EXPLORING NET ZERO

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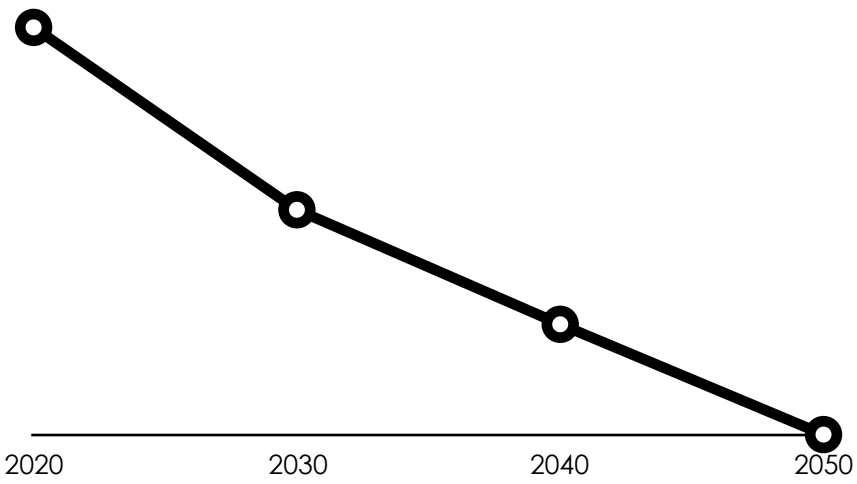


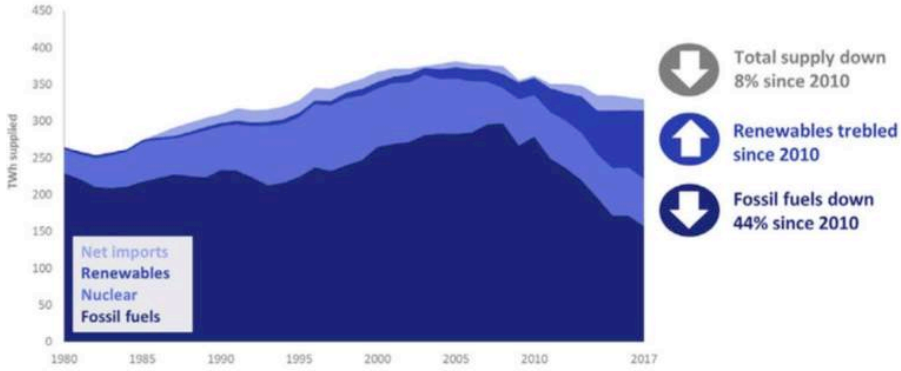
Net zero: power

Swift decarbonisation of the UK's electricity system is essential to meet an economy-wide net zero emissions goal, as the transition in other sectors is expected to be based around electrification. Cutting carbon emissions from transport and heat is dependent on the availability of low-carbon electricity, needed to charge electric vehicles, create low-carbon gases such as hydrogen and ammonia, and to power heat pumps in homes.

A surge in wind and solar capacity, coupled with a shift away from coal, has seen rapid decarbonisation of the power sector, which has been the primary driver of the UK's falling carbon output in recent years. The path to a net zero power supply sees continued investment in renewable and nuclear energy, and in new technologies such as batteries.

Since 1990, the carbon dioxide produced by UK power stations has fallen by 57%, declining by 8% from 2016 to 2017 alone. This precipitous fall has been driven by two policies – the carbon price floor, which increases the cost of generating electricity from coal, thereby favouring the burning of gas; and support for renewable energy in the forms of feed-in-tariffs, renewable obligation certificates and contracts for difference.

In 2017, the UK sourced more than half of its electricity from low carbon sources for the first time, with around 30% from renewables and 20% from nuclear. Coal-fired power stations generated just 6.7% of electricity, down from more than 40% in 2012. The majority of the remainder (40.4%) was generated by burning natural gas which, although cleaner than coal, is not a low-carbon fuel. Reliance on natural gas also leaves the UK vulnerable to supply shocks and rising import dependence.



UK electricity generation by fuel. Source: BEIS

The amount of electricity needed to power the UK is also decreasing as homes, domestic products and industrial processes become more efficient. This trend, however, is expected to reverse in the future as electricity is used in new applications, such as transport and heating.

Looking ahead

An expected increase in demand for electricity means that a net zero power sector needs to replace existing carbon-intensive power stations with low-carbon alternatives, but also increase overall system capacity. One estimate suggests peak demand could increase from around 65GW today to between 75 and 80GW in 2050.

The Committee on Climate Change estimates that investment capable of generating 200 TWh of electricity will be needed during the 2020s (current annual demand is 330 TWh). This will replace closing coal power stations, which will all be offline by 2025, and the UK's fleet of nuclear power stations, of which closures will begin in 2023 as plants reach the end of their lives. By 2030, just one of the nuclear power stations currently in use will still be in operation, while many gas power stations will also reach the end of their lifetimes over the next decade.

The dramatic falls in the cost of wind and solar capacity will likely see the vast majority of this capacity replaced by turbines and panels. A more flexible electricity system is needed to accommodate the variable supply from technologies driven by the weather. This generally involves utilising four 'flexibility mechanisms':

- Interconnectors that allow the UK's power grid to export renewable energy or import it from a much larger geographic area
- Demand side management, incentivising the shift of non-essential industrial and household processes to times when electricity supply is abundant
- Increasing storage of electricity (for example in batteries or pumped hydro facilities), allowing it to be 'banked' when generated but not needed, then

released when demand rises. Batteries of electric vehicles plugged in with 'smart' chargers could provide a nationwide 'distributed battery'
- Boosting the number of small gas 'peaking' plants, which are able to respond rapidly to fluctuations in demand

The UK's Sheringham Shoal Wind Farm. Photo by Harald Pettersen

BEIS and Ofgem have released a 'Smart systems and flexibility plan' that details the work needed to manage an electricity system largely based on renewables. The UK has also taken a lead in a number of these areas, pioneering new techniques to aggregate and manage storage, and cutting-edge technology firms that allow people more visibility (and therefore control) over their energy demand.

The benefits of moving to a smarter energy system are vast, estimated at up to £8 billion per year by 2030 by the National Infrastructure Commission, or £17-40 billion by 2050 by researchers at Imperial College London.

Forecasts

Predicting the exact shape of the electricity system in decades to come is a difficult and complicated task, and often fails to account for disruptive technologies that can upend the 'normal' order. That being said, National Grid's most recent forecast of the future of the energy system sees carbon intensity as low as 20g/kWh in 2050 (down from around 300 g/kWh today); so extending all the way to zero emissions is not fanciful.

This scenario is based on rapid expansion of renewable and nuclear capacity during the 2020s and widespread take up of electric vehicles. Taking this scenario all the way to zero emissions could be done by more investment in renewable energy and flexible technologies, or by the deployment of carbon capture and storage (CCS). The power sector could even become a net absorber of carbon dioxide if bioenergy with carbon capture (BECCS) is rolled out.

The 2018 National Infrastructure Assessment found that a switch towards low-carbon and renewable sources for power and heating would see householders pay the same in real terms for their energy in 2050 as they do today.

Some scenarios have been modelled that are based on 100% renewable energy, but the general consensus is that a mixture of low carbon technologies, including nuclear power, will be used to decarbonise the power sector.

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