

Energy Statement

Robin Hood Street, Cheetham Hill, Manchester, M8 9GH

Prepared on behalf of:
Tang Associates

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Introduction

This report has been produced on behalf of Tang Associates to demonstrate how the application for the construction of a three-storey building providing x9 new build apartments on Robin Hood Street, Manchester can address the target for 20% of energy usage to be provided through renewable/low carbon technology and sustainability requirements set by Manchester City Council. The energy assessment has been prepared in accordance with the Manchester City Council Validation Checklist with reference to policies EN4 and EN6 of the Core Strategy for the City of Manchester.

The following report demonstrates how approximately 48.68% of energy used will be provided through Air Source Heat Pump technology combined with a low fabric specification and additional energy efficient measures outlined further below in this report.

About the development

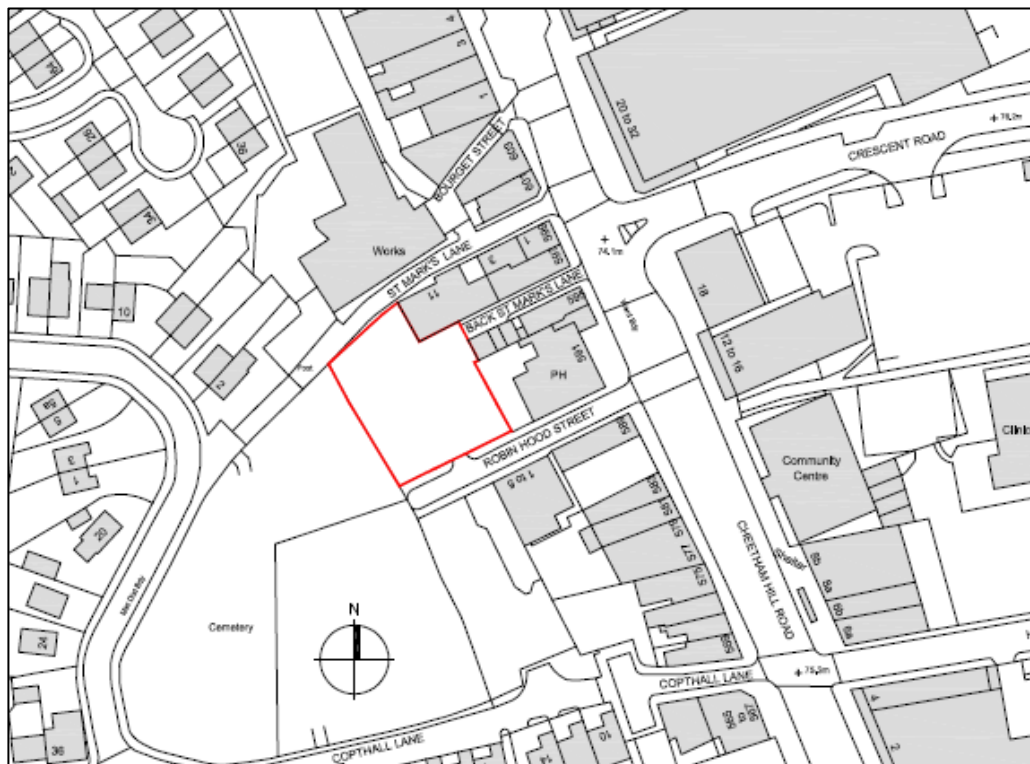


Figure 1 - Site Location Plan

Development proposals are for the construction of a three-storey building providing x9 new build apartments on Robin Hood Street, Manchester. For the purpose of the assessment, SAP calculations have been carried out for all nine apartments and this report accompanies the energy modelling undertaken to address the planning requirements.

Summary of Targets

The target for 20% of energy usage to be provided through renewable/low carbon technology is applicable to the proposed development at Robin Hood Street, Manchester.

