

Challenge Europe Climate 2020 survey

Introduction

Sustainable development and climate change are highly complex issues, which require collaboration across all of society and across professional fields. They also know no geographical or other boundaries. Academic and higher education institutions have a key role to play in supporting action, both as leaders in knowledge generation and transfer, and as educators and major employers. Therefore, the sector is well placed to provide models of good practice for others.

The Climate 2020 project focuses on a survey of third level education institutions across the island of Ireland, on the research they conduct related to sustainable development and climate change, and on the action they take as corporate institutions. It aims to initiate a catalogue of good practice in the third level education sector, and a catalogue of research relevant to sustainable development and climate change. The catalogues are intended to showcase the breadth of ongoing work in Northern Ireland/Ireland, to provide examples of replicable initiatives and to support cross sectoral networking among professionals dealing with sustainable development and climate change. It is important to note, however, that this project only has initiated the work; it is apparent that much more work is being done. One aim of the project is, indeed, to encourage more extensive showcasing or cataloguing of the full breadth of action.

As part of the project, it is intended that short case studies of ongoing action and research initiatives will be published on the websites of Comhar, the Sustainable Development Council in the Republic of Ireland and the Sustainable Development Commission in Northern Ireland. These are intended to help professionals and activists to source information and models of action.

Background

Challenge Europe is a three year British Council project aimed at accelerating progress to a low carbon future. The project involves teams of around 20 'Climate change advocates' aged 18-35 in 15 European countries, including Northern Ireland/Ireland as a single team. The aim is to develop new ways of reducing our carbon emissions, or developing more effective uses of existing methods. Key areas of interest are business, education/communication and policy. In Northern Ireland/Ireland, projects also aim to have an all-island remit, to

the extent possible. Further information is available at <http://challengeeurope.britishcouncil.org/>.

The project is supported by Comhar, the Sustainable Development Council in the Republic of Ireland; the Sustainable Development Commission in Northern Ireland; the Arena Network of Business in the Community Northern Ireland and Cultivate Living and Learning Centre in Dublin.

Methodology

Two separate survey questionnaires were developed, one focusing on action at a corporate level and one focusing on research conducted at the institution. Both surveys were circulated to third level education sector institutions across the island of Ireland; including universities and Further Education Colleges in Northern Ireland and universities and Institutes of Technology in the Republic of Ireland. In total, 54 questionnaires were circulated.

Efforts were made for both surveys to identify key individuals who would be able to co-ordinate responses within their institution due to their familiarity with activities, e.g. Vice Presidents for Research, Directors of Strategic Planning and Directors of Development.

The hard copy survey circulated in early February 2009 was followed up with a phone call, and an e-mail reminder was also sent around a month later. By June 2009, 16 questionnaires had been returned, resulting in an interim response rate of 30%. However, two responses indicated a preference that details not be published, and two responses reported no specific activity.

Findings

The interim findings indicate that there is a considerable amount of research relating to sustainable development and climate change, in many cases conducted within local, regional or international consortia or partnerships. A second key theme to emerge is education, with several institutions highlighting modules, degree courses and shorter professional courses, as well as initiatives aimed at educating the student and staff body more generally on issues relating to sustainability.

Many initiatives involve a business or commercial aspect, and a number are directly related to business development. Finally, third level education institutions are involved in a broad range of institution wide, corporate type initiatives. However, the responses received were predominantly from research departments, or otherwise focused on research, which may underplay the level of institution wide initiatives that exist. **Overall, it should be noted that this exercise is a sample survey, and makes no claim to provide a complete picture**, as this was outside the resources and remit of the project.

Research

The survey highlighted a significant body of ongoing research relevant to sustainable development and climate change. A few key themes emerged from the responses, in particular renewable energy, energy efficiency and environmental research on the impacts of climate change on different elements of ecosystems. Projects often tend to be consortia or partnerships clustering expertise from several institutions, often with an international aspect. Appendix 1 briefly outlines projects listed and responses received. Here, however, only the responding institution has been included, as responses do not always indicate clearly whether projects are carried out through consortia or within the responding institution only.

Many institutions have internal research centres focusing on sustainability. Examples include:

Northern Ireland

- Institute for a Sustainable World at Queen's University of Belfast
- Centre for Sustainable Technologies at University of Ulster
- InnoTech at South Western Regional College

Republic of Ireland

- Tyndall Centre at University College Cork,
- Earth Systems Institute at University College Dublin
- Charles Parsons Initiative at University of Limerick,
- Centre for Renewable Energy at Dundalk IT,
- Centre for Clean Technology at Cork IT,
- Energy Research Centre and Centre for Climate and Air Pollution Studies at NUIG

Institution wide initiatives

Five institutions outlined institution wide initiatives related to sustainable development. The key themes were energy efficiency and education/awareness raising. However, it should be noted that many responses received covered research work only, and therefore it is likely that the extent of institute wide initiatives is wider than represented here.

For example, National University of Ireland Galway (NUIG), Cork IT and Dundalk IT have recently launched initiatives aimed at encouraging switch off of machinery during campus down time; at Dundalk IT, this is coupled to automatic switch off of computers every evening, and at NUIG to awareness raising on reducing waste. Cork IT is embarking on a Sustainable Campus Programme aimed at reduced use of water, electricity, gas and resources and less waste generation, which involves awareness raising as well as prevention assessment, installation of monitoring equipment, options generation and project

implementation. Energy efficiency is a priority also at University College Dublin (UCD), which has incorporated this as part of its building management system.

NUIG, Dundalk IT and South Western Regional College (SWRC) in Northern Ireland have invested in renewable energy systems on campus. At NUIG, this includes for example solar water heating at one restaurant (meeting 45% of need) and introduction of a 5% biodiesel blend in the van fleet, while Dundalk IT has a wind turbine producing half of the institute's electricity needs and will install a flow battery allowing energy to be stored. SWRC utilizes coppice willow, which is researched at the college, and also has the Camphill Renewables Farm, a demonstration site incorporating a range of sustainable energy sources, from an anaerobic digester to photovoltaics and a wind turbine, that has been used in curriculum development and as an educational tool.

University of Limerick has had a long standing, advisory Environmental Committee of academics, which has resulted in a car pooling initiative, reduced energy consumption, and improved awareness of environmental issues. Cork IT and NUIG are in the process of establishing committees including staff and students to support awareness raising programmes.

Professional education and training

Seven institutions reported professional education and training initiatives, ranging from postgraduate training to shorter courses.

Dundalk IT offers an MSc in Renewable Energy, while NUIG is launching an MSc in Environment and Society in 2010. DIT also offers an MSc in Sustainable Development. NUIG and University of Limerick (with University College Cork, Trinity College Dublin, the National University of Ireland, Maynooth, Cork Institute of Technology, Queen's University Belfast, and Met Éireann) are also part of the Environment Graduate Programme, a consortium of research teams aimed at encouraging take up of PhD level research and supporting doctoral candidates. UCD has an emphasis on sustainable development within a number of PhD programmes offered by the Earth Systems Institute, which is a research centre that concentrates the college's expertise on sustainable development across faculties.

Cork IT began a BEng degree course in Sustainable Energy in 2008, and University of Limerick is introducing an interprofessional Bsc in Energy in 2009. Tipperary Institute runs a degree in Environmental and Natural Resource Management, and South Western Regional College in Northern Ireland offers a Foundation Degree in Rural Sustainability, accredited by Queen's University of Belfast. University of Limerick is developing a module in sustainable development, to be integrated into all degree programmes at the university.

Tipperary Institute also offers shorter professional courses such as Certificate in Renewable Energy, while SWRC trains wind turbine installers and includes biomass boiler installation in the plumbing course. SWRC also ran an Environmental Entrepreneurs programme, which aimed to support innovative business development in the field of renewables.

Conclusion

The interim findings of the survey highlight a significant range and volume of action related to sustainability and climate change. Further work is required to build a wider picture incorporating a larger number of institutions.

Appendix 1: Research

Title of project	Trends in Sustainability
Contact	R Barkemeyer (Queen's University Management School) See http://www.qub.ac.uk/mgt/sustainability/research/trendsinsustainability/index.html for more detail. Also see website for current publications in this area
Outline	<p>There is general consensus that a concerted effort by all individuals, governments, businesses and sectors is required if the goal of sustainable development is to be achieved. Increasing awareness and understanding of sustainable development and the associated challenges and opportunities, has therefore been a fundamental goal of policy makers and interested parties across the globe.</p> <p>This in turn raises an interesting question, i.e., to what extent has sustainable development permeated and entered the general public domain? This is a challenging question, primarily because sustainable development is a broad and multi-faceted concept, that is known by many names depending on the context (e.g., sustainability, corporate social responsibility, etc.) and which incorporates a vast number of economic, social and environmental issues.</p> <p>The 'Trends in Sustainability' website has been developed by the Sustainability & Management Group based in Queen's University Management School to address some of these challenges. It provides an online user-friendly tool to help interested policy-makers and researchers track and understand the extent to which 'sustainable development' is reflected in people's daily lives globally. Amongst other things, the tool enables depiction of the trends both on a regional basis and on an 'issue' basis.</p> <p>The tool enables users to undertake two types of analysis:</p> <p>Assessment of trends in sustainability issues and concepts: These analyses will allow the user to assess how the frequency in the occurrence of certain concepts in the print media has changed over time. The outputs of such analyses can therefore answer the following types of questions: How has the frequency with which 'climate change' appears in the print media changed over time? Comparison of issue trends is also possible.</p> <p>Assessment of the geographical incidence of issues: These analyses will show what sustainability issues are most prevalent in certain geographies. For example, users will be able to assess the most frequently mentioned sustainability issue in South Africa. Inter-country comparisons are also possible.</p>
Timescale	Ongoing

Title of project	Willingness to pay for reducing greenhouse gases
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	emissions and for implementing the measures to reach the Kyoto Protocol targets in the Basque Autonomous Community
Contact	Alberto Longo School of Biological Sciences QUB a.longo@gub.ac.uk
Outline	<p>The Basque Government has recently approved the Basque Plan to Combat Climate Change (BPCCC) which defines targets of and pathways for greenhouse gases reductions across sectors and activities within the Basque Autonomous Community (BAC). Reaching these targets requires a cost to society: all agents, including firms, governments and citizens will have to change consumption habits and modify production activities in order to reduce greenhouse gases emissions.</p> <p>In this study we analyse the general public's attitudes toward and knowledge about energy and climate change in the BAC. We conducted a contingent valuation study with three main objectives: (1) assess public's acceptability of the BPCCC; (2) analyse people's awareness of climate change; and (3) investigate their knowledge and attitudes towards energy.</p> <p>Results show that the respondents are generally aware of the existence of human induced climate change and are concerned with its effects not only for the rest of the world, but also for the BAC and future generations. We also find that the recent financial crisis has had little impact on people's perception about the importance of protecting the environment compared to other socioeconomic goals.</p> <p>The contingent valuation survey focused on eliciting households willingness to pay (WTP) for implementing three hypothetical programs that decrease current greenhouse gases emissions levels in the BAC compared to 1990 levels by (i) 4% through the promotion of renewable energy for producing electricity; (ii) 0.5% through the implementation of energy efficient measures; (iii) 16% through the implementation of the BPCCC. We find, even under the most conservative estimate, that households in the BAC are on average willing to pay 133 EUR as an additional tax for the next four years to support the implementation of the BPCCC.</p>
Timescale	January 2008 - December 2008
Key funding source(s)	Minister of the Environment of the Basque Autonomous Community

Name of	Impact of Climate and Settling on Long-term Performance
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programme/project	of Capping Material for Nuclear Waste Disposal and Management of Contaminated Land Sites
Contact	Dr. Debra Phillips School of Planning, Architecture and Civil Engineering Queen's University of Belfast
Outline	<p>Low permeability caps are an important contamination control option considered for the LLWR site near Drigg and also for radioactively contaminated land on many NDA sites. There is a need understand the long-term performance of natural (i.e. clay, bentonite) capping materials proposed to support safe assessments and to engender confidence in stakeholders. The main research focus of this cap study for radioactively contaminated land are to examine 1) response to projected settlement values, 2) climate induced deterioration (e.g. desiccation and cracking; erosion due to heavy rain events), and 3) the overall permeability of the design. Two 1.5m × 1.5m physical models of a cap will be constructed and stressed according to settlement and climate induced deterioration to examine their impact on the long-term performance of the cap. Engineering tests and soil thin section studies will be carried-out on these models. This study will measure the combined effects of root growth/deterioration and crack development through the soil with depth and their relationship to hydraulic conductivity. Performance of the cap design will be investigated under normal wet conditions and under dry weather (draughts) conditions. Desiccation and crack development in dry conditions which increase permeability will also be studied. The correlations between the number/width/length of cracks caused by settlement and climate impacts in addition to increased permeability due to vegetation growth will be investigated in relation to hydraulic performance. Changes in microstructure of the soil will be examined and quantified with soil thin sections and will be correlated to macro scale performance.</p>
Timescale	3 years
Key funding source(s)	Nuclear Decommissioning Authority

Name of programme/project	SUPERGEN 2
Contact	Graham Savidge Biological Sciences (Marine Laboratory, Portaferry)
Outline	Overall programme relates to engineering and other aspects of tidal and wave energy extraction. Specific project relates to ecological consequences of marine energy extraction systems.

	To assess the influence of physical forces on marine life, plants and communities. Inshore marine energy devices are likely to have a significant impact on the wave and current fields which in turn will have consequences for kelp beds. These beds are major components of the coastal ecosystem. Field observations of kelp beds and experimental studies of kelp plants will be carried out involving high resolution measurements of small scale current motion. The project is at the leading edge of integrating marine physical and biological disciplines.
Timescale	2009-2011
Key funding source(s)	Engineering and Physical Sciences Research Council (EPSRC)

Name of programme/project	Marine Current Turbines
Contact	Graham Savidge Biological Sciences (Marine Laboratory, Portaferry)
Outline	Ongoing comprehensive suite of ecological observations (large animals; benthos; currents) in Strangford Narrows as required by environmental Monitoring Programme for FEPA licence for deployment of SeaGen tidal turbine. Of major national and international interest.
Timescale	2007 - ongoing
Key funding source(s)	Commercial contract

Name of programme/project	MABFUEL
Contact	Graham Savidge Biological Sciences (Marine Laboratory, Portaferry)
Outline	Production of methane by anaerobic digestion of seaweeds - Lab based studies on optimal conditions required for production of methane in Ads using seaweeds as organic substrate. Liaison with QUESTOR
Timescale	2009-2011
Key funding source(s)	EU

Name of programme/project	Marine Institute Galway
Contact	Graham Savidge Biological Sciences (Marine Laboratory, Portaferry)
Outline	Production of methane by anaerobic digestion of seaweeds.

