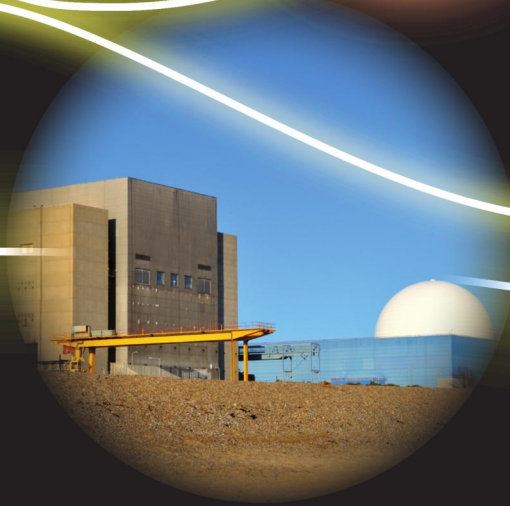


OU Energy



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The Open
University



Energy and Buildings

Energy and the Built Environment covers the domestic and industrial uses of energy. One of the central aims of the EU 20:20:20 energy policy is to reduce the consumption of energy by 20%. From a domestic perspective, abatement and efficiency savings in energy use can be achieved by appropriate retrofitting of existing buildings using novel materials and by changes in consumer habits. For new buildings, emerging technologies in design, construction and operation allow new ways of conceptualising the sustainability and energy aspects of our built environment.

There is significant interest at The Open University in demand-side aspects of energy use. In particular, we research into perceptions of energy use and identify factors that affect consumer responses to novel technologies (e.g. smart meters). We also investigate the potential of new methods of design using Building Information Modelling (BIM) technologies across built environment lifecycles and scales.

Funding

Previous research at The Open University has involved the study of microgeneration technologies as part of a UK strategy to reduce carbon emissions from buildings and to meet climate change related targets. With funding from the Higher Education Innovation Fund ('Carbon Connections') and industry, the OU and The Energy Saving Trust undertook the first large-scale Heat Pump Field Trial in the UK. We monitored over 80 domestic ground and air-source heat pumps in private and social dwellings to provide an independent evaluation of this technology. The OU team investigated the experience of using heat pumps and evaluated the effect of user behaviours on measured heat pump system efficiency.

Selected Publications

Jacky Bourgeois; Janet van der Linden; Blaine Price and Gerd Kortuem (2013). *Technology probes: experiences with home energy feedback*. In: *Methods for Studying Technology in the Home*, 27 Apr 2013, Paris (forthcoming). <http://oro.open.ac.uk/36791/>

Blaine Price; Janet van der Linden; Jacky Bourgeois and Gerd Kortuem (2013). *When looking out of the window is not enough: informing the design of in-home technologies for domestic energy microgeneration*. In: *First International Conference on Information and Communication Technologies for Sustainability*, 14–16 February 2013, Zurich, Switzerland. <http://oro.open.ac.uk/35460/>

Derek Jones and Emma Dewberry (2013). *Building Information Modelling Design Ecologies: A New Model?* *International Journal of 3-D Information Modelling*, IGI Global, 2(1), pp. 53–64. <http://oro.open.ac.uk/37906/>

Sally Caird; Robin Roy and Stephen Potter (2012). *Domestic heat pumps in the UK: user behaviour, satisfaction and performance*. *Energy Efficiency*, 5(3) pp. 283–301. <http://oro.open.ac.uk/31521/>

Robina Hetherington; Robin Laney and Stephen Peake (2012). *Zone modelling and visualisation: keys to the design of low carbon buildings*. In: *16th International Conference on Information Visualisation (IV)*, 11–13 July 2012, Montpellier, France. <http://oro.open.ac.uk/33573/>

Robina Hetherington; Robin Laney; Stephen Peake and David Oldham (2011). *Integrated building design, information and simulation modelling: the need for a new hierarchy*. In: *Building Simulation 2011*, 14–16 November 2011, Sydney, Australia. <http://oro.open.ac.uk/29470/>

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Energy and the Environment

The extraction and supply of fuels for heating, transport and electricity generation can result in significant local environmental impacts. By-product wastes raise particular concerns. Other energy impacts, such as atmospheric pollution, can be globally harmful. Carbon dioxide emissions are noted for their potential to accelerate global warming. Sulphur dioxide and nitrous oxides are noted for enhancing the acidification of rain. Phosphates are noted for their impacts on biodiversity in the oceans, and numerous other elements are noted for their potential to add toxicity to the environment by air, land, and water pathways.