Targets set Nationally

Part L of the Building Regulations sets requirements for the conservation of fuel and power in buildings within England and Wales. Among other requirements, new buildings are expected to meet or exceed a TER (Target Emission Rate), a maximum level of regulated emissions expressed in kg of CO₂ per m² per year.

Targets set by Manchester City Council

In accordance with the Manchester City Council Validation Checklist;

'This statement must address the guidance within Chapter 4 of the 'Guide to Development in Manchester and policies EN4 and EN6 of the Core Strategy for the City of Manchester, confirm the proposals for the provision of onsite renewable energy to provide 20% of final site energy demand and CO₂ reduction.'

Based on the above, the development will need to demonstrate that 20% of energy usage will be provided through renewable/low carbon technology.

This report outlines the strategy employed in meeting this target and the results achieved.

All results and strategies are directly affected by the inputs listed in this and accompanying documents; any deviation from these is certain to output different results. Enforcement bodies must ensure that they are satisfied that the below inputs are an accurate reflection of the final building before using this reporting to demonstrate compliance.

Proposed Specification

The following section of the report outlines measures which have been taken to reduce the energy demand of the proposal. Energy efficient services have been considered at the earliest design stage.

To reduce energy use for the development on Robin Hood Street, the following measures have been included –

- U-Values in line with Part L minimum requirements
- Heated access corridors
- Glazing (whole frame) u-value 1.2W/m²k with a g value of 0.45
- High efficiency lighting
- Natural ventilation (with extract fans only)
- Design Air Permeability (DAP) of 5.00
- Limiting thermal bridging – *for the purpose of the assessment, Aircrete Products Association (APA) Partially filled cavity walls & SAP Appendix R: Table R2 PSI values have been used for the purpose of the assessment. A masonry cavity wall construction with a minimum of 85mm foil-faced insulation with a thermal conductivity of 0.022W/m²k has been assumed.*

The specification for these items as proposed for the project is outlined in table 1 below:

Table 1

Proposed Constructive Specification

Demand Reduction Measures	Specification
<i>Building Fabric - U-Values (W/m²K)</i>	
Walls	0.17
Party & Corridor Walls	0.00
Ground Floor	0.11
Flat Roof	0.12
Glazing (glazed doors and windows (whole frame)	1.20
<i>Building Fabric - Other</i>	
Air Permeability (m ³ /hm ²)	5.00
Thermal Bridging	APA & SAP 10.2 Appendix R details
<i>Services</i>	
Ventilation	Natural
Low Energy Lighting	Approx. x15 5W LED Ceiling Bulbs

Consideration of Renewable Technology

Photovoltaic Solar Panels

Photovoltaic panel systems convert energy from the sun into electricity through semi-conductor cells mounted in collector panels. The panels are connected to an inverter to turn the DC output into AC for use in the building to which they are attached and to be fed back into the grid when not required. Photovoltaic arrays provide a quiet and effective renewable energy source with a relatively low aesthetic impact. The major benefit of PV systems is the significant reductions they can achieve in comparison to other technologies, in terms of CO₂ and energy use. The PV panels should ideally be orientated between southeast and southwest (optimally south). The optimal tilt angle (inclination of panel from horizontal) should be calculated to ensure the best possible output of the system during the year. In the UK, the angles of most pitched roofs are suitable for mounting PV panels. Panels can also be mounted on A-frames on flat roofed buildings. PV technology comes in a range of forms: PV panels that can be retrofitted to the roof of an existing building or equally, sunk to fit flush with the roof line; PV cells that are 'laminated' between sheets of glass to provide shading in a glazed area, and PV cladding.

PV systems are low maintenance as they have no moving parts and panels generally have 25 year warranties, although the lifetime of the panel can be expected to be beyond this time. PV systems should not be shaded. Shading caused by other buildings, greenery and roof 'furniture' such as chimneys or satellite dishes, even over a small area of the panel, can significantly reduce performance. Excess energy can be exported to the grid. Although the Feed-in Tariffs are generally not high, exporters can negotiate with their utility company. Future consideration may be given to the benefits of battery storage.

