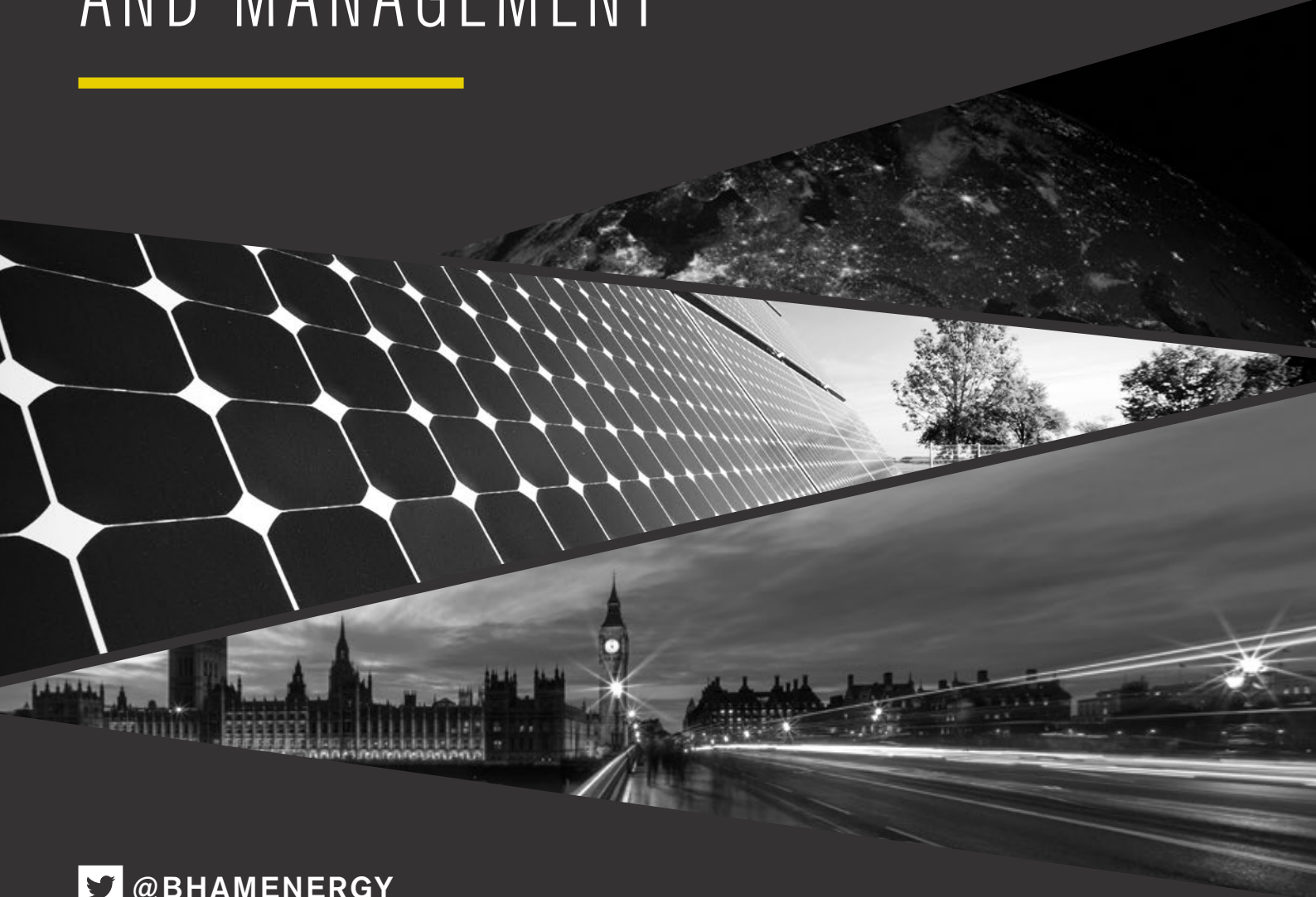


UNIVERSITY OF
BIRMINGHAM



BIRMINGHAM
ENERGY INSTITUTE

BIRMINGHAM CENTRE FOR ENVIRONMENTAL AND ENERGY ECONOMICS AND MANAGEMENT



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ABOUT THE BIRMINGHAM ENERGY INSTITUTE



**BIRMINGHAM
ENERGY
INSTITUTE**

The Birmingham Energy Institute is the focal point for the University and its national partners, to create change in the way we deliver, consume and think about energy. The Institute harnesses expertise from the fundamental sciences and engineering through to business and economics to deliver co-ordinated research, education and the development of global partnerships. By creating technology and guiding policy today, we aim to help shape energy solutions tomorrow.