	<p>Estimation of kelp (seaweed) biomass using acoustic techniques</p> <p>Development of acoustic techniques to allow estimation of biomass of kelp in situ in relation to exploitation of kelp as a sustainable resource.</p>
Timescale	2008-2010

Name of programme/project	REDO: Renewable Energy and Discourses of Objection - Towards Deliberative Policy Making
Contact	<p>Dr Geraint Ellis Senior Lecturer Institute of Spatial and Environmental Planning (ISEP) School of Planning, Architecture and Civil Engineering Tel: +44 (0)28 9097 4370 E-Mail: g.ellis@qub.ac.uk</p>
Outline	<p>This project aims to analyse the range of interests, perceptions and tactics related to the development of renewable energy infrastructure in order to inform more effective decision-making that supports sustainable development.</p> <p>The project challenges the tendency to apply over-simplified categories of supporters and objectors to wind farm developments, which overlooks the complexity of the attitudes held and the potential to explore alternative means of resolving the resulting disputes. This will be developed through a case study of the ongoing controversy over a proposed wind farm on the Tunes Plateau off Northern Ireland, one of the most wind-rich parts of the UK. The case study will be used to deepen understanding of the nature of such disputes by identifying the range of interests involved in the debate over the proposed wind farm and analysing their core beliefs, using a technique known as Q-Methodology. This will be used to assess the main areas of conflict and consensus on the proposal and identify potential mediated solutions to such disputes. It is anticipated that the project's findings will inform institutional reform and help identify new approaches to decision-making for locational disputes involving renewable energy infrastructure.</p> <p>The project is now closed and the final report has been issued. However if you are interested in obtaining further Information, please have a look at the REDO webpages - http://www.qub.ac.uk/research-centres/REDOWelcome/</p>
Timescale	2005-2006
Key funding source(s)	Economic and Social Research Council (ESRC)

Name of programme/project	Skills for managing spatial diversity
Contact	<p>Dr Brendan Murtagh Reader Institute of Spatial and Environmental Planning (ISEP) School of Planning, Architecture and Civil Engineering Tel: +44 (0)28 9097 4742 E-Mail: b.murtagh@qub.ac.uk</p>
Outline	<p>This study aims to open a debate about the skills needed to develop sustainable places and communities in Northern Ireland. In particular this research considers the way in which race, religion and poverty interlock to produce 'wicked' urban problems. Drawing on experiences in Northern Ireland, the project offers models of practice to: inform the national debate on Community Cohesion; the management of ethnically diverse places; and the skills set that may help professionals and practitioners resist the pulling effects of residential segregation.</p> <p>The main objectives of the research are to:</p> <ul style="list-style-type: none"> • To contribute to the scholarly debate on the development of skills to manage ethno-spatial diversity in the United Kingdom; • To locate this debate in an analysis of international practice where ethnic residential segregation is managed via planning, housing and urban development systems; • To scope and evaluate the skills set needed to manage ethno-spatial communities in Northern Ireland and highlight the connectivity with national debates on community cohesion. • To audit the current supply of knowledge and skills on spatial planning and development in the region; • To set out the implications for the development of a framework for skills and how this might be applied regionally and nationally.
Key funding source(s)	<p>This research project is a response to a joint invitation by the Economic and Social Research Council (ESRC) and the Academy for Sustainable Communities (ASC) into the development of skills for areas such as spatial planning, social renewal and local; sustainable development.</p>

Name of programme/project	Sustainable construction for developing countries: An examination of decision-making processes used in the planning, designing and building of housing for post-disaster reconstruction.
Contact	Dr Carolyn Hayles School of Planning, Architecture and Civil Engineering
Outline	A number of housing projects funded by charities and NGO's in response to disasters, in developing countries are deemed to be inappropriate due to poor project management and limited resources which may comprise one or more of the following: limited knowledge of local climatic conditions; local materials; and the way people live and work within their communities; and often simply lack of experience. The introduction of structured decision making to allow for the audit of the cognitive processes adopted, alongside access to appropriate tools and techniques to engender the adoption of local knowledge, will reduce the risk of unsustainable building projects. Research is currently being undertaken to capture tacit, implicit and explicit knowledge and map the project management practices of leading aid agencies (NGOs and charities working in disaster relief) to understand decision making practices that result in best practice amongst these organisations.

Name of programme/project	Are building and construction graduate skills meeting the needs of a greener built environment?
Contact	Dr Carolyn Hayles School of Planning, Architecture and Civil Engineering
Outline	The construction and building industry is an industry where employees with knowledge and understanding of sustainability and sustainable development are in increasingly high demand. This is as a result of the push to implement more environmentally sustainable management policies, practices and operations to meet current environmentally focused legislation. The intention of this research is to establish whether skills priorities have changed given the increased awareness of the need to focus on the environment and on building 'green' and whether our current graduates leave QUB with the skills required to meet the needs of the industry.

Name of programme/project	An Investigation into Students' Perceptions and Awareness of Sustainability Issues
Contact	Dr Carolyn Hayles School of Planning, Architecture and Civil Engineering
Outline	This research looks at students' perceptions and awareness of environmental Issues prior to and after completion of a module on sustainable construction and green building design. The module introduces students to the key issues surrounding sustainability and the wide ranging impact that the construction

	<p>industry has on the environment.</p> <p>Students complete a survey on sustainability and paradigm shift activity at the beginning and end of the semester. Results are used to explore whether undertaking the module was associated with more informed and/or transformed perceptions and awareness of sustainability and environmental issues. This knowledge can contribute to the development of teaching materials and delivery.</p>
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Name of programme/project	PLUREL: Science for Sustainable Rural-Urban Regions
Contact	<p>Dr Alberto Longo Lecturer in Environmental Economics Institute of Agri-food and Land Use School of Biological Sciences Tel: +44 (0)28 9097 6537 E-mail: a.longo@qub.ac.uk</p>
Outline	<p>PLUREL is an integrated project under the European Commission's Sixth Framework Programme for research. Sustainable rural-urban land use relationships require proper policies and planning. PLUREL aims to contribute to this by developing strategies as well as planning and forecasting tools.</p> <p>These will help analyse urbanisation trends in the European Union, while they will also contribute to better guidance of urbanisation processes and to minimise their negative impacts. PLUREL's main study subject is the so-called Rural-Urban Region (RUR). The idea of a RUR is an extended form of a Functional Urban Region, i.e. the concept used to describe an urban core and its surrounding commuting ring. The RUR extends beyond today's rings of intense interaction with the core city, as it also includes lands for recreational use, food supply and nature reserve functions in predominantly rural areas.</p> <p>Thirty-one universities, research institutes and private enterprises from fifteen countries participate in PLUREL. Partners do not only come from Europe, but also from China, a country where rural-urban regions are rapidly developing. Inclusion of greater Hangzhou amongst the project's seven case study regions therefore provides an interesting perspective for the European situation. Rural-urban-regions in France, Germany, Poland, The Netherlands, Slovenia and the United Kingdom are also studied. The regions studied represent a wide variety in terms of political, economic, land-use and other characteristics. They all have in common, however, that links between their urban and rural areas are under rapid</p>

	development. Stakeholders in all cases, such as local planners and interest groups, are actively involved in project work. Detailed local analyses are combined with studies at the European level. In this way conclusions can be drawn for Europe as a whole, based on a typology of rural-urban-regions.
Key funding source(s)	EU

Name of programme/project	EXIOPOL: A New Environmental Accounting Framework Using Externality Data and Input-Output Tools for Policy Analysis
Contact	Dr Alberto Longo Lecturer in Environmental Economics Institute of Agri-food and Land Use School of Biological Sciences Tel: +44 (0)28 9097 6537 E-mail: a.longo@qub.ac.uk
Outline	EXIOPOL is an integrated project under the European Commission's Sixth Framework Programme for research. Its main objectives are: <ul style="list-style-type: none"> • To synthesise and develop further estimates of the external costs of key environmental impacts for Europe • To set up an environmentally extended (EE) Input-Output (I-O) framework in which as many of these estimates as possible are included, allowing the estimation of environmental impacts and external costs of different economic sector activities, final consumption activities and resource consumption for countries in the EU • To apply the results of the external cost estimates and EE I-O analysis for the analysis of policy questions of importance, as well as for the evaluation of the value and impact of past research on external costs on policy-making in the EU
Key funding source(s)	EU

Name of programme/project	Sustainable Development through Compressive Membrane Action in FRP Reinforced Concrete Slabs
Contact	Prof David Cleland Centre for Built Environment Research (CBER) School of Planning, Architecture and Civil Engineering Tel: +44 (0)28 9097 5474E-Mail: d.cleland@qub.ac.uk

<p>Outline</p>	<p>This research investigates the performance of FRP (Fibre Reinforced Polymer) reinforcement in laterally restrained slabs. The objective of the research is to design high performance slabs with small amounts of corrosion free reinforcement. FRP is a durable replacement to steel in reinforced traditional slabs. In the past the severe corrosion of steel reinforcement has occurred and the cost to rectify the damages sometimes exceeded the original cost of the structure and involved considerable disruption. The implementation of FRP reinforcement in civil engineering would help to produce sustainable and durable structures.</p> <p>Compressive Membrane Action (CMA) is an enhanced strength development which occurs in laterally restrained slabs. Previous investigations into laterally restrained steel reinforced slabs showed that these slabs demonstrated a different type of behaviour and developed strength far in excess of the design strength calculated by conventional methods. So far FRP reinforced slabs have been purposely designed with excessive reinforcement to avoid catastrophic failure due to FRP fracture and also to improve the stiffness of the slab. However using CMA behaviour, the amount of FRP in the slab can be lowered, allowing for the design of economical and high performance slabs without compromising strength and serviceability. Sustainability is expected to be achieved in the UK by emphasising key tasks such as sustainable consumption, lower energy consumption and using sustainable resources etc. Introducing FRP reinforcement and incorporating CMA with the FRP reinforced slabs can obtain these three major sustainable achievements.</p> <ul style="list-style-type: none"> • Since FRP is a very durable material, unlike steel reinforced structures the FRP reinforced structures will have a longer life span. • As a result of considering CMA action, it is possible to reduce the amount of reinforcement required for laterally restrained slab without compromising its performance. Therefore fewer resources are used. • FRP is a light weight material compared to steel reinforcement. Therefore associated energy consumption for mobilisation and handling in the site is lower. <p>The successful development of FRP reinforced laterally restrained slabs is not only advantageous in achieving good structural design but also makes a contribution to creating a more sustainable world.</p>
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<p>Name of programme/project</p>	<p>FlexiArch: A flexible precast concrete arch</p>
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Contact	<p>Prof Adrian Long Centre for Built Environment Research (CBER) School of Planning, Architecture and Civil Engineering Tel: +44 (0)28 9097 4005 E-Mail: a.long@qub.ac.uk</p>
Outline	<p>Arches have been used in construction for over 2000 years, as they are strong and exceptionally durable. However their use is less frequent in modern construction, as construction is difficult and time consuming, as temporary formwork is needed to support the arch until it is fully constructed. FlexiArch is a “flat pack” precast concrete solution, that allows durable arched bridges to be constructed quickly and easily, that was conceived by staff and students at Queen’s in the late 1990s. The concept was patented in the early 2000s, and in collaboration with Macrete Ireland, the first FlexiArch bridge was installed near Belfast in September 2007.</p> <p>Sustainability is a key aspect of the FlexiArch design. As FlexiArch contains no reinforcement (the main cause of deterioration of modern reinforced concrete structures), it is an extremely durable when properly maintained. FlexiARch is quick and easy to install, reducing any disruption to local communities. It also is transported as a flat beam, reducing transportation costs.</p>

Name of programme/project	Development of a Hazardous Waste Classification Tool for Civil Engineers
Contact	<p>Dr Rory Doherty Environmental Engineering Research Centre School of Planning, Architecture and Civil Engineering Tel: +44 (0)28 9097 4746 E-mail: r.doherty@qub.ac.uk</p>
Outline	<p>The aim of this research is to develop a tool, which would correctly classify Construction, Demolition and Excavation (CDE) wastes allowing efficient use of the Waste Hierarchy at the design stage of civil engineering projects. If potential waste production and classification is considered at the design stage of a construction project, the sustainable strategies of waste minimisation and reuse/recycling of materials become enshrined in the project.</p> <p>The decision making tool will help the end user to classify potential wastes based on the European Waste Catalogue. The tool will eliminate error in waste classification and identify the best process to manage waste. The tool will also reduce the time taken to classify waste as it will be simple to use and eliminates the need to refer to the numerous documents routinely used to classify waste. As the tool is simple to use and requires minimum knowledge it can be used by all</p>

	stakeholders involved in the construction process from design to project completion
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Name of programme/project	Sustainable Remediation Technologies - QUESTOR funded project S7
Contact	Dr Rory Doherty Environmental Engineering Research Centre School of Planning, Architecture and Civil Engineering Tel: +44 (0)28 9097 4746 E-mail: r.doherty@qub.ac.uk
Outline	<p>Active groundwater remediation technologies are energy intensive and this energy requirement is sustained for the life of the remediation. Therefore active technologies are often less sustainable in terms of cost-efficiency, contamination reduction and environmental balance than passive remediation technologies.</p> <p>Geophysical techniques have recently been used to monitor a variety of subsurface environments, including groundwater, contaminant plumes and microbial activity. This project applies geophysical techniques to active groundwater remediation technologies (air sparging and pump and treat) using a series of laboratory and field tests. The geophysical techniques provide decision-making methodologies to increase the efficiency of these active remediation technologies, optimising the need for subsurface drilling, reducing energy consumption and making active remediation a more practicable and sustainable option.</p>

Name of programme/project	Wetland Characterisation/Restoration
Contact	Dr Raymond Flynn Environmental Engineering Research Centre (EERC) School of Planning, Architecture and Civil Engineering Tel: +44 (0) 28 9097 4044 E-mail: r.flynn@qub.ac.uk
Outline	<p>(Completed in Collaboration with Staatsbosbeheer, Trinity College Dublin and the Irish National Parks and Wildlife Service)</p> <p>Widespread reclamation of natural wetland environments has presented Environmental Engineers with a number of new inter-related challenges ranging from predicting the response of peat to drainage to the restoration of damaged wetland habitats. The recent EU Habitat and Water Framework Directives stipulate that groundwater dependant wetlands should be protected from human activity. Understanding the interactions between regional and wetland groundwater regimes is essential</p>

	in order to develop appropriate wetland conservation and engineered restoration programmes. This research examines the role played by groundwater in supporting wetlands and what type of conditions must be in place in order to protect threatened wetland environments and to restore areas damaged by human activity.
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Name of programme/project	Influence of Organic Matter on Colloid Transport and Attenuation
Contact	Dr Raymond Flynn Environmental Engineering Research Centre (EERC) School of Planning, Architecture and Civil Engineering Tel: +44 (0) 28 9097 4044 E-mail: r.flynn@qub.ac.uk
Outline	(Completed in collaboration with the Department of Environmental Geosciences, University of Vienna) Both colloids and organic matter are ubiquitous in the environment and strongly influence water quality and public health. However, the interaction of these materials has yet to be adequately quantified. This laboratory-based research aims to quantify the role that natural organic matter plays in colloidal transport through porous media. Results have important implications in processes ranging from the efficiency of water filters to enhanced transport of colloids in contact with humic-rich waters, and the potential use of organics/colloids in enhancing contaminated site remediation.

Name of programme/project	Aquatic Pollutant Hydrological Pathway Assessment
Contact	Dr Raymond Flynn Environmental Engineering Research Centre (EERC) School of Planning, Architecture and Civil Engineering Tel: +44 (0) 28 9097 4044 E-mail: r.flynn@qub.ac.uk
Outline	(Completed in Collaboration with Trinity College Dublin and University College Dublin) The EU Water Framework Directive requires member states to develop and implement river basin district (RBD) management plans. Irish hydromorphological and geological conditions make this task particularly challenging. This multidisciplinary study proposes integrating existing research/data with further focused data acquisition employing proven techniques, hitherto rarely employed in Ireland, to better constrain semi-distributive hydrological models, thus improving our understanding of the pathways transporting particulate and dissolved constituents.

Name of programme/project	Hydrogeology of Poorly Productive Aquifers
Contact	Dr Raymond Flynn Environmental Engineering Research Centre (EERC) School of Planning, Architecture and Civil Engineering Tel: +44 (0) 28 9097 4044 E-mail: r.flynn@qub.ac.uk
Outline	Poorly productive bedrock aquifers underlie over 60% of the Island of Ireland. Scarce relevant data suggests that many of these units are highly heterogeneous and need to be investigated in detail if site-specific conditions are to be extrapolated to the catchment scale. This project investigates hydrogeological and hydrochemical conditions in bedrock and their inter-relationship with shallower geological units. Integration of site-specific data with regional survey results is anticipated to permit more realistic hydrogeological models of bedrock units to be developed. These models will be used to evaluate future climatic/human impacts on groundwater in bedrock aquifers.
Key funding source(s)	Irish Department of Communications, Marine and Natural Resources

Name of programme/project	Oyster™: wave powered hydro-electric plant
Contact	Prof Trevor Whittaker Environmental Engineering Research Centre (EERC) School of Planning, Architecture and Civil Engineering Tel: +44 (0) 28 9097 4031 E-mail: t.whittaker@qub.ac.uk
Outline	Oyster™ is a seabed mounted Oscillating Wave Surge Converter (OWSC), that operates near to shore in between 10 and 15m depth of water. It is a modular system that can be arranged in clusters of up to 5MW capacity, and the clusters can also be combined into 100MW arrays. Oyster™ exploits an amplified wave surge component to provide a higher capture efficiency in most commonly occurring seas. Decoupling allows electricity generation to continue in extreme seas. It has been designed to allow rapid installation and removal in short weather windows using non-specialist vessels. A 350 kW prototype unit will be installed in Orkney in 2009.

Name of programme/project	LIMPET: shoreline wave power plant
Contact	Prof Trevor Whittaker Environmental Engineering Research Centre (EERC) School of Planning, Architecture and Civil Engineering Tel: +44 (0) 28 9097 4031

	E-mail: t.whittaker@qub.ac.uk
Outline	LIMPET is a fixed structure shoreline Oscillating Water Column (OWC) wave power plant that operates with a pneumatic turbine. A 500 kW prototype unit was installed at Isle of Islay, Scotland in 2000, and this has been extensively researched, publicised and internationally recognized.

