



Durham
University

Science and society

Issue 2 Summer 2013

Durham Energy Institute Review

This issue:

DEI News roundup
Urban Climate Justice
New MSc Energy and Society
Low Carbon Energy for Development
Local Action in Durham
Customer-Led Network Revolution



Beijing China - Swarming.
Photo by Peng Xiaotei.
Winner of the 2013 Energy and
Society Photography Competition,
Durham University

A message from the new Executive Director of the DEI

I am thrilled to take up the opportunity to lead DEI into the next phase of its development. Since starting in March, it has felt like coming home as I first studied Economics and Sociology at Durham University from 1971-74. My first impressions of DEI before joining have now been confirmed; The Institute has an amazing network of researchers – developing high quality research, a growing impact on UK and global energy policy debates and new forms of inter-disciplinary collaboration. The sheer diversity of DEI's work has been very stimulating and this breadth has further expanded with new appointments at the University. Just in the last term there have been additions to DEI capacity in Anthropology, Biology, Earth sciences and Economics. The range of exciting work being undertaken at the Institute on energy risk, development, smart networks and grids, and low carbon transitions is celebrated here. All of this expertise will come together for the teaching of the New Masters course in Energy and Society, for developing the energy leaders of the future.

I originally came to Durham University in January as a Fellow of the Institute of Advanced Study to work on the 'Arab Spring' and its impact on the UK and global oil and gas prices. My conclusions from this research potentially provide an over-arching context for DEI's global work on energy, technology and society.

The events of the 2011-13 'Arab Spring' have shown geo-political issues will remain at the heart of our energy issues in the twenty first century, as they were in much of the twentieth century, especially in the energy crisis years of the 1970s. My view is that the oil price has been driven to new long run high equilibriums by the global geopolitics of 'energy security', with North Africa and the Middle East at the heart of the problem. In 2011, according to BP it was the 'supply disruptions', especially those in Libya, which had led to rising prices. Yet even though Libyan oil output is back on stream and Iraqi oil output is close to 30 year highs, oil prices in 2013 remain at over \$100/barrel and have averaged just over \$110 a

barrel in 2011-12. Indeed BP has recently argued that global oil prices would have been sharply higher if not for rising US oil output.

The long term pricing of oil reflects a geo-political judgement by global markets on how to balance the risks and returns in the political economy of oil. The price of oil seems to be at a new equilibrium reflecting these political risks. Oil prices have never been consistently higher than in the last 3 years. The oil market has been screaming at us since the invasion of Iraq in 2003 and particularly since 2011, that we are in a renewed high energy price era.

In the UK meanwhile, the physical energy crisis is most likely to be felt first in electricity. The Energy Bill going through Parliament has been steered by three Ministers in the last nine months. Even after the Bill has been passed, electricity capacity auctions are not likely before 2015, so new capacity is unlikely to be on stream before 2018. This is too late to fill the looming capacity gap, long predicted for 2014-17.

There will not be enough wind or nuclear power to fill the gap in time. Having studied by candlelight in Durham during the Miners' strikes of 1972-4, I remember the old era of the 'lights going out'. Another such era looms on the UK horizon.

A rather inevitable repeat of the 1990s 'dash for gas' is likely to be the only short term answer in the UK. We will have to increasingly import gas to generate sufficient electricity for 2015-20; an estimated 60 per cent may have to be fuelled by gas. UK wholesale ('spot') gas prices also reached a four year high at the end of March 2013.

DEI plans to do more work on the energy issues of the Middle East and on the global and UK issues of energy risk. The global energy crisis and the UK's looming electricity crisis may dominate more than just DEI's thinking in the next few years. DEI's role within both academia and for the wider public is to openly debate these huge energy issues for our future.



Dr. Wilf Wilde
Executive Director,
Durham Energy
Institute

The global energy crisis and the UK's looming electricity crisis may dominate more than just DEI's thinking in the next few years.

DEI News



Dr Simone Abram has been appointed as a Reader in Anthropology and will be Director of the new MSc Energy and Society being run in collaboration with the DEI.



Prof. Tooraj Jamasb joined Durham University Business School on 1 March 2013 as Professor of Energy Economics from Heriot-Watt University.



Prof. Andrew Aplin, Professor in Unconventional Hydrocarbons, has joined the Department of Earth Sciences from Newcastle University. Prof Andy Aplin joined CEREEES in March 2013.



Dr Daniel Knight has been awarded an Addison Wheeler Fellowship to work with Dr Sandra Bell (Anthropology). His work will build on the DEI-funded Small Grant "Under the wings of Daedalus", researching solar energy transition in Greece.



Dr John Bothwell, Reader in Bioenergy, has joined the School of Biological and Biomedical Sciences from Queen's University, Belfast. He focuses on the evolutionary, ecological and economic importance of the macroalgae.



Prof. Georgios Theodoropoulos has joined the School of Engineering and Computing Sciences. He is Executive Director of the Institute of Advanced Research Computing. His interests include Computational Infrastructures for Complex Socio-Technical Systems, Smart Cities, and Sustainable and Resilient Communities.



Dr Chris Greenwell (Earth Sciences) has been awarded a four year Royal Society Industrial Fellowship to work with the oilfield support company M-I SWACO on 'Mineral interface determination during shale hydration.



Dr Wilf Wilde has been appointed as the new Executive Director of Durham Energy Institute (DEI). Wilf was formerly a Director at the energy regulator, Ofgem and has held a number of other roles in industry.



Prof. Nikos D. Hatziaargyriou has started a 3 month COFUND Policy and Enterprise Fellowship, in the Institute of Advanced Study. He is a world leader in the field of future power systems, particularly smartgrids and the integration of distributed and renewable energy generation into power systems.





Energy Risk

Probabilistic Methods Applied to Power Systems

Durham University will host the 2014 International Conference on Probabilistic Methods Applied to Power Systems (PMAPS) from 7-10 July 2014. This is one of the major specialist conferences in the field, and it brings together academic and industrial researchers from across the world to share their latest findings.

