APPG Environment Briefing: How do we power an affordable net zero economy without the lights going out?

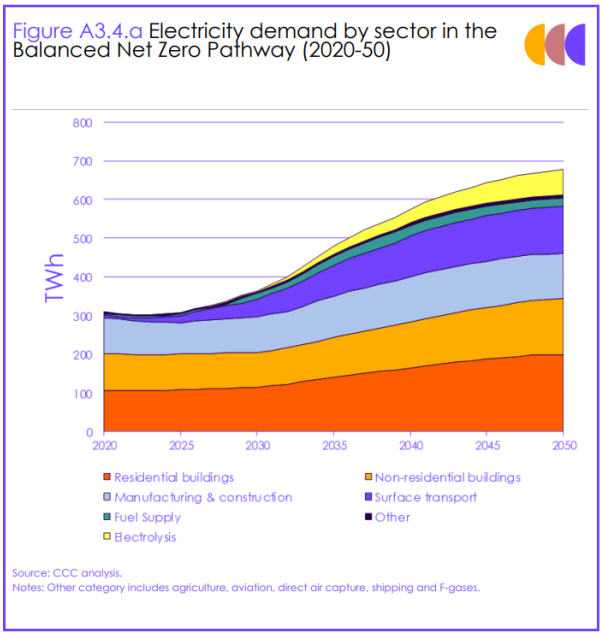
Introduction

In 2019, the UK Government committed in law, through an amendment to the Climate Change Act (2008) to achieve net zero greenhouse gas emissions by 2050. Every sector of the UK economy needs to decarbonise and the energy system which supports it must do the same. Since the industrial revolution, fossil fuels have dominated the market, powering our vehicles, homes, and industry. But increasingly, new forms of renewable energy such as wind and solar have been deployed to cut greenhouse gas emissions, replacing dirtier sources like coal.

Over the past decade, the UK has made renewable power cheaper than building new fossil fuel power stations through innovation and subsidised early-stage deployment. Offshore wind is now amongst the cheapest forms of electricity in the UK, with onshore wind even cheaper. As the power sector decarbonises, cheap electricity is also expected to become the energy source of choice for heating and transport, from heat pumps to electric cars, replacing fossil fuels like oil and gas. The government's Net Zero Strategy, published in 2021, signalled an electrification of the economy. Two major things have happened which will accelerate demand for clean electricity over the next decade. First, new petrol and diesel cars cannot be sold in the UK from 2030. Second, the government has set an ambition for electric heat pumps to be the household heating source of choice by 2035. This will make a big difference to the type of energy we demand daily, transitioning away from petrol stations and gas boilers - to EV charging points and heat pumps.

Electricity demand could double

As a result of these changes, electricity demand could increase by a half over the next 15 years, and double or treble by 2050. In practice, that means going from 300 TWh of electricity demand today to 360 TWh in 2030, 460 TWh in 2035, and 610 TWh in 2050. The key question for policymakers is: how do we supply that new demand, in a secure and cost-effective way? Crudely, how can we afford it, and how do we stop the lights going out?



History tells us we should be confident about our ability to deliver. Since 1990, the UK has reduced its emissions by 44% whilst growing the economy by 78%. The majority of emissions reductions have been through power sector decarbonisation; first the switch from coal to gas and then increasingly through deployment of renewables. The lights haven't gone out. Nevertheless, there is some way to go and significant challenges ahead. Three quarters of our energy needs are still met by petrol and direct use of natural gas. The power sector still accounts for 11% of annual UK emissions. The next decade is crucial to building the infrastructure needed to transition to a net zero energy system, decarbonising the power sector – with increasing demands on it.

Power sector decarbonisation by 2035

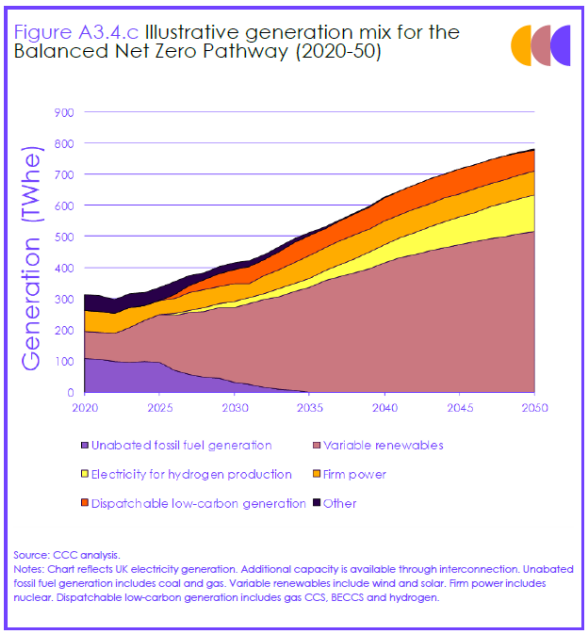
The UK has announced it aims to decarbonise the power sector by 2035, subject to security of supply. Similar developed economies like the USA, Canada and Germany have done the same, with Germany going for 100% renewable power. In the main, reducing emissions in the UK power sector will be achieved by reducing dependence on unabated gas, which still equates to around 40% of our annual electricity needs. Last year, wind, solar and other renewable sources produced a record proportion of UK electricity (42%), eclipsing fossil fuels for the first time. Decarbonising the power sector will further increase the share of renewables supplying the UK's electricity, but it is also likely to rely on new nuclear, the development of effective carbon capture and storage (CCS) technology, as well as biomass and hydrogen. The CCC and Ember have both published plans for how this might look in the UK, but the official government roadmap to a 2035 decarbonised power sector is unpublished. The Net Zero Strategy promised the deployment of a range of supporting measures to ensure a stable and efficient power supply that remains responsive to consumer demand, but details of what this means in practice need to be agreed.