Payback times for this technology are usually approximately twenty years; but this is reducing year on year as the technology matures and are set to reduce further as fuel prices increase. Integrating PV into a building and replacing other building materials can further offset the cost.

Solar Hot Water Systems

Solar water heating systems use the energy from the sun to heat water stored in a hot water cylinder inside the building. A solar collector comprises a housing that contains piping, through which the carrier fluid circulates, and a glass panel to retain the radiation from the sun. The temperature inside the collector increases and this heat is then transferred to a carrier fluid. In an open loop system, the hot water is heated directly.

Solar thermal panels are generally black in appearance for maximising energy absorption and the glass panels have a special coating in order to retain as much heat as possible. Two types of collector exist: flat plate and evacuated tube. Flat plate collectors can be mounted on or flush with the roof. The air in the collection tubes can be evacuated to reduce heat losses within the frame by convection. Evacuated tube collectors need to be re-evacuated every few years. They are more difficult to install but are more efficient and allow higher temperature heating.

Solar thermal collectors offer a good price-performance ratio. Solar hot water systems are best suited to developments with high hot water requirements, such as hotels, care homes and leisure centres. Many systems have been installed in the UK and they work well, even without direct sunlight. Solar thermal systems should be sized to the hot water requirements of the user since any excess heat that is generated cannot be exported elsewhere. The optimal angle for mounting depends on when the water demand is greatest. Ideally, the collectors should be mounted onto a non-shaded, south-facing roof.

Solar thermal technology is a cost effective way to reduce carbon emissions, especially if it is replacing electric water heating. Due to limited roof space, solar hot water cannot be used effectively alongside photovoltaic arrays. Accordingly, it is considered preferable to install photovoltaic panels as these represent a greater carbon saving.

Biomass Heating

With the long term availability of fossil fuels such as oil and gas, and the persistent number of price rises of oil and natural gas a growing concern in the UK, alternative heating methods such as wood burning boilers are becoming more popular.

Due to technical advances in wood burning technology, and improvements in the preparation of wood fuels, efficiencies of new wood pellet burning boilers have increased to around 90%, with carbon monoxide emissions dropping dramatically. There are three types of wood burning boiler - logs, woodchips and wood pellets. Wood logs are the most readily available, generally produced as a by-product from forestry and woodland from sawmills, tree surgery and wind damage.

Wood chips have a high moisture content which tends to restrict their efficiency to only 50% and they tend to suffer from blockages hence we would be cautious about their use on this site. Storage space requirements are also high due to the irregularity of the chips. Wood pellets are made from dry waste wood, such as used pallets and off-cuts/sawdust from furniture manufacturers. The waste wood is compressed into uniform, high density pellets that are easier to transport, handle and store than other forms of wood fuel.

Biomass combustion systems (BCS) are generally more mechanically complex than conventional boiler heating systems, especially when it comes to fuel delivery, storage, handling and combustion. The complexity is necessary because of the different combustion characteristics of biomass as compared to conventional fossil fuels. The increased complexity means higher capital costs than for conventional systems. BCSs typically require more frequent maintenance and greater operator attention than conventional systems. As a result, the degree of operator dedication to the system is critical to its success. They often require special attention to fire insurance premiums, air quality standards, ash disposal options and general safety issues.

Domestic scale boilers such as Woodchip-fed systems remain very costly and the requirements for siting both the boiler and the fuel source were considered impractical for this development.

There are also some concerns on current availability of suitable fuel within a reasonable distance of the development as well as the additional traffic that would be associated with it. The use of efficient heat pumps is considered more suitable.

Biomass can be burnt directly to provide heat in buildings using wood from forests, urban tree pruning, and farmed coppices or as liquid biofuel, such as bio diesel. In non-domestic applications, biomass boilers replace conventional fossil fuel boilers and come with automated features to enable reduced user intervention. Due to the size of the proposed project, biomass energy has not been considered as an economically suitable technology for this development.

