Industry and Parliament Trust

Sustainable Futures

Examining investment and technological innovation for a low-carbon economy

CONTENTS

"Now, we put out a lot of carbon dioxide every year, over 26 billion tons… It's an average of about five tons for everyone on the planet. And, somehow, we have to make changes that will bring that down to zero"

– Bill Gates

THE COMMISSIONERS

Chair of the Commission:

PROFESSOR DAVID COPE, LIFE MEMBER, CLARE HALL, UNIVERSITY OF CAMBRIDGE, IS THE FORMER DIRECTOR OF THE PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY (POST), AND VISITING PROFESSOR OF SCIENCE POLICY AND INNOVATION, DOSHISHA UNIVERSITY, KYOTO, JAPAN

In David's role as Director of POST, until March 2012, his responsibilities were to ensure that parliamentarians had access to the most up-to-date and comprehensive information on all aspects of energy demand and supply. For example, the Office produced a briefing on the *Carbon Footprint of Electricity Generation* which has become a key reference source.

David has had a lifetime's involvement with energy matters. His time as Director of the UK Centre for Economic and Environmental Development at Cambridge involved him in numerous studies on energy matters (such as the future of nuclear power). He joined the Centre from having been Environmental Team Leader with the International Energy Agency and began his interest in energy matters through a research programme when he was a lecturer at Nottingham University.

Kostas Andriosopoulos , Assistant Professor in Finance & Energy Economics, ESCP Europe

Kostas Andriospoulos is an Assistant Professor in Finance & Energy Economics, Director of the Research Centre for Energy Management, and Academic Director of the Full-time Executive Masters in Energy Management at the ESCP Europe Business School.

Gordon Birtwistle MP

A veteran local councillor and engineer, Gordon Birtwistle became the Liberal Democrat MP for Burnley in the 2010 General Election.

Janine Freeman, Head of EU & UK Public Affairs, National Grid

Janine has been with National Grid for 13 years and currently heads up National Grid's EU & UK public affairs team. She is responsible for coordinating policy development as well as government and community engagement.

Professor Patrick Gougeon, Director, ESCP Europe London Campus

Professor Patrick Gougeon is Director of the ESCP Europe London Campus. In the course of his career with the school he has occupied several positions in France and abroad.

Grant Holland, Utilities Manager, BOC

Grant has over 20 years of experience in the Industrial Gas business working for BOC in Project Management, Global Process Safety and Operational Management roles in the UK and overseas.

Peter Kocen, Public Affairs Manager, Energy UK

Peter Kocen is the Public Affairs Manager at Energy UK, the trade association for the energy industry. Prior to joining the energy sector, Peter worked in legal publishing.

Ian Liddell-Grainger MP

Ian was first elected as the Conservative Member of Parliament for Bridgwater and West Somerset at the June 2001 General Election.

Denise Massey, Managing Director, Energy Innovation Centre

With more than 16 years of strategic planning and development experience, Denise heads up the world-class Energy Innovation Centre, taking the lead in assisting individuals and businesses in getting their ideas to commercialisation.

Christine McGourty, Energy sector

Christine McGourty joined the energy sector in 2009, after more than 20 years in national news journalism, reporting on science and technology news in every branch of the media – national radio and TV news bulletins, national newspapers and specialist magazines.

Lord O'Neill of Clackmannan

Martin O'Neill was a Labour Member of Parliament from 1979 to 2005, for constituencies located in the Forth Valley and the Ochils. At the May 2005 general election, Martin retired from the House of Commons, and was subsequently made a life peer, Baron O'Neill of Clackmannan.

Lord Redesdale

Lord Redesdale was made a life peer in 2000 but first entered the House of Lords in 1991. He has been the Liberal Democrat spokesperson for International Development, Defence and Energy. Lord Redesdale is Chief Executive of the Energy Managers Association.

Rt Hon Caroline Spelman MP

Elected in 1992 as Conservative MP for the Meriden constituency, in the West Midlands. From 2010 to 2012 she was Secretary of State for Environment, Food and Rural Affairs.

Robin Walker MP

Robin Walker has been the Conservative MP for Worcester since his election in May 2010.

Dr Melanie Wedgbury, Head of External Communications, Drax Power

Melanie joined Drax as Head of External Communications in September 2002.

ESCP EUROPE BUSINESS SCHOOL

RCEM RESEARCH CENTRE FOR ENERGY MANAGEMENT @ ESCP Europe Business School

INTRODUCTION

WE ARE ALL FAMILIAR WITH THE 'TRI-LEMMA' BETWEEN DECARBONISING ELECTRICITY PRODUCTION, SECURITY OF ENERGY SUPPLY AND AFFORDABILITY.

Decarbonising the electricity sector and securing energy supplies without doing harm to the economy is the biggest challenge the UK faces, which is the focus of the case studies in this report. It seems that innovation and investment in green energy provide the necessary balance between these three discrete factors.

The IPT Energy Commission took in a broad sweep of different case studies from consumer behaviour to the production and supply of energy, as well as research and development within the sector. In the course of the six months we identified four themes that we thought were of particular interest. These were consumer attitudes, innovation in the development of the electricity grid, a global perspective on supply and partnerships for research and development. The themes form the four short chapters of this report.

Although this project has been labelled an Energy Commission, one thing became very clear – the issues that we have discussed and the challenges that the United Kingdom faces are not specific to the energy sector, but affect all dimensions of our economy and society. This is part of the purpose for inviting colleagues from a range of sectors to comment and contribute.