An example of this, researched by The Open University, involves the sequestration of methane, formed from the decomposition of waste within municipal landfills. This waste can be co-processed to minimise its volume and environmental impact, and to generate low-carbon electrical power.



Funding

Much of The Open University's research on Energy and Environment is performed by the Integrated Waste Services group (<http://iws.open.ac.uk/>). Environmental considerations inform the majority of OU energy related research.

Research involved with noise abatement strategies has been undertaken by the Acoustics Research Department. The most recent project has been the EU FP7 Project HOSANNA. For further details on this project, please contact Professor Keith Attenborough (K.Attenborough@open.ac.uk).

Selected Publications

Frauke Urban; **Giles Mohan** and Sarah Cook (2013). *China as a new shaper of international development: the environmental implications*. *Environment, Development and Sustainability*, 15(3) pp. 257–263. <http://oro.open.ac.uk/35602/>

Stephen Burnley and **Terry Coleman** (2012). *Factors influencing the life cycle burdens of the recovery of energy from residual municipal waste*. In: Venice 2012, Fourth International Symposium on Energy from Biomass and Waste, 12-14 November 2012, Venice. <http://oro.open.ac.uk/35294/>

Swarup De and **Álvaro Faria** (2011). *Dynamic spatial Bayesian models for radioactivity deposition*. *Journal of Time Series Analysis*, 32(6) pp. 607–617. <http://oro.open.ac.uk/29932/>

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Energy and International Development

The last fifty years have seen remarkable progress in prosperity in large parts of the world, notably much of East Asia. Other regions, such as Africa and South Asia, continue to face significant challenges. Historically, development has tended to follow the energy intensive paths established by Europe and North America. In many respects these paths are now unsustainable and the challenge becomes one of reconciling global equity and sustainability.

Research at the Open University, mainly centred within the Development Policy and Practice group, ranges from energy and climate change policy for East Africa; the effects of globalisation on commodities in a sub-Saharan Africa context; through to the potential for hydroelectric deployment in Western Africa.



Funding

The Open University has been actively involved in the *The Making the Most of Commodities Programme* which addresses the opportunities opened for minerals and energy producing economies in sub-Saharan Africa. Its primary focus is on how to enhance the economic and social opportunities arising from the exploitation of primary commodities. For more information, please contact Professor Raphael Kaplinsky (r.kaplinsky@open.ac.uk).

ESRC has recently funded research within the field of bioenergy led by The Open University. For further details on a UK oriented study: *Knowledge production for sustainable bio-energy*, please contact Dr Les Levidow (l.levidow@open.ac.uk).

Selected Publications

Frauke Urban; **Giles Mohan** and Sarah Cook (2013). *China as a new shaper of international development: the environmental implications*. *Environment, Development and Sustainability*, 15(3) pp. 257–263. <http://oro.open.ac.uk/35602/>

Les Levidow; Theo Papaioannou and Alexander Borda-Rodriguez (2013). *Path-dependent UK bioenergy*. *Science as Culture*, 22(2) pp. 213–221. <http://oro.open.ac.uk/37711/>

Raphael Kaplinsky; Masuma Farooki; Ludovico Alcorta and Niki Rodousakis (2012). *Promoting Industrial Diversification in Resource Intensive Economies: The Experiences of Sub-Saharan Africa and Central Asia Regions*. Vienna: United Nations Industrial Development Organisation. <http://oro.open.ac.uk/35771/>

Devendra Kodwani (2010). *Governance mechanisms for telecommunications and electricity industries in India: 19th Century to 21st Century*. In: *International Conference on Regulation and Competition Policy for Development: Practice and Challenges*, 27–28 Jan 2010, University of Jordan, Amman. <http://oro.open.ac.uk/26869/>

Further Information

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Fossil Fuels

Fossil fuels including oil, natural gas and coal are currently the main energy carriers for electricity generation within the United Kingdom. For the first quarter of 2013, 41% of UK electricity was generated from coal and 26% was generated from natural gas. Transferring entirely from coal to gas would reduce the UK's annual carbon dioxide emissions. However, given the most probable energy demand scenarios for the future, the associated emissions reduction would not be enough to allow the UK to reach its greenhouse gas emissions reduction targets.

