We must start preparing for net zero's extreme power scenarios

LCP's Kyle Martin takes a look at some of the implications of the Climate Change Committee report for the power sector

The Committee on Climate Change (CCC) has published its report on moving to a net zero economy and the UK's role in halting global warming. In summary, the CCC concludes that "net-zero is necessary, feasible and cost-effective" by 2050.

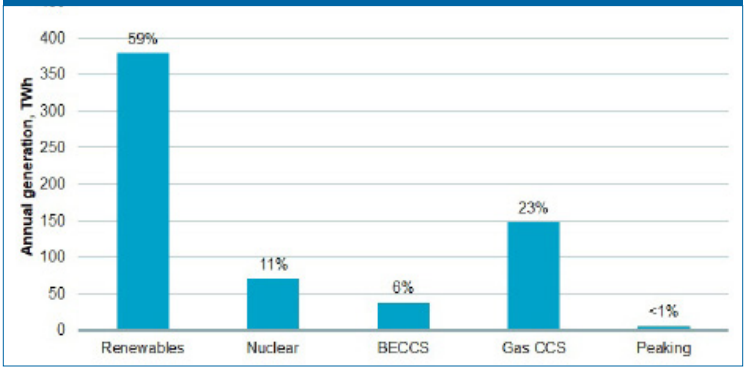
This has received mixed views from commentators, as is to be expected from any report that proposes such significant changes across the economy. While the proposals have been welcomed overall, there are several organisations that are either calling for the report to go much further or for a much slower rate of change.

While fully supporting the ambition of the CCC's report I recognise that the recommendations need to be realistic if they are to be credible. There are some significant lifestyle changes we will need to make if we are going to meet this target.

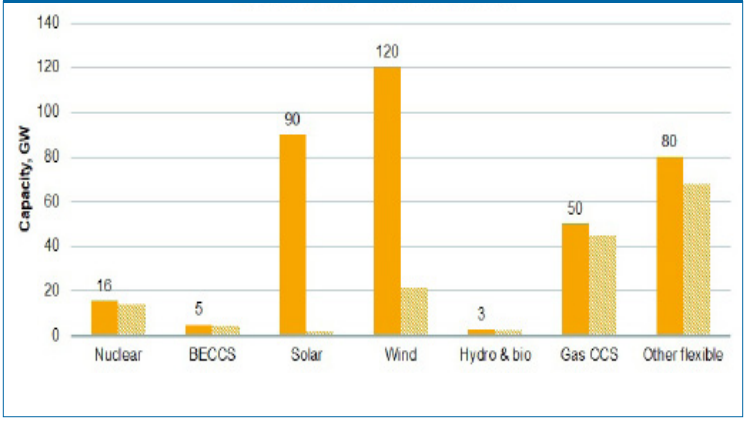
If the CCC had demanded everyone to become vegan overnight It would alienate a significant proportion of the public, while allowing more criticism of the other sectors that also need to rapidly decarbonise. Instead, the CCC has set out a number of sensible changes to our behaviour including a 20% reduction in the amount of beef, lamb and dairy produce consumed, reducing aviation use, switching to low carbon heating and using low carbon transport. Although some of these changes are desirable (I'd happily switch my car for a Tesla tomorrow) others will be more challenging.

Changes to the power sector will ultimately be driven by government policy and regulation, with the industry largely building the infrastructure needed to decarbonise this sector.

2050 GENERATION MIX – CCC FURTHER AMBITION SCENARIO



POSSIBLE 2050 CAPACITY MIX



Electricity production will continue to play a pivotal role in decarbonising the economy. As the cost of low carbon technologies continue to fall, this will allow heat and transport to decarbonise through electrification. With this increase in electrification, which the CCC suggests could result in electricity demand increasing to 645TWh by 2050, significant questions are raised about which technologies will have to be installed, and the speed of deployment.

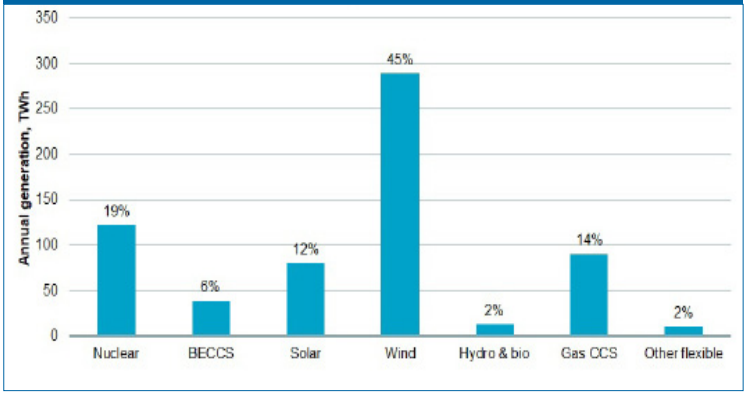
The CCC also stresses the need for carbon capture and storage (CCS) if we are to meet net zero by 2050.

