

The Grange University Hospital Emergency Department Extension

Energy Strategy

May 2023

Quality information

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Revision	Revision date	Details	Authorized	Name	Position
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Table of Contents

Executive Summary	4
1. Introduction	5
2. Description of project brief and scope	6
3. Review of planning policy and Building Regulations requirements	7
3.1 National Policy and Legislation	7
3.1.1 UK Climate Change Act	7
3.1.2 Planning Policy Wales	7
3.2 Local planning policy	7
3.2.1 Torfaen Local Development Plan (2013-2021)	7
3.3 Building Regulations	8
3.3.1 GUH ED extension applicability	8
3.4 NHS Wales	9
4. Review of potential energy strategies	10
4.1 Energy hierarchy	10
4.2 Minimise demand	10
4.3 Meet demand efficiently	11
5. Initial Low and Zero Carbon technologies feasibility assessment	12
5.1 Solar photovoltaic panels	13
5.1.1 Suitability of photovoltaic panels to GUH ED Extension	13
5.2 Air Source Heat Pumps	13
5.2.1 Suitability of Air Source Heat Pumps to GUH ED Extension	14
5.3 Combined Heat and Power (CHP)	14
5.3.1 Suitability of CHP to GUH ED Extension	14
5.4 Selected Strategy	14
6. Conclusion	15
Appendix A Limitations	16

Figures

Figure 1. The Energy Hierarchy for Planning	7
Figure 2. The energy hierarchy	10

Tables

Table 1. Target fabric specification of the proposed GUH ED extension	10
Table 2. Summary of Low and Zero Carbon technologies for the proposed GUH ED Extension	12

Executive Summary

This Energy Strategy has been prepared in support of the planning application for The Grange University Hospital Emergency Department (GUH ED) Extension.

It sets out the Planning Policies and Building Regulations that are applicable to the proposed new extension and demonstrates how the design of the building follows the energy hierarchy, including highly insulated façades to reduce heating demands, inclusion of local shading with low proportion of external windows to reduce cooling demands, and use of automatic lighting controls to reduce lighting energy consumption.

The size of the proposed extension means it does not meet the £10M threshold for the NHS UK Net Zero Carbon Building Standards, and therefore it has been agreed with NHS Wales Shared Services Partnership that there are no NHS specific targets applicable to the building. The building is therefore targeting BREEAM 'Very Good', based on pre-assessments carried out to date.

The proposed servicing strategy is to connect to the current hospital's gas fired CHP and chillers for space heating, DHW and cooling; providing economies of scale and allowing for a central maintenance strategy to be applied to the site. New local mechanical ventilation units will be installed with low specific fan powers and high efficiency heat recovery to minimise power consumption whilst providing fresh air to the occupants.

Finally, this energy strategy reviewed the potential Low and Zero Carbon technologies that may be suitable for the building and identified that there is suitable area on the current hospital roof to install a large PV array as part of the works. The design includes a PV array installed on the current building's roof; please refer to the proposed site plan for details.

1. Introduction

AECOM have been appointed by Aneurin Bevan University Health Board (the Applicant) to deliver an Energy Strategy for the proposed Grange University Hospital Emergency Department (GUH ED) Extension.

This Energy Strategy includes a review of planning policies relating to the development at a national and local level and provides details on how the design has followed the energy hierarchy to reduce energy demands and meet them efficiency. The strategy includes a desktop feasibility study of Low and Zero Carbon (LZC) technologies to identify suitable technologies for inclusion in the proposed extension.

2. Description of project brief and scope

The proposal involves an extension to the existing emergency department of the Grange University Hospital building in Torfaen, Wales.

The proposed extension is a two storey building with a partial third storey for an enclosed roof plant room. The ground floor provides waiting and reception areas as well as emergency department triage rooms to extend the existing hospital's emergency department capacity. The first floor of the building includes open-plan office spaces for staff along with meeting rooms.

The total GIA of the proposed GUH ED Extension is approximately 957m², which is less than 2% of the current hospital floor area.

This strategy describes the requirements applicable to the proposed extension and which low and zero carbon technologies are suitable given the proposed extension's size, use and connection to the existing hospital.

