40-46 Princess St, Manchester

Sustainability Report

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1.0 Introduction

The purpose of this document is to provide a feasibility study into potential sustainable energy saving technologies that could be beneficial for the proposed refurbishment at 40-46 Princess St, Manchester.

The building is proposed to consist of basement and ground floor retail space; ground floor reception and open plan offices space over 6 storeys with a nett internal floor area of circa 4,800m^2 with the total building area being 5830m^2.

The building is proposed to retain the existing structure to all sides with the following works envisaged:

- Extension to 4th offices
- Modifications to front entrance
- Opening up windows in the external façade
- Opening up the lightwell in the centre of the building
- New utility sub-station
- Scenic Lift installation

The 40-46 Princess St building is listed and as a result alternations to the external façade will be limited, for example existing single pane windows will be retained as part of the refurbishment.

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2.0 Sustainable Systems

2.1 Solar Thermal (Hot Water)

Solar water heating systems are a well-established and well developed technology, with simple components.

These systems work by collecting solar energy to heat water, most commonly for hot water needs.

Solar thermal heating systems use a heat collector that is usually mounted on a roof in which a fluid is heated by the sun. This fluid is used to heat water that is stored in either a separate hot water cylinder or in a twin-coil hot water cylinder (the second coil is used to provide additional heating from a boiler or other heat source).

Maintenance costs for solar water heating systems are generally quite low and require little maintenance.

Office buildings with no canteen have low hot water demand. As a consequence it is considered that a central hot water storage system is not appropriate for this project. Also the roof structure does not appear to be loadbearing and as such additional steelwork may be required to accommodate the increased loading and also to provide man access for maintenance.

2.2 Photovoltaic Panels (PV)

Photovoltaic (PV) modules mounted on the roof convert solar energy into electricity. Electricity generated is exported into the electricity network when not required to serve the occupied building load.

The existing roof does not appear to be loadbearing and due to the weight of the PVs additional steelwork may be required to accommodate the increased loading.

The existing roof is not accessible and therefore to install PVs would require the inclusion of safe man access to the roof, further increasing the installation cost. This would also affect the building aesthetics.

As a result of the additional structural and maintenance requirements we do not consider this option would have an economically viable payback period.

2.3 Ground Source Heat Pumps

Ground Source Heat Pumps (GSHP) utilises the energy which is stored within the earth's crust. The system uses the solar energy which is stored due to the ground's high thermal mass. A heat pump extracts heat from the ground and pumps it into the building at a higher temperature via the circulation of a heat exchange fluid, i.e. water.

Ground Source Heat Pumps consists of a series of ground loops which are laid within the ground in either boreholes, which are typically 15m – 180m deep, or horizontal.

Horizontal ground loops are generally buried in 1-2m deep trenches; however, these can require a large external area to provide a sufficient heat store for the heat exchange. Due to the low grade (temperature) heat available from such systems the space heating is generally underfloor heating as opposed to wall mounted radiators.

This will also have the added advantage of improving the heat pumps Coefficient of Performance (CoP), however, due to the low grade heat 'top-up' heating will be required to any pre-heated domestic hot water.

A GSHP would not be suitable for this development as the external space required for the horizontal or vertical ground loops is not available.

2.4 Air Source Heat Pumps

Air source heat pumps (ASHP) absorb heat from the outside air. This is generally used to serve fan coil units, however can be used to heat radiators, underfloor heating systems or heat domestic hot water systems.

The systems can operate in temperatures as low as -20°c which means that they are suitable for installations within the UK. Hot water and Heating can be provided 365 days a year.

As the proposed system will be supplying cooling to the building, it is therefore not eligible for payback through the Renewable Heat Incentive (RHI).

We do consider this type of system is suitable and a viable option to heat and cool the office areas.

2.5 Biomass Heating

A biomass fuel is any plant-derived organic fuel material that renews itself over a short period. Biomass energy systems are based on either the direct or indirect combustion of fuels derived from those plant sources. The most common form of biomass is the direct combustion of treated or untreated wood.

Biomass-fuels can be used to produce energy on a continuous basis (unlike renewables such as wind or solar energy) and it can be an economic alternative to fossil fuels as it is a potential source of both heat and electricity. However, biomass systems have particular design management and maintenance requirements associated with sourcing, transportation and storage and are therefore more commonly used in commercial developments rather than domestic installations. It can be less convenient to operate than conventional mains supplied fuels such as natural gas and are more management intensive.

A biomass boiler system would not be feasible for this type of building with only a moderate intermittent heating demand and a very low hot water demand. Also there is limited plant space, and city centre location would not be feasible for housing the boiler plant and accommodating fuel storage and deliveries. Therefore due to the site constraints and the impracticalities of delivering and managing fuels on the development this option has not been considered any further. Also due to the combustion materials produced it is likely that the installation of the flue could be required to be higher that the buildings pitched roof.

