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Unpacking the Sixth Carbon Budget – The transition for energy

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Climate
Change
Committee

Agenda

1. **Our approach**
   Outline of methodological approach to the Sixth Carbon Budget

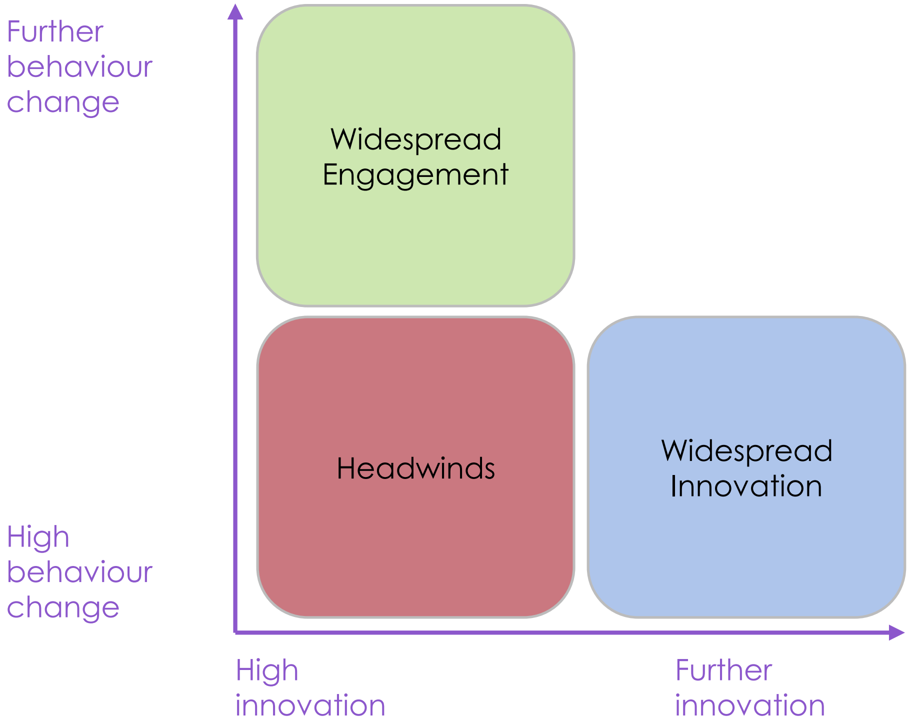
2. **Our recommended path**
   Emission pathways, costs and co-impacts, and policy recommendations