The report makes no attempt to take a comprehensive view, nor is it specifically aimed at promoting any particular policy; it is essentially a series of case studies. The purpose of these vignettes is to highlight factors that we felt merited further exploration. If we have come to any conclusions it is that there is no single silver bullet to address the questions we raised.

My thanks go firstly to my fellow Commissioners, who contributed to the report, to those who gave evidence for their time and expertise, to the Industry and Parliament Trust (IPT) and to those who helped make the Commission happen.

We believe that all eight cases merit further exploration. What this document does is to outline a few of the salient points from each case. The IPT will aim, as 2013 progresses, to return to each of the topics to go into further detail and explore what industry and Parliament might do practically together in order to move the agenda forward in each instance. If you would like to join any of the discussions please get in touch with the IPT.

Professor David Cope

CHANGING ATTITUDES TOWARDS CONSUMPTION

"IT IS AN INTERESTING VARIATION ON HOW YOU CAN MEET THE CONUNDRUM. IF YOU DON'T HAVE ENOUGH GENERATING CAPACITY, YOU HAVE TO DO ENERGY EFFICIENCY. I DON'T LIKE THE TERM 'ENERGY EFFICIENCY' BECAUSE IT'S NOT 'MANAGEMENT'. ENERGY EFFICIENCY IS WALKING INTO A ROOM AND TURNING THE LIGHTS OFF WHEN YOU LEAVE, WHEREAS 'ENERGY MANAGEMENT' IS WONDERING WHY THE LIGHTS WERE ON WHEN YOU WALKED IN. BUT IT'S ACTUALLY ABOUT WORKING TO A BUDGET – THAT'S WHAT COMPANIES NOW HAVE TO START DOING"

Industry Case Study – Lord Redesdale, Chief Executive, Energy Managers Association (EMA)

The IPT Energy Commission has been looking at the usage of energy in the UK. It is predicted that energy management will grow in prominence as the cost of all forms of energy increases over the next few years. The most effective way of reducing your energy spend is to simply use less, but how many companies actively train their staff in energy management?

To go some way to rectifying this problem, the EMA is launching the Low Energy Company (LEC) initiative in October. Its goal is to train a substantial percentage of UK employees in foundation level energy management. Companies whose employees undertake approved training in the specified proportions will be awarded LEC status.

There are three reasons an organisation will want to achieve LEC status; to negate the effect rising energy has on the bottom line; to establish good corporate social practice; and, most significantly, it will be a procurement requirement laid out by companies higher up the supply chain.

Supply chain companies that do not take energy management seriously will inevitably pass on costs to organisations they supply. Therefore, it is in the interests of procurers of these goods and services to make it a condition that any company supplying to them becomes LEC certified.

Work carried out by the EMA has shown that employees trained in energy management save, on average, 10% of their baseline energy usage. At what point does the cost of training save money when compared against rising bills?

For many companies the greatest return on investment would be to train their entire staff in energy management.

The reality is that the era of "cheap" energy is over and whilst we have all grown accustomed to our ways of working, we can only maintain such standards if we make our buildings more efficient and train those who work within these spaces to use energy more efficiently.

Case Study: 1

VALIDATING THE ROLE OF THE ENERGY MANAGER

"PEOPLE WILL CHANGE THEIR ATTITUDES MASSIVELY TO ENERGY IN THE WORKPLACE AS THE PRICE OF ENERGY INCREASES AND THE GREAT THING ABOUT THAT IS THAT THEY WILL CHANGE THEIR ATTITUDES AT HOME AS WELL."

Energy costs have become of increasing concern in the UK, with many families facing the prospect of fuel poverty while businesses are concerned about their ability to compete.

Every organisation takes health and safety training seriously, and it would make sense - considering the savings that could be made – for organisations to teach everyone, both at their induction, and during their employment, about energy management.

At the moment it is very difficult to know who an energy manager is as there are few formal qualifications, and most employees do not consider it their responsibility. The Commission discovered that if a company trains a member of staff it can save between 10%-20% of the energy that they use. However, a cultural shift needs to take place as a significant percentage of employees still take the view that "it doesn't affect me". These are typically office workers but offices account for more than 40 per cent of emissions in the United Kingdom. For example, when an office worker uses a computer or sends an email with attachments, the servers and the system all use energy. Every employee has an energy cost, which largely goes unrecognised by most office workers.

Not only is there a financial incentive for the company, but there are clear advantages in developing a corporate social responsibility strategy. The consequences of any change in larger firms will be important all the way down the supply chain. If companies at the top of the chain adopt a particular attitude to energy management they are likely to make it mandatory, or at least desirable, in their supply-chain.

The Government plans to call for smart-meters to be installed by 2020. Smart metering technology has the potential to provide business with a transparent view of their energy usage. By using something as simple as an application on a mobile device, users may be able to control their company's electricity or gas usage more intuitively.

It is entirely possible that every future office building could have visual-display units on the wall, indicating how much energy any particular department is using. This would strengthen the role of the energy manager in an organisation because saving energy would become an element of the business that concerned everyone. One could conceive of schemes where, if a department exceeded a pre-determined energy limit, the excess would come out of its budget. This would provide an opportunity for both a culture change in energy use at work and an extension of the functions of energy managers.

Case Study: 2

SMART METERING: QUANTIFYING ENERGY TO THE DOMESTIC CONSUMER

"YOU NEED TO GET IT INTO PEOPLE'S MINDS THAT YOU CAN MAKE A DIFFERENCE BY CREATING INCENTIVES TO MAKE PEOPLE WANT TO BE IN CHARGE OF THAT MANAGEMENT."

