

Intended for
Planning

Document type
Report

Date
March 2022

KINGS HOUSE, MANCHESTER PLANNING ENERGY STATEMENT

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Project name Kings House, Manchester
Project no. 1620011488
Document type Report
Document Ref 1620011488-RAM-XX-XX-RP-ZZ-00001
Version 01
Date 18/03/2022
Prepared by Dan Lowe
Checked by [Name]
Approved by [Name]
Description Energy Statement intended for Planning Purposes

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Rev	Date	Prepared by	Checked by	Approved by	Description
01	18/03/2022	DL			Draft issue for comment

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1. INTRODUCTION

The Kings House, Manchester development is the refurbishment of a 19th century office building located within Parsonage garden conservation area. The building is bounded by King Street West, Back Bridge Street and Southgate in the centre of Manchester.

This document is an energy statement for planning and is designed to address the following aspects:

- Energy Efficiency
- Environmental Design

This report will outline the procedures and methods which, when implemented, can help toward a reduction in carbon emissions across the site.

2. ENERGY REDUCTION DRIVERS

2.1 Requirements

In terms of energy conservation, the requirement for existing non-domestic buildings falls under Approved Document Part L2B of the building regulations. The current version applicable to the development, at the time of writing, is Part L2B 2013 with 2016 amendments.

Generally, as part of meeting Part L 2B of the building regulations, it needs to be demonstrated that any changes to the building do not have a negative impact on its energy consumption. Part L2B, includes details of what improvements and to what level improvements need to be made based on the work being implemented.

It should also be noted that under Part L2B, there are exemptions for listed buildings where energy efficiency requirements do not have to be met if the changes would alter the buildings character or appearance. Whilst Kings House is not a listed building it falls within the parsonage garden conservation area, as such improvement can be made to the façade but careful planning design and installation should be considered throughout the process.

2.2 Additional Drivers

Over the last few years there has been a call into action over the impacts of climate change, to lower carbon emissions and the reliance on fossil fuels.

The Client is acting on this and have set very stringent targets as a route to net zero carbon, creating their own framework for achieving it. As part of this change, decisions and analysis is no longer based on regulated energy loads as it has in the past, but now looks at the whole lifecycle:

- Energy in operation in line with TM54. So, looks to map out how energy will be used within the building including for unregulated loads as well as regulated loads
- Embodied energy associated with construction, products, in-use and end of life

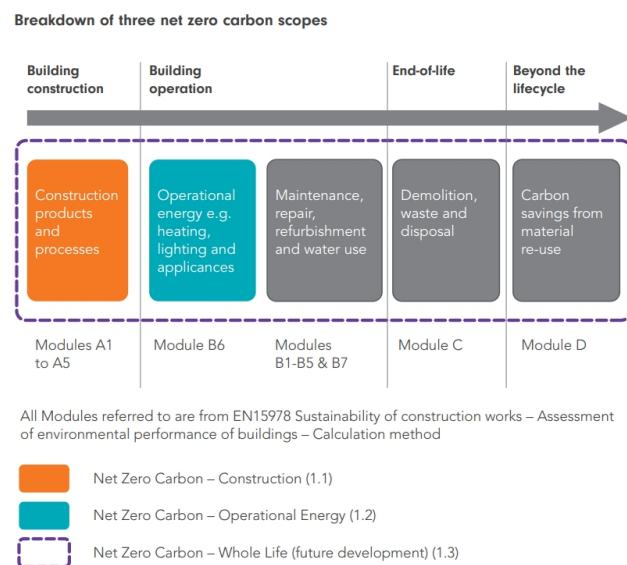


Figure 1 – UKGBC Net Zero Carbon Modules

As part of this philosophy, the Client has embraced the embodied carbon elements by looking to refurbish and repurpose Kings house, Manchester, rather than building new, saving significant levels

of carbon emissions. At the same time, they have a target of achieving an energy intensity of 130kWh/m² (GIA)/yr for existing buildings.

2.3 Limitations

There are limits to what can be sensibly achieved for the building, with multiple factors restricting energy saving opportunities including:

- Massing – As the building is existing the massing and materials are pre-existing
- Geometry and orientation – As the building is existing the geometry and orientation is pre-defined

The majority of the existing glazing is single glazed and at the end of its life. As such, proposals include to change the glazing to double glazed in a sympathetic way to maintain the appearance of the building, whilst significantly improving the air tightness and thermal performance.

3. ENERGY REDUCTION STRATEGY

The design of the Kings House, Manchester development will be based on a 3 stage approach that prioritises the reduction of buildings' energy demands and maximises use of on-site renewables as this has a significant impact on reducing operational carbon emissions.