Will kicking gas off the grid make the lights go out?

The 2035 power sector decarbonisation target is 'subject to security of supply', which is an important caveat. It is estimated that by 2035, 50 TWh of dispatchable generation would be needed to ensure security of supply. Unabated gas currently provides the UK's dispatchable generation, as the main source of system flexibility. Dispatchable power quickly fills the void of intermittent renewables, when the sun doesn't shine or the wind doesn't blow. Currently, renewable electricity cannot be stored for long periods of time, meaning dispatchable power must back it up. However, low carbon solutions to replace gas are increasing, including: interconnectors (import and export), better battery storage, hydrogen storage, pumped hydro, and improved demand management. Gas with CCS is one option, but it will add costs to the consumer, making it more expensive than renewables and competitive with nuclear at £85/MWh if running baseload. Finding a low carbon, cost-effective replacement for unabated gas is key.

What about the role of nuclear?

Estimates suggest renewable energy can only provide 70 to 80% of our power needs by 2035. Under the CCC balanced pathway model (pictured), in 2035 – wind would generate 265 TWh whilst solar would generate 60 TWh, leaving an important gap to fill. A study by Imperial College London puts solar power lower in their 2035 scenario (at 19 TWh) with wind doing the bulk of the work at 383 TWh, but with an overall electricity system 88% renewable. Either way, there will be a need for non-intermittent generation, such as nuclear. This is listed as 'firm power' in the CCC's graph (right). Around 60 TWh (20%) of UK electricity generation is currently provided by nuclear. However, the majority of that is set to retire in the 2020s. New nuclear projects will help to maintain the level of firm power in the UK system at around 20%.

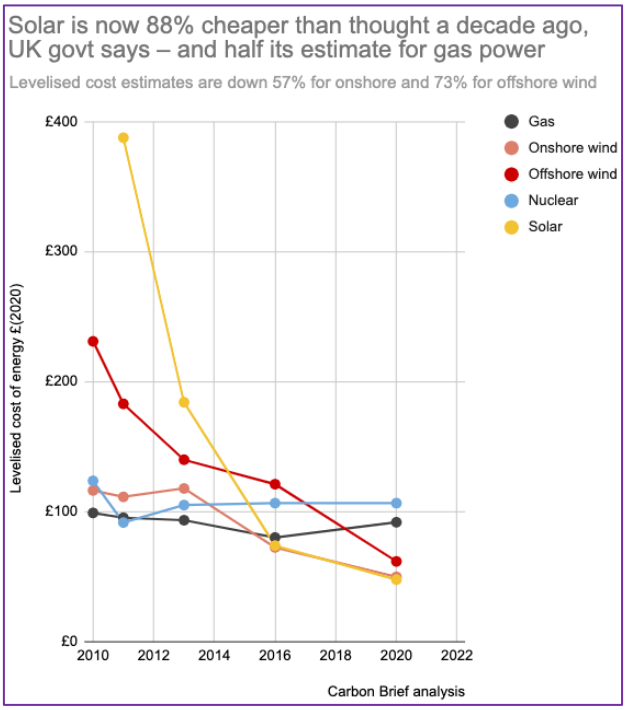


The Government has set out its own plans for ensuring a well-balanced future energy mix in the Energy White Paper, including plans for one conventional new nuclear plant to be underway by the end of the Parliament. Since the White Paper, further funding has been announced for Small

Modular Reactors (SMRs). Given the period of low wind in 2021, there could be a greater emphasis on low carbon alternatives to gas, like nuclear, forming a greater share of the energy mix. However, one of the problems with nuclear power is that it is not very flexible (when it's on, it's on). The other issue is the price, which has been historically high. With a series of nuclear programmes, the government hopes to reduce the cost of nuclear, but it remains one of the most expensive technologies (see Carbon Brief graph below).

How much is this going to cost?