2.6 Wind Turbines

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

For a development of this size a pole mounted turbine could be considered, however, the city centre location of the development will produce variable wind speeds and direction. However, with the added potential for noise generation and Radio / TV interference this option is not been considered any further.

2.7 District Heating System

District heating schemes, supply heat from a central source directly to residential and commercial properties through a network of pipes carrying hot water. This means that individual homes and businesses do not need to generate their own heat on site for space heating and domestic hot water requirements.

Heat/Hydraulic Interface Units (HIU) are installed within a property which is connected to a district heating system, this allows the heat to be provided to the property via a heat exchanger built into the unit, they also come with a meter which enables the amount of heat being taken from the district heating metered and charged accordingly. HIU are generally required due to the high pressures within the district heating system which would be far in excess of what the building pipework system could handle.

There is no district heating system close the site, therefore the proposed refurbishment cannot be connected to a district heating system.

2.8 Combined Heat and Power

Combined Heat and Power (CHP) is the simultaneous generation of heat and electrical power from the same energy system. CHP makes use of the 'waste' heat resulting from electrical generation; resulting in increase overall thermal efficiency compared to using electrical delivered by the national grid. CHP can also benefit from lower operating costs.

CHP systems require a year round base load to operate effectively; this base load will not be present in the office refurbishment (there is no substantial hot water load). As a result we do not consider CHP will be technically viable for the refurbishment.

2.9 Rainwater Harvesting

Rainwater harvesting installations collect rain fall from roof areas and store for re-use to serve non-potable water systems. (e.g. to flush WCs).

The installation of this type of system will reduce the utility water consumption and could reduce water charges. As the building is primarily offices there could be a reasonable amount of water consumption on site. As a result we consider this installation may have a suitable playback period and therefore could be considered for further investigation for this project.

2.10 Green Roofs

Green roofs are a deck onto which vegetation is intentionally grown. The benefits of green roofs can be the reduce requirement for cooling during the summer period, attenuating or capturing rainwater runoff and providing a range of habitats for urban wildlife.

Due to damp winter climate in the UK generally green roofs will add little or no thermal performance to the roof to reduce heating loads.

There is not sufficient available flat roof to install a green roof and therefore this option is not viable. Also it would require the roof to be loadbearing, due to the weight of the green roof and the potential capture of rainwater. As such additional steelwork may be required to accommodate the increased loading.

3.0 Feasibility Statement

The use of Air Source Heat Pumps (ASHP's) to provide space heating and comfort cooling is a technically feasible, energy efficient option.

The installation of rainwater harvesting could be considered to provide captured water to the Landlord's toilets serving the office space and reduce water consumption from the utility network.

3.1 Summary Renewables, Low and Zero Carbon Technologies

A summary of the renewable and LZC technologies considered is provided in the table below:

Energy source	CWC comments	Potential for use
Solar thermal	Minimal hot water demand, therefore solar hot water heating utilising roof mounted solar panels not considered technically or economically viable.	No
Photovoltaic	Structural and maintenance requirements result in this option not being economically viable.	No
Ground source heat pump	No space available, therefore not technically viable.	No
Air source heat pumps	Likely to be technically and economically viable.	Yes
Biomass boilers	Absence of fuel storage and plant space preclude this option.	No
Wind	Very limited area available therefore cannot be physically accommodated. Would not recommend in city centre area.	No
District Heating	No district heating system near site, therefore not viable.	No
CHP	No year round heat load exists, therefore not technically viable	No
Rainwater Harvesting	This option could be technically viable, subject to available plant space.	Possible
Green Roofs	No available flat roof and additional structural load make this option not technically viable.	No

3.2 Additional Measures That Could Be Employed

In addition to the above the following improvements could also be employed as part of the design, construction and operation:

- Improved roof fabric performance (improved U-values to the existing and extended roof).
- Unblocked window opening fitted with new windows complying with the requirements of the Building Regulations Part L.
- Improved air tightness of the new extension.
- Inclusion of power factor correction.
- LED lighting and lighting control.
- The inclusion of eco lifts.
- Review energy efficient grants and incentives as part of the design. Ensure all equipment proposed is designed to be efficient and reduce energy usage.
- Construction management – ensure the construction uses sustainable resources, material used to achieve optimum energy efficiency, materials with low embodied impacts, recycled materials, etc.
- Energy monitoring of substantial energy uses.
- Waste management (construction and building operation) – recyclable waste storage, minimisation of waste generated, etc.