Green Gown Awards 2015
Finalist's case study
Dissemination supported by: hefce Higher Education Funding Council for England

University of Cambridge
Research & Development
LEDing the way to greener plant growth

University of Cambridge
Department of Plant Sciences

Profile
- HEI
- 19,000 Full Time Equivalent Students
- 10,500 staff
- Urban

About the project
Summary
As one of the most energy intensive departments at the University of Cambridge, the Department of Plant Sciences has been developing LED lighting systems to reduce the energy used to grow plants and algae for research. Various LED types have been extensively trialed to find systems capable of growing a wide variety of species as well as current standard fluorescent tubes.
An LED refit developed for algae-growing incubation shakers halves the electricity used for lighting. Plant growth rooms are now being fitted with LED arrays that use 60% less electricity than fluorescent tube technology. Once refits are fully rolled out annual savings approaching 500 tonnes CO_2e and £100,000 are expected.

Project partners
- Staff and students of the Department of Plant Sciences
- Energy & Carbon Reduction Project (ECRP), Energy & Environment Section
- Infors UK – Incubation shakers
- Conviron UK – Plant growth room lighting arrays
- Valoya – Plant growth room LEDs

The results
The problem
Plants and algae are grown under tightly controlled conditions to help guarantee the quality of research. One of the key variables to be controlled is light level. Across the department's growth facilities, thousands of lights blaze away all year round to grow what our researchers need. The cost of running the lights and managing the waste heat they generate totals hundreds of thousands of pounds each year.

The approach
With support from the ECRP, the department has been researching what exactly artificial lighting needs to provide to guarantee good growth from whatever plant and algae species need to be cultivated. Various LED specifications from industrial partners were extensively tested with plants and algae used by the department's various research groups. Trial results fed back to partners helped the development of further prototypes and production-ready LED refits.

Finalist's case study

Dissemination supported by: hefce Higher Education Funding Council for England

Our goals

To significantly reduce the department's electricity consumption and carbon emissions.
To be a leader and an innovator in the development of LED growth lighting for research applications.

Obstacles and solutions

Ensuring that new lights do not grow plant and algae variants any differently from the current lighting systems.	Early trials of different lighting types represented the full range of what departmental research demands from artificial lighting. The best performing LED variants from this first stage were fine-tuned before a more comprehensive set of trials was undertaken to cover as many research groups and plant/conditions iterations as possible.
Changeover from old to new lighting systems must not affect ongoing research.	Despite the large energy reductions that are to be achieved with these LED solutions it has been important to proceed cautiously. A step-by-step roll-out of the technology has ensured that the university does not invest heavily in lighting that is not fit for all demands placed on it.
Engaging and involving typically conservative researchers.	Making the aims of the project and the ultimate benefits clear to senior researchers has been key. Transparency in communication and continued outreach throughout have been necessary; particularly when inviting trials. Both informal and formal meetings provide space for raising and addressing concerns.
LEDs that satisfy the demanding brief were not commercially available.	After trying a variety of commercially available options, the department benefitted by having long-term equipment partners that could be brought on-board. Making use of these relationships ensured the fulfilment of the project to mutual benefit.
High developmental costs.	Through the Energy & Carbon Reduction Project (ECRP), the university has a budget available to support initiatives that improve energy efficiency and tackle carbon intensity. This valuable assistance has ensured that this long-term and high-cost investment has been able to realise its exciting potential.

Performance and results

Algae-growing incubation shaker LED refits:

- Electricity used to power the lights is reduced by 55%.
- Less waste heat is generated from LEDs reducing demand and stress on chilling circuit components.
- The LED refit has an expected lifespan matching that of the shaker, eradicating periodic costs to replace the lamps (as was the case with the previous lighting system).
- The consistency of lighting level within the shaker is superior with LEDs and can be set more accurately.

Plant growth room LEDs:

- Electricity used to power the lights at typical levels is reduced by 60%.

- Less waste heat is generated by LEDs meaning that fans in the lighting arrays could be removed, reducing baseload power demand of the plant growth rooms. The demand on facility chillers is also much reduced, saving more energy.
- The final LED specification is scalable, meaning that as well as the technology being rolled out to other plant growth rooms, it could be applicable for growth cabinets and even top-up greenhouse lighting.

The future

Lessons learned

- Engage with as many stakeholders as possible early on and continue to involve them throughout the process. A cautious methodological approach ensures that all are kept onside.
- Strong relationships with suppliers, partners and funders (both internal and external) are vital for maintaining momentum.
- Flexibility is important, but don't lose sight of the overall aims. Clear communication of this is important.

Sharing your project

Other departments and affiliates that use incubation shakers or have plant growth rooms have been kept informed of project progress and have visited the department at various stages.

Staff presence within organisations such as the UK Controlled Environment User Group and S-Lab has ensured that the work being done on this project is being distributed to other research institutions. The department is open to inquiries and visits either directly or through our industry partners.

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

Professor Jeremy Sanders CBE FRS, Pro-Vice-Chancellor for Institutional Affairs

"I am delighted that the Department of Plant Sciences' LED lighting project is a Green Gown Awards finalist. It is delivering sizeable improvements in a research discipline renowned for being energy-intensive. Winning the Research & Development category would be deserved recognition for pioneering work with exciting potential for widespread application."

Further information

Martin Howes, Energy Co-ordinator, Department of Plant Sciences, University of Cambridge
Email: Martin.howes@plantsci.cam.ac.uk
Website: http://www.plantsci.cam.ac.uk/intranet/support/energy