Research relating to fossil fuels at The Open University span two distinct themes. The first involves the characterisation of materials for future high-efficiency power stations with the potential to reduce emissions from such plants. The second involves Carbon Capture and Storage — technologies that sequester carbon dioxide generated from fossil fuel plants and store it underground. Of particular interest to researchers at the OU is the policy landscape that surrounds its potential deployment in the UK and Europe.

Funding

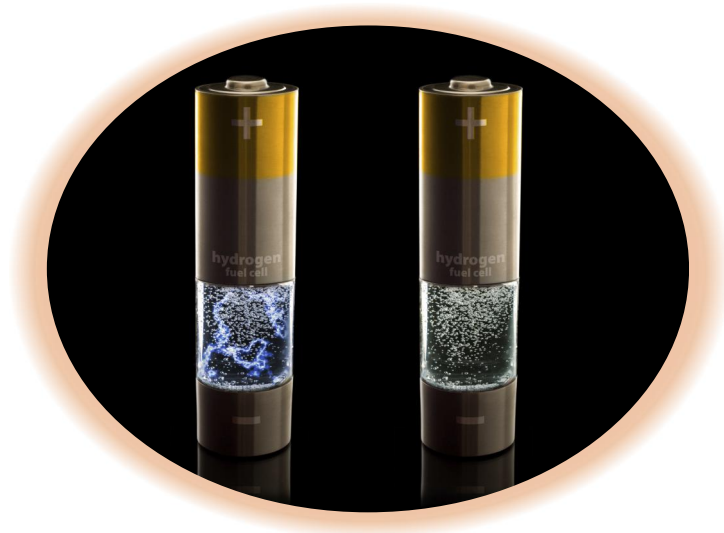
Members of the Department of Materials at The Open University are funded on an EPSRC project (Ref: EP/G068305/1) to look at the characterisation of high-chromium martensitic steels. Such materials have the potential to be used in future high-temperature ultra-supercritical power plants. For further information, please contact Professor John Bouchard (john.bouchard@open.ac.uk).

Selected Publications

Olaf Corry and Hauke Riesch (2012). *Beyond 'for or against': environmental NGO-evaluations of CCS as a climate change solution*. In: Nils Markusson; Simon Shackley and Benjamin Evar (eds). *The Social Dynamics of Carbon Capture and Storage*. Earthscan Science in Society Series. Abingdon: Routledge, pp. 91–108. <http://oro.open.ac.uk/31091/>

Further Information

For further information on OU fossil fuels and CCS research, please contact Professor William Nuttall (Professor of Energy):
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Hydrogen Energy

Hydrogen has the potential to emerge as a low-carbon energy carrier in the 21st century. Currently hydrogen is produced commercially from natural gas, but this not an especially clean process. Alternatively, hydrogen can be produced from water using electricity or directly using high-temperature processes. A hydrogen economy will require advances in production, purification, distribution, storage, and new disruptive end-use technologies.

The Open University has interests in hydrogen including policy issues, sustainable transport applications, and fundamental science associated with production, purification, and storage. The Open University is considering how hydrogen will be treated as a future commodity, how markets for such technologies may operate and their impacts and synergies with other energy industries.

Funding

Hydrogen is an area of research that is being significantly enhanced at The Open University. Collaborative activity is underway with the Institute of Physics. Applications for funding from Research Councils UK are under preparation. Much of our research is collaborative with the University of Cambridge and the University of Limerick, Ireland .

