POLICY BRIEFING

January 2021

Net Zero Power Sector Scenarios

This Policy Briefing provides summary information on the power sector and renewables deployment scenarios used by the Climate Change Committee (CCC) in their report ***The Sixth Carbon Budget: The UK Path to Net Zero*[1]. ** This briefing is divided into 4 sections. The first section describes the Climate Change Committee Scenarios. Section 2 illustrates the electricity demand and generation in the UK by 2050. Section 3 shows the renewable capacity installed in the UK by 2050 and finally section 4 outlines some conclusions.

Key points of this briefing

- The purpose of this briefing is to provide members with information on the renewable energy deployment levels included in the CCC's advice to government, this is not a statement of industry's views on deployment levels.
- The deployment levels of different renewable technologies included in the CCC's 6th carbon budget are not immediately obvious and identifying these figures involves digging through the details of the methodology that accompanies the budget.
- SR have undertaken this task on behalf of members and provides this information in an easily accessible form.
- These deployment levels are based on meeting the UK's energy needs. The 6th carbon budget highlights the potential for exporting energy either as electricity or hydrogen. The deployment levels stated do not include any capacity for supporting the export market.
- The CCC makes no recommendations on how these levels of deployment would be distributed across the UK.
- We provide this information to inform industry discussions on future levels of deployment; discussions that are currently active and ongoing.

[1] https://www.theccc.org.uk/publication/sixth-carbon-budget/

1. Climate Change Committee (CCC) Scenarios

The scenario analysis of this report includes behavioural changes, lower residual emissions in several sectors, lower use of fossil fuels and higher levels of peatland restoration and tree-planting. For this, the CCC constructed 3 exploratory scenarios to reach net zero by 2050, one of which is similar to Further Ambition scenario developed in the 2019 report. The other two are more optimistic either regarding behavioural change or improvements in technology costs.

1. **Headwinds scenario**: Similar to the Further Ambition scenario of 2019. In this scenario people change their behaviour and new technologies develop, but we do not see widespread behavioural shifts or innovations that significantly reduce the cost of green technologies ahead of the CCC current projections. This scenario is more reliant on the use of large hydrogen and carbon capture and storage (CCS) infrastructure to achieve net zero.

2. **Widespread Engagement scenario**: In this scenario the CCC assumes higher levels of societal and behavioural changes. People and businesses are willing to make more changes to their behaviour. This reduces demand for the most high-carbon activities and increases the uptake of some climate mitigation measures. Assumptions on cost reductions are similar to Headwinds.

3. **Widespread Innovation scenario:** The CCC assumes greater success in reducing costs of low-carbon technologies. This allows more widespread electrification, a more resource- and energy-efficient economy, and more cost-effective technologies to remove CO_2 from the atmosphere. Assumed societal/behavioural changes are similar to Headwinds.

The CCC also constructed an exploratory scenario named Balanced Net Zero Pathway, as a further scenario that reaches net zero by 2050. It was designed to drive progress through the 2020s, while creating options in a way that seeks to keep the exploratory scenarios open.

4. **Balanced Net Zero Pathway scenario:** This scenario is informed by the range of solutions across the 'exploratory' scenarios that would put the UK on track to net zero and would meet the recommended carbon budget. According to the CCC assessment, this scenario is considered plausible and is the basis of the advice in this report.

Finally, the CCC constructed another scenario named Tailwinds scenario that goes beyond the balanced pathway to achieve net zero before 2050:

5. **Tailwinds scenario:** This scenario assumes success of both innovation and societal/behavioural change and goes beyond the Balanced Pathway to achieve net zero before 2050.

Key assumptions regarding the power sector across the scenarios

Sector	Balanced Net Zero Pathway	Headwinds	Widespread Engagement	Widespread Innovation	Tailwinds
Power generation	**Renewables make up 80% of total electricity generation.**	**Renewables make up 75%** of total electricity generation. Lower electricity demand due to greater use of hydrogen in homes.	**Renewables make up 85%** of total electricity generation.	**Renewables make up 80%** of total electricity generation. Highest electricity demand.	**Renewables make up 90%** of total electricity generation.
Hydrogen production	**Split of green and blue hydrogen production. Limited BECCS[2].**	High hydrogen demand. Mostly blue hydrogen production.	Low hydrogen demand. Mostly green hydrogen production.	Mostly green hydrogen production.	Mostly green hydrogen production and BECCS.
Gas removals	**BECCS used in generating power, hydrogen, biojet, energy-from-waste and industrial heat. Some DACCS[3].**	More BECCS used in power, hydrogen, and energy-from waste. No DACCS.	BECCS used mostly in power generation and biojet production. No DACCS.	Similar split of uses as in the Balanced Pathway. Large use of DACCS.	More BECCS used in power and hydrogen. Large use of DACCS.
Phase out of unabated gas	**2035**	2040	2035	2035	2035

2. Annual electricity demand and generation in the UK by 2050

Figure 1 shows the electricity demand from sectors for each scenario by 2050. In this, it is possible to see that the residential and non-residential buildings together will represent the highest electricity demand by 2050, followed by the manufacturing and construction and surface transport sectors.

