

## Energy and climate change – time for hope or concern?

**Some recent developments in the energy and climate change fields, both in the UK and internationally, have given rise to optimism while others are major cause for concern. Martin Quick investigates.**

International climate negotiations are proceeding at a snail's pace, and the US President is struggling to get new legislation on climate change through congress. But the global renewable energy industry is booming as new studies highlight its current and future potential. Added to this, the new UK government claims it will be the 'greenest ever'. Among these conflicting indicators, where are things really moving?

### Assessing UK and European energy resources

A major UK study,<sup>1</sup> *The Offshore Valuation*, coordinated by the Public Interest Research Centre, involving government departments and industry, shows the huge potential for renewable energy from the UK marine environment, mainly from offshore wind. A scenario exploiting just under 30% of the resource could, by 2050, produce energy equivalent to that extracted from North Sea oil and gas, and make the UK a net electricity exporter. The higher output scenarios assume strong grid connections to mainland Europe and technologies that provide energy storage, to cater for intermittency (see *Roadmap 2050* below). The net present worth (NPW) – the value to the nation of the energy generated minus the costs, relative to not exploiting the offshore resources, and brought back to a common date by a notional discount rate – is evaluated for different scenarios. The NPW is positive except in cases where future energy prices are assumed to be very (unrealistically?) low. Where energy prices are high, the NPW is large, up to more than £300 billion.

The European *Roadmap 2050* has been produced by a group of energy experts funded by the European Climate Foundation.<sup>2</sup> This study develops a number of scenarios for an 80% reduction in CO<sub>2</sub> emissions in Europe by 2050. Major improvements in energy efficiency are fundamental to the concept. Long distance grid interconnections (including high voltage DC links with their very low power losses over long distances) are needed to link the energy sources to centres of demand. To allow for industrial and other uses that cannot be completely de-carbonised, the study assumes virtually complete de-carbonisation of electricity production, by scenarios with different combinations of renewables, carbon capture and

storage (CCS) and nuclear power, including a scenario of 100% renewables. A variety of renewable sources is assumed, including a major contribution from solar energy in southern Europe and a large wind capacity (onshore and offshore) in the north. A high degree of electrification of heating and transport is assumed. Off-peak charging of electric vehicles, and heat-pumps with hot water storage on a community or district scale can provide energy storage and demand shaping to ease the incorporation of a high proportion of intermittent renewables. Proposals of this kind, including some with links with North Africa, have significant support within the various EU institutions.

The Centre for Alternative Technology has published an extended and updated version of its report *Zero Carbon Britain*.<sup>3</sup> This proposes developments that could make the UK a net zero carbon emitter by 2030. Unlike many other reports, it starts by assessing how to bring down energy consumption before considering how this demand could be met by low carbon methods of energy production. It has a significant section on land use and agriculture, an important sector when one is aiming at such a stringent target. The report also discusses methods of changing public attitudes, necessary to achieve the lifestyle changes involved. To make the huge changes in energy and transport infrastructure proposed within 20 years is an extremely ambitious target, but something of this order is needed if we really are to reduce the risk of severe climate change.

There is a large degree of overlap between these studies. They would require massive changes to energy infrastructure and have high upfront costs, but would lead to long-term benefits, not only in relation to greenhouse gas emissions, but also for the economy and international security in a world where oil is likely to be in very short supply. The German Ministry of Defence has produced an assessment of the risks in a post 'peak oil' world, indicating the likelihood of conflicts and breakdown of societies if the world has not moved substantially away from dependency on oil and gas.<sup>4</sup> The UK Ministry of Defence and the US Pentagon have similar concerns in relation to both resource shortages and severe climate change.

In order to meet the targets for greenhouse gas emission reductions that these reports aim at, it is essential that action is taken early. This will require a major effort to persuade populations to support the huge changes needed – not least in a European context, where major power-line routes would be

needed in sensitive areas like the Pyrenees. Given the wide range of objectives to be met, changes to the way projects are implemented and financed are likely to be needed to create an overall system that delivers the necessary results – pure reliance on market forces is very unlikely to deliver.

### Energy cost trends and alternative sources

Any study looking over such a long timescale is bound to have major uncertainties in the relative costs of different scenarios. The cost of wind turbines (especially offshore) has recently increased due to bottlenecks in the supply chain. In the past few years, the capital costs of nuclear power stations have grown considerably. For example, up until recently in the USA, construction costs were being quoted by industry sources at \$2,000 per kilowatt (kW), but more recent analysis suggests that the real figures could be as high as \$8,000/kW.<sup>5</sup> This makes it much less likely that any new nuclear programme in the UK could meet the government's stated criterion of no public subsidy. Timetables and costs for the completion of nuclear plants in countries outside East Asia have been considerably extended. The cost of photovoltaic electricity generation is falling rapidly with new technologies and greater supplies of high purity silicon. In some areas with high levels of sunshine, utility scale installations are being constructed.