Selected Publications

Bartek A. Glowacki, **William J. Nuttall** and Richard H. Clarke (2013). *Beyond the Helium Conundrum*. IEEE Transactions on Applied Superconductivity, 23(3) 0500113. DOI: 10.1109/TASC.2013.2244633

James P. Warren (2006). *Hydrogen: tomorrow's fuel or just hot air? The Icelandic Experience*. Traffic Engineering & Control, 47(5) pp. 168–170.
<http://oro.open.ac.uk/9698/>

Further Information

For further information on OU hydrogen energy research, please contact Professor William Nuttall (Professor of Energy):

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Nuclear Energy

A number of interesting issues surround nuclear energy. On one hand, large amounts of base-load electricity can be generated by nuclear power stations with minimal emissions. On the other hand, questions surround the economic viability, and perceived risks and public acceptability associated with powerplant operations and radioactive wastes. Within a UK context, there are currently 14 Advanced Gas Reactors, 1 MAGNOX, and 1 Pressurised Water Reactor operating – these generate around 18% of the UK's electricity production. The majority of the current reactors are scheduled to be decommissioned by 2023.

Research at The Open University focusses in two main areas. The first area looks at improving the characterisation of materials that are contained within these reactors. OU research informs appropriate strategies to prolong plant lifetimes. OU research also considers the properties of materials needed for future reactors that may be constructed in the UK. The second area looks at nuclear policy and its impact on energy generation scenarios within the UK and for other countries that are developing nuclear power.



Funding

The Open University leads the EPSRC's PROMINENT consortium, a £1.8M grant researching the performance of metallic materials for applications in nuclear power. For further information, please contact Professor Mike Fitzpatrick (michael.fitzpatrick@open.ac.uk).

The Open University is the lead partner in an EPSRC funded Indo-UK project "JOINT" which looks at the characterisation of joins from various joining technologies. For further information, please contact Professor John Bouchard (john.bouchard@open.ac.uk).

The Open University is one of the partner institutions of the EPSRC funded Indo-UK "NREFS" project. This project looks at the management of nuclear risk issues. For further information, please contact Professor William Nuttall (william.nuttall@open.ac.uk).

The Open University is a partner in the £2M Lloyd's Register Foundation International Joint Research Centre for the Safety of Nuclear Energy, led by the University of Lancaster in collaboration with Harbin Engineering University and the University of Tennessee.

Selected Publications

O. Muránsky; T.M. Holden; O. Kirstein; **J. A. James**; A. M. Paradowska and L. Edwards (2013). *Evaluation of residual stresses in electron-beam welded Zr_{2.5}Nb_{0.9}Hf Zircadyne flange mock-up of a reflector vessel beam tube flange*. Journal of Nuclear Materials, 438(1-3) pp. 154–162. <http://oro.open.ac.uk/37806/>

Stephen F. Ashley; Geoffrey T. Parks; **William J. Nuttall**; Colin Boxall and Robin W. Grimes (2012). *Thorium Fuels Has Risks*. Nature, 492(7427) pp. 31–33. <http://oro.open.ac.uk/36458/>

H. Jazaeri; P. J. Bouchard; M. Hutchings and P. Lindner (2012). *Study of creep cavitation in a stainless steel weldment*. In: 4th International Conference on Integrity of High Temperature Welds, 25–27 September 2012, London. <http://oro.open.ac.uk/35736/>

M. Preuss; P. Frankel; S. Lozano-Perez; D. Hudson; E. Polatidis; N. Ni; J. Wei; C. English; **S. Storer; K. B. Chong; M. E. Fitzpatrick**; P. Wang; J. Smith; C. Grovenor; G. Smith; J. Sykes; B. Cottis; S. Lyon; L. Hallstadius; B. Comstock; A. Ambard and M. Blat-Yrieix (2011). *Studies regarding corrosion mechanisms in zirconium alloys*. Journal of ASTM International, 8(9) <http://oro.open.ac.uk/29881/>

Further Information

For further information on OU nuclear energy research, please contact Professor Mike Fitzpatrick (Lloyd's Register Foundation Chair in Materials Fabrication and Engineering):

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Energy Policy

At its core energy policy seeks to balance concerns for economic affordability, environmental stability, and security of supply. Other important considerations include fuel poverty, technology policy, and international equity. Specific energy technologies raise their own issues, such as their impacts on local environment. For developed countries with significant infrastructure: dominant questions surround the abatement of generating capacity, mitigation of carbon dioxide emissions, and development/renewal of the existing infrastructure. For developing countries: questions surround the ability for energy poverty to be addressed, for additional energy to be made available to areas that have minimal infrastructure, and the sustainability of such energy supply.