[2] Bio-Energy with Carbon Capture and Storage.
[3] Direct Air Capture with Carbon Storage

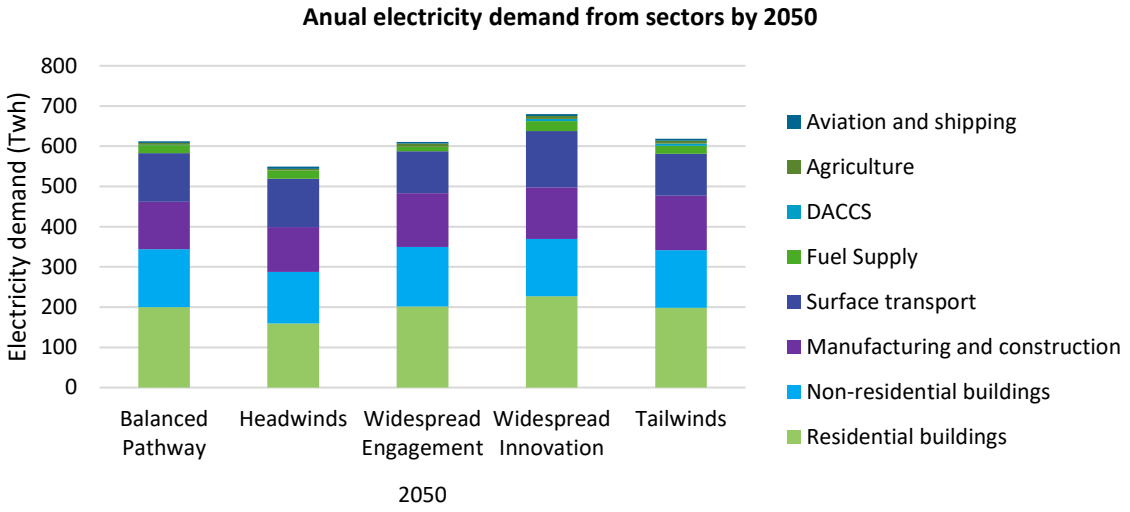

Figure 1: Annual electricity demand from sectors by 2050

Electricity demand doubles in the scenarios up to 2050, compared to current levels of around 300 TWh.

For each scenario, the CCC provided assumptions on electricity demand (Figure 1). These inputs reflect the use of electrification to decarbonise other sectors. This, in turn, was predominantly determined by the modelling carried out in those sectors, including surface transport, manufacturing, buildings, fuel supply, greenhouse gas removals, aviation and shipping.

Demand inputs included assumptions on flexibility provided by heat and transport. It was assumed that preheating and hot water tanks enable certain homes to shift their electricity demand four hours away from peak, while homes with storage heaters can shift their demand at all times. In transport, it was assumed that 80% of charging demand can be shifted up to eight hours outside of peak. – These demands already consider energy efficiency measures in buildings and industry, thus avoiding 40 TWh of new demand and helping to limit total demand to 610 TWh (for the case of the balanced pathway scenario).

Figure 2 illustrates the annual electricity generation in the UK by 2050. In this graph it is possible to see that renewable generation would represent the highest proportion of generation across all scenarios, with values between 75% and 90 % of total generation.

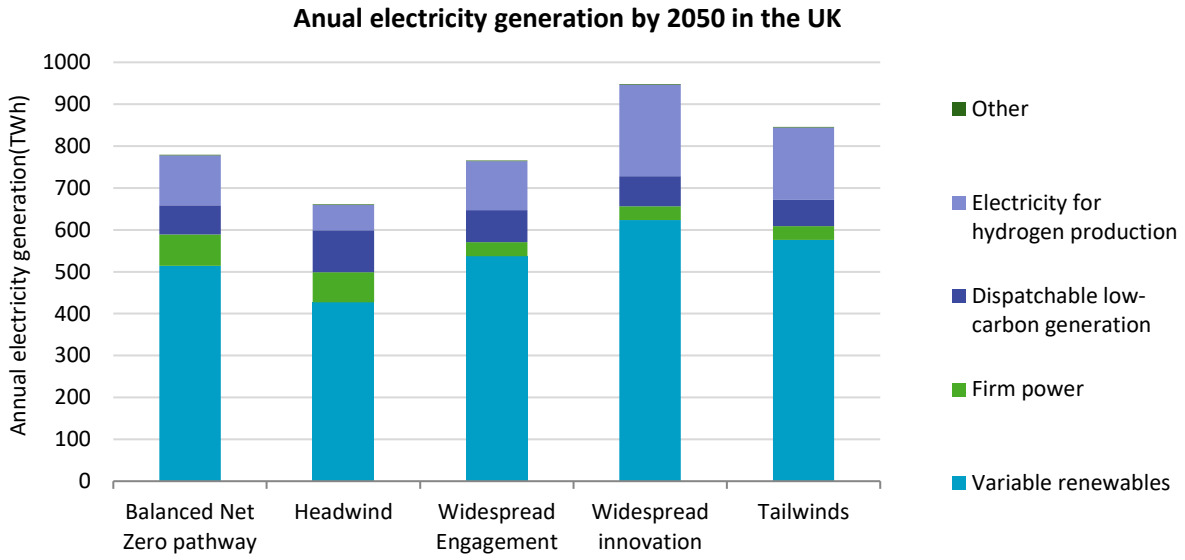

Figure 2: Annual electricity generation by 2050 in the UK

The Chart reflects UK electricity generation. Additional capacity is available through interconnection. Variable renewables include wind and solar. Firm power includes nuclear. Dispatchable low-carbon generation includes gas CCS, BECCS and hydrogen.