We have over 140 academics engaged in energy and energy related research and development

The Institute is driving technology innovation and developing the thinking required to solve the challenges facing the UK, as it seeks to develop sustainable energy solutions in transport, electricity and heat supply. Co-ordinated research, education and global partnerships are at the heart of our vision.



BIRMINGHAM CENTRE FOR ENVIRONMENTAL AND ENERGY ECONOMICS AND MANAGEMENT

Building upon Birmingham Business School's established expertise in the field of environmental economics, the centre brings together individuals from a variety of disciplines to examine the complex relationship between economic activity, energy and the environment. The geographic scope of the centre's interests and activities are as global as the environmental issues themselves.

Aside from its focus on firm behaviour, EEEM also examines a range of subjects addressing the links between social and economic behaviour and the environment. These subjects are examined at multiple levels of analysis, incorporating individuals, firms, industries and nations.

ENERGY: THE GLOBAL CHALLENGE

The world is faced with many challenging questions to answer about our future energy supplies. Where will our energy come from? What energy vectors will we use to store and transport energy? How will we use and consume energy in the future? In answering these questions, due consideration must be given to global competition for scarce resources. Furthermore we need to consider the need to live within our environmental constraints. The latest global goals for decarbonisation coming from COP21 will surely influence our future energy mix. Closer to home our attention is drawn to local environmental issues such as air quality and the impact of waste.

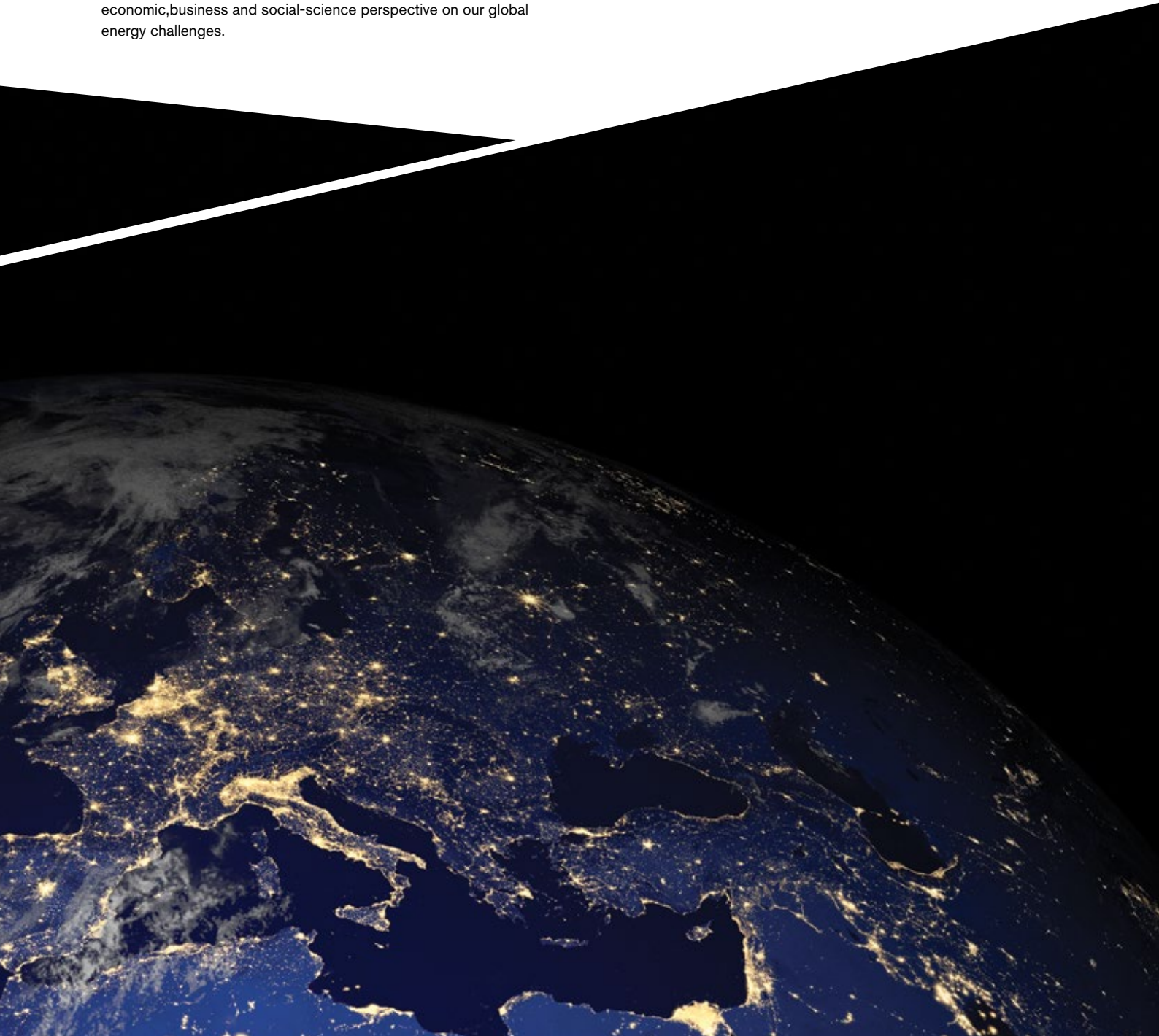
The solutions to our energy challenges are not only technical, but also informed by business, economics, law and policy. The Birmingham Centre for Environmental & Energy Economics & Management complements the University of Birmingham's expertise in energy technologies by providing a complementary economic, business and social-science perspective on our global energy challenges.



