UK 2012 | Climate Change Risk Assessment

Energy

Sector Perspective

- The UK energy sector employs around 150,000 people and contributes 3.7% to GDP. The UK's 'energy mix' consists of around 51% petroleum, 32% natural gas, 11% coal and 6% nuclear or renewable-generated electricity.[1] Responsibility for the sector at UK Government level resides with the Department of Energy & Climate Change (DECC), with some responsibilities (e.g. for emissions targets) devolved to Scotland, Wales and Northern Ireland.

- Although the biggest issue for the sector is currently energy security, climate change mitigation remains an important policy driver since power stations currently account for just under one-third of total UK carbon dioxide emissions.

- Adapting to a changing climate may become more of an issue when planning for the 2030s and beyond. Climate change impacts may include: changes in energy demand due to rising temperatures; increasing flood risks to energy infrastructure due to more intense rainfall and rising sea levels; and constraints on water availability for power station operations.

- In terms of the current climate, the sector is most vulnerable to extreme weather events that have an immediate impact on the ability to supply energy. For example, the flooding of infrastructure during the 2005 Carlisle floods resulted in over 63,000 customer interruptions to electricity supply.

- Although the energy industry has relatively high awareness of the risks posed by climate change and is used to responding to extreme weather events, its overall level of risk from climate change may be intensified by interdependencies with other sectors. In some cases, key climate impacts on those sectors (e.g. a potential increase in disruption to transport infrastructure and therefore to the movement of supplies of some fuels) may have a major impact on the UK's energy industry.

[1] All 2009 figures.

Energy

Climate change is projected to result in changes in temperature, rainfall patterns and sea levels, as detailed in the UK Climate Projections (UKCP09) analysis. Although reduced heating demand in milder winters may be a major benefit, there may also be a number of negative impacts on UK energy security and supply.

The Climate Change Risk Assessment (CCRA) has completed an assessment of a range of impacts for which this sector may need to prepare. Some of the key points from this assessment are summarised here. All results presented are for the whole UK, unless indicated.

The results presented here do not take account of changes in society (e.g. population growth, economic growth and developments in new technologies); nor do they take account of responses to climate risks (e.g. future or planned Government policies or private adaptation investment plans).

Focus on… Energy Demand

Milder winters may lead to reduced energy demand for domestic heating, with the largest decreases in the south of the UK. The economic and social benefits of a reduction in winter heating demand are potentially very large and may exceed £1 billion per year.

Higher summer temperatures, however, may result in a rise in energy demand for cooling, particularly in the south. Cooling of buildings (including air conditioning, refrigeration and cooling of information technology and communications infrastructure) currently accounts for around 4% of total UK electricity use and demand for cooling is already increasing. The indicative annual cost of increased cooling demand is estimated to be between £0.1 and £1 billion by the 2050s and over £1 billion by the 2080s.

Confidence

L — Decrease in energy demand for domestic heating: between 10% and 40% by the 2050s (equivalent to between 40 and 150 TWh per year), rising to between 20% and 60% by the 2080s (between 60 and 210 TWh per year).[2] This would translate into an annual benefit ranging from £0.6 billion to £2.5 billion by the 2050s and from £1 billion to £3.4 billion by the 2080s.[3]

H — Increase in energy demand for cooling (example): in London, from 1.6 TWh per year (2004) to between 2.2 and 2.5 TWh per year by 2030.[4]

