

Institute for Sustainable Energy and the Environment



I-SEE
Institute for Sustainable Energy
and the Environment



UNIVERSITY OF
BATH

Introduction from Vice-Chancellor

The University of Bath is an internationally leading institution, delivering world class research and teaching. The University is ranked in the top 10 universities in the UK and boasts a research portfolio of over £100 million. Bath has internationally recognized researchers and includes amongst its staff a joint Nobel Prize winner. Our intellectual reputation is further augmented by state-of-the-art facilities across campus making the University a world class institution.

The University of Bath is committed to addressing the needs of industry, business, government and society both now and for future generations. In order to meet these long-term strategic goals, the University is proud to launch our Institute for Sustainable Energy and the Environment (I•SEE). The Institute brings together researchers in 13 departments and 7 centres of expertise in the areas of energy, environment, sustainability, public policy and behavioural change.

The vision of the Institute is to take an interdisciplinary approach to the major global challenges facing society today and for future generations. The activities of the Institute have been clustered into 12 themed areas which will address the future energy landscape, environmental sustainability, behavioural change and wellbeing. This publication sets out the research areas in the Institute. I hope that you find it informative and interesting.



I•SEE Vision

The vision for I•SEE is to focus, integrate, enhance and demonstrate fundamental and applied research on sustainable energy and the environment. The Institute brings researchers together from across the disciplines in order to establish an integrated, inter-disciplinary understanding of the relationship between technological systems, social practices, human behaviour and sustainability, and build a sound conceptual basis for understanding and influencing change processes aimed at meeting the challenge of climate change and the need to secure a low carbon economy within the broader context of sustainability.

I•SEE Management Board



Professor Geoffrey P Hammond – Director



Professor William Scott – Deputy Director



Professor Saiful Islam – Deputy Director



Dr Miles Davis – ISEE Project Manager

Climate Change Mitigation

“The scientific evidence that climate change is a serious and urgent issue is now compelling. It warrants strong action to reduce greenhouse gas emissions around the world to reduce the risk of very damaging and potentially irreversible impacts on ecosystems, societies and economies.” (Stern Review, 2006).

The Institute for Sustainable Energy and the Environment (I•SEE) brings together significant expertise to address the challenges of climate change mitigation in terms of providing technological solutions, socio-economic impacts and policy instruments. Key research areas include renewable energy technologies, biofuels, sustainable building materials and design, integration of future energy sources, energy storage, biodiversity, habitat mapping, educational interventions, economic instruments for sustainability, energy and climate policy, behavioural change and impacts.

The diversity of the research at Bath ranges from the work of Professors Saiful Islam and Laurie Peter addressing energy storage and conversion, to the work of Professor Anil Markandya who was a coordinating Lead Author for the IPCC's Third Assessment Report and in October 2007 which shared the Nobel Peace Prize with Al Gore to Dr Philippe Blondel's research into investigating underwater habitats to study the effects of climate change.

Further information regarding our research on climate change mitigation can be found at <http://www.bath.ac.uk/i-see>



Well-being, capability and resilience in communities

Well-being can be viewed as what is non-instrumentally or ultimately good for a person, and understanding the impacts of climate change on wellbeing is key in developing mitigation strategies. Research on well-being is a major theme of the Centre for Developmental Studies (CDS), led by Dr. James Copestake. CDS combines five themes: poverty and wellbeing, policy and politics, markets and micro-finance, socio-cultural studies, and environmental sustainability.

This, together with work in the Centre for Research in Education and the Environment (CREE), led by Prof. Bill Scott, on the contribution that educational and training programmes, and learning more generally, can make to community-focused sustainability, research in the School of Management, research led by Prof. Peter Reason, on community-based action-enquiry approaches to sustainability, and the psychological research led by Prof. Alan Lewis on energy use, personal carbon trading, and sustainable lifestyles, are important elements of the contribution that social science research makes to I•SEE. Prof. Bas Verplanken, with his research on the breaking of habits, is also a key player in the ESRC/Defra funded, research programme on sustainable behaviours. For further information regarding our research please see <http://www.bath.ac.uk/i-see/research/wellbeing/>

Energy Efficiency Improvement & Demand Reduction

Increasing the efficiency in the way we generate, distribute and transmit energy in conjunction with improvements in the efficiency of energy using products has a vital role to play in ensuring sustainability. Energy Demand Reduction can be achieved through a number of complementary routes on both the demand and supply side. The Energy Efficiency and Demand Reduction theme of I•SEE brings together expertise in a number of complementary technologies for efficiency and demand reduction. The technological research of the University is augmented by key research in the fields of socio-economic and behavioural change linked to energy. Only by taking a holistic approach considering the technological and socio-economic challenges together can the necessary improvements in energy use be achieved. Research in this area includes novel low energy lighting using GaN LEDs led by Dr. Duncan Allsopp and Prof. Wang Nang Wang. A related company, Nanogan Limited has been successfully spun out of the University.