3. Review of planning policy and Building Regulations requirements

3.1 National Policy and Legislation

3.1.1 UK Climate Change Act

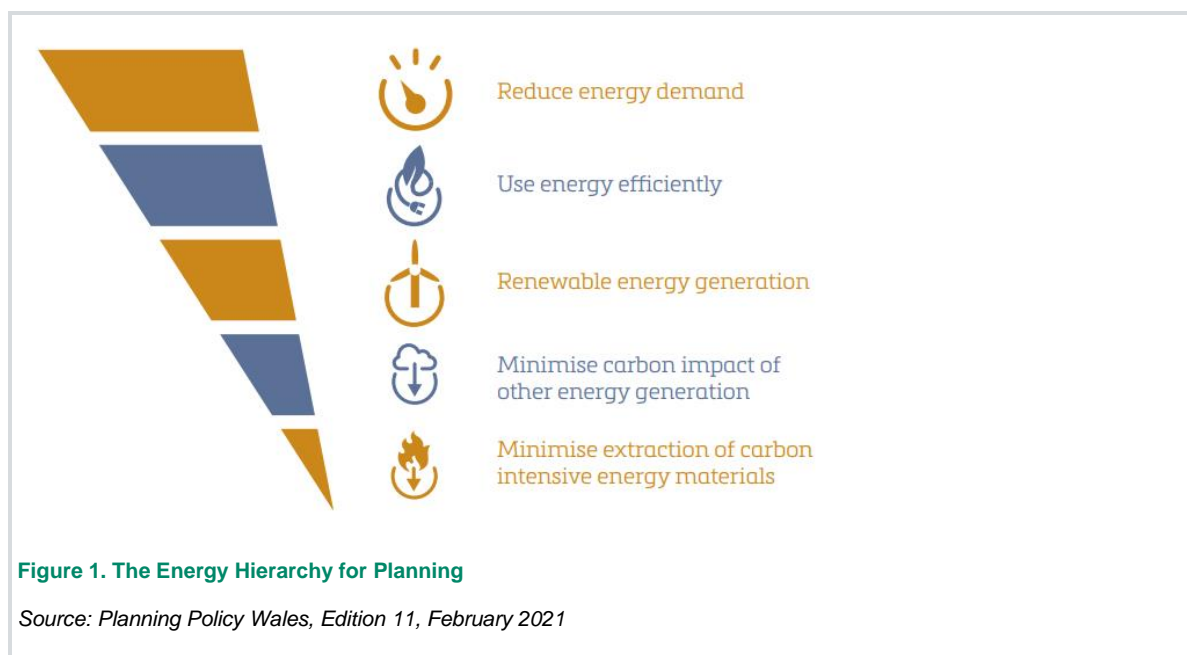
The Climate Change Act (2008) sets a legally binding target to reduce UK carbon emissions by at least 100% by 2050, against a 1990 baseline. The Committee on Climate Change advises the Government on the setting of binding 5-year carbon budgets on a pathway to achieving the 2050 target. The first six carbon budgets covering the period up to 2037 have been set in law. The current (fourth) budget requires a 51% emissions reduction by 2025, while future budgets require reductions of 57% by 2030 and 78% by 2035.

The Act is the driver behind a framework of national strategy and policy documents such as the UK Low Carbon Transition Plan (2009) and Future Building Standards (expected 2025). These in turn have informed the development of national and local planning policy and updates to the Building Regulations.

3.1.2 Planning Policy Wales

Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government. The “*primary objective of PPW is to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental, and cultural well-being of Wales, as required by the Planning (Wales) Act 2015, the Well-being of Future Generations (Wales) Act 2015 and other key legislations.*”

The PPW sets out the “Energy Hierarchy for Planning” which sets out how energy demands should be reduced, and energy efficiency increased before introducing renewable energy generation. The hierarchy then goes on to recognise the benefit of minimising the carbon impact of other energy generation and minimising the extraction of carbon intensive energy materials.



3.2 Local planning policy

3.2.1 Torfaen Local Development Plan (2013-2021)

The Torfaen Local Development Plan¹ was adopted in December 2013 and is “designed to regulate the development and use of land in the public interest.” Within the plan, the following policies are of relevance to this Energy Strategy.

