

## 1. Executive Summary

The existing systems and building fabric at the Humanities Building are currently inefficient, dated and in need of significant overhaul/upgrade in order to achieve the Universities ambition of a Zero Carbon estate by 2038. A key element to this is heat decarbonization which in turn triggers both complementary & supplementary energy/system efficiency improvements.

Over the next two/three years the following works are crucial to this strategy and are crucial to transitioning away from imported gas towards renewable forms of imported electricity:

- Upgraded Roof & insulation – new Bauder roof system
- External Wall Upgrade - with insulated plasterboard
- New Triple & Double Glazed Windows – Planning Restrictions
- LED lighting
- Ventilation upgrade(s)
- Air Source Heat Pumps (ASHP) sized at 50% peak load to deliver 75% of space heating demand (Steam connection remains for 25% - Winter load) & new secondary heating system
- BMS
- Solar PV panels – 10.1% contribution

Please refer to Architect & MEP consultant sections for technical proposals

The impact of such changes could be an **77% reduction in carbon emissions**, equating to a saving of 481 tons of Carbon each year with annual energy bills reducing by 35% each year.

The fabric upgrades reduce the primary energy associated with heating by 70%

The transition to an all-electric solution often adds significant loads to the existing electrical infrastructure. The Humanities building is served via 1no 800KVA substation and appears to have adequate spare capacity for the additional ASHP load (TBA to confirm).

## 2. Methodology

A Heat Decarbonisation plan generally follows the steps outlined below:

- Step one – Review Existing systems and operations to identify a baseload
- Step two – Reduce heating demand/emissions with Fabric Efficiency improvements
- Step three - Review/select low carbon heating solution
- Step four - Reduce electrical consumption - through Energy efficiency measures
- Step five - Reduce electrical consumption further - Apply renewables
- Step six – Agree Green Energy Tariff &/or offset remaining carbon.

Step one - establishing a baseload / baseline

Data has been collated and reviewed from previous display energy certificates which indicates gas consumption of 1,459,728 KWhrs. There is currently no metering in place and so when the DEC's were produced they were from crude estimates, calculated on a m2 basis across the entire steam network serving multiple buildings.

Accordingly, the associated figures have been discounted and the CIBSE Benchmark consumption figure of 240KWhrs/m2 (2,616,000 KWhrs) has been used as the basis of this study

For University campus buildings the CIBSE benchmark for Electrical Consumption is 80kwh/m2 which relates to approximately 870,000 KWhrs for the Humanities Building. As mentioned previously, University operations were disrupted through the Covid pandemic and so historic data has been reviewed between 2018 & 2020 which is likely more accurate.

This has identified an electrical baseload of 690,000 KWhrs which, whilst lower than the CIBSE benchmark, appears to be a reasonable representation of the general operations. Of the 690,000 total, 393,000 KWhrs are associated with fixed building services (regulated energy).

A digital representation of the building was created using a dynamic simulation model software which uses industry standard room templates containing standard operating conditions. These templates were amended as necessary to suit the general building operating conditions.

This enabled benchmark for the building's energy consumption and carbon emissions to be established that closely represents a building of this nature and have been used to assess the impact of the energy improvement measures proposed.

In addition to the above the University have advised three notional energy performance targets which shall be reported against:

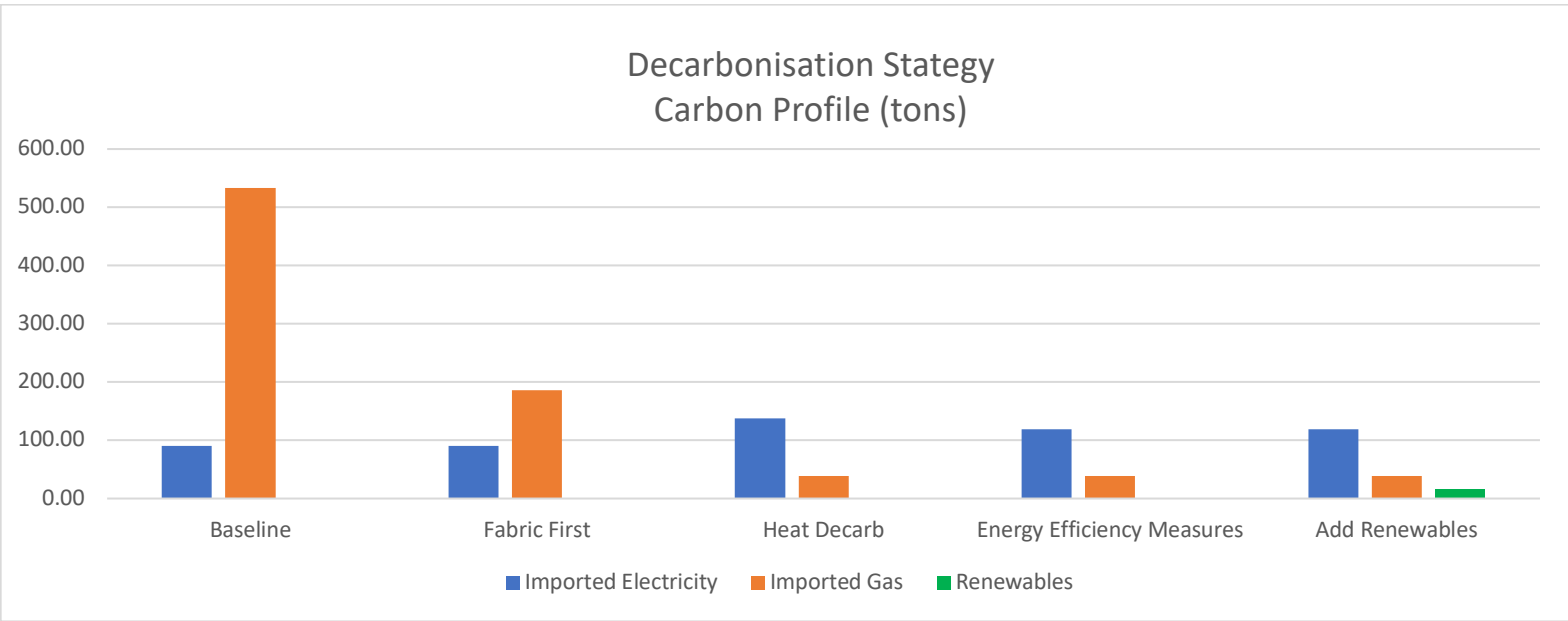
1. Onsite Renewable Energy contribution – 20% of operational energy
2. Primary Heating Energy – 80Kwhrs with a stretch target of 50Kwhrs
3. Energy Use Intensity – 90Kwhrs with a stretch target of 60Kwhrs

3. Overview of Works

Find below an overview of the relevant building & servicing upgrades:

| STEP              | Key Elements  | Proposed Works                                                               |
|-------------------|---------------|------------------------------------------------------------------------------|
| Fabric Efficiency | Roof          | Upgrade to 0.14 – 0.17W/m²K (plant deck excluded - refer to architects info) |
|                   | Walls         | Upgrade to 0.21 - 0.23W/m²K (refer to architects info)                       |
|                   | Windows       | Upgrade to 1.3 & 1.7W/m²K (refer to architects info)                         |
|                   | Air Leakage   | No change assumed                                                            |
| Low Carb Heating  | Heating       | Full secondary renewal inc. 50% ASHP Peak (refer to MEP info)                |
| Energy Efficiency | Ventilation   | AHUs Upgraded (refer to MEP info)                                            |
|                   | Cooling       | Extent TBC                                                                   |
|                   | BMS           | Yes plus local temperature controls (refer to MEP info)                      |
|                   | Lighting      | Full LED upgrade (refer to MEP info)                                         |
| Renewables        | Photovoltaics | 150KW (peak) roof mounted array                                              |