The work of the Sustainable Energy Research Team under the direction of Prof. Geoffrey Hammond with the Department of Mechanical Engineering includes research on Industrial Energy Demand Reduction in conjunction with the UK Energy Research Centre (UKERC). The research undertaken within this theme is integrated with detailed research relating to social interaction with energy technologies. Examples of this include the LowCarbonWorks project which investigated the barriers to widespread uptake of lower carbon technologies, review of policy instruments for renewable technologies and utility regulation in the energy sector. Further information regarding our research is available at <http://www.bath.ac.uk/i-see/research/energydemand/>

Sustainable built environment

Buildings and the built environment are considered to be responsible for 45% of CO2 emissions in the UK. A significant reduction in the environmental impact of the built environment is necessary in order for UK Government targets of a 80% reduction by 2050 to be achieved. Prof. Peter Walker's leading research in conjunction with industry partners includes the development of straw bale panels for housing (Modcell) and the manufacture of sustainable prefabricated housing from renewable materials (Balehaus). Other work includes research into low carbon mortars, hemp-lime construction and unfired clay bricks all of which could provide significant carbon and energy savings both in new build and retrofitting.

The interaction of humans with the built environment is also considered by research undertaken within the Faculty of Engineering and Design at Bath particularly within the Research Unit for the Engineering and Design of Environments. The Unit is led by Dr. Marialena Nikolopoulou and research within this Unit considers thermal comfort in open public spaces, the use of open spaces within building design, urban microclimate, bioclimatic design, the better use of natural lighting and building facades for heating, cooling and lighting within buildings to improve user comfort. The work of the Sustainable Energy Research Team includes research on micro-generation in conjunction with the EPSRC SUPERGEN Highly Distributed Energy Future (HiDEF) Consortium and the ICE database of embodied energy and carbon of over 400 types of materials. Further information regarding our research in the sustainable built environment is available at <http://www.bath.ac.uk/i-see/research/energydemand/>



Energy Storage and Conversion

I•SEE is centrally addressing the research challenges facing society by leading and participating in flagship EPSRC SUPERGEN initiatives. The Energy Storage consortium led by Professor Saiful Islam is focusing on developing new functional nano-materials to improve rechargeable lithium ion batteries and supercapacitor technology for hybrid electric vehicle applications. Professor Islam uses supercomputers to build atomic-scale models of materials that help us understand their structures and behaviour. Professor Laurie Peter and his group lead international research on photovoltaics through two SUPERGEN consortia, Photovoltaic materials for the 21st Century (PV-21) and Excitonic solar cells. Current research is on new routes to low cost solar cells. This includes preparation of thin semiconductor films by electrodeposition, and the study of physical and chemical processes in sensitized nanocrystalline solar cells.

Dr Tim Mays within the Department of Chemical Engineering is leading the EPSRC SUPERGEN Sustainable Hydrogen Energy Consortium which is a multi-partner, interdisciplinary collaboration investigating the production, storage, integration and socioeconomic factors related to Hydrogen. Hydrogen ultimately derived from renewable sources and used as an energy vector will lead to a reduction in the use of limited fossil fuel reserves, improved air quality, increased security and flexibility of energy supply, greater energy diversity and the creation of new industries. The research at Bath within this consortium is considering hydrogen storage in novel nanoporous materials and comparing the storage kinetics and equilibria of different storage systems. Further information regarding our research is available at <http://www.bath.ac.uk/i-see/research/energystorage/>

Electricity Generation, Transmission & Distribution

The generation, transmission and distribution of electricity results in a significant carbon footprint. In order to reduce the carbon footprint of electricity distribution, meet emissions targets and meet Government ambitions for renewable energy generation, there needs to be an increase in energy derived from renewable sources entering the grid. Integration of renewable energy within the grid creates a number of issues in terms of transmission, distribution and security. Professor Geoffrey Hammond, Director of I•SEE is a key participant within the SUPERGEN Highly Distributed Power Systems consortium and is leading the inaugural flagship collaboration between E.ON UK/ EPSRC investigating Transition Pathways to a Low Carbon Economy. The project will bring together technologists, engineers, social scientists and modelers to determine potential future scenarios for the energy mix in 2020, 2030 and 2050.