¹ [Adopted-Torfaen-LDP-Written-Statement.pdf](#)

- **“Strategic Policy S3- Climate change:**
 - *“Development proposals shall seek to mitigate the causes of further climate change and adapt to the current and future effects of climate change; and will be supported where they demonstrate consideration of the following hierarchy of criteria (where appropriate):*
 - *“Achieving Sustainable Design to ensure residual energy requirements are minimised through: -*
 - *“Supporting climate responsive development through location, orientation, density, layout, built form, materials and landscaping;*
 - *“Achieving energy efficiency in developments and in line with national standards where required; and*
 - *“Utilising renewable and low or zero carbon energy technologies to generate heat and electricity requirements which includes heating, cooling and power networks powered by renewable energy sources, or that connect to existing Combined Heat and Power or communal / district heating networks”*

The supporting text for policy S3, paragraph 5.3.5, states:

“Non-residential development proposals will be expected to meet BREEAM ‘Very Good’ standard (in accord with the requirements set out in para 4.12.4 of PPW - 5th Edition) or subsequent national standards.”

3.3 Building Regulations

Part L of the Building Regulations 2010, as amended, describes the energy efficiency requirements for buildings in Wales. There are two Approved Document L volumes (Volume 1 covers dwellings and Volume 2 covers non-domestic buildings) that give technical guidance on how to meet the requirements of the Building Regulations.

Part L of the Building Regulations is regularly updated to require increasing levels of energy efficiency, as part of the Government’s drive towards ‘net zero carbon’ by 2050. The currently applicable version is Part L (2022), which came into effect on 29th March 2023².

3.3.1 GUH ED extension applicability

The proposed building is an extension to the existing hospital and doesn’t meet the limits to be deemed a “new building” (as described in paragraph 10.7 of Approved Document L2) as although it has a floor area greater than 100m², it is much less than 25% of the floor area of the existing building. Therefore, it does not need to show compliance with the same carbon and primary energy targets as apply to new buildings, i.e., it does not require a BER/TER and BPEC/TPEC calculation.

However, it must comply with all sections applicable to extensions described within Approved Document L2 (2022), including:

- Section 4 – Limiting heat gains and losses
 - Describes the limiting U-values for new and existing thermal elements (e.g., walls, roofs, and windows) and limiting the solar gains through windows in the summer to reduce heating and cooling energy consumption
- Sections 5 and 6 – Building services
 - Describes the minimum building services efficiencies and controls required for new and refurbished buildings (e.g., minimum efficiencies for gas boilers with less than 2MW output should be no less than 93%)
- Section 10 – New thermal elements
 - Provides guidance for new and replacement thermal elements in existing buildings under a range of scenarios (e.g., extensions, or replacement thermal elements in an existing building, etc.)
- Section 12 – Consequential improvements
 - Consequential improvements describe the additional energy efficiency improvements that should be undertaken when building work includes:

² <https://www.gov.wales/sites/default/files/publications/2022-09/approved-document-l-vol-2.pdf>

- Extensions to existing buildings, or
- The initial provision of any fixed building service, or
- The increase in the installed capacity of any fixed building service

3.4 NHS Wales

The NHS Wales Decarbonisation Strategic Delivery Plan³ presents the roadmap for the NHS in Wales to decarbonise their building estates over the period 2020 to 2030 using a staged approach. Between 2022 and 2026 NHS Wales commits to the following actions relating to operational energy and carbon emissions:

- *“Reduce carbon emissions by 16% in line with 2025 interim target*
- *“Low carbon heat evolution plans for acute hospitals will be in place*
- *“By 2025, all lighting across the estate will be LED*
- *“The total renewable energy potential for the NHS Wales estate will be known, with an implementation plan progressing”*

Discussions with NHS Wales Shared Services Partnership have confirmed that while there are no specific targets set for this extension it has been agreed that the design of the project will seek to meet the aims of the NHS Wales Decarbonisation Strategic Delivery Plan.

Following discussions with NHS Wales Shared Services Partnership a target of BREEAM (2018) ‘Very Good’ has been agreed for the proposed extension. This is in line with the Torfaen Local Development Plan, policy S3 – climate change, which requires non-residential developments to achieve BREEAM ‘Very Good’.

