Institution: Keele University

Unit of Assessment: B7 Earth Systems and Environmental Sciences

Title of case study: Environmental Outreach to Business and the Community

1. Summary of the impact

This case study is based around a network of activities and collaborations, that have affected over 100 companies and around 25,000 people directly (and many more indirectly). This is illustrated through 4 specific initiatives:

a) Project Green
b) Science for Sustainability
c) Resilience of land/water resources
d) Keele University Sustainability Hub

These initiatives have been developed directly from expertise in specific areas of environmental and sustainability research, with a strong focus on collaboration across the traditional disciplinary boundaries – geoscience, chemistry, engineering and social science have all been key components.

'Project Green' was launched in 2011, and was initially an 18-month project to provide sustainability training and internships for job-seeking graduates; the project (including follow-on schemes) has supported well over 200 graduates, with placements in over 100 organisations (mainly businesses), and external funding of over £1M.

'Science for Sustainability' was established in 2006, to disseminate important environmental sustainability issues to communities and the public through displays, road-shows, public talks, school outreach and partnership working with Councils and third-sector organisations; it operates locally, regionally and nationally, and has so far engaged >25,000 people from schools and the general public

The work on land/water resilience is one specific example of collaborative work that is having a major impact on drought/flood issues that are of increasing global importance, using new environmental monitoring and data analysis techniques that have been developed at Keele.

The 'Keele University Sustainability Hub' comprises a £3.5M renovation of a derelict farmhouse, to create a unique 'green' resource. This exemplar sustainable building houses teaching (including a new MSc programme), research on sustainable energy and community engagement, and a wide range of external engagement and outreach activities. Its underpinning principle is the cross-fertilization of these activities, and the Hub has hosted an average of >1000 users per month since opening in 2011. Developing environmental sustainability research is a key 'top-level' strategic vision for Keele, and the Sustainability Hub acts as a focal point for education, outreach, widening participation and, most importantly, collaborative research and development and engagement with industry, business and the public sector and other external organisations.

2. Underpinning research

Keele University has a long history of environmental and sustainability research, both in discipline-specific projects and multidisciplinary programmes going back nearly 20 years. Environmental geophysics, sustainable technology and materials chemistry and environmental policy represent the core of Keele's environment-related research, with funding well in excess of £10M from RCUK (NERC, EPSRC, ESRC), EU, industry and other funding bodies. Since 2008, Keele has been awarded ~£3M of external research funding across the environmental-sustainability research, including several large, multidisciplinary grants.

In 2011, Keele University was awarded £3.4M from the HEFCE Strategic Development Fund, to develop its campus-wide sustainability initiative, and explicitly to include resources and facilities to support research in its new Sustainability Hub building. Specific research programmes that are integrated into the Hub's educational and outreach activities include the following:

i) Resilience of land/water resources: This includes the characterisation, monitoring and assessment of river-ground water systems, the impact of climate change on these systems, and the interaction/impact of pollutants (e.g. industrial spillages) on soil proprieties and agricultural/land management practices. Keele has been awarded significant RCUK and industrial funding to support this research. For example: Cassidy – Characterising ground waters with GPR (EPSRC, £260k); Ullah – Long-term/large-scale interactions of carbon and nitrogen in freshwater systems (NERC, £400k to Keele as part of a £2.5M NERC consortium grant with seven other HEI and NERC partners); Cassidy – Tree-induced subsidence (Industrial PhD funding from InFront Solutions, £60k).

ii) Low carbon energy generation: The work of Styles on coal-bed methane extraction, geothermal energy, and wind-turbine characteristics (see second Impact Case Study) is focused around the Hub, and includes pilot research using boreholes (up to 800 m) into the underlying coal seams, and vertical axis wind turbine experiments. The work of the Styles group over the past 20 years, with funding in excess of £5M and extensive publications, informs a substantial component of Project Green and our follow on engagement with regional businesses and organisations.