The Centre for Sustainable Power Distribution has recently been elected to join the prestigious Institution of Engineering and Technology (IET) Power Academy placing it as one of the Top 7 research centres in the UK. The staff within the centre have internationally recognized expertise in power system planning, operation and management, distributed generation, power system, economic and market operation. Current research includes the SUPERGEN FlexNet consortium investigating the factors that will dictate the future form of the UK electricity network and the degree of flexibility required and the work of Dr Furong Li investigating a novel charging methodology that could re-shape the UK's electricity pricing system, ultimately benefiting consumers with secure, sustainable and affordable electricity. Further information is available at <http://www.bath.ac.uk/i-see/research/energyinfrastructure/>



Low carbon transportation and advanced / alternative fuels

The transport sector is a major energy user responsible for approximately 25% of total UK carbon emissions. The Powertrain and Vehicle Research Centre (PVRC) led by Prof. Gary Hawley has received significant capital investment to develop state of the art facilities where engines, powertrain systems and vehicles can be performance analysed and optimised in controlled environments that replicate on road conditions. Cutting edge research within the £3M portfolio of the centre includes contributing to the "Succeeding through Innovation" project sponsored by DTI, Ford and BP. The project has demonstrated how better control and optimisation of coolant and lubricant oil can reduce fuel consumption by up to 6%.

The development of sustainable second and third generation biofuels will require a cross sector approach to the development of feedstocks, their processing and refining and ultimately their use within engines. PVRC in conjunction with the Centre for Sustainable Chemical Technologies (CSCT) led by Prof. Matthew Davidson expertise in crop production, catalysis, reactor technology and automotive engineering has been brought together to provide a supply chain approach to biofuel development. The supply chain approach allows for fuel characteristics to be modified at any stage of processing to develop a viable fuel. Research within the CSCT focuses on five core themes, renewable resources, clean energy, cleaner processes, life cycle impact reduction and chemistry in healthcare. The CSCT includes a recently awarded £7.5 million doctoral training centre that will provide multidisciplinary research and training for the next generation in the area of sustainable chemical technologies. Further details of our research are available at <http://www.bath.ac.uk/i-see/research/lowcarbontransport/>



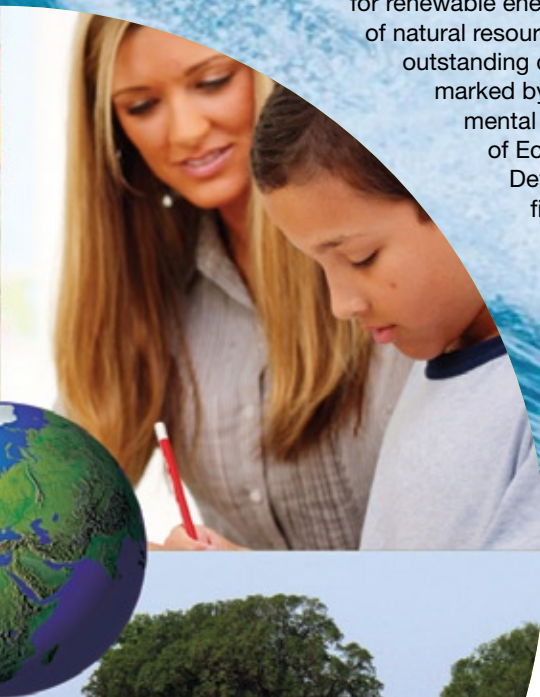
Technology assessment of energy systems

Understanding the overall impact of different energy sources and supply mixes, as well as demand reduction measures, will be vitally important in selecting routes to sustainability, and in meeting UK Government climate change and renewable energy targets. A number of complementary appraisal techniques have been proposed to accurately evaluate the energy performance, environmental impact (including carbon dioxide emissions) and economics of various energy systems.

The Sustainable Energy Research Team led by Prof. Geoffrey Hammond promotes sustainability through high quality research and publications. Currently the team is actively involved in the technology assessment of sustainable energy systems. Using a toolkit of methods derived from the engineering and environmental sciences such as carbon and environmental footprinting, environmental life-cycle assessment (LCA), and thermodynamic analysis. Their research is sponsored by a wide range of funders including Research Councils, UK Government Departments and Agencies, the UK Energy Research Centre, regional bodies, and industry. Current projects involve the 'whole systems' appraisal of bioenergy systems, large-scale power plants (fossil fuelled, nuclear and wind power), domestic micro-generators (such as heat pumps, micro-wind-turbines, small-scale combined heat and power plants, solar hot water systems, and solar photovoltaic cell arrays), and the embodied energy and carbon emissions associated with construction materials. Further details of our research are available at <http://www.bath.ac.uk/i-see/research/techassess/>