Domestic energy consumption accounts for roughly 20 per cent of the peak-load for electricity in the UK. A September 2012 report by British Gas and Oxford Economics estimated that the net benefit of a smart meter roll-out to all homes and businesses in the UK would be nearly £14 billion between 2012 and 2030. The end to estimated billing may not sound like a quantum leap but it could make a big difference to customers' understanding of their energy usage and a real opportunity for the energy supply and distribution industries - if they get it right - to rebuild some trust with customers.

There is a lot of confusion about 'smart' as there is a problem with the terminology; 'smart' is used for so many things. A smart meter itself is a box that will provide energy users and providers with accurate and up-to-date information on energy being used. Fundamentally, smart meters should enable people to manage their bills more effectively. However, smart meters are essentially just a starting point. The potential to allow consumers remote control over their energy supply through an app on a mobile phone or similar systems presents some interesting opportunities for consumers to take further control over their energy consumption.

One aspect of the introduction of this type of technology is that someone other than the immediate occupier could also access the system. For example, control of houses for vulnerable people could be monitored externally to make sure that they are not using too much, or too little, energy. It would be important for appropriate safeguards to be in place. For example, they would need to be signatories to the *Smart Energy Code* and take specified services available from the Data Communications Company (DCC). There is, however, the opportunity for the DCC to make use of its infrastructure for additional services such as smart water meters or to provide an additional communications link into the home for services such as personal healthcare alarms for the elderly.

In order to allay public anxiety about access to the data that is being gathered as smart meters are gradually rolled out nation-wide, the Government has defined a policy aimed at giving consumers control of how much and how often their smart metering data is accessed by suppliers. These suppliers must also tell customers how the data will be used so that customers are able to make informed decisions with regard to their privacy. Customers must give their permission for suppliers to use any smart metering data for the purposes of sales or marketing and suppliers must make clear the reason for sharing any data with a third party and how the information will be used. With the protection of data, it is absolutely critical that robust demarcation is determined from the beginning, as the scale of the new information that will be available once the smart meter programme is rolled out nationally will be unprecedented.

The Government has stated that suppliers will have the primary consumer engagement role and this should be supported by a programme of centralised engagement from a Central Delivery Body (CDB). This new body will look to build consumer support for the roll-out, by increasing confidence in the benefits of smart meters and by providing reassurance on areas of consumer concern. It will also seek to facilitate the realisation of consumer benefits, by building acceptance of the installation of smart meters and by helping consumers to use smart metering to manage their energy consumption. It will also ensure that vulnerable, low income and pre-payment consumers can benefit from the roll-out.

Although suppliers will address installing smart meters in different ways, consumers will also benefit from a licence-backed *Smart Metering Installation Code of Practice*. This will ensure consumers receive a high standard of service and understand what to expect from the installation visit; how to use their smart meters and In-Home Displays; how their actions can improve energy efficiency and understand what their data choices are.

INNOVATION TO MANAGE SUPPLY

"THE WAY PEOPLE USE ENERGY IS CHANGING. MODELLING ENERGY USE EVEN 2-5 YEARS AHEAD IS BECOMING INCREASINGLY COMPLICATED AND THE DISTRIBUTION NETWORK OPERATORS WILL CONTINUE TO BECOME MORE IMPORTANT."

Industry Case Study – Dave Openshaw C Eng FIET, UK Power Networks

Innovation in electricity networks has to satisfy many objectives including safety, efficiency, reliability, and quality of service. However, the current key area of focus is to support energy policy which has significant implications for the electricity industry such as:

- variable wind and solar electricity production leading to increased difficulty in real-time balancing of generation and demand and volatility in electricity market spot prices;
- increasing demand for electricity from electric vehicles and heat pumps which might drive disproportionate increases in peak demand;
- the need to develop smart electricity grids and markets to create an efficient dynamism between electricity usage, network capacity and available low carbon generation.

The following are case studies from UK Power Network's innovation portfolio drawing on Ofgem's Low Carbon Network Fund. Each project combines technological and market innovation.

Low Carbon London explores the scope for responsive demand by conducting a day-ahead, critical peak pricing trial using smart meters to emulate a future where day-to-day, or even during the-day variations in wind generation output will significantly impact the real-time marginal cost of electricity production. It is also determining the scope for industrial and commercial consumers to provide a real-time rapid response to network constraints as an alternative to building expensive network infrastructure.

Flexible Plug & Play Networks explores the scope for faster and cheaper connections of onshore wind generation by means of smart grid technologies to maximise network capacity and optimise power flows.

Smarter Network Storage uses a grid-scale lithium-ion electricity storage device to address local load growth without resorting to major new electricity infrastructure; to provide upstream ancillary services to National Grid and provide system balancing opportunities to reduce market price volatility.

Overall Implications

As a consequence of energy policy, companies like UK Power Networks will need to evolve from passive network operators to active system operators. Companies need to make full use of responsive demand, dispatchable generation and energy storage in order to obviate the need for massive infrastructure investment, so as to accommodate low carbon technologies. System operators also need to leverage the scope for smart grid and smart market products to provide end-to-end electricity system benefits.

Industry Case Study – Chris Lowsley, BEng, CEng, MIET, MIAM, EA Technology

My Electric Avenue project …

The *My Electric Avenue* initiative is an exciting project which promises to deliver real, significant benefits on both commercial and technical levels through the engagement of customers, for electricity companies, small and medium-sized enterprises (SMEs) and companies new to the electricity industry.