Probabilistic methods are a key subject in current power systems research and development, both in academia and in industry. Probability and statistics is the natural language in which to analyse the impact of high penetrations of renewable energy within power systems, both in terms of system planning (e.g. what is the economic level of network capacity for connection of remote wind farms? How much conventional generating capacity can be replaced by a given fleet of wind farms?) and in system operation (e.g. how much operating reserve must National Grid contract in order to manage the uncertainty in short-term wind power forecasts? How much generation should utilities start up on what lead time in order to manage this uncertainty?).

Probability and statistics is also required for modern physical asset management.

There is ongoing pressure, both from the regulator and from shareholders, for network owners to manage their assets efficiently. This requires statistical assessment of the condition of their asset bases, to project those asset conditions into the future under different possible maintenance regimes, and to evaluate consequences for customers of network outages and other scenarios.

The award of PMAPS to Durham reflects the strengths of DEI in this field, both in fundamental research and in industrial work. Examples of key current research include work on wind turbine reliability within Engineering (Chris Crabtree, Simon Hogg, Peter Tavner), and industrial and fundamental work on power network reliability by Chris Dent and Simon Blake (Engineering) and Matthias Troffaes (Mathematical Sciences). Exciting new prospects include a PhD (student Antony Lawson, supervisors Chris Dent and Michael Goldstein) on planning electricity networks under uncertainty, and applying the leading work on system reliability and uncertainty analysis more widely into energy system applications.

The PMAPS conference will benefit from the excellent facilities available on Durham's Science site. The event will begin with three tutorials on physical asset management by George Anders (Technical University of Lodz), on smartgrid deployment by Phil Taylor (who has recently moved from Durham to Newcastle and who leads Durham's part in the Customer Led Network Revolution smartgrid trial), and on system control. The plenary session on the first afternoon will contain a keynote address on renewables integration, and then an all-industrial panel discussion to set the scene for the rest of the conference. This will be followed by two and a half days of contributed papers. The proceedings are distributed to all attendees, and then archived in [IEEEExplore](#), making them widely available to researchers worldwide.

This will be an ideal opportunity for DEI researchers and supporters to promote their work to the key people in the PMAPS community, and to learn from the experiences of the many leading experts who are present.

For further information contact Dr Chris Dent on chris.dent@durham.ac.uk





Seaweed and waste: making bioenergy cost effective and subsidy free through combined waste remediation

The UK “Renewable Energy Roadmap” document has recently been updated by the Department for Energy and Climate Change (DECC) to reflect progress made from 2011-12. Key changes include a requirement to increase renewable electricity generation (from 10% to 27%) and a 40% increase in production capacity. The resulting drive for investment in biomass energy is highlighted by the UK converting its first coal fired electricity generator into a biomass-fired generator. This opened at Tilbury in 2012, with a second to follow at Ironbridge.

A multidisciplinary Durham University team from the Departments of Earth Sciences (Chris Greenwell), Biology (John Bothwell), and Durham University Business School (Felicity Greenwell, Victoria Wells), together with Karen Mooney from Queen’s University Belfast and Rodi Wout, an independent marine consultant, are carrying out a feasibility study to explore the potential for locally grown or gathered macroalgae (seaweed) to provide an alternative gas supply for the UK’s domestic market.

To identify barriers and solutions, and benchmark the feasibility study, the team is using the Isle of Man (IoM) as a case study for the development and integration of UK and international marine bioenergy resources. The IoM offers significant opportunities for energy generation from renewable biomass, having a long coastline, a predominantly coastal community structure, and owning its territorial seabed out to

12 nautical miles (or 22.22km). It also has attractive taxation status and investment opportunities for technology driven business and, as a net energy importer (gas) and exporter (electricity back to the UK), is committed to 10% renewable energy generation by 2015. Furthermore, work is simplified by the island’s vertically integrated energy market, in which a single body (the Manx Electricity Authority) is responsible for electricity energy generation, distribution and retailing.

The DU team and IoM government have estimated that about 7 per cent of the IoM’s domestic gas supply could be generated by seaweed-derived biogas. Accordingly, our feasibility study will evaluate annual seaweed biomass yields by assessing potential seaweed growth rates in the island’s coastal waters and monitoring available volumes of beach cast seaweed. Waste streams such as creamery waste, sewage sludge and agricultural residues can improve digestion of the seaweeds to produce biogas. This waste remediation is an economic necessity as the disposal fees for the waste streams are expected to make energy generation potentially economically viable without subsidy.

The socio-economic aspects of seaweed biomass energy are also being explored in collaboration with the Manx Electricity Authority through an investigation into the public acceptance and stakeholder perceptions surrounding bioenergy. Through the use of various methodologies and techniques from interviews, questionnaires and focus groups we will develop a better understanding of public perceptions towards renewables in general and marine bioenergy in particular. The results will be used to create a business model based on the field trial results.

Our IoM project is currently seeking funding to support the development of the research into a commercially viable model to secure its continuation and the team would be very interested to hear from anyone who would like to discuss the work further, email chris.greenwell@durham.ac.uk



Energy for Development

Low carbon energy for development

Together with colleagues from the UK Energy Research Centre (UKERC), the University of Sussex, Imperial College London and the Midland Energy Consortium (MEC), Professor Marcus Power (Geography) and Dr Ben Campbell (Anthropology) have helped to set-up the Low Carbon Energy for Development Network (LCEDN) with support from the DEI and the Department of Energy and Climate Change (DECC).

It is becoming increasingly recognised that the majority of people living in the Global South have a rapidly growing need for access to some kind of basic modern energy service. In sub-Saharan Africa access to electricity is currently estimated to be at 31%. In fact, the entire installed generation capacity in the region is just 68 gigawatts (no more than Spain's), most of which is concentrated in South Africa. Although notable, the sub-Saharan region is not exceptional in this respect. Almost 1.4 billion people in the Global South have no access to electricity, and over 2.5 billion remain dependent upon burning carbon-based fuels for everyday tasks.

