Living Laboratory Annual Report 2013-2014

Purpose

The purpose of this report is to provide an update on the second year of the University of Cambridge's Living Laboratory for Sustainability.

Background

The Living Lab's goal is to improve the sustainability of the University of Cambridge by using the estate to test and research real world environmental problems while enhancing the educational experience of students attending the University. The Living Lab seeks to involve students from diverse academic backgrounds in creating solutions to the operational challenges of the University. It also looks to be a platform for academic staff to suggest and steer research on the University estate, and to be a tool for Estate Management to improve the environmental practices of the University.

The Living Lab achieves its aims through developing projects that connect students, academic staff and Estate Management staff. This collaboration is leading to innovative research and practical projects that enhance Cambridge's sustainability.

Originally, the Living Lab was a 2-year project that started in October 2012 with funding from Santander to enable programme delivery. It has since evolved with an additional three years of funding from Santander for the continuation of the programme.

Objectives

- The Living Lab's objectives are to:
- Improve the sustainability of the University by using the estate to test and research real world environmental problems.
- Support students in developing knowledge and skills and gaining experience in sustainability projects.
- Promote interdisciplinary teamwork by enabling students from different disciplines to work together on sustainability projects and share their perspectives in seminars or informal collaborative discussions.
- Ensure that the learning from the projects directly influences University operations.
- Facilitate the continuation of the Living Lab concept in light of the recent extension of funding for the next three years.

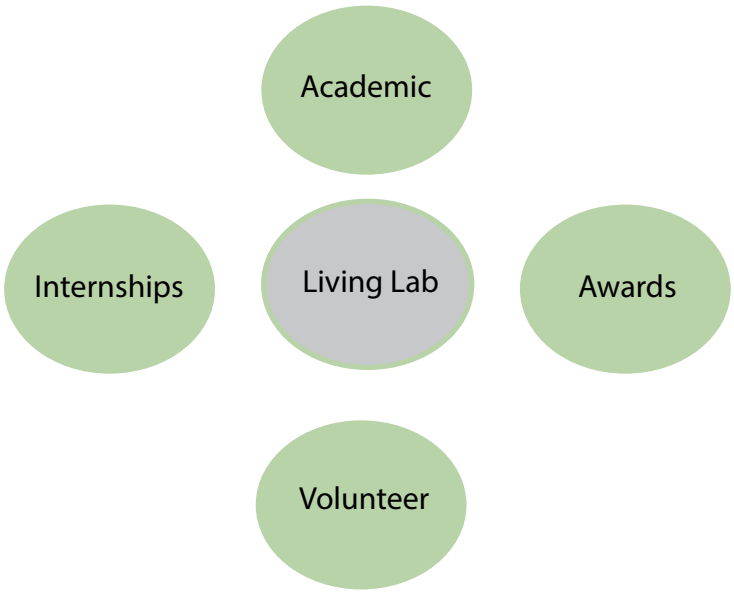
Coordination and Governance

The Living Lab sits within the Environment and Energy Section at the University of Cambridge within Estate Management. Programme management is undertaken by the Living Laboratory for Sustainability Coordinator, Claire Hopkins, under the direction of the Environmental Officer, Toby Balson. Outputs and learning from Living Lab projects are fed back into Estate Management through the Environment and Energy Section.

Ideas for projects come from students and academic staff, as well as from Estate Management staff. The Living Lab originally had an Advisory Group made up of staff, students, and academics, but the governance arrangements have been changed so that the project reports directly into the Environmental Strategy Committee at the University. This allows for more direct reporting and better resource and time allocation.

Framework

Now going into its third year, the Living Lab has restructured its strands and reduced the number from five areas of work to four as described below. The Affiliated strand and the Small Scale strand have been combined into the Volunteer strand because it was found that the level of student commitment and roles were very similar.



Academic Projects

These are student projects that lead to academic credit towards their degree, for example final year undergraduate and MPhil projects. These projects have academic supervisors working with students as well as support from estate staff.