Environmental Sustainability



Environmental sustainability can be viewed as balancing the 'three pillars' of economic and social development with environmental protection. Environmental sustainability is the core ethos behind the development of I•SEE at the University of Bath. The University is conducting world leading research addressing each of the pillars. Key research areas include green accounting, the definition of subsidies for renewable energy, "getting the prices right" in the setting of environmental taxes, the efficient use of natural resources and the establishment of an effective regime for climate change mitigation. The outstanding quality of the environmental economics team, headed by Prof. Anil Markandya was marked by its inclusion within the Nobel Peace Prize 2007 award to the UN's Inter-governmental Panel on Climate Change (IPCC). The research undertaken within the Departments of Economics and Social Policy Sciences forms a key component of the Centre for Development Studies (CDS). The Centre directed by Dr. James Copestake combines five themes: poverty and wellbeing, policy and politics, markets and micro-finance, socio-cultural studies and environmental sustainability. Included within the CDS is the prestigious ESRC Research Group on Wellbeing in Developing Countries dedicated to the study of poverty, inequality and the quality of life in developing countries. Further information regarding our research is available at <http://www.bath.ac.uk/i-see/research/sustainability/>



Economics and Ethics of Sustainability

The adoption of a more sustainable ethos by society will be dependent not only on the availability of technology and the willingness of society to adopt change but also on the economics of the change. Environmental economics involves the application of economic methods to evaluate environmental issues, including natural resource exploitation, defining subsidies for renewable energy or farming, setting environmental taxes and establishing effective regimes for climate change mitigation. The outstanding quality of environmental economics research has been noted above. The understanding of human interaction with environmental and economic measures is further supported by teaching and research within the Department of Psychology. The research directed by Dr. Alan Lewis has explored ways of encouraging institutional investors (e.g. pension funds) to invest in companies with plausible green credentials and to engage with less sympathetic ones in the hope of changing their practices. Research by Prof. Bas Verplanken investigates how environmental attitudes and values are affected as personal habits fracture and change. The Centre for Business Organisations and Society (CBOS) led by Prof. Andrew Millington was established in order to provide a forum for research in the area of Business and Society. Research within CBOS includes International and Social Environmental Procurement, Global Sustainable Public Procurement, identification and modeling of social and economic drivers of degradation of the marine environment and climate change and business profitability. Further information regarding our research is available at <http://www.bath.ac.uk/i-see/research/policy/>

Effective policy & practice around sustainable behaviour

Technological and engineering advances towards addressing sustainability require underpinning at the macro level by effective policy, regulation and social acceptability in order to maximise their impact. The formulation of effective policy and ensuring its uptake requires an interdisciplinary approach to understand the technologies available, drivers, social norms and preconceptions. Policy research at the University is exemplified by the Centre for Development Studies within its Governance, Policy and Politics theme focusing on national and international politics, cross-national comparisons, and the local dynamics of entitlement and allocation. The cross-disciplinary nature of policy research at the University is further demonstrated by the research of Dr. Joseph Szarka within the Department of European Studies and Modern Languages on politics and policy-making in the EU, especially around environmental, energy and climate policy. Supporting the policy research is ongoing work within the Centre for Research in Education and the Environment led by Prof. Bill Scott in developing approaches to education and the public understanding of the environmental sciences. Members of the centre have written a number of significant books exploring the relationships between sustainable development and learning, seeing sustainable development as inherently a learning process. For further information please see <http://www.bath.ac.uk/i-see/research/policy/>

Educating the decision makers of tomorrow

The University of Bath has a unique blend of high quality research and teaching, together with a range of knowledge exchange and technology transfer initiatives. Bath offers a number of undergraduate and postgraduate courses in the energy field, including the Doctoral Training Centre in Sustainable Chemical Technologies, MScs in Electrical Power Systems, Façade Engineering, and Power Transmission and Motion Control in conjunction with sandwich courses with time in industry. Postgraduate courses are available full-time, part-time or by distance learning to provide a flexible approach to teaching.

The Integrated Environment Management MSc is recognized by the Institute of Environmental Management and Assessment (IEMA) and provides students with a blended learning experience within environmental management. The flexibility provided by the use of the open-source tool Moodle allows students to learn while taking the minimum time away from their employer. Significant postgraduate programmes focused on environment and sustainability are also part of the work of research centres in the School of Management and the Faculty of Humanities and Social Sciences. There are currently distance learning students in over 40 countries worldwide and over 2000 international students studying at Bath. The University provides opportunities for business learning through CPD courses including modules focusing on Cleaner Technology, Energy Management and Environmental Impact. For further information please see <http://www.bath.ac.uk/grad-office>