Name of programme/project	A wave-powered desalination plant
Contact	Prof Trevor Whittaker Environmental Engineering Research Centre (EERC) School of Planning, Architecture and Civil Engineering Tel: +44 (0) 28 9097 4031 E-mail: t.whittaker@qub.ac.uk
Outline	The limited availability of fresh water is estimated to be associated with 80% of diseases and 30% of all deaths in the developing world. Sea water is readily available in many areas of the world where limited drinking water is a problem. However the high energetic requirement for desalination means that its implementation is often restricted due to limited energy supply. Wave-powered desalination offers an environmentally sensitive solution for areas where there is a shortage of water and sufficiently energetic waves. QUB are collaborating with El Instituto Tecnológico de las Canarias (ITC), Gran Canaria, Spain to bring together the expertise in wave power electricity generation developed at QUB with the knowledge of desalination technology developed at ITC to identify a potential solution for wave power desalination.

Name of programme/project	SEABUS-Network
Contact	Professor Frank Figge Professor of Management and Sustainability Queen's University Management School 25 University Square Belfast BT7 1NN Northern Ireland/UK Tel: +44 (0)28 9097 1363 E-mail: f.figge@qub.ac.uk
Outline	The "International Research Network on Social and Environmental Aspects in Business and Management" (SEABUS-Network) has established a worldwide network of research institutions in order to foster the conceptual and methodological exchange on innovative research on environmental and social aspects in business and management. Under the umbrella of this network the partners strive to further establish their research in the area of the

	management of social and environmental aspects in companies within the international scientific community. The network currently comprises eight research institutions from all over the world.
Key funding source(s)	German Federal Ministry of Education and Research

Name of programme/project	NeW – Sustainably successful?
Contact	Professor Frank Figge Professor of Management and Sustainability Queen's University Management School 25 University Square Belfast BT7 1NN Northern Ireland/UK Tel: +44 (0)28 9097 1363 E-mail: f.figge@qub.ac.uk
Outline	<p>The NeW-project uses the Sustainable Value approach to measure the corporate sustainability performance of manufacturing companies in Germany. The Sustainable Value approach uses opportunity cost thinking to assess and manage sustainability performance. This approach allows researchers to measure and manage sustainability performance in monetary terms. While all existing approaches to measure sustainability performance are burden-based Sustainable Value uses value-oriented thinking that was restricted to the measurement of financial performance to date.</p> <p>To further facilitate the use of the Sustainable Value approach researchers of IZT and Queen's University Belfast have also developed the Sustainable Value Calculator - an online tool that enables companies to calculate and express their sustainability performance in monetary terms.</p> <p>The project is conducted in association with the Institute for Futures Studies and Technology Assessment (IZT) and the Wuppertal Institute (both Germany) as research partners and cooperates with BMW Group, Muckenhaupt & Nusselt GmbH & Co KG, Deutsche Telekom and SAM Group.</p>
Key funding source(s)	German Federal Ministry of Education and Research

Name of programme/project	Theory of Sampling and Environmental Decision Making
Contact	Dr Rory Doherty Environmental Engineering Research Centre

	School of Planning, Architecture and Civil Engineering Tel: +44 (0)28 9097 4746 E-mail: r.doherty@qub.ac.uk
Outline	Soil matrices are an often highly heterogeneous mixture of naturally occurring soil particles and anthropogenic material. The sampling of such a heterogeneous mixture and the uncertainties associated with it, is often ignored with the main emphasis on potential error only considered post sampling. This work combines the use of conceptual, deterministic and stochastic, models to develop a sampling tool. The models simulated the heterogeneity present within soil matrices, and aided the development of experimental procedures that utilised correct sampling techniques to characterise uncertainty. The errors generated when no sampling procedures are followed could render any laboratory analysis and the decisions based on these results invalid even if the laboratories are fully accredited. If sampling theory is applied to environmental, geotechnical or any engineering sampling then the risk of poor decision-making and liabilities and associated costs is reduced.

Name of initiative	'Effects of climatic change and eutrophication on the glacial relict, <i>Mysis relicta</i>, in Lough Neagh'
Contact	Dr David Griffiths, Environmental Sciences Research Institute, University of Ulster http://www.science.ulster.ac.uk/esri/
Outline	Aim: to identify the importance of anthropogenic enrichment and temperature change on a conservationally important species with very restricted thermal and oxygen requirements in a highly productive, warming, lake. Thermal change more important than eutrophication, though both contribute to a 90% reduction in abundance of an important species in the L Neagh ecosystem. Published in <i>Freshwater Biology</i> (2007) 52, 1957–1967
Key funding sources	Many of the measurements were done by an undergraduate on placement and a MRes project student. No external funding.

Name of initiative	'Adaptation to climate and environmental change, with a focus on the fisheries sector'
Contact	Dr S Coulthard, School of Environmental Sciences, University of Ulster http://www.science.ulster.ac.uk/envsci/
Description	Relevant publications include: Coulthard, S. (2008) Adapting to environmental change in artisanal fisheries – insights from a South Indian lagoon. <i>Global Environmental Change</i> 18 (3) pp.479-489

	<p>Coulthard, S (in press). Adaptation and conflict within fisheries – insights for living with climate change. Chapter in the forthcoming book <i>Adapting to climate change: thresholds, values, governance</i>. Adger, N.W., Lorenzoni, I. and O'Brien, K. (eds). Cambridge University Press, Cambridge</p> <p>This chapter followed on from a presentation of the following paper in 2008 Coulthard, S (2008) Title: Should we hang up our nets? Adaptation and conflict within fisheries – insights for living with climate change. Conference proceedings 'Living with climate change: are there limits to adaptation?' 7 & 8 February 2008, Royal Geographical Society, London</p>
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Name of initiative	'A comparative analysis of adaptive capacity to climate change –perspectives from the UK and India'' (provisional title)
Contact	David Crosset, University of Ulster (PhD candidate)
Outline	<p>Looking at the factors which influence people's capacity to mitigate climate change (sustainable behaviours) and cope with the impacts of climate change (adaptive capacity) amongst city dwellers in Chennai and Belfast</p> <p>In particular, the study will investigate the differences in the relationship between community and state in Belfast and Chennai and how these influence the adaptive capacity of the two communities.</p> <p>An integrated definition of adaptive capacity as outlined by Ayers and Huq (2008) will be employed. This definition includes both the capacity to adapt to unavoidable climate change and the capacity to change behaviour to mitigate future climate change. The research seeks to answer three main questions:</p> <ol style="list-style-type: none"> 1. What are the characteristics of state/community relationships? How do they affect adaptive capacity to major climate change risks? 2. How do these findings inform current debates on the differing role of the developed and developing nations in responding to climate change? 3. What are the benefits and limitations of a comparative analysis of climate change adaptation between the north and south?
Key funding sources	Funded by Department of the Environment (DoE NI) with additional funding sought through the Royal Geographic Society

Name of initiative	'Modelling the long-term regional variation in annual population maxima of the spruce aphid'
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Contact	Professor Keith Day, School of Environmental Sciences, University of Ulster http://www.science.ulster.ac.uk/envsci/
Outline	<p>Partial defoliation of spruce by the green spruce aphid <i>Elatobium abietinum</i> (Walker), is a recurrent event in European and, increasingly, North American forests. Knowledge of endogenous and exogenous factors affecting the aphid were incorporated into general discrete models of population dynamics describing a unique time series of population estimates from forest foliage. Alternative models were evaluated and also applied to a completely independent time series of aphid data derived from the Rothamsted Insect Survey's nationwide network of suction traps.</p> <p>Overall, the data from the two distinct geographical locations provided strong support for a model that included log-linear density-dependence (approximately instantaneous) and linear associations with two local climate metrics derived from cold winter temperatures and thermal sum during spring. These two climate metrics show high inter-annual variance but no directional patterns over 78 years and hence there were no directional changes in aphid abundance in either time series that suggested climate change signalling.</p>
Key funding sources	Originates from European Community FPIV project

Name of Programme/Project	Supergen II – Biomass & Bioenergy
Contact	Professor NJ Hewitt, Dr D McIlveen-Wright, Dr Y Huang Centre for Sustainable Technologies School of the Built Environment University of Ulster http://www.beri.ulster.ac.uk/
Field which initiative relates to	Renewable Energy – Carbon Reduction Biomass
Outline:	The Consortium is managed by Aston University with the University of Leeds as the financial hub. The other research partners include Cranfield University, Imperial College, Kings College London, the University of Manchester and the University of Sheffield, as well as Rothamsted Research Institute, the Institute of Grassland and Environmental Research and Forest Research. The planned industrial partners are Alstom, Amec, Bical, Biffa, Biomass Engineering, BP, Coppice Resources, E.ON UK, Johnson Matthey, Rural Generation and RWE nPower. In addition there are four associate academic partners - Irish Seaweed Centre, Scottish Association for Marine Science (SAMS), the University of Oxford and the University of Ulster.

	The project studies the production of different types of biomass and investigating their behaviour in thermal conversion processes, with particular emphasis on the interaction and interface between production and conversion. Conversion processes are being investigated to improve their performance. Finally the bioenergy products are being expanded to include transport fuels and renewable chemicals within the context of a biorefinery. A wide range of system studies are included to evaluate the performance, cost, and socio-economic benefits of a wide range of bioenergy chains.
Timescale	July 2007- July 2011
Key Funding Source(s)	Engineering and Physical Sciences Research Council (EPSRC)

Name of Programme/Project	Charles Parsons Energy Research Award
Lead/contact research and College/School/ Department	Professor NJ Hewitt, Dr D McIlveen-Wright, Dr Y Huang, Dr T Hyde, Dr P Griffiths, Dr M Smyth Centre for Sustainable Technologies School of the Built Environment University of Ulster http://www.beri.ulster.ac.uk/
Field which initiative relates to	Energy Efficiency, Renewable Energy, Carbon Reduction
Outline:	<p>A number of areas are supported:</p> <p>1. Biomass, Bioenergy and Energy Systems Modelling: All-Ireland Energy System Modelling and Biomass & Bioenergy. This project will analyse the impacts of future energy technologies upon the types power generation that Ireland will need within the medium to long term. It will use the in-house plant process simulator “Eclipse” which is a proven techno-economic analysis tool for predicting plant performance, emissions, running costs and capital costs. Biomass & Bioenergy will develop new gasifier systems understanding the impacts of fuel mixtures in addition to the traditional issues associated with gasification namely, fuel shape, & size, moisture content etc.</p> <p>2. Heat Pumps and Energy Storage: Performance improvements coupled with simplified systems are seen as they way forward. Air-source heat pumps in the moderate Irish climate will give significant energy and environmental savings and units developed by Ulster are capable of reaching 65°C thus allowing retrofit into most homes with standard boiler radiator systems. Energy storage is also a key aspect of the success of the air-source heat pump (ASHP). Tariff management and operation at times best suited to the ASHP i.e. warmer</p>

	<p>afternoons will provide improved levels of comfort as well as operation in non-peak times, thus reducing the levels of stress on a sometimes already over-stretched electricity network.</p> <p>3. Advanced Glazing: Window energy performance is recognised as crucial in reducing building energy consumption. Low temperature (<200°C) sealing techniques developed at the University of Ulster have led to the development of a vacuum glazing with a very low U-value. Long term durability and performance characterisation data for fabricated vacuum glazing is required to establish confidence in the technology.</p> <p>4. Solar Energy: Systems using vacuum or partial vacuum technology offer the greatest performance improvement for northern maritime climates. Solar water heating has the potential to significantly reduce building CO2 emissions. Efficient, low-cost Integrated Collector/Storage Solar Water Heater ICSSWH systems are key to exploiting the as-yet-undeveloped market for solar water heating in climates such as Ireland and the UK. The only significant barrier preventing the wide-scale implementation of this solar water heating technology is heat loss during non-collection periods. The aim is to develop ICSSWH vessels with improved energy storage that can be economically competitive with traditional forms of water heating.</p>
Timescale	2007-2013
Key Funding Source(s)	Department of Communications, Energy and Natural Resources, Republic of Ireland (DCENR) and Science Foundation Ireland

Name of Programme/Project	DECARBit
Lead/contact research and College/School/ Department	Dr S Rezvani, Dr Y Huang, Dr DR McIlveen-Wright, Professor NJ Hewitt Centre for Sustainable Technologies School of the Built Environment University of Ulster http://www.beri.ulster.ac.uk/
Field which initiative relates to	Carbon Capture and Storage
Outline:	<p>The overall objective of DECARBit is to enable zero-emission pre-combustion power plants by 2020 with a capture cost of less than 15€/ton with the highest feasible capture rate.</p> <p>Today the energy supply and use in Europe is heavily based on fossil fuels and imports and to comply with the aspiring policies adopted for Green House Gases (GHG) cuts, progressive R&DD1 action is needed within CCS. DECARBit aims at performing research, development and piloting of advanced pre-</p>

	<p>combustion CO2 capture technologies which will substantially reduce emissions of greenhouse gases from fossil fuel power plants.</p> <p>Expected achievements</p> <ul style="list-style-type: none"> • To assess and research new techniques for pre-combustion CO2 capture. • To develop advanced oxygen production techniques. • To continue the development efforts in FP6 projects in the pre-combustion area for key enabling technologies. • To underpin the cost reduction objective. • To establish collaborative schemes with emerging large-scale CCS initiatives in Europe. • To perform an assessment of the advanced pre-combustion capture techniques to the benefit of other energy intensive industries.
Timescale	2007-2011
Key Funding Source(s)	EU FP7

Name of Programme/Project	Biofuel Micro-generation with Cryogenic Energy Storage BMT-CES
Lead/contact research and College/School/ Department	<p>Professor NJ Hewitt, Dr Y Huang Centre for Sustainable Technologies School of the Built Environment University of Ulster http://www.beri.ulster.ac.uk/</p>
Field which initiative relates to	Renewable Energy – Biomass – Energy Storage – Carbon Reduction
Outline:	<p>This proposal is concerned with developing a trigeneration system (power, heat and refrigeration) which is fuelled by renewable fuels and can be used in the domestic environment or scaled up to be used in larger, industrial based environments. The system would allow heat, power and refrigeration to be produced locally, where it is needed, using a novel energy storage system and a novel control and optimisation system to produce high efficiency operation.</p> <p>A power generator will be used to generate power using renewable fuels (biofuels). Waste heat from the generator would be collected and used to supply heating and hot water. The waste heat would also be utilised to drive an absorption/adsorption refrigerator. Off peak electricity energy generated but not used will be stored in the electrical storage</p>

	<p>system</p> <p>The project will link together specialised personnel in the UK and China who have the critical expertise necessary to bring together all aspects of this challenging project. The project will also benefit research links between the UK and China.</p> <p>There is substantial potential demand for the system in the UK, China and other parts of the world as the results would provide benefits to government, academia, manufacturers and consumers.</p>
Timescale	2008-2011
Key Funding Source(s)	Engineering and Physical Sciences Research Council (EPSRC)

Name of Programme/Project	CALEBRE (Consumer Appealing Low Energy Technologies for Building Retrofit)
Lead/contact research and College/School/ Department	<p>Professor NJ Hewitt, Dr T Hyde, Dr P Griffiths Centre for Sustainable Technologies School of the Built Environment University of Ulster http://www.beri.ulster.ac.uk/</p>
Field which initiative relates to	Energy Efficiency in Homes
Outline:	<p>The UK domestic sector is responsible for almost 40% of national carbon emissions. Any serious attempt to reduce these emissions must recognise the fact that the rate of housing stock renewal is slow, that space and water heating dominate the usage, and that householder appeal and interaction play a paramount role. This places the emphasis on retrofit solutions, and technologies that relate to energy supply and reduction in demand, plus alignment with user lifestyles.</p> <p>For any new technology to be successful, it must be accepted by the end users and meet their needs. These needs include their social, emotional, practical and economic needs. For technologies such as insulation (demand reduction) or heat pumps (energy supply), it is critical that they are considered as a coherent, integrated solution in the context of the built environment and the end users / householders. To this end, this project will identify the barriers and opportunities for possible energy saving and low carbon energy supply technologies, primarily from the perspective of the home and the householders. Other stakeholders in the process, such as installers, decorators, house maintainers and future home owners will also be pertinent to the success of the technologies, so their views will also be considered.</p>

	<p>This will enable the technologies to be specified and adapted to meet the needs of the ends users whilst satisfying the energy efficiency improvements desired for the property in question. The modified technologies will then be trialled in a dedicated, occupied and instrumented test house, providing further knowledge about technical performance, user interaction and occupant thermal comfort. For the trialled technologies, designs will be devised that encompass their functionality together with their cost-effective manufacture. It is anticipated that every household will require a suite of energy-related measures that matches the limitations of the house and the requirements of the householders. A design and selection tool will be produced for use by householders and installers to identify these measures as a single transaction (a 'one-stop-shop' approach) for deployment. The tool will be available for uptake by industry, and will be capable of expansion to accommodate other technologies in future.</p>
Timescale	2008-2012
Key Funding Source(s)	Engineering and Physical Sciences Research Council (EPSRC)