³ <https://www.gov.wales/sites/default/files/publications/2021-03/nhs-wales-decarbonisation-strategic-delivery-plan.pdf>

4. Review of potential energy strategies

The following section outlines the potential energy strategy options for the proposed GUH ED Extension, accounting for the requirements of Part L of the Building Regulations.

4.1 Energy hierarchy

The energy hierarchy has been followed in the design of the proposed GUH ED extension. This ensures that energy consumption is first minimised before energy efficient systems are specified and finally renewable energy generation is included to meet the remaining demand.

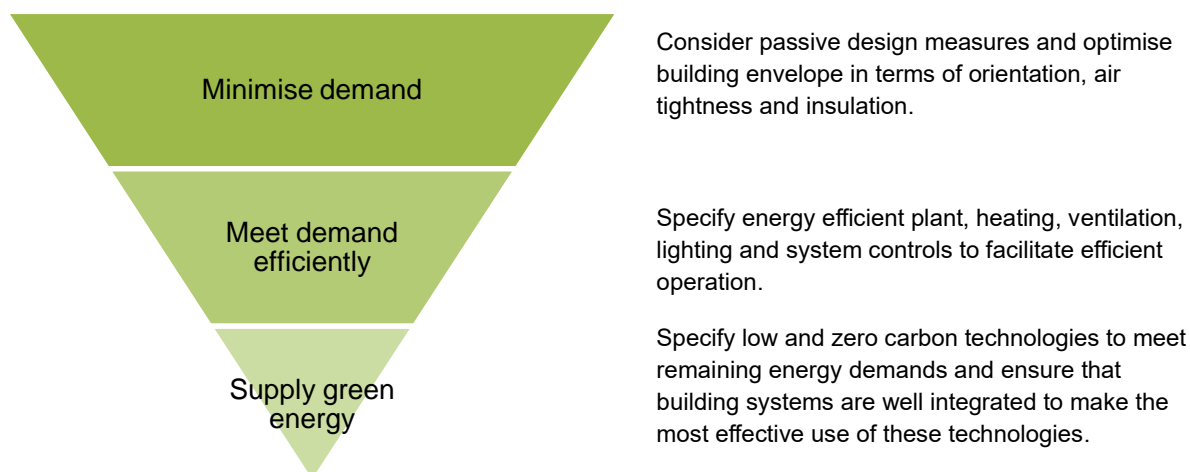


Figure 2. The energy hierarchy

4.2 Minimise demand

To reduce the energy demand associated with the proposed GUH ED Extension the following aspects have been considered:

- Air tightness and insulation.
 - The proposed extension is targeting U-values and air tightness which improve on the limiting values from Approved Document L2 2022, Table 4.1, to reduce heat losses, thus reducing demand. The currently targeted fabric specification is shown in the below table.

Table 1. Target fabric specification of the proposed GUH ED extension

Element	Proposed value	Limiting value
Air tightness	2.5 m ³ /m ² .hr at 50Pa	8.0 m ³ /m ² .hr at 50Pa
External wall U-value	0.15 W/m ² .K	0.26 W/m ² .K
Roof U-value	0.12 W/m ² .K	0.20 W/m ² .K
Ground floor U-value	0.12 W/m ² .K	0.22 W/m ² .K
External glazing	1.20 W/m ² .K	1.60 W/m ² .K

- Approved Document L2, Table 10.1, limits the maximum areas of openings in extensions to ensure solar gains, and therefore cooling demand, is limited. The current design of the proposed GUD ED extension meets these limits.
 - The proportion of external windows and pedestrian doors to external wall area should not exceed 40% for places of assembly, offices, and shops. The proposed extension's design has approximately 11% of exposed walls as windows or pedestrian doors.

- Rooflights should not exceed 20% of roof area for places of assembly, offices, and shops. The proposed extension's design has no rooflights due to roof plant and limited space.
- The minimal external openings will both reduce heat loss, reducing heating energy consumption, as well as minimising solar gains reducing cooling demands.
- Building orientation, including accounting for required building adjacencies as part of the functional requirements.
 - The space available for locating the proposed extension next to the existing emergency department entrances limits the ability to orientate the building to maximise solar gains for passive heating.
 - The windows proposed for the GUH ED extension balance provision of natural lighting, whilst ensuring privacy for patients. In addition, solar shading in the form of vertical fins on east and west facades are proposed to prevent excessive solar gains, reducing cooling demands.