The demand for 'modern' energy services

is complicated by the need for that demand to be met through more sustainable means than has been the case for those who already have access to those services in the rest of the world. Increases in world population and growing urbanization also look likely to amplify the challenge of squaring growing energy needs with the global imperative for reducing greenhouse gas emissions. There is therefore, huge pressure on developing nations to grow their energy supply in a sustainable and 'clean' way. Indeed, the challenges for both the development of low-carbon alternatives as well as their adoption by low-income communities are numerous and interlinked.

The UK based LCEDN was officially launched in January 2012. The network operates as a platform for academics, practitioners, policy-makers and private sector organisations to interact and cooperate on research for low-carbon development. It includes representatives from DECC, the Department of International Development Food and Industry (DFID), Research Council UK (RCUK) and the 5 academic research centres that facilitate the network: the Science and Technology Policy Research Department (SPRU) at the University of Sussex, the Energy Futures Lab at Imperial College, the UK Energy Research Centre (UKERC), the Midlands Energy Consortium (MEC) as well as the DEI. The network continues to be funded by DECC.

While the UK boasts considerable pools of expertise in both the energy and development fields the two are rarely brought into conversation. The limited connections between different research communities, lack of coherence between research and policy agendas, profusion of new funding opportunities and increasingly urgent development needs demand a flexible, critical and proactive response which can be provided by the LCEDN network. The strong enthusiasm of the UK research community to engage with the energy for development agenda and the important role of the network was made evident by the success of two LCEDN workshops held in 2011 which were well attended by academics from throughout the UK and across numerous disciplines. The 3rd Low Carbon Energy for Development (LCEDN) International Workshop held in June was a resounding success. To find out more about the event and network please visit www.durham.ac.uk/dei/projects/lcedn

Professor Power can be contacted at Marcus.power@durham.ac.uk

Dr Campbell can be contacted at Ben.campbell@durham.ac.uk

Understanding New Energy Models for Cities in the South

Two post-graduate Geography students at the Durham Energy Institute have been exploring issues around the development of alternative perspectives on energy in cities in the global south. Jonathan Silver and Andrés Luque have undertaken research in India, Ghana, Brazil and South Africa on a range of energy related issues. They use a number of methods including participatory methods which engage communities while also training some residents in evaluation so that they can shape the research directly and develop new skills.

In South Africa, Jonathan Silver undertook an evaluation of a retrofitting pilot project to install insulated ceilings in publically financed housing for the City of Cape Town. As in many other places in Cape Town the households in this small community suffer from energy poverty with insufficient finances to properly heat their homes and many households relying on alternative, inefficient, often dangerous, alternative fuel supplies. The study found the retrofitting had a significant impact for many households with a reduction in the amount of electricity needed to heat the house and reduced fuel costs for energy which for some meant opportunities to save, or redirect those savings to other critical needs such as food or other household appliances. It also increased the resilience of households to climate conditions such as rain, wind, cold and damp. All problems which are likely to be exacerbated by climate change. Other impacts included improvements to family health and livelihood opportunities.

The potential of affordable retrofitting options in publicly financed housing is a critical issue in countries around the world where stocks of public housing, crucial for providing affordable housing options for low-income housing, are deteriorating, lack energy efficiency and are increasingly sold off. The evaluation report has been used to further discussions about the retrofit agenda in Cape Town, particularly in relation to up to 40,000 housing units requiring insulated ceilings.

The research is also being used by the International Council for Low Energy Initiatives (ICLEI) - Local Governments for Sustainability as a case study for their African climate change program.

Andrés Luque is looking at the ways by which stakeholders in the São Paulo and Mumbai metropolitan regions are promoting solar technologies. This includes local policies making solar hot water systems mandatory for all new construction, alliances between social housing agencies and private energy utilities to install solar technologies, and NGOs re-imagining solar systems based on the needs of the urban poor, amongst others. The broad motivations identified are diverse, from the need to align rapid urban growth processes with the material and symbolic benefits offered by green technologies to a marked concern regarding the limited ability of national electricity networks to respond to growing energy demands. In this way, in the city of the global South, solar hot water systems aim to balance the daily peak electricity loads generated by the daily practice of showering using electric showers. In the process, energy technologies are mobilised to serve the contrasting interests of different sectors of the city, from upscale neighbourhoods housing the growing middle classes to the slums (favelas in Portuguese) and their need for affordable energy. The resulting analysis points to the emergence of a local governance of energy, where the energy problematic is seen from an urban perspective and the city as a key site for intervention.

The work exemplifies the DEI's approach to energy issues which is to view energy technologies through a social lens. Not only to encourage the development of innovative technologies that can meet the low-carbon needs of the future, but also to explore the impacts that these technologies have on people and societies, and the ways societies adopt, shape and adapt to these technologies.

Visit the www.energygeographies.com for summaries of all research being undertaken by Jonathan and Andrés, and a blog exploring alternative perspectives on energy.





Methodologies

Durham Student's gear-up for next year's Solar Car World Challenge

Durham University Solar Car (or DUSC) is a student led project that aims to design and manufacture innovative solar powered cars to compete at international competitions. The team is made up of forty students from a range of academic departments. Previously the team has travelled to the USA to compete in the North American Solar Challenge and Australia to compete in the World Solar Challenge. DUSC hope to travel to America next year to compete in the 2014 American Solar Challenge.

The DEI has given invaluable support and assistance to the DUSC project. On top of sponsoring the project, the DEI has always been delighted to share their expertise with DUSC. The DEI has put the team in touch with useful business contacts, helped redesign DUSC promotional material and provided opportunities for presentation about this exciting project.