Focus on… Flood Risk

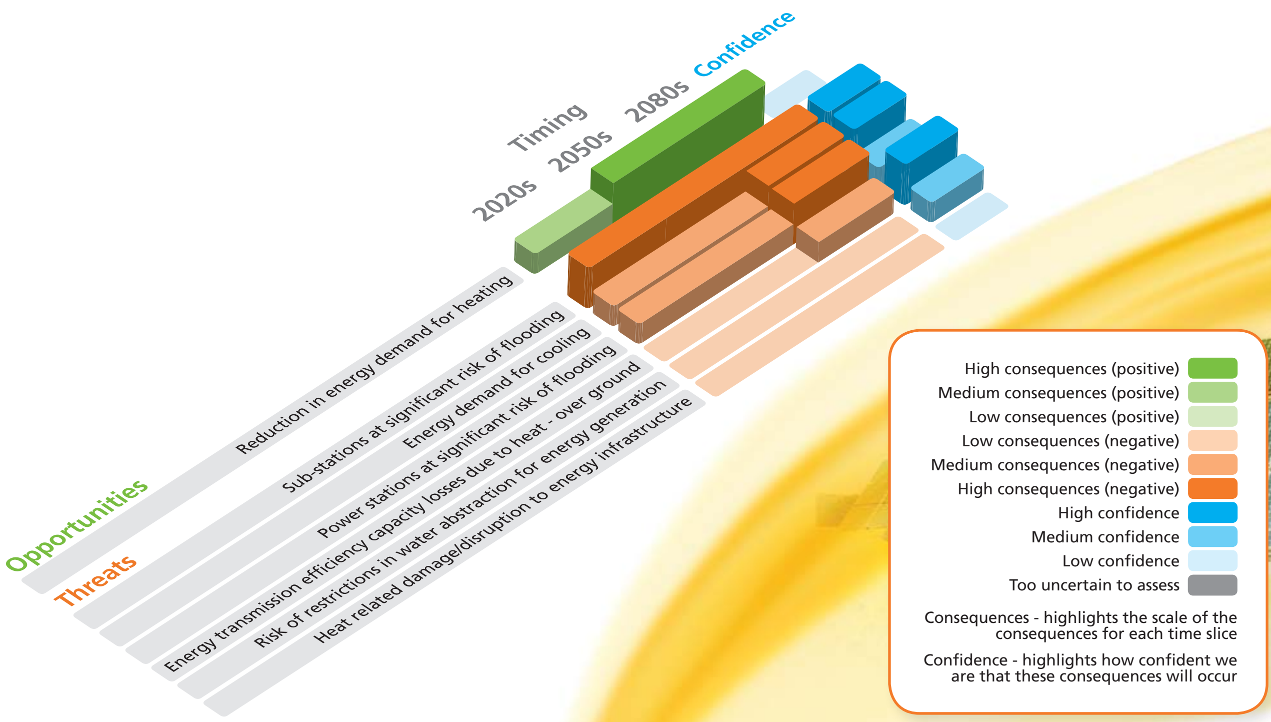
The main risk posed by flooding in this sector is to power stations and electricity transmission and primary distribution substations. Substations are at greater risk of river flooding, while power stations are at greater risk of tidal flooding.

There may be opportunities to increase resilience to flooding as current energy infrastructure reaches the end of its lifetime and is replaced, but this will depend strongly on the design and location of new infrastructure. As a result of the Pitt Review,[5] the sector has been tasked with increasing the resilience of energy infrastructure to flooding.

Confidence

M — Generating capacity of power stations in England and Wales with a significant likelihood of flooding:[6] between 19 and 25 GW by the 2080s (between 23% and 30% of current generating capacity), compared to about 10 GW or 12% of total generating capacity currently with a significant likelihood of flooding.[7]

H — Substations in England and Wales with a significant likelihood of flooding: 46 today, between 51 and 73 by the 2050s and between 57 and 79 by the 2080s.



The assessment of flood risk for the CCRA has assumed that there are no changes in existing flood and coastal erosion risk management measures; the analysis takes account of current flood defences and protection against coastal erosion, but does not include any future changes as a result of adaptation policies or deterioration of existing flood defences and coastal protection measures. ***The figures here apply to river and tidal flooding in England and Wales only.***

Focus on… Water Abstraction

The use of water to cool power plant components is essential to the process of electricity generation. Most nuclear power stations use seawater, but a number of conventional power stations are located inland and use freshwater from rivers or lakes. Climate change may reduce the amount of water available for abstraction by inland power stations, primarily due to lower river flows in summertime.

Higher temperatures resulting from climate change may also increase the temperature of water abstracted for power station cooling, reducing plant efficiency and therefore potentially affecting energy supplies. This may be a particular problem for the Thames and Anglian regions, which already have the highest average water temperatures.

Confidence

M — Reduction in sustainable abstraction[8] (examples): up to 21% for the Severn and up to 18% for the Thames river basin regions by the 2020s and up to 11% for the Humber river basin region by the 2080s.

Focus on… Heat-related Damage

Although power cuts in 2003 and 2006 were the result of high temperatures exacerbating pre-existing network faults, industry design standards ensure that electricity and gas infrastructure is generally capable of withstanding high temperatures. As a result, the overall risk associated with heat-related damage due to climate change is low. This assumes maintenance operations are carried out promptly and effectively, with particular attention to old infrastructure.

Confidence

L — Network maintenance costs to prevent heat-related outages: a very indicative assessment suggests annual costs may be between £1 million and £100 million by the 2080s.

Focus on… Transmission Capacity

Higher air temperatures may make it necessary to reduce the amount of electrical current passing through overhead power lines in particular, as well as through underground cables and power transformers. Known as 'de-rating', this ensures that the equipment does not overheat. Although helping to prevent power outages, de-rating decreases transmission capacity, which with rising demand may become significant. Possible actions to reduce this problem include increasing the height of overhead lines and replacing underground cables with larger cables. Widespread introduction of 'smart' network technology may also significantly mitigate the risk.

