



# *Living Laboratory* Annual Report 2012-2013

## Purpose

The purpose of this report is to provide Santander with an update on the first year of the University of Cambridge 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 improving 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.

It is a 2-year project that started in October 2012 with funding from Santander to enable programme delivery and the successful creation and recruitment of a programme coordinator.

## 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 beyond the 2-year funded programme.



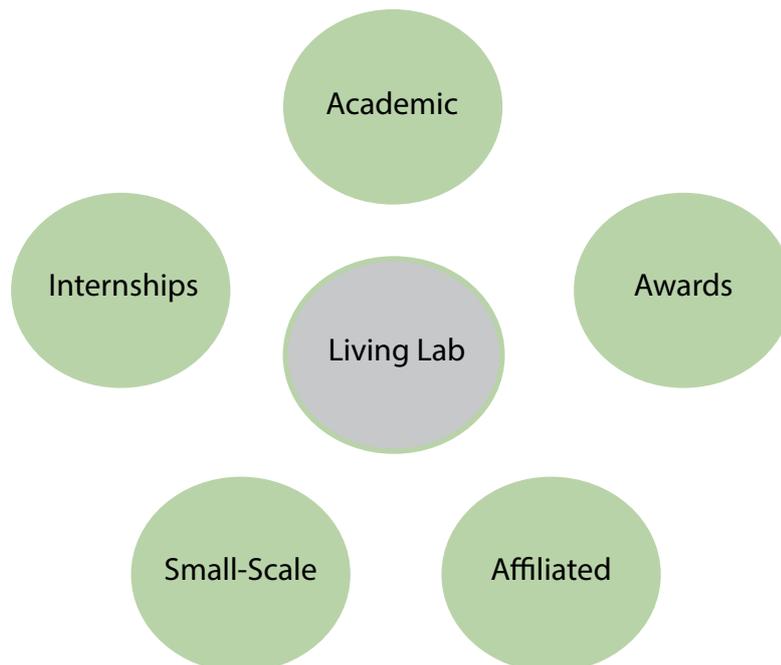
## Coordination and Governance

The Living Lab sits within Estate Management at the University of Cambridge within the Environment and Energy Section. Programme management is undertaken by the Living Laboratory for Sustainability Coordinator, Claire Hopkins, under the direction of the Head of Environment and Energy, Joanna Simpson. Outputs and learning from Living Lab projects are fed back into Estate Management through the Environment and Energy Section. The Living Lab is overseen by an Advisory Group, which is responsible for providing strategic direction to the programme. The Advisory Group includes Estate Management staff as well as engaged academics and representatives from student groups.

Ideas for projects come from students and academic staff, as well as from Estate Management staff. The Living Lab Coordinator maintains a database of all of the ideas. Ideas also come from the Energy and Carbon Reduction Project (ECRP). The ECRP is a 10-year project with a £2 million budget to help the University reach its carbon reduction goals.

## Framework

The Living Lab has five strands to engage the University community at different levels.



### 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. The Living Lab Coordinator leads on identifying projects through publicising the programme and meetings and discussions with interested staff and students.

### 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, as judged by the Advisory Group, to enable the solution to be implemented.

### Small-Scale Projects

These are projects carried out by students that are not part of their academic studies. For example,



these 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. Small-Scale Projects are decided and monitored by the Environment and Energy Section, specifically by the Living Lab Coordinator.

### Internships

Paid internships are offered to students during the summer holiday period to take on focused projects.

### Affiliated Projects

These are relevant projects that are already occurring or are being undertaken by other organisations within the University that the Living Lab can help support and promote. These projects could be from, for example, student societies or academic research.