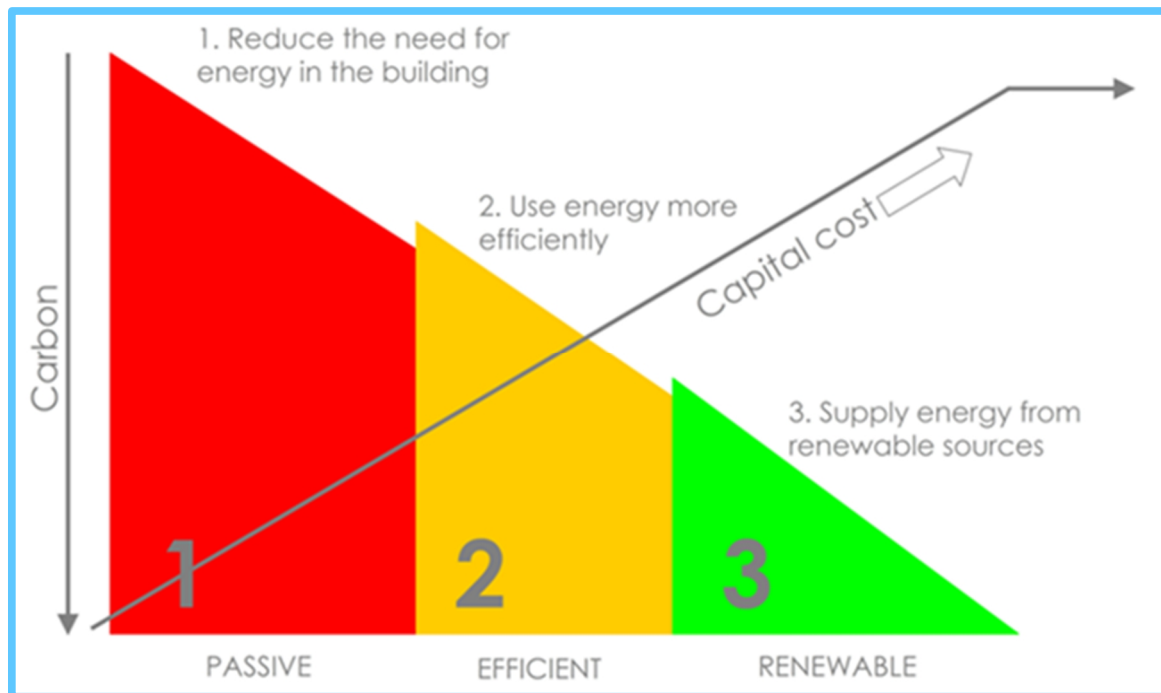


Figure 2 - Hierarchical Approach to Reducing Operational Carbon Emissions

Stage 1 – Passive Design - to reduce the buildings energy consumption and thereby CO₂ emissions. As mentioned in the limitations section of this report, there are elements of the building design which are out of our control. However, improvements in the building fabric and in particular the glazing and framing specification are proposed to improve the energy efficiency of the building. The upgrades will help to reduce the heating, cooling and lighting demands of the building.

Stage 2 – Efficient Design - to reduce the energy consumption from MEP systems and thereby CO₂ emissions – we have developed building services strategies that provide the building with heating, cooling, ventilation, lighting and domestic hot water using electrical energy from the national grid. Our strategy has been to eliminate the requirement for fossil fuels (gas and/or oil) within the building, together with an increased use of (low carbon) electricity powered MEP systems, because of ongoing decarbonisation of the grid. Highly efficient services shall be used, which will look to be significantly improved beyond the efficiency requirements of Part L.

Stage 3 – Renewable Energy Design - The final stage to reduce the carbon emissions from the building is to consider the use of on-site renewable energy systems and LZC (Low Zero Carbon) technologies. Within the Kings House, Manchester development this has focussed on the use of heat pumps for heating. The limitations of the building status does mean that the availability of other systems, such as solar photovoltaic panels are limited.

The building has been developed to reduce the requirement for heating and cooling. This has been achieved through improvements to the façade, particularly glazing performance, whilst doing so in a sympathetic way to align with the conservation status.

The heating and limited cooling requirements of the building are being provided by the use of a hybrid VRF system that can provide heating and cooling to the building. The system looks to recovery heat/coolth from one area of a zone and use it in another as required, helping to further save energy. The system looks to reduce the level of refrigerant and uses a type with a lower Global Warming Potential (GWP) than a more traditional VRF system.

3.1 Energy Statement

The Kings House, Manchester development is located within Manchester City Centre enclosed by King Street West, Back Bridge Street and Southgate in the centre of Manchester and has been designed to embed sustainable credentials through integrated architectural and engineering. From the requirements of the Client, the project brief and through constructive dialogue at design meetings, the proposal for the development shall utilise electricity as the energy source for all building services.