Awards

Each year a challenge will be held to develop solutions to a particular problem or question relating to the estate. A prize will be offered to the winning submission or top submissions to enable the solution to be implemented.

Volunteer Projects

As mentioned this strand has been altered to better suit the needs of the students. The projects in this strand are unrelated to students' academic studies. For example, they may include students volunteering to undertake waste or energy audits. These projects involve less of a time commitment and do not necessarily require an academic supervisor. These projects may involve other organisations or interested parties for example student societies.

Internships

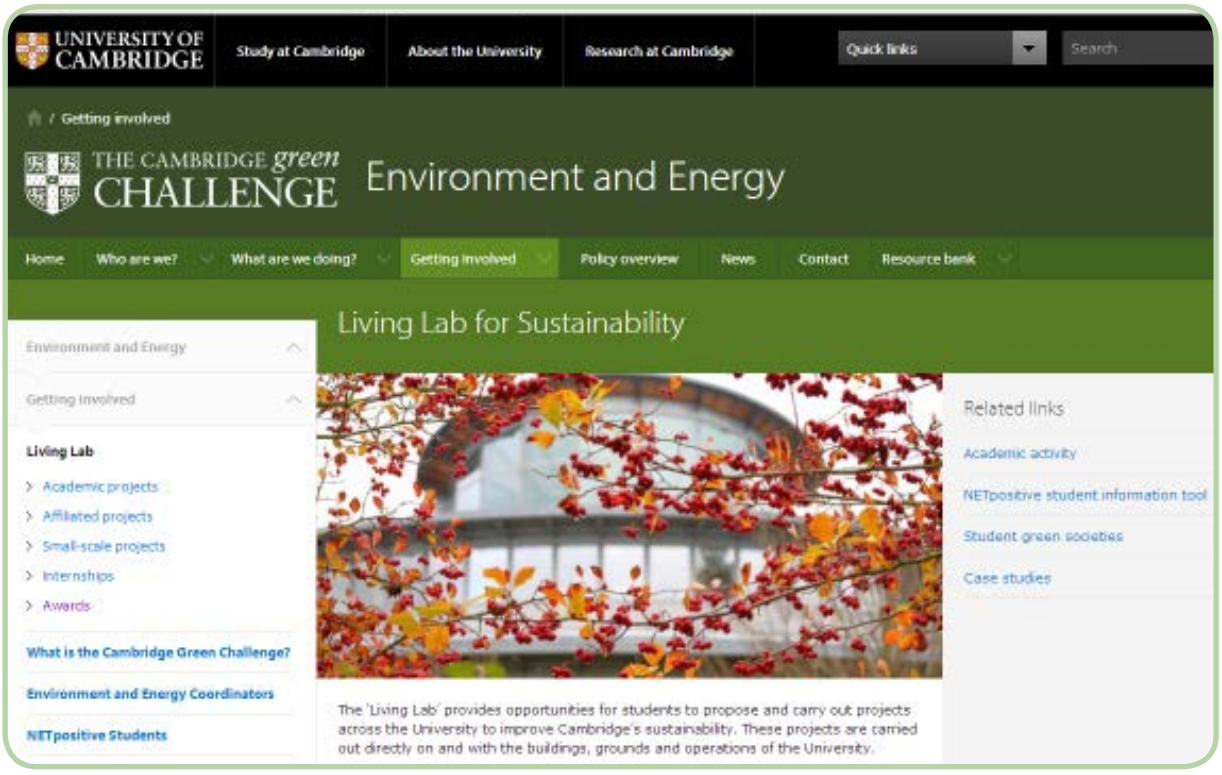
Paid internships are offered to students during the summer holiday period to take on focused projects. Students gain professional experience and skills in the field of sustainability by working with members of the Environment and Energy Section. Internships give students the chance to apply the theory learned in their degrees to the real world and make them more capable candidates for employment upon leaving the university.

