Centre for Climate Change Economics and Policy

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Decarbonising electricity generation

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E·S·R·C Economic & Social Research Council

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The Grantham Research Institute on Climate Change and the Environment was established in 2008 at the London School of Economics and Political Science. The Institute brings together international expertise on economics, as well as finance, geography, the environment, international development and political economy to establish a world-leading centre for policy-relevant research, teaching and training in climate change and the environment. It is funded by the Grantham Foundation for the Protection of the Environment, which also funds the Grantham Institute for Climate Change at Imperial College London, and the Global Green Growth Institute. More information about the Grantham Research Institute can be found at: http://www.lse.ac.uk/grantham/

Decarbonising Electricity Generation

Briefing note

Chris Duffy

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The power sector, the largest source of UK emissions, must be largely decarbonised by 2030 if the UK is to reduce emissions consistent with its statutory carbon budgets (see CCC, 2008). A low-carbon power sector is also important for the decarbonisation of the transport and heating sectors (the second and third largest sources of UK emissions, respectively) through their electrification. Other sectors, including agriculture, shipping and aviation, must also start to decarbonise, but emissions reductions in these sectors may be more difficult and costly than for the power sector. This briefing note summarises research by the Grantham Research Institute (GRI) on Climate Change and the Environment at the London School of Economics and Political Science, on key elements of power sector decarbonisation including: the policy regime, low-carbon technologies, grid upgrade requirements and the potential for innovation and growth.

1. Policy regime

- Decarbonisation of UK economy will not happen without strong policy for the market failures, including: carbon pricing; R&D funding; network policy, e.g. broadband and public transport, etc. (see Romani *et al*, 2011; Stern, 2012).

- The UK climate change policy framework is complex and should be simplified. In the absence of a strong price signal from the EU-ETS, higher and more uniform domestic carbon prices should be sought across the economy in a cost-effective way. The Government should also assess more thoroughly how policy instruments overlap and interact, so that the effective carbon price becomes more uniform across industry sectors and different stages of production. Simplification of policy could involve merging the Climate Change Levy and CRC Energy Efficiency Scheme into a single levy related to carbon content (see Bowen and Rydge, 2011).

- Electricity Market Reform (EMR) will introduce a new policy regime for encouraging the necessary low-carbon investment in the power sector. This policy should provide a clear and credible policy framework that provides certainty for investors. One way to achieve this certainty would be to include a carbon intensity target for the electricity sector, likely to be in the 'flexible' range of 50-100g CO_2/kWh.[1] This target would address the tension between carbon budgets and the levy control framework and provide the clarity and direction industry needs: the target would give an indication of how much low-carbon power is required in the generation mix and the levy control framework would encourage industry to provide this low-carbon generation at least cost.

[1] Closer to 50g is consistent with meeting the carbon budgets, but would require much stronger investment and more rapid build rates.

- An intensity target, by shifting focus from deploying physical quantities of renewable capacity to the objective of decarbonisation, would give a clearer sense of direction for the industry and encourage investment across a range of technologies, including carbon capture and storage (CCS). This would avoid over-investment in any one technology – such as gas generation without CCS, which would likely be inconsistent with the economy-wide UK carbon budgets. It would also, in conjunction with strong public/private R&D partnerships, promote investment, learning and innovation across a range of technologies. This would help avoid 'picking winners' and closing off valuable options.[2]

2. Key technologies for the UK

- Four technologies are particularly important for a decarbonised UK power sector: wind power (onshore and offshore), combined cycle gas turbines (CCGT) plants, carbon capture and storage (CCS) and nuclear energy.

- The Fourth Carbon Budget advises that 30 to 40 GW of low-carbon plant is required by 2030. Onshore and offshore wind power are currently the cheapest renewable technologies available in the UK, although they can raise potential environmental issues – particularly through the visual impacts of turbines. The best approach to renewable energy investments would be to allow the market to invest in a portfolio of different energy technologies (including, wind, solar, combined heat and power etc.) to balance the cost to consumers and environmental concerns.

- Combined cycle gas turbine (CCGT) power plants will be an important part of the generation mix. They can be ramped up and down relatively quickly to meet sudden peaks of demand or drops in supply. As renewable sources, such as wind, are intermittent i.e. the wind can stop blowing, this can lead to sudden drops in supply. Rapid response gas can step in at short notice keeping the system in balance and the lights on. Natural gas plants are also important to replace 'dirty' coal plants.

- However, too much reliance on gas may be inconsistent with the UK Government's climate change objectives. For instance, investment in new gas capacity that would lead to decarbonisation levels of only 200 g CO_2/kWh by 2030, as envisaged in the recent UK Gas Generation Strategy, could jeopardise the UK achieving its mandatory emission targets at least cost.

- Investment in technologies complementary to power generation, such as CCS, will be essential to reduce emissions. In particular, it is crucial to find out as soon as possible whether gas-fired power stations fitted with CCS can become economically viable within the next decade or so.

- New nuclear plants will be required post-2020 to provide low-carbon base load.

3. A smarter, more flexible and interconnected grid

- The future energy system will need to be more flexible to manage a broader range of energy sources e.g. wind, CCGT, solar, nuclear etc. This will require significant

[2] There is great uncertainty around future learning rates and generation costs. Investment in only one technology today risks 'lock-in' and closing off options if learning leads to other technologies becoming more cost-effective in the future.

improvements in order to make the grid smarter, more flexible and better interconnected. This will include improved energy storage, more interconnection with other European electricity networks, and better demand management (including through the development of smart grids). Additional R&D in these areas will be essential to ensure a full portfolio of options is available in the coming decades.

4. Innovation and growth

- Strong policy and investment in decarbonisation is likely to promote several decades of learning and low-carbon innovation in the UK.

- Evidence from the automotive industry shows that proactive policies are needed to make business move from 'dirty' to 'green' innovation.

- Green innovation may also have broader benefits for economic productivity and the labour market. GRI is currently conducting new empirical research on this – finding to be released later this year.

- Growth in the low-carbon and renewable energy sub-sectors in the UK was over 5 per cent between 2009/10 and 2010/11, compared to negligible growth for the UK economy as a whole (Department for Business, Innovation and Skills, 2012).

5. Further reading

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