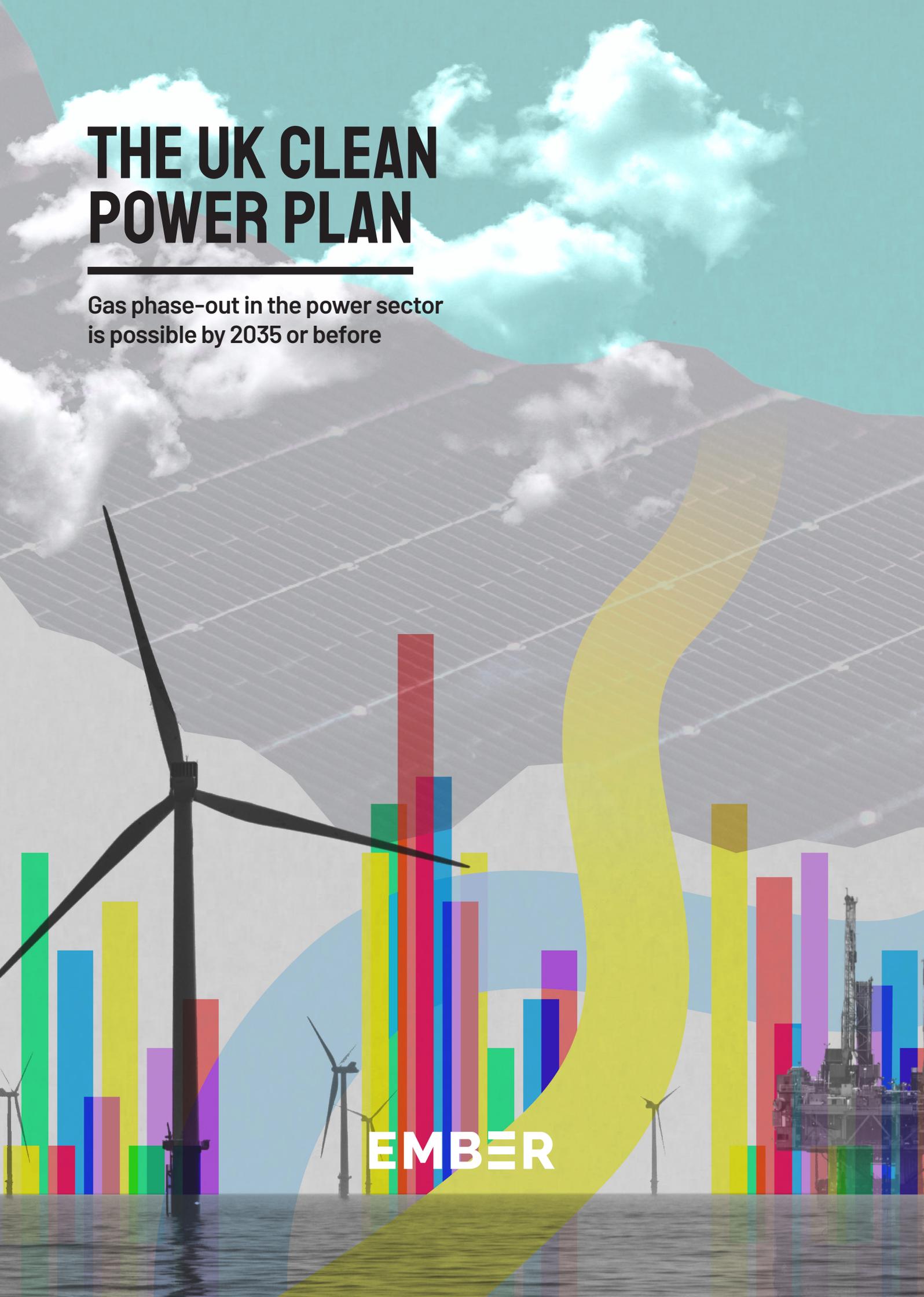


THE UK CLEAN POWER PLAN

Gas phase-out in the power sector
is possible by 2035 or before



EMBER



About this briefing

This briefing compares scenarios for decarbonising the UK power sector by 2035 that have been developed by three independent analysts and expert groups. We find there is broad consensus among models on the need to phase-out of unabated gas power and increase the share of renewables in order to decarbonising the power sector cost-effectively by 2035.

