
VITAL ENERGI SOLUTIONS LIMITED

DESIGN and ACCESS STATEMENT

The Christie Hospital Heat Pump Installation

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Design and Access Statement

The Christie Hospital Heat Pump Installation

1. Introduction

This document provides Manchester City Council with information in respect of the proposed planning application in relation to certain works proposed by The Christie NHS Foundation Trust ('the Trust') at The Christie hospital, Manchester.

In summary, these works will involve the installation of two air sourced heat pumps (ASHP)(consisting of 2 off ASHP compressor modules and two vertical airflow collectors), one water sourced heat pump (WSHP) (to be supplied with hot water from the CHP unit), two thermal stores, one GRP enclosure and associated pipework, cabling and their support systems.

The heat pumps will supplement the heat services that are provided by the existing CHP unit (currently being replaced) while reducing the heat supplied from the existing boilers which operate on natural gas. With the introduction of these heat pumps the carbon footprint of The Christie hospital estate will be significantly reduced. These works are generally referred to as the "The Christie Hospital Heat Pump Installation" throughout this document.

The Trust has engaged Vital Energi to carry out all of the works associated with The Christie Hospital Heat Pump Installation and accordingly this planning application and associated supporting documentation will be submitted in partnership between Vital Energi and The Trust on behalf of the Trust.

1.1. Layout of this document

This planning application relates to the plant and equipment to be installed as part of The Christie Hospital Heat Pump Installation with its proposed location being on an existing flat roof section of block 26 at the Christie hospital.

2. Background and rationale

2.1. Existing energy related engineering infrastructure

The heating, ventilation and air conditioning (HVAC) and domestic hot water (DHW) infrastructures at The Christie is typical of many acute hospitals where steam is generated within centralised plant located within an energy centre and then distributed around the hospital estate to a number of plantrooms where it is converted, via heat exchangers to "secondary" hot water for use in space heating and DHW systems.

At the Christie, steam will be generated by a gas fired CHP unit (currently being installed under planning consent 128523/FO/2020) and supplemented by gas fired steam boilers, all located within the existing energy centre and its adjacent external service area. Steam is then distributed from the energy centre to dispersed plantrooms across the hospital

estate via a network of steam pipework where it is then converted to hot water for use in space heating and DHW systems using local HVAC and domestic hot water heat exchangers.

The CHP unit will also provide low grade heat in the form of low temperature hot water (LTHW), this being distributed to a number of plant rooms where it will be used to displace steam generated by the boilers. Additional LTHW will be generated from the CHP units exhaust via an exhaust gas heat exchanger to further reduce the steam generated by the boilers from natural gas.

2.2. The need for change

As part of the CEF Energy Project covered by planning consent 128523/FO/2020, besides the replacement of an existing CHP unit, the Trust are currently undertaking a number of carbon abatement initiatives including energy conservation measures (ECM's), these carbon abatement initiatives are summarising below:

- Upgrades and optimisation of the hospital computerised building energy management system (BEMS). This will improve the efficiency and efficacy of the heating, ventilation and air conditioning (HVAC) systems across the hospital estate;
- Replacement of large electric fans (in HVAC plant) with modern, low energy units;
- Upgrades to / replacement of pipework insulation, thus reducing gas consumption;
- Upgrades to valves and controls on HVAC plant;
- Installation of 284kWp solar photo voltaic system (originally it was proposed to only install 84kWp of solar photo voltaic capacity)
- Replacement of 3,000 lights with high efficiency LED luminaires;
- Chiller plant upgrades;
- Installation of a 2.0MWe Battery Energy Storage System (BESS) to maximise the benefit from the existing CHP unit while reducing imported power consumption.

The above carbon abatement initiatives will reduce the thermal demand of the hospital estate by 16% and the electrical demand of the hospital estate by 15% and will reduce carbon emissions by 1,382 tonnes per annum.

The heat pump installation will further reduce carbon emissions by an additional 176 tonnes per annum.

Once the CEF Energy Project is completed, the Trust will have completed the first and second stage of its journey in reducing the carbon footprint at the Christie hospital site in support of the Manchester City councils response to the councils Climate change emergency declaration and the commitment for the city of Manchester to be carbon neutral by 2038.