Heat Pumps

Heat pumps transfer heat from a lower temperature source to one of a higher temperature. These are split into three main categories:

- Air source heat pumps operate by converting the energy of the outside air into heat, creating a comfortable temperature inside the building as well as supplying energy for the hot water system. Air-to-water systems provide hot water for direct use or to supply 'wet' heating through underfloor heating or radiators. Air-to-air systems provide hot air, either directly into an internal space, or to be distributed by fans.
- Ground source heat pumps apply the same principle to heat energy stored underground. In this case a circuit of piping is buried horizontally or via a bore hole.
- Water source heat pumps absorb heat from a local water source, such as a lake, river, well, or borehole.

The most prevalent system is an air source heat pump. As with all heat pumps, air source models are most efficient when supplying low temperature systems such as underfloor heating. An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15°C. Cold water or another fluid is circulated through pipes, picking up the ambient temperature and then passing through the heat exchanger (the evaporator) in the heat pump unit. The heat exchanger extracts heat from the fluid, using a refrigerant compression cycle to upgrade the heat to a usable temperature (+55°C). This heat is then transferred to the heating system via another heat exchanger, the condenser of the heat pump.

Accordingly, ASHP heating systems generally run at a lower temperature than conventional heating systems. There are two main types of air source heat pumps. An air-to-water system uses the heat to warm water. Heat pumps heat water to a lower temperature than a standard boiler system would, so they are better suited to underfloor heating systems than radiator systems. An air-to-air system produces warm air, which is circulated by fans to heat the building. Whilst heat pumps are not a wholly renewable energy source due to use of electricity, the renewable component is considered as the heat is extracted from the air. It is measured as the difference between heat outputs, less the primary electrical energy input. Using this heat, for every Watt of electrical energy supplied to the system, 4 Watts or more of heating energy can be supplied to a heating system. This 'Coefficient of Performance' (CoP) of 4 is effectively an 'efficiency' of 400% for the system and compares very favourably with even the best gas condensing boiler's efficiency of around 85%. The smaller the temperature difference between the source and the output temperature of the heat pump (i.e. the temperature of the distribution system) the higher the heat pump's CoP.

Unlike boilers, there is no pollution on-site and as the mix of power stations used to supply the electricity grid gets 'cleaner', with more renewable electricity generation being brought on line, so the carbon emissions from the heat pumps system will decrease even further. The key operational benefit of air source heat pumps for the user is the reduction in fuel bills. In addition, space savings can be made over other plant types as an air source heat pump unit is compact, and requires no storage space for fuel.

Since air source heat pumps produce less heat than traditional boilers, it is essential that the building where the air source heat pump is proposed is well insulated and draught proofed for the heating system to be effective. Fans and compressors integral to the air source heat pump unit generate some noise, but this is generally acceptable especially where outdoor units can be located away from windows and adjacent buildings. By selecting a heat pump with an outdoor sound rating of 7.6 dB or lower and mounting the unit on a noise-absorbing base these issues can be resolved for the site. Costs for installing a typical system vary but they are considerably more economical to install than an equivalent capacity ground source heat system and can produce similar levels of energy and carbon savings. Actual running costs and savings for space heating will vary depending on several factors - including the size and use pattern of the building and how well insulated it is.

Wind Turbines

Wind turbines are used to generate electricity as they extract energy from the wind using a rotor which usually comprises a few large blades similar in profile to the wing of an aeroplane. The wind force drives a turbine to produce electricity which means the effectiveness of the turbine is completely dependent on the wind speed.

There are two types of domestic wind turbines;

- Pole mounted – Pole mounted turbines are free standing and have to be situated in a suitably exposed position. The typical generation capacity is around 6Kw.
- Building mounted – Building mounted turbines are a lot smaller than mast mounted systems and are most commonly installed on the roof of a home where there is again suitable exposure to a wind resource. The typical capacity for these are around 2Kw.

