will be achieved.		
6.2	System 3 MEV installed	Greenwood CV2 GIP or equal and approved in wet areas	
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	Heating is provided by individual wall mounted condensing combi boiler with auto ignition. This is a mains gas boiler.	Baxi Duo-tec 2 Combi 24 89.0% efficiency	
7.3	The heating system has a programmer, room thermostat and TRV control.	*This is above standard bldg regs controls*	
7.4	The boiler has an interlock to switch it off when there is no demand from room thermostat(s).		
7.5	Weather compensation is not installed.		
7.6	Radiators with TRV's are installed throughout.		
7.7	The central heating pump and boiler are inside the dwelling.	*Within the heated space*	

8. Water Heating			
8.1	No hot water storage is installed. Hot water is supplied direct from the combi boiler.		
8.2	Water usage per person per day is ≤125 Litres.	To meet Part G	
9. Renewables			
9.1	Selected dwellings will be provided with a 2kWp photovoltaic array on the most southerly facing roof pitch.	Block 3 = 2kWp (South) Block 5 = 2kWp (West) Block 6 = 2kWp (South) Total array size = 6kWp	
10. Other			
10.1	Accredited Construction Details (ACD) of limiting thermal bridging are installed at every junction in the main fabric. The defined Y value must be calculated for each dwelling.		
10.2	Split lintels will be installed to meet Energy Saving Trust Enhanced Construction Detail MV03.	Psi value of 0.01W/mK.	
10.3	Low energy (LE) lights are installed throughout.		
10.4	Windows can be half opened in summer to prevent overheating.		
10.5	No cooling is installed to dwellings.		

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