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# Finalist's case study

## University of Cambridge Carbon Reduction

Major Energy & Carbon Reduction  
Works at Grade II Listed  
1934-2010 Built Environment  
Cambridge University Library

### About the project

#### Summary

Major energy and carbon reduction projects (£1.45m) carried out at Cambridge University Library since 2014 have delivered significant energy savings (electricity savings of 705,000kWh and gas savings of 1,650,000kWh) and a 25% reduction in carbon (630 tonnes) per annum. Further improvements to the Building Management System (BMS) including widening the environment condition range in the book stacks and upgrades to the heating system (£1.73m) is estimated to reduce annual carbon emissions by a further 200 tonnes upon completion in 2017.

### The results

#### The problem

The Cambridge University Library (CUL) is one of the largest buildings on the University's estate and has one of the largest carbon footprints of any University building. It was therefore used as one of the pilot buildings for the Energy and Carbon Reduction Project (ECRP).

CUL was built in phases with the original building dating back to 1934. There were seven ageing chillers located on the roof and basement supplying chilled water to air handling units serving book stacks, reading rooms and other parts of the building.

As one of the world's most important repositories of the recorded word, many of the archive areas require stringent environmental control, which consumes a significant amount of energy.

#### The approach

Since 2014, the ECRP team has been working with CUL to deliver major energy and carbon reduction projects as well as initiate many local engagement projects.

Major projects include improvements to the building's BMS; installation of a centralised chilled water network with three highly efficient chillers to replace seven chillers used to serve respective air handling units; and the use electrical desiccant dehumidification to minimise the requirement for chilled water dehumidification and



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#### Profile

- Higher Education
- 18,000 students
- 10,000 staff
- Urban
- 2500 staff
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subsequent reheat. Further BMS work on widening the environment condition range in the book stacks and a major heating system upgrade is currently underway and is due to be complete in 2017.

Demonstrating the success of the major projects was crucial to keeping staff engaged and encouraged them to contribute positively towards the University's overall environmental sustainability goals. Staff can feel disengaged and demotivated if they do not see improvements being made to energy inefficient systems within their building. This is not the case in the CUL. There are many local engagement activities, such as the "Green Futures Group" which engages with staff and facility users on a variety of initiatives to help them understand how individuals can help reduce energy use and carbon. The Group also introduced a recycling room adjacent to the staff area and the installed energy dashboards in the reader's area.

The Operations Team at CUL continues to monitor and evaluate equipment and behaviours to ensure technology runs smoothly and that staff members are doing all they can. In addition, carbon reduction is now an embedded part of the development and maintenance strategy at CUL and features regularly on meeting agendas, and when considering projects, purchases and building plans. CUL routinely includes the need for new staff to be environmentally engaged in the library's operational sustainability, as part of their job description and selection criteria.

## Our goals

The University's Environmental Sustainability Vision, Policy and Strategy demonstrates its commitment to making a positive impact through outstanding environmental sustainability performance. This project in particular aligns with the 'underpinning principles' of this vision, including:

- *'To maximise the wider positive impact of the University's environmental sustainability actions at local, national and international level through communication, collaboration, partnership'*. The project has demonstrated clear collaboration and partnership through the cooperative efforts between end users and the Estate Management project team, and the sharing of experience and learning internally and externally.
- *'To create a culture where the University community is engaged, empowered and supported in improving their personal and collective environmental sustainability practices'*. The success of the project has instigated staff engagement on broader energy and sustainability matters at CUL, in particular through their 'Green Futures Group'.
- *'To protect and enhance the natural environment by reducing our direct environmental impact'*. The project has contributed to this principle by reducing energy consumption and carbon emissions.

## Obstacles and solutions

Ageing building services became increasingly inefficient and increased maintenance liability. Significant financial investment required for major upgrade.

This project has overcome many technical, financial and cultural hurdles through the commitment of senior management and the cooperation between the project team and end users. A strong financial business case on energy and carbon reduction grounds has greatly assisted and expedited major investment from maintenance sections for building services upgrade for mutual benefits.

The major works not only reduced the number of key assets, improved the overall efficiency of the building services, delivered significant energy and carbon saving, but also greatly reduced maintenance costs and liability.