Authors

Phil MacDonald and Wilf Lytton.

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Executive Summary

In 2015, the UK led the world by committing to a coal phase-out, becoming the first nation to do so. Scores of governments have followed¹ and transitioning away from coal is recognised globally as a critical first step towards tackling climate change. Now, ahead of the crucial COP26 summit in Glasgow, the UK can again lead the world by committing to the phase-out of unabated gas in the power sector and supercharge the domestic green industrial revolution across the country. A gas phase-out also gives the UK the opportunity to swiftly move away from expensive imported gas, and instead build cheap domestic renewables.

“It is possible to phase out unabated gas by 2035 and build a power system with 75% to 90% share of variable renewable generation by 2050.”

The Climate Change Committee, Sixth Carbon Budget,

“Emissions from power generation fall to net zero in advanced economies by 2035 and globally by 2040.”

The International Energy Agency (IEA), [Net Zero by 2050](#)

Experts agree

This briefing summarises the findings from three expert groups, who show that a zero-emissions power sector is possible and desirable for the UK. The Climate Change Committee, National Grid, and the Energy Systems Catapult have demonstrated the UK power sector can be more than 99% fossil free by 2035 or before. This timescale fits with the International Energy Agency’s analysis - to reach global net zero emissions by 2050, all OECD power sectors must be net zero emissions by 2035, followed by a fully net zero global power sector by 2040. Moreover, this transition can be done without risking security of supply.

1. <https://www.poweringpastcoal.org/members>

Countries agree

An unspoken consensus is emerging across influential countries and blocs that the first step on the road to net zero by 2050 is a zero-emissions power sector by 2035, as Ember outlined in this [recent report](#). In the United States, President Biden has committed the country to “a carbon pollution-free electricity sector no later than 2035”. And in the European Union, the ‘Fit for 55’ package indicates nearly zero-carbon electricity across the bloc by the mid-2030s.

Models agree

A zero-emissions power sector is the next major step towards meeting the UK’s economy-wide target of net-zero emissions by 2050. By replacing fossil power with clean electricity, the power sector can enable the decarbonisation of other sectors of the economy, including heating, transport and industry. In this briefing, we compare the key findings of modelling by the CCC, National Grid and ESC scenarios, and show how they all point towards the decarbonisation of the UK power sector in the 2030s.

Three scenarios for the UK

	Fully decarbonised electricity by	Generation by renewables in 2030	2035 electricity generation (approx. TWh)	2050 electricity generation (approx. TWh)
CCC Balanced Pathway	2035	60%	Wind - 265 TWh Solar - 60 TWh Gas CCS - 30TWh Hydrogen - 20 TWh BECCS - c. 15 TWh	Wind - 430 TWh Solar - 85 TWh
National Grid ESO	2035 (>99% clean power) 2030 (>97% clean power)	86-90%	Wind - 330-425 TWh Solar - 30-47 TWh Gas CCS - 0-5 TWh Hydrogen - <1 TWh BECCS - 17-26 TWh	Wind 514-645 TWh Solar - 50-81 TWh Gas CCS - 0-19 TWh Hydrogen - 1-7 TWh BECCS - 36-53 TWh
ESC/Good energy (Zero Carbon Britain)	2030	84%	Not available	Wind - 420 TWh* Solar - 130 TWh* Tidal - 45 TWh* Geothermal - 40 TWh*

* Figures estimated from ESC/Good Energy report. CCS is Carbon Capture and Storage. BECCS is Bioenergy with Carbon Capture and Storage

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Introduction

The Government's recent enshrining in law of a 78% reduction in UK greenhouse gas (GHG) emissions by 2035 (compared to 1990 levels) will lead to a major shift in the UK's energy system in the coming decade.² The Government now needs to strengthen its strategy for meeting that target. Key to that will be the phase-out of unabated gas-fired electricity generation in the UK, effectively removing the last major source of power sector emissions. Several pathways have been put forward to address the question of how and when the phase-out of unabated gas power should take place and this briefing examines the main features of three prominent pathways: the Sixth Carbon Budget by the Climate Change Committee (CCC), Energy Systems Catapult's (ESC) modeling for Good Energy, and National Grid's *Future Energy Scenarios 2021*.