The team was established in 2002 with the aim of promoting science, engineering and renewable energy sources across the country. The first car was built in 2004. During the early years of the team's existence, DUSC travelled to schools to display and discuss the car. In 2008 DUSC competed in their first event, the North American Solar Challenge (NASC), as the only British participant. The team performed very well, finishing an impressive

14th out of 26 competitors and received the "Best Rookie Team" award. In 2011 the team travelled to Australia to compete against the worlds top universities in the World Solar Challenge (WSC), DUSC finished 33rd out of 42 competitors. This was considered a very respectable position given that DUSC's budget is a fraction of its competitors', such as MIT and Stanford.

Today DUSC is made up of around 40 students from a range of different academic departments. They plan to travel to America to compete in the 2014 American Solar Car Challenge. To improve on their performance at the last WSC, they have designed a completely new car for the next race. The engineering challenge was enormous as the power output of the solar panels is only 1KW, roughly the power consumption of a hairdryer. As a result the design is centered on a highly aerodynamically efficient shape. The design also incorporates a number of innovative features such as a carbon fiber monocoque chassis, in-wheel motors and highly efficient Gochermann solar panels. Over the coming months the team will build the car using cutting-edge manufacturing techniques.

DUSC relies exclusively on funding from sponsors to cover the costs of manufacture and transportation. Sponsorship comes in many forms; as well as cash they have received materials in-kind from Amber composites and have been given useful advice from South West Durham Training. In return, sponsors gain exposure to Durham students, exposure to the UK and internationally through appearances in media such as BBC's Inside Out programme, trade magazines and

newspapers. Over \$6 million are generated from global exposure per WSC event!

The team offers several sponsorship packages to suit the needs of different companies. For further information visit www.dur.ac.uk/dei/dusc



Local Action

The work being undertaken by the DEI is helping Durham's communities make the transition to a low-carbon world and to ensure that Durham retains its place as a world class city in the future. DEI supports community energy initiatives across the world with a number of research projects being undertaken in collaboration with community groups.

Imagining a new way of saving energy.

How do fuel poor households understand their own energy management practices? What internal and external factors influence the customer journey when engaging in energy efficiency intervention schemes? These are questions currently being explored by Cliff Duff, Durham County Council Energy Officer, for research he is carrying out as a part-time student on Durham University's MA in Social Anthropology. He is inspired by energy researcher Elisabeth Shove's observation that successive waves of energy-saving information have been targeted at people who are mistakenly defined and treated as "socially anonymous citizens" (Shove 1999). Cliff hopes his research will lead to more sensitive and imaginative ways to deliver energy-saving interventions under the Government New Green Deal programme and would like to interview students and staff who are interested in this area of work.

For further information contact Cliff Duff on Clifford.duff@durham.ac.uk

Testing a new decision-making tool locally

A decision-making tool developed through the 'Interdisciplinary Cluster on Energy Systems Equity and Vulnerability' (InCluESEV) project has been tested by local community energy projects in Durham. In the EPSRC funded research, an interdisciplinary team of researchers including Charlotte Adams (Engineering) and Sandra Bell (Anthropology) from Durham University, assembled a range of professionals concerned with energy provision to develop a method for assessing how micro-generation projects might be influenced if concepts such as equity and social justice are brought into play. The outcome is a conceptual tool designed to help community organisations, local authorities, housing associations and policy makers deploy decision making criteria based on equity and justice. During 2012 the method was tested by two county Durham Community Energy projects: Oakenshaw Community Association, whose plans to set up a wind turbine are well advanced, and Witton Park Community group, in the early stages of

planning a micro-hydro project. The groups found the tool useful, but perhaps inevitably the language in which it was couched was judged too "professional" or "academic". This feedback has been taken to heart and the tool modified accordingly. The project also uncovered details of the institutional and bureaucratic barriers that impede and deter communities from adopting community energy generation projects, which typically take up to five years from conception to generation. A report will highlight these issues and make recommendations as to how community generation projects may be facilitated and encouraged in the UK.

A university in transition.

An initiative funded by the DEI through its small grants program will enhance the effectiveness of the social and technological low carbon ambitions of the university. Led by Tara Duncan (Greenspace) and working with Paul Riddlesden (Energy Manager) at Durham University, the project is reviewing how the

low carbon transition is being approached by the university. It aims to increase the effectiveness of interventions to reduce energy consumption and carbon emissions at the University by improving interactions between researchers and officers. This includes looking outside of Durham University to other Higher Education Institutions to collect information on best practice. It will also explore what the relationship should be between these interventions at the university level and initiatives being undertaken for Durham city as a whole. The project will not only assist the transition for Durham University but will provide valuable insights into how to encourage behaviour change and introduce low carbon technology in a large diverse organisation with varied building stock, including many buildings with Heritage status.

For further information contact Tara Duncan, Sustainability Manager, Greenspace, on tara.duncan@durham.ac.uk





Smart Networks and Grids

Smart Energy Practices - Changing Social Behaviour To Meet Low Carbon Aspirations

An interdisciplinary project being undertaken between the departments of Geography, Anthropology, Mathematics, Engineering and Computer Sciences at Durham University is exploring the potential of smart grids to transform our daily energy use. A key question being explored is how the use of new technologies, such as smart meters, energy monitors, solar panels and heat pumps, together with new energy tariffs are changing everyday practices and can be used to effectively manage electricity network demand.

The research is one focus of the Customer-Led Network Revolution (CLNR) Project at the Durham Energy Institute. This collaboration between academia and business is the UK's biggest ever Smart Grid project and is at the forefront of the move towards a low carbon economy. The £54 million scheme is led by Northern Powergrid, the electricity distribution network operator for the North East and Yorkshire, and funded through the Office of the Gas and Electricity Markets' (OFGEM)

Low Carbon Networks Fund (LCNF). The other lead business partners in the project are British Gas and EA Technology. Alongside real-world interventions on the electricity network and in homes and businesses to trial potential responses, the project tests how different interventions result in changes in users' behaviours and so their electricity consumption.