Confidence

H — Network capacity losses due to de-rating of overhead power lines: between 1% and 5% by the 2080s for the transmission network and between 1% and 19% by the 2080s for the distribution network.

L — Potential annual cost of actions to reduce de-rating: in the order of £10 to £100 million.[9]

[2] Based on current population figures and current housing stock.
[3] Based on 2009 prices with no uplift or discounting.
[4] Day *et al.* (2009) *Energy and Buildings,* 4, pp.1942 – 948
[5] The Pitt Review: *Learning Lessons from the 2007 Floods* (Cabinet Office, 2008).
[6] Exposure to flooding (of any depth) with a frequency greater than 1 in 75 years.
[7] Figures in this and subsequent bullet point assume no change in location, number of sites and capacity.
[8] Maintaining the current level of environmental flows required to protect water ecosystems.
[9] Based on research published by ENA (2011): Electricity Networks Climate Change Adaptation Report.

The Challenge of Adaptation

Overall, the UK energy sector has a reasonably high awareness of the potential impacts of climate change. It has also started to develop strategies for adapting to climate change, although the extent of this varies between organisations. Examples of key initiatives include the following:

- After serious flooding in Carlisle (2005) and the South Midlands and South Yorkshire (2007), a working group drawn from electricity network companies, DECC, the Office of the Gas and Electricity Markets (Ofgem), the Environment Agency, the Scottish Environmental Protection Agency, the Met Office and the Pitt Review produced guidance on analysing flood risk to substations. Electricity companies have now started a 10-year programme to improve substation resilience to flooding.
- 'Reporting authorities' appointed in response to the Climate Change Act 2008 include Ofgem, electricity generators, electricity transmitters, electricity distributors and gas transporters. These organisations have prepared reports detailing (i) climate change risk assessments they have carried out on their assets and (ii) potential adaptation options.

Energy infrastructure generally has a long life-cycle. However, when replacement is necessary, measures to reduce climate risks (e.g. inclusion of improved flood defences) can be built into new designs. On the other hand, the long lead-times often involved in implementing decisions mean that the response time of the sector may be slow in many cases, simply for practical reasons.

The ability to adapt to climate change may also partly depend on the ability to forecast relevant changes. For example, adaptation decisions at coastal power stations regarding sea level rise can generally be made with a relatively high degree of confidence. Conversely, there are uncertainties regarding the impact of climate change on river flows and hence the availability of water inland for cooling processes.

In terms of energy policy, although this is mostly focused on emissions reduction, policies are also in place designed to facilitate adaptation and adaptation is being addressed across Government (e.g. in DECC's Departmental Adaptation Plan).

A major challenge with respect to adaptation, however, is the uncertainty surrounding the precise way the energy sector will evolve in the coming years and decades, with the energy mix beyond 2050 particularly unclear. Fossil fuels, renewables and nuclear power all have different vulnerabilities to climate change. Areas where more clarity is needed also include:

- Site-specific flood risks at individual energy infrastructure locations.
- The potential evolution of international energy dependencies, as some of the most strategically important oil and gas pipelines are located in parts of the world with extreme climates.
- Implementation timeframes if adaptation measures in this sector are to prove effective.

Where to Get Further Information

For copies of the CCRA Energy Sector Report, the CCRA Evidence Report and Devolved Administration Reports, please visit www.defra.gov.uk/environment/climate/government/

How the CCRA was conducted

The CCRA reviewed the evidence for more than 700 potential climate impacts on the UK economy, society and environment. Over 100 of these impacts across 11 sectors were taken forward for more detailed analysis, having been selected on the basis of likelihood, potential consequences and how urgently adaptation action may be needed to address them.

A plausible range of climate change scenarios was used in the analysis. Some aspects of socio-economic change (e.g. population growth) were also taken into consideration. Adaptation policies that are planned for the future were not considered, so that the underlying level of risk could first be compared across sectors.

The results presented here are based on the UKCP09 Medium emissions scenario for the 2020s (2010-2039) and the Low, Medium and High emissions scenarios for the 2050s (2040-2069) and the 2080s (2070-2099). A range of climate projections representing lower, central and upper estimates were considered within each emissions scenario.

Risks are categorised as low, medium or high based on their economic, social and environmental consequences.

The CCRA findings are also categorised as having low, medium or high confidence. The level of confidence is the degree to which the findings are considered valid, based on the type, amount, quality and consistency of the evidence studied.

Further information on how the CCRA results should be interpreted is presented in the CCRA Evidence Report. www.defra.gov.uk/environment/climate/government/

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