Communication

Website

The Living Lab website, containing information about previous projects and upcoming opportunities, can be found at:

www.environment.admin.cam.ac.uk/getting-involved/living-laboratory-sustainability



Living Lab video

A promotional video has been produced to celebrate the Living Lab's achievements as well as encourage involvement from staff and students. The video can be found here:

http://youtu.be/dmDoSOv85o0

Speaking Events

The Living Lab Coordinator spoke at the 2014 Annual Climate Forum hosted by the Cambridge Hub along with two other students completing projects with the Living Lab. The Living Lab coordinator also went to the Environmental Association for Universities and Colleges (EAUC) Annual Conference and held a seminar with one of the Living Lab students on how to create a living lab and what types of projects can be completed.

2013-2014 Project Strand Activity

Academic Projects

Four students completed their 4th year projects for their degrees in Engineering with the Living Lab. All of the projects and their findings were presented to members of Estate Management at the end of the Easter Term.

Bryn Pickering

Bryn's project looked into the current generation of on-site renewable energy on the University's estate. The aim was a rigorous analysis of the entire timeline of each renewable installation in order to ascertain whether a better, more unified, method of installing and maximising usefulness of renewable energy on the estate was possible. Bryn found that if the University hopes to use on-site renewable sources to aid CO_2 emission reduction then it requires a different methodology to current practice. One of his findings was that using photovoltaic (PV) arrays alone would not be enough to offset a substantial proportion of building emissions to meet the University's carbon reduction goals. The use of ground source heat pumps alone or in conjunction with a PV installation would increase the emissions offset from on-site renewable sources. His work also highlighted that improved monitoring and maintenance of ground source heat pumps is required so that they may be successfully integrated across the estate.

Viktor Bystrom

Viktor's project was a case study about how the Merton Rule, a Planning regulation that says that 10% of a new building's energy must be produced by renewable energy, was being implemented across the University and how the University could use renewables to reach its carbon reduction targets. In his study, Viktor found that the University had typically chosen to use roof mounted solar

PV panels to comply with this requirement. He took this information and examined what the long-term potential of such an approach was and if this would enable the University to meet its carbon reduction targets. He also looked at wind and other sources of renewable energy for the University based on feasibility studies performed at the University. Viktor also considered existing energy saving schemes and their potential for reducing energy demand in order for the University to reach its carbon reduction goals.

Viktor found that there is significant potential for reducing energy demand and concluded that targeting energy demand rather than installing site-wide renewables would be a more suitable way to meet the University's carbon reduction targets. It was also suggested that the only way renewables could make a sizeable contribution is if solar PV panels were installed on University farmland. He found that just adding PV and wind would not alone be enough to reach the University's targets.

Min Lee

Min's project focused on one of the large energy using buildings at the University, The Sainsbury Laboratory. She aimed to perform an energy audit of the building in order to investigate the reasons for the discrepancies between the energy predictions that were made at the design stage of the building and the consumption that the building has in actuality. The survey also aimed to investigate the thermal comfort of the occupants, the occupants' opinions about their personal controls over the environment and their impact on the energy efficiency of the building. Min confirmed that the building was consuming significantly more energy than expected, and made some excellent recommendations to help reduce this.

Her suggestions included the installation of more sub-meters for gas, tailoring the building management system to the operational hours of the building and optomising the position of light sensors. She also highlighted that occupants ought to be made aware of the existing lighting and thermal controls to reduce energy wastage.

Kevin Li

Kevin studied the renewable energy, specifically solar energy, used on the University estate. He reviewed one project in particular, the Department of Engineering's Energy Roof. He discussed how to best allocate PV modules across the estate and estimation about the energy contribution by solar energy.

Kevin found that the installation of the Energy Roof at Engineering could have been done more effectively,

but that it is functioning well and is an excellent teaching tool. He took the example of the roof at Engineering and applied it to the rest of the estate. He calculated the total roof area of the estate and found the active area for PV is 47.5% of the University roof space. If all of the PV is put on this space it could decrease scope 2 emissions by 2.5% from a 2005 baseline and help the University meet its carbon reduction targets.

Kaitlin Venestra

Kaitlin produced a case study of potential strategies for sustainable refurbishment of the Earth Sciences building at the University of Cambridge with consideration of the effects of predicted global climate change on the building's energy and comfort performance over the coming century. The project was undertaken as an individual dissertation for her MPhil in Architecture and Urban Studies.