This technology has the potential to provide back-up generation during security of supply events, but just as importantly it will be crucial to produce hydrogen for use in 'hard to decarbonise' sectors, including shipping and aviation.

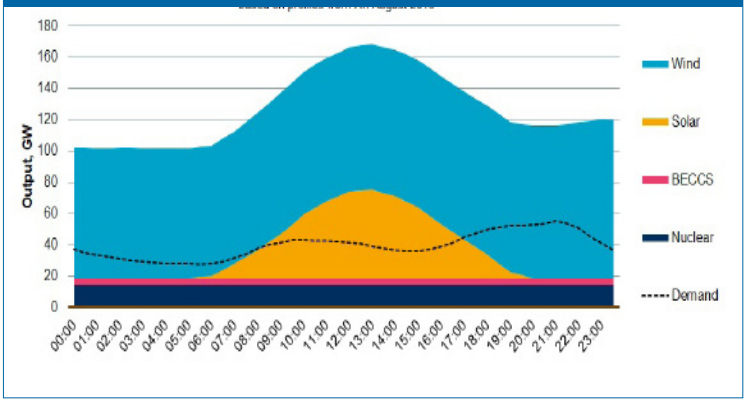
With peak demand of up to 150GW, the size of the system will grow. Security of supply will be more important as our increased reliance on electricity means we need to guarantee the supply of electricity.

Looking at the CCC's 'Further Ambition' scenario, which reduces emissions to close to zero, we can see that the generation mix is dominated by renewables (59%), with firm power provided from low-carbon generation including nuclear (11%), bioenergy with CCS (Beccs, 6%) and mid-merit gas with CCS (23%). Open- >

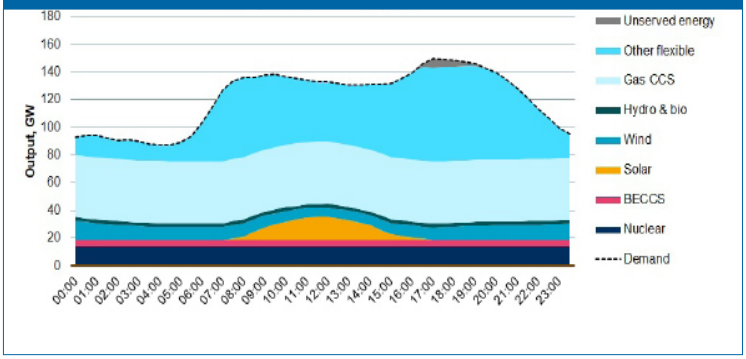
POSSIBLE 2050 GENERATION MIX



2050 DAY WITH LOW DEMAND & HIGH RENEWABLE OUTPUT



2050 DAY WITH HIGH DEMAND & LOW RENEWABLE OUTPUT



cycle gas peaking plant would provide back-up generation during periods of high demand and low renewable output, but their output is limited to <1% of the total annual generation.

How feasible is this scenario? To understand this, LCP has created a more detailed capacity and generation mix that is consistent with these assumptions, while making one change to the CCC assumptions.

MODELLING THE IMPACT

Our analysis shows that, accounting for the intermittency of renewable generation, the CCC report implies a gas CCS capacity requirement of 70GW.

This would require almost 3GW of new capacity to be deployed per year, assuming deployment started as early as 2025. We instead limit gas CCS build to 50GW, with 6GW of baseload nuclear capacity providing the remainder of the 23% of total generation required.

To provide 59% of generation from renewables we estimate that over 200GW of renewable capacity is likely to be required, made up of predominantly wind and solar. The 80GW of "other flexible" would predominantly be the backup gas plant envisaged in the CCC scenario, but it would also include other technologies such as interconnection and battery storage.

How does a market like this operate? For one thing there is a significant amount of renewable curtailment implied by this modelling. To illustrate this, we can look at one extreme day where low demand is combined with high renewable output. We can see the high levels of curtailment required, with over 120GW of renewable generation to be contained. The sample day used is 7 August 2016, with the values increased to match the CCC's 2050 scenario.

We can also see the need for high levels of backup capacity. Pulling out an extreme day of high demand and low renewable output, we can see that there is a small amount of unserved energy, even with 80GW of flexible backup capacity and 50GW of gas CCS. The sample day used is 19 January 2016, with the CCC's peak demand (close to the 150GW peak) used to show a day of extreme high demand. These extreme days, with very high levels of renewable curtailment and utilisation of vast quantities of backup generation, illustrate the benefits of long-term storage.

There is no doubt the level of change that needs to be delivered is challenging, but it also necessary. The UK must decarbonise its economy and putting the right tools in place now will allow us to reach these ambitions in the most efficient way.

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