iii) Applied sustainable technologies: The 'Science for Sustainability' programme (SfS) is based on the sustainable/green technology and environmental change research of Robinson and Ormerod (UoA15), and see also UoA21. The SfS initiative aims to a) promote and disseminate research in clean energy, environmental policy and sustainable business practices and b) stimulate public discourse and wider interest/engagement in environmental science-related issues, particularly amongst young people. The underpinning research includes funding for fuel cell technologies and biogas utilisation (Ormerod) going back to 1995 of over £5m from RCUK, EU and industry; climate change studies using glacial indicators (Robinson), and sustainability and sustainable community engagement research projects (Ormerod and Robinson, >£600k, including recent ESRC/EPSRC funding 'Reducing energy consumption through energy knowledge networks' (RECCKN).

3. References to the research

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4. Details of the impact

Resilience of Land/Water Resources: From 2006-2010, Cassidy and Pringle were funded by InFront Solutions Ltd (a national environmental engineering consultancy) for doctoral-level research into the effect of extreme climate variation (wet-dry cycles) on the moisture/physical properties of swelling clays associated with Tree-Induced Subsidence (TIS). Tree-induced subsidence costs UK homeowners/taxpayers in excess of £400M per year in building damage, and is an increasingly world-wide problem for major insurance companies. The research showed that the damaging influence of tree root systems is more spatially extensive than defined in the UK/EU building guidelines and that current TIS assessment techniques are limited in their ability to define the extent and scale of building-impacting ground movement [1].

The work has been showcased by the Clay Research Group, a UK-based, EU-wide research and development forum that advises the international insurance industry (e.g. Zurich Insurance, Direct Line) who have now incorporated the research findings into their guidance on assessing TIS impacts and mitigation techniques [2]. As a direct consequence, Keele staff have been invited to present keynotes at major end-user events/conferences, including the UK Subsidence forum (the key UK event for dissemination of research for the international insurance and building technology community), the South African National Geoscience Congress [3], and exhibiting at the Royal Society's "Labs to riches" research engagement event in 2009.

'Science for Sustainability': From 2008, the Science for Sustainability (SfS) programme has delivered over 350 sustainability/environmental events to nearly 10,000 schoolchildren nationally. Keele staff have worked with approximately 900 teachers and delivered over 100 science outreach and engagement events to more than 16,000 members of the public [4]. These include the "Science tent" at Bestival (which attracts more than 50,000 visitors per annum) in 2011, 2012 and 2013, and invited participation in the British Science Festival, the largest science communication event in Europe [5]. The SfS environmental education group has been shortlisted for three major national awards: the 'Social responsibility' category of the Green Gown Awards (for two years running in 2009 and 2010), the HEI sector sustainability award, and the 'Communication' category award in "Sustain" magazine (the only dedicated UK magazine for Sustainability, Business and the Built Environment) in 2008.

Keele University Sustainability Hub: The £3.5M refurbishment of a derelict 19th century farm (including £2.5M of HEFCE funding and £160k from the Wolfson Foundation), provides a focus for the strategic development of environmental/sustainability research and education across the University. Recently nominated for a Queen's Anniversary Prize, the Hub serves many purposes: a test-bed for new technologies, an outreach centre for schools, a centre for public awareness and a meeting place for interdisciplinary sustainability research. This investment was underpinned by the development of undergraduate and taught postgraduate degrees in Environmental Sustainability, which include strong industrial research collaboration (e.g. placements, industry-supported projects, specialist industrial lectures). The opening of the Sustainability Hub in 2011 led to key partnerships being developed with local councils, businesses (from local SMEs to international major companies such as Rolls Royce, Siemens and Schott), government departments and charitable bodies (e.g. Wildlife Trust, RSPB, Keep Britain Tidy). Since opening, the Hub has had over 20,000 visitors, including members of the public, schools, visiting academics and government representatives [6]. The October 2011 meeting of the Environmental Audit Committee (EAC) was held at the Hub, and led to the establishment of the Sustainability Knowledge Alliance (SKA), which runs annual events jointly hosted by the Royal Society and the British Academy. The SKA have been instrumental in informing government on sustainability and environmental policy-making [6]. Business-related research at the Hub has led to major economic gains for regional industries and national recognition for research innovation. For example, a collaboration between Hub research staff and McCamley Ltd (developer of a prototype 'vertical' wind turbine) was short-listed for a Lord Stafford Innovation Award for engagement of Universities with industry. Working directly with Keele scientists has enabled the company to fully evaluate the performance of the prototype turbine (e.g. assessing MW generation output, vibration and noise levels) and establish its potential application for new markets such as urban-based renewable energy [7].