Chapter 1

Our approach

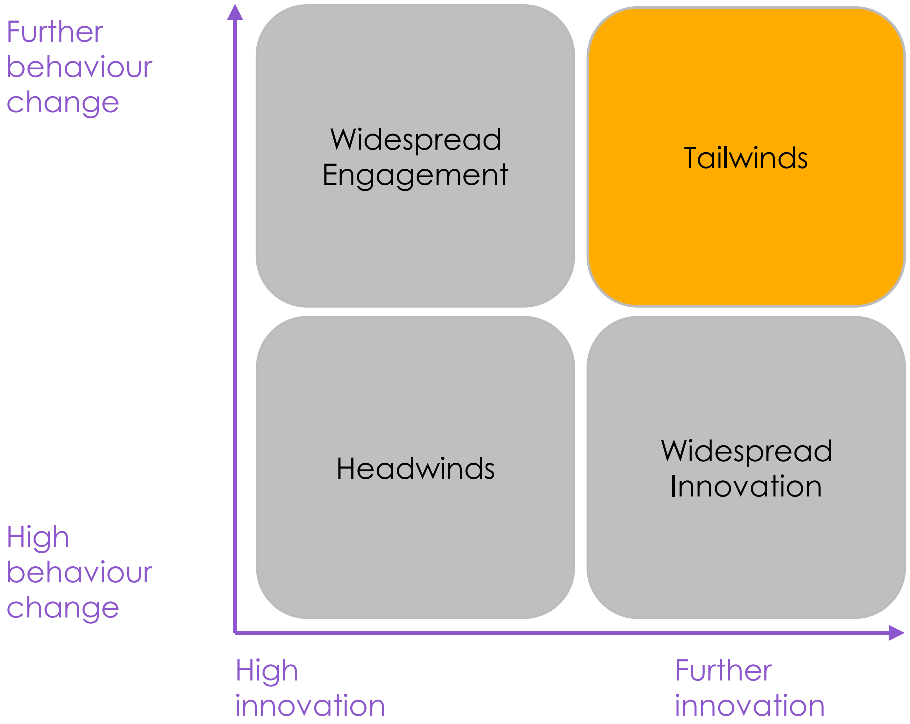
Our approach

Three exploratory scenarios to reach Net Zero by 2050



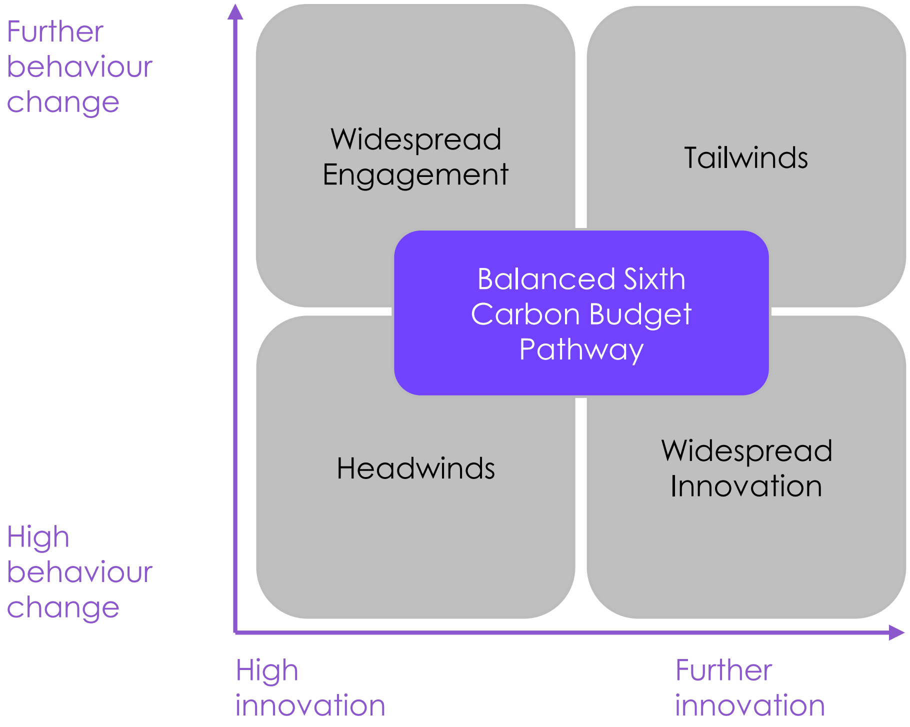
Our approach

One highly optimistic scenario with success on infrastructure, innovation, societal and behavioural change