As sales of electric vehicles (EVs) increase, there is a need to assess the potential impact that a cluster of EVs may have in a local area served by one electricity substation. In the event of all EVs being recharged at the same time and without any preparation, the load on the local electricity network may exceed the substation capacity.

Working with SSEPD, Nissan, Fleetdrive Electric, Zero Carbon Futures plus others, *My Electric Avenue* demonstrates a unique and pioneering approach. It is the first time that an electricity company has empowered a third party (EA Technology) to develop, manage and deliver a network innovation project on its behalf; to test a possible approach and to help to shape the design and delivery of future network innovation competitions.

The project is looking for ten 'electric avenues' – groups or 'clusters' of ten people or more – where each person will drive an electric car for 18 months to trial a new technology which will monitor and control the electricity used when the car is being charged.

The project will provide essential learning about managing the strain on the distribution network from the anticipated increased uptake of electric vehicles. It will also deliver a cost-effective solution to electricity companies reducing the need for network reinforcement and allowing a faster uptake of EVs.

The project has received support from Ofgem through the Low Carbon Fund.

Case Study: 3

THE CHANGING ROLE OF THE DISTRIBUTION NETWORK OPERATOR

"WE ALL RELY ON HAVING ENERGY AT OUR FINGERTIPS - FROM THE WARMTH AND LIGHT WE RELY ON AT HOME, AND THE POWER WHICH KEEPS OUR FACTORIES AND OFFICES GOING, TO THE MOBILE COMMUNICATIONS AND OTHER TECHNOLOGIES THAT ARE ESSENTIAL PARTS OF OUR MODERN LIFESTYLE. OVER THE NEXT DECADE SIGNIFICANT INVESTMENT WILL BE NEEDED IN ORDER TO MAINTAIN SECURITY OF SUPPLY, AND HELP THE TRANSITION TOWARDS A LOWER CARBON ENERGY SYSTEM IN AN AFFORDABLE AND SUSTAINABLE WAY."

As the nature of the electricity grid changes, Distribution Network Operators (DNOs) are evolving from passive to active network managers, embracing new technologies and engaging far more with consumers. In order to ensure DNOs adapt, the sector requires a well-developed and flexible innovation strategy as there is much long term uncertainty. There is a whole range of scenarios that could affect the specific nature of the electricity grid in the longer term, and the strategic investments that DNOs make now need to take these into account.

How might DNOs deal with these challenges? The conventional logic is simply to invest in stronger cables and bigger transformers. However, this alone is a) not very likely to be cost-effective, b) could be extremely disruptive to the general public – particularly in built up areas in terms of excavations and traffic problems and c) does not enable management of the supply/demand on the grid to minimise peak energy use or make best use of the lowest carbon sources of power generation.

Smart-grid technologies such as demand response, time-of-use tariffs and storage can enhance the network performance while extracting additional capacity at peak times. There is also the ability to create a more flexible, multi-reliant grid. Consequently the role of the DNO becomes more focused on using new technologies to 'tweak' existing systems rather than replacing old infrastructure per se. However, the current customer and tabloid media perception of energy suppliers and lack of understanding of the structure of the energy industry are likely to represent a significant challenge to the distribution operators in implementing change. Smarter Network Storage (SNS) is one project that the Commission examined. This is essentially a large lithium-ion battery, which can store electricity for when it is required. There is further work that needs to be done when taking a national perspective on cost-effectiveness, since economies of scale tend to favour siting of such systems nearer to the transmission end. As well as providing storage, technology such as SNS provides other benefits such as the ability to convert from AC to DC and back again.

The Low-Carbon Network Fund, an Ofgem initiative, is an excellent catalyst for encouraging innovation in this area. DNOs are incentivised by funding for up to 90 per cent of a project's cost to undertake research and development. The Fund is targeted at high-risk, first-of-a-kind-type projects that have a low return and therefore would not be attractive from a conventional investment perspective but which have the potential to result in a great deal of learning and to pave the way for what might be far more economically efficient technologies.

Case Study: 4

THE ELECTRIC VEHICLE AND CHANGING DEMANDS OF THE CONSUMER

"THERE ARE A LOT OF VARIABLES. WE'RE DOING A LOT OF MODELLING OF WHERE CAPACITY ACTUALLY IS. THE ISSUE HERE IS AROUND CLUSTERING AND ASYMMETRICAL GROWTH PATTERNS. WE ARE THEREFORE HAVING TO PLAN FOR A RANGE OF SCENARIOS."

The successful introduction of electric vehicles will be a key part of the move towards meeting environmental targets. There has been considerable activity and publicity from manufacturers since 2011, but there are still only a small number of vehicles on the road, with a current figure of around 3000 electric vehicles (EVs) in the UK. DECC estimates however that by 2020 this number will rise to around two million. Electrification of transport will inevitably mean an increase in electricity demand.

The problem here is that as power demand for EVs, along with that from other low-carbon electricity technologies, rises, there may be a tendency to accentuate peak demand and affect the distribution network disproportionately at certain times.

If EVs are evenly spread geographically, the network would in theory be able to cope; the real issue comes if clustering occurs. For example, because it is far easier to install charging facilities in new-build housing or offices, demand may be concentrated at such sites. Demand may also 'cluster' over time. EV owners might all plug-in their cars at 6pm, on top of the existing peak tea-time electricity demand which will cause local issues on the network. There is currently an assumption that people do not have all their appliances on at the same time as their neighbours. However, the amount of energy each EV would require creates a new set of issues for the electricity grid that is difficult to model.

