University of Gloucestershire

# University of Gloucestershire, City Campus

Energy Statement

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**Ove Arup & Partners Ltd**
63 St Thomas Street
Bristol BS1 6JZ
United Kingdom
www.arup.com

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# 1 Executive Summary

This Energy Statement has been prepared on behalf of the University of Gloucestershire in support of the planning application to refurbish the former Debenhams building in the centre of Gloucester to use it as a new educational facility for the University.

The purpose of this Energy Statement is to define an energy strategy which meets the aspirations of the University and the requirements of relevant national legislation and local energy policy in terms of demand reduction, operational efficiency, and sustainable supply.

Due to the current stage of design of the project. The energy strategy is based on thermal modelling of certain aspects of the building (fabric and heating), previous project experience and benchmark figures.

# 2 Energy Strategy

The Energy Strategy for the buildings incorporates the following principles:

- High insulation standards throughout.
- Improved air-tightness standards.
- External shading and high-performance glazing to minimize façade heat transmission.
- Good daylight provision.
- Intelligent lighting control
- LED lighting throughout
- Low g-value glass to reduce solar gain.
- Ventilation design to minimise requirements for active cooling.
- High efficiency heat pumps.
- Low energy services distribution systems and lighting.
- High quality, automatic controls/building management systems to increase operational efficiency.
- Adoption of PVs at roof level.

Measures proposed include both passive design measures (architectural and building fabric optimisation) and active measures (energy efficient services design), as well the inclusion of renewable energy technologies. This approach is in line with the best practice hierarchy to reduce carbon dioxide emissions:

- Use of passive architectural design as well as energy efficient systems and modes of operation to provide a building which is inherently low in energy consumption ("Be lean");
- Consideration of decentralised heating, cooling and power schemes ("Be clean");
- Production of renewable energy on-site ("Be green").

## 2.1 Energy Targets

The refurbished building will use the aspirations of following assessment criteria to reduce the energy use of the building and improve wellbeing of the occupants:

- Building Research Establishment Environmental Assessment Method (BREEAM) with 'Excellent' aspirations.

ENE 01 - To recognise and encourage buildings designed to minimise operational energy demand, primary energy consumption and $CO_2$ emissions.
ENE 04 –Local LZC technologies have been specified for the building/development in line with the recommendations of the feasibility study and this method of supply results in a meaningful reduction in regulated carbon dioxide ($CO_2$) emissions.

As this is a refurbishment project, it comes under Part L2B, therefore there are no specific energy requirements that the building must satisfy for Part L

## 2.2 Energy Reduction Measures

### 2.2.1 Passive Design (Be Lean)

Before active measures to improve energy efficiency or carbon emissions are incorporated, it is important to reduce the energy demands of the building.


- The building has facades with heritage interest, therefore there are balances that need to be found with regards to energy saving methods and retaining features of interest. The most prominent facades are shown above, which face onto the Oxebode and Kings Square. These are facing in a southern orientation. The façade shown above on the left is of prime heritage interest, due to the art deco windows, therefore there is no scope to add shading to this. The façade on the right will have vertical fins to provide some shading. . In addition, high-performance glazing has been provided to limit the solar loads into the building.
- Spaces that can utilise daylight such as office spaces and teaching spaces have been located on the façade to maximise daylight. Spaces that require limited daylighting such as unoccupied rooms such as stores, archives and server rooms have been located internally or on the northern side of the building. Thereby saving lighting energy consumption.
- Measures such as daylight-linked lighting controls and absence detection will reduce the power consumption and heat gains from lights when possible.

- The following u-values are aspirational targets. The building is being completed in phases, therefore the fabric upgrades of the external walls are being implemented to the corresponding phase being completed at the time.

  External walls: U-value of 0.16 W/m2K.

  Ground floor slab: U-value of 0.18 W/m2K.

  Roof: U-value of 0.15 W/m2K.

  Personnel Doors and Louvres: U-value of 2.2 W/m2K.

  Windows 1.6 W/m2K, g value of 0.4

  Air permeability assumed 10 m3/m2h at 50 Pa

- These are considered to be very good u-values, and much better performing than those specified in building regulations for a refurbishment. These are equivalent to a very good performing new build. High performance façade criteria will limit heat conduction and infiltration, reducing the building's heating load in particular.
- Ceiling heights will be maximised and where suitable, spaces have exposed ceilings. The exposed thermal mass will be beneficial to passive ventilation and to a lesser degree the pre cooling and heating of the mechanically ventilated spaces.

### 2.2.2 Active Efficiency (Be Clean)

Once passive measures to reduce demand have been adopted, energy efficient systems are used to provide the heating, cooling, and electricity demands remaining.