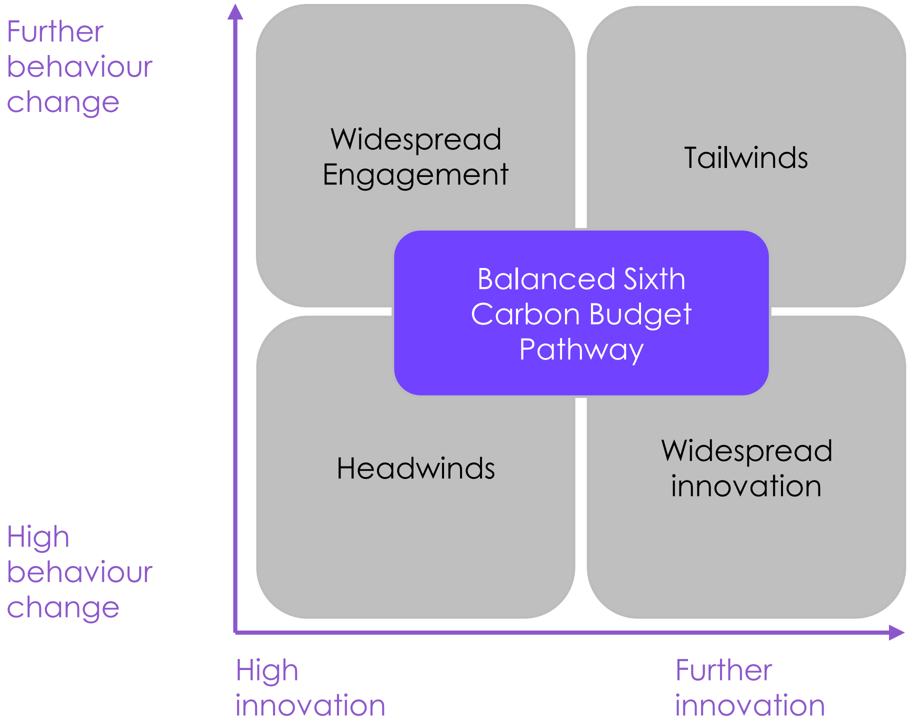


Our approach

A balanced pathway to keep options open



Our approach
Consistent with the Paris Agreement

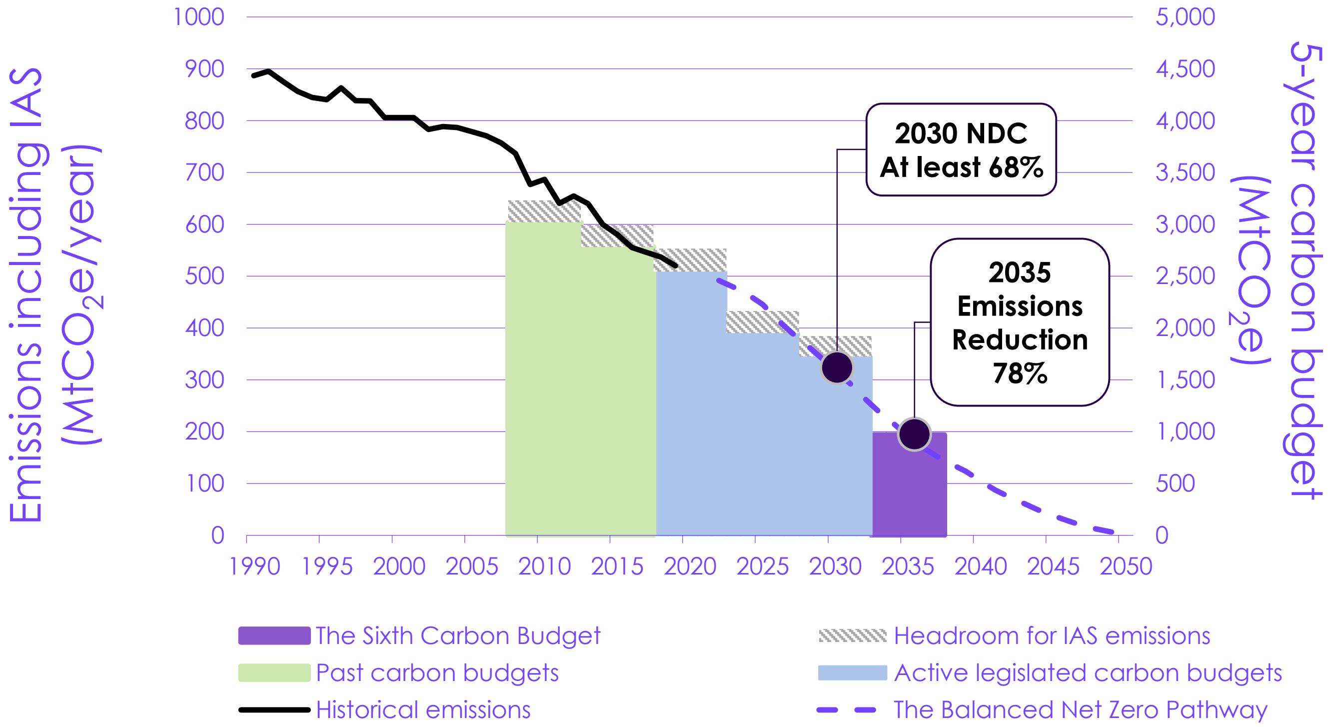


Climate science and international circumstances

- Need deep reductions globally to 2030 to keep 1.5°C in play
- Paris demands 'highest possible ambition'
- UK leadership matters as President of COP26
- Equity arguments reinforce need for strong UK action