4.3 Meet demand efficiently

Within the design of the proposed extension, the following features are proposed to meet the energy demands efficiently:

- It is proposed to connect the extension to the existing hospital's heating, cooling and domestic hot water generating plant, which have sufficient capacity to serve the proposed extension.
 - Construction on the existing hospital building began in 2018, with the building fully opening in November 2020. Therefore, plant is a maximum of 5-years old at the time of writing. As there is sufficient capacity within this plant to serve the proposed extension, it would incur unnecessary embodied carbon to install separate plant to service the proposed extension.
 - This strategy removes the need for new plant to provide these services and reduces on-going maintenance costs.
 - Furthermore, once the central plant reaches the end of its service life and replaced with a low or zero carbon alternative the benefits will then apply to both the existing hospital and proposed extension.
 - In accordance with the requirements of paragraph 5.10 of Approved Document L2, new heating emitters will be sized to operate at a flow temperature of 55°C or lower. This will future proof these emitters for future low carbon retrofit.
- New energy efficient ventilation plant will be provided to the proposed GUH ED Extension and will include high efficiency heat recovery where suitable given the usage of the spaces.
 - The proposed new ventilation system is targeting a Specific Fan Power (SFP) of 1.4 W/l/s and includes heat recovery with efficiency of 85%.
- LED lighting will be provided throughout the building, reducing energy consumption compared to older alternatives. Where appropriate to a space's function, automatic occupancy and daylight controls will be provided to reduce consumption when conditions allow.

5. Initial Low and Zero Carbon technologies feasibility assessment

The following sections consider a range of Low and Zero Carbon (LZC) technologies and their suitability to the proposed GUH ED Extension. This initial desktop review has identified several technologies that may be suitable, as summarised in the below table.

Table 2. Summary of Low and Zero Carbon technologies for the proposed GUH ED Extension

Technology	Suitable?	Benefits	Considerations
Solar Photovoltaic Panels	Yes	<ul style="list-style-type: none"> • Silent with low visual impact • Low cost • Low maintenance 	<ul style="list-style-type: none"> • Provision of suitable roof areas (south facing at 30° pitch or east/west facing at 10° pitch) to maximise energy generation/area • Carbon savings reduce as grid decarbonises
Solar Thermal Hot Water	No	<ul style="list-style-type: none"> • Solar thermal collectors perform relatively well throughout the year • Evacuated tube collectors are more efficient than flat plate collectors • Carbon savings are maintained whilst grid decarbonises when displacing gas boilers 	<ul style="list-style-type: none"> • Evacuated tube collectors are typically more expensive than flat plate collectors • Consider available roof area in coordination with potential use of roof mounted PV • Requires a second system to supplement STHW when solar output is low • Limited hot water demand in the extension • Connection to existing plant systems complicates control
Wind Turbines	Unlikely	<ul style="list-style-type: none"> • Established technology to generate electricity • Available in a range of sizes 	<ul style="list-style-type: none"> • Minimum distance required between turbines and obstacles, including buildings, since turbines' output is significantly reduced in turbulent airflow • The site includes a helipad for emergency access reducing the suitability for the site • Noise and shadow flicker can impact surrounding buildings
Combined Heat and Power	Yes	<ul style="list-style-type: none"> • Gas fired CHP reduces CO₂ emissions in the short term 	<ul style="list-style-type: none"> • As the electricity grid decarbonises, CO₂ savings associated with gas-fired CHPs reduce and will soon become more carbon intensive than electricity-fuelled heating • Future regulations are likely to restrict the use of fossil-fuelled heating • Existing building currently uses CHP to provide heating and DHW, spare capacity to supply new extension is available
Biomass Boilers	Unlikely	<ul style="list-style-type: none"> • Wood chips and pellets can be sourced from local suppliers 	<ul style="list-style-type: none"> • Potential impacts on air quality • Requires additional space for fuel storage and larger plant • Requires routes for fuel deliveries • Connection to existing plant system complicates control and reduces benefits
Air Source Heat Pumps	Yes	<ul style="list-style-type: none"> • Mature technology and straight forward to install • ASHPs are a non-fossil fuelled heating technology. • Generally, the lowest capital cost heat pump option 	<ul style="list-style-type: none"> • Requires electricity to operate • Controller and careful design and commissioning required to ensure efficient ASHP operation in winter • ASHPs generate some noise pollution • ASHPs operate most efficiently with lower temperature heating systems • The refrigerant used in heat pumps can be toxic, flammable and are an asphyxiation risk • Would need dedicated plant for extension

