Low-carbon, non-nuclear electricity scenarios for the UK

Over the last few months, proposals have begun to be put forward for new nuclear power stations and a new coal-fired power station in the UK. These are argued to be consistent with strategies to tackle climate change while maintaining energy security. Indeed, in its energy white paper (EWP) of 2007, the government explicitly argued that a new generation of nuclear power stations was needed1. But several detailed studies published in the last few years have highlighted alternative paths. In this article, I briefly outline three of the most comprehensive of those studies.

One of the key concerns stated in the EWP is that a large number of power stations are planned to close in the near future, and hence potentially there could be a shortfall in electricity supply. In 2007, 76 gigawatts (GW) of electricity capacity were connected to the national grid[2]. By 2020, the government estimates that 30% of this capacity (22.5GW) will be closed[3]. This lost capacity includes older coal and oil plants – closed in order to comply with new EU emissions regulations – and ageing nuclear power stations that will reach the end of their planned operating life. So how do the alternative scenarios tackle this potential shortfall? And what do they suggest for further into the future?

Pöyry study[4]

This study was published by Pöyry Energy Consulting, one of Europe's leading energy consultancies. It assessed six scenarios for the electricity sector up to 2030, the scenarios making different assumptions about energy demand and renewable energy policies. The key constraint was that the UK should meet its proposed EU target of supplying 15% of its total energy from renewable energy sources by 2020. The study used the EURENO model, which had been previously used to provide analysis for the government in drawing up its own energy strategy. The model explicitly takes account of the variability of renewable energy sources, such as wind and solar, to assess the ability of (for example) the national grid to meet peaks in demand.

The report concluded that the UK is capable of hitting its renewable energy target – requiring 35%–45% of electricity to come from renewable sources – and successfully implement its National Energy Efficiency Action Plan to reduce total energy demand. Under these conditions, the analysis indicates that *no* major new power stations (nuclear, coal or gas) would be needed to ensure that Britain can meet its electricity requirements up to at least 2020. Moreover, the report finds that this strategy would reduce the UK's CO_2 emissions by up to 37% by this time.

The study estimated that the total installed renewable energy capacity in the electricity sector in 2020 would be between 32GW and 52GW, of which around two-thirds would be wind farms (offshore and onshore). In just one of the six scenarios was there a slight dip below the desired 20% margin of spare power capacity (for coping with winter peak demand), and this was only short-lived. The authors argued that this could best be dealt with using demand-side management or by installing small 'top-up' peaking plants.

In the period after 2020 when more of the UK's existing coal and nuclear plants are due to close, the report observes that a number of further options could be deployed including more combined heat and power plants, further roll-out of renewables, and possibly carbon capture and storage.

Tyndall Centre study[5]

This study was published by the Tyndall Centre for Climate Change Research, one of the world's most influential climate research institutes. It models the development of the whole UK energy sector up to 2050. The key constraint was that the UK should meet its share of a global target to keep the atmospheric CO_2 concentration below 450ppm (parts per million). This, the authors note, implies a cut in emissions of 90% by 2050.

The results indicate that the emissions reduction target can be met with major near-term efforts to curb energy demand and large-scale R&D and investment in new technologies. Its emissions reduction targets are more demanding than those in the Pöyry study, and hence it argues that there will be a large role for carbon capture and storage technologies, so long as adequate major investment is made to make this technology widely available.

In terms of the electricity sector, the key changes that are projected up to 2030 are:

- a major expansion of renewable energy, especially offshore and onshore wind;
- a major expansion of carbon capture and storage, especially with coal-fired power stations; and
- a significant expansion of electricity demand, as transport energy comes increasingly from electricity rather than oil (due to, e.g., plug-in electric cars).

Zero Carbon Britain[6]

This study was published by the Centre for Alternative Technology in Wales, a leading education and research centre on green lifestyles and technologies. It proposes a detailed scenario for the UK whereby direct carbon emissions across the economy are reduced to zero over a 20 year period. Hence it is more ambitious than either of the preceding studies.

The scenario proposed in this report is based on measures that lead to a 50% reduction in total energy demand over the period, coupled with a major expansion of renewable energy. The huge reduction in energy demand is achieved through a combination of economics instruments – the main one being 'tradable energy quotas' – and technological improvements to support lifestyle change, such as better insulation, more efficient public transport, plug-in electric cars and 'smart' meters. The expansion of renewable energy is rather more rapid than in the studies above, with about 50% of electricity supplied by wind, 35% supplied by marine (tidal and wave) sources, and a few percent each for biomass, solar and hydro.

Concluding comments

These studies show that the goals of tackling climate change and improving energy security can be achieved without recourse to new nuclear power or large, new, unabated coal plants such as that currently proposed at Kingsnorth in Kent. The key condition is that major investments are made quickly in energy efficiency, renewable energy technologies and carbon capture and storage, supported by other policies to curb energy demand.

Dr Stuart Parkinson is Executive Director of Scientists for Global Responsibility. His background includes academic research on energy and climate issues.

References

1. Department for Trade and Industry (2007). Meeting the energy challenge – A white paper on energy. The Stationery Office, London. http://www.berr.gov.uk/whatwedo/energy/whitepaper/page39534.html
2. p127-129 of: DTI (2007) – as note 1.
3. As note 2.
4. Pöyry Energy Consulting (2008). Implications of the UK meeting its 2020 renewable energy target. A report to WWF-UK and Greenpeace UK. http://assets.wwf.org.uk/downloads/poyry_2020renewablestarget.pdf
5. Bows A, Mander S, Starkey R, Bleda M, Anderson K (2006). Living within a carbon budget. Report for Friends of the Earth and The Co-operative Bank. Tyndall Centre for Climate Change Research, University of Manchester. http://www.tyndall.ac.uk/
6. Centre for Alternative Technology (2007). Zero Carbon Britain – an alternative energy strategy. CAT publications, Machynlleth. http://www.zerocarbonbritain.org/