In the [Sixth Carbon Budget](#), the CCC advised the Government to phase out unabated gas power by 2035 in order to meet the 78% GHG reduction target - a similar timeline to the IEA's [Net Zero by 2050 roadmap](#), which proposes net zero power sectors in all OECD countries by 2035. The ESC modeling indicates that a fully decarbonised electricity grid can, however, be achieved sooner—by 2030—through a more rapid expansion of renewables if more supportive policies are put in place. In this year's edition of their annual [Future Energy Scenarios](#), National Grid set out three credible pathways to reach net-zero by 2050 and found that each scenario requires significantly less than 1% unabated fossil fuels by 2035, with more than 80% of power generation supplied from wind and solar.

Irrespective of the pathway chosen, there is a broad consensus that signalling an end to unabated gas power delivers benefits beyond simply meeting emissions targets. It provides opportunities to promote energy self-sufficiency, low-cost electricity, and champion British businesses involved in delivering clean energy. The Government has already committed to reducing the UK's contribution to climate change by [ending support for fossil fuel energy overseas](#) in March this year. The CCC's advice to phase-out unabated gas power by 2035 presents an opportunity to now adopt a similar approach for the UK.

2. <https://www.gov.uk/government/news/uk-enshrines-new-target-in-law-to-slash-emissions-by-78-by-2035>

Why act now?

Concrete action to cut emissions taken in the short-term will build confidence in the Government's net-zero vision for the UK. A rapid transition to a clean power sector unlocks decarbonisation everywhere else in the economy, through electrification of heat, transport, industry and more. The success of the UK coal phase-out, announced in 2015, demonstrates that climate leadership and levelling up the country go hand in hand. And rather than [raising electricity prices and increasing our dependence on expensive gas sourced from overseas](#), as some feared the coal phase-out would lead to, it instead ushered in a new generation of low-cost renewable energy technologies, diversified electricity supply, created new skilled jobs across the country, and brought much needed investment to the UK's electricity infrastructure, yielding benefits to both business and consumers years ahead of the official phase-out deadline. The gas phase-out can repeat that success.

Lower electricity bills

This year's rocketing energy bills are being driven by the growing cost of imported fossil gas. The monthly average day ahead price had more than doubled over the course of December 2020 to January 2021, a trend that a forthcoming briefing from Ember will dig deeper into. The UK can move quickly to reduce fossil gas imports by generating an increasing proportion of its electricity from much cheaper wind and solar power.

International impact

Later this year, the UK will host the United Nations Climate Change Conference (COP26) and our ambition and record on tackling climate change will come under international scrutiny. The UK has been gifted with an opportunity to capitalise on the hard won successes of its decarbonisation strategy by committing to the phase-out of unabated gas-fired electricity generation by 2035. Both the CCC's Sixth Carbon Budget and National Grid's *Future Energy Scenarios* reports show this is well within our grasp, while analysis by Ember shows [wind power has already pushed gas use in the UK to a 5 year low](#).

Announcing a phase-out of unabated gas power would also extend the UK's ambitions ahead of those of continental Europe and help to cement transatlantic ties with the Biden administration, which in April 2021 published its own plans for fully decarbonising the US electricity sector by 2035.