3. Electricity generation mix for UK in 2050 in five CCC net zero power sector scenarios.

Capacity ranges were another key modelling input. For each scenario and each year, the model could select from a range of possible capacity levels of different generation technologies, including wind, solar, gas CCS and nuclear. This range was informed by existing capacity that represented a lower bound while historical build rates provided the basis to estimate an upper limit.

Table 1 shows the installed capacity per renewable technology by 2050. The values for offshore wind, onshore wind and solar PV were obtained/deduced directly from the CCC report, while the values for wave and tidal, and hydropower were calculated as follows:

Wave and tidal: A very conservative scenario is assumed. This considers that in the balanced pathway scenario all the capacity in the pipeline today (1.2 GW) is deployed by 2030 and maintained by 2050. For the rest of the scenarios the value is calculated proportional to the electricity generation.

Hydropower: A conservative scenario is assumed as well. This considers 1 GW of deployment by 2050 in the balanced pathway scenario[4]. For the rest of the scenarios the value is calculated proportional to the electricity generation.

[4] This value is based on a report from the Imperial College London, page 110. https://www.theccc.org.uk/wp-content/uploads/2018/06/Imperial-College-2018-Analysis-of-Alternative-UK-Heat-Decarbonisation-Pathways.pdf.

Table 1: Renewable installed capacity by 2050 in the UK

	Installed capacity (GW)				
Area	**Balanced Net Zero pathway**	**Headwind**	**Widespread Engagement**	**Widespread innovation**	**Tailwinds**
Offshore wind	**95**	65	100	140	125
Onshore wind	**30**	25	30	35	35
Solar PV	**85**	85	80	90	75
Wave and tidal	**1.2**	0.0	1.2	1.5	1.3
Hydropower	**1.0**	0.8	1.0	1.2	1.1
Total	**210**	175	211	266	236

Figure 3 illustrates the renewable capacity installed by 2050 for each renewable technology in the UK. In this it is possible to see that offshore wind as well as solar PV will represent more than the 70 % of the total renewable capacity installed by 2050.

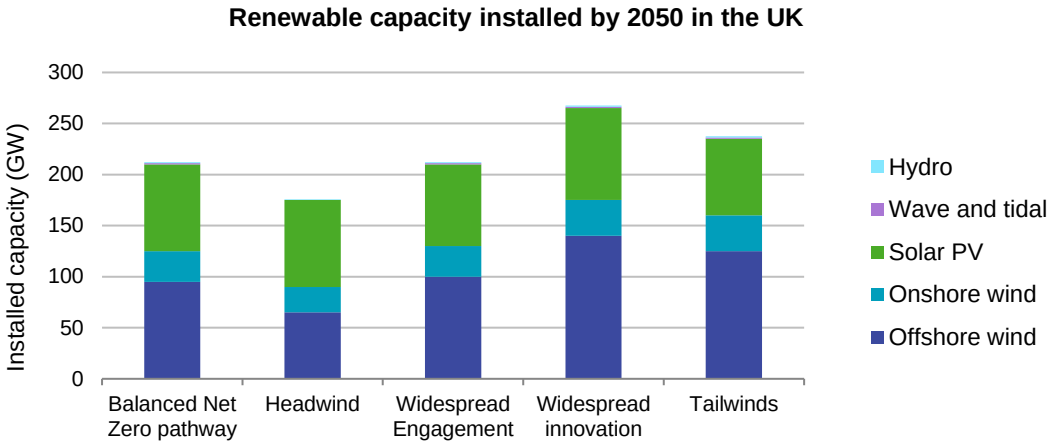

Figure 3: Installed capacity by 2050 for five scenarios in the UK

4. Conclusions

All the scenarios rely on sustained growth in the UK's offshore wind capacity, which will require consistent lease and CfD auctions to facilitate investment in project development. The UK, primarily England, also needs to rapidly increase the installation of solar PV to meet the CCC's net zero energy mix.

Most scenarios consider the phase out of gas by 2035 except the Headwind scenario which considers the phase out of gas by 2040.

The Headwind scenario considers that people change behaviour and demand is reduced. Additionally, this scenario is more reliant on the use of large hydrogen (mostly blue) and BECCS infrastructure to achieve net zero. Therefore, this scenario includes lower levels of renewable capacity installed compared to others.

All scenarios consider high levels of electrification.