Technology	Suitable?	Benefits	Considerations
Water Source Heat Pumps	No	<ul style="list-style-type: none"> • More efficient than ASHP • WSHPs are less expensive than GSHPs, but more expensive than ASHPs • Can be suitable for large non-domestic buildings • WSHPs are a non-fossil fuelled heating technology 	<ul style="list-style-type: none"> • No suitable body of running water close to the site • Requires electricity to operate • Require permission from Environment Agency for water abstraction and discharge • WSHPs operate most efficiently with lower temperature heating systems • The refrigerant used in heat pumps can be toxic, flammable and are an asphyxiation risk.
Ground Source Heat Pumps	Maybe	<ul style="list-style-type: none"> • No visual impact • Where space is limited, a vertical closed loop system can be considered rather than a horizontal system • Can be suitable for large non-domestic buildings • GSHPs are a non-fossil fuelled heating technology 	<ul style="list-style-type: none"> • GSHPs are expensive compared to other heat pump types • Geological and hydrological conditions on site must be confirmed via investigation • GSHPs operate most efficiently with lower temperature heating systems • Consideration of long-term ground cooling effects must be made • The refrigerant used in heat pumps can be toxic, flammable and are an asphyxiation risk. • Would need to be a separate plant system dedicated to extension
District Energy	No	<ul style="list-style-type: none"> • Can utilise low carbon technologies that do not readily scale down to serve single buildings 	<ul style="list-style-type: none"> • Requires an existing or new operational heat network • No current existing networks in the Cwmbran area

5.1 Solar photovoltaic panels

Photovoltaic (PV) modules convert sunlight into DC electricity and can be readily integrated into buildings. PV systems are modular and are available in different sizes, allowing flexibility in the PV layout. The size of the system and number of PV panels is normally determined by the available roof area or the electricity requirement.

PV panels should last 25 years or more, but the inverter is likely to need replacing after about 10-15 years. Little maintenance is required for PV. The panels need to be kept clean and should not be overshadowed by trees or other buildings.

5.1.1 Suitability of photovoltaic panels to GUH ED Extension

PV is an established technology, and therefore considered to be low risk. Considerations for PV include ensuring that the roof structure can support the weight of PV panels and contacting the Distribution Network Operator (DNO) to request permission to connect to the network. The DNO will confirm whether or not the local grid has the capacity for the extra output of the PV installation, if export is required.

There is limited roof area on top of the proposed GUH ED Extension to incorporate PV into the design, as the roof is predominately taken up with enclosed roof plant. The roof area of the plant enclosure could be used for PV panels, however there is small area compared to the overall footprint of the extension.

There is, however, a large area of east facing roof space on the existing hospital building which is suitable for PV installation. As the extension will be connected to the existing building's electrical systems the extension will benefit from the zero-carbon electricity generated by roof mounted PV panels.

Photovoltaic panels are suitable for installation on the existing hospital building to offset energy consumption from the proposed extension. The design includes a PV array installed on the current building's roof; please refer to the proposed site plan for details.

5.2 Air Source Heat Pumps

An Air Source Heat Pump (ASHP) uses the principles of the refrigeration cycle to transfer heat from air outside the building to heat a building. A reverse refrigeration (vapour compression cycle) is used to increase the

temperature of the air by using expelled heat from the condenser; this air is used to heat the internal environment.

The efficiency of an ASHP is dependent on a number of variables; the most dominant of these are the temperature of the collector coil and the temperatures of the system in the building being supplied. ASHPs work most effectively to deliver low temperatures.

The advantages of an ASHP:

- Uses around 1/3 the amount of electricity of a resistance heater.
- Few moving parts therefore maintenance is low, however it must be ensured that the outdoor heat exchanger and fan is kept free from leaves and debris.
- Used to heat air, or water.