Meanwhile, the BP Deepwater Horizon oil rig disaster in the Gulf of Mexico has starkly shown the risks of 'unconventional' oil extraction from hard-to-reach reserves, as easily accessible sources become depleted. The environmental impact and high energy use in extracting oil from tar sands is also well known. Even exploiting conventional reserves can cause major problems. In the Niger delta, it is estimated that, on average, oil equivalent to the Exxon Valdez spill has leaked every year and, combined with flaring, has caused massive health problems for the local population.<sup>6</sup> Overall, particularly if the industry has to clean up its act or is prevented from operating in environmentally sensitive areas like the Arctic, it is likely the price of oil will escalate in the near future.<sup>7</sup>

There is a somewhat different picture for natural gas, where extraction of 'tight' gas from shale deposits in the USA is extending the resource base.<sup>8</sup> However, there is some opposition to this, due to concerns about pollution of underground water resources. Exploration of the potential in the UK and mainland Europe is now underway.

Although natural gas is the least carbon intensive of the fossil fuels, most assessments of climate change risks indicate that the need to limit greenhouse gas emissions is a tighter constraint than the ultimate availability of oil and gas. Hence, even if gas supply does become more abundant in the medium term, increasing dependence upon it could still help to push global temperatures to dangerous levels. Furthermore, it should be remembered that significant gas reserves lie in politically unstable parts of the world, so access is less than certain.

Carbon capture and storage – where the exhaust gases from carbon emitting plants are ‘captured’ and then piped to underground storage facilities – continues to be developed towards large-scale commercial operation. However, this development still seems likely to be lengthy. CCS involves significant extra costs and loss of efficiency, although innovative technologies might minimise these. The UK government has recently scaled back its plans for CCS demonstration plants (see below).

For some years, there have been claims that there is huge potential for oil extracted from algae, with very large production from a given area – side-stepping many of the problems related to conventional biofuels. Cultivation in open ponds would seem to be the cheapest method, but this has the problem of the desired species becoming contaminated with unwanted plants. The alternative is the use of isolated ‘bio-reactors’ designed to maximise the exposure to sunlight of the algae ‘soup’, and with the possibility of enhancing production by fertilising the plants with carbon dioxide from power plants. Many of the trials have so far run into problems of harvesting. However, there is growing interest among a range of influential oil users, not least the US military,<sup>9</sup> so development may speed up.

## Climate negotiations and global rivalries

The outlook for reaching international agreement on further curbs on greenhouse gas emissions continues to look doubtful. The very limited agreement at Copenhagen in December 2009, after such intense negotiations, has led to a major loss of diplomatic momentum in the months since. The Cancun negotiations a year later only made limited further progress. A key problem continues to be the severe difficulty in passing legislation through the US congress to curb emissions. Without such legislation, President Obama is unwilling to sign up to legally binding targets at an international level. China, in turn, will not sign up to targets without the USA – especially as its emissions per head of population are considerably lower. With the two biggest carbon emitters at an impasse, the outlook for legally binding international targets does not look good in the near future.

However, there are developments within both the USA and China that give more reason for hope. Obama’s \$150 million clean technology fund is helping to support developments in renewable energy. Meanwhile, China is surging ahead with the development and deployment of renewable energy.<sup>10</sup> China is now the world leader in the production of wind turbines, solar photovoltaics, and solar hot-water panels, and is making substantial efforts to improve its rather low levels of energy efficiency. Renewables now account for 9% of the country’s total primary energy use – a considerably higher proportion than in, for example, the UK. Notably, a significant fraction of China’s emissions is due to the embodied energy in products exported to wealthier nations. Hence, decisions on economic policies and lifestyle in, for example, the USA, UK and mainland Europe can have a significant effect on the total emissions of China.