She found that the building's traditional construction, alongside retrofit measures that include passive features can completely meet the thermal needs of a lower energy occupant without the aid of mechanical conditioning. The risk of severe overheating within the building increases if laboratory equipment remains and external temperatures rise as forecast in the worst-case climate change scenarios. She recommends in the worst case scenario, the University should consider moving the Department of Earth Sciences to a different building which is fitted to deal with the high internal heat gains of scientific laboratory equipment.

I am extremely grateful to the Living Laboratory for the amount of data and contact information about the Earth Sciences Department provided and for helping make this research work possible.

-Kaitlin Venestra

Jan Monica

For Jan's MPhil, he looked at how costly energy-efficient retrofits often fail to deliver on projected energy savings and problems frequently derive from a misalignment between occupant behaviour and increasingly complex building operational systems. His study set out to explore social media and email techniques to strengthen user feedback loops in buildings to report on user behaviour and perceived problems in the environment of the building. He carried out a case study in the Engineering Department, in which a closed Facebook group and short online surveys were tested as tools to collect occupants' time-referenced, momentary emotions associated with the indoor environment.

Jan found that participation was low in the Facebook group he created and only four members regularly completed the short surveys. In contrast, he found that about 60% of people in his study regularly participated in the 14 short surveys he sent, adding up to 347 responses. The average response time of around one minute indicates that people reported momentary emotional experiences. This suggests that email surveys might be a better way of reporting than social media for environmental related issues in buildings.

Ray Pritchard

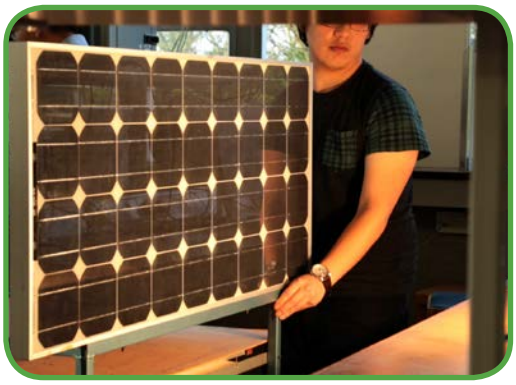
BREEAM (Building Research Establishment Environmental Assessment Methodology) certification and low-energy building designs have been booming in recent years, thanks largely to a combination of client-led demand and government-led energy performance requirements. However, despite the proliferation of green buildings, there is a growing recognition of the disparity between design expectations and as-built performance. For his MPhil, Ray investigated this 'energy performance gap' which, for typical new-builds, is frequently cited to result in energy use which is 1.5 to 5 times higher than design estimates. The University of Cambridge requires any new building to achieve a BREEAM rating of 'Excellent' with a minimum rating of 'Very Good.'" However, given the existence of performance gaps in the University estates in Cambridge and elsewhere, BREEAM's suitability for realising energy efficient buildings was brought into question in Ray's MPhil project. Ray focused on the Institute of Manufacturing as a case study and found that much of the performance gap in this building was due to overestimations during the design stage of the building. His work contributed to a summer internship completed by Ishbel Cullen which looked at the practices of the University when it comes to Post Occupancy Evaluation, POE, a process of review and assessment after a building has been built to ensure compliance with the design estimates. The POE process at the University is now being reviewed by Estate Management and much of the research that has taken place is being used in consideration of how to improve the process here at Cambridge.

Dimitra Dansiou

Dimitra is a PhD student whose research aims to understand the complex nature of energy consumption and comfort practices and the ways these form, interact and change in a workplace environment. Through the understanding of energy related practices, her study aims to improve energy efficiency measures and feedback strategies in office spaces.

Dimitra has been researching the real time energy displays (devices that show the energy consumption of a specific building and building area) that are being implemented across the University. She first studied the offices before the implementation of the energy screens and her initial findings highlighted the influence of social dynamics and existing technological configurations towards a profile of a passive office user. The conclusions suggested the need for further information, supporting the need for the implementation of the energy displays. Dimitra has planned to collect a second round of data to understand what happens when energy use feedback arrives. Her research will help the University understand how best to implement this technology and the kind of supporting materials needed to make it most effective in changing behaviour and reducing energy use in buildings.