Key aspects of our approach can be summarised as follows:

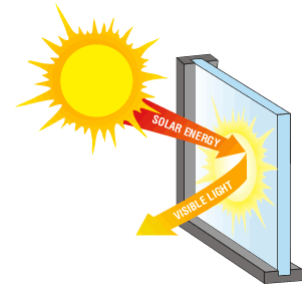
Ventilation Strategy: The existing ventilation design is a combination of either supply only ventilation or separate supply and extract fans. This means the building has a distinctive lack of heat recovery resulting in wasted heat energy. As such, the proposal for the building refurbishment is to introduce a mechanical ventilation with heat recovery with louvres or openings to be introduced to the rear and lightwell elevations as well as the roof. The ventilation strategy however shall be a mixed mode system whereby natural ventilation take priority

Fabric U Values: Opportunities to improve the building fabric are limited due to the façade listing and in particular the mosaic tiles which are located both externally and internally. Where new facade elements are introduced, these will be designed to modern fabric performance and standards.

Glazing Specification: The existing building has a single glazed façade with a very distinctive dark tint. The single glazing is at its end of life and is in need of an upgrade. As such, it is proposed to upgrade the single glazing and framing system to an improved double-glazed unit with a thermally broken framing system. This will be done sympathetically, with the aim of getting the new glazing and framing to match the existing glazing as closely as possible and maintain a similar dark tint to the glazing specification. The upgrade to the glazing will help to save significant energy for the building.

Air Leakage: The existing Kings House, Manchester development is currently quite leaky, mainly due to its age. As such, the design will look to improve the air leakage rate as part of any upgrade works to the glazing design.

Daylight Linked Lighting Control: Within all appropriate spaces, controls will be adopted for luminaires adjacent to windows. Photocell devices sense the amount of daylight in the room and dim the lighting, accordingly, whilst maximising the use of natural light and minimising artificial lighting.



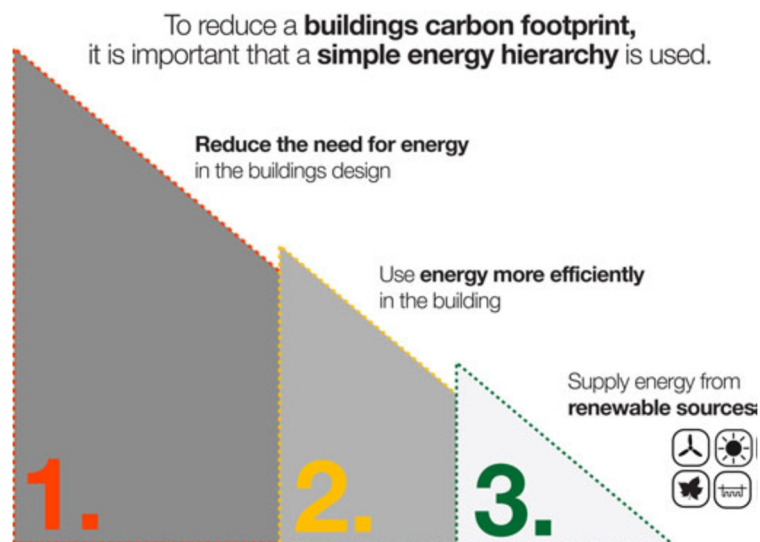
Air Source Heat Pumps: The king house, Manchester development will utilise air source heat pumps, mainly in the form of a Hybrid VRF system, to provide low temperature hot water heating and chilled water cooling for the building via fan coil units.

In addition to this, ASHPs will be utilized for LTHW heating to pick up any additional heating requirements (heating coils in AHU's etc) as well as for the domestic hot water generation. Air source heat pumps (ASHP) have a high COP and can provide energy and CO₂ savings compared to more traditional gas boiler systems and also removes the need for fossil fuels.

Metering and Monitoring: Sub-metering of water, heating and electricity will be provided, allowing the building to be monitored and well managed. This data will also be used to continually improve the buildings energy use and identify areas of high usage for review.

3.2 Energy Reduction Strategy

We have adopted a three-stage energy reduction strategy which looks to reduce the energy demand by passive means in the first instance, then to use high efficiency / low energy building services systems and finally the consideration of renewable or Low or Zero Carbon Technologies (LZCTs). This approach is summarised in the following diagram.



To identify how this has been applied for the Pall Mall, Manchester development, the energy reduction strategy for each system is defined in the following table.