The Government has confirmed a £60 million capital investment in the Energy Research Accelerator (ERA). Together with private sector and university support the decision unlocks £180 million total investment in the Midlands region.

The Energy Research Accelerator (ERA) will tackle some of the biggest challenges facing the global economy by transforming research and development in three critical areas of energy: Thermal, Integrated Systems and Geo-Energy.

The core objectives of ERA are to make better use of primary resources, bring about smarter energy systems, reduce our dependence on importing energy, enhance energy security and resilience, and help achieve the UK's carbon reduction targets.



THE ENERGY EFFICIENCY OF FIRMS

WHY ARE SOME FIRMS GREENER THAN OTHERS?

On top of increasingly stringent regulations, there is also growing corporate social responsibility for firms to 'green up', but some companies are – or appear to be – more environmentally friendly than others.

Our researchers have conducted a number of cutting-edge studies – looking at companies around the world, from Ghana to Japan – to discover more about why this might be. The results provide a deeper insight into how businesses can achieve increased energy efficiency.

Outsourcing: In recent years there has been a dramatic rise in the number of firms shifting stages of their production processes overseas. We have investigated whether firms outsource the pollution-intensive stages of production to countries with laxer regulations in order to appear greener and to minimise domestic environmental costs – and we've found evidence to suggest that this is the case. There's a bigger issue too: that pollution can appear to be reducing in certain countries, when in fact it's only being shifted elsewhere.

Environmental spillovers: We have found that domestic firms in developing countries can benefit from contact and trade with international firms. This 'spillover effect' – which includes energy efficiency – is due to foreign-owned firms being more likely to implement environmental management systems, and the presence of foreign-owned firms in those sectors from which a company is buying being more likely to encourage good environmental practice. We have also investigated whether firms based in the developing world that are run by overseas-trained management are 'greener', and our econometric results suggest that the foreign training of a firm's decision-maker does reduce fuel use.

Spatial clustering: Our research has found that firms can learn from the behaviour of neighbouring companies: 'Spatial clustering' can encourage similar ways of working – including more energy-efficient practices and a reduction in pollution emissions – through sheer imitation, networking contacts and 'yardstick competition'.

Dirty money: We have looked at whether there is a wage premium for working in a pollution-intensive industry, and the answer is that there is – but an extremely small one: Our results for the economy as a whole suggest a wage premium of about one-quarter of one per cent associated with the risk of working in a dirty job.