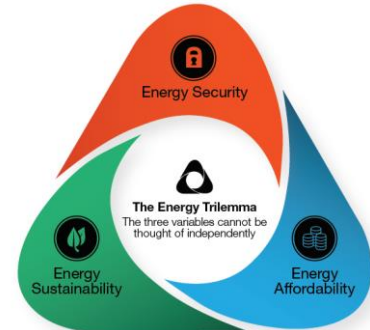
At the Christie, the Trust has recognised that it needs to further reduce its carbon footprint in support of the city of Manchester to be carbon neutral by 2038 and propose to achieve this through the Christie hospital Heat Pump Installation project.

2.3. The energy trilemma

In updating the energy generation at The Christie hospital site, the Trust faces the 'trilemma' which many other energy intensive organisations face in terms of developing energy systems which addresses three aspects, namely;

- Energy supply security
- Energy costs
- Carbon abatement

Each aspect of this Trilemma must be assessed by originations; however, it goes without saying that energy supply security is primary for NHS buildings, especially in the case of cancer treatment centres such as The Christie, as set out below.



2.3.1. Cost pressures

The utility costs (gas and electricity) for The Christie hospital are in excess of £1.073m per annum.

The ongoing decarbonisation of the electricity grid in the UK has increased the costs of electricity, especially to intensive energy users such as hospitals. In addition, carbon taxes associated with grid supplied electricity (CCL: Climate change Levy) has increased by 50% in the past 6 years. The Trust has been able to mitigate the impact of these increasing electricity costs and CCL charges through the benefit of the new CHP unit currently being installed.

The Trust now wish to invest some of the cost benefits from the CHP into further carbon abatement initiatives such as the proposed heat pump installation.

2.3.2. Sustainability and reducing carbon emissions

Whilst it is theoretically possible to develop a solution today to provide a resilience energy system for The Christie and at the same time achieve net zero carbon emissions, the capital costs and ongoing running costs to do so are prohibitive and commercially unsustainable for the Trust.

The Trust has therefore set out to procure affordable additional carbon abatement in the form of the installation of the proposed heat pumps as part of the "future proofing" that was designed into the heat distribution system upgrades that formed part of the CEF Energy Project.

2.4. Energy Conservation Measures

A review has been undertaken of the opportunity to further reduce energy consumption at the Christie. Due to the ECM's implemented as part of the CEF Energy Project, there is limited opportunity to make significant reductions in consumption and the associated carbon reductions that this would bring. While ongoing investigations will continue to

identify further ECM's, the Trust are investing in an additional 200kWp of photo voltaic capacity although its installation does not form part of this planning application.

2.5. Carbon abatement consideration

Whilst cost pressures and supply resilience are crucial to ensure good quality clinical services can be maintained and provided at all times, the Trust has considered a range of low carbon energy generation solutions as set out in section 2.6 below.

2.6. Energy from low carbon and renewable sources

A number of renewable and low carbon technologies were considered for primary heat and power generation at The Christie hospital; however, these have been discounted for the following reasons;

2.6.1. Discounted technologies

- **Biomass boiler plant:** With the withdrawal of Renewable Heat Incentive (RHI) in March 2021, the cost of generating heat from biomass is not affordable to the Trust. There is insufficient space within the energy centre or surrounding area to accommodate a biomass plant of sufficient capacity. Additionally; impact on air quality, uncertainty regarding long-term fuel supply, affordability and increased traffic movement were factors considered in rejecting this technology.
- **Biodiesel CHP:** Whilst this technology would reduce carbon emissions from the hospital, the capital costs and ongoing operating costs are cost prohibitive. In addition, the inability to secure long-term fuel supply contracts introduces an unacceptable risk to the Trust;
- **Solar thermal technologies:** This technology is no longer supported by the RHI and the majority of heat generated is at very low temperature (40°C) which is not suitable for the Trust site infrastructure;
- **Fuel Cell technology:** Whilst fuel cells operate on hydrogen, they currently use natural gas as the fuel source from which hydrogen is extracted. Fuel cells operate at slightly higher efficiencies than conventional gas fired CHP systems and emit significantly less nitrogen oxides (NOx) emissions compared to conventional CHP systems. However, there are two significant challenges which affect the commercial viability of deploying fuel cells;
 - the low temperature heat generated by fuel cells would require significant capital investment to replace the secondary heating systems at the hospital; and
 - the capital cost of fuel cells is circa three times that of an equivalent conventional CHP system.

2.7. The journey to net carbon zero by 2038

The Trust is committed to Manchester City Council's drive towards net carbon zero by 2038 and has taken this into account in the redevelopment of the energy generation infrastructure, currently being undertaken as part of the CEF Energy Project.

The Trust envisages two potential pathways to achieve this goal, through either;

- Utilisation of decarbonised gas; or
- Replacement the CHP and boiler systems with alternative technologies by 2037

These options are set in more detail in the following two sections.