Heating	Measure	Description	Benefit
	Improvement of thermal performance of the glazing and fabric (where appropriate)	The proposal looks to improve the glazing performance changing to a double glazed unit, rather than the existing single glazing and poor performing framing system. Where new thermal elements are introduced, these will align with the Part L requirements	Reduced heat loss and heat gain, resulting in significant energy savings and reduced embodied carbon from mechanical equipment.
	High performance glazing	Improved U-values and low E internal coating to reflect heat within the building.	Reduced heat loss and heat gain
	Use of thermal modelling software in design	This allows us to be significantly more accurate in design and take account of known gains in winter which can help to reduce design “margins on margins”. The size of emitters, pipework and plant can therefore be selected with greater precision and the system can be designed to be smaller and harder working, hence operating at peak efficiency for greater periods of time.	Greater system efficiency and reduced energy consumption
	Use of air source heat pump systems (HVRF).	A low energy system which has the benefit of a high coefficient of performance.	Reduced annual heating demand and carbon emissions. Lower refrigerant quantity and GWP than traditional VRF systems.
	Removal of fossil fuels	The buildings heating and cooling systems are to be electrically driven, with the emphasis to remove fossil fuels from the building as we head towards an electric future with green infrastructure, making it a net zero ready building.	Reduced carbon emissions and creating a more sustainable building for the future.
Hot Water	Measure	Description	Benefit
	Use of flow and time restricted taps	These deliver a controlled amount of domestic water with automatic shut off when not required.	Reduced consumption, hence reduced wastage of water and heat
	Use of air source heat pump systems.	Generating hot water via air source heat pump systems can provide a low energy hot water solution and moves away from fossil fuels towards an electrical solution.	Reduced energy demand (and carbon emissions) to provide hot water
Small Power	Measure	Description	Benefit
	Phase balanced design	This ensures that the use of electricity is efficiently balanced across all three phases. As the amount of electricity drawn is	Reduced demand and improved efficiency

		affected by the peak demand of any one phase, to ensure a similar load profile across all three phases reduces the peak and hence ensures that electricity is used efficiently.	
	Power factor correction	To balance still further the phases and deal with the occupant driven phase imbalances which cannot be designed out.	Reduced demand and improved efficiency
	Mechanical systems will be selected to maximise energy efficiency and reduce electrical demand	This will be achieved through the use of such technologies as demand matched variable speed pumps and fans, high efficiency motors, etc.	Reduced electricity consumption
Ventilation	Measure	Description	Benefit
	Mixed Mode ventilation	Natural ventilation shall be the priority method of ventilation for the building. Mechanical ventilation systems shall be used to only provide ventilation in areas it is needed (occupied areas) based on Co2 and internal conditions. Units control to a dedicated zone	Reduced plant sizes saving on energy consumption and embodied carbon.
	Heat recovery	Introduce heat recovery to the building to maximise heat reclamation from exhaust air.	Significant reduction in heating demand.
	Demand matched ventilation	Systems will only operate when required and to the minimum extent required through the use of time controls and CO ₂ monitoring/controls.	Reduced electricity consumption, reduced demand on heating system
Cooling	Measure	Description	Benefit
	Utilisation of Reverse Cycle ASHP	Systems with will be specified to ensure that, in the very few rooms that are provided with cooling, it is extremely energy efficient and heat rejection can be reused within the heating system for the generation of domestic hot water	reduced electrical demand
	Improvement of thermal performance of the glazing and fabric (where appropriate)	The proposal looks to improve the glazing performance changing to a double glazed unit with thermally broken frame, rather than the existing single glazing and poor performing framing system. Where new thermal elements are introduced, these will align with the Part L requirements	Reduced heat loss and heat gain, resulting in significant energy savings and reduced embodied carbon from mechanical equipment.
Lighting	Measure	Description	Benefit

	High efficiency fittings	The electric lighting system will be designed around energy efficient products, utilising high frequency ballasts and efficient LEDs where possible.	Reduced electrical consumption
	Daylight linking technology	All electric lighting systems in occupied rooms with external windows will be provided with daylight linking technology. This will ensure that the lights will dim or turn off whenever there is sufficient natural daylight available. The lighting system will be designed to operate as a top up to the natural daylight design, rather than from a “default on” mode.	Reduced electrical consumption
	Occupancy sensors	These will be provided where appropriate (with manual override) to ensure that lights are not left on when rooms are unoccupied. Again, the default scenario for the lighting system will be off	Reduced electrical demand
Gas	Removal of gas	The building will be electrically driven removing the need for fossil fuels	Reduced carbon emissions and creating a more sustainable building for the future.

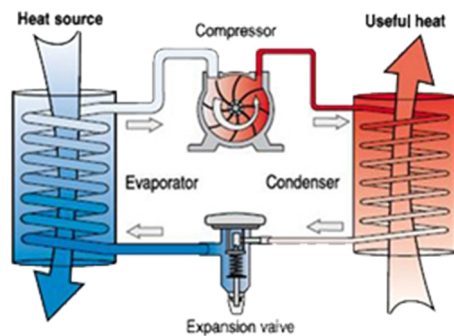
3.3 Use of Low or Zero Carbon Technologies (LZCTs)

The use of LZCT's have been considered for the development, based on the site constraints and servicing proposals. The following technologies have been considered:

- Air Source Heat Pumps (ASHP)
- Ground Source Heat Pumps (GSHP)
- Photovoltaics (PV)
- Solar Thermal Hot Water (STHW)
- Wind Turbines
- Combine Heat and Power (CHP)

3.4 Air Source Heat Pumps

Air source heat pump (ASHP) technology can provide an effective energy reduction contribution to the buildings heating and cooling requirement. Heat energy is extracted / discharged from / to the air. The advantage over ground source heat pump technology is that there are no large areas of land required and no groundworks required, providing a simpler, significantly cheaper installation. High coefficients of performance (CoPs) can be expected, but lower than a GSHP alternative). However, efficiencies tend to fluctuate due to the ever-changing external air temperatures, resulting in lower COP's in very cold periods.