Research at the Open University considers several facets of energy policy. For large-scale infrastructures, policies surrounding the deployment of new technologies, including: nuclear, carbon capture and storage, and hydrogen production are of current interest. For small scale infrastructures: policies surrounding the development and deployment of biofuels, fuel cells, combined heat and power, and other micro-generation technologies are of significant interest to a number of members within the community. More broadly, the OU addresses energy futures and utilities policy.

Funding

Within the area of renewable energy: ESRC has recently funded research within the field of bioenergy that has been led at The Open University. For further details of a UK oriented study: *Knowledge production for sustainable bio-energy*, please contact Dr Les Levidow (l.levidow@open.ac.uk).

Within the area of nuclear energy: The Open University is also involved with the EPSRC funded Indo-UK “NREFS” project. This project looks at the management of nuclear risk issues. For further information, please contact Professor William Nuttall (william.nuttall@open.ac.uk)

Further details on various research projects being undertaken in the area of energy and international development can be found on the Development Policy and Practice website.

Selected Publications

Les Levidow; Theo Papaioannou and Alexander Borda-Rodriguez (2013). *Path-dependent UK bioenergy*. *Science as Culture*, 22(2) pp. 213–221. <http://oro.open.ac.uk/37711/>

William Nuttall (2013). *ENEF competitiveness SWOT report part II*. Brussels, Belgium: European Commission. See: DG-Energy website.

William J. Nuttall (2012). *The ideal portfolio today and in 2030*. Chapter of *EU Energy Innovation Policy Towards 2050*; J.-M. Glachant, N. Ahner and L. Meeus (eds). Claeys and Casteels Publishing, Deventer, The Netherlands, pp. 119–130. ISBN: 978–9–081690–430.

Olivier Bahn; **Neil R. Edwards**; Reto Knutti and Thomas F. Stocker (2011). *Energy policies avoiding a tipping point in the climate system*. *Energy policy*, 39(1) pp. 334–348. <http://oro.open.ac.uk/25654/>

Stephen Peake (2010). *Policymaking as design in complex systems - the international climate change regime*. *Emergence: Complexity and Organization*, 12(2) pp. 15–22. <http://oro.open.ac.uk/23513/>

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For further information on OU energy policy research, please contact Dr Stephen Peake (Senior Lecturer in Environmental Technology):

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Renewable Energy

Renewable energy spans a rather broad remit, including: solar thermal and solar photovoltaics, on- and off-shore wind turbines, hydro, wave, geothermal, and biofuels. Electricity generated from most sources of renewable energy are essentially free of harmful greenhouse gas (GHG) emissions and avoid the geopolitical risks associated with fossil fuels. For solar photovoltaics and wind power, questions surround the intermittency/availability of generation and the integration of these systems into electricity grids.

One of the major cornerstones of research since the inception of The Open University has centred round renewable energy technologies. The distinctive approach of the OU to research has included examining the contentious claims for 'sustainable biofuels', especially regarding GHG emissions due to indirect land-use change, as a basis for EU and national mandatory emissions reduction targets. The OU is significantly involved with local utility companies in research surrounding the adoption and integration of renewable energy technologies into smart-grids. Such smart-grids will distribute electricity in the cities of tomorrow.



Funding

ESRC has recently funded research within the field of bioenergy that has been led at The Open University. For further details of a UK oriented study: *Knowledge production for sustainable bio-energy*, please contact Dr Les Levidow (l.levidow@open.ac.uk).

Funding has also been obtained for research that specifically geared at the role of microgeneration. For further details on the *Community owned renewable technology enterprises and economic development* project, please contact Dr George Callaghan (george.callaghan@open.ac.uk).

As part of the £7m MK:SMART project, the OU has a £150,000 package to explore the use of IT systems to support the potential deployment of smart-grids in the cities of the future.