If the heat pump is designed with reverse capabilities, then heating or cooling could be achieved depending on the demand. Although heat pumps do not require the use of flammable or asphyxiating fuels (such as mains gas) the refrigerants used in heat pumps can be both flammable and asphyxiating; in such cases the use of leak detection equipment should be considered.

5.2.1 Suitability of Air Source Heat Pumps to GUH ED Extension

ASHPs are likely to be suitable for the proposed extension when it is considered in isolation (an independent building). ASHPs tend to achieve lower performance (CoP of 2.0 to 3.5) than Ground Source Heat Pumps (CoP of 3.0 to 4.5) during the winter because the ambient air temperature is low while the ground temperature remains stable. If PV is installed, this renewable energy could be used to partly power the ASHP.

Given the proposed connection to the existing hospital with its existing CHP and chiller plant systems to minimise maintenance requirements, plant costs, and embodied carbon by not requiring two sets of plant equipment; additional ASHPs to serve the proposed extension were not recommended.

5.3 Combined Heat and Power (CHP)

Combined Heat and Power (CHP) is an efficient way of generating energy, where waste heat from generating electricity is captured and used for space heating in buildings. Most systems replace (or run in parallel to) the boiler system and will be linked directly into the building electricity distribution system. Heat generated can be used for space and water heating, and additional heat storage may be installed to lengthen usage periods, to assist in warm-up and to improve overall energy efficiency. Most CHP systems are gas powered, but other fuels can be used for larger systems including biomass or waste materials.

The principal physical constraint associated with a CHP system is the size of the CHP unit and its associated thermal store.

As the National Grid decarbonises the carbon emissions associated with grid-supplied electricity reduces, and therefore the carbon emissions savings associated with CHP reduces; therefore, new CHP systems are unlikely to be carbon efficient for new buildings.

5.3.1 Suitability of CHP to GUH ED Extension

The existing hospital building currently uses a gas-fired CHP system with gas boilers to provide space heating and DHW. It has been confirmed that there is spare capacity to provide space heating and DHW to the proposed extension from this system. This means that one central plant system is used for all spaces, providing economies of scale, and allowing for a central maintenance strategy to be applied.

CHP is therefore proposed for the extension through connection to the existing building systems.

5.4 Selected Strategy

Based on the initial LZC technologies assessment the proposed GUH ED Extension will make use of the existing CHP system on site and install a new PV array on the roof of the current hospital. This will allow for a central maintenance strategy for heating and hot water, as well as centralised decarbonisation in the future. The PV will generate onsite electricity in support of the increased consumption of the new extension.

6. Conclusion

AECOM has reviewed the proposed GUH ED Extension against national and local policy as well as current Building Regulations. The proposed design follows the energy hierarchy including highly insulated façades to reduce heating demands, inclusion of local shading with low proportion of external windows to reduce cooling demands, and use of automatic lighting controls to reduce lighting energy consumption.

The size of the proposed extension means it does not meet the £10M threshold for the NHS UK Net Zero Carbon Building Standards, and therefore it has been agreed with NHS Wales Shared Services Partnership that there are no NHS specific targets applicable to the building. The building is therefore targeting BREEAM 'Very Good', based on pre-assessments carried out to date.

The proposed servicing strategy is to connect to the current hospital's gas fired CHP and chillers for space heating, DHW, and cooling. While this does not allow for alternative heating sources (such as ASHP), it provides economy of scale for system efficiencies as well as allowing for a central maintenance strategy for the site. Reducing the amount of new plant equipment required for the proposed extension reduces the embodied carbon associated with the new emergency department.

New roof mounted AHUs will be provided, achieving low specific fan powers and high heat recovery efficiency. These features will reduce the energy consumed to deliver fresh air to the spaces and the amount of heat required to condition the air, respectively.

Finally, potential LZC technologies were reviewed which identified PV as the most suitable technology given the proposed HVAC strategy. As there is limited roof space on the proposed extension it is currently proposed to install a large PV array on the current hospital roof as part of these works. The design includes a PV array installed on the current building's roof; please refer to the proposed site plan for details.

At subsequent stages of design, energy modelling of the extension will be undertaken to evaluate the contribution that these measures make to the proposed extension's energy performance against the BREEAM energy targets required by the NHS.

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