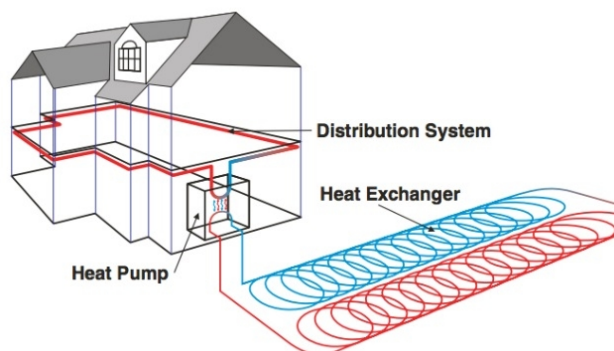


ASHP Heat Exchanger

This technology is feasible for the site and could be used as part of a Hybrid Variable Refrigerant Flow (HVRF) system providing both heating and cooling to the office spaces. A HVRF system consists of external condensers linked to branch controllers via low GWP (675) refrigerant lines. From the branch controller, heating or cooling is supplied to emitters (typically fan coil units) via chilled or low temperature hot water. The branch controller also recovers heat and cooht to pass it between spaces as required.

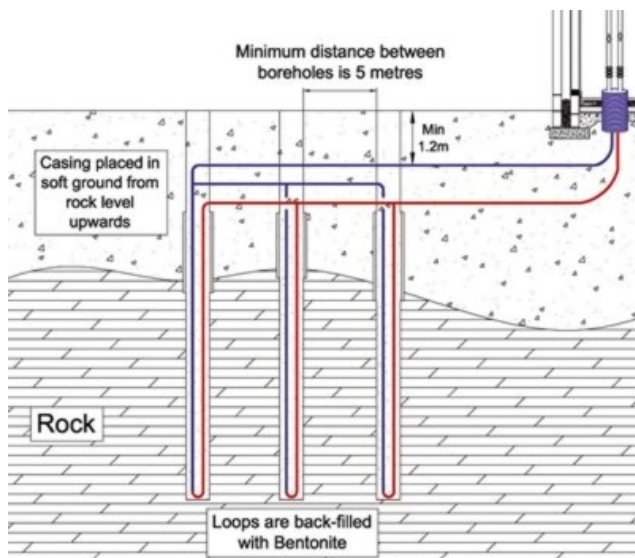
3.5 Ground Source Heat Pumps

Ground source heat pumps work in a similar manner to air source heat pumps, but take heat from the ground rather than the air. Utilising the relatively steady state conditions of the earth heat energy can be extracted / discharged providing preheating in winter and precooling in summer resulting in relatively high steady coefficients of performance (CoPs) in comparison to ASHP alternatives.



GSHP – Horizontal Installation

There are two main methods of extracting discharging heat energy from and to the earth, horizontal pipework or vertical bore holes. The horizontal arrangement pipes are laid over a large area close to the surface e.g. 1metre depth. Boreholes can be piled down to depths of 100m, taking less surface area but will require more specialist plant equipment to drive the bore holes into the earth.



GSHP – Vertical Borehole Installation

The use of a GSHP would be to provide low temperature hot water. Given the existing nature of the building, installing bore holes or ground loops are not seen as a feasible option for the project, particularly as ASHP's are a feasible and less disruptive route.

3.6 Photovoltaic Panels

Photovoltaics (PV) is a system which generates electrical power by converting sunlight into direct current electricity through the use of semiconducting materials that exhibit the photovoltaic effect. A PV system utilises solar panels constructed of a number of solar cells converting sun light to electricity. Direct sunlight onto the solar panels provides the highest level of electrical generation, however solar panels are still effective on cloudy days converting diffuse light into electricity. To ensure the maximum electrical yield can be captured by the PV array, all panels should face south with no obstructions to cause over-shadowing.

A key advantage of PV cells is their potential to be integrated into the fabric of the building, however, this is not possible on King Housel, due to the conservation area. Maintenance costs are low, requiring occasional cleaning and maintaining/ replacing panels and inverters as necessary.