Photovoltaic (PV) Project Class



The Living Lab has funded software for a PV course in the Department of Engineering. Students are able to use professional software provided by the Living Lab to model buildings and assess their potential for photovoltaics. Over twenty students have completed this course and presented their findings to Estate Management. This practical course lets students examine both the financial and practical feasibility of PV arrays, combining theoretical learning and professional experience.

Volunteer

Harrison Bowers

Harrison was part of an International Alliance of Research Universities (IARU) Sustainability Fellowship programme, where Cambridge exchanges students with other member institutions. At Yale, he carried out large scale freezer audits of ultra-low temperature freezers. On his return he volunteered with the Living Lab creating freezer auditing training and helping lead a pilot freezer audit at the University. Ultra-low temperature freezers can use the same amount of energy a day as a family home. The University has a very large stock of these freezers and proper freezer maintenance and correct sample storage have been linked to significant energy savings. Harrison's work is the start of a larger investigation that could potentially lead to huge savings for the University.

Helen Taylor

Helen volunteered with the Living Lab and looked at the freezers in the Gurdon Institute at the University. She performed an investigation into the most cost effective and energy efficient models that can be purchased for lab use, before reporting her findings to the Gurdon to help them purchase the most energy efficient freezers that suited their needs.

PDN Audit

A team of five volunteer students had the opportunity to receive training and complete a full professional audit of the Department of Physiology, Development and Neuroscience buildings. Professor Doug Crawford-Brown led a team of students in

the completion of a study of cost-effective measures to improve the thermal energy performance of the buildings as well as an analysis of the management of the scientific equipment within the buildings. Students carried out an occupancy analysis, equipment audits, preliminary electricity metering analysis and a thermal imaging analysis that revealed points of improvement within the buildings. The focus of the report was on potential improvements in the U-values of walls, windows, and doors of the buildings, within the constraints of maintaining desired interior temperatures, humidity and air flow for scientific research.

The top solutions that were most feasible with the highest return on investment were proper management of scientific equipment, insulation in walls around heating pipes, secondary glazing and improved lagging. The results have been handed over to Estate Management and will be considered for implementation and have also been handed to a consultant who has been auditing other buildings at the University.

Awards

Seed Award

The Living Lab hosted the Seed Award as its annual competition. Students were encouraged to propose ideas that would be funded up to £750. Two projects were picked as winners:

Skills for Sustainability

Run in partnership with the Cambridge Hub, a student volunteer organisation, students receive training in various areas of sustainability and then complete projects with partnering organisations. Skills for Sustainability provides recognition and structure to student-led projects in sustainability both at the University and in the wider community. The project is embarking on its initial year with the help and support from the Environment and Energy Section.

Through this programme, the University benefits from students assisting the reduction of its own environmental impact whilst fostering the creation of future leaders equipped to address sustainability challenges through developing their experiences now.

-Emily Dunning

One World Challenge

The Seed Award also helped to fund the One World Challenge, an online contest where participants form teams and, over a three-week period, take on challenges that encourage environmental awareness and action. Points are awarded for accomplished activities and teams can compare their success with other teams in the University as well as at other participating universities. For more information on the One World Challenge visit the website: www.cam.weact.ch.

Internships

Jalal Ahmed

Jalal worked this summer as the Environmental Data Intern, sitting within the University's Environment and Energy Section. The University is obligated to submit environmental data to the Higher Education Statistics Agency (HESA) annually and in previous years this has proved to be a time-consuming task as environmental data responsibilities are widespread. In particular, the HESA data required last year was revamped and now requires environmental data in greater detail than before. Jalal was tasked with providing a coordinated approach to the collection, analysis, and reporting of environmental data. He produced several tools that are now actively being used to handle the University's environmental data.