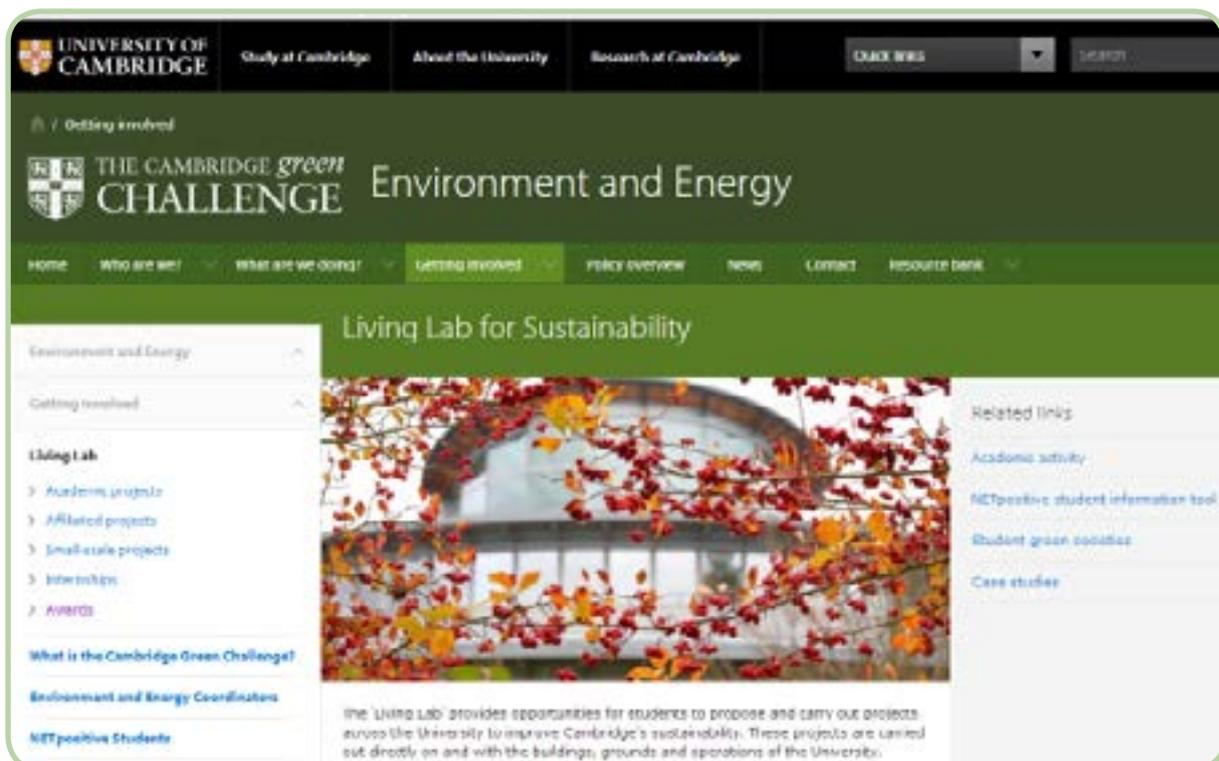
## Communication

The Living Lab is promoted through web content, presentations, meetings and external media. A communications strategy is being developed for the Environment and Energy Section.

### Web Content

The Living Lab has a web page that serves as an information point for interested parties. It is hosted on the Environment and Energy Section website, launched September 2013. The website hosts available projects that can be completed by students as well as information on past projects that students have completed.

The new website can be found at this address: <http://www.environment.admin.cam.ac.uk/getting-involved/living-lab>





### Presentations and Meetings

The Living Lab Coordinator has made and will continue to make presentations to interested academic courses and groups to generate interest in the programme. The Living Lab Coordinator organises meetings with University academics and staff to develop Living Lab projects and build relationships with departments to gain student interest.

### External Media

The Living Lab has been and will continue to be represented in University publications, such as departmental newsletters, to publicise opportunities. The Living Lab will also be included in online publications like Greenlines, the University's monthly sustainability newsletter.

## 2012-2013 Project Strand Activity

### Academic Projects

There are several projects in this strand that are in progress or that have been completed over the last 2012-2013 academic year. Students undertaking these projects are undergraduates, MPhil and PhD students from a variety of academic disciplines and backgrounds.

Efstratios Gavotsis worked with the Living Lab for his MPhil in Architecture. One of the papers for his degree is concerned with energy and carbon reduction with technical intervention as opposed to building occupant intervention. He found that changing occupant behaviour in a building rather than installing technical interventions can reduce the energy use of that building by 5 to 20%. His research has helped reaffirm the importance of occupant behaviour in buildings and the need for occupant engagement in sustainability.

Alex Coburn produced a paper for his MPhil in Architecture dissertation that discussed retrofit options for listed buildings. Specifically, the Scott Polar Research Institute was investigated as a case study. It was found that, in this case study, draught-proofing would be a more effective energy-saving strategy than replacing the original windows throughout the building. The strategy that he proposed indicates that it would be the most cost effective solution in reducing the energy consumption for the building while considering the building's listed status. His recommendations have been passed onto members of the Environment and Energy Section for consideration.