Smart Grids are advanced electricity networks that intelligently integrate the requirements of all connected users - generators, consumers and those that do both—with the physical characteristics of the network to efficiently deliver sustainable, economic and secure electricity. The project encourages companies to work with partners to help develop a smarter electricity distribution network or "Smart Grid" with the aim of creating a better match between generation and demand for electricity across the whole grid system.

This aim requires a fundamental change in the relationship between providers and consumers where energy demand can be changed to meet supply – changing the time and amount of energy used to match the available resource – instead of energy being available 'on tap' as has been the dominant approach in the UK over the past fifty years.

Developing an effective low carbon electricity network requires identifying ways in which both

electricity demand and electricity networks themselves can become more flexible and sustainable systems. To achieve this, researchers at Durham believe that it is useful to see electricity networks as 'sociotechnical' – with the social behaviours of consumers and providers being understood as inseparable from the electrical and digital technology of the network. Smart grids are having an impact on social practices at the same time that social practices are determining how the smart grid can be achieved on the ground.

A new article by the project team "Systems of Electricity provision and the constitution of 'smart' energy practices" (Bulkeley, Powells, Bell and Lyon) suggests that the smart grid can be seen as a new way in which the electricity network is being governed. They argue that processes of governing are essential to the reproduction of everyday social practice. Smart grid interventions are therefore not neutral, operating on the views and values of autonomous individuals, but are actually an important part of making up what is seen as the appropriate and legitimate use of electricity.

“An interdisciplinary project being undertaken between the departments of Geography, Anthropology, Mathematics, Engineering and Computer Sciences at Durham University is exploring the potential of smart grids to transform our daily energy use. A key question being explored is how the use of new technologies, such as smart meters, energy monitors, solar panels and heat pumps, together with new energy tariffs are changing everyday practices and can be used to effectively manage electricity network demand.”

The project has found that smart grid interventions will be more successfully incorporated into social practices where either they ‘fit in’ to existing practice and systems or where they are able to establish new norms about how and why electricity should be used. For instance where there are solar panels on a residential property the timing of clothes washing can become shaped by using the electricity when it is cheapest i.e. when the sun is shining. Decision making then revolves around tariff levels at different times (i.e. how much money can be made or saved), which in turn could shape the pattern of supply required across the electricity grid network resulting in no evening peak electricity use. There is therefore an important element of self-regulation to the success of the smart grid, with individuals understanding and calculating their own energy use and production and managing their use and behaviour. This finding challenges the usual assumption that individuals are rather passive about their energy use and unable to manage it economically.

The project will continue to explore issues of how the smart grid is shaping household energy use such as:

- How and why different low carbon technologies are adopted;
- Which kinds of daily practice - washing, cooking, lighting and so on - are most flexible and why;
- How new ideas about responsibility for electricity use are being shaped by the arrival of the smart grid.

The project is also exploring what impact the mass uptake of Electric Vehicles will have in the UK.

Key Facts about CLNR

The CLNR team based at Durham University includes:

Professor Harriet Bulkeley (Geography)

Dr Sandra Bell (Anthropology)

Professor Janusz Bialek (School of Engineering and Computer Science)

Dr Steve Lyon (Anthropology)

Dr Gareth Powells (Geography)

Professor Philip Taylor (School of Engineering and Computer Science)

CLNR briefing notes and publications available from www.networkrevolution.co.uk/industryzone/projectlibrary:

Domestic and SME tariff development for CLNR

Demonstrating enhanced automatic voltage control for today’s low carbon network

Customer-Led Network Revolution - integrating renewable energy into LV networks using energy storage

For further information about the article “Systems of electricity provision and the constitution of ‘smart’ energy practices” presented to the November RMIT conference ‘Beyond Behaviour Change’ contact dei.admin@durham.ac.uk

For further information on the CLNR project visit the DEI project webpages at www.durham.ac.uk/dei/research/clnr



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Low Carbon Transitions

Urban climate justice: examining the responses of global cities to climate change

What is a just response to climate change? What does this constitute at the urban level? With new pressures to reduce Green House Gas (GHG) emissions cities have come to be viewed as a key arena within which to address climate change. However how issues of social justice and who gets what, where and when might be considered at the city level have not been addressed by the international community.

Professors Harriet Bulkeley and Dr Sara Fuller of Durham University and Gareth Edwards at St Andrews University have been exploring these issues and have developed an analytical tool to illustrate the many sides of climate justice in the city. Their paper 'Towards Climate Justice in the city?' was presented at the World Bank Sixth Urban Research and Knowledge Symposium 2012 in Barcelona.

The new paper argues that it is important to recognise inequalities and differences at the city level if justice is to be achieved in responses to climate change. Issues of inequality and uneven landscapes of rights and responsibilities for climate change are not often addressed when looking at the urban level, although they have long been key to discussions at the international level. Policy and research on urban responses to climate change largely either see the city as one entity or only recognise differences in physical characteristics across the city.

When issues of justice are explored they are often approached as either relating to the distribution of rights or responsibilities, or as about how policy processes might be made more open. The authors argue that the act of recognising inequalities is a third form of justice that is required if a just response to climate change is to be achieved.

When looking at the urban level it is not appropriate to talk about a single target or duty to address climate change. Different cities may have different rights and responsibilities for mitigation and adaptation activities. Equally there are likely to be differences within cities as to who carries the duties, burdens and benefits of addressing climate change. Processes of urbanisation and economic development generate uneven socio-economic and power landscapes within cities which frame

climate change responses and affect groups differently (such as women, working class, or minority ethnic groups). For climate justice to be achievable, processes of redistribution must recognise inequalities between different groups. The design of policy responses to climate change must also recognise different levels of exclusions and vulnerability, and attempt to ensure equal participation of different groups and transparency of decision-making processes. However it is important to ensure that those actors with the most capacity and accountability for action with the most means to carry forward action remain part of the process.

