Can the UK meet its energy demands and drastically reduce emissions? If anyone knows, it's the director of the UK Energy Research Centre, **Jim Skea**.

Finding the energy

Are we able to reduce our carbon footprint without compromising our quality of life? Will new forms of sustainable energy keep the lights on? And will fiercely contested energy markets allow it all to happen? These questions are all part of the challenge that the research councils set the UK Energy Research Centre (UKERC) when it started in 2004. The charge was to take a whole systems, integrated approach to energy research, drawing on scientific, technical, environmental, economic and social perspectives.

For the 75 researchers who have embarked on this adventure, inter-disciplinarity is not an abstract academic aspiration. These tough questions can't be addressed unless people from different disciplines share their perspectives and apply themselves to common tasks. For example, connecting new sources of energy, such as wind, to an electricity system requires investment in new infrastructure. Engineers have a critical role to play here, but in a competitive energy market, engineering isn't enough. People need to design the market structures and incentives that will drive investment. Within UKERC, engineers have started to think in terms of prices and markets, while economists have appreciated that you can't price away the laws of physics.

Our flagship project is UKERC Energy 2050 – an ambitious effort to envision an energy system which meets our long-term needs for sustainable and reliable energy. We are also looking critically at the hard choices that the UK must make. Sometimes the same policy or technology will reduce carbon emissions and improve energy security, such as energy efficiency, renewables and nuclear power. In other circumstances, there may be a tension between security and climate change. For example, investing in coal-fired power stations may well improve energy security, but the climate change impacts will be negative unless the station is fitted with expensive carbon capture technology – yet to be proven on a commercial scale.

To help us pick our way through this maze, the UKERC Energy 2050 project relies on a set of scenarios for the UK energy system. Each scenario contains assumptions about technological change, people's behaviour and the availability of various forms of energy. They provide a set of common storylines to which people working in different disciplines can relate. The scenarios represent possible futures for the UK energy system. They are not predictions of what we believe to be the most likely outcome. Locking into a single forecast will not help us plan against uncertain developments, such as the evolution of global energy markets, over which we have no control.

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Our core scenarios focus on carbon-emissions reductions, specifically the UK's current target of reducing carbon emissions by 60 percent by 2050. But we are also considering scenarios that enable us to explore other issues. For example, one set of scenarios considers how to accelerate the development of new energy technologies and improve existing ones. Our computer models can be used to assess the long-term benefits of technologies with lower costs and better performance. Meanwhile our technologists and engineers are developing roadmaps which identify the steps that need to be taken to secure these benefits. These will include meeting certain research and development challenges as well as putting in place policy measures, such as a renewables obligation on electricity suppliers, which help to pull technologies onto the market.

We are also considering the role of behaviour and lifestyle change in reducing energy use. This is a particularly difficult challenge. Social scientists have developed a good understanding of how behaviour change occurs, for example, how our evolving sense of what is 'normal' in terms of comfort and cleanliness affects energy use in the home. But this understanding is largely qualitative. Policy-makers are increasingly setting hard quantitative targets for carbon emissions. It is difficult to assess whether and to what extent behaviour change can contribute to meeting these targets. The scenario approach adopted in UKERC Energy 2050 provides a mechanism for communication between

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quantitative energy modellers and a wider group of social scientists.

The energy system has a profound impact on the natural environment, not only on the climate, but also on atmospheric pollution, water and land use. We are exploring the impacts of each of our scenarios using an environmental impacts matrix which captures the consequences of energy use. The implication of increasing bio-energy use is a key issue which is rapidly rising up the political agenda. But the interaction between the energy system and the environment is not all one way. In response to environmental concerns, policy-makers may curb outright exploitation of some forms of energy. For example, fears about landscape changes may halt some onshore wind farms. Or broader ecological concerns could thwart the race for oil and gas reserves in the Arctic. We are exploring the consequences, in terms of cost and the attainability of our climate policy goals, of doing without certain energy supplies.

Finally, we are examining the complex question of energy security by hypothesising a set of sideswipes to our core scenarios. We take a defined collection of adverse events – such as the loss of important sources of supply, or damage to critical pieces of energy infrastructure – and work through the consequence for consumers in terms of cost and availability of supply. We do this with one 'normal' energy system and another 'resilient' energy system.

Energy security is about much more than reducing our dependence on imports. We define our 'resilient' energy system using a broad set of indicators which includes diversity of supply, increased efficiency by customers and a hardened infrastructure of wires, pipes and storage. This resilient energy system is inevitably more expensive. The key question we are addressing is the balance between the costs and benefits should we face energy supply sideswipes in the future.

The UKERC Energy 2050 project has proved to be an enormously challenging but, at the same time, stimulating effort. Running alongside UKERC's more conventional research, it has brought a sharper focus to the whole system of interdisciplinary work that we were set up to do. The urgency and pace of climate and energy policy-making have accelerated in the UK. Our message for policy-makers is that the means are available to work towards the ambitious goals that have been set. But it won't be easy and we will need a variety of measures, influencing both technological development and people's behaviour. Well-designed measures need the kind of evidence that the UKERC Energy 2050 project will deliver. ✿

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UKERC was established in 2004 by NERC, the Engineering and Physical Science Research Council and the Economic and Social Research Council and is collaboration between nine main academic institutions and research centres with a headquarters at Imperial College.

More information
www.ukerc.ac.uk.