Our recommended path

The recommended sixth carbon budget and 2030 NDC



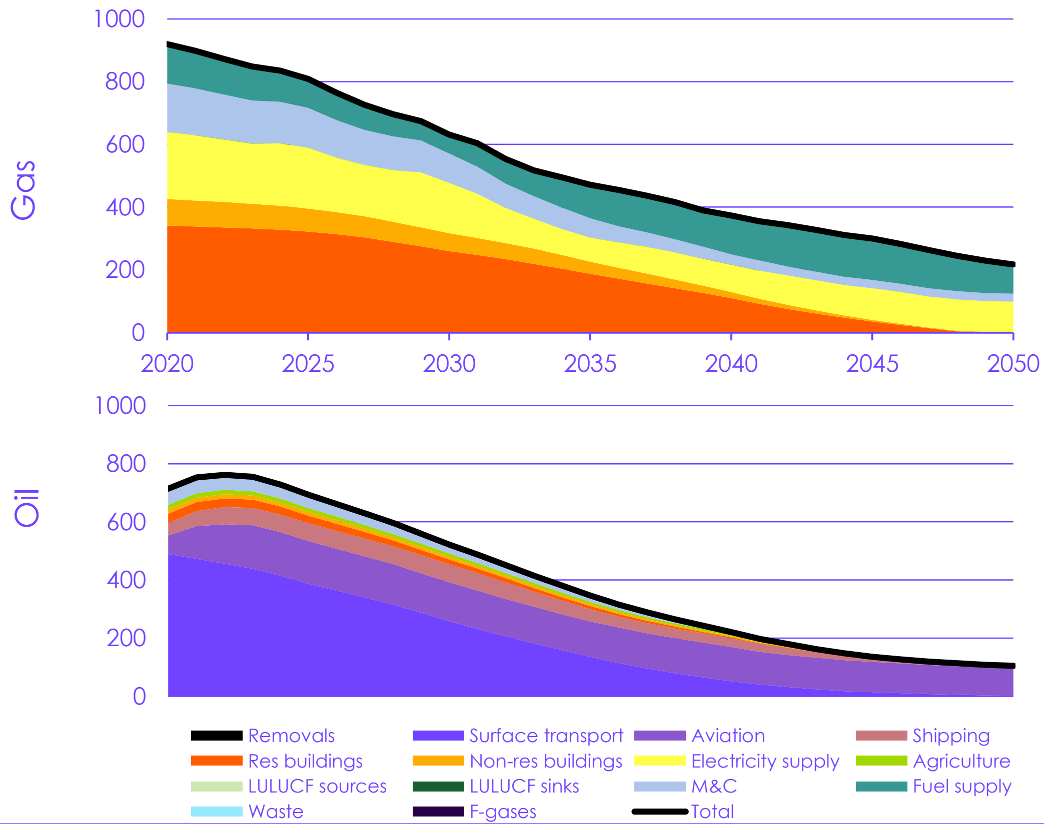
Notes:
Emissions shown including emissions from international aviation and shipping (IAS) and on an AR5 basis, including peatlands. Adjustments for IAS emissions to carbon budgets 1-3 based on historical IAS emissions data; adjustments to carbon budgets 4 and 5 based on IAS emissions under the Balanced Net Zero Pathway.

Source:
BEIS (2020) Provisional UK greenhouse gas emissions national statistics 2019; CCC analysis.

Our recommended path

Changes in energy demand

Fossil fuels (TWh)



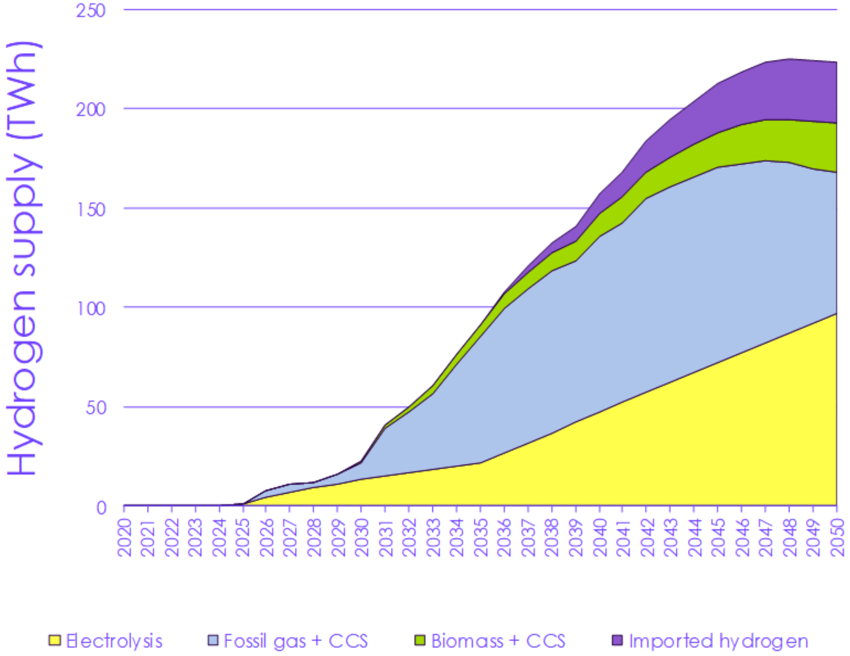
Fossil fuels are largely phased out