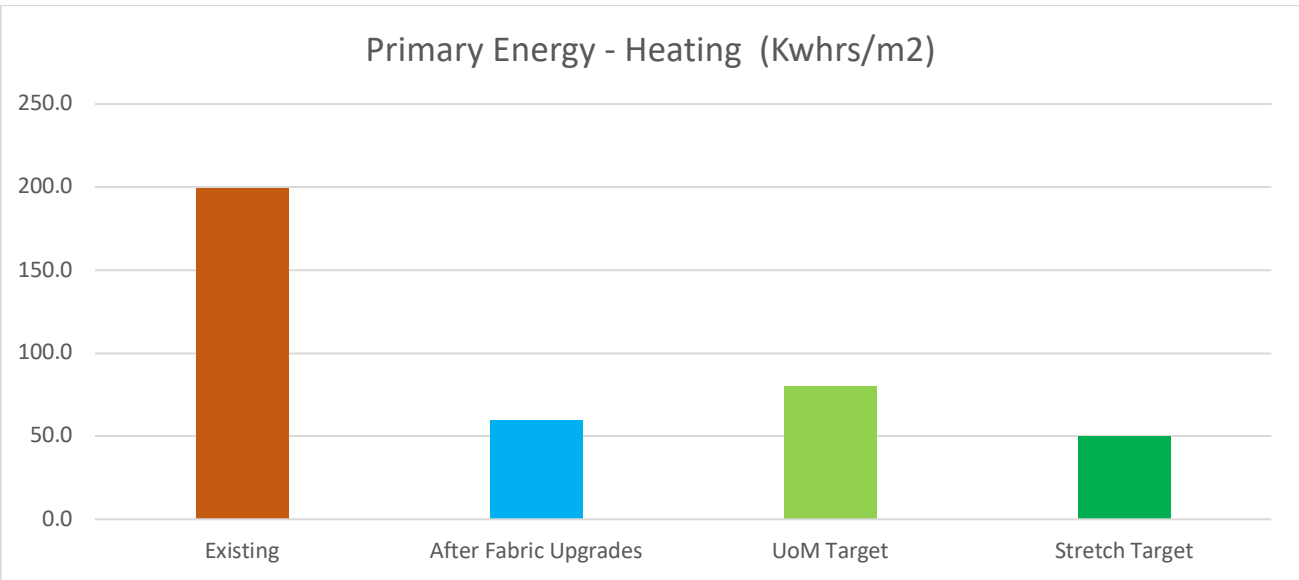
The impact of these works reduces the operational carbon emissions by 77% as illustrated below.



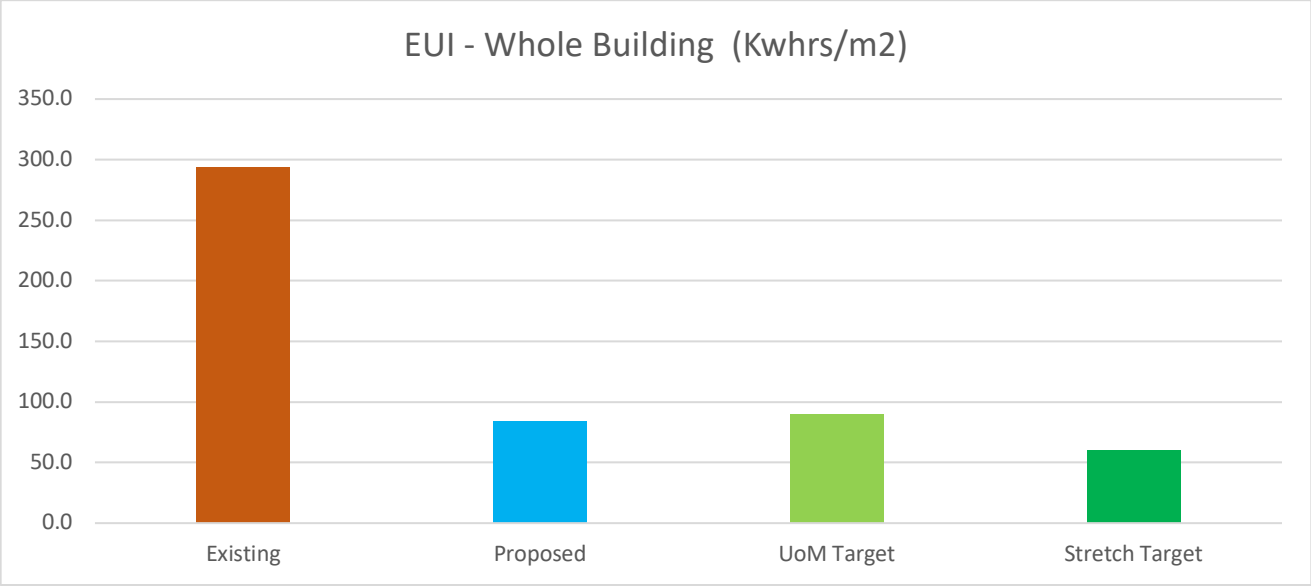
The PV array is estimated to contribute to 10.1% of the final energy consumption. Whilst this is less than the 20% notional target, the array design is limited by a number of factors including the access requirements. This will be developed further at the next stage.