Ciju Puthupally

Ciju was the Communications Intern. Ciju's work focussed on two broad projects. First he reviewed the Environment and Energy Section's current communications in the light of behavioural psychology and the approaches of peer institutions to produce a report detailing recommendations for improvement. Secondly, with the benefit of that evaluation, he worked on expanding the Environment and Energy Section's resource base by producing materials such as compelling statistics, induction sheets, and best practice guides on ultra-low temperature freezers, server management and procurement. Much of Ciju's work is now online and available for staff across the University to use.

The exposure this internship gave me to the technicalities of sustainability initiatives, not only from my own project, but from being part of a wider environmental team – sitting in on their meetings, experiencing their day-to-day work, hearing their views – has been invaluable. On the whole, I feel a great deal more literate about the practical side of sustainability.

-Ciju Puthupally

Ishbel Cullen

Ishbel, from Australian National University, was the Post Occupancy Evaluation (POE) Intern. POE is a process of review and assessment after a building has been built to ensure compliance with the design estimates as well as the needs of the occupier of the building. The aims of the project were to review past approaches to POE, research best practice and make recommendations for how POE should be undertaken in the future at the University. This work was initiated because it had been recognised that the current approach to POE was limited in effectiveness. Ishbel was able to meet with Ray Pritchard and consult him on his research and was also able to work with Project Managers in Estate Management to perform her research. With the University experiencing a period of large expenditure on new projects, POE is particularly important. Ishbel was able to present her findings to Estate Management with recommendations of a revised structure for POE. Her recommendations are now being taken into consideration by the Project Management team.

Initially I felt challenged by aspects of the project, especially considering I do not have any background in architecture, engineering or the construction industry. However, I soon realised that detailed technical knowledge was not required for me to make a useful contribution. Instead I used my skills in research, communication and critical thinking to highlight problems and identify solutions. This was empowering for me to recognise my strengths and apply them in an unfamiliar context. I really enjoyed working in a real world setting, where my research could influence real change. I'm grateful to the Living Laboratory for providing this rewarding experience.

-Ishbel Cullen

Fred Lowther Harris

Fred was the Video Conferencing Intern from the University of Copenhagen. His project was to carry out research related to the improved use of video conferencing within the University of Cambridge. A range of approaches were taken in order to get a rounded and comprehensive view, such as contacting all University departments and faculties to compile information, and producing a survey to understand what the members of the University require from video conferencing facilities. He also reviewed the University's current system and compared it to other Universities.

His survey yielded very useful results and gave better insight to the use of video conferencing at the University. He reported these results back to Video Conferencing Services at the University. Conclusions from his survey were that overall people who have used the video conferencing services at the University were happy with it, but that general awareness of the facilities was low across the University. It was also suggested that the service be provided without cost and be advertised to drive wider uptake.

Recognition

Over the past year the Living Lab was recognised in two separate ways, both nationally and internationally.

Green Gown Award

The Living Lab was nominated and shortlisted for the Green Gown Awards, a national awards scheme that recognises best practice in the sector. Though the Living Lab did not win it was an honour to be nominated and recognition of the programme's ongoing success.

IARU Green Guide

The Living Lab was featured as best practice in an International Association of Research Universities (IARU) publication as best practice in creating a living lab. Universities all over the world can consult the guide and contact the Living Lab at Cambridge for help and support.
http://www.iaruni.org/sustainability/green-guide

Future Plans

The Living Lab is grateful for the continued support and funding from Santander which has enabled it to continue its work for the next three years. The Living Lab plans to continue to support students through its revised four strands and to develop new and exciting projects with academic staff. In addition, it will continue to consider the results of projects for adoption on the estate.
The Living Lab is currently exploring options to support and partner with the Cambridge Hub for the 2015 Climate and Sustainability Forum as well as researching any other Volunteer Projects that need support. The Living Lab projects will continue to be promoted online as well as via other internal and external publications to increase the interest in the programme.

With three more years of funding, there are plans to increase the number of academic courses and modules that the Living Lab can support. The Living Lab also plans to continue to fund summer internships and maintain the successful academic and volunteer strands.