Project Green: The economic and industry-related impact of the Sustainability Hub is also evidenced by the success of the "Project Green" business-link initiative and its successors, "Keele Connect", "Project FIT" and "Destination Green". Originally funded by HEFCE's Economic Challenge Investment Fund in 2009 and running every year since, this ~£1+M funded initiative combines staff expertise from the environmental sciences and management disciplines across the University. It has provided environmental sustainability-related internships and training to well over 200 graduates in more than 100 different companies, predominantly SMEs, across the region. For example, the most recent cohort of 19 graduates in Destination Green saved 16 organisations 62,000 tonnes of CO_2, 2600 tonnes of waste, 220 MWh of electricity and £60,000 [8]. The programme also resulted in over half the cohort obtaining graduate level jobs, predominantly in the environmental/sustainability sector [8]. An excellent example of the impact of the internship programme is the 2011-12 research collaboration with Kerry Foods, Burton-on-Trent (part of the international Kerry group). In a combined Destination Green/MSc research project supervised by Keele sustainability staff, the company was able to identify potentially recoverable losses of £300,000 per annum in their food processing and waste-water streams [9]. As a result, they have instigated a dedicated programme of waste and environmental awareness across the company (from senior management through to production line), and in its first year of operation was predicted to save the company over £20,000 in lost revenue due to waste-water charges alone [9].

All of these activities align with Keele's institutional vision to be *"an environmentally aware and sustainable outward-facing campus community"* [10].

5. Sources to corroborate the impact

[1] Jones GM, Cassidy NJ, Thomas PA, Plante S and Pringle JK, 2009. Imaging and Monitoring Tree-Induced Subsidence Using Electrical Resistivity Imaging, *Near-Surface Geophysics*, 7 (3), 191-206.

[2] http://www.theclayresearchgroup.org

[3] "Assessing Tree-Induced Subsidence with geophysics", SUBSIDENCE: Emerging Issues 2010 conference, Aston University, 19th May 2010 (Cassidy & Jones)
"Non-invasive Investigation: Modern Techniques", SUBSIDENCE: Emerging Issues 2007 conference, Aston University, 12th June 2007 (Cassidy)
"Geophysics for growth - the latest in soil/crop science geophysics: what can it do for you?" South African Combined Congress, 2010, Bloemfontein, South Africa 19-21 Jan 2010. (Cassidy).

[4] http://www.esci.keele.ac.uk/sfs/
"SfS Event Statistics, 2008-2013" from Keele University SfS Coordinator. In confidential report "EPSAM, B7 UoA Sustainability Hub Impact case study : Institutional Figures.pdf".

[5] http://2012.bestival.net/areas#tomorrows-world/science-tent;
http://www.britishscienceassociation.org/british-science-festival/scientific-sections
http://www.britishscienceassociation.org/british-science-festival/newcastle-2013

[6] Chair of the Parliamentary Environmental Audit Committee (EAC).

[7] www.thelordstaffordawards.co.uk/news.php?item=90**.** Quote extract from McCamley Managing Director *"Working with the University has enabled us to access research facilities and expertise that otherwise would have been beyond our reach..."*

[8] "Keele Connect Summary 2011", "Destination Green Summary 2012" and "Project Green Keele University Placements Review 2008-2011" from Keele University Employer Engagement Officer, Research & Enterprise Services. In confidential report "EPSAM, B7 UoA Sustainability Hub Impact case study: Institutional Figures.pdf".

[9] Green S, 2011. Greening Business: Improving Environmental Impact in the Food Processing industry. Keele University MSc Thesis, pp136.

[10] http://www.keele.ac.uk/strategicplan/