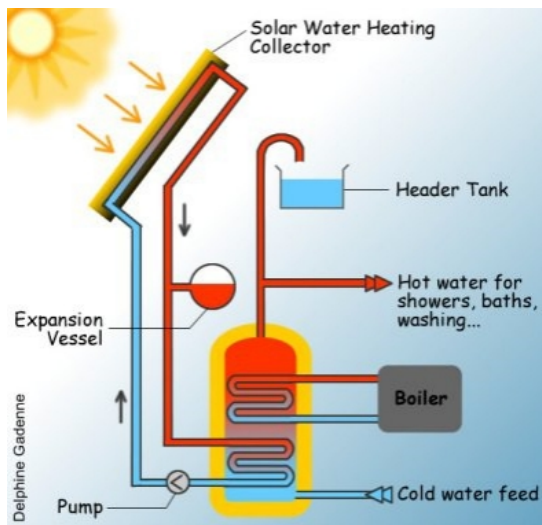
A PV array allows for a direct benefit towards reducing offsite- electricity grid demands, and as such reducing energy bills and carbon emissions.

Kings House, Manchester, has a restricted roof space of which the majority will be utilised by mechanical plant such as external condensers. As such, there is very limited space available for photovoltaics on the roof and even locating above the plant deck is limited by the condensers which need to be unobstructed above for air flow reasons. As such, the PV area would be limited and would result in very little energy generation and low efficiency.

3.7 Solar Thermal Water Heating

Solar thermal collectors convert the sun's radiation into heat, which is transferred to a medium such as a water/glycol mix (to prevent freezing). Solar water heating is usually used for hot water generation, as this is a year-round demand. It is not normally used for space heating as the greatest demand is in winter, when the sun's rays are weakest. Ideally the collectors should be mounted on a South-facing roof, although southeast and southwest will also function successfully. The collectors need to be inclined at between 10-60° from horizontal – with 35° being the optimum.

Solar hot water uses a heat collector, usually as panels on the roof in which liquid is heated by the sun. The fluid is used to heat up water that is stored in either a separate hot water cylinder or a twin hot water cylinder. There are two types of solar collector: flat plate and evacuated tubes, the latter being generally more efficient.



Similar to PV this is limited to the plant space but shading of the panels would result in a low energy yield, particularly as solar thermal panels require direct sunlight to work effectively.

3.8 Wind Turbines

Wind turbines harness the power of the wind to produce electricity through circular motion.



Key benefits of a wind turbines are:

- No fuel costs
- No polluting emissions
- Maintenance costs are low
- If consistent wind resource is present, they can provide very good generation potential
- Proven technology
- Storage potential through battery banks

Given the city centre location, wind turbines are not seen as a feasible or practical solution for the development.

3.9 CHP

Combined heat and power engines generate heat and power concurrently. Typically, gas engines drive an electricity generator through a power cycle and the by-product of this power generation can be used for heating through heat recovery systems utilising energy from the exhaust gas. The rotation of an alternator which generates electrical power also produces heat, a heat exchanger can be used to recover the generated heat in order to heat up water which can be distributed for heating through district heating networks.

CHP systems require a high and continual heat load all year around and usually align well to buildings with high process heating demand or developments with heated swimming pools or similar. As the proposed development will not have a significant base load due to low domestic hot water demand, it is not seen as a feasible option.

3.10 LZCT Summary

A summary of the LZCT options for the development can be found in the table below:

Technology	Technical Feasibility	Carbon Saving Potential
Air Source Heat Pumps	ASHP's have the potential to provide both heating and cooling to the development. A VRF system is proposed for the office areas.	Good
Ground Source Heat Pumps	As the building is existing and in a City Centre location, the ground works associated with a GSHP make this option unfeasible.	Good
PV	Photovoltaics could help to offset some of the buildings electrical load. However, the panels will be restricted to a small area, which would be overshadowed.	OK
Solar Thermal	There is minimal domestic hot water demand for the building, therefore solar thermal not feasible. Panels will be restricted to a small area, which would be overshadowed.	Poor
Wind	The nature of the building and City Centre location make the use of wind turbines unfeasible	Poor
CHP	There is not a sufficiently high DHW load to make the use of CHP viable	N/A

From the review, the most feasible technologies are as follows:

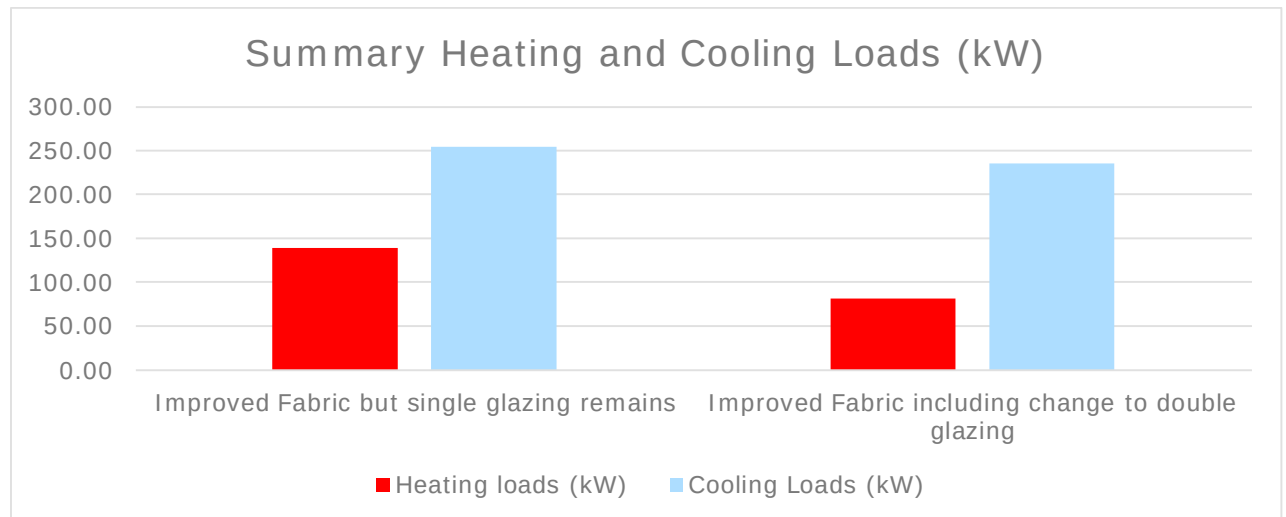
- Air Source Heat Pumps
-

For the current building proposals, Air source heat pumps will be used as part of a Hybrid Variable Refrigerant Flow (VRF) system.

4. ENERGY ANALYSIS

As Kings House sits within the Parsonage Garden conservation area an additional assessment was undertaken to review the impact on heating and cooling loads that retaining single glazing would have in comparison to changing the windows to be double glazed alternatives.

Below outlines the comparison against the fabric elements of the King's House refurbishment being upgraded with and without upgrading the single glazing to double glazed units



This is also quantified in the table below:

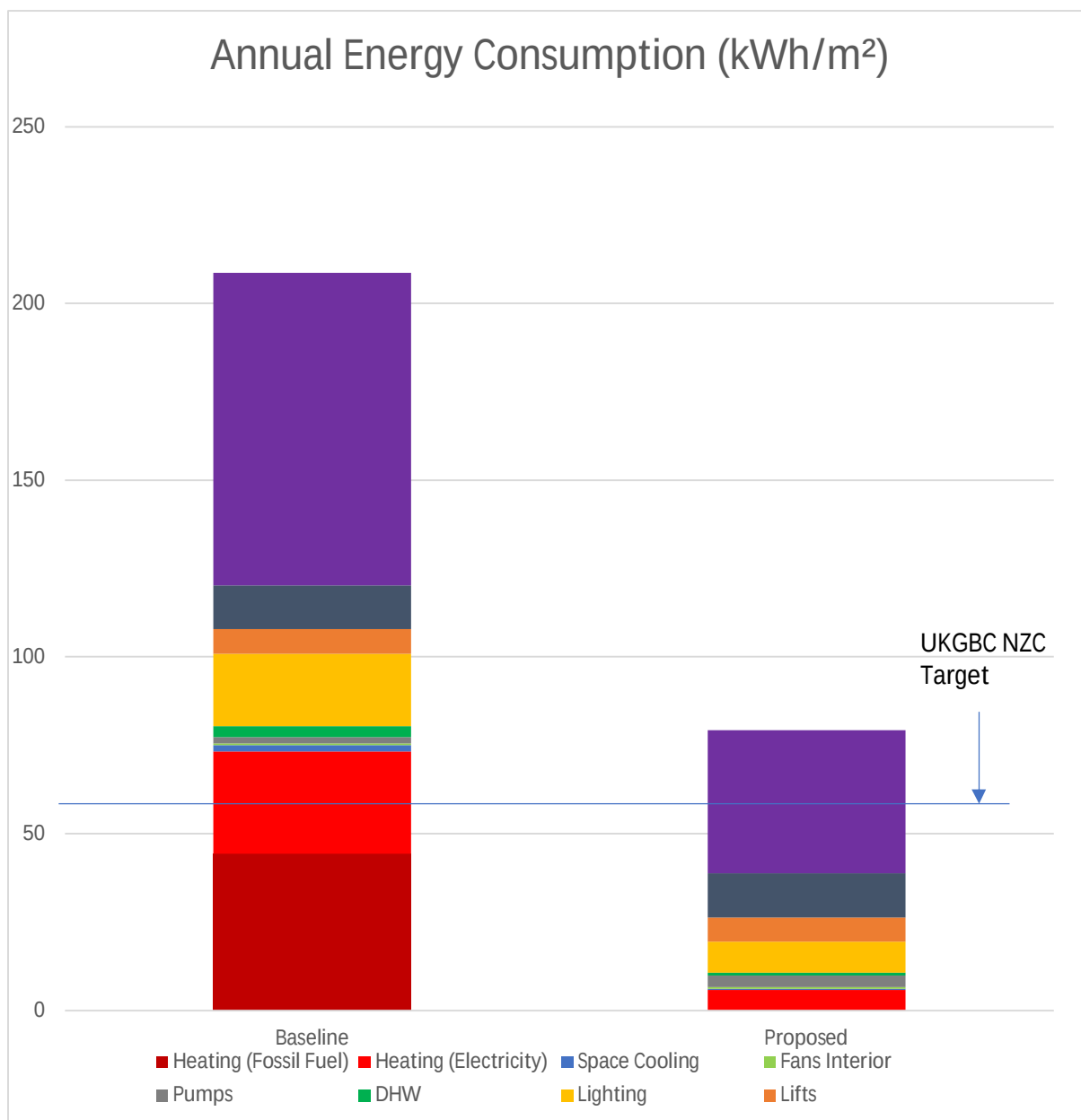
	Heating loads (kW)	Cooling Loads (kW)
Improved Fabric but single glazing remains*	139.2	253.9
Improved Fabric including change to double glazing*	81.1	235.2
Reduction	42%	7%