The policy and decision-making tool for climate justice developed by the team is based on a matrix approach which enables the multiple dimensions of justice to be taken into account. It provides a means to capture and analyse the ways justice is being articulated in urban responses to climate change and to explore differences in view and where challenges might lie in designing and implementing urban responses. The climate justice matrix is a useful tool for urban policy-making to ensure climate justice issues are fully incorporated into the design of urban responses and a means to engage communities and stakeholders in the development of future urban responses to climate change.

A paper presented by the team at the Sixth Urban Research and Knowledge Symposium 2012 applied the climate justice matrix to three examples of 'climate change experiments' introduced in Philadelphia and Hong Kong. The Friends of the Earth Power Smart contest and the Climateers project in Hong Kong and the Retrofit Philly "Coolest Block" contest in Philadelphia. The tool was very effective in highlighting that although certain elements of climate change justice had been drawn on in these cases and they had all achieved positive results, they were all missing an understanding of some justice dimensions. The research suggests using the matrix to design these interventions would have enabled even more effective climate justice outcomes to be achieved and would enable the schemes to move beyond their initial successes to achieve longer-term sustainability.

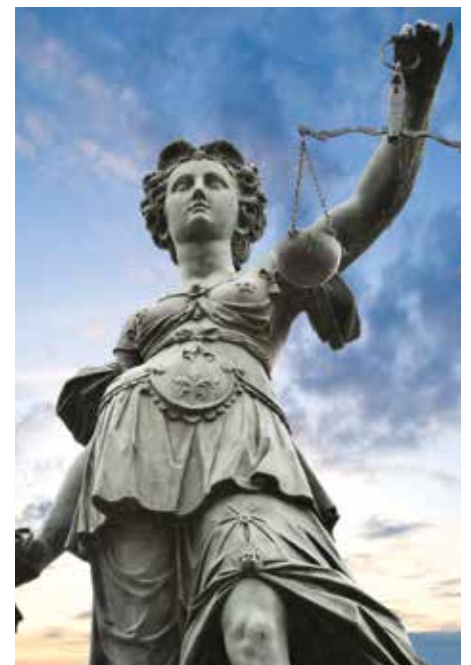
The paper 'Towards Climate Justice in the City? Examining the politics, practice and implications of urban climate change responses in global cities' builds on earlier work for the Joseph Rowntree Foundation by Harriet Bulkeley and Sara Fuller: **JRF Viewpoint: Low carbon communities and social justice.**

If you are interested in finding out more about the climate justice matrix and applying it in your work please contact Professor Harriet Bulkeley on h.a.bulkeley@durham.ac.uk or visit the www.dur.ac.uk/dei/research/societyandenergy/lowcarboncommunities/ DEI Urban Low Carbon Transitions webpages.

Distributive justice – who gets what, where and when? At the international level or inter-generational level this has been articulated as: the rights to emit certain levels of GHGs, the right to be protected from climate change, or the responsibility to reduce emissions or pay compensation.

Procedural justice – who should participate in different decision-making and policy processes?

Recognising inequalities – recognising the inequalities which exist in particular contexts which structure their contribution to GHG emissions or vulnerability to impacts, and also affect the ability of people to participate in and benefit from decision-making processes.





The Kythnos Microgrid in Greece

In April, the DEI was delighted to welcome Professor Nikos Hatzigiorgiou for a 3 month COFUND Policy and Enterprise Fellowship, based in the Institute of Advanced Study. He is Professor of Power Systems at the National Technical University of Athens and is a world leader in the field of future power systems, particularly the integration of distributed and renewable energy generation into power systems. He has undertaken significant work investigating the potential of 'microgrids', as one of the most promising novel distribution network structures for smartgrids.

Smart Grids are electricity networks that can intelligently integrate the actions of all their users – generators, consumers and those that assume both roles – in order to efficiently deliver sustainable, economic and secure electricity supplies. A Smart Grid employs innovative products and services together with intelligent monitoring, control, communication and self-healing technologies.

The use of **Microgrids** enable the control of increasingly complex distribution networks which have increased numbers of Distributed Generators (DGs) (including microgenerators such as photovoltaics (PV)), storage devices, and flexible loads. In the case of faults or other external disturbances or disasters, these control capabilities allow distribution networks to operate isolated from the main grid thus increasing the quality of supply.

The EU funded MORE MICROGRIDS project (<http://www.microgrids.eu>) aimed to develop decentralized control techniques for large numbers of DGs. The Kythnos Microgrid is the first actual test site where decentralized control

of flexible loads has been implemented using intelligent Multi-Agent Systems (MAS).

The pilot Microgrid in Kythnos island, Greece, electrifies an isolated settlement of 12 houses in the small valley of Gaidouromantra. The electric system in site was installed for the first time in 2001, and was financially supported from European programs.

The rationale was to meet the social and environmental needs for electricity in small, remote settlements with abundant local renewable resources, but where conventional power supply systems are too expensive to install, operate and maintain. The commercial driver was the 1,6 billion people worldwide without electric power.

The aim of the system is to use 100% solar energy produced by the PVs or stored in the batteries, with the diesel genset only used as back-up, in the case of prolonged clouds or emergencies. A separate PV array of about 2kW is mounted on the roof of a control system building (System House) and along with a 32-kWh battery bank is used to provide power for monitoring and communication. The battery inverters in the Kythnos system have the capacity to limit the power output of the PV inverters when the battery bank is full.

The houses are supplied with a single phase electricity service, limited by a 6A fuse. This means that each home can have lighting, a refrigerator, water pump and small electrical appliances. The residents were asked from the beginning to use high-performance, energy-efficient appliances, such as fluorescent lamps and refrigerators with good insulation.

Initially, load management was performed by control devices on the electric board of each house. When the frequency of the grid dropped below 49.14 Hz, all houses were disconnected. After this "shut-down" the diesel

generator charged the batteries. After some time, the houses were reconnected randomly when the frequency was increased to 50 Hz. The problem faced was that although the users favoured energy consumption based on the principle of equality, the consumers were not involved in the management of the microgrid and they had a tendency to overuse the system. This overuse can lead to shut downs in the system during periods when all the settlers are present (July-August) and the energy use needs are higher.

In response the project (<http://www.microgrids.eu>) developed intelligent load controllers and installed them in several houses. The water pump (1-2 kW) at each house, which is used to supply water to its residents typically uses the largest energy load, but is considered as non-critical and in cases of energy shortage is disconnected. This was achieved via a Wi-Fi interface to the Local Area Network which simplifies the installation of the units.

Load management is effected by the application of Multi-Agent technologies, i.e. pieces of computer software that are installed at different points in the system. If the PVs are capable of producing more power than the appliances request, then the central agent sends a message to the batteries informing the relevant agents that there is a surplus of power. The agents are then able to decide if there is need for the batteries to be charged, according to their state of charge. If the loads in operation demand more power than the production units can offer, the central agent informs the Load Agents that there is need for load shedding. The ILCs agents, equipped with intelligence and communication skills, negotiate in order to decide autonomously which appliance will be disconnected and more fairly distribute the energy usage between users.

There has been a good level of community acceptance for the installation of the Intelligent Controllers to act autonomously on their loads. The Multi-Agent system installed has provided an "objective" technical limitation and protection of the system to prevent over-use. This has helped to maintain good relationships between neighbours instead of requiring them to negotiate distribution amongst themselves and instead of encouraging behavior in which each house uses as much energy as possible in case of stored energy running out. To gain acceptance from the community it was essential to involve or at least explain the negotiation process of the Intelligent Controllers to the users and a demonstration software was developed for this purpose. Overall, the technical and economic evaluation of the system has been positive: the system has been reliable, users pay regularly, and the maintenance and repairs of the system are well organised.

For further information visit www.smartrue.gr or contact Prof. Nikos Hatzigiorgiou on nh@power.ece.ntua.gr



The Universal Sustainable Habitat Development project: An integrated solution for sustainable communities in low to middle income countries.

An exciting and innovative international project is being led by Mark Booth from the School of Medicine, Pharmacy and Health at Durham and Khaiko Makwela-Wali (Director of Green Globe Architecture) with many colleagues across Engineering, Anthropology, Geography, Physics, Chemistry, Education, Earth Sciences at Durham University.

The Universal Sustainable Habitat Development (USHD) project aims to enable the development and introduction of clean, accessible energy to rural and peri-urban areas in Sub Saharan Africa. The basic concept involves building new community infrastructures (such as schools, community centres, health centres, domestic housing, and sports centres) that meet all their energy needs from renewable sources that are integrated into the buildings. By providing a sustainable environment, the USHD aims to build sustainable and resilient communities that access all the opportunities that are associated with a stable, sustainable energy supply. For the rural and urban poor to cope with environmental degradation and reduce

their vulnerabilities they need to access capital assets, energy, food good infrastructure, functional community support systems and institutions. All of these require provision of energy; as such this is a most important sector in the emerging Green Economy.

The USHD concept includes supplying the building's and user's energy needs from sustainable and renewable energy resources. The integration and management of these energy resources have been incorporated into the fundamental architectural design of the USHD. Energy is generated and harnessed to supply electrical power to the building for services such as lighting, computing, refrigeration, medical and educational activities.

The project has developed a conceptual architectural framework which flexibly integrates all required energy resources based on the consumption needs of different community infrastructures. This framework can be extended at relatively low cost to provide larger spaces. The design of the electrical system for the USHD is based upon the proposed uses for different buildings. The energy consumption patterns and water needs of typical domestic dwellings, schools and health centres monitored in earlier projects in Nigeria and Rwanda have been used to design the proposed energy systems that will be used to power the buildings. The cost and performance of different systems have been considered for the USHD. Models were developed using the Hybrid Optimisation Model for Electric Renewables (HOMER) evaluation tool developed by the National Renewable Energy Laboratory (NREL).

A number of studies at Durham have been undertaken into the different energy sources, storage and costs of providing such systems. Randomised trials have been undertaken of specific devices, different energy generating technologies (including solar, small scale wind turbines, micro hydro, and biogas) and storage devices (including thermal, water storage, batteries, biogas store for waste).

The USHD project has already gained a number of high profile supporters including the Archbishop of Canterbury as Patron. As a multi-disciplinary, multi-sectorial project much effort has been put into engaging with academia, industry and the third sector. In this context, the team have been in discussions with key government, industry, and community stakeholders, including the UK Deputy High Commissioner in Nigeria, South African and Malwai Governments, The Science and Technology Commissioner from Lagos State Government, the Bishop of Kaduna, Romag, Gentoo, Northumbria Water, IBM and Proctor and Gamble.

Discussions regarding investment opportunities by commercial organisations interested in the link between sustainable infrastructure and community development are welcome. The project has potential beyond the rural African landscape and its principles are adoptable wherever renewable resources are available.

For further information on the USHD project visit www.durham.ac.uk/dei/projects/ushd or contact Mark Booth on mark.booth@durham.ac.uk.

New MSc Energy and Society

Durham Masters launched in a flash.

The launch took place in “flash” style outside the Bill Bryson Library and featured a one hour exhibition of the Durham University Solar Car and electric vehicle. Aimed at attracting and inspiring Durham’s students to take an interest in their energy use; information and entertainment was provided by the Durham Energy Institute (DEI), Greenspace, Department of Anthropology, and the Centre for Doctoral Training in Energy. Thanks also go to the Sports Department for providing a static bike and rowing machine for the energy maximiser 2 minute challenge.

Greenspace used the event to invite ideas for the £5million Students Green Fund, currently running on Facebook under Students Green Fund Durham Bid.

Despite torrential rain, students and members of the DEI Advisory Board chatted with department staff and tried out the challenges and quizzes provided. The weather did little to dampen their enthusiasm for the energy projects on display, with students commenting that “this is a course of real interest to me after my final year”.

Speaking at the event, course leader, Dr Simone Abram said “This is the first course to bring together energy and societal scientists to fully explore energy efficiency, sustainability and innovation in social and technological terms. Graduates of the MSc will be in demand from industry, community organisations, NGOs and governments around the world”.

Applications are now open for graduates with a good first degree (typically a 2:1) in a broad range of disciplines, particularly from the social and engineering sciences. Some of the subjects studied include:

Context and Challenges; Society and Practices; Energy in Practice (field study); Renewable Energy and the Environment; Energy, Markets and Risk; Advanced Power and Governance; and Society, Energy, Environment and Resilience

Further information on the course content and application process for the course can be found here: <https://www.dur.ac.uk/mscenergyandsociety/>

For an informal chat please contact Dr Simone Abram on Simone.Abram@durham.ac.uk or Dr Ben Campbell on Ben.Campbell@durham.ac.uk



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anth.postgraduate@durham.ac.uk

COMMENCING OCTOBER 2013



WHY DURHAM?

- Ranked 5th in the UK (*Sunday Times University Guide* 2013)
- A global Top 100 University (*THE World University Rankings* 2012)
- 92% of taught postgraduates secured employment within six months of graduating



DEI Executive Director Dr Wilf Wide and Board Chairman, Ian Burdon



www.durham.ac.uk/mscenergyandsociety

Professor Tooraj Jamasb, New Chair in Energy Economics at Durham University Business School



We caught up with Tooraj as he settles into his new life at Durham.

What was your first memory?

I remember that my father would bring these notepads from work for me before I knew how to write. I would sit down determinedly and "write" in the notebook filling it from cover to cover and then would ask him to bring me some more. I had a little pile of them.

What did you want to be as a child?

I wanted to be a pilot but luckily my mother hated the idea and dad talked me out of it!

What or who has been your biggest influence to date?

My family and teachers. I remember my

primary school teacher in Iran forcing me to memorise English text and never being quite satisfied with what I had done. My uncle was also a perpetual student from art history to sociology to philosophy etc. He was not happy with the compartmentalisation of disciplines in university.

If you had £1million to spend on research what would you do with it?

I would spend it on post-doc positions and PhDs so that students do not have to worry about a job straight after graduation. It would also ensure that we do not lose our best talents.

What are the real myths around climate change and energy?

There are no easy solutions. When it comes to energy and the environment, nothing comes free and it is always about trade-offs. That is where Economics can contribute most.

What are you most proud of?

Contributing to such an important subject area and motivating others to do the same. Energy research combines all the most intriguing elements of research: society, business, technology and politics.

You recently moved to Durham to take-up the Chair in Energy Economics, what are your impressions of Durham?

It is nice to be back in an old institution. I moved from an old institution at Cambridge University to the newness of Heriot-Watt University in Edinburgh so it feels as if I have

come home again. I have come to realise that old institutions relate to the passage of time in a different way. It changes the way people work - 'We have been there and seen it before'. Durham City is half the size of Cambridge but is much hillier - I will need to buy some comfortable shoes!

What would you say to undergraduates looking for a career in academia?

It is rather like being self-employed in a supporting organisation and you always work with smart people. Some of that smartness may rub-off!

What makes Durham University so good?

It seems to be managing the task of combining old and modern and reinventing itself very well.

If you didn't do this, what would you be doing?

I would probably be working for an international organisation doing research-orientated work.

What are you hoping to achieve through your involvement with the DEI?

The DEI is what brought me to Durham. I saw a scale and scope and structure for energy research in Durham. There is a lot of energy, optimism and positive thinking here and I am looking forward to getting involved.

Events at the DEI

British Science Festival

The Durham Centre for Doctoral Training in Energy has been awarded a place at the 2013 British Science Festival, to take place in Newcastle, 7-12 September 2013. The CDT students will be running an 'Energy Dragons Den' workshop on the future of energy. GCSE pupils are invited to act as the Dragons, making decisions on whether to invest in particular technologies or ideas they think will solve future energy problems. The workshop aims to teach pupils about various different types of renewable and non-renewable energy, and the technical and social/economic advantages and problems of each.

DEI Research Generators

The DEI holds regular research generator meetings on the first Thursday of every month bringing together researchers from a range of disciplinary backgrounds to make contact and discuss energy topics in an informal environment - without Powerpoint, agendas, chairpersons or minutes. For further information visit DEI events webpages.

www.dur.ac.uk/m.a.fox/

PMAPS 2014 International Conference

The DEI is hosting this four day international conference on the application of probabilistic methods to energy systems from 7 to 10 July 2014. Contact chris.dent@durham.ac.uk for more information about this event. For more information about this event go to www.durham.ac.uk/dei/events/pmaps2014

The Contested Politics Of Urban Electricity Networks: Insights From Urban Infrastructure Studies Session At 2013 RGS-IBG Annual Conference 28 To 30 August, London

Andrés Luque and Jonathan Silver, two DEI postgraduate students, are organising the session which will focus on the political and political ecological dimensions shaping electricity networks and their current transformation. The session will focus on three areas: Social movements and protest in the electric city; the uneven geographies of the electric city; and Rewiring the electric city.

For further information on DEI events visit www.durham.ac.uk/dei/events or email dei.admin@durham.ac.uk

Communicate your work!

The Durham Energy Institute provides support to academics and students from all disciplines engaged in energy research at Durham University. Ensuring

high quality energy-related research can engage multidisciplinary stakeholders, win funding and attain high visibility.

If you would like your project or event to feature in the October 2013 issue of the DEI Review or on our website please **contact dei.admin@durham.ac.uk**