Name of Programme/Project	Digital Compressor Development for Heat Pumps
Lead/contact research and College/School/ Department	<p>Professor NJ Hewitt Centre for Sustainable Technologies School of the Built Environment University of Ulster http://www.beri.ulster.ac.uk/</p>
Field which initiative relates to	Energy Efficiency – Carbon Reduction
Outline:	<p>Aim This project will endeavour to understand the interactions of advanced air source heat pumps and the role of variable capacity (digital) compressor technology and energy storage when utilised to heat homes with traditional high temperature radiators.</p> <p>Objectives</p> <ol style="list-style-type: none"> 1. Characterise the performance of a suitable digital compressor (preferably with economised vapour injection) when operating in an air-source heat pump designed for retrofit applications across its operating envelop 2. Establish the performance of the digital compressor at part-load 3. Select and evaluate appropriate energy storage mechanisms e.g. phase change materials such as micro-encapsulated paraffin waxes. 4. Develop a compact storage mechanism comparable with

	<p>the digital compressor air source heat pump which is suitable for peak efficiency operation as well as electricity demand side management</p> <ol style="list-style-type: none"> 5. Evaluate the whole system in the laboratory, taking account of any benefits that can be accrued from using reverse cycle defrost (low air temperatures) when coupled with thermal energy storage. 6. Evaluate such a unit in a field trial in a typical home where the dynamics of domestic use will determine levels of comfort and cost.
Timescale	2008-2011
Key Funding Source(s)	Department of Employment and Learning Northern Ireland (DEL), Copeland Ltd

Name of Programme/Project	Energy Storage
Lead/contact research and College/School/ Department	<p>Professor NJ Hewitt, Professor WS McGreal School of the Built Environment University of Ulster http://www.beri.ulster.ac.uk/</p>
Field which initiative relates to	Carbon Reduction , Renewable Energy Storage
Outline:	<p>The aim of the project is to assess the extent to which the existing and future built environment can provide local energy storage and virtual bulk thermal and electrical energy storage for non-dispatchable small and large scale renewable energy in providing technology solutions as part of a holistic response to future energy systems in Ireland.</p> <p>In order to meet this aim a number of key objectives must be met:</p> <ol style="list-style-type: none"> 1. Develop through the partnership a network of stakeholders willing to contribute to the shaping of this initiative. 2. Utilise and enhance building energy models to ascertain the levels of energy storage in the building stock under heating and cooling conditions. 3. Utilise electricity and energy demand profiles and predict the impacts of energy efficiency programmes on energy use in for example 2020. 4. Undertake a major review and analysis of passive and active energy storage mechanisms for thermal and electrical energy, signposting new concepts that could be exploited by this consortium in the future. 5. Enhance and utilise models for the likely penetration of non-dispatchable renewable energy in the built environment and understand the role of planning and

	<p>socio-economic acceptability in this process.</p> <ol style="list-style-type: none"> 6. Develop where possible the most likely first-generation mechanisms for the storage of thermal and electrical energy in the built environment and understand their impact based on deployment models for renewable energy and energy efficiency. 7. Understand the impacts of enhanced energy storage on the levels of penetration of non-dispatchable renewable energy. 8. Identify significant areas of built environment planning and legislation, the compliance with and/or adaptation is important in optimising this opportunity. 9. Shape and respond to energy research initiatives to complement this activity and aid in future sustainability. 10. Create opportunities for investment in developed and potential concepts through industry and venture capitalists.
Timescale	2008-2011
Key Funding Source(s)	Department of Employment and Learning Northern Ireland (DEL)

Name of Programme/Project	Solar Energy Storage
Lead/contact research and College/School/ Department	<p>Dr M Smyth Centre for Sustainable Technologies School of the Built Environment University of Ulster http://www.beri.ulster.ac.uk/</p>
Field which initiative relates to	Renewable Energy & Energy Efficiency
Outline:	<p>The main objective of the project will aim to develop the twin vessel Integrated Collector Storage Solar Water Heater from a demonstrated of idea to a system near to commercialisation with significant potential to provide cost effect solar water heating in Northern Maritime climates. Initial research has demonstrated that the basic principle is sound and that the system is technologically viable. However to be able to commercially exploit this technology, it is important that the technical risks are evaluated through a detailed study involving experimental investigation, system optimisation and cost benefit, including retail price and payback period. The key objectives are as follows.</p> <ol style="list-style-type: none"> I. Design and fabricate a number of twin vessel heat retaining ICS prototypes. II. Undertake laboratory (internal and external) experimental

	<p>characterisation to determine the primary operational characteristics of the design.</p> <p>III. Conduct a field trial test of the ICS unit under real operating conditions</p> <p>IV. Undertake a detailed evaluation of the system to confirm cost effectiveness and payback</p> <p>V. Produce a comprehensive commercialisation plan, including full market assessment, best route to commercialisation, manufacturability, integration and complete IP protection.</p>
Timescale	2009-2010
Key Funding Source(s)	Invest Northern Ireland, Proof of Concept

Name of Programme/Project	Biomara
Lead/contact research and College/School/ Department	<p>Professor NJ Hewitt, Dr Y Huang Centre for Sustainable Technologies School of the Built Environment University of Ulster http://www.beri.ulster.ac.uk/</p>
Field which initiative relates to	Renewable Energy – Bioethanol, Biodiesel
Outline:	<p>Whilst there is evidence that large-scale biofuels production from algae is possible, further investigation is needed to find out which strains are likely to be the most productive and the optimal conditions for their growth before it can be produced on a commercial scale and brought to market. The key objective of this project therefore is to investigate the practicalities and underlying methodologies required to harness algal biomass as a biofuel source on a competitive and sustainable basis. This will include consideration of the underlying science and technology, as well as process control and engineering needs, supply chain issues, social and economic impacts.</p> <p>The primary purpose of this new knowledge is to raise the efficiency of existing technology and introduce new technologies more productive and competitive with traditional sources of energy. The dissemination of the new knowledge for this purpose will be a priority and eventually training, support and advice will be provided to end users through appropriate networks and industry associations. Innovation and entrepreneurship will be fostered through these networks.</p> <p>Much of the focus will be on local generation of energy needs in a carbon-neutral and sustainable manner. The infrastructural needs of new, smaller-scale and more local production of liquid and gas</p>

	<p>biofuels will need to be rethought and new, more appropriate, cross-border and multi-purpose forms of infrastructure introduced, which are softer and less expensive than traditional energy supply infrastructure such as under-sea cables.</p> <p>Alongside this research the project will work with a cross-sectoral stakeholder group to ensure that the results are used for onward end use development and influence fuel supply and demand.</p>
Timescale	2009-2013
Key Funding Source(s)	EU Interreg IVA, Crown Estates, HEI, Department of Enterprise, Trade and Industry NI (DETI), Invest NI

Name of Initiative	North Western Environmental and Energy Consortium (NWEEC)
Lead organisation and partners (where relevant)	<p>South West College (Omagh Campus) Lead</p> <p>Institute of Technology Sligo</p> <p>GreenFarm Energy Ireland Ltd</p>
Outline:	<p>Formed in 2002 the NWEEC aims to</p> <ul style="list-style-type: none"> • improve the provision of information, training and education in sustainable practices and renewable energy applications • to carry out research into these renewable practices • produce a knowledge base which will benefit the local community <p>With farm wastes such as animal slurries being identified as a major disposal problem the NWEEC aims to address this and provide information on viable options to alleviate these problems within the farming community. It is the aim of the project to assess if the utilisation of agricultural waste in a renewable energy project is economically viable. If appropriate treatment is found to be possible and economic it is believed that this information will be of benefit to the local community through the provision of an alternative pathway for waste disposal. New technologies in this area are believed to offer a method to turn an environmental problem into an economic opportunity.</p> <p><u>Project description</u></p> <p>This project aims to analyse current practice, identify potential solutions and conduct basic research into biological and thermal treatment of organic wastes.</p> <p>Three elements have been identified for this project, these being</p> <ul style="list-style-type: none"> • Information gathering (Logistics) • Laboratory modular fit • Commercial analysis and development <p><u>Information gathering and logistics</u></p>

This report aims to document the progress to date on the initial information gathering element of the project concerning the collection of data on the, level and type of waste production, livestock numbers and farm size within the project areas of the ICBAN district, these areas can be found in Table 1.1 below.

Project areas for Northern and Southern Ireland. District council areas were used for Northern Ireland and Counties were used for Southern Ireland.

Project Area	
Northern Ireland District Councils	Southern Ireland Counties
Cookstown	Cavan
Dungannon	Donegal
Fermanagh	Leitrim
Omagh	Monaghan
Strabane	Sligo

Through carrying out the information gathering elements, the project aims to

- Conduct an assessment of the types and quantities of organic waste produced within the project counties of Tyrone, Fermanagh, Donegal, Sligo, Leitrim, Cavan and Monaghan
- This assessment is to entail a comprehensive survey of the current practice of waste production in these areas, how it is treated and its method of disposal
- A Geographical Information System (GIS) survey to produce a digital, map based data base for waste production in the project areas
- A feasibility study of waste transport systems to a centralised digestion plant as identified through the use of the GIS system
- An information database is to be compiled which will be available for consultation and training as well as an educational resource for students and interested parties
-

Laboratory modular fit

Working in conjunction with Omagh College and GreenFarm Energy, IT Sligo has under taken to carry out the laboratory modular fit component of the project.

IT Sligo are to perform technical, economic analysis of the waste treatment system coming from the vessel installed in Omagh. To carry out this component, a laboratory scale waste treatment

	<p>bioreactor is to be constructed at IT Sligo. This is to be used to characterise and manipulate the waste input and output streams of the system such as water and solid content, nutrient and gas components and to model the necessary steps in the treatment and digestion of the incoming waste. Studies will involve the microbial digestion treatment, Nitrogen (N) Phosphorous (P) and Potassium (K) as well as heavy metal analysis. Through the use of the anaerobic digestion process, wastes treated by this method are to be viewed as energy resources with improved nutrient contents rather than waste products with a disposal problem.</p> <p><u>Commercial analysis and development</u> An assessment of the economic potential of treatment products will provide an analysis of the viability of various treatment options with products such as biogas, compost, liquid fertiliser, carbon black and pyrolysis oil all being taken into consideration. A treatment plant model will be considered along with the logistical information and analysis of treatment products to produce a feasibility analysis for waste treatment options.</p> <p>Results to date (spring 2009) include construction of farm scale anaerobic digestion facility, documentation of all areas of AD, legislation, energy generation (55,000 word document) and lab analysis of AD systems and creation of lab techniques (35,000 word report).</p>
Key funding source(s)	INTERREG
Further information	Aaron Black, South West College

Name of Initiative	RENEW
Lead organisation and partners (where relevant)	Agri-Food and Biosciences Institute (AFBI, lead) South West College (Omagh) Institute of Technology Sligo Growers/end users
Outline:	<p>Aims and Benefits</p> <ul style="list-style-type: none"> • Establishment and production of short rotation coppice willow to provide a renewable energy fuel • For heat conversion in a range of boiler systems in NI and Rol • To co-ordinate production and consumption on a managed supply chain • To integrate public and private sector partners • To disseminate the outcomes to as broad an audience as possible • To evaluate SRC as a bioremediation system

	<p>Project Objectives</p> <ul style="list-style-type: none"> • By end of 2008 to produce 2MW of installed thermal capacity at a minimum of six locations, 3 in the Republic of Ireland and 3 in Northern Ireland • By end 2005 to establish 40 additional hectares of short rotation coppice in Northern Ireland and the Republic of Ireland • By end of 2007 to integrate into the Project boiler sizes in the range of 25kW and the 500kW thermal output • Provide an active dissemination of information through at least one organisation in the Republic of Ireland and Northern Ireland • Produce logistical and technical support for the producer and consumers involved in the project • Carry out studies on the use of short rotation coppice as a bioremediations system and to demonstrate legislative compliance in both jurisdictions <p>Project activity</p> <ul style="list-style-type: none"> • Production of short Rotation Coppice Willow in both NI and Rol • Chip handling, drying and storage • Feasibility studies on several individual projects for boiler installation • Providing specification and tender documents for boiler installation where feasibility study indicated viability • Conversion of fuel chip to heat energy • Monitoring of processes including sustainability and viability • Dissemination and technology transfer • Bioremediation – data collection and analysis • Project management – administrative and technical
Key funding source(s)	INTERREG, Department of Enterprise, Trade and Industry Northern Ireland (DETI)
Further information	Aaron Black, South West College http://www.afbini.gov.uk/index/services/services-specialist-advice/renewable-energy.htm

Name of Initiative	InnoTech Centre
Lead organisation and partners (where relevant)	South West College
Outline:	The Sustainability strand at InnoTech Centre provides the expertise for businesses and entrepreneurs to bring innovative ideas to reality. The key to business innovation is a culture of

experimentation and risk-taking.

Through cutting edge R&D we are nurturing innovation, driving technological development and building management practice to solve industrial problems.

Sustaining, Developing

Developing sustainability is a key challenge for any modern business. Practices and processes have evolved dramatically and organisations are increasingly aware of the requirement to deliver on sustainability. The results are multiple opportunities for the creation of innovative sustainable technologies. InnoTech has direct experience in this field. Together with local business. Thinking. Creating. Doing.

Sustainability is South West College's main area of specialism and has been a focus of intensive R&D for over five years, developed by applying renewable technologies within the college and with industry partners.

Designing, Installing

The college has played a major role in the design and installation of many renewable technologies. Installed demonstrators include:

- Anaerobic Digestion: 212m³ digester, 40kWe genset
- Biomass boilers (and associated handling systems): 150kWh & 250kWh willow
- Wind turbine: 20kWe
- Solar Photovoltaics: 2kWe
- Ground source heat pump: 5kWh
- Solar water heating: 10kWh

InnoTech specialises in applying new technologies in support of the agricultural, quarrying, engineering/manufacturing, construction and electronics industries. Allied with leading edge expertise in Design and Electronics/Software/ICT, InnoTech offers an unparalleled advantage to local business.

Networking, Transferring

InnoTech is part of an international network considering sustainability issues. Through strategic partnerships, sustainability at InnoTech delivers technical support services aimed at transferring national and international best practise in current and next generation technologies including deriving energy from waste, renewables, eco-building products and carbon footprint reduction.

Our experience in Tech-transfer has resulted in the installation of biomass boilers, wind turbines, anaerobic digestion and in vessel composting technologies.

The InnoTech Centre can offer assistance in design and

	<p>installation of renewable energy (hydro, wind, solar PV and water heating and biomass), growing and utilisation of biomass products, energy from waste, Combined Heat and Power(CHP), carbon footprinting, sustainability policy writing for your business, eco-building design and products, composting technology and custom product development and design.</p> <p>Within the sustainability strand we have graduates in science, engineering and geography. This allows the InnoTech Centre to offer services in a wide range of sustainability areas from environmental management to renewable technology design.</p> <p>Training, Educating The Centre can also provide continuous professional development and bespoke training in various aspects of sustainability.</p> <p>Through the South West College InnoTech offers a Foundation Degree in Sustainability which includes modules in Business, Renewable Energy, Waste Management, Environmental Management and Energy Efficiency.</p> <p>Through its focus in the area of renewables, the college provides training in the areas of Wind Turbine and Biomass Boiler installation. The college is the only accredited supplier of wind turbine installation training in Ireland and the UK. Bespoke training courses have been developed for businesses covering their specific areas of interest, these courses have resulted in increased uptake of renewable technology and the creation of new environmentally focused businesses within the college's catchment area.</p> <p>As at spring 2009, the Centre had a staff resource of 12 Industrial Technology and Training Associates (4 Sustainability), 3 Research Lecturers and 1 Lecturer.</p>
Key funding source(s)	Department of Employment and Learning Northern Ireland (DEL)
Further information	Aaron Black, South West College http://www.swc.ac.uk/Multimedia/Video/Innotech/innotech.htm

Name of Initiative	Earth Systems Institute (ESI)
Lead organisation and partners (where relevant)	University College Dublin (UCD, lead), Trinity College Dublin (TCD), Queens University Belfast, National University of Ireland Galway, Comhar Sustainable Development Council, Geological Survey Ireland, Met Eireann, Sustainable Energy Ireland, Teagasc
Outline:	<p>Objectives and Methods UCD has recently organised its capacities in regard to sustainable in general, and in regard to climate change in particular, into an</p>

Earth Systems Institute (ESI). ESI unique in Ireland in the range and depth of expertise it brings to bear to understand relationships between energy, climate change and hazards; relating science to policy, supporting meeting climate change and energy obligations; informing public and policy process; commitment to make Ireland an innovation hub for green technologies. Built on existing investments in the Programme for Research in Third Level Institutions (PRTL) and in industry-academic partnerships, e.g. the creation of a sensor web for the environment (CLARITY), the mobilisation of expertise in agri-food and nano technology, and simulation and computational science to improve understanding and inform choices. Integration of economics and policy analysis, and using mathematical and computational sciences to understand extreme risk are unique features. Training academics, policy makers and innovators to create and use smart policy and smart technologies to drive transformation of economy and enhance environmental quality is at the heart of the mission. More than 300 researchers (physical, biological science, engineering, social sciences) are organised into 5 centres – Earth, Bioresources, Energy, Urban and Policy. We have a commitment to complementary partnership with other universities on the island of Ireland, with international centres of expertise, and with other agencies that deliver research, innovation and policy support.