- The building will be serviced via electric heating and cooling systems to be in line with the UK's grid decarbonisation.
- The boosted mains cold water service to the building will be metered and monitored by the building management system. Sub metering will be used in areas or for equipment using ten percent or more of the buildings total water demand. A leak detection system is proposed for the building and for the mains pipework coming to the building from the campus. Flow control devices regulating the supply of water to each WC are to be installed. Low flow water saving fittings have been specified.
- All luminaries will be LED. The controls will be selected to optimise the use of electric lighting in each area according to its use.
- Where daylight savings can be made separate modulating photo-electric controls will maximise daylight by switching off rows of unwanted illuminated luminaires. In offices and toilets PIR absence control will also be used to prevent occurrences of lights being left on while the space is unoccupied.
- A Building Management System (BMS) will be used to monitor the building's mechanical and electrical equipment ensuring that the plant operates efficiently. This will enable the client to assess and establish areas that could be targeted for future further energy reduction measures.
- Ventilation units with high heat recovery and low specific fan powers will be specified

### 2.2.3 Renewable Energy (Be Green)

The use of renewable energy not only leads to reduced emissions of greenhouse gases and other pollutants, but can also help to conserve the finite global fossil fuel resources.
We considered a wide range of technologies that are available and identified which technologies are suitable to the projects energy needs and also which technologies are excluded for not being appropriate.
An LZC appraisal has been carried out on the proposed building. The energy demand of the building has been minimised through design of built form and services using ambient energy and passive solutions, making every effort to minimise the need for mechanical ventilation, heating and cooling systems. A range of passive design measures has been incorporated into the design of the building to reduce the overall energy demand.
In addition to passive design techniques developed to reduce primary energy demand an analysis of potential low and zero carbon energy sources has also been carried out in order to assess which LZC technologies are applicable to the project, resulting in a meaningful reduction in regulated carbon dioxide ($CO_2$) emissions.
Below are the recognised local (on-site or near-site) LZC technologies that have been considered for this project.

| Renewable Source | LZC TECHNOLOGY | On-Site | Near-Site | Comments |
|---|---|---|---|---|
| Wind | Micro Wind Turbine | Possible | N/A | Size of turbine required is prohibitive. location and noise issues. (discounted) |
| Solar | Solar Photovoltaic (PV) Panels | ✓ | N/A | Could be accommodated |
| Solar | Solar Thermal Panels | Possible | N/A | PV's more appropriate use of space. Low amount of domestic hot water. (discounted) |
| Aerothermal | Air Source Heat Pump | ✓ | N/A | Will provide heating and cooling |
| Geothermal | Ground Source Heat Pump | N/A | N/A | Insufficient open space, need to minimise archaeological impact on site |
| Geothermal | Vertical Closed Loop Ground Source Heat Pump | N/A | N/A | Insufficient open space |
| Hydrothermal and Ocean Energy | Water Source Heat Pump | N/A | N/A | No suitable water course |
| Hydropower | Hydro-Electric / Micro Hydro | N/A | N/A | No suitable water source |
| Biomass | Biomass Boiler Plant | N/A | N/A | Insufficient plant space available. |

| Renewable Source | LZC TECHNOLOGY | On-Site | Near-Site | Comments |
|---|---|---|---|---|
| Biomass | Biomass Combined Heat and Power | N/A | N/A | Insufficient space for micro scheme. |

### 2.2.4 Solar Photovoltaic (PV) Panels

Due to the stage the project is at, an assessment will be carried out at the next stage as to the viability of photovoltaics in terms of embodied carbon, carbon reductions and economic viability.

# 3 Baseline Energy Demand and Carbon Emission Savings

Gloucester City Council's planning policy (the Joint Core Strategy Policy SD3) requires new developments to minimise its energy requirements via passive methods primarily, and then the implementation of renewable energy sources

Due to the early stage that the project is at, the initial calculations are extrapolated from previous Arup projects and benchmark figures for total energy usage. We have looked at buildings with the same building fabric performance and similar usages.

It is anticipated that the building will have a total energy usage of between 120kWh/m2 and 160kWh/m2. The figures are in a range as the project is still at Stage 2 of design, therefore limited thermal modelling has been carried out, it is also a refurbishment, therefore there are still design elements which need to be worked through to see whether they are feasible. The kWh/m2 range equates to between 2,760,000 – 3,860,000 kWh per year

From initial thermal modelling of the heating system, it was predicted that the energy use for the building with no fabric improvements would be 1,879,450kWh. With the improved u-values, this annual energy use could be reduced down to 372,280kWh (an 80% reduction). This is equivalent to 708,164 kgCO2/yr. This is a significant saving, through passive measures.

Through the implementation of air source heat pumps to provide heating, the resulting electrical energy needed to satisfy the annual heating load would be 105,461kWh, due to the SCOP of the unit. This provides a further saving of approximately 123,086 kgCO2/yr.

## 3.1 Conclusion

The analysis indicates that with the passive measures implemented, the building has huge potential to reduce its baseline energy consumption, in particular the heating demand. The inclusion of heat pumps in the scheme will contribute further to a carbon reduction in the drive to provide a low energy use building.

Please note that these figures have been calculated very early in the design of the building and therefore they are likely to vary as the project progresses.