As mentioned above, the efficiency of a wind turbine is dependent on wind speed, meaning that the placing is crucial. Taller systems require sufficient space, so domestic wind turbines are typically found in fields or rural areas. It is important to note that wind turbines require planning permission and for off grid systems, batteries will need replacing around every 6 – 10 years.

Most small wind turbines generate Direct Current (DC) electricity. As such, an inverter is required to convert DC electricity to AC to be compatible for powering appliances in homes. Any unused or excess AC electricity can be exported to the grid and sold to the local electricity supply company. Therefore, expensive battery storage is not necessarily required.

Although the equipment and installation for wind turbines is expensive, the technology is designed to cut electricity bills as there are no operating costs other than maintenance checks that are required every few years. If a dwelling isn't connected to the electricity grid and the occupier has battery storage, excess electricity can be stored and used on a day where there are lighter or lower speed winds. As wind generated electricity is a renewable energy source, wind turbines also cut the carbon footprint of a development as no carbon emissions or toxins are released into the atmosphere.

The Future Homes Standard

Under the government's current plans, gas and oil boilers will be banned in newbuild homes from 2025. The government has stated that "... a low carbon heating system will be integral to the specification of the Future Homes Standard and we anticipate that heat pumps will become the primary heating technology for new homes".

Proposed Space and Water Heating

The energy systems for use at the development have been considered and selected in response to the local authority's policies with particular consideration to reducing energy consumption. Electricity has been chosen as the most sustainable fuel and will future-proof the dwelling. Heat pumps for both space and water heating have been selected to reducing carbon dioxide emissions. To further enhance the development's energy systems, enhanced controls and heat emission has been recommended.

The proposed heating system is an air source heat pump (ASHP). This will provide heating and hot water and replace the need for mains gas. This is in anticipation of the announcement from Government that no new homes are to connect to mains gas from 2025.

The specification for these items as proposed for the project is outlined below:

Table 2

Space Heating and Hot Water Specification

Element	Specification
<i>Heating System</i>	
Type	ASHP
Efficiency (COP)	2.45
Emitters	Radiators & Underfloor heating with pipes in thin screed for ground floor flats & pipes in wood for the storeys above
Controls	Time and temperature zone controls
<i>Hot Water</i>	
Type	175 litre hot water cylinder with full insulation and maximum standing 1.9kwh/day loss

Proposed Low and Zero Carbon Technology

Taking various factors into account such as location, ease of installation and the client's preferred solution, individual ASHP's have all been selected as the most desirable and feasible choice of renewable/low carbon technology for the development.

As such, each apartment will have their own individual ASHP unit to supply electricity to from a renewable source. After consultation with the client and a review of the architect's drawings, it has been decided that the ASHP's will be best located on the flat roof amenity space above the second and/or third floor.