Green jobs: Green growth is increasingly being seen as a means of simultaneously meeting current and future climate change obligations and reducing unemployment. We have examined how the provision of green goods and services has affected various aspects of the US economy. A key finding is that industries that increased their provision of green goods and services grew more slowly, reduced their expenditure on technology inputs and increased their demand for medium-educated workers, while at the same time reducing their demand for low-skilled workers.



GREENING BUSINESS

BIG BUSINESS FACES A CONUNDRUM: HOW TO REDUCE ENVIRONMENTAL IMPACT WHILE CONTINUING TO BE SUCCESSFUL? HOW TO BECOME MORE ENVIRONMENTALLY EFFICIENT TO OFFSET THE NEED TO USE MORE RESOURCES?

Our research covers business ethics and corporate social responsibility, exploring firm-stakeholder relationships, the strategic management of these, and their impacts on company performance and reputation.

One of our research themes is 'green-washing' – where businesses articulate lofty environmental aspirations but often fail to achieve their goals. Why does that happen? Is it because big business isn't really committed to conserving the environment, or is the delivery of environmental objectives more complicated than they imagined?

We examine questions of strategy and implementation in relation to how businesses pursue – or fail to pursue – a green agenda, and look at the role played by voluntary environmental standards. Does it make a difference, for example, if you sign up to UN Global Compact?

Keeping your own house in environmental order is one thing, but most big businesses operate beyond their own borders – so we look at how firms (which rarely do everything in-house) manage environmental impacts associated with the goods or services they buy from their value-chain partners. Increasingly, big companies are held responsible for the wider impacts of their operations, yet it is difficult to manage accountability, visibility and traceability across value-chains. How can multinationals be sure that, somewhere along the line, they're not polluting rivers in India with chemical dye or harming orang-utans in Sumatra?

Research suggests that very few businesses have accounting systems that allow them to understand their environmental impact and the risks to their current and future profitability of unsustainable business practices. The absence of evidence on how much poor eco-efficiency practices

and corporate social irresponsibility costs is a major obstacle to the greening of business. Another obstacle to change is the absence of evidence as to the value to businesses of improved eco-efficiency and corporate social responsibility. Greening business requires greening the accounting system and improving corporate accountability. Researchers in the Business School are investigating how innovative accounting techniques can translate big ideas such as climate change, biodiversity and sustainable development into everyday business practices.

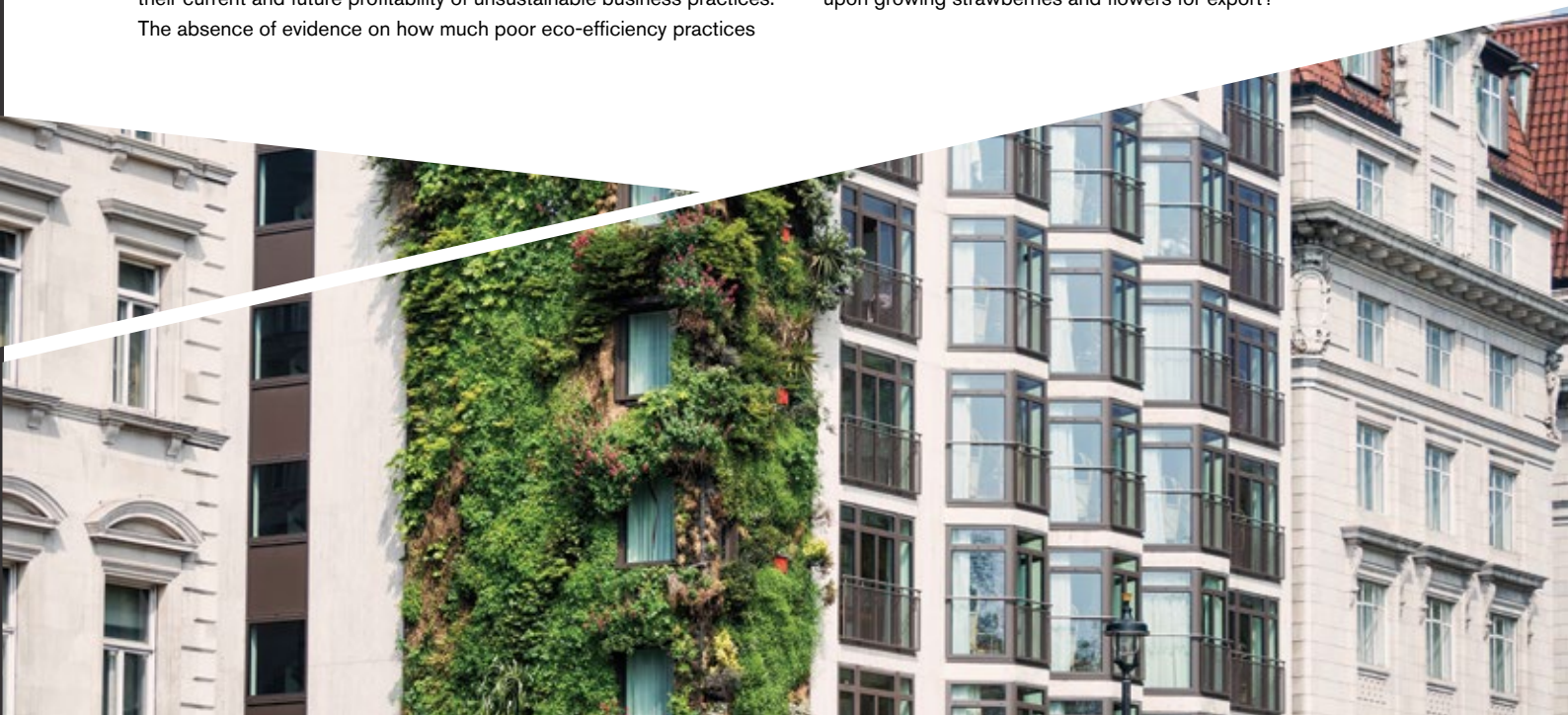
The University has recently completed two large-scale international comparative projects on how public bodies and private companies embed social responsibility within their supply chains, and a HEFCE-funded project on embedding principles of social responsibility in management education.