Electric vehicles may demand 3 to 7 kW of power and that load may be needed for four to eight hours. There may be situations where the local distribution networks cannot cope if there are clusters of EVs on individual circuits and demand is of any significant scale. There may be a need for early interventions before consumers get used to electric vehicles; the UK cannot change its infrastructure overnight and to replace the whole network would cost billions. Therefore, the critical need is to upgrade the existing network. One way to address this challenge is to use technology that continually examines capacity and sends a signal to local 'slave' devices – the charging points – to monitor charging and to allow it only when the network has capacity.

With variable wind-generation and solar it is difficult to predict, even four hours ahead, in order to schedule the generation needed to meet the demand of some of these new technologies, such as EVs. In recent years, the System Operator has enhanced the way in which it forecasts variable wind and solar generation and works proactively with weather forecasters to improve the ability to predict the output of such generation. As the volume of this variable generation increases over the next decade, the capability to forecast output with greater accuracy will become ever more important, especially when coupled to the variability of UK weather.

It is important to note that there are ways to effectively balance the system. Generators of all kinds can come on or off the grid to help balance supply and demand, or to manage 'constraints' – effectively bottlenecks – in the network. This is normal and can include buying generation onto or off the network one or two days ahead of real time. The challenge comes when one looks ahead to predict the effects that technologies, such as EV's, might have in 10 to 20 years' time, as well as the necessary changes that might be needed by way of electricity distribution.

GLOBAL PERSPECTIVES ON PRODUCTION

"IF BRITAIN WAS TO CLOSE DOWN ALTOGETHER OVERNIGHT, THEN CHINA WOULD TAKE UP THE SLACK OF CARBON EMISSIONS IN TWO YEARS. IF AMERICA CLOSED DOWN, JUST THE GROWTH IN CHINA'S EMISSIONS WOULD REPLACE AMERICA'S EMISSIONS IN 12 YEARS."

Industry Case Study – Kostas Andriosopoulos, Assistant Professor in Finance & Energy Economics, ESCP Europe

Few would disagree with the view that energy companies and policy makers are facing significant challenges as we enter a new era. The issues to be addressed are many: can we count on technological breakthroughs to cope with surging energy demand and at the same time handle the long term environmental constraints? What type of regulatory framework is most likely to provide the incentives for the necessary changes to take place? To what extent are nations ready to cooperate in addressing global energy and environmental challenges? Can we be assured that capital markets will provide the tremendous funds needed to develop energy infrastructures and improve energy efficiency?

Moreover, the recent success of shale gas in the USA has prompted geologists in a number of European countries to examine the productive possibilities of their own shale resources. Many European countries have launched investigations for future exploitation but in doing so face various difficulties related to the geology and the density of their populations compared with the USA. Moreover legal, fiscal and land-use particularities for onshore drilling present additional difficulties. What is more, there is considerable environmental skepticism and opposition from lobby groups and the media regarding shale gas drilling in Europe.

Nonetheless, despite the numerous difficulties that Europe is facing compared with the USA, it is still witnessing a growing enthusiasm for shale gas. Energy import dependency is a real concern and so many consider the EU's potential shale gas reserves as a partial solution for Europe's energy security problems. Key questions still remain unanswered in the European markets with regard to the cost of production and the commercially viable quantities of shale gas, for example. Policy makers and regulators, at both the country and the EU level, need to consider all the above mentioned points in order to form their future policy for the shale gas industry.

As a leading European Business School, ESCP Europe ought to be involved in shaping the future of the energy industry and this was the main drive for establishing the Research Centre for Energy Management (RCEM) based at its London Campus. Bringing together the expertise of its faculty from across five campuses in Europe (Paris, London, Berlin, Madrid and Torino) together with its many external international associates, the objective of the RCEM at ESCP Europe Business School is to build a strong proactive partnership between energy corporations, government agencies and the academic community in preparation for a new energy era.

This is achieved through the promotion of rigorous and objective empirical research on issues related to energy management, finance, and policy, in order to support decision-making by both government and industry. The results of RCEM's research become available to the public through publications, workshops and conferences, educational programmes and other public outreach activities. Research at RCEM is also enhanced through direct cooperation with government agencies and academic and industry associates from across the globe.

Furthermore, with its two energy programmes, the Executive Master in Energy Management (EMEM), and the Master in Energy Management (MEM), ESCP Europe Business School has a mission to educate and train tomorrow's leaders in the energy domain. The sector has long been segmented into upstream versus downstream, oil and gas versus utilities, resulting in a high degree of specialisation. Today's managers need to have a broader perspective with an integrated view of the various issues in order to cope with the complexity; to have a clear understanding of antagonisms between players; and eventually be able to anticipate and design proper sets of actions and strategies. Preparing future managers for these challenges is the ultimate goal of our programmes.

Case Study: 5

THE NATURAL GAS REVOLUTION: AN UNCONVENTIONAL GLOBAL MARKET

"WE GET 20 PER CENT OF OUR GAS THROUGH THAT ONE TERMINAL, WE HAVEN'T GOT ANY BACK-UP. EVERYBODY IS LOOKING AT GAS AS BEING THE SOLUTION BECAUSE IF YOU'RE TAKING OUT COAL AND GOING TO GAS, LIQUEFIED NATURAL GAS IS PRETTY GOOD."