Outcomes

A structured PhD combining a strong disciplinary focus with a business orientation will prepare graduates for the world of enterprise and innovation

ESI places particular priority on the *conversion of research into innovation and business*, with an innovation lab, innovation and entrepreneurship training in Structured PhD, industry and agency placements, social and corporate partnerships, innovation models, tools.

We are also committed to *embedding understanding of the issues and the science, and of research in our undergraduate programmes*, achieved by offering of courses at all levels of undergraduate programme, and the provision of Undergraduate research groups in each Centre.

Public support for research and the role of universities can only be engendered if we explain what we do and what we have to offer. The Earth Systems Institute 'Meeting the Climate Change Challenge' series is a 23 lecture series offered free to the public every Friday at 12:30 in 2009 in the Royal College of Physicians, Dublin has attracted full houses every week. (see: <http://www.ucd.ie/earth/> for the programme and videocams of the presentations).

Ireland has *very demanding energy and climate change obligations* to meet by 2020 for the non trading sectors (agriculture, transport, residential, non energy intensive business, waste). These include a

	20 per cent reduction in greenhouse gas emissions, a 20 per cent increase in energy efficiency, a 16 per cent share of final consumption provided by renewable. They can only be met if smart technologies and smart policies are mobilised. ESI and its partners intend to play a full part in bringing these to fruition and tracking their impact on our obligations.
Timescale	2009-2014 (Phase 1) and 2015-2019 (Phase 2)
Key funding source(s)	Programme for Research in Third Level Institutions (PRTLII), Science Foundation Ireland (SFI), Environmental Protection Agency (EPA) , EU (FP 6 and 7), industry
Further information	http://www.ucd.ie/earth/

Name of Initiative	Emissions: reduction and control
Lead organisation and partners (where relevant)	University College Dublin (UCD, lead), University of Dublin (TCD), Queen's University Belfast, National University of Ireland Galway Comhar Sustainable Development Council, Geological Survey Ireland, Met Eireann, Sustainable Energy Ireland, Teagasc
Outline:	<p>To provide the Irish Agricultural and industrial sectors with the technology and expertise to reduce greenhouse gas emissions and to clean up contaminated soil and groundwater. This will contribute directly to the national objective of reducing greenhouse gas emissions.</p> <p>Research will focus on:</p> <ul style="list-style-type: none"> • Dietary/management strategies to reduce emissions from the Irish livestock industry. • Land-use strategies and carbon sequestration techniques to reduce carbon dioxide emissions. • Computational models, micro- & nano-technologies to remediate toxic environmental pollutants. • Evaluating the ecotoxicological implications of new nanoparticle technology. <p>Outputs will include:</p> <ul style="list-style-type: none"> • New strategies for emission reduction and control that inform policy. • Systems/technologies that drive innovation in environmental management and bioresource exploitation. • Graduates/postgraduates with competencies and expertise in emission reduction and control.
Timescale	2009-2014 (Phase 1) and 2015-2019 (Phase 2)
Key funding source(s)	Programme for Research in Third Level Institutions (PRTLII), Science Foundation Ireland (SFI), EPA, EU (FP 6 and 7), industry
Further	Dr Fiona Doohan, UCD

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Name of Initiative	Energy Supply and Renewable and Sustainable Energy
Lead organisation and partners (where relevant)	University College Dublin (UCD, lead), University of Dublin (TCD), Queens University Belfast, National University of Ireland Galway Comhar Sustainable Development Council, Geological Survey Ireland, Met Eireann, Sustainable Energy Ireland, Teagasc
Outline:	<p>Objectives: To build a diversified energy portfolio focussing on reliable electric and chemical energy supply leading to <i>an energy secure and low carbon emissions Ireland</i>. To meet the challenges of climate change, penetration of renewables and the emerging Smart grid concept.</p> <p>Research will focus on:</p> <ul style="list-style-type: none"> • Power systems and ICT-power infrastructures including a multi-user Smart grid. • Wind/wave/solar power including novel materials/devices harnessing energy in electric and chemical (stored) forms. • Biomass processing/supply ensuring optimum conversion efficiency and minimal environmental impact. • Offshore exploration providing increased energy supply. • Development of smart low-carbon and very low energy buildings (partnered with CLARITY). • Energy in transportation and light-weight materials. <p>Outputs:</p> <ul style="list-style-type: none"> • Highly trained personnel for an energy and environmentally aware professional sector; • Research leading to spin-outs/SMEs producing high-tech devices for power transformation/distribution/supply. • IP resulting from innovation and infrastructural design.
Timescale	2009-2014 (Phase 1) and 2015-2019 (Phase 2)
Key funding source(s)	Programme for Research in Third Level Institutions (PRTL), Science Foundation Ireland (SFI), Environmental Protection Agency (EPA), EU (FP 6 and 7), industry
Further information	Professor Don MacElroy, UCD

Name of Initiative	Transport and Infrastructure
Lead organisation and partners (where relevant)	University College Dublin (UCD, lead), Trinity College Dublin (TCD), Queens University Belfast, National University of Ireland Galway, Comhar Sustainable Development Council, Geological Survey Ireland, Met Eireann, Sustainable Energy Ireland, Teagasc

relevant)	Survey Ireland, Met Eireann, Sustainable Energy Ireland, Teagasc
Outline:	<p>Objectives</p> <p>To contribute to the reduction of greenhouse gas emissions from the road transport system, including in particular road infrastructure, and the development of systems for freight transport in ways that are economically efficient and environmentally effective. To support the development of models, technologies and policies that address the challenge of modal shift (from cars to other less environmentally demanding modes) To create a platform for innovation led enterprise Research will focus on:</p> <ul style="list-style-type: none"> • Testing of bridges and road infrastructure to assess capacity to absorb lower carbon freight systems. • Assessment of structures using dynamic response measurements to assess performance characteristics • Testing of low carbon materials for infrastructure to identify outcomes that are structurally, economically and environmentally efficient. • Development and application of land use models that allow scenarios to be assessed that examine the carbon, economic and other implications of alternative settlement patterns. • Mobilisation of models to test the economic and environmental outcomes of alternative modal shares, and the policies that can shift the mix in a more socially and environmentally benign direction. • Understand the link between transport infrastructure, land use change and energy and climate change performance.
Timescale	2009-2014 (Phase 1) and 2015-2019 (Phase 2)
Key funding source(s)	Programme for Research in Third Level Institutions (PRTL), Science Foundation Ireland (SFI), Environmental Protection Agency (EPA), EU (FP 6 and 7), industry
Further information	Professor Eugene O'Brien, UCD

Name of Initiative	Climate change, water and geohazards
Lead organisation and partners (where relevant)	University College Dublin (UCD, lead), Trinity College Dublin (TCD), Queens University Belfast, National University of Ireland Galway, Comhar Sustainable Development Council, Geological Survey Ireland, Met Eireann, Sustainable Energy Ireland, Teagasc
Outline:	<p>Objectives</p> <p>To improve the ability to track carbon performance, and the quality of prediction as regards climate change and its implications,</p>

	<p>including the development of credible quantitative risk assessment. To develop means of estimating flood risk, and identifying priority reactions as regards adaptation. To create a platform for innovation led enterprise</p> <p>Research will focus on:</p> <ul style="list-style-type: none"> • Provision of software tools by which individuals can track and access their carbon footprint (CLARITY) • Improving the existing climate modelling capacities • Developing a better understanding of bio-climate interactions • Developing techniques (with CASL) for improving understanding of understanding of extreme risks, and how to address them analytically and from a policy perspective. • Determining the influence of climate change on bioresource productivity and how climate affects atmospheric emissions from ecosystems • The development of an accurate prediction of climate change in Ireland by 2020 and beyond • Quantification of its impacts on Irish bioresources and transport infrastructure • Development of appropriate mitigation strategies.
Timescale	2009-2014 (Phase 1) and 2015-2019 (Phase 2)
Key funding source(s)	Programme for Research in Third Level Institutions (PRTLII), Science Foundation Ireland (SFI), Environmental Protection Agency (EPA), EU (FP 6 and 7), industry
Further information	Professor Peter Lynch, Dr Rodrigo Caballero, Professor Chris Bean; UCD

Name of Initiative	Sustainable Bioresources
Lead organisation and partners (where relevant)	University College Dublin (UCD, lead), Trinity College Dublin (TCD), Queens University Belfast, National University of Ireland Galway, Comhar Sustainable Development Council, Geological Survey Ireland, Met Eireann, Sustainable Energy Ireland, Teagasc
Outline:	<p>Objectives</p> <p>Agriculture & Forestry is a key source of Irish food, fibre, fuel and biomass. This sector faces major challenges (climate change, energy/labour costs, environmental concerns, consumer demands, healthy food demands). This workpackage is focused on ensuring the sustainable and competitive production of AgriFood and Forestry bioresources.</p> <p><i>Research will focus on:</i></p>

	<ul style="list-style-type: none"> • Biodiversity and environmental protection: evolutionary robustness of ecosystems and organisms, and their adaptability to climate change. • Identifying genetic, nutritional, physiological, management and process parameters critical for sustainable and competitive Agriculture and Forestry bioresource productivity. • Developing modelling systems and novel technologies (nanotechnologies, process technologies and sensors) to improve the productivity of the Agriculture and Forestry sectors. <p><i>Outputs will include:</i></p> <ul style="list-style-type: none"> • Competitive production of food, fibre, fuel and biomass and novel bioresources in an environmentally compatible manner, • Innovative technologies, processes and bioresources/biometabolites that drive development of the AgriFood and Forestry sectors. <p>Innovative and skilled graduates/postgraduates for the AgriFood and Forestry sector</p>
Timescale	2009-2014 (Phase 1) and 2015-2019 (Phase 2)
Key funding source(s)	Programme for Research in Third Level Institutions (PRTLII), Science Foundation Ireland (SFI), Environmental Protection Agency (EPA), EU (FP 6 and 7), industry
Further information	Dr Kevin McDonnell, UCD

Name of Initiative	Economics and Policy Analysis
Lead organisation and partners (where relevant)	University College Dublin (UCD, lead), Trinity College Dublin (TCD), Queens University Belfast, National University of Ireland Galway, Comhar Sustainable Development Council, Geological Survey Ireland, Met Eireann, Sustainable Energy Ireland, Teagasc
Outline:	<p>Smart technology will not succeed unless it is accompanied by smart policy. This means policies that drive the achievement of objectives in ways that support economic development, minimise the burden of compliance, are fair, and support and sustain innovation.</p> <p>Aims</p> <p>ESI infrastructure will support research that focuses on understanding: why markets fail to deliver energy, climate change and environmental objectives, and what mix of policies can be mobilised to correct for this market failure, including markets such as the European Union Emissions Trading Scheme; how human behaviour and quality of life are shaped, and how they can be oriented in manners that are fair and institutionally effective, and</p>

	<p>supportive of socially desired environmental and related objectives; how 'green tech' and related innovation and enterprise can be stimulated and sustained; how the benefits and costs of technologies emerging from other work packages can be assessed.</p> <p>Outputs</p> <ul style="list-style-type: none"> • Contributions to the international research evidence based literature • Support for national and international policy design and implementation • A cadre of highly trained PhDs who will populate national and international agencies to support the design and implementation of smart policies, including those that support innovation and enterprise. <p>Undergraduate students with an understanding of, and excitement about, applying economics and other disciplinary approaches to policy analysis.</p>
Timescale	2009-2014 (Phase 1) and 2015-2019 (Phase 2)
Key funding source(s)	Programme for Research in Third Level Institutions (PRTL), Science Foundation Ireland (SFI), Environmental Protection Agency (EPA), EU (FP 6 and 7), industry
Further information	Professor Frank Convery, UCD

Name of Initiative	Integrated Modelling
Lead organisation and partners (where relevant)	University College Dublin (UCD, lead), Trinity College Dublin (TCD), Queens University Belfast, National University of Ireland Galway, Comhar Sustainable Development Council, Geological Survey Ireland, Met Eireann, Sustainable Energy Ireland, Teagasc
Outline:	<p>Aims</p> <p>The Earth system comprises the coupled components of atmosphere, solid earth, ocean, cryosphere and biosphere. This dendritic coupling leads to immense complexity across a broad range of temporal and spatial scales. Understanding and predicting the evolution of the Earth system is one of the outstanding challenges of modern sciences. Perturbations in one component cause 'ripples' and feedbacks through the entire system.</p> <p>Methods</p> <p>High-end computing is revolutionising our ability to understand the Earth system. Large scale numerical simulations of coupled systems bridge the gap between small spatial & temporal scale controlled laboratory experiments and real world observational data. Once properly conditioned, simulations allow us to estimate future states of the Earth system. This understanding is critically important as possible interventionist engineering solutions to climate changes are being mooted internationally; having</p>

	implications from ocean usage to farming practice. This WP cuts horizontally through/binds the entire ESI Work Programme. Each of the Research work packages mobilise suites of computer based models to address the particularities of the research questions they address. There is a need to focus a specific effort on how these models might be linked to provide fresh insights as regards both the research questions being addressed, and also the wider policy obligations in energy and climate change.
Timescale	2009-2014 (Phase 1) and 2015-2019 (Phase 2)
Key funding source(s)	Programme for Research in Third Level Institutions (PRTL), Science Foundation Ireland (SFI), Environmental Protection Agency (EPA), EU (FP 6 and 7), industry
Further information	Professor Chris Bean, Dr Scott Rickard, UCD

Name of Initiative	Extreme Risk analysis
Lead organisation and partners (where relevant)	University College Dublin (UCD, lead), Trinity College Dublin (TCD), Queens University Belfast, National University of Ireland Galway, Comhar Sustainable Development Council, Geological Survey Ireland, Met Eireann, Sustainable Energy Ireland, Teagasc
Outline:	<p>Aims</p> <p>Due to their sheer size, extreme natural events are of enormous societal and economic significance, yet in general, they are notoriously difficult to predict. The 'energy output' from an individual extreme event (e.g. 'once a century' flood) can often dwarf the cumulative energy of 'normal' events, causing societal and economic havoc. Estimating the expected size of these events within a given future time window allows one to develop pre-emptive engineering solutions to minimise their impact. However, future size estimation is challenging; actual past extreme event observations are usually statistically under-sampled (e.g. few recorded observations in living memory) and their underlying statistical distribution may differ from their smaller event counterparts (break in scaling).</p> <p>Methods</p> <p>Using detailed geological past event detection coupled with populations of numerical simulations we will attempt to overcome these limitations and estimate likelihoods of; extreme winds; major slope failures (including marine); heat waves; large floods; extreme waves/tsunamis.</p> <p>Much of the impact of climate change will be felt through changes in the frequency and intensity of extreme wind, rain and heatwaves. Modeling such changes poses distinct challenges: in particular, the combination of high resolution and lengthy model runs (necessary to obtain accurate statistics) makes for extreme</p>

	computational demands. This work package will combine statistical, observational and computational approaches to forecast changes in extreme events in Ireland. We will leverage the recent major investment in computer infrastructure both at UCD and nationally through ICHEC, and the experience gained in our ongoing work on extreme wind events.
Timescale	2009-2014 (Phase 1) and 2015-2019 (Phase 2)
Key funding source(s)	Programme for Research in Third Level Institutions (PRTLII), Science Foundation Ireland (SFI), Environmental Protection Agency (EPA), EU (FP 6 and 7), industry
Further information	Professor Chris Bean, Dr Scott Rickard, UCD