Phased introduction of low or zero carbon technologies such as this proposed Christie Hospital Heat Pump Installation project will provide early carbon savings while supporting the development of a long-term strategy to achieve net carbon zero by 2038 at the Christie.

2.7.1. Scenario 1: Decarbonised gas

A number of studies are underway in respect of replacing natural gas with zero carbon gas fuels, whether this be through storage at local level or decarbonisation of the gas grid in the UK.

Many recent studies envisage a role for both biomethane and hydrogen in a transition to low carbon heating. Options for increasing biomethane injection to the gas grid until 2030 to reduce emissions are being considered. Post-2030, a range of measures, including blending hydrogen into the gas grid are also being considered with a view to eventually displacing all of the natural gas within the gas grid with 100% hydrogen.

In consideration of this, the new CHP and combination boiler currently being installed as part of The Christie hospital energy centre are "hydrogen ready", please refer to section 2.8.2 below for further details.



2.7.2. Scenario 2: Replacement of primary energy systems and reconfiguration of the secondary HVAC systems

Over the next 20 years the Trust will iteratively replace its HVAC and domestic hot water (DHW) systems across the hospital estate as they become time expired. The new systems will be installed and commissioned to operate at lower temperatures (<60°C) where possible, enabling the deployment of heat pumps (or such other future heat generating low-carbon technologies) which could eventually displace the gas fired systems.

In parallel with the iterative replacement of the HVAC and DHW systems over the next 20 years, the new CHP system (currently being installed as part of the CEF Energy Project) will be due for replacement in 2037 (based on the standard 15-year lifecycle). This then

gives the Trust the option of replacing the CHP with an alternative technology (such as a fuel cell or additional heat pumps) in order to further reduce carbon emissions.

2.8. Future proofing

2.8.1. Spatial allowances within the reconfiguration of the existing Energy Centre

To accommodate the installation of future low carbon heat generation plant; the existing energy centre could be re-configured to allow space for new, low carbon heat generation technologies which can be retrofitted in future years. As new technologies (low carbon) become commercially and technically viable to install, these could displace the time expired CHP, gas boilers etc (removing the dependency on the decarbonisation of the gas grid taking place by 2038). As the gas fired equipment is replaced (or converted to operate on low/zero carbon gaseous fuel), the carbon intensity of the associated generated heat will of course reduce.

However, without major capital investment, it is not practical to install the heat pumps which form part of this planning application at the energy centre. An alternative suitable location for the heat pumps has been identified on a flat roof space adjacent to the energy centre.

2.8.2. Hydrogen ready plant

As part of The CEF Energy Project, the Trust is procuring an affordable and resilient energy infrastructure system which will provide “future -proofing” in terms of achieving net zero carbon by 2038.

The CHP and combination boiler currently being installed at The Christie hospital energy centre are “hydrogen ready” meaning that they can continue to operate on a mix of natural gas/hydrogen with some modifications. With major modification it may also be possible for the CHP and boilers to operation on 100% Hydrogen. Accordingly, in parallel with the decarbonisation of the electricity grid (which is already underway), the Trust will eventually have an energy infrastructure which will be zero carbon.

In addition, with modification, the boilers will be capable of operating on renewable ‘bio-liquid’ fuels should these become readily available and commercially via for the Trust in the future.

2.8.3. Green Gas

The current, and foreseeable, carbon content of natural gas is 0.184kg CO₂ per kWh of gas. Green gas is a collective term for gas injected into the main gas supply which has either come from a renewable source of methane (e.g. anaerobic digestion with a methanisation process) or a zero carbon source such as hydrogen.

There are green gas certificates that claim to help offset the carbon associated with this carbon content but these are not officially recognised within current UK carbon reporting mechanisms and come at a premium (circa 1/p/kWh).

3. Proposed Heat Pump Installation

3.1. Trust objectives from the energy project

The Christie NHS Foundation Trust recognises the importance of sustainable development and has developed and implemented a strategy in the form of the Sustainable Development Management Plan.

The Sustainable Development Management Plan seeks to make certain that the Authority provides high quality healthcare today and into the future in a way that minimises negative effects on the environment, resulting in reduction in carbon footprint and demonstrating how sustainable development initiatives will be implemented.

This Foundation Trust has engaged Vital Energi to carry out the Heat Pump Installation project at The Christie which will significantly reduce the Foundation Trust's CO₂ emissions as well as enhancing the resilience of the heat supply at the hospital for the next 15 years.