The primary heating energy (required to heat the building) is significantly reduced as a direct result of the proposed fabric upgrades to the roof, windows and external walls.

At this stage (inclusive of a design margin) the annual heating demand is predicted to be reduced by approximately 70% achieving 59.5KWhrs/m2. Whilst this is above the notional target of 80Kwhrs/m2 there is scope to develop this further at the next design stage.



In addition the baseline & proposed Energy Use Intensity (EUI) of the building has been calculated and compared to a notional target of 90KWhrs/m2 – please see below



The current proposal is estimated to achieve a EUI of 84KWhrs and takes into consideration the significant upgrades to fabric & building services as outlined previously. Accordingly a stretch target of 60KWhrs/m2 will be targetted at the next design stage.

## 4. Conclusion

A Heat Decarbonisation plan generally follows the steps outlined below:

- Step one – Review Existing systems and operations to identify the annual carbon baseload –
  - **623 tons of Carbon assumed for Humanities**
- Step two – Reduce heating demand/emissions with Fabric Efficiency improvements –
  - **Fabric Upgrades save 276 tons of Carbon**
- Step three - Review/select low carbon heating solution –
  - **Converting to Air Source Heat Pumps to provide the heating saves a further 101 tons of Carbon**
- Step four - Reduce electrical consumption - through Energy efficiency measures –
  - **LED lighting & Ventilation improvements save a further 18 tons of Carbon**
- Step five - Reduce electrical consumption further - Apply renewables
  - **PV panels contribute to a further reduction of 16 tons of Carbon**
- Step six – Agree Green Energy Tariff & or offset remaining carbon.
  - **Reduced from 623 to 141 tons following the decarbonization plan**

Overall the carbon emissions are predicted to reduce by 77%

Secondary measures of energy performance have been considered as follows:

- Primary Heating consumption is 59.5 KWhrs/m<sup>2</sup> versus a Notional target of 80KWhrs/m<sup>2</sup>
- Energy Use Intensity is 84 KWhrs/m<sup>2</sup> versus a Notional target of 90KWhrs/m<sup>2</sup>
- Renewable Energy in the form of PV panels will provide 10.1% of the building operational energy

A Utility running cost assessment has been undertaken as follows.

| Runing Cost Appraisal | Imported Gas (6p/KWhr) | Imported Elec (25p/KWhr)             | Total          |
|-----------------------|------------------------|--------------------------------------|----------------|
| Before                | £ 152,251.20           | £ 172,692.50                         | £ 324,943.70   |
| After                 | £ 10,524.17            | £ 200,928.76                         | £ 211,452.93   |
|                       |                        | Annual Saving                        | £ 113,490.77   |
|                       |                        | Saving over 20 years post completion | £ 4,344,197.02 |

Resulting in a reduction of utility costs of 35%

NB - factoring in inflation at 5% per annum as per the previous 10 years (2010-2020)