Name of Initiative	Spatial and Urban Analysis
Lead organisation and partners (where relevant)	University College Dublin (UCD, lead), Trinity College Dublin (TCD), Queens University Belfast, National University of Ireland Galway, Comhar Sustainable Development Council, Geological Survey Ireland, Met Eireann, Sustainable Energy Ireland, Teagasc
Outline:	<p>Aims</p> <p>The aim of this work package is to provide spatial analysis support to the other work packages, to support the development of new technologies and systems for supporting planners faced with complex decision-situations, to link spatial analysis and environmental assessment, to demonstrate systems for managing natural resources including forestry, agriculture, peatlands, water and air quality and the impacts of urbanisation, and to show the economic effects of new transport infrastructure on land use and land value, travel behaviour, economics of air transport.</p> <p>Methods</p> <p>Most of the research being addressed by ESI researchers has a spatial component. Recent developments in computer technologies, the associated analytical power of geographical information systems (GIS) and the explosive growth of personal communication technologies have given rise to new research areas as well as new methods and techniques for solving problems. Under PRTLII 2, a substantial investment was made in Urban Institute Ireland in spatially referenced data (URBIS), and on its mobilisation via GIS and remote sensing technologies and in the modelling of these data as decision support tools in land use planning in general, and for the Greater Dublin region in particular.</p>
Timescale	2009-2014 (Phase 1) and 2015-2019 (Phase 2)
Key funding	Programme for Research in Third Level Institutions (PRTLII),

source(s)	Science Foundation Ireland (SFI), Environmental Protection Agency (EPA), EU (FP 6 and 7), industry
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Name of programme/project	Palaeoceanographic records of abrupt climate change: a preliminary investigation
Contact	Dr R J Edwards School of Natural Sciences, Trinity College Dublin
Field which initiative relates to	Earth sciences - ocean circulation change
Outline:	This project will analyse existing box and short gravity cores to examine the nature of the palaeoceanographic record they contain with a specific focus on their potential for elucidating multi-centennial to millennial scale, climate-related processes. The coring sites are located within the sensitive NE Atlantic region which has a proven track-record for furnishing high-quality palaeoceanographic records of Late Quaternary climate change. This project will target the last glacial to Holocene sequences in this region with the following objectives: 1. Catalogue and characterise the recent (Holocene) foraminiferal assemblages of the sampling sites and their relationship to key oceanographic variables (e.g. temperature, salinity, water depth etc); 2. Examine changes in these and associated parameters through time by reference to down-core variation in foraminiferal assemblages (benthic and planktonic), and their stable isotopic signatures ($\delta^{18}O$; $\delta^{13}C$); 3. Establish core chronologies and sedimentation rates via a dating programme including AMS radiocarbon analysis of microfossils coupled with stable isotope foraminiferal tuning to Greenland ice core record(s), augmented where appropriate by tephrochronology 4. Assess the evidence for millennial to sub-millennial palaeoceanographic changes from combined sedimentological, microfossil and geochronological analysis, and explore their significance for the current understanding of climate-cryosphere-ocean linkages in the N. Atlantic.
Timescale	2009-10
Key funding source(s)	INFOMAR

Name of programme/project	Testing the utility of a combined geochemical and microfossil-based approach to sea-level reconstruction in western Ireland
Contact	Dr R J Edwards School of Natural Sciences, Trinity College Dublin
Field which initiative relates to	Earth sciences - sea level change
Outline: aims/objectives, methods, intended or achieved	Relative sea-level (RSL) data from western Ireland can provide critical constraints on geophysical models seeking to describe the interplay between dynamic ice sheet responses to climate change, isostatic rebound and 'global' eustatic sea-level rise.

outcomes	Despite this, there is a virtual absence of reliable RSL data from large stretches of the Irish coastline and traditional reconstruction methodologies have failed to extract the required information even though there are thick sedimentary sequences in the region. This project will apply a new methodological approach to RSL reconstruction in Ireland to address this important knowledge gap. It will achieve this by answering the following research questions: (1) are carbon / nitrogen ratios (C/N) and carbon isotopes ($\delta^{13}C$) diagnostic tools for discriminating between inter-tidal and terrestrial sediments in western Ireland?; (2) can a composite geochemical and microfossil-based approach improve relative sea-level reconstructions in terms of both data quality (accuracy/precision) and availability (spatial/temporal distribution)?; (3) does a new glacial rebound model for Ireland reliably simulate RSL change within the Shannon estuary?
Timescale	2008-2011
Key funding source(s)	IRCSET

Name of programme/project	Examining the evidence for a recent acceleration in the rate of sea level rise using combined instrumental and proxy data
Contact	Dr R J Edwards School of Natural Sciences, Trinity College Dublin
Field which initiative relates to	Earth sciences - sea level change
Outline:	Scientists agree that sea level rise is potentially one of the most devastating impacts of future climate change, but tide gauge records are too short to show whether sea levels are rising faster today than in the past. This project will use high-resolution geological indicators to relocate former sea levels. These geological-based reconstructions will be validated against tide gauge data and historical evidence of coastal change. They will then be extended to reconstruct sea level rise over the last 200-300 years, and evaluate the evidence for accelerations that may be linked with human activities.
Timescale	2006-09
Key funding source(s)	Science Foundation Ireland (SFI)

Name of programme/project	Deposits of thermohaline currents on slopes west of Ireland - implications for climate change
Contact	Dr R J Edwards School of Natural Sciences, Trinity College Dublin
Field which initiative relates to	Earth sciences - ocean circulation change
Outline:	

	Ocean currents are important to global temperature regulation, providing poleward transport of heat. Where the currents impinge on the seabed, they can transport and deposit sand and mud. Such deposits can be used to identify periods when currents were active in the past, and to constrain variations in current strength and depth. The project will investigate underwater slopes to the west of Ireland where deposits spanning the last glaciation are found. An extensive array of cores on the west Porcupine Bank will be used to reconstruct the history of current activity and to relate this to climate records onshore.
Timescale	2006-09
Key funding source(s)	Science Foundation Ireland (SFI)

Name of programme/project	A vulnerability assessment of Ireland's coastal archaeological heritage
Contact	Dr R J Edwards School of Natural Sciences, Trinity College Dublin
Field which initiative relates to	Earth sciences - sea level change
Outline:	<p>Ireland's coastline has a long history of occupation, from Mesolithic hunter-gatherers to modern fishing and farming communities. Several pioneering studies have demonstrated that estuarine and coastal environments hold an immensely important record of people's interaction with the sea. However, coastal and inter-tidal archaeological heritage is inherently threatened due to the dynamic nature of the environments in which it is found. At present, this archaeological resource is poorly understood. Furthermore, there is little baseline knowledge of the vulnerability of Ireland's coastal archaeological resource, or how this may be affected by processes associated with coastal change and future sea-level rise.</p> <p>This report provides a preliminary assessment of vulnerability by identifying key regions that are most susceptible to coastal change, and examining the nature of the archaeological resource contained within them.</p> <p>A glacial rebound model is used to simulate long-term relative sea-level (RSL) and coastal changes around Ireland over the last 20 000 years. Fifteen simulated RSL curves for locations around Ireland reveal the contrasting patterns of change, with northern and northeastern parts of Ireland experiencing long-term uplift and large portions of western, southern and southeastern Ireland experiencing long-term subsidence. These differential land-level movements will either reduce or enhance the rate of sea-level rise predicted to occur as a consequence of human-induced climate change. Estimates for the average rate of RSL rise to 2050 range from 1.3 to 6.5 mm/yr depending on location and scenario used, with the largest rates being experience in the</p>

	<p>south west of Ireland. These rates suggest that the predicted land loss and length of threatened coastline presented in a recent DoE report should be regarded as conservative estimates. Changes in coastal configuration during the last 20 000 years are reconstructed by combining the simulated RSL data with topographic and bathymetric information. These changes are used in combination with the RSL estimates to highlight three regions that are potentially most at risk from future RSL rise and any increase in storminess associated with climate change. These regions are: the inlets of southern Ireland; the Shannon estuary; the coastline of Mayo, Connemara and associated islands.</p> <p>The nature of the threats to coastal archaeology is summarised, and then illustrated with reference to the three case study regions mentioned above. These examples highlight the destruction that is already underway, and the uniquely fragile nature of coastal archaeological heritage. This vulnerability makes rapid identification and investigation of paramount importance. Processes such as RSL rise reduce the time available for this and thereby amplify the threat. Unlike certain environments or ecosystems that can migrate naturally or via engineered intervention, our archaeological heritage can neither be 'moved' nor 're-created'. It is a finite resource which, once lost, is gone forever. It is hoped that by prioritising areas that are most at risk, and by highlighting regions with greatest archaeological potential, these losses can be minimised.</p> <p>There is now a need for a significant desk-top study to document and assess existing coastal archaeological sites. In addition, improved bathymetric and geophysical surveys in key locations have the potential to improve understanding of palaeogeographic change, and highlight those areas of greatest archaeological potential or vulnerability.</p>
Timescale	2006
Key funding source(s)	Heritage Council

Name of programme/project	Holocene sea-level change and glacio-isostatic adjustment in Ireland
Contact	Dr R J Edwards School of Natural Sciences, Trinity College Dublin
Field which initiative relates to	Earth sciences - sea level change
Outline:	Geologically-based sea-level data were extracted from almost sixty publications and compiled into a sea level database for Ireland (Brooks & Edwards, 2006). This online database (http://www.naturalscience.tcd.ie/SL_Database.php) comprises over 200 entries which are screened and arranged using a strict

	<p>quality tier system. These data conform to internationally recognised protocols for sea level studies and provide the most complete picture of post-glacial relative sea-level (RSL) change around the Irish coast. They were used to develop a new glacial rebound model for Ireland which is capable of simulating RSL changes since the last glacial maximum (Brooks et al., 2008). This model represents a significant advance from earlier studies by incorporating a revised, terrain-corrected ice sheet model for Ireland. Model results were tested by the collection of new sea level data from eight study sites in western Ireland. Thirty-two AMS radiocarbon dates were used to provide new constraints on post glacial RSL changes. These data show reasonable agreement with simulations by the new model, suggesting it successfully captures the general patterns of change. Some discrepancies around the time of the mid Holocene are noted, and may relate to inadequate treatment of Holocene meltwater additions by current models. This will require further research to resolve.</p>
Timescale	2003-06
Key funding source(s)	Enterprise Ireland

Name of initiative	Charles Parsons Initiative
Contact	<p>Associated to the University of Limerick: Marine Robotics Research Centre Optical Fibre Sensors Research Centre Centre for Environmental Research Limerick Clare Energy Agency (www.lcea.ie)</p>
Outline	<p>The purpose of the Charles Parsons Initiative in UL is to consolidate the work and expertise of several UL based research centres focused on sustainable forms of energy. Several key players in CPI joined UL (from Birmingham, Oxford, Liverpool, London, Twente, Pretoria) during the '90s after each had more than 10 years' experience abroad. These set about establishing independent research groups for studies of biomass, catalysis, geochemistry and carbon sequestration in soils and sediments, photonics and environmental sustainability. Several researchers already at UL were establishing research in wave energy, biofuels and marine technology. These activities led to the establishment of the Centre of Environmental Research (CER), the Optical Fibre Sensor Research Centre (OFSRC), and the Marine Robotics Research Centre (MRRC), which merged in 2006 to form CPI with the mission to tackle issues of immediate national priority in energy and sustainable environment as set out in the Strategy for Science, Technology and Innovation. Furthermore, the establishment of the Limerick Clare Energy Agency (LCEA) – the first of its kind on a university campus – and a partnership with</p>

BRE Ireland are a testament to the ability of this critical mass to attract mobile organizations with related interest to Limerick. CPI has 30 faculty and 60 researchers in total and expects to grow this aggressively over the period 2006-2013.

Mission statement of CPI

The pursuit of world class research, education and training in the science and engineering of energy and a sustainable environment.

Objectives of CPI

- Sustain prosperity with reduced 'human footprint'
- Address future energy needs with sustainability
- Produce high caliber specialists in sustainability, energy and environment related areas
- Contribute to world scientific achievements in the areas of sustainable energy and environment
- Generate high quality intellectual property
- Attract high level undergraduate and postgraduate students
- Disseminate knowledge and achievements gained to society
- Quantitatively evaluate the sustainability of alternative energy technologies, conservation measures and policy scenarios
- Evaluate the environmental impacts of energy technologies and strategic environmental assessment of energy plans and policies
- Cooperate with relevant bodies for better quality research

Significant developments in infrastructure to support energy research in marine and gasification have been achieved.

1. UL Remotely Operated Vehicle (ROV) Latis developed for high resolution ocean mapping and resource scoping. Off shore trials of ROV Latis on Celtic Explorer research cruise are currently being conducted (March 2009 (RV-ST-09-06), testing ROV Latis effectiveness as a SMART ROV for near seabed intervention tasks and scoping the ocean energy resource. The cruise will also sample sediments off the west coast for analysis of Humic carbon and sequestered carbon.
2. Solid Oxide Fuel Cells have an exceptional scope for use as electric power generation systems for their high energy conversion efficiencies. Present-day SOFCs have satisfactory performance with hydrogen fuel at 800-1000°C. Our goal is to find some higher efficiency using novel nanostructured materials that will operate at relatively low operating temperature compared to that of

	the existing technology with hydrocarbons as fuel. The nanostructured LCMS perovskites fabricated in our laboratory shows quite a lot of promise in this direction.
Key funding sources	CPI received their funding from the Charles Parsons' Energy Research Awards, an initiative under the Irish Government's <i>Strategy for Science, Technology and Innovation 2006-2013</i> (Science Foundation of Ireland, SFI)
Further information	http://www.cpi.ul.ie/

Name of initiative	Buildwise
Lead organisation	NUI Galway, University College Cork
Outline	<p>Tyndall is one of a consortium of universities and research partners working on this Building Energy Management Smart System. Such systems can result in 15-20% savings in the energy usage and running cost of a given building by examining usage patterns of the utilities and energy sources available which, when combined with user requests, will most efficiently and cost effectively address the user need.</p> <p>Tyndall's role in the project is in the design and deployment of wireless sensor motes. Main goal is to design and deploy an energy and environmental data management platform with integrated database management system. Industrialisation of the project is due in 2010.</p>
Key funding sources	Enterprise Ireland
Further information	Brendan O'Flynn, Tyndall Centre, University College Cork http://www.tyndall.ie/

Name of initiative	ITOBO (Information and Communication Technology for Sustainable and Optimised Building Operation)
Lead organisation	University College Cork
Outline	Related to work done on the building energy management smart system Buildwise, the vision is to create a holistic, methodological framework and toolset for smart, user-friendly, energy efficient information management and decision support. Tyndall is developing the wireless sensor mote as part of a consortium of research and industry partners.
Key funding sources	Science Foundation Ireland
Further information	Karsten Menzel, UCC; Mike Hayes, Tyndall Centre, UCC http://www.tyndall.ie/

Name of initiative	NEMBES (Network Embedded Systems)
Lead organisation	Cork Institute of Technology (CIT), University College Cork (UCC)
Outline	Another consortium project in which Tyndall is developing wireless sensor mote. Objective is to bring together the key national experts in the field and make Ireland a recognised international centre of research, education and innovation in networked embedded systems research and applications.
Key funding sources	Higher Education Authority
Further information	Alan Mathewson, Tyndall Centre http://www.tyndall.ie/

Name of initiative	E4U (Electronics Enable Energy Efficient Usage)
Lead organisation	University College Cork – led by Eutema (Austria), University College Cork consortium member
Outline	E4U aims at fostering world leadership in ICT enabled energy efficiency through accelerating research and development for energy efficient ICT systems. It will achieve this through the creation of a strategic research roadmap for power electronics in alignment with the national, EU & international policy framework. Tyndall is one of four partners creating this roadmap..
Key funding sources	European Commission ICT programme in FP7
Further information	Mike Hayes, Tyndall National Institute, UCC http://www.tyndall.ie/

Name of initiative	SERVE (Sustainable Energy in a Rural Village Environment)
Lead organisation	Tipperary Institute; North Tipperary County Council; Sustainable Projects Ireland Ltd (SPIL)
Outline	Sustainable Energy in a Rural Village Environment seeks to support the development of an eco-village in North Tipperary; to retro-fit existing houses with renewable energy and sustainable energy equipment; and to carry out research on its social and economic impacts. In early 2009, the project was ongoing. Some retro-fitting has been carried out and village development is in progress.
Key funding sources	CONCERTO EU Programme
Further information	Seamus Hoyne, Tipperary Institute http://www.servecommunity.ie/home

Name of initiative	Carnegie Rural Area Research Programme and Hosting Programme
Lead organisation	Tipperary Institute; Carnegie Trust
Outline	<p>Seeks to engage communities and public bodies in the development of resilient rural communities which are able to respond to climate change and to facilitate a response in the wider society.</p> <p>Brings together a range of actors to pursue a range of collaborative activities relating to food, energy, decision-making, land-use, bio-diversity and so on.</p> <p>In early 2009, initial meetings and conference held; some action groups in place; community of practice established.</p>
Key funding sources	Carnegie UK
Further information	Ciaran Lynch, Tipperary Institute www.tippinst.ie

