

The Energy Gap



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There is growing discussion in the UK about the need for new and additional sources of low carbon energy to replace the energy lost by the phasing out of fossil fuels and the closure of existing nuclear power stations. These discussions, among scientists, engineers, policy-makers and the media, commonly refer to an 'energy gap'.

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There is widespread consensus that between now and 2020, substantial investment is needed in new power generation capacity. This need arises from a coincidence of several factors: continued economic growth and hence rising demand for energy services; the expected retirement of a large proportion of the existing nuclear power stations and some coal fired stations; and the need to shift towards low carbon electricity sources. The term 'energy gap' has been used in a variety of contexts and with various meanings but its precise character is not well-defined.

This document reviews several trends and issues which have been related to discussions of an 'energy gap'.



1. UK consumption, production and security of supply

Energy use is measured in tonnes of oil equivalent (toe¹). Total primary energy demand, which includes losses in transmission, was 245.1 million toe in 2003.² Total final energy consumption was 158 million toe in 2003 and is projected to rise by between 0.7% and 0.8% per year to 2010.³

Electricity forms a major component in that final consumption and is expected to grow even faster as more people buy household appliances, like dishwashers. UK policy makes a strong commitment to increasing the historic rate of energy efficiency improvement, which according to some scenarios could substantially flatten or even turn down the expected trends in energy use. However, demand for final energy is unlikely to reduce strongly, and may well continue to increase despite these measures.

The UK imports energy, such as coal, oil and natural gas, because some raw materials are unavailable and because costs, competition and political support affect the viability of UK energy production. By 2020, the Government projects, we could be dependent on imported energy, in the form of natural gas, for up to 75% of our primary energy needs. Some people worry that the UK should produce more of the energy it consumes for security reasons; a reliance on imported natural gas leaves the UK vulnerable to a rogue state shutting off the pipelines, and so on.

2. Meeting CO₂ reduction targets

Reduction of CO₂ emissions is a central component of the Government's energy policy, with commitments of reducing emissions by 20% below 1990 levels by 2020 and ambitions of a 60% reduction by 2050.⁴

Electricity generation is a major contributor to CO₂ emissions, and as there is a variety of lower carbon alternatives to current technologies, this sector is expected to make a major contribution to overall national reductions. Emission reduction from power generation means either changing the primary energy source to one that is inherently lower carbon (for example moving from coal to gas, or from gas to renewables or nuclear power), increasing the efficiency of power generation or its distribution, or removing the carbon afterwards, from the exhaust gases.

Gradual replacement or conversion is therefore needed of existing fossil fuelled power stations by lower carbon ones, giving rise to a need for new capacity and new investment.

Fuel type	Carbon content	
Coal	(kg/GJ)	22.5
Fuel oil	(kg/GJ)	19.6
Natural gas	(kg/GJ)	14.2

Table: Carbon content of fossil fuels⁵

3. Loss of existing sources

The following table illustrates the projected declining contribution of both coal and nuclear in the next 5 years, as some of the oldest plants come to the end of their useful life; this trend will continue for a further 10 years or so. As they decline, a reliable source of base-load electricity generation will be lost.

New capacity will be required to replace the loss of existing sources. European legislation to reduce sulphur dioxide and nitrogen oxide emissions will further restrict power generation from some coal-fired stations. Therefore new capacity is likely to be a mixture of natural gas, renewable energy of various types, such as wind power, and possibly nuclear power.

Fuel type	2000	2005	2010
Coal	111.9	116	90
Oil	2.1	2	2
Gas	127	135	145
Nuclear	78.3	80	65
Renewables	10.1	15	40
Imports	14.3	10	8
Pumped Storage	2.6	2	2
TOTAL	346.3	361	352

Table: Electricity Generation by fuel, in TWh⁶

4. Uncertainty about new sources

Renewable technologies include biomass, geothermal, hydroelectric, solar, tidal, wave and wind power. Currently, renewables produce less than 3% of UK electricity but the Government has pledged to increase this to 10% by 2010, aspiring to 20% by 2020. To reach 10%, the UK needs to build about 10,000 MW of



renewable capacity by 2010; only 1,200 MW had been installed by 2002.⁷

Whilst the renewable energy resource is very large, most technologies are at a comparatively early stage of maturity, and their installation is capital intensive. Generation of electricity from renewable energy sources will increase but due to their intermittent nature-renewable energy sources, such as wind power, are hard to predict and control- there are concerns that they won't be able to meet electricity demand.

Comments

The concepts that underlie the various uses of the term 'energy gap' vary considerably as described above. An attempt to quantify the exact 'gap' is very difficult as the actual amount of energy shortfall is reliant on factors we don't yet know, such as the weather⁸, demand, energy efficiency and the prices on world markets.

What is clear, is that a variety of factors are coming together which collectively mean that the UK needs to put in place significant amounts of new power generation capacity during the next 10 to 15 years, with particular need for a significant low carbon contribution.

There has been much discussion about what new technologies should be built and in particular, the cost of new technologies has been widely debated. As with building any large infrastructure costs are very difficult to determine. However, the Royal Academy of Engineering (www.raeng.org.uk) has published a report, The Cost of Generating Electricity, that provides indicators of cost performance for a range of different generation technologies and fuels.

¹ The tonne of oil equivalent enables different fuels to be compared and aggregated. 1 tonne of oil equivalent = 107 kilocalories, 396.83 therms, 41.868 gigajoules, 11,630 kWh

² Digest of United Kingdom Energy Statistics (DUKES), TSO, 2004, p.12

³ Energy Paper 68: Energy projections for the UK, Department for Trade and Industry (DTI)

⁴ Energy White Paper Our Energy Future - Creating a Low Carbon Economy, TSO, February 2003, p.25

⁵ The Cost of Generating Electricity, Royal Academy of Engineering, March 2004, p.23

⁶ DTI Updated Emissions Projections, November 2004, p.12

⁷ Energy White Paper Our Energy Future - Creating a Low Carbon Economy, TSO, February 2003

⁸ The amount of energy we use is linked to the outside temperature. In cold winters we use more energy for heating.