Selected Publications

David Elliott (2013). *Renewables: A Review of Sustainable Energy Supply Options*. IOP Publishing Ltd, ISBN: 978-0-7503-01041-3. <http://oro.open.ac.uk/38901/>

Blaine Price; Janet van der Linden; Jacky Bourgeois and Gerd Kortuem (2013). *When looking out of the window is not enough: informing the design of in-home technologies for domestic energy microgeneration*. In: First International Conference on Information and Communication Technologies for Sustainability, 14-16 February 2013, Zurich, Switzerland. <http://oro.open.ac.uk/35460/>

Les Levidow; Theo Papaioannou and Alexander Borda-Rodriguez (2013). *Path-dependent UK bioenergy*. *Science as Culture*, 22(2) pp. 213-221. <http://oro.open.ac.uk/37711/>

Sally Caird; Robin Roy and Stephen Potter (2012). *Domestic heat pumps in the UK: user behaviour, satisfaction and performance*. *Energy Efficiency*, 5(3) pp. 283-301. <http://oro.open.ac.uk/31521/>

Sally Caird and Robin Roy (2010). *Adoption and use of household microgeneration heat technologies*. *Low Carbon Economy*, 1(2) pp. 61-70. <http://oro.open.ac.uk/25915/>

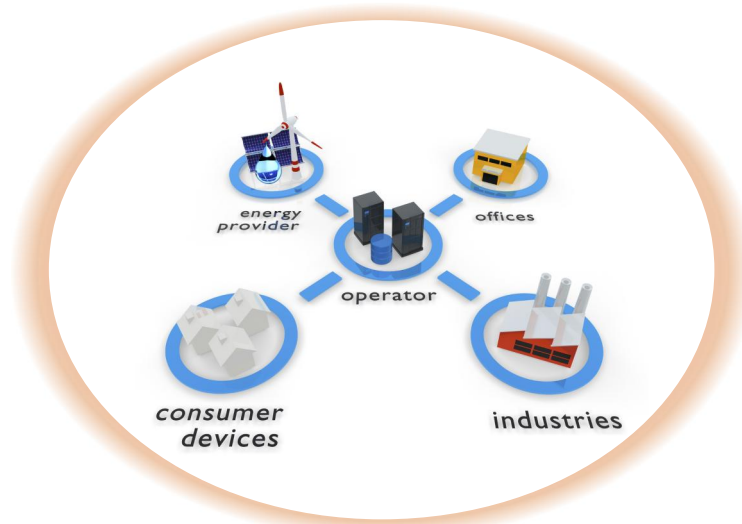
Further Information

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Smart Grids

The smart grid is a modernised network for utilities, including: electricity grids, gas pipelines, and water networks. Smart grids need information and communications technologies (ICT) to ensure that the distribution of these utilities is optimally matched to their production. By doing so, the smart grid aims to offer improvements to the efficiency, reliability, economics, and sustainability of such networks. Significant ICT is needed to allow the behaviours of the suppliers and the consumers to be matched in real-time. For electricity grids, smart-grid technologies are essential for accommodating renewable energy technologies and for supporting future demand from electric vehicles.

Research at The Open University covers technological, economic, organisational, and behavioural aspects of smart grids. This includes: ICT solutions to optimise the performance and usability of home energy-generation systems; models and simulations to investigate demand-response strategies; behaviour-change strategies to influence consumption of electricity, water and gas; and investigating consumer attitudes toward smart-grid rollouts.

Funding

The Low Carbon Network Fund grant is part of the £14M Project Falcon (Flexibility and Low Carbon Optimised Networks). The aim of this project is to trial a series of Smart Grid electricity network interventions in Milton Keynes. The OU contributes to the project's dissemination among partners and users. Watch the introduction to Project Falcon on Youtube and visit the Low Carbon UK Project site.

The overall objective of the GAMBAS project is the development of an innovative and adaptive middleware to enable privacy-preserving and automated utilizations of behaviour-driven services that adapt autonomously to the context of users. This work has prototypical application in the domain of public transport. For further information on this project, please contact Professor Gerd Kortuem (gerd.kortuem@open.ac.uk).