In recent years, the cost of renewables has fallen significantly, with offshore wind costs falling from £150/MWh to £45/MWh over the last decade. That compares to £50/MWh for gas generation, meaning renewables are now the cheapest generation technology on a levelised cost basis (the total cost of building and operating the asset over its lifetime).



The volatile nature of fossil fuels continues to be a cost for the UK to mitigate against, with international markets for these fuels prone to crisis. The current energy price crisis has been driven by sharp rises in the wholesale price of gas, with the cost of gas four times higher in January 2022 than a year earlier. Without a decarbonised power sector, electricity prices closely follow gas, with 85% of the recent rise in electricity prices due to gas.

Petrol prices have also soared due to the volatility of international markets, hitting record highs, but the effects of future price volatility can be avoided by an increase in electric vehicle uptake and the decarbonisation of the electricity system. Data from Green Alliance shows that over four years, a battery EV could save up to £4,500 in fuel costs compared to a petrol engine vehicle.

Currently, renewables are helping to limit price rises for electricity, by reducing the amount of gas needed for generation, and by refunding part of the wholesale price under contracts for difference (CfDs). Refunds are made to suppliers, and should be passed back to consumers – £157million for Q4 2021, and forecasts of around £600million for Q1 2022. Ofgem, the energy regulator, estimates that CfDs in the financial year 2021/22 have provided savings equating to £15-20 per household. This saving is more than double the £7 increase on bills which fund energy efficiency measures to cut the bills of vulnerable households.

There will be initial costs associated with integrating a larger share of renewables, such as strengthening transmission networks and maintaining enough capacity to meet demand at peak times. Integration costs could be between £25-30/MWh for a system with 75% to 90% of variable renewables. However, the CCC conclude that with sufficient flexibility, a system based on renewables could actually be cheaper than one running on fossil fuels, with one estimate showing overall system savings of £9 billion by 2050. Meanwhile, according to Imperial College London, a zero carbon power system could reduce the cost of electricity by 19 per cent as soon as 2035.

Finally, with new interconnectors with partners such as France, Denmark and Norway, the UK is likely to become a significant exporter of electricity by the mid-2020's. The UK is currently a net

importer of electricity. Exports are likely to reach 65-111 TWh in 2035, equivalent to 15-20% of domestic generation, with interconnection helping the UK export excess energy, better manage peak demand, and lower costs.

How can energy efficiency play a part?

The majority (85%) of the projected increase in electricity demand is a result of the electrification of surface transport and heat in buildings. Heat pumps are four times more efficient than gas boilers and electric vehicles three times more efficient than internal combustion engine cars. Technological advancements are likely to improve efficiencies further, as we have seen with wind turbines and LED lightbulbs, with LED bulbs now seven times more efficient than incandescent equivalents.

The UK has some of the leakiest homes in Europe meaning more demand for heat to keep them warm, whatever the heating source. The Local Authority Delivery scheme of the Green Homes Grant has already saved recipient households £1.2 billion on their energy bills, with a lower demand for heating. Expanding retrofit schemes to improve the insulation of housing stock can further reduce demand for heating, as well as save on emissions and bills. New homes are also expected to be more energy efficient under the Future Homes Standard.

What do voters think?

Overall, there is strong support for environmental policies, with the environment ranked as the top concern for the British public at the end of 2021. There is also support for specific policies, including on renewables and the 2035 power sector decarbonisation target:

- Polling by *YouGov* and *Ember* showed that 66% of British adults support the 2035 clean electricity target, while just 11% oppose it
- Polling by *Ipsos Mori* shows 71% support increased investment in renewable energy in the UK
- *UK Climate Assembly*: supported 80-90% wind and solar power for electricity supply, compared to 34% for nuclear and 22% for fossil fuels with Carbon Capture and Storage (CCS)
- Polling by *Public First* showed 76% of people surveyed support Government funding for energy efficiency upgrades to homes

Conclusion

Given known renewable technologies like wind and solar are now the cheapest form of electricity, not only can the UK decarbonise power confidently with regard to security of supply, it can help alleviate pressure on consumer bills. The switch to clean power needs to happen to reduce carbon emissions, but substantial evidence shows it can also bring down energy bills, create jobs and insulate the UK from volatile international fossil fuel prices. There are some challenges involved in the transition to a decarbonised power system which require technological advancements, private investment, and changes in consumer habits over a long period of time, but none of these are insurmountable. Taking expert advice from the Climate Change Committee, the UK should be ambitious in its approach to the electrification of the economy, building on the Net Zero Strategy and Energy White Paper.

Key sources and further reading

Sixth Carbon Budget - Climate Change Committee (theccc.org.uk)
Sector-summary-Electricity-generation.pdf (theccc.org.uk)
The UK Clean Power Plan - Ember (ember-climate.org)
EFL_Net Zero GB Electricity_White Paper.pdf (imperial.ac.uk)

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