Dimitra Dantsiou is using the Living Lab to help research behaviour and sustainability for her PhD. She is examining the impact of behavioural change campaigns at the University of Cambridge, specifically Switch Off Week 2013. Switch Off Week was a week-long event that encouraged University members to be more aware of their energy use. She plans to look at the reductions made during Switch Off Week and see if they continue beyond the event. Dimitra also plans to

*"Usually finding one's data for the research, takes a considerable amount of time. The Living Lab, enabled me to have easy and quick access to a lot of useful information without the need to wait for a long time. It helped me practice on an actual case study rather than a fictional building. This makes the process of learning much more interesting and instructive. I was given the chance to interact with many of the University staff and students making new friendships. It gave me the feeling of contribution to making the University more sustainable."*

*-Efstratios Gavotsis*



assess awareness of the event through a staff survey. Results from her research will help the University to plan future engagement events that promote sustainability. She also has been researching the use and effectiveness of energy dashboards, a tool that allows occupants to see their building's energy consumption in real time. The University is considering using energy dashboards in many of its buildings. Her research will help inform the University as to effective placement of dashboards and corresponding recognition and competitions to go with the technology.

Dana Boyer is completing her MPhil in Sustainable Development. She is studying the feasibility of incorporating vegetation into the built environment with the aim of increasing human wellbeing. She is specifically looking at its feasibility within a portion of the Department of Engineering.

William Hudson is completing his MPhil in Sustainable Development. He is examining the performance of past heat pump installations around the University estate in recent years - and potentially other commercial installations around the city. It is hoped that weaknesses in past GSHP planning, installation and operation can be identified, and benefits of improved practices in the future can be demonstrated. This may lead to a 'best practice' document for future planning and installation, as well as an examination of current practices in pump operation.

*"The Living Lab has worked as a platform for my research to explore in a creative and collaborative way the sustainability aspects of the University campus. It provided support and guidance along with enthusiasm for new ideas, turning the University into that testing ground to study, apply and share lessons learned both with the academic community and the public."*

*-Dimitra Dantsiou*

Four students will be undertaking research for their fourth year dissertations in Engineering. Two students will be examining one of the newest buildings at the University, the Sainsbury Laboratory. This project will involve the analysis of the energy load for the building, comparing the building energy load and the energy load generated by building users, and investigating what the highest energy users are within the building. It will include identifying reasons for any discrepancies in the performance of the building and making recommendations on how the energy use of the Sainsbury Lab could be reduced. Two students will be looking into the renewable energy sources at the University. One student will examine the current renewables and assess their efficiency and the other student will be looking at renewable strategy and implementation for the future of the University. Students began research into their projects this summer 2013 and will continue to work with the Living Lab through the 2013-2014 academic year.

*"Universities have a unique opportunity to not only improve the sustainability of their estates, but to train the next generation of sustainability champions and provide exemplar sites of sustainability for the communities in which they live. The Cambridge Centre for Climate Change Mitigation Research, and the Cambridge Retrofit programme we facilitate, are therefore finding our participation in the Living Lab of Cambridge essential in joining up our research, education and engagement missions, opening the University estate to our students as a ground for projects giving professional experience to our students while contributing to the sustainability of our workplace."*

*-Professor Doug Crawford-Brown*



## Awards

In late June 2013, GreenBRIDGE, a student society, in partnership with the Living Lab hosted the Living Lab Sustainable Retrofit Challenge 2013. This challenge called on participants to propose realistic yet innovative design solutions for the Department of Chemistry building, to reduce carbon emissions and energy use and help encourage changing occupant behaviour in buildings. Teams from across the country submitted proposals. The top four teams presented in front of a panel of judges that included University professors, Estate Management professionals, and City Council planners.

The winner was the SEDT team from the University of Bath. They proposed an integrated façade renovation strategy that would significantly improve energy efficiency whilst adding value to the street character of Lensfield Road. They also proposed an artificial lighting strategy to replace the existing inefficient T8 fluorescent lighting system with sensor-controlled LED lamps. Included in their proposal was occupant energy literacy with recurring competitions, led through rotating Energy Champions for students and staff, to drive occupant engagement. Their proposal also included the use of photovoltaics on the roof.

All of the submissions have been passed onto the Environment and Energy Section's Building Energy Manager, who has the responsibility of looking at the solutions for energy reduction in major University buildings.

*"I have collaborated with Claire and the Living Lab for the Sustainable Retrofit Challenge which took place last June. It would be really difficult to organise without the Living Lab's support. Claire has been very proactive and contributed a lot to organising the event with success."*

*-Eleni Soulti*

*GreenBRIDGE Event Coordinator*



## Small-Scale Projects

One Small-Scale Project was completed in the 2012-2013 academic year. The Living Lab, in partnership with the Cambridge University Environmental Consulting Society (CUECS) performed a thermal analysis of the Institute of Criminology building. The thermal analysis was followed with an energy audit of the building. CUECS presented their findings to members of Estate Management and issues in the building have been reported to the Maintenance Unit.