A common cry of big companies is that they are 'giving the customer what they want', so should we be looking to create a 'new normal' – where the greener option is the preferable, even the automatic, choice?

Already there is evidence of 'choice editing', where businesses help customers make greener or more socially responsible choices: Fizzy drinks manufacturers are increasing their range of low sugar products to attempt to reduce people's sugar intake; car manufacturers are offering more hybrid options.

But who, ultimately, is responsible for corporate greening: the companies themselves, their value-chain partners or the public who buy from them? A carmaker might do all it can to reduce its carbon footprint, but that footprint is tiny in comparison to the value-chain footprint, and insignificant compared to the customer who drives the car around.

Greening big business is complicated further by issues of social responsibility to value-chain partners in developing countries. If supermarkets stop selling strawberries at Christmas and flower wholesalers dispense with Kenyan-grown blooms, what happens to those people whose livelihoods depend upon growing strawberries and flowers for export?



INTERNATIONAL BUSINESS

MONITORING THE GREAT WALL OF CHANGE IN CHINA

China's industrial revolution, like Britain's before it, has been powered by coal – and on an unprecedented scale, making the country the biggest emitter of greenhouse gases on the planet. Yet in 2014, for the first time in 15 years, the country's fossil fuel consumption fell by nearly three per cent.

At the same time, there has been a marked shift in China's environmental policy: it is now the world's biggest investor in renewable energy, particularly in power generation from sources such as solar and hydro.

One of the constraints in China has been access to finance – particularly among private sector companies – to fund investment projects to improve energy efficiency. Now, however, the China Banking Regulatory Commission has issued green credit guidelines, which should make it easier for companies to become more environmentally friendly.

While the pace of change in China is slow – not least because of the challenges of coordinating local and national government policies – the path of economic growth has taken a new turn, towards energy innovation and new technology.

Here at Birmingham, we are playing a key role in monitoring the changes and helping to shape the future of China – and the rest of the world – by carrying out leading-edge research related to the three Es – energy, environment and economy:

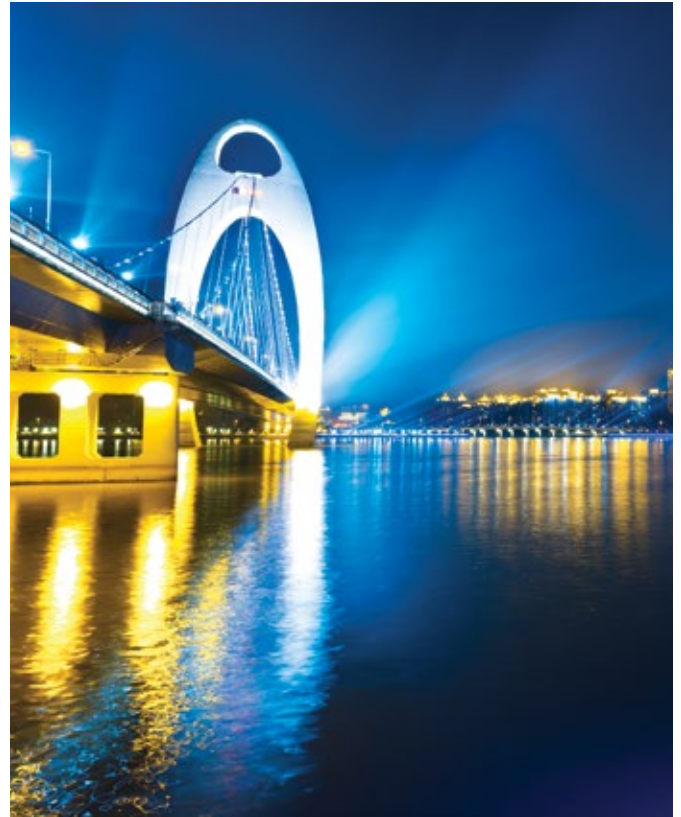
- A book, *Energy Security and Sustainable Economic Growth in China*, co-authored by academics in Birmingham, provides a unique study of the Chinese energy market at both national and provincial levels, covering issues such as energy security, institutional reforms, international relations, and environmental implications now and in the future.
- We have investigated the impact of foreign entry on the gasoline retail market in China, finding that the arrival of Royal Dutch Shell reduced the average price of gasoline by up to five per cent
- Our academics have examined the direct and indirect effects of the migration of the rural population into already overcrowded urban areas, which has potentially important implications for China's energy use
- We have looked at whether economic growth in China could be constrained by the physical development of the energy distribution network.



THE UNIVERSITY OF BIRMINGHAM'S CHINA INSTITUTE HAS BEEN CREATED TO REFLECT THE UNIVERSITY'S EXTENSIVE ACADEMIC ACTIVITIES OUR COLLEAGUES UNDERTAKE IN CHINA. BIRMINGHAM MAINTAINS LONGSTANDING LINKS WITH CHINA AND THIS PROVIDES MANY OPPORTUNITIES FOR COLLABORATIVE RESEARCH.

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**CHINA
INSTITUTE**
中国学院



THE BIRMINGHAM ENERGY INSTITUTE SEEKS TO ENCOURAGE INTERNATIONAL COLLABORATION AND PARTNERSHIPS. THERE IS A CHINESE LANGUAGE VERSION OF ITS MAIN BROCHURE, WHICH CAN BE ACCESSED AT:
WWW.BIRMINGHAM.AC.UK/ENERGY-CHINA



MAKING WAVES IN AFRICA – BUT IS HYDROPOWER THE ANSWER?

Africa's economy has enjoyed a period of rapid expansion in recent years, yet an estimated two-thirds of the population still has no access to electricity. One proposed solution to the energy problem in Africa is to significantly increase investment in hydropower, which – it is argued – is clean, reliable and affordable.

But is it? We have carried out extensive research into Africa's growing reliance on hydropower in the light of climate change-induced unpredictability of rainfall and the potential power outages this may cause. If changing rainfall patterns lead to reduced river flow, then the price of energy may rise and power failures become more prevalent, resulting in significant costs to the African economy.

Although our findings point to current plans for African dam-building being fairly well matched with river-flow predictions – meaning fears that international donors and national governments are making a series of

expensive and environmentally damaging investments may be overstated – a paper written by Birmingham academics explains that predictions of less rainfall and more extreme weather events for certain countries in Africa throw into question the viability of certain planned hydropower investments.

Industrialisation is seen as a key driver to economic success to countries with rural-based economies, and among the factors deemed important to bring this about is infrastructure: energy, in particular water, is vital for industrial production as well as transportation.

Our academics are examining the international aspects of energy security, particularly in developing and newly industrialised countries, and how economic growth affects energy distribution.