The site currently has an energy centre which provides The Christie hospital with steam, LTHW and approximately three quarters of the site electricity. These utilities will be generated by a CHP engine genset feeding 1 off combination boiler (once installed) which recovers exhaust heat as well as having a fired section to produce steam and 3 off steam boilers all of which operate on natural gas.

3.2. Proposed Works Summary

The proposed works will involve the installation of two air sourced heat pumps (ASHP)(consisting of 2 off ASHP compressor modules and two vertical airflow collectors), one water sourced heat pump (WSHP) (to be supplied with hot water from the CHP unit), two thermal stores, one GRP enclosure and associated pipework, cabling and their support systems.

The heat pumps will supplement the heat services that are provided by the existing CHP unit (currently being replaced) while reducing the heat supplied from the existing boilers which operate on natural gas. Details of how the heat pumps are to be interconnected with the CHP's LTHW system can be found by referring to drawing VI 21 CHR P&ID 008 Rev 4 , a copy of which has been downloaded as part of this planning application.

With the introduction of these heat pumps the carbon footprint of The Christie hospital estate will be significantly reduced while improving the resilience of the heat supply to the hospital.

The existing CHP Primary LTHW distribution system which currently transmits the CHP's low-grade heat to two plantrooms is to be upgraded as part of the Heat Pump Installation project. This upgrade will allow the heat generated by the new heat pumps and the CHP unit to be transmitted to five plantrooms where it will be used to provide heating and DHW services via new plate heat exchangers.

To maximise the efficiency of the air sourced heat pumps, within these five plantrooms, the replacement of secondary heating pumps and the replacement of 3-port control valves with 2-port control valves is to be undertaken. The new pumps will operate under differential pressure control resulting in a reduction in the return temperature to the heat pumps.

3.3. Energy supply and demand

The proposed heat pumps will provide approximately 12% of the hospital's thermal demand, this being 1,879,398 kWh's per annum.

The CHP unit will continue to act as the primary heat generator with the heat pumps acting as the second lead heat source. The steam boilers will continue to provide top up heat when the CHP or heat pumps are not available, or during periods when the demand is greater than the CHP unit and heat pumps can provide.

3.4. Proposed Heat Pump Installation

This application is in relation to equipment which will be installed on a flat roof area of block 26. It is assumed that planning consent is not required for the pipework distribution systems, cabling and containment between this location, the energy centre and the five plantrooms as this would be classified as Permitted Development or Non-material Change to planning consent 128523/FO/2020.

The equipment to be installed externally on the identified flat roof section of block 26 includes:

- 2 x air sourced heat pump compressor modules
- 1 x water sourced heat pump to be located within the below GRP enclosure
- 1 x 4,000Ltr vertical thermal storage vessel
- 1 x 3,000Ltr vertical thermal storage vessel
- 1 x GRP enclosure (to house the WSHP and 1 x LV electrical distribution board)
- Interconnection pipework, cabling and containment
- 1 x galvanised support platform to support the above equipment
- 2 x ASHP vertical airflow collectors (to be supported directly off the existing concrete roof)

4. Planning Application considerations

4.1. Introduction

This section sets out the detail of how the Heat Pump Installation Project impacts on certain aspects including, visual, social, noise, emissions, economic, flooding, SUDS and involvement.

4.2. Visual Impact

The plant and equipment to be installed on the identified roof area of block 26 will have very limited visual impact on only one neighbouring property.