Traditionally, the UK has met gas demand from sources in the North Sea, but these supplies are declining. Whereas the UK was self-sufficient in gas supplies in 2000, over 50% was imported in 2011. It is estimated that there are 250 years of natural gas remaining at current global consumption rates and the UK is ideally situated to use the fuel as a contribution to its diversity of supply. Major new innovations such as floating liquefaction and gas to liquids plants may extend the existing range of CO2 reduction scenarios such as: 1) gas replacing coal; 2) gas complementing renewables, and 3) gas-fired electricity generation with Carbon Capture & Storage (CCS).

Shale gas is likely to supply virtually all of the envisaged 44% increase in gas production in the USA between now and 2040. Three years ago no-one would have envisaged this. It is also interesting that there are many geo-political issues. Gas as an energy source for the UK must be considered in a global context.

There is now a plateau in US gas production and since gas is so cheap to produce there, the price has become artificially low. However, the decreasing price of US gas is unlikely to 'spill over' into European and UK markets for two reasons: 1) because the markets are decoupled and 2) the USA does not currently have the capacity to export its gas in any significant amounts, although it has announced the intention to do so in the medium term.

As a consequence of declining gas prices in the USA, larger energy intensive companies are increasingly shifting production there to use the cheaper gas. The challenge for the UK is that the Chinese and Indian requirement for energy is also increasing and they are starting to look at using gas as well. While the USA is changing from coal to gas, the demand-side economics remain uncontrolled.

Liquefied Natural Gas (LNG) is firmly established as a vital element of the UK's gas supplies, helping to meet the strategic need for a more diverse energy mix, providing a vital link between the UK and European gas markets, and playing an important role in securing the UK's gas supply. It is expected that over 80% will need to be imported by 2020.

Although gas provides a lower carbon alternative to other fossil fuels (50-60% lower compared with coal) it can provide only a proportion of the energy mix of the UK. This is compounded by the fact that the UK's gas-fired electricity generation tends to be in rather small units (800MW to 1,200MW) and there are challenges presented by the scale of generation to justify additional investment. Perhaps if the UK were to go for larger gas-fired power stations it would provide economies of scale. However, with the current configuration, the opportunistic character of UK investment will remain on a much smaller scale and this means that, even if the country were to benefit from prices as low as those of US gas, the ability to use the fuel on a significantly increased scale would be constrained.

Case Study: 6

THE SUSTAINABILITY OF BIOMASS

"BIOMASS CONSTITUTES A WHOLE RANGE OF ORGANIC PLANT-BASED MATERIALS: AGRICULTURAL RESIDUES, FORESTRY PRODUCTS AND RESIDUES, AND ALSO SOME RECOVERED MATERIALS, SUCH AS WOOD. MOST OF THESE MATERIALS ARE THE BY-PRODUCTS FROM FARMING AND FORESTRY PROCESSES AND THEREFORE USE MATERIALS THAT ARE OTHERWISE NOT GOING TO BE USED."

There is an enormous amount of biomass available globally, offering a sustainable material which can be used to create energy. For example, when a tree is harvested by the timber industry for construction purposes, about 50% of its wood is typically wasted. Sawmills can therefore be a significant source of biomass. Similarly, biomass can be sourced from forest 'thinnings', a forest management process which removes small trees to allow others to grow bigger and service the higher value construction market for timber.

However, there is relatively little viable biomass in the UK because it is a small country without a great deal of forestry. Just 8% of the UK landmass is wooded and there are not enough forests in the UK under commercial management to make the sourcing of 100% of biomass from the UK possible. As a result, most of the currently-used material comes from overseas and is generally imported as compressed wood pellets. Wood is much less energy-dense than fossil fuels. Therefore, both transport costs and the sustainability of transporting the volume of materials to the UK must be a consideration.

It is counterintuitive that transporting biomass to the UK over thousands of miles makes environmental sense. However, when calculating the full carbon footprint of biomass, from field to furnace, it is evident that significant carbon savings are made when compared with burning coal. It is crucial from an environmental point of view that biomass plants burn only sustainable materials: there is no point using biomass if, overall, it releases more CO2 than any conventional fossil fuels that it might replace.

Sustainable biomass can be burned to produce renewable power but robust sustainability criteria are necessary. Despite an abundance of sustainable biomass in the world, the supply chain necessary to get the resource to the centres of demand is in its infancy and investment is needed. This investment could not only tap into a significant renewable resource potential but bring with it much in the way of job creation.

The feasibility of developing the technology is another consideration. The UK (and several other European countries) have many existing coal-fired stations that could potentially be converted to biomass, providing both a cost-effective and reliable renewable power source. This is cost-effective compared with other renewable technologies and the perfect complement to intermittent (i.e. wind power) and inflexible (i.e. nuclear) power technologies. However, environmental legislation means that much of the UK's older generation capacity will close in the very near future. In countries such as China and the USA, there is no incentive at present to encourage wider use of biomass. This is not simply due to the low initial price of other sources of energy, but because of geography – it is actually easier to transport the material from the South-east of the USA to the UK than it is from there to the rest of the USA for example.

The case for converting existing coal-fired power stations to biomass appears to be a strong one. Unabated coal is removed from the energy mix in favour of a cost-effective, low carbon and reliable renewable power source.

PARTNERSHIPS FOR RESEARCH AND INNOVATION

"ONE IN 10 INNOVATIONS WORK. INNOVATION IS NOT CERTAIN AND PEOPLE OFTEN AREN'T WILLING TO TAKE EVEN A ONE IN 10 CHANCE. BUT IF WE DON'T - AS A COUNTRY - PUSH THAT BOUNDARY A LITTLE BIT, THEN WE WON'T GET THE ACCELERATION WE NEED OVER THE NEXT 20 YEARS."