LAYING DOWN THE LAW ON GREEN ENERGY?

MANY PEOPLE ESPOUSE ENVIRONMENTAL CAUSES, BUT WE ARE GENERALLY SLOW TO CHANGE OUR BEHAVIOURS AND RELUCTANT TO BEAR THE COST OF MOVING TO GREENER, RENEWABLE ENERGY SOURCES. HOW DO WE INCENTIVISE PEOPLE TO BUY IN TO THE LONG-TERM ENVIRONMENTAL VISION WHILE PROMOTING ENERGY SECURITY?

Although in 2014 global carbon emissions did not rise, this achievement leaves us far short of a much-needed reduction in greenhouse gas emissions. The world cannot presently agree on binding carbon reduction targets. Nevertheless, the climate change imperatives are clear, so that it becomes vital to determine what sort of incentives or governance structures we want in place to accelerate the decarbonisation of energy.

Are we prepared to make immediate financial sacrifices, such as decommissioning coal in our energy mix, in order to bring about long-term benefits, not least from taking a lead in the development

of clean technologies? Might we be prepared to invest in the likes of carbon capture systems or novel modes of energy storage?

There are many other issues surrounding energy and the environment, and all have a legal aspect to them. For example, researchers in Birmingham Law School have written a book on food regulation in Europe, and is currently working on the socio-economic aspects of harvesting and developing pharmaceutical products from marine sponges (funded by Marie Curie) and – on behalf of the WWF (UK) – a review of sustainability duties in the UK.

Academics in the School of Law work with a wide range of government departments and public sectors in the UK and Europe – including the European Parliament, the European Commission and the House of Commons – to advise on future developments. We also carry out research projects on the legal impact of proposed change, such as the regulation of nanotechnologies for the UK Department for Business, Innovation and Skills and the Department for Environment, Food and Rural Affairs.

Our researchers, then, operate at the cutting edge of environmental law and are well placed to help shape the greener world in which we want to live.



ENGAGING WITH THE POLICY MAKERS

SHAPING ENERGY & ENVIRONMENTAL POLICY

All economic wealth ultimately derives from the environment.

For the purposes of energy and environmental decision-making, an important challenge is to understand the links between the economy and the environment.

UK environmental policy covers a raft of issues, from agricultural and energy externalities to floods and landfill. Formulating policy is a scientifically complicated, interdisciplinary endeavour.

Our energy policy is similarly complex, given concerns both about the environment, the economy and security of the nation's energy supplies. Our research and expertise contributes to energy and environmental policy debates: For example, we have drawn awareness to the fact that along with stocks of natural capital (such as fish and oil), we also have stocks of waste (such as landfill and nuclear waste) that need to be included in any analysis of sustainable development.

If the UK is to meet its challenging climate change targets, there is a need for greater understanding of the relationship between government expenditure programmes and carbon emission levels. University of Birmingham academics have been working with Scottish Parliamentary committees to further develop the Scottish Government's Carbon Assessment of Government Spending to improve the quality of parliamentary scrutiny in relation to climate change.

**'OUR ACADEMICS ARE HELPING TO DEFINE
TECHNOLOGY ROADMAPS AND POLICY OPTIONS
TO INFORM OUR FUTURE ENERGY POLICIES.'**

PROF MARTIN FREER

DIRECTOR OF THE BIRMINGHAM ENERGY INSTITUTE

In the West Midlands, there are hundreds of historical landfill sites and these represent enduring sources of disamenity, inasmuch as they exert a depressing effect on house prices.

Analysis of house price differentials makes it possible to derive an estimate of the costs of landfill disposal, which is an important component of any rational system of dealing with waste.

Weighing up the economic costs and benefits also applies to the problem of flooding: Research carried out at Birmingham includes evaluating the advantages of flood prevention by examining the impact on house prices in the vicinity of flood relief infrastructure. The hope is that this work will provide a better estimate of the benefits of flood relief projects than we have at present.



INDUSTRY AND PARLIAMENT TRUST

In September 2014, we collaborated with the Industry and Parliament Trust (IPT), an independent, non-lobbying, non-partisan charity that provides a trusted platform of engagement between Parliament and UK business, to launch the Sustainability Commission. Co-chaired by Birmingham's Professor Steve Brammer and MP Caroline Spelman, the aim of the Commission was to explore how businesses across the UK were approaching the challenges of creating a sustainable business model.