A green industrial revolution

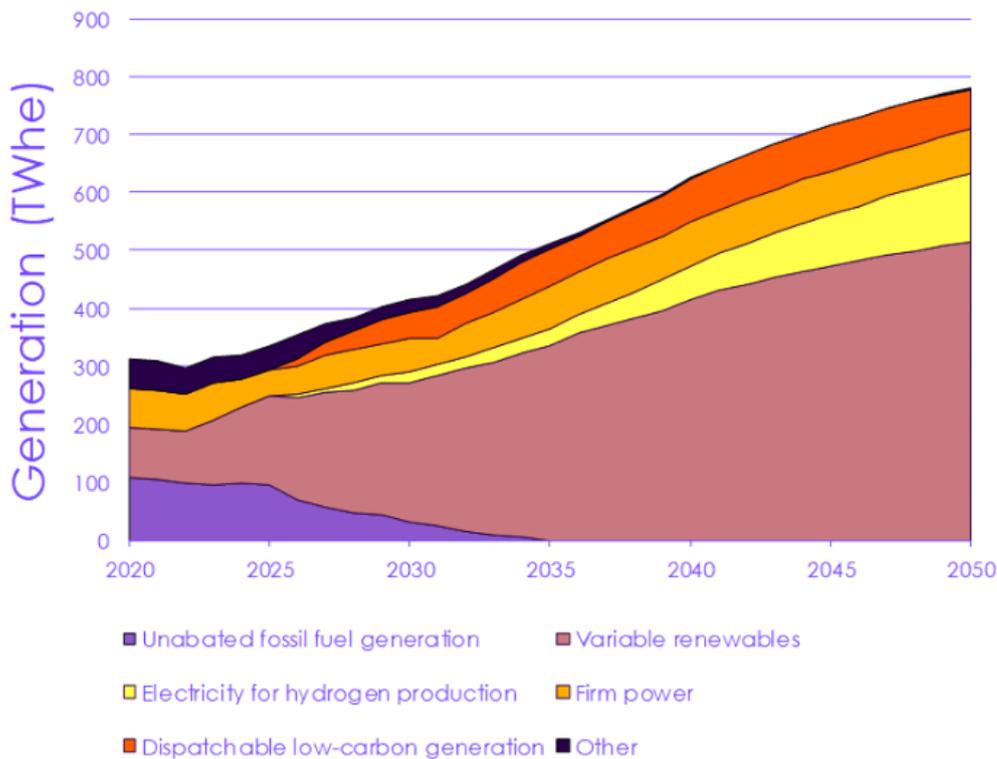
As the UK re-asserts its economic and political independence, the country can take advantage of access to an abundance of coastal areas suitable for offshore wind development to achieve energy security, cut electricity costs, and reduce dependence on imported fuel and electricity in the process. Indeed, the Offshore Renewable Energy (ORE) catapult suggests [the almost limitless potential of UK offshore wind can lead to a boom in green hydrogen which “can match best years of North Sea oil and gas”](#). Drawing a line under fossil gas brings the UK one step closer to a future where we are an energy and technology exporter, not importer.

Finally, the Government has committed to levelling up the UK economy by supporting communities across the country. Renewable energy is one of the fastest growing sources of employment in the UK, providing skilled jobs and distributed benefits, particularly for areas bordering the North Sea. Indeed, [the UK’s green economy is now four times larger than its manufacturing sector](#). A phase-out of gas in power will make it easier for renewable electricity providers to secure investment in new capacity, creating more opportunities in these regions, including for those recently employed in the oil and gas industry.

What the Sixth Carbon Budget says

To date, the UK has successfully cut emissions faster than required by the Climate Change Committee’s carbon budgets, but will need to make new commitments to stay within its carbon budgets beyond 2023. The CCC’s central scenario (‘Balanced Net Zero Pathway’) is predicated on electricity sector emissions falling rapidly from the mid 2020s. For this to happen, the CCC advises that **‘the burning of unabated natural gas for electricity generation should be phased out entirely by 2035’** while **‘the low-carbon share increases from 50% now to 100% by 2035.’** Gas-fired plants operating beyond 2034 would be required to either capture and store their CO₂ emissions using CCS or burn low-carbon hydrogen.