Name of Initiative	ILLUMINATE
Lead organisation and partners (where relevant)	Trinity College Dublin (TCD, lead), University of Limerick (Mary Immaculate College), Marine Institute (MI), Dundalk Institute of Technology (DkIT).
Outline:	<p>Academic staff member Dr Eleanor Jennings is currently involved in ILLUMINATE, an EPA funded project which is running from 2006. ILLUMINATE is exploring the potential impacts of climate change on nutrient inputs to three west of Ireland lakes using a combination of catchment and in-lake dynamic modelling. In the project a catchment model linked to an ecological pressure-response model is being applied for the first time in an Irish context. The sites at which the models are being applied are the L. Leane catchment in Co. Kerry and the L. Feeagh and L. Mask catchments in Co. Mayo. The catchment model GWLF is being used to simulate loads of sediment, nutrients and dissolved organic carbon (DOC) and the combined physical-biological model DYRESM-CAEDYM is being used to model in-lake biological processes. Forecasting of future catchment and climate pressures is being carried out using projected landuse and population estimates and projected meteorological data. Output from the modelling work will be demonstrated to interested parties –</p>

	including the managers of River Basin Districts in the Irish Ecoregion – at a workshop organised specifically for the purpose towards the end of the research.
Timescale	2006-2009
Key funding source(s)	Environmental Protection Agency (EPA)
Further information	Dr Eleanor Jennings, DkIT

Name of Initiative	RESCALE
Lead organisation and partners (where relevant)	NUI Maynooth (lead), Trinity College Dublin (TCD), Dundalk Institute of Technology (DkIT)
Outline:	Academic staff member Dr Eleanor Jennings is currently involved in the RESCALE project, a Marine Institute funded project based at the Burrishoole catchment in Co. Mayo (2008-2009) assessing potential climate change impacts on salmonids. This project is part of the Marine Institute Climate Change Research Programme. The project includes analysis, evaluation and integration of observational data, high resolution climate scenarios and catchment-based models to assess the likely changes in key aquatic processes for the Burrishoole catchment. An important outcome of this research will be the development of a catchment-based data collection and modelling framework to support the long-term monitoring of climate change impacts.
Timescale	2008-September 2009
Key funding source(s)	Marine Institute
Further information	Dr Eleanor Jennings, DkIT

Name of Initiative	Climate CASCADE
Lead organisation and partners (where relevant)	Trinity College Dublin (TCD), Dundalk Institute of Technology (DkIT), Marine Institute (MI), University of Helsinki, Finland, Centre for Ecology & Hydrology UK (CEH)
Outline:	The proposed project Climate CASCADE will involve collaboration between DkIT, TCD and MI and will assess the impact of climate change on carbon cycling making use of high frequency data from in-situ instrumentation in Burrishoole. Through an approach that integrates empirical data with output from dynamic models, the CLIMATE-cascade project examines how environmental, notably

	climatic changes, are likely to impact the export of dissolved organic carbon (DOC) from a peatland catchment in the west of Ireland. The project goes on to assess the wider implications of changes in concentrations of DOC in waters draining acid-sensitive catchments for in-lake C dynamics, aquatic ecosystem health and for the provision of potable water.
Timescale	2009-2012
Key funding source(s)	Environmental Protection Agency (EPA)
Further information	Dr Eleanor Jennings, DkIT

Name of Initiative	Energy Research Centre
Lead organisation and partners (where relevant)	Environmental Change Institute at the National University of Ireland, Galway. NUI Galway Partners: College of Science; College of Engineering and Informatics; College of Arts, Social Sciences Celtic Studies; and the College of Business, Law and Public Policy
Outline:	The Energy Research Centre (ERC) was formed in 2007 and was officially launched in December, 2008. It is organised into four thematic research groups: Bioenergy, Renewable Resources, Energy Efficient Technologies, and Energy and Society. The aim of the Centre is to bring together researchers across a variety of disciplines - including science, engineering, and the humanities - to engage in research, education and outreach in the fields of Energy and Environment. Regular meetings, research symposiums, an ERC website and brochure, and the official launch event, have provided platforms for increased communication between researchers, new collaborations, press opportunities (ministerial visits, radio interviews & newspaper articles), raising profiles for individual researchers, and much greater visibility of the ECI's energy activities to various stakeholders and the general public.
Key funding source(s)	Enterprise Ireland, Science Foundation Ireland, Environmental Protection Agency, Sustainable Energy Ireland
Further information	www.nuigalway.ie/eci

Name of Initiative	Centre for Climate and Air Pollution Studies (C-CAPS)
Lead organisation and partners (where relevant)	Environmental Change Institute at the National University of Ireland, Galway
Outline: aims/objectives, methods,	The Centre for Climate & Air Pollution Studies (C-CAPS) was formed in 2007. The Centre aims to consolidate research in the area of atmospheric composition, climate change and natural

intended outcomes,	<p>feedbacks, air-sea exchange, and air quality impacts on health and ecosystems, into an integrated Centre within the Environmental Change Institute (ECI). It will promote durable and sustainable multi- and inter-disciplinary research with the aim to deliver the most informed quantification and predictive assessments of climate change and the impacts of air pollution.</p> <p>The Centre is organised into five thematic research groups: Climate Change, Atmospheric Composition, Air Quality, Atmosphere-Ocean Exchange, and Climate-Ecosystem Interactions.</p> <p>Research facilities include the Mace Head Atmospheric Research Supersite (http://www.macehead.org), an atmosphere-ocean modelling and informatics facility, and a chemical combustion facility (http://c3.nuigalway.ie).</p> <p>Examples of ongoing C-CAPS research projects include: aerosol composition studies, CloudNet activities, and regional climate modelling.</p>
Key funding source(s)	Higher Education Authority's Programme for Research in Third Level Institutes (PRTLII) Cycle 4; Environmental Protection Agency; European Union; Marine Institute
Further information	http://www.nuigalway.ie/ccaps/

Education/training

Name of Initiative	Camphill Renewables Farm
Lead organisation and partners (where relevant)	South West College (Omagh Campus) lead partner Camphill Community Clanabogan
Outline:	<p>The demonstration of renewable energy technologies. Through this project the following technologies were installed; Wind, Biomass, Solar PV and water heating, Ground Source Heat Pump.</p> <p>The renewables farm has been used to demonstrate to the public the application of renewable energy and show it in a real world working environment. This project was created 4 years ago and to date (spring 2009) has hosted over 2,000 visitors. These have included farmers, scientists, engineers, students, teachers/lecturers and the general public. As this was the first of the demonstration projects the South West College set up with a project partner it formed the basis for the future project work of the college. This demonstration facility fitted in perfectly with the ethos of the Camphill community being environmentally responsible and assisting in raising the profile of the community in the area through demonstration activities.</p> <p>By demonstrating renewable energy on site, installed and</p>

	operational, the college has a resource which is of use for curriculum development. This has resulted in the creation of the wind and biomass installers academy courses at the South West College. This project has assisted the college in becoming the premier resource for renewable energy information in the South West Region.
Timescale	Ongoing
Key funding source(s)	South West College
Further information	Aaron Black, South West College

Name of Initiative	Environmental Entrepreneurs
Lead organisation and partners (where relevant)	South West College First Western
Outline:	<p>This project began by scoping areas such as renewable building products, renewable energy, traditional skills and organic production. This initial report was created to identify areas within which work was already being carried within Northern and the Republic of Ireland in the area of renewables/waste/organics. Following this a report investigated the areas within which a course could be created to assist business development in the project region in the above areas. This identified renewable and waste management as areas within which there could be growth for both current businesses and new startups.</p> <p>Following these initial reports, a course was created within the South West College (Omagh Campus) which covered the above topics. The course was delivered using keynote speakers from specific industries, college staff with specialist knowledge and industry field visits to sites of excellence both in Ireland and in an International visit to Austria.</p> <p>The Austrian field visit included large scale CHP from biomass, anaerobic digestion, renewables installation and technology, harvesting equipment and monitoring systems. Some 25 environmental business people participated in this course and were trained in new technologies. Two scoping documents on current and future prospects in the fields of renewables/waste/organics were also produced.</p>
Key funding source(s)	LEADER
Further information	Aaron Black, South West College

Name of Initiative	Wind Turbine Installers' Academy and biomass installers
Lead organisation and partners (where relevant)	South West College
Outline: aims/objectives, methods, intended outcomes,	<p>Creation of an installers course to train electricians in the installation of renewable technology (wind). The course in the college is the only accredited wind installation course on the island of Ireland.</p> <p>The wind turbine installers course is designed to prepare participants to become recognised certified, competent, electrical installers of wind turbines. Students learn how the wind is utilised as a resource, site selection techniques, expected energy outputs, safety, electrical connections, installation and commissioning. The South West College is the only accredited centre for wind turbine installation in Ireland and hosts wind lab technology for demonstration and training.</p> <p>Biomass installers training. Students on the plumbing course within the South West College are trained in the installation of biomass boilers within their course. By training installers for biomass technology, this assists in the development of renewables and knowledge on their installation techniques.</p> <p>The college has available to it a wind lab containing wind tunnel, turbine installation simulator, demonstration turbine, fluid flow system for analysing blade dynamics for wind turbines. The college has several biomass boilers – 150kWh wood chip, 250kWh wood chip, 20kWh pellet, 20kWh log.</p> <ul style="list-style-type: none"> • These boilers are used both for college heating and demonstration of the technology to installers and the general public.
Key funding source(s)	INTERREG
Further information	Aaron Black, South West College

Name of Initiative	Foundation Degree - Rural Sustainability (Queen's University Belfast)
Lead organisation and partners (where relevant)	South West College
Outline: aims/objectives,	Full or part time course with industrial placement accredited by QUB.

methods, intended outcomes,	<p>Three years PT or 2 years FT. Students are taught using both college demonstration facilities (renewable energy & AD demonstrators, composting, business diversification and biodiesel) and industrial visits (Balcas), class lecturers and seminars. Students gain knowledge in the areas of business management, finance, sustainability, waste and renewable technologies. Students have access to a wide range of lecturers and speakers in the college and within industry such as Michael Harnett, Malcom Dawson and John Gilliland. Graduates are entitled to display the letters FdSc after their name. The Foundation Degree is linked to a full Honours Degree programme in the Queen's University of Belfast.</p> <p>As at spring 2009, there were 25 students on Foundation Degree course, with a graduation class of 7 in Summer 2009.</p>
Key funding source(s)	Department of Employment and Learning Northern Ireland (DEL)
Further information	<p>Dr John Moore, South West College</p> <p>http://www.qub.ac.uk/schools/InstituteofAgri-FoodLandUse/ProspectiveStudents/UndergraduateStudies/FdScRuralSustainability/</p>

Name of initiative	BSc in Energy
Lead organization and key partners, where relevant	University of Limerick
Outline	<p>The aims of the BSc Energy are:</p> <ol style="list-style-type: none"> 1. To provide a broad based education and training in the principles of energy relevant to modern industrial practice 2. To meet current and anticipated demand for graduates in energy with an interdisciplinary training in physics, chemistry, electronics, finance and the built environment for careers in energy control, energy management, energy markers and energy science 3. To produce graduates with a strong background appropriate for 4th level studies and research in energy science leading to PhD degrees, in keeping with the government directive to double the number of PhD graduates from current levels 4. To enhance our programme of science degrees in the light of revised national priorities in the area of energy sustainability. 5. <p>Course will begin in September 2009.</p> <p>It is anticipated there will be 30 graduates per annum from 2013, building to 90 graduates per annum in 2017 with the ability to significantly enhance the environmental sustainability of energy</p>

	generation and use both in Ireland and worldwide.
Key funding sources	University of Limerick, Higher Education Authority (HEA)

Name of initiative	SIF Education for Sustainable Development
Lead organization	University of Limerick (UL), Limerick Institute of Technology (LIT) and Shannon Development
Outline	<ol style="list-style-type: none"> 1. Formation of working groups of academics interested in SD, 2. creation of an interdisciplinary module on SD suitable for students in all courses in UL, 3. seed funding programme to integrate SD into existing modules or develop new discipline-specific modules, 4. Formation of training group to oversee series of seminars for staff and students, formation of a working <p>Outputs: Future</p> <ol style="list-style-type: none"> 1. An interdisciplinary module on SD 2. 10-20 SF teaching and learning innovations in new or existing modules 3. 20-30 seminars 4. Farmers' market, energy awareness campaign, special section for SD resources in the library, production of a Green Limerick guide and other initiatives
Key funding sources	Higher Education Authority (HEA) Strategic Innovation Fund

Name of initiative	Campus wide Sustainable Development module
Lead organisation	University of Limerick
Outline	<p>It is intended that all University of Limerick degree programmes will use this module. This module is designed to equip students with the knowledge, skills and attitudes to engage with a globalised society and economy, and to participate fully and meaningfully in a sustainable future. It addresses the three arenas of sustainable development: economic, environmental and social. In economics, greater awareness of the impact of human activity, equity, and the fragility of ecosystems is focused on; human impact, social justice and equality issues are addressed in society; and issues such as resource use, waste management and energy are covered in the environmental sphere.</p> <p>The aim of this module is for students to receive a comprehensive, balanced education in sustainable development in both a general and discipline specific fashion.</p> <p>This module fits with the UL Strategic Plan by helping to empower</p>

	<p>students to meet the real challenges of tomorrow, offering students the opportunity to broaden their curriculum, anticipating societal needs and helping to create well rounded, creative, ethical citizens who will make a significant contribution to their communities. The module also integrates global issues into programmes and enhances both staff and student capacity for participation in globalised knowledge economy and society.</p> <p>The module will be run as part of the BSc in Energy in academic year 2009-10.</p>
Key funding sources	Higher Education Authority (HEA) Strategic Innovation Fund

Name of Initiative	Renewable Energy Education Programmes – BER, Cert in Renewable Energy; Cert in Domestic Sustainable Energy
Lead organisation and partners (where relevant)	Tipperary Institute and AIEA for BER
Outline:	<p>To produce a cohort of graduates with skills in a broad range of renewable and sustainable energy areas.</p> <p>Many graduates produced some of whom are working within the field and who have developed energy projects.</p>
Timescale	Indefinite
Key funding source(s)	Student fees

Name of Initiative	Degree in Environmental And Natural Resource Management
Lead organisation and partners (where relevant)	Tipperary Institute
Outline:	<p>The objective is to produce graduates who are familiar with the science of the environment; who are knowledgeable about and committed to sustainable development; and who can communicate these issues and facilitate the engagement of the general communities and the public.</p>
Timescale	Indefinite
Key funding source(s)	Department of Education and Science

Name of Initiative	New B.Eng. (Hons) Level 8 Degree in Sustainable Energy
Lead organisation and partners (where relevant)	Cork Institute of Technology (CIT), Clean Technology Centre; National Maritime College of Ireland
Outline:	<p>A new degree programme CR510 (CAO Code) has been developed and launched in September 2008.</p> <p>The industry related course aims to provide engineering graduates who have the skills and knowledge in the energy and sustainability sector that most current graduates are lacking.</p> <p>The course is broad based with input from mech, elec, building services and civil/chem. Engineering departments and the NMCI (Marine Engineering)</p> <p>Target graduate numbers of 60 per year.</p> <p>55 students attending in year 1 with 385 points minimum, 45 students in year 3 all with a level 7 engineering degree as prerequisite.</p> <p>Very high level of interest on CAO entry for Sept 2009.</p>
Timescale	Commenced September 2008, all 4 years running by September 2009
Key funding source(s)	Higher Education Authority
Further information	Chris Gibbons, CIT http://www.cit.ie/courses/courselisting/sustainableenergytechnologyhonourscr510/

Name of Initiative	Environmental Change Institute's Outreach Programme
Lead organisation and partners (where relevant)	Environmental Change Institute at the National University of Ireland, Galway
Outline:	<p>The aims and intended outcomes of the programme are to promote interaction between environmental researchers, relevant stakeholders, policy makers, and the general public, awareness of issues relating to environmental change, and increase the profile of the Environmental Change Institute. These are achieved in a variety of ways including:</p> <ul style="list-style-type: none"> • A primary outreach programme consisting of several stand-alone interactive presentations on a variety of environmental topics related to the SESE curriculum • Internal and external networking and research symposium events • Organization of public workshops, seminars, conferences, and lectures, involving ECI researchers and external

	<p>experts</p> <ul style="list-style-type: none"> • Involvement in local and national science fairs and science education promotion events, such as National Science Week, Science & Technology Careers Days, and World Ocean Day • Hosting secondary school tours • Development and delivery of a transition year environmental peer education training programme the “Digital Hedge School (DHS) Project”. The DHS Project is in its third year. • High levels of interaction and collaboration with other NUI Galway Outreach Officers (attached to various institutes and departments) and local science education providers (such as the Galway Atlantaquaria, Brigit’s Garden, the Galway Education Centre) • Development of outreach programmes specific to individual projects and centres associated with the ECI including the Griffith Geoscience Project and the recently formed Energy Research Centre. • Production of promotional materials such as brochures, posters, and banners • Creation and maintenance of the ECI website (www.nuigalway.ie/eci) and several of our research centres and projects (www.nuigalway.ie/energy; www.nuigalway.ie/c-caps; www.envgrad.ie) • Liaising closely with NUI Galway’s press office to ensure media coverage of ECI events and important research findings. • Internal communications media such as a quarterly newsletter and regular email updates
Key funding source(s)	HEA Programme for Research at Third Level Institutions (PRTL) Cycle 4; Environmental Protection Agency (EPA)
Further information	www.nuigalway.ie/eci

Name of Initiative	Taught MSc Degree Environment and Society
Lead organisation and partners (where relevant)	Environmental Change Institute at the National University of Ireland, Galway.