By upgrading the glazing to double glazed units, along with the rest of the fabric, could provide a 42% reduction in heating load and a 7% reduction in cooling load.

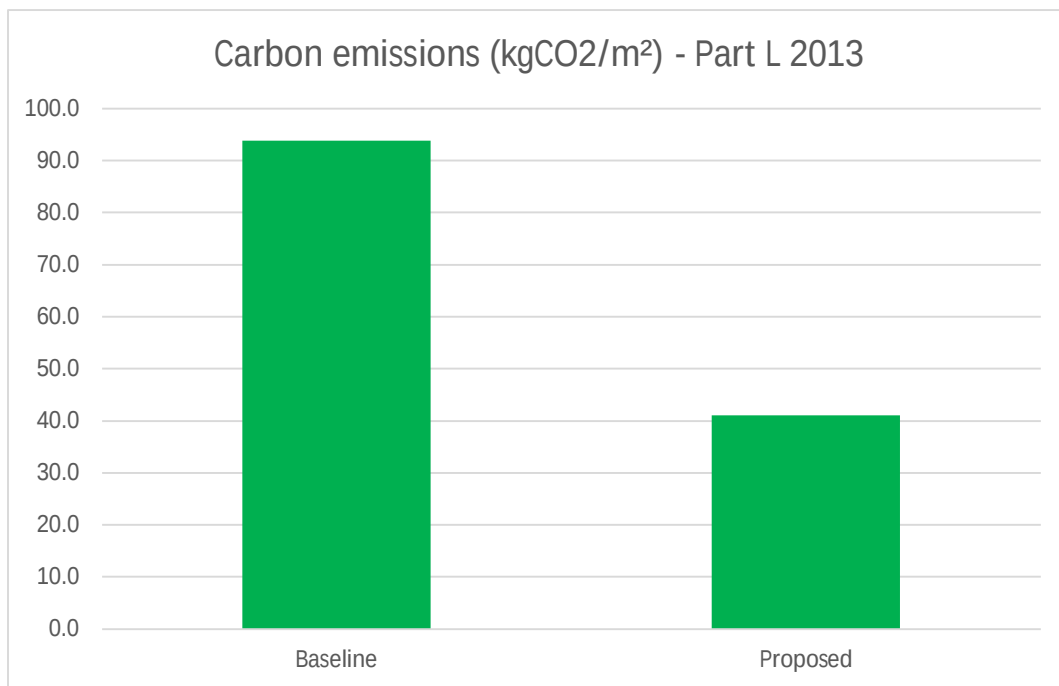
In furtherance to this changing to double glazed units would not only help to reduce conductive heat losses and gains, but also solar gain and infiltration losses and gains.

**The infiltration has been taken as 0.25Ach-1 when new double-glazed units are fitted to account for the opportunity to improve the junction detailing, whereas when single glazing is retained, the infiltration rate of 0.5Ach-1 has been applied.*

Operational energy analysis inline with TM54 guidance has been completed for the Kings House, Manchester development, for both the baseline building (the building as it currently stands) and for the proposed changes. The graph below shows the results of the analysis complete with the proposed changes:



	Annual Energy (kWh/m ²)	Annual Carbon emissions (kgCO ₂ /m ²)
Baseline	208.6	93.8
Proposed	79.2	41.0



It can be seen that the proposed changes provide a significant saving in terms of energy and carbon emissions. Current predictions and analysis results in a 62% energy saving and a 56% carbon emission saving.

The results also demonstrate that energy consumption is within Bruntwoods target of 130kWh/m²/annum, currently 39% lower than the 2025 target. This is a very challenging target can only be achieved though the holistic approach taken to the building improvement.

5. CONCLUSION

Overall, the Kings House, Manchester development has had a thorough and proactive approach to reviewing its energy impact and carbon emissions, not just from an operational standpoint, but from a whole life carbon view.

This has resulted in the upgrades and servicing strategy having a positive impact on the buildings energy consumption, providing significant energy and carbon savings over the existing building. Any modifications to the building will be done in a sympathetic way to align with the conservation area Kings House.