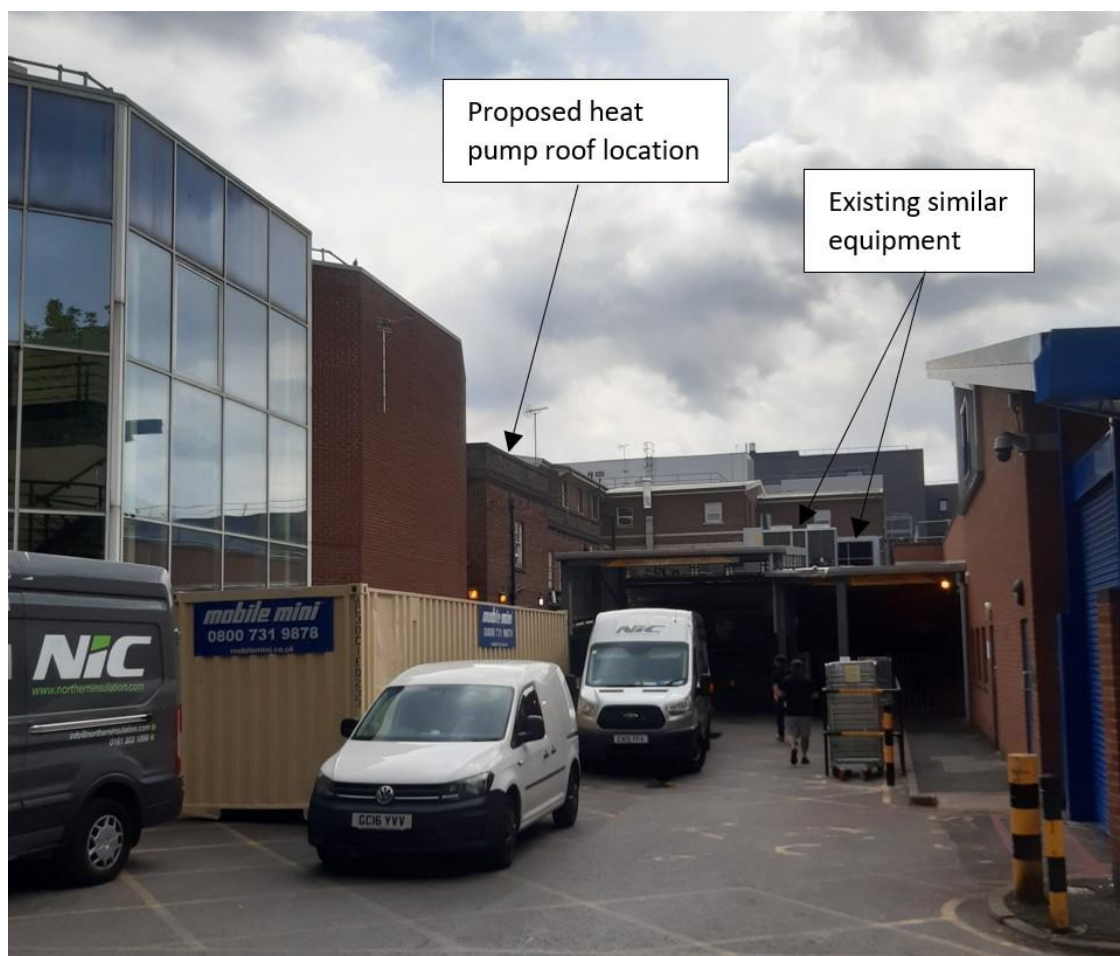
Only part of the heat pump installation will be visible to one neighbouring property from the north elevation. The visual changes to all other elevations cannot be seen by neighbouring properties due to the location and height of other hospital buildings.

The visual impact on the view from the identified property located on Tatton Grove will be limited to one window only with the vast majority of the installation being hidden by block 30 which is shown on the left of the below photograph.

To the right of the proposed location and visible from the identified property, there is located similar plant and equipment, please refer to the photograph below. Hence the new heat pumps will be in keeping with the current view from this Tatton grove property. The below photograph shows the existing view form the identified property.

Please refer to Annex A for details of future layout, elevation and equipment drawings which have been submitted as part of this planning application.

We can confirm that no trees and hedges are required to be removed to allow for the installation of the new equipment associated with this planning application.



4.3. Social

The Energy centre is currently operated and maintained by Vital Energi under a long-term service agreement.

Once the heat pump installation is completed, it is expected that Vital Energi will to operate and maintain the heat pumps using their existing mobile technicians. No additional car parking spaces will be required as the current estates car parking facility will be used by Vital Energi personnel who will only need to attend on a part time basis.

4.4. Noise

Noise has been considered and is being addressed through the use of sound attenuation and by using variable speed fans.

The ASHP compressors and WSHP are each to be located within acoustic enclosures. The ASHP vertical airflow collectors incorporate variable speed fans so that their noise levels are minimised. The general arrangement of these are shown on drawing VI 21 CHR LAY 010 Rev.04.

An acoustic consultancy report has been completed to identify current noise levels and confirm the attenuation required to be installed to achieve acceptable future noise levels at sensitive receptors, please refer to the Noise Break-out Assessment, reference 98141/3/2/6 completed by LCP Acoustics. The recommendations for attenuation within the above report have been incorporated into the design of the new plant and equipment.

Please note that it is only the noise level design criteria requirement associated with the nearest residential receiver to the north of the site (Tatton Grove) which is relevant to this planning application as the requirement associated with other tested locations relate to hospital premises only and compliance with NHS guidelines (HTM's).