The Commission's report, published in February 2015, found that leading businesses were 'benefiting hugely' from their engagement with sustainability, while also concluding that:

- Business has an absolutely central role to play in achieving a prosperous, socially just, and environmentally sustainable future
- Government should play a central role in supporting broader and deeper engagement with sustainability through creating an improved enabling infrastructure
- Greater collaboration across industry, and between business, government and civil society organisations is essential to advancing sustainability
- Companies can and should encourage sustainability and co-operation across their supply chain
- Capital markets must be reformed to encourage sustainable behaviour
- In particular, Governments can encourage integrating sustainability reporting by...players in the financial market supply chain that ensure environmental and social costs are internalised into profit and loss statements.

Made up of a collection of parliamentarians and representatives from industry and academia, the Sustainability Commission is a notable example of our engagement with policy makers at the highest level.

COLD COMMISSION

The 'cold economy' is crucial to modern society; without it, the supply of food, medicine and data would, quite simply, collapse. Cold is also vital for many other applications, including air conditioning, super-critical technologies and freezing and powdering materials for recycling and easy disposal.

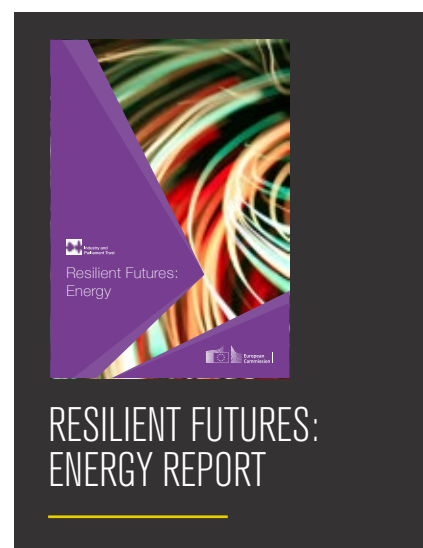
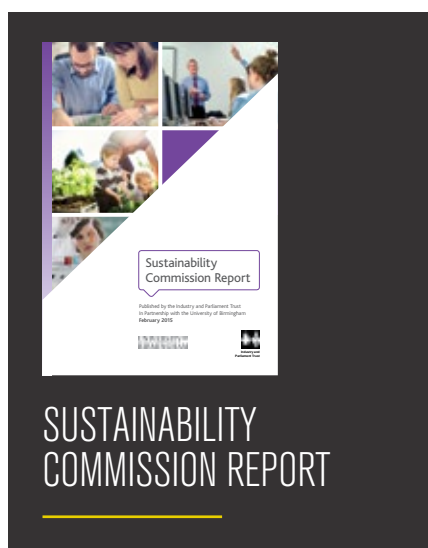
Yet the process of cooling to ultra-low temperatures currently consumes vast amounts of energy and causes a great deal of pollution. At the same time, a lot of cold energy is going to waste, especially with the re-gasification of liquefied natural gas. Natural gas is 'packaged' in cold to condense it for transport by sea, but the packaging is usually thrown away when it is re-gasified at important terminals. Yet it could be recycled to provide zero-emission cooling and power in a wide range of static and mobile applications.

In 2015, the Birmingham Energy Institute launched a Policy Commission, entitled Doing Cold Smarter, to look at cold at a system level, and how to combine the growing demand with the large amounts of waste. This approach would cut energy consumption, greenhouse gas emissions, toxic air pollution, waste and cost.

In emerging economies it could also help to reduce high levels of post-harvest food loss, which in turn would conserve water, land and energy, improve farmers' incomes and stimulate trade and growth without harming the environment.

Birmingham Policy Commissions bring together leading figures from the public, private and third sectors, along with Birmingham academics, to generate new thinking on contemporary issues of global, national and civic concern. Among those appointed to the 'cold commission' is Toby Peters, Visiting Professor of Power and Cold Economy at Birmingham.

Summarising the need for the Policy Commission, he said: 'As the need for cold across the globe rapidly increases – with rising demand for air conditioning, industrial and medical cooling, refrigerated food storage and transport – a new sustainable approach is required to the way cold is provided.'



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