THE ENGINEERING PRACTICE

Highfield PICU

Energy Strategy

PICU-TEP-XX-XX-RP-ME-0007

Ref:	2256	**Date:**	22nd January 2021
Prepared by:	T. Davis	**Position:**	Associate
Checked by:	G. Neal	**Position:**	Director
Signed:	[redacted]	**Date:**	22nd January 2021

Chartered Mechanical and Electrical Consultants

Contents

1 Introduction

The purpose of this report is to outline the energy strategy for the proposed annex building for the Highfield Unit at the Warneford Hospital, Oxford.

The Highfield Unit is a 2,058m^2 facility providing specialist inpatient services for young people with acute mental health needs. It was constructed in 2012. A new annex to the building is proposed, providing an 8-bed Psychiatric Intensive Care Unit (PICU).

The proposed annex will be a 795m^2 two storey building. Ventilation plant will be located at first floor level. The proposed building aims to be highly energy efficient; the location and nature of the development will help dictate the energy strategy required.

In compliance with the Oxford City Council Local Plan 2036, an energy strategy has been compiled for the building services design for the building. The following approach to energy efficient design has been taken:

Be Lean

Be Lean aims to reduce the energy demand of buildings through careful design of built form and services, using ambient energy and passive solutions and making every effort to minimise the energy consumed by mechanical ventilation, heating and cooling systems. A range of passive design measures have been incorporated into the design of the proposed development to reduce the overall energy demand, including:

- Building fabric and thermal envelope performance
- Low energy lighting and ventilation strategies

Be Clean

Be Clean targets the efficient supply of energy, giving priority to decentralised / district energy supplies where low and zero carbon technologies can be most efficiently deployed.

Be Green

Be Green looks to reduce the building's CO_2 emissions through the use of on-site low carbon and renewable sources where feasible.

2 Summary

The impact made by the implementation of low energy design and the incorporation of low carbon technologies has been assessed by modelling the building within IES's Virtual Environment software package.

Using a baseline building, incorporating gas heating and benchmark U-Values and plant efficiencies, the following improvements have been made:

Energy Hierarchy	Description	Building Emissions Rating (CO_2/m^2.yr)	Percentage Improvement
Benchmark	Gas heating Part L2A limiting U-values Part L2A limiting air tightness	59.1	n/a
Be Lean	Improved U-values Improved air tightness Efficient LED lighting Efficient building systems	50.6	14%
Be Clean	Incorporation of the ground source heat pump system serving the Highfield Unit	47.9	5% (19% over benchmark)
Be Green	No further low carbon technologies proposed	47.9	n/a

The final strategy achieves a 3.6% reduction in emissions below the Part L target.

3 Planning Context

The energy performance for the building has been considered against both regional and local planning guidance.

3.1 Oxford City Council Local Plan

The Local Plan for Oxford City Council provides an overarching framework to deliver the vision of the City in 2036.

Policy RE1 requires that new development applications demonstrate that the following sustainable design and construction principles have been incorporated, where relevant:

- Maximising energy efficiency and the use of low carbon energy;

The remaining items within the list are not applicable to the building energy design.

The policy also states that, should a heat network exist in close proximity to a scheme, it is expected that the scheme will connect to it; this connection will count towards the development's carbon reduction requirements.

3.2 Applicable Legislation

3.2.1 Building Regulations

Approved Document L2: Conservation of fuel and power in buildings other than dwellings (2013 Edition with 2016 amendments). Part L2A covers new buildings while Part L2B covers extensions and changes to existing buildings.

This Approved Documents give guidance for compliance with the Building Regulations for building work carried out in England. Approved Document L2A specifies minimum standard for individual aspects of the building design, including:

- Fabric u-values
- Air tightness
- Ventilation
- Lighting
- Limiting solar gain

Additionally the document asks for demonstration by means of calculation, that the annual CO_2 emissions from the proposed building would not exceed a targeted level of a notional building having the same size and shape as the proposed building.

The 2013 edition of the Non-Domestic Building Services Compliance Guides (as amended) is the current editions in use in England. This document supports the 2013 editions of Approved Documents L2A & B. It provides guidance on complying with Building Regulations requirements for space heating and hot water systems, mechanical ventilation, comfort cooling, fixed internal and external lighting and renewable energy systems.

3.2.2 European Energy Performance of Buildings Directive

The EU Energy Performance of Buildings Directive (EPBD) is implemented in the UK by the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007.

The EPBD introduced higher standards of energy conservation for new and refurbished buildings from April 2006 and requires energy performance certification for all buildings when sold or leased. In addition, it introduced regular inspections for larger air conditioning systems and advice on more efficient boiler operation for commercial properties.

Energy Performance Certificates (EPC) is required on construction, sale or lease of all buildings from October 2008 – both dwellings and non-dwellings. The certificate includes an energy rating, as well as advice on how to make cost effective improvements to the building to make it more energy efficient. The ratings are similar to those currently used for white goods, ranging from A to G, with A the best and G the worst.

A Display Energy Certificate (DEC) and advisory report are required for buildings with a total useful floor area over $500m^2$ that are occupied in whole or part by public authorities and frequently visited by the public. Note that the total useful floor area is defined as the gross floor area, as measured in accordance with the Building Regulations.

Private organisations, including those that may share a building with a relevant institution, do not need to display a DEC, but may elect to do so, on a voluntary basis.

3.2.3 Climate Change Act 2008

The Climate Change Act issued in 2008 sets 2050 target for the reduction of greenhouse gas emissions in the UK.