Outline:	<p>A project to develop a taught masters degree on the subject of “Environment and Society” is underway. The aim of the project is to provide a postgraduate environmental training opportunity with a degree that is distinctly different from others currently on offer in Ireland. The MSc will call on the expertise of ECI researchers, with modules to include the subjects of Energy, Climate Change, Ecology and Taxonomy, Environmental Law, Environmental Policy (to name but a few). It is also being proposed that the MSc degree include a highly original, field based, civic engagement module. The expected outcomes include a more highly trained base of environmental researchers, a valuable foundation for community interaction and contribution, and an increased profile for the ECI and its centres and researchers.</p> <p>The programme is targeted for inclusion in the 2010 curriculum.</p>
Key funding source(s)	Internal
Further information	Sarah Knight, Outreach Officer, Environmental Change Institute, NUI Galway

Name of Initiative	Environment Graduate Programme
Lead organisation and partners (where relevant)	<p>Environmental Change Institute at the National University of Ireland, Galway.</p> <p>National and EU Partners: University College Cork, Trinity College Dublin, University of Limerick, the National University of Ireland, Maynooth, Cork Institute of Technology, Queen’s University Belfast, Met Éireann and the Finnish Centre of Excellence.</p>
Outline:	<p>Research teams from the Environmental Change Institute at the National University of Ireland, Galway, University College Cork, Trinity College Dublin, University of Limerick, the National University of Ireland, Maynooth, Cork Institute of Technology, Queen’s University Belfast, and Met Éireann have been funded as a national consortium (along with the Finnish Centre of Excellence) to establish the “Environment Graduate Programme” (EGP). The main aim of the EGP is to counter this projected lack of adequate doctoral student numbers, and as such inter-university graduate schools are being created in areas of particular research strengths, to provide advanced training and intellectual support for 4th level research students. The EGP will address the need for a more structured approach to postgraduate degrees was recognised, in order to realize a desire for:</p> <ul style="list-style-type: none"> • highly, broadly trained and experienced researchers; • timely PhD completion (corresponding to the funding period); and, • improved completion rates. • <p>The strategic objectives of the EGP are to:</p> <ul style="list-style-type: none"> • Develop within Ireland a national, inter-institutional

	<p>graduate programme through an existing, strong, active network of leading academics;</p> <ul style="list-style-type: none"> • Provide generic and inter-disciplinary and specialised skills training and support original research to foster enhanced intellectual and creative capacities in graduate students; • Use a world-class PhD structured research programme in environment to attract top-class students from national universities and from abroad; • Offer shared access to a world class infrastructure supporting innovative research; and, • Provide a forum for sharing good practice in researcher education and the development of research careers. <p>The development of graduate schools is intended to support a projected doubling of PhD students by 2013.</p>
Key funding source(s)	Higher Education Authority's Programme for Research in Third Level Institutes (PRTLII) Cycle 4
Further information	Sarah Knight, Outreach Officer, Environment Change Institute, NUI Galway

Campus wide initiatives

Name of initiative	Environmental committee
Lead organisation	University of Limerick
Outline	<p>Environmental Committee</p> <p>Terms of reference:</p> <ol style="list-style-type: none"> 1. To advise the President on environmental issues as they affect UL 2. To propose policy and its implementation on environmental issues for adoption by the university 3. To contribute to increasing environmental awareness among the Campus Community 4. To evaluate the implementation of the University's environmental policies <p>The University offers courses of an environmental nature and many staff members are carrying out research projects in this area.</p> <p>Achievements include</p> <ul style="list-style-type: none"> • Increased staff awareness of environmental facilities on campus –recycle points, organic outlets, bicycle shops • Car pooling scheme implemented • Energy consumption of the university reduced • Increased recycling

	<ul style="list-style-type: none"> Increased staff awareness on water usage/waste
Key funding sources	University of Limerick

Name of Initiative	Recycling and waste reduction
Lead organisation and partners (where relevant)	Dundalk Institute of Technology (DkIT)
Outline:	<p>This involves the segregation and recycling of:</p> <ul style="list-style-type: none"> ➤ Waste paper and cardboard. ➤ Glass. ➤ Light bulbs. ➤ Cooking oil. ➤ Copper and steel used by the plumbing apprentices. ➤ Copper wire from the electrical trades crafts. ➤ Aluminum cans and tins. ➤ Plastic bottles. ➤ Battery Recycling. ➤ Ink and Toner Cartridges ➤ Mobile phones. ➤ Polystyrene. ➤ All electrical goods including computers and monitors. ➤ Delft. ➤ Lost property. <p>To reduce our reduction of consumables we:</p> <ul style="list-style-type: none"> ➤ Set all photocopiers to default double sided copying which reduced our paper usage by about 30%. ➤ Introduced reusable envelopes for internal mail. <p>In October 2008 we achieved 60% recycling of all our waste.</p> <p>This project has been running since 2001 and has resulted in substantial reduction in land fill costs and at least 1000 trees per annum saved.</p>
Key funding source(s)	“Partnership” funding and internal funding.
Further information	http://ww2.dkit.ie/staff_and_admin/environmental_committee

Energy efficiency

Name of Initiative	DkIT Unplugged Initiative
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Lead organisation and partners (where relevant)	Dundalk Institute of Technology
Outline:	<p>In February 2009, DkIT rolled out automatic shut down of computers at 10pm every night. CANDI – Computer Automatic Nightly Shut Down Initiative. This involves 600 staff and 600 student computers. Computer services will monitor this by examining the number of computers attached to the network before and after the roll out of the initiative. We will also examine the actual energy consumption in association with CREDIT – Centre for Renewable Energy at Dundalk Institute of Technology.</p> <p>The second phase of the DkIT Unplugged Initiative will be a communications and awareness program to start reducing other energy usages around the campus.</p>
Key funding source(s)	None specific
Further information	http://ww2.dkit.ie/staff_and_admin/environmental_committee

Name of Initiative	Climate Change Response Group – Switch Off Campaign
Lead organisation and partners (where relevant)	Cork Institute of Technology (CIT)
Outline:	<p>Awareness raising of staff and students to encourage electrical device switch off during college down time (weekends, holiday periods).</p> <p>The project resulted in approximately 5-8% reduction in electrical use during down times, however analysis was severely hampered by lack of adequate metering.</p>
Timescale	Spring 2007 – summer 2008
Key funding source(s)	CIT seed funds
Further information	www.cit.ie

Name of Initiative	CIT's Sustainable Campus Programme (CSCP)
Lead organisation and partners (where relevant)	Cork Institute of Technology (CIT) Building Office and Clean Technology Centre

relevant)																	
Outline:	<p>Cork Institute of Technology (CIT) proposes to establish a sustainable campus programme at its Bishopstown Campus. The programme focuses on all areas of sustainability – ie. it will be an integrated programme, with the following aims:</p> <ul style="list-style-type: none"> ▪ Reduce water use ▪ Reduce electricity use ▪ Reduce natural gas use ▪ Reduce waste generated ▪ Reduce major resource use ▪ Involve and educate staff and students <p>The programme will involve baseline auditing, installation of appropriate monitoring equipment, prevention opportunity assessment, options generation, and projects implementation.</p> <p>The results of such a programme will have replicability, not just across all other third level institutions, but all public sector organisations.</p> <p>In 2007 CIT had an annual spend for its Bishopstown campus of approximately €642,000 (electricity), €200,000 (gas), €145,000 (waste), and €120,000 (water). In addition, other unquantified resources (e.g. in laboratories, maintenance, offices etc.) are consumed.</p> <p>The following MINIMUM annual savings are anticipated:</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 30%;">Water</td> <td style="width: 15%;">20%</td> <td style="width: 30%;">10,000 m³</td> <td style="width: 25%;">€24,000</td> </tr> <tr> <td>Electricity</td> <td>10%</td> <td>500 MWh</td> <td>€64,200</td> </tr> <tr> <td>Waste</td> <td>5%</td> <td>16.5 tonnes</td> <td>€7,250</td> </tr> <tr> <td>Paper</td> <td>10%</td> <td>to be quantified</td> <td>ditto</td> </tr> </table>	Water	20%	10,000 m ³	€24,000	Electricity	10%	500 MWh	€64,200	Waste	5%	16.5 tonnes	€7,250	Paper	10%	to be quantified	ditto
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Paper	10%	to be quantified	ditto														
Timescale	April 2009 – March 2011																
Key funding source(s)	Environmental Protection Agency (EPA), CIT																
Further information	Chris Gibbons, CIT																

Name of Initiative	CIT's Sustainable Campus Committee
Lead organisation and partners (where relevant)	Cork Institute of Technology (CIT) Clean Technology Centre

Outline:	To support the efforts of the CIT Sustainable Campus Programme, to provide continuity and communicate results and work of programme to senior management and staff and student bodies. To set and track progress toward campus targets on sustainability by 2020.
Timescale	Present – 2020
Key funding source(s)	To be identified as needs arise
Further information	Chris Gibbons, CIT

Name of Initiative	Installation of CHP Plants
Lead organisation and partners (where relevant)	National University of Ireland, Galway
Outline:	<p>In 2007, NUI Galway installed its first natural gas combined heat and power plant. This produces approximately 35-40% of peak winter heating load for 40,000m² buildings. It also produces over €137,000 electricity per year for use on campus.</p> <p>Since then, 3 additional CHP plants have been installed, including the new sports centre on campus. This will produce 80% of peak winter heating load for 6,000m² building and 25m pool. It also produces over €30,000 electricity per year for use in the sports hall.</p> <p>The installation of CHP plants has assisted NUI Galway to improve its energy efficiency and reduce its carbon footprint, by reducing greenhouse gas emissions. It has also been used as an educational tool for staff and students on campus. Other opportunities for the installation of CHP on campus are currently being investigated.</p>
Key funding source(s)	Sustainable Energy Ireland (SEI), NUI Galway
Further information	<p>Sinead Higgins, Environmental Manager, Buildings Office, NUI Galway</p> <p>http://www.nuigalway.ie/administration_services/buildings_office/environment.html</p>

Name of Initiative	Green Transport
Lead organisation and partners (where relevant)	National University of Ireland, Galway
Outline:	In mid 2007, NUI Galway switched from regular diesel (4.7 million litres/year) to a blend of 5% biodiesel in its fleet of vans, reducing CO ₂ emissions by about 3% each year. The biodiesel is manufactured locally by reworking used vegetable oils from

	restaurants / fast food outlets. An electric golf buggy is also in use by grounds staff, further reducing our reliance on diesel.
Key funding source(s)	Project was cost neutral.
Further information	Sinead Higgins, Environmental Manager, Buildings Office, NUI Galway http://www.nuigalway.ie/administration_services/buildings_office/environment.html

Name of Initiative	Fuel displacement
Lead organisation and partners (where relevant)	National University of Ireland, Galway
Outline:	In 2007, a 14 MW boiler was converted from heavy fuel oil to natural gas. The aim of this project was to reduce our fuel related emissions and achieve savings. There are further plans to install a biomass boiler in 2009, further replacing fuel oil.
Key funding source(s)	
Further information	Sinead Higgins, Environmental Manager, Buildings Office, NUI Galway http://www.nuigalway.ie/administration_services/buildings_office/environment.html

Name of Initiative	Solar panels
Lead organisation and partners (where relevant)	National University of Ireland, Galway
Outline:	A 40m ² high efficient vacuum tube array was installed, with a 3000 litre dual coil water tank. It is estimated that this contributes approximately 45% of the annual domestic hot water requirement for An Bialann (4.7million litres/yr). It is estimated that 5.8 tonnes of CO ₂ have been reduced because it displaced 45% of existing LPG water heaters. A Solar thermal system for another restaurant was installed in 2008 while an additional one is due to be installed in 2009.
Key funding source(s)	Sustainable Energy Ireland (SEI), NUI Galway
Further information	Sinead Higgins, Environmental Manager, Buildings Office, NUI Galway http://www.nuigalway.ie/administration_services/buildings_office/environment.html

Name of Initiative	Electricity from Renewable Sources
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Lead organisation and partners (where relevant)	National University of Ireland, Galway
Outline:	In January 2009 the electricity contract was awarded to a company guaranteeing a minimum of 15% electricity to be supplied from renewable sources. The aim was to reduce our reliance on fossil fuels and assist in reducing NUI Galway's carbon footprint.
Key funding source(s)	Sustainable Energy Ireland (SEI), NUI Galway
Further information	Sinead Higgins, Environmental Manager, Buildings Office, NUI Galway http://www.nuigalway.ie/administration_services/buildings_office/environment.html

Awareness raising

Name of Initiative	'Kill a Watt' – if not you, who? Campaign
Lead organisation and partners (where relevant)	National University of Ireland, Galway
Outline: aims/objectives, methods, intended outcomes,	<p>An energy awareness campaign is currently being rolled out at NUIG. The objectives are as follows:</p> <ul style="list-style-type: none"> • Raise overall energy awareness among all users of NUIG campus on an ongoing basis; • Target specific users / schools where energy usage is high and further increase awareness among staff and students; • Engage staff / students in energy saving activities; • Inform staff / students of ongoing energy management projects; • Reduce energy consumption throughout NUIG through awareness raising measures; • Outline simple changes staff/students can make to improve energy efficiency at NUIG. <p>The aim is to achieve a 5% reduction in electrical consumption per sq metre/year in 2009 and 2010 and increase awareness on campus.</p> <p>An energy team was set up in February 2009 with staff and student representation from each of the colleges to ensure that there is effective communication to all / from all staff and students on campus. A variety of communication tools will be used to get buy in from all stakeholders including articles in campus newspapers, features on campus radio, poster campaign, competitions and activities during green week..</p>
Key funding source(s)	Sinead Higgins, Environmental Manager, Buildings Office, NUI Galway

	http://www.nuigalway.ie/administration_services/buildings_office/environment.html
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Name of Initiative	'Choose to Reduce – if not you, who' Campaign
Lead organisation and partners (where relevant)	National University of Ireland, Galway
Outline: aims/objectives, methods, intended outcomes,	<p>A waste awareness campaign will be rolled out later this year. The objectives are as follows:</p> <ul style="list-style-type: none"> • Raise awareness/educate all stakeholders on correct waste management practises; • Identify and target areas where waste production is high; • Engage staff / students in waste reduction activities; • Promote recycling facilities on campus; • Outline simple steps staff/students can make to reduce/reuse waste <p>The aim is to improve our current recycling rate of 25% to a minimum of 40% and reduce overall waste production.</p> <p>A waste team will be set up in 2009 with staff and student representation from each of the colleges to ensure that there is effective communication to all / from all staff and students on campus. A variety of communication tools will be used to get buy in from all stakeholders including articles in campus newspapers, features on campus radio, poster campaign, competitions and activities during green week.</p>
Key funding source(s)	
Further information	<p>Sinead Higgins, Environmental Manager, Buildings Office, NUI Galway</p> <p>http://www.nuigalway.ie/administration_services/buildings_office/environment.html</p>

Name of Initiative	Energy Team/Energy Bureau
Lead organisation and partners (where relevant)	National University of Ireland, Galway
Outline: aims/objectives, methods, intended outcomes,	<p>An Energy Team was set up at NUI Galway in February 2009 with staff and student representation from each college. The role of the energy team is as follows:</p> <ul style="list-style-type: none"> • Planning and implementing the energy awareness campaign for NUI Galway; • Organising energy awareness events, such as energy awareness day / week; • Designing promotional posters, leaflets and other

	<p>information materials;</p> <ul style="list-style-type: none"> • Raising energy awareness in their own departments/sections by raising issue at department/sector meetings; • Providing updates on how their department/section is progressing and any problems they encounter; • Working with buildings manager and environmental manager to track savings and consumption which can be used in promotional material. <p>In the next 6 months, NUI Galway is planning to engage the services of an Energy Management Bureau, which will include web based software linked to the staff intranet.</p> <p>Target: 5% reduction in electricity consumption in 2009 and 2010.</p>
Key funding source(s)	
Further information	<p>Sinead Higgins, Environmental Manager, Buildings Office, NUI Galway http://www.nuigalway.ie/administration_services/buildings_office/environment.html</p>