Selected Publications

Jacky Bourgeois; Janet van der Linden; Blaine Price and Gerd Kortuem (2013). *Technology probes: experiences with home energy feedback*. In: *Methods for Studying Technology in the Home*, 27 Apr 2013, Paris (forthcoming). <http://oro.open.ac.uk/36791/>

Blaine Price; Janet van der Linden; Jacky Bourgeois and Gerd Kortuem (2013). *When looking out of the window is not enough: informing the design of in-home technologies for domestic energy microgeneration*. In: *First International Conference on Information and Communication Technologies for Sustainability*, 14–16 February 2013, Zurich, Switzerland. <http://oro.open.ac.uk/35460/>

Liliana Pasquale; Mazeiar Salehie; Raian Ali; Inah Omoronyia and **Bashar Nuseibeh** (2012). *On the role of primary and secondary assets in adaptive security: An application in smart grids*. In: *Software Engineering for Adaptive and Self-Managing Systems (SEAMS)*, 2012 ICSE Workshop, 4–5 June 2012, Switzerland. <http://oro.open.ac.uk/34986/>

Mazeiar Salehie; Liliana Pasquale; Inah Omoronyia and **Bashar Nuseibeh** (2012). *Adaptive security and privacy in smart grids: A software engineering vision*. In: *Software Engineering for the Smart Grid (SE4SG)*, 2012 International Workshop, 3 June 2012, University of Zurich. <http://oro.open.ac.uk/34945/>

Further Information

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Energy and Sustainable Transport

Two of the main aims of the European plan on climate change involve the reduction of greenhouse gas emissions and energy use by 20% by 2020. The UK Climate Change Act provides a framework for seeking annual reductions in CO₂ emissions culminating in an 80% reduction by 2050. One area requiring significant decarbonisation is transport, given its general reliance on fossil fuels and low carbon reduction to date. Cuts in emissions from the transport sector can come from (1) efficiency savings in the use of existing methods of transport, (2) modal shift to low-emission travel, (3) the transfer from fossil fuels to low carbon fuels, and (4) the development of new low carbon mobility systems.

Research at The Open University has focussed on the transition towards transport designs and systems that offer the potential for a radical reduction in overall energy use and greenhouse gas emissions. This cross-disciplinary programme has included work on travel behaviour, low-carbon vehicle technologies, energy use in transport and city systems, traffic modelling, the management of radical transport developments, transport taxation, and transport policy implementation.

Funding

The Open University supported the successful £7M *Plugged in Places* bid for the Milton Keynes Electric Vehicles Project, and secured a £120,000 SEEDA grant to develop user engagement with this local low carbon vehicle initiative. For further details, please visit the Low Carbon Vehicles & Innovation in Transport Systems and Services blog (<http://www.open.ac.uk/blogs/LowCarbon/>).

As part of the £7m MK:SMART project, the OU has a £150,000 package to explore the use of IT systems to support advanced sustainable transport developments.

The OU is contributing towards the E.ON's Thinking Energy smart homes trial in Milton Keynes, which includes exploring the use of electric vehicles as part of a package of domestic energy measures.

The overall objective of the GAMBAS project is the development of an innovative and adaptive middleware to enable the privacy-preserving and automated utilization of behaviour-driven services that adapt autonomously to the context of users. This work has prototypical application in the domain of public transport. For further information on this project, please contact Professor Gerd Kortuem (gerd.kortuem@open.ac.uk).

Selected Publications

Stefan Foell; Reza Rawassizadeh and Gerd Kortuem (2013). *Informing the design of future transport information services with travel behaviour data*. In: Workshop on SenCity: Uncovering the Hidden Pulse of a City, 9 Sep 2013, Zurich, Switzerland. <http://oro.open.ac.uk/37858/>

Stephen Potter (2012). *Transport and energy use*. In: Rodrique Jean-Paul, Theo Notteboom, and Jon Shaw (Eds). *The Sage Handbook of Transport Studies*; Sage Publishing.

Stephen Potter and Abukari Atchulo (2012). *The role of company car taxation to promote low carbon vehicle technologies*. In: Universities Transport Studies Group Annual Conference, University of Aberdeen, January.

Stephen Potter (2012). *Transport planning*. In: Mike Tovey (Ed.), *Design for Transport: A User-Centered Approach to Vehicle Design and Travel*. Design for Social Responsibility. Farnham, UK: Gower, pp. 107–120. <http://oro.open.ac.uk/35376/>

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