Part 1 states:

"It is the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least 80% lower than 1990 baseline"

4 Prudent use of natural resources

This section of the report sets out how the proposed development minimises energy demand through the use of design measures.

4.1 Be Lean

4.1.1 Passive Design

Improving & optimising passive design is the most effective means for energy demand reduction, ensuring the building is inherently low in energy use.

There are a range of energy-efficiency measures that will be applied as an integral part of the design process:

Thermal Envelope Performance

Improving the U-value of the facade of a building reduces the transfer of heat from within a room to the outside and vice versa, so reducing the associated heating or cooling energy required to serve the space.

The following table gives details of the proposed improvements in façade performance over the minimum requirements set out within the Part L document:

	U-values ($W/m^2.K$)		
Element	**Part L2A**	**Proposed**	**% Improvement**
Façade	0.35	0.22	37
Windows	2.2	1.6	27
Roof	0.25	0.18	28
Floor	0.25	0.18	28

Envelope Air Tightness

Air tightness is important to limit the amount of unwanted air infiltration into a building and improves the response factor of the building to external temperature changes. When the external temperatures are significantly lower (or higher) than the desired internal temperatures, infiltration increases the heating or cooling load of the building.

Building façades will be specified to achieve very good air tightness levels and careful design of the vertical and horizontal interfaces within the building envelope will be made. Good practice construction techniques will be employed and air tightness tests will be made on completion to ensure that finished construction achieves the design values. The following air tightness target will be adopted:

$5.0m^3/hr.m^2$ @ 50Pa

This is a 50% reduction on the limiting value given within Part L of the Building Regulations ($10m^3/hr.m^2$ @ 50Pa)

Minimising Solar Gain

The extent of glazing within the building design has been carefully considered to minimise unwanted solar gains whilst maximising the beneficial effects of natural day lighting. In this particular instance, the roof overhang provides good shading to the occupied spaces.

Passive Solar Gains

Passive solar gains during the winter can be used to offset the fabric heat losses in the winter to help reduce the heating load for the building. The active building controls will automatically adjust the amount of heating in each zone thereby reducing the amount of heating energy supplied.

Ventilation

Natural ventilation, through operable windows and trickle vents, has been used wherever possible to allow comfort conditions to be achieved within internal areas with outside air. This achieves the combined benefits of connecting occupants with the outdoors, providing high levels of fresh air, rapidly diluting indoor pollution levels, offering easy occupant control and saving energy.

4.1.2 Energy Efficient Building Systems

Following the incorporation of the passive design measures described above, the building systems proposed for the building will be designed to reduce their energy consumption to a minimum. This will be achieved through effective design, the selection of efficient equipment and via controls and monitoring of the systems.

Building Systems

The proposed energy efficiency measures for the building will include the following:

- Variable speed drives on pumps and fans
- Reduced specific fan power at central ventilation plant
- High efficiency heat recovery devices to all ventilation plant

Lighting

Low energy LED lighting will be used and will make a significant contribution to energy demand reduction.

Internal lux levels will be specified to suit the internal tasks within the building. Where possible, lower levels will be used, which will have a significant impact on the amount of energy used by the lighting.

Heating

Within the building, lower supply temperatures will be used where suitable to help minimise heat losses from pipework. Variable speed pumps will also be specified.

Occupant control and the metering of heat will assist in controlling and monitoring the building's heat consumption.

Ventilation

All ventilation systems will incorporate energy efficient fans, speed control and heat recovery.

Ductwork distribution networks will be designed to minimise pressure drops to assist in reducing fan energy consumption.

Monitoring

Metering and monitoring will be employed throughout the development to assist in identifying areas of high energy demand.

4.2 Be Clean

This section details the assessment for a decentralised / district energy system.

4.2.1 Description

A decentralised energy system is one that is not connected to the grid.

Within a district heating or cooling system, hot or chilled water is generated centrally from an energy centre, either as a standalone building or incorporated in to an occupied building. The energy centre would typically contain boilers, chillers or heat pumps, depending on the energy strategy, and all circulation pumps and water treatment equipment.

From the energy centre, water is then distributed to other buildings on site via buried pipework.

The primary advantage with a district heating or cooling system is that it is better suited for low and zero carbon technologies that require a steady base load to operate efficiently.

4.2.2 Application to the Highfield Unit

While there are no decentralised or district energy systems present on the Warneford Hospital site, the Highfield Unit was designed with the potential to be extended in the future. As such, there is capacity within the existing system to deliver heat to the new annex.

In addition, space heating within the Highfield Unit is provided via a ground source heat pump system. Extending this system to serve the annex would not only help to lower the CO_2 emissions of the new building but increase the efficiency of the heat pump system by providing a higher base load.

.

4.3 Be Green

This section considers the feasibility of incorporating low and zero carbon technologies in to the development.

As the heat to the annex building will be provided via an existing ground source heat pump system, all low and zero carbon technologies that provide heat, such as biomass, have not been considered for this project.

Wind Turbines

Wind turbines harness the kinetic energy in the wind and convert this to electrical energy through a mechanical turbine. The efficiency of wind turbines depends heavily on the (i) wind speed and (ii) the swept area of the turbine's blades.

Given the historic nature of the hospital site and its location within an urban environment, wind turbines have not been considered feasible for the project.

Photovoltaics

Photovoltaic panels are semiconductors which convert incident sunlight into electricity. They work well as long as unshaded space can be identified; there are many roofs across the country which are suitable for PV.

While there is some south facing roof available on the proposed building, the introduction of PV panels would have to sit within the overall historical context of the site.

It is deemed therefore that photovoltaic panels are potentially feasible from a technical perspective subject to aesthetic consideration.