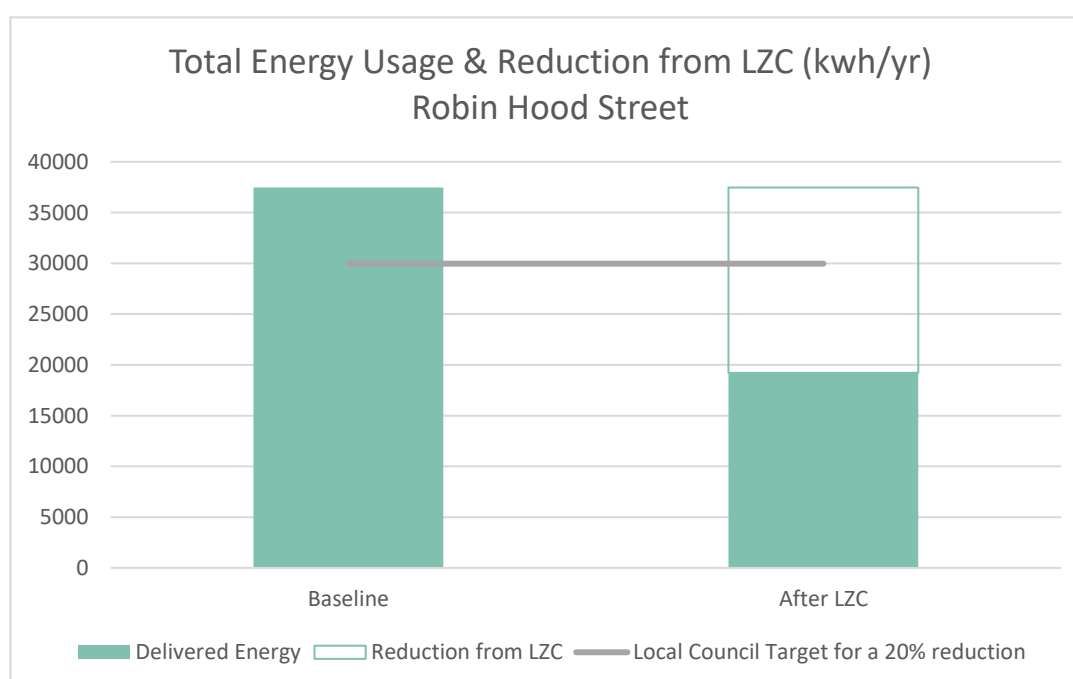
Predicted Energy Use from Low and Zero Carbon Technology

The development has been assessed using the SAP methodology, the results of which provide the predicted energy use and the energy saved. Full details of the assumptions that have been used to produce these calculations are outlined within the accompanying SAP Specification Document. Enforcement bodies must ensure that they are satisfied that these inputs are an accurate reflection of the final building before using this reporting and attached energy modelling output documents to demonstrate compliance.

Table 3 below summarises the results (the energy figures can be found within the associated SAP documents):

Table 3

	Predicted Energy Demand (kWh/m ²)				Energy Use from LZC			
	Total Energy Usage from Space Heating	Total Energy Usage from Water Heating	Total Pumps, Fans and Keep Hot	Total Lighting	Total Energy Demand	Total Energy Delivered	Energy Displaced by Heatpump	% Reduction from Renewable LZC
Robin Hood Street	12946.61	22916.27	0.00	1594.92	37457.80	19224.07	37457.80	48.68%



Predicted Carbon Emissions

As can be seen from table 3 below, the specification outlined throughout the energy statement for the proposed development on Robin Hood Street will result in a saving of 3,919.90kg CO₂/year which equates to a **58.00%** reduction in CO₂ emissions. The carbon figures can be found within the associated SAP documents.

Table 4

SAP 10	Area Weighted Average CO ₂ Rate (kg CO ₂ /m ² /year)	Total Floor Area (m ²)	Area Weighted Average Total Emissions (kg CO ₂ /year)	Reduction in CO ₂
Baseline	11.77	574.20	6758.14	N/A
Be Green	4.94	574.20	2838.24	-58.00%

Conclusion

This report outlines how a variety of sustainability criteria have been considered alongside the proposed design. Based on the modelling undertaken, it has been demonstrated that **48.68%** of energy used will be through Low and Zero Carbon technology.

- Individual ASHP's with a COP of 2.45
- Low fabric u-values in line with Part L minimum requirements
- Heated access corridors
- High efficiency lighting
- Limiting thermal bridging

In addition to this, the proposed development at Robin Hood Street will reduce CO₂ emissions by **58.00%** beyond the requirements of Part L of the Building Regulations, where the building and services specification described in this report is implemented.

As such, the specification listed throughout this report will exceed the requirement for 20% of the development's total energy usage to be provided through renewable/low carbon technology in line with the Manchester City Council Validation Checklist (with reference to policies EN4 and EN6 of the Core Strategy for the City of Manchester) and is therefore compliant with the carbon reduction policies of Manchester City Council.