*"I worked with Living Lab to conduct an energy conservation audit of the Institute of Criminology. It directed me to the Institute as a good case study, and got me in contact with all the right people within the University estate. I would definitely recommend it to students looking for a practical and educational extra-curricular activity."*

*-Ibrahim Yates  
CUECS Member*



## Internships-2013

Two interns, a Building Energy Performance Intern and a Promoting Positive Behaviour Intern, were hired for 8 weeks each. There were also two International Association of Research Universities (IARU) Sustainability Fellows undertaking Living Lab projects.

IARU consists of ten of the world's leading research-intensive universities who share similar visions for higher education and sustainability. As part of the IARU Sustainability Fellowship Program, the Environment and Energy Section of the University of Cambridge exchanges students with other IARU Institutions. IARU Sustainability Fellowships provide selected students with the opportunity to work on targeted campus sustainability projects at IARU member institutions. The students in the office this summer were from Yale and ETH Zurich. They chose to work on plug loads at the University and reviewing the University's environmental design guidelines.



The Building Energy Performance Intern, Tom Norris, examined the Alison Richard Building, the Kavli Institute and the Hauser Forum. This project involved analysing the energy load for each building, comparing the building energy load and the energy load generated by building users, and investigating what the highest energy users are within the buildings. Tom worked with Estate Management professionals and building users to develop recommendations on how the energy use of the buildings could be reduced. Tom was able to highlight a major need for increased monitoring as well as some equipment that was malfunctioning.

Specifically, Tom was able to highlight that several ground source heat pumps were not performing as designed. This finding will allow the University to fix the malfunction and save gas and electricity in these buildings. Tom was also able to work on an ongoing innovative monitoring project with the Faculty of Computer Science and Technology to address the monitoring issues he found in the buildings he was studying. All of Tom's findings and suggestions will be considered by the Environment and Energy Section. He will be continuing his research and work with the Living Lab for his final year dissertation.

*"My experience at the Living Lab has been invaluable in my research towards my final year dissertation and I hope that my resulting report will aid the future policy of the University in the field of sustainability. All the staff in the administrative service have been extremely receptive to my suggestions and the future is looking bright with regard to implementing building energy performance monitoring solutions across the estate."*

*-Tom Norris*





Katherine Hagemann from Yale University performed a cost-benefit analysis of laboratory equipment, specifically drying ovens, fridges and freezers, to see if replacing existing equipment with more efficient models would be financially and environmentally beneficial to the University. She was able to make a case for replacement for a large variety of brands of drying ovens and freezers used across the University. She also developed a tool to assess the plug load of specific equipment that can be used to help determine the financial and environmental ramifications of replacement. She created another auditing tool that student volunteers can use to help highlight whether specific equipment could potentially have a case for replacement. The Environment and Energy Section are considering the use of these tools in future projects as well as how best to take the results of the cost benefit analysis forward.



Ivelina Grozeva from ETH Zurich reviewed and made recommendations for improving the University's environmental design guidelines for constructing new buildings. She reviewed the 2008 policy and met with project managers in Estate Management, and examined the University's use of BREEAM.

Her final report proposed a bespoke sustainability framework be developed and implemented for new buildings. Ivelina also proposed that this framework be developed into a web tool which is specific to new buildings and refurbishments that building users could interact with. Her report opens up thinking on the positives and negatives the University faces when using BREEAM and will feed into the future review of the environmental design guidelines to inform future decisions on new buildings and renovations.

*"During my IARU internship I was able to gain an insight into the practical implementation of sustainability issues, I had the chance to meet the people responsible for the built environment of the University of Cambridge and develop a knowledge of what the new framework could look like to hopefully facilitate the sustainable future of the University's estate. My IARU internship has been a very valuable experience working in a pleasant atmosphere and I sincerely hope my findings and my recommendations will contribute to a sounder and better environment for the University."*

*-Ivelina Grozeva*



The Promoting Positive Behaviour Intern, Sophus Zu-Ermgassen, started by researching behaviour change campaigns at other universities and organisations. Sophus also looked at programmes that have been run already at the University of Cambridge. Following his research, Sophus worked with key University staff in buildings on the estate to design and produce resources for several behavioural campaigns and initiatives to be implemented in the next academic year. Sophus focused on the Department of Chemistry and the Gurdon Institute. He designed a campaign around shutting fume cupboard hoods as well as created best practice guides for -80 freezers and staff inductions. The resources created during this internship will be available to all departments from the Environment and Energy Section upon request. A pilot fume cupboard hood campaign, 'Shut the Sash', will be run in the Department of Chemistry over the 2013-2014 academic year and, if successful, it is estimated that it could reduce the University's carbon emissions by up to 2% and save £225,000.