Following completion of the installation of the new plant and equipment, LCP Acoustics will carry out further noise monitor to confirm that the noise level design criteria has been achieved at the hospital boundary with the nearest residential property on Tatton grove. In the unlikely event that they are not, additional attenuation measures will be installed as necessary to achieve this.

4.5. Emissions

There are no emissions from the new equipment forming the Heat Pump Installation project.

4.6. Economic

No direct contribution to the local economy although the hospitals annual spend on energy will be slightly increased.

4.7. Flood Risk

The site location has been checked using the Environment Agency flood map planning tool and is assessed as a flood zone 1, an area with a low probability of flooding. Please refer to document, Christies flood-map-planning-2020-09-11, for further details.

4.8. SUDS arrangements

The installation of the new plant and equipment does not increase hardstanding area and hence will not provide any additional surface water collection. The quantity of the runoff will remain unchanged with the hospitals existing water drainage network continuing to accommodate the surface water drainage.

4.9. Involvement

Very limited impact to local community from both a visual and environmental perspective. No local consultation undertaken.

5. Equipment installation and engineering works

5.1. Design

Standard industrial equipment has been proposed, sited in close proximity to the Energy centre to contain installation costs and retain existing access and roadways without the need to build new access.

5.2. Evaluation

The plant proposed is proven technology using standard industrial equipment. Plant will be designed, constructed and operated to relevant industrial, professional, safety and environmental requirements and legislation.

5.3. Installation or construction period

The sequence of work will commence with the installation of the support platform followed by the positioning of the new equipment. The upgrading of the Primary LTHW distribution system, plantroom modifications the provision of services to the heat pumps will then be completed with minimal disruption to heat and electricity supplies to the hospital.

The plant, equipment and pipework will be delivered to site throughout the construction period via articulated vehicle, this being off-loaded by the use of a crane or a hyab.

Deliveries should not have any effect on public highways as all offloading will be on the hospital property. During the main plant deliveries, a traffic plan will be required to control access around the hospital site.

Unauthorised access to the construction area will be controlled using temporary fencing.

The new plant and equipment's design incorporates sufficient space and access to maintain and remove equipment in the event of routine or reactive maintenance.

There will be minimal, intermittent noise generated during construction; in general, this will be confined to normal working hours. There may be times when deliveries of major plant items are required outside normal working hours to avoid disruption to site services.

These would be carefully coordinated with the Foundation Trust to minimise their impact on hospital services or residences within the local area.

During the construction phase, the location of temporary welfare facilities on the hospital complex will be agreed with the hospital trust prior to commencement of the on-site construction works which will last approximately 6 months in total.

The installation of this equipment will not have any detrimental effect on the facilities of the hospital, ambulance parking or the number of car parking spaces available.

6. Green Credentials (environmental impact)

The installation of the heat pumps will allow the hospital to benefit from low carbon heat generation further significantly reducing the carbon emissions of the hospital.

The extension of the existing SCADA system and the installation of metering will form part of the installation works so that the power consumption, heat generation and efficiency of the heat pumps can be established and reported to the relevant authorities and the Trust.

The current carbon footprint associated with The Christie hospital's electrical and gas demand is currently 11,953 tonnes per annum. Following completion of the works associated with this planning application, this carbon footprint will reduce by 176 tonnes per annum to 11,77 tonnes per annum. This represents a reduction in the hospital's carbon footprint of 1.5%

Design and Access Statement

The Christie Hospital Heat Pump Installation

ANNEXE A – Planning Drawings and Reports

VI 21 CHR LAY 010 Rev 4	Proposed Heat Pump & Associated Plant General Arrangement
VI 21 CHR LAY 012 Rev 1	Proposed Heat Pump & Associated Plant Existing West Elevation
VI 21 CHR LAY 013 Rev 1	Proposed Heat Pump & Associated Plant West Elevation
VI 21 CHR LAY 014 Rev 1	Proposed Heat Pump & Associated Plant Existing North Elevation
VI 21 CHR LAY 015 Rev 1	Proposed Heat Pump & Associated Plant North Elevation
VI 21 CHR P&ID 008 Rev 4	Proposed Primary LTHW System P&ID

LCP 98141/3/2/6 Noise Break-out Assessment

Christies flood-map-planning-2020-09-11

ASHP Vertical Air Collector drawings

ASHP Compressor Housing drawings

The above have been attached via the online application tool.

Note that a South and West elevation is not included since these views are obscured from any viewpoint by hospital adjacent buildings.