Industry Case Study – Luke Dicicco MCIPR, Head of Communications & Inward Investment Britain's Energy Coast (BEC)

BEC is an economic development agency established in 2009 to help strengthen and diversify the economy of West Cumbria (which consists of the boroughs of Copeland and Allerdale), North West England. It is a partnership between government at local and national level as well as the business community of West Cumbria, in particular those related to the energy sector. The organisation is, uniquely, funded by contributions from the Nuclear Decommissioning Authority, Sellafield Ltd and Nuclear Management Partners and managed as a Regional Growth Fund funding programme.

BEC's mission is "to lead the transition of West Cumbria into an economy which will flourish in a low carbon future". It delivers business support, support for the energy sector, funds capital projects, delivers a high quality property service and helps to position West Cumbria in the global market place. Combined, these activities will help to create an environment where businesses can innovate and grow; resulting in wealth and jobs that directly benefit the West Cumbria community and aid Britain's response to the pressing challenges of climate change and energy security."

West Cumbria is key to Britain's energy security and is set to benefit from a potential £90bn investment in the local nuclear industry and billions more in clean technologies. In the process, more than 3,000 new jobs will be created. The purpose of the presentation to the Industry and Parliament Trust's Energy Commission in March 2013 was to elaborate on BEC's involvement with renewable energy projects.

These include a district heating system in North Workington and the development of a "green" community in the rural village of Bootle, as well as exploring the possibility of powering Westlakes Science & Technology Park – which is home to almost 80 businesses employing 1,500 people – from geothermal energy. Plans are in an advanced stage to install electric vehicle charging points throughout West Cumbria and to develop further a Marine Energy Test Centre/Generating Facility with links to the European Marine Energy Centre in Orkney. Meanwhile, anaerobic digestion and biomass projects are being developed and supported, using an abundance of natural resources available to the area – one of its four key competitive advantages.

Along with the area's manufacturing capability, global reputation in the nuclear sector and cluster of world-leading R&D facilities, West Cumbria is strongly positioned to develop energy innovation and diversification and to represent the complete low carbon mix.

BRITAIN'S ENERGY COAST™ CUMBRIA

R&D PROJECT OUTLINE

"HTIP, A START-UP SME, HAS DEVELOPED A TRULY NOVEL DEVICE REPRESENTING A REAL BREAKTHROUGH IN POWER CONVERSION. IT WILL ENABLE THE ELECTRICITY NETWORK TO BE MORE RESILIENT AND PROVIDE GREATER FLEXIBILITY IN MANAGING VOLTAGE LEVELS ON THE NETWORK IN THE FACE OF INCREASED ELECTRICAL LOADS AND VARIABILITY OF RENEWABLE ENERGY SUPPLY."

Industry Case Study: Denise Massey, Energy Innovation Centre

Background to the company

HTIP is a small R&D company with experience in electronics that has developed a highly novel solid state voltage optimiser/stabiliser suitable for both domestic and commercial applications and that is recognised for its commercial potential. However the owner has struggled to secure funding to develop the device as the cost and risk are too high for industry alone to support and larger commercial parties who were interested in the technology wanted unreasonable commercial terms. However in March 2013 the company secured a DECC grant, which was matched by private DNO funding, enabling this technology to be developed. Had this not been secured, the owner had planned to give up trying to develop the technology as the constant effort to secure funding had become too onerous.

Perceived technology need

With increased distributed generation such as photovoltaics, there may be instances where domestic properties may experience over-voltage when the distributed generators are producing energy.

Over-voltage can often be invisible to the consumer but with the roll-out of smart meters, supply voltages will be more transparent. Over-voltage supply has the following effects:

- unnecessary consumption of electricity with a corresponding increase in electricity costs.
- increase in dissipation heat causing premature appliance and equipment failure.
- higher network costs and losses
- increased carbon emissions
- costs to consumers
- compensation and repair costs.

Over-voltage can be mitigated by large capital expenditure by the DNOs or by strategic deployment of expensive equipment. HTIP's proposal is to provide a low cost solution which is easy to deploy, giving greater precision and control.

What is the Technology Proposal (R&D project)?

The project is to adapt earlier work on domestic voltage regulation and to deploy it on a low voltage network. The regulator will be smaller in size than other alternative regulators, which will allow easy deployment on poles or within street cabinets with restricted space. It is envisaged the product will cost only £500 per unit.

Why is it unique?

The HTIP voltage regulator will be totally solid state. Initial work at the Centre for Advanced Photonics and Electronics, University of Cambridge, has validated the technology and confirmed the potential for transformer replacement at reduced size and cost. As well as giving the DNOs a solution to a problem, the device will be something they can use more creatively and proactively when managing their network, also allowing them indirectly to solve low voltage problems on weaker parts of the network.

Energy Innovation Centre

Case Study: 7

RESEARCH AND DEVELOPMENT FUNDING: THE VALLEY OF DEATH

"LOTS OF FIRMS HAVE HAD THEIR FINGERS BURNED BY GIVING THEIR INTELLECTUAL PROPERTY (IP) AWAY BECAUSE THEY'RE ENGINEERS, NOT SHARP FINANCIERS. CONVERSELY, INVESTORS AREN'T TECHNICALLY AWARE. SO, TECHNOLOGY PRESENTS GREATER RISKS FOR INVESTORS. WHAT WE NEED IS A CHANGE OF CULTURE."