## Affiliated Projects

There have been three Affiliated Projects undertaken since the start of the Living Lab.

At Murray Edwards College, a plot of land was allotted to a group of keen gardeners from various Cambridge organisations including Growing Spaces, Transition Cambridge, Cambridge Hub and the Living Lab. This land has been used to build a community garden that allows University staff, students and community members to grow fruit and vegetables together. This project aims to build biodiversity in the area as well as to improve the wellbeing of the community. The Garden has over 20 regular volunteers and the support of a steering committee. The Living Lab has provided strategic guidance to this project to help the garden get started, and was able to help connect the various groups together to make this project a success. It has also provided publicity to gather volunteers.



The University Library has been identified as one of a small set of buildings on the University estate that has priority as a target for energy and carbon reduction measures, due to the percentage of the University's energy and carbon footprints represented by these buildings. The Living Lab partnered with Cambridge Retrofit, a landmark community-scale energy efficiency initiative to retrofit buildings, to address the problems in the building.

Professor Doug Crawford-Brown, head of Cambridge Retrofit, led a team of students in the completion of a study of cost-effective measures to improve the thermal energy performance of the building envelope. Students carried out an occupancy analysis, a preliminary electricity metering analysis and a thermal imaging analysis that revealed points of significant heat loss throughout the building. The focus of the report was on potential improvements in the U-values of walls, windows, doors and the roof of the University Library, within the constraints of maintaining desired interior temperatures, humidity and air flow.

The report's proposals were presented to the University Library and are being considered for implementation. The top solutions that were most feasible with the highest return on investment are insulation for radiators, insulation in walls around heating pipes, secondary glazing and improved lagging. This project continued this summer with the students carrying out an electricity survey of lights and plug loads in the building. The final report on the energy profile of the building will be finished at the beginning of the 2013-2014 academic year. The results will be presented to Estate Management for consideration.





The Living Lab also helped to support the Cambridge Hub's 2013 Climate and Sustainability Forum, an annual event aimed at engaging the University and wider community in sustainability, by sponsoring the catering for the event. The Forum hosted speakers from the University of Cambridge and Anglia Ruskin University, who spoke about the research being done with regards to climate change mitigation. Both local and national climate and sustainability groups were able to share their successes and the challenges they have encountered throughout the day's events. The Living Lab was able to present and promote itself through this event. There were inspiring talks, interactive workshops and opportunities to network with the speakers, guests and other organisations.



*"It has been fantastic working with Claire and the rest of the team from the Living Lab*

*over the last year. Their support for the Climate and Sustainability Forum, as well as the more general collaboration we have had with them to support student activity on environmental sustainability issues within the University and beyond has been really valuable to us and we are looking forward to working together over the coming year!"*

*-Emily Dunning  
Cambridge Hub Manager*

## Future Plans

The Living Lab Coordinator will continue to strengthen the Academic Projects strand by facilitating ongoing projects and by reaching out and making connections with different departments to increase student and academic interest as well as the diversity of academic disciplines that projects covered. Progress has already been made as the Living Lab has started conversations to work with the Psychology Department and the Department of Land Economy in the coming months.

There will be an Award held during the 2013-2014 academic year in which students will submit funding applications for sustainability projects that they would like to carry out on the University estate. The winning application will receive funding and support from the Living Lab to carry out their project proposals. This will give the students a greater sense of impact and involvement in the environmental practices of the University.

Partnerships have been formed with student groups and several Small-Scale Projects are being developed. These projects include more work on energy and waste auditing in University buildings as well as examining the biodiversity of the estate. Internships will be offered to students during the 2014 summer holiday. Relevant projects will be identified by estate staff and the Living Lab Advisory Group. The possibility of having students being employed to carry out projects during term time is also being explored.

The Living Lab is currently exploring supporting and partnering with the Cambridge Hub for the 2014 Climate and Sustainability Forum as well as researching any other Affiliated Projects that need support. The Living Lab Coordinator will continue to publicise and promote Living Lab projects online as well as other internal and external publications to increase the interest in the programme both internally and externally to the University.

With the continued support of Santander, each strand of the Living Lab will be developed in order to increase the effectiveness and impact of the programme over this academic year.