## Is the UK on track?

In the last few months, there have been a whole range of important developments related to the UK’s low carbon sector. In September, the world’s largest offshore wind energy development – the 100-turbine Thanet wind farm – opened off the Kent coast.<sup>11</sup> With this, the UK’s offshore wind capacity became the largest in the world. Meanwhile, Scotland is on course to exceed its target of generating 31% of its electricity from renewable sources by 2011, prompting the government to revise its 2020 target to 80%.<sup>12</sup>

However, the UK as a whole has still a long way to go to meet its targets for expanding renewable energy, improving energy efficiency and reducing greenhouse gas emissions. The coalition government’s comprehensive spending review provided some good news and some bad news.<sup>13</sup> A £200 million fund for developing low carbon technologies – especially measures to help offshore wind – was retained. The Feed-in Tariff and Renewable Heat Incentive – which support small-scale renewables – were also retained. However, plans for a ‘Green Investment Bank’ were much less ambitious than is needed. Only one of the originally proposed four CCS demonstration plants will receive funding in the short-term. Also disturbing was the announcement of large cuts to spending on ‘Warm Front’ home energy efficiency measures. However, new legislation to improve energy efficiency and energy security markedly is being proposed.<sup>14</sup>

## Concluding comments

It is important to remember that the low carbon economy offers enormous potential, not only for major improvements to energy security and large reductions in carbon emissions, but also for generating employment in these economically straitened times. The UK is finally starting to reap this potential, but the government and public commitment over the next few years will be crucial.

**Martin Quick CEng is a retired mechanical engineer who worked in the energy industry. He is also a former member of SGR’s National Co-ordinating Committee.**

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## SGR Conference and AGM 2011

### Emerging technologies: are the risks being neglected?

Saturday 21st May 2011

Alan Baxter and Associates’ Gallery, Farringdon, London EC1

As in previous years, the event will feature invited speakers and a poster session.

If you would like to present a poster, please contact the SGR Office (details on back page) for more information.

Full details of the event and a booking form will be sent to members nearer the date. In the meantime, for the latest information, please see:

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On 16 December 2010, the UK government announced new proposals for reforms to the electricity market, designed to accelerate the introduction of low carbon energy – see: <http://www.decc.gov.uk/>

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(web links correct as of 1 December 2010)

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## Census 2011 – who will have access to the data?

**With a subsidiary of major arms company, Lockheed Martin, being a lead contractor for the UK's 2011 census, Geoff Meaden asks if the data collected will really be secure.**

In March 2011, Britain's once-a-decade national census will be carried out. The aim is to record a wide range of information on every person in every household in the United Kingdom, in order to help guide provision for local and national public services. To this end, the census is compulsory. A little-known fact about the census, however, is that the main contract, including data capture, was won by a subsidiary of US corporation, Lockheed Martin, which also helped with the 2001 census.<sup>1</sup> Lockheed Martin is the world's second largest weapons manufacturer<sup>2</sup> and makes Trident nuclear missiles for the USA and UK. It also holds a one-third share in the management contract for Britain's Atomic Weapons Establishment (AWE) at Aldermaston, which is undergoing redevelopment as the government pushes towards replacing its nuclear weapons system. A recent growth area for Lockheed Martin has been 'intelligence and surveillance' and, as part of this work, the company has moved into data collection. Vice-President, Lorraine Martin is reported to have said, "We want to know what's going on anytime, any place on the planet".<sup>3</sup>

There are serious concerns that the data gathered by the census may fall under the US Patriot Act if a US-owned company is involved in its collection and, as

such, there would be a legal requirement for the company to make the information available to their government. Additionally, there is concern that the census information may be made more widely available in the USA, not only for law enforcement purposes, but also to private entities. We have no legal precedents as to whether, under the pretext of national security, this census information can be acquired by the US government. The UK Office of National Statistics claims that our data will be safe<sup>4</sup> but the UK government has demonstrated on several occasions lax security arrangements in the management of digital data containing personal records.

The data gathered by the ten-yearly census is easily the most comprehensive data set in the UK, and it is used extensively for various socio-economic purposes. During the 2001 census 6% of households in the UK failed to comply with submitting their household information.<sup>5</sup> This means that about three million people were 'unaccounted'. Given that there is significant distrust among people of British government connections to large corporations, having Lockheed Martin involved in gathering census information is hardly likely to encourage compliance. This will result in increasingly unreliable census data. One wonders how many US citizens would be happy for a British weapons manufacturer and surveillance company to collect their census data!

By contracting Lockheed Martin to do this work, what was a perfectly respectable and useful socio-

economic activity may now be perceived as part of the security world of intelligence and surveillance. There will be a range of ethical reasons why people may not wish to comply, from concerns about the security of their personal data to not wishing to boost the profits of a weapons manufacturer. So I hope that we in the science and technology communities will give support to people who do not wish to comply with the 2011 UK national census, and that we will campaign to get this contract terminated in the future.

**Dr Geoff Meaden has recently retired as Principal Lecturer, Department of Geographical and Life Sciences, Canterbury Christ Church University, Canterbury, Kent.**

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