The UK is ideally placed to lead in realising innovative solutions to energy issues through research and development. There are several structurally significant funding schemes in place, which are vital to ensuring that the research and development of new technologies have the best chance of reaching the market. For instance, the Low Carbon Network Fund, a deployment mechanism developed by Ofgem, has put aside £0.5bn between 2010-2015 to catalyse activity through projects that otherwise might not have been funded. This is just one of a whole range of funds available to enable the development of low-carbon technologies.

There is a perception that government grant awards are politically driven and are remote from industry need. However, the methodology in place tends to try to avoid this happening in practice and safeguards the process. Changing these perceptions, and working with industry, is the first challenge for government funds. The second challenge is that many schemes require matching funding before the disbursement of public funds which is particularly difficult to secure at present, especially if a project is considered blue sky or high risk in any way. Closer alignment between industry funds and public funds would alleviate some of these challenges.

The challenges of private funding for research and development are slightly different. Essentially the return on investment is too short for many of the low carbon technologies potentially available. Private equity funds look at returns in five to seven years, but technology development can take a lot longer.

For SMEs and university spin-outs, working with venture capitalists may be perceived as commercially difficult, as they may not have the necessary business acumen to negotiate with such organisations and therefore agreements need to be very clear.

There remain a number of intellectual property (IP) challenges for companies and research institutions in developing new technologies, although recently there has been a change in culture at British research-led universities with regard to spinning out companies and IP, often originating from the inspiration of particular individuals. It has been argued that universities are focused primarily on the quality of research and intellectual property is not high on their agenda. IP and commercialisation is now a more significant focus, but it may still present challenges for commercial partners, which can hinder collaboration. Over the past ten years this shift in emphasis among universities towards a more commercial and collaborative model between higher education and the commercial sector has made great strides but is an interface that can be slow and resource–intensive. The issue of who owns the IP created is often the key factor. University technologies are predominantly at a very early stage which in itself presents a challenge to adoption and makes negotiations on future IP value and ownership a difficult and protracted process.

Case Study: 8

SUPPORTING SMALL AND MEDIUM SIZED ENTERPRISES

"THE CHALLENGE FOR THIS AREA IS AROUND TIMEFRAMES AND RESOURCES. IT CAN TAKE UP TO FIFTEEN YEARS FOR AN SME TO GET AN IDEA FROM PROOF OF CONCEPT TO COMMERCIAL PRODUCTION. SUPPORT FROM BIG INDUSTRY CAN ASSIST IN SHORTENING THE JOURNEY BUT HISTORICALLY IT HAS NOT BEEN VERY GOOD AT WORKING WITH SMES, AND SMES FIND IT REALLY DIFFICULT TO WORK WITH BIG INDUSTRY – THEY HAVE VERY DIFFERENT DRIVERS, DIFFERENT CULTURES AND DIFFERENT TIMESCALES."

SMEs are deeply involved with accelerating new applications to market. Twelve months is not long for a big business but it is a significant period for an SME and can make the difference between success and failure. This is a major hurdle which some players in the sector are trying to address. Furthermore, changes to legislation have a huge impact on the work of SMEs and there is a lack of clarity and consistency here at a UK and EU level. This is an issue for SMEs across a range of industries but particularly when considering some of the specific challenges for developing new energy technologies.

Part of the challenge for SMEs is raising awareness about the specific issues they face. There needs to be a greater understanding and support for the SMEs involved in innovative green technology in the UK. UKTI does an excellent job abroad of promoting the idea that the energy industry is 'open for business'. They are pushing the 'UK Plc' message and the UK has a brilliant story to tell, but is not so good at selling this message internally. Additionally, there is currently a lack of risk appetite from public and private investors in the UK. In order to encourage further investment, investors essentially need better information and a lead from public investment funds. Innovation is an uncertain business and for private sector investors this is exacerbated by the technical nature of the products being developed.

If the UK does not push that boundary then it will not get the acceleration needed over the next 20 years. Essentially what is required is 'fail fast money'. Instead, at present we have a significant number of research projects unable to progress to commercialisation or indeed to a point where they can be proven not to be viable. For this development to happen there needs to be a change in culture – the risk appetite for public funds needs to be higher than both banks and private equity. It is commonly acknowledged that in the USA, for example, failure is a sign of a healthy innovation eco system, showing that the boundaries are being pushed and that "learning" is being generated from failures. Historical culture and the attitude of the general public, and the media in the UK, has created an environment that looks on failure negatively.

The best source for this support might be from large companies embracing open innovation as they have both the understanding and the impetus to invest in the innovation needed to help SMEs succeed. Increasingly, large companies are looking at all their supply-chains because they know they are vulnerable to its weakest link. Large companies are likely to increase their support to SMEs, as it helps the whole supply-chain and they have the capacity, as well as being best placed, to do so. This, coupled with an increased risk appetite from public funds, would go some way to creating a more positive environment for SMEs working on low carbon energy projects in the UK to flourish.

Industry and Parliament Trust

THE INDUSTRY AND PARLIAMENT TRUST

The Industry and Parliament Trust is an educational charity dedicated to promoting mutual understanding between Parliament and UK business.

Industry and Parliament Trust
Suite 101
3 Whitehall Court
London
SW1A 2EL

Visit us online: **www.ipt.org.uk**
Registered as a charity no 287527.
A company limited by guarantee, registered in England no 1308583