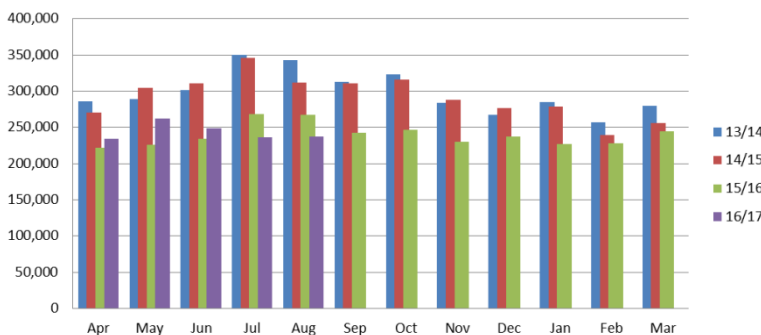
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	Furthermore, under the old system there was no backup if one of the chillers failed, however with the new centralised system, even if one of the chillers fail, the other two are still powerful enough to meet demand.
Significant energy consumption on stringent environmental condition controls	<p>It is vital that the internal environmental conditions are maintained within acceptable tolerances to protect the extremely valuable collections and individual pieces.</p> <p>We liaised with the National Library of Scotland (NLS) in the planning of this BMS project as they had already moved to using flexible set points within their archives. External collaboration was a key element in overcoming the cultural barriers to this project as the library professionals were able to liaise with their peers at the NLS and receive assurance that it would not risk the integrity of the books and artefacts. By fine tuning the BMS controls and improving the internal sensor quality, the internal environmental conditions can be maintained ever better within acceptable tolerances to protect the extremely valuable collections and individual pieces, but using far less energy. The agreement on widening the environmental condition range will produce further energy and carbon saving without compromising the library's critical environment operational parameters and end users' comfort.</p>

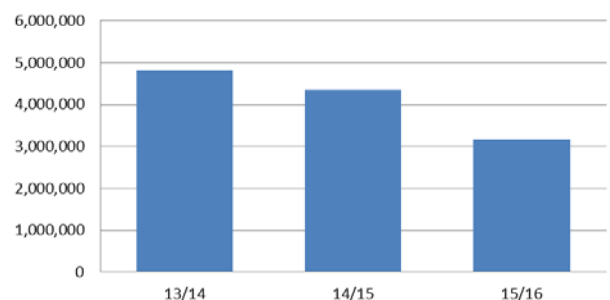
### Performance and results

The observed reduction in energy consumption (approx. 705,000kWh of electricity and 1,650,000kWh of gas) and cost avoidance of over £144,000 per annum has greatly exceeded the projects projected savings. Detailed electricity and gas consumption trends are shown in the graphs below. The associated carbon saving is 630 tonnes per year.

University Library Electricity kWh



University Library Invoiced Gas kWh





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The table below shows kWh of energy consumption per m<sup>2</sup> of gross internal area per year post implementation and a comparison with a typical library.

Cambridge University Library	2013/14	2014/15	2015/16	Typical Library
Electricity (kWh/m <sup>2</sup> yr)	82	81	66	70
Gas (kWh/m <sup>2</sup> yr)	111	100	73	191

## The future

### Lessons learned

1. Energy and carbon reduction in listed buildings is challenging but also very rewarding.
2. A strong financial business case for energy and carbon reduction can greatly assist and expedite major capital investment for building services upgrade.
3. Success requires a long term commitment to energy and carbon reduction by senior management.

### Sharing your project

This project is being replicated on the University estate. The success of this project has applicability to libraries, museums and other buildings across the University and other sectors. A case study can be downloaded from our website: <http://www.environment.admin.cam.ac.uk/resource-bank/case-studies/energy-and-carbon-reduction/university-library>

### What has it meant to your institution to be a Green Gown Award finalist?

Being shortlisted as a Green Gown Award finalist recognises the vital importance that the University of Cambridge attaches to embedding sustainability across our estate, and it rewards the efforts of all of our staff and our sustainability champions who have worked tirelessly to get projects off the ground and to bring about meaningful, sustainable change.

### Further information

Web: [www.environment.admin.cam.ac.uk](http://www.environment.admin.cam.ac.uk)

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