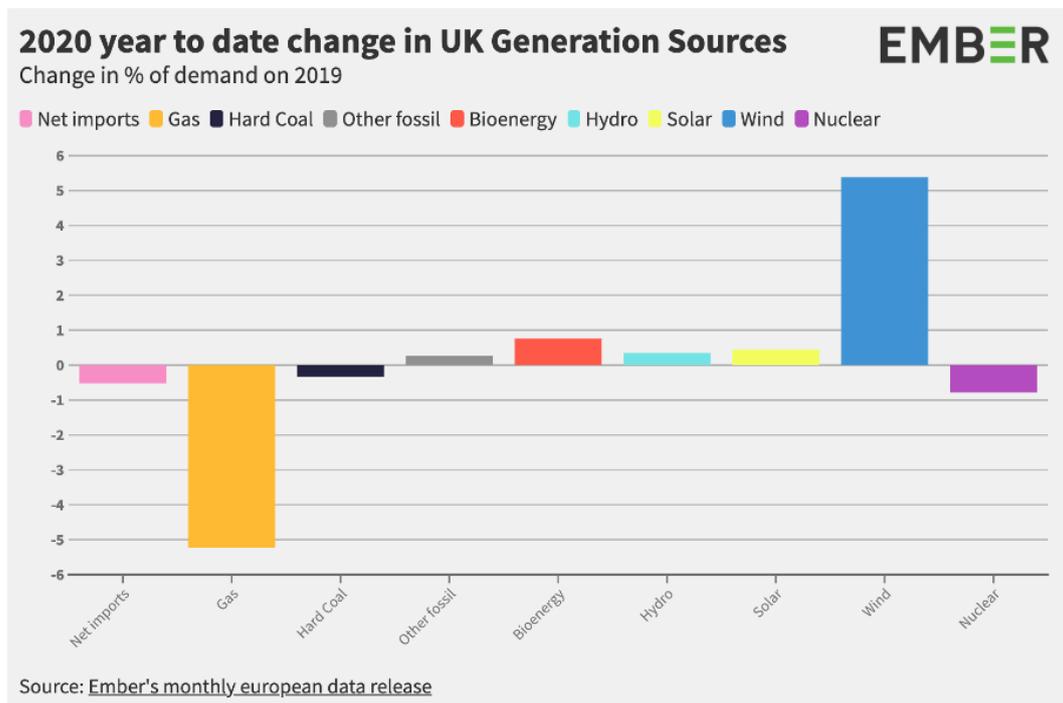
Figure 3.4.c Illustrative generation mix for the Balanced Net Zero Pathway (2020-50)



To meet this ambition, the CCC has made the following recommendations to Ministers in the Sixth Carbon Budget:

1. **Ahead of COP26, the Government should commit to a 2035 unabated gas phase-out for the electricity sector**
2. **Legislate to ensure any new gas plant must be genuinely ready for Carbon Capture and Storage and/or hydrogen conversion: with a requirement that they are located in areas that will be supported by CO₂ and/or hydrogen infrastructure**
3. **Legislated end to any new build unabated gas by 2030**

Analysis carried out by Ember shows [growth in wind power has pushed UK gas generation to a 5 year low](#), with a sizable drop in gas power demand and corresponding uptick in wind power. Requiring gas plant operators to develop plans for decarbonising or retiring their fossil assets by 2035 will ensure this trend continues, providing a sufficient lead-in time to deploy low-carbon forms of generation to replace them.



What are the uncertainties?

The CCC's projections are not the default outcome: rather, they require that the Government takes a series of actions in the immediate future that will reduce the overall cost and risks associated with decarbonising the UK's electricity generation. There are important decisions to be made over the role of CCS and hydrogen and how to accelerate the growth of renewables.

Security of supply

“without [gas CCS and hydrogen] the electricity system would require further reductions in demand, higher flexibility, and extensive storage”

Sixth Carbon Budget, Electricity Sector Summary, pg 32

Security of electricity supply can be maintained even with slower construction of gas CCS and/or hydrogen, but it would require significant changes to the electricity system. Demand is a major variable: in other CCC scenarios, including Headwinds, demand is significantly lower, which leads to a lower requirement for firm capacity. Similarly, accelerated deployment of wind and solar; innovation in long-term energy storage; and higher flexibility, all serve to reduce the level of gas CCS.

The Sixth Carbon Budget also allows for the maintenance of some unabated gas capacity as an emergency reserve for dunkelflaute (wind drought). These plants would have *extremely* low load factors, and so would require a new business model or policy to enable their operation. However, this may not be necessary if there is progress on gas CCS or longer term energy storage. A government commitment to gas phase-out could be worded to allow for this, either by specifying the phase-out applied 'to normal operation' or giving the secretary of state the power to intervene if security of supply was threatened. Similar caveats were present in the initial coal phase-out commitment, but were quickly made obsolete by technology improvements.

Fossil gas with CCS and hydrogen

The CCC's scenarios rely on the UK maintaining gas-fired power generation with CCS from the 2020s onwards. Despite the relatively high cost of CCS, the CCC see dispatchable gas power as an important component in the UK's energy system, acting as a counterbalance to variable renewable generation. The CCC's estimate for the total volumes of CO₂ drawdown required—45-95 MtCO₂/year by 2050—is equivalent to 10-20% of UK economy-wide emissions in 2019. However, in two of the five scenarios developed by the CCC, net-zero emissions are achieved by 2050 with minimal CCS.

Low carbon hydrogen might also be used in dispatchable generation in place of fossil gas³ if it can be shown to be cost-effective. Under the CCC Balanced Pathway, hydrogen gas plants provide 20 TWh of generation by 2035, meeting 5% of demand.

Maintaining Nuclear

The Sixth Carbon Budget recognises the zero-carbon and ‘Firm power’ contribution of nuclear, consistently providing around 20% of UK generation from just ~10GW of capacity. In most scenarios the CCC models a maintenance of that capacity, requiring limited new build to replace retiring plants, but not significant growth. However, *if* costs were reduced significantly, or Small Modular Reactors became available, the CCC notes an opportunity for a significant increase in nuclear capacity. This speculative growth is not a key contingency for the gas phase-out, however.

Accelerated renewable growth

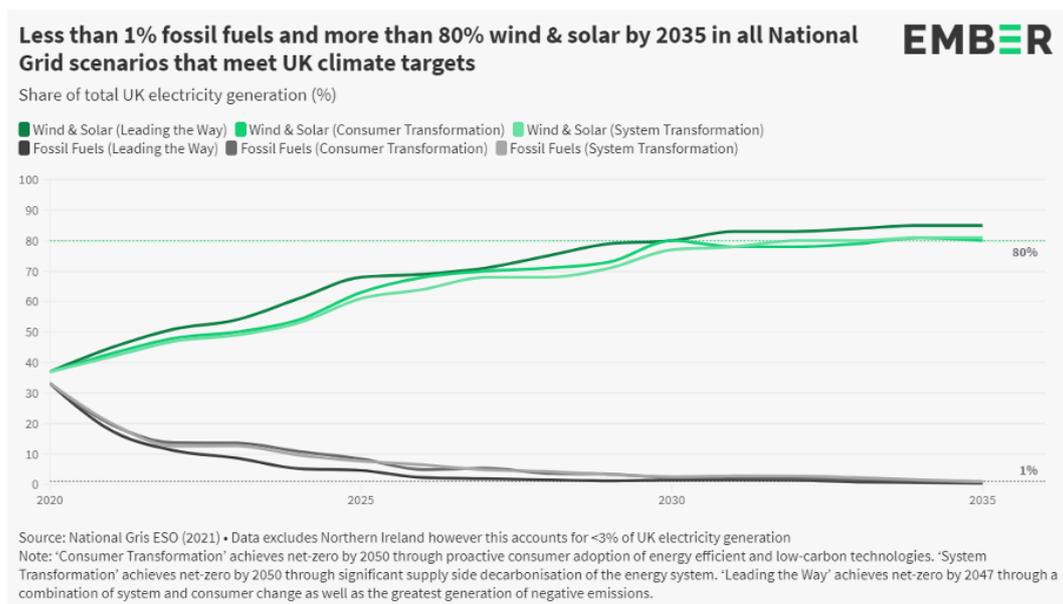
The growth and cost reduction of renewable generation in recent years has outperformed most analysts’ expectations and in all scenarios is likely to replace much of the gas capacity closed by 2035. The CCC’s Balanced Pathway sees wind and solar contributing 75-90% of electricity supply by 2050, up from the 50-75% in the CCC’s 2019 Net-Zero report. All other CCC scenarios (other than *Headwinds*) have even higher renewable growth, with as much as 245 GW offshore wind possible. Greater availability of wind and solar drives down the residual generation required from other technologies.

3. Climate Change Committee. (2020). The Sixth Carbon Budget: The UK’s path to Net Zero. pp135

What National Grid says

Each year National Grid, the UK's electricity system operator, with the help of a wide range of stakeholders, models a range of different, credible ways to decarbonise the UK energy system by 2050.

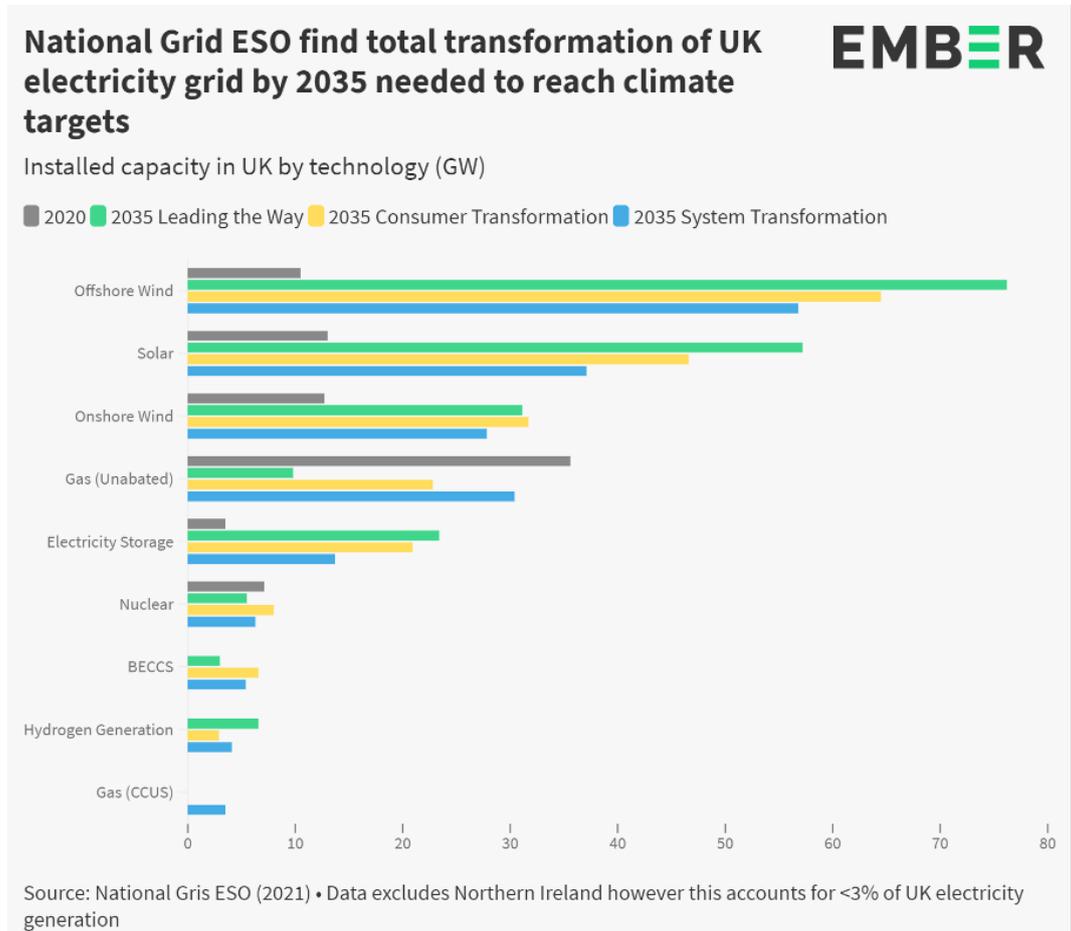
In the latest Future Energy Scenarios, released in July 2021, **all of National Grid's scenarios which meet UK climate targets require less than 1% unabated fossil fuels by 2035.**⁴ Additionally, Grid sees renewables accounting for 86-90% of power generation by that date, of which at least 80% is from wind and solar. To achieve this, renewable electricity capacity expands rapidly to 2035, led by offshore wind which increases up to almost eight fold by 2035 (10.5 GW in 2020 and 56.8-76.2 GW in 2035). Some unabated gas capacity does remain available for security of supply but its contribution to power generation is so low as to be negligible.



Importantly, following the rapid expansion of wind and solar the UK becomes a significant net exporter of electricity in all scenarios reaching 65-111 TWh in 2035, equivalent to 15-20% of domestic generation. This lays the foundations for the UK to expand as a massive exporter of clean power through to 2050, particularly with the advent of recent successful trials of floating offshore wind in Scotland.

4. Clean power by 2035 to meet climate targets says National Grid (Ember - August 2021) <https://ember-climate.org/commentary/2021/08/11/clean-power-by-2035-to-meet-climate-targets-says-national-grid/>

As well as large growth in wind and solar, National Grid scenarios rely upon a significant increase in energy storage capacity, and some increase in hydrogen. Grid see a similar capacity of nuclear power in 2035 to today, but place a much smaller emphasis on gas CCS than the CCC models. BECCS plays a small role, at a similar capacity to the CCC.



What the Energy System Catapult modeling says

Whilst the bulk of modeling to date has gravitated towards 2035 as a realistic deadline for the end of unabated gas, [a stretch date of 2030 is proposed in modelling by the Energy Systems Catapult, for the renewable energy company Good Energy](#). We're including this in the briefing to highlight that accelerated scenarios exist. The model imagines how to build a clean electricity system without nuclear or CCS.

ESC's modeling sees **renewables accounting for 84% of electricity generation by 2030**, compared to the CCC's estimate of 60%. Wind and solar generation dominate their 2050 scenario although tidal and geothermal power make significant contributions. ESC's analysis assumes a very limited role for nuclear power while fossil energy sources (including for hydrogen production) are completely removed from the electricity system by 2050. To maintain system flexibility, ESC's scenarios rely on significant electricity storage capacity with **140 GW of grid and domestic storage by 2050** under their *Zero Carbon Britain* scenario.



To achieve a fully decarbonised electricity sector by 2030, ESC makes a number of policy recommendations, including:

- Hold yearly Contracts for Difference auctions for renewables
- Develop a stable and wide-ranging carbon price
- Incentivise the installation of solar panels on new buildings
- Change the role of the Capacity Market and balancing mechanism to meet the demands of net-zero
- Create incentives to utilise surplus renewable power, for example, in the production of green hydrogen, or to build utility-scale battery sites.

In a nutshell

Multiple independent models agree that phasing out unabated gas-fired electricity generation by 2035 is essential to meet the UK's legislated carbon targets, and carries few risks if government decisions are made swiftly for a smooth transition.

All the models agree that renewables will be at the core of this transition, especially offshore wind and solar, and so the Government's focus must be on ensuring rapid deployment in those sectors. A step change in capacity for energy storage is also essential in all scenarios, as is a growing hydrogen sector. In all models we assess here, unabated gas power has been reduced to just a few percent of total annual generation by the end of this decade.

The models disagree on the size of the role for gas CCS and nuclear, but suggest that they will likely play a role in stabilising the 2035 grid, albeit likely a small one.

If a strong commitment is made by Government in 2021, the UK grid can be almost free of the cost and emissions inherent in fossil gas use by the end of this decade, and have fully eliminated it from the power sector by 2035. Such a phase-out could help accelerate the green industrial revolution in the UK, as well as forge new international partnerships united in the transition to clean electricity. COP26 serves as a platform to demonstrate leadership and multilateral cooperation on climate change. Committing to a gas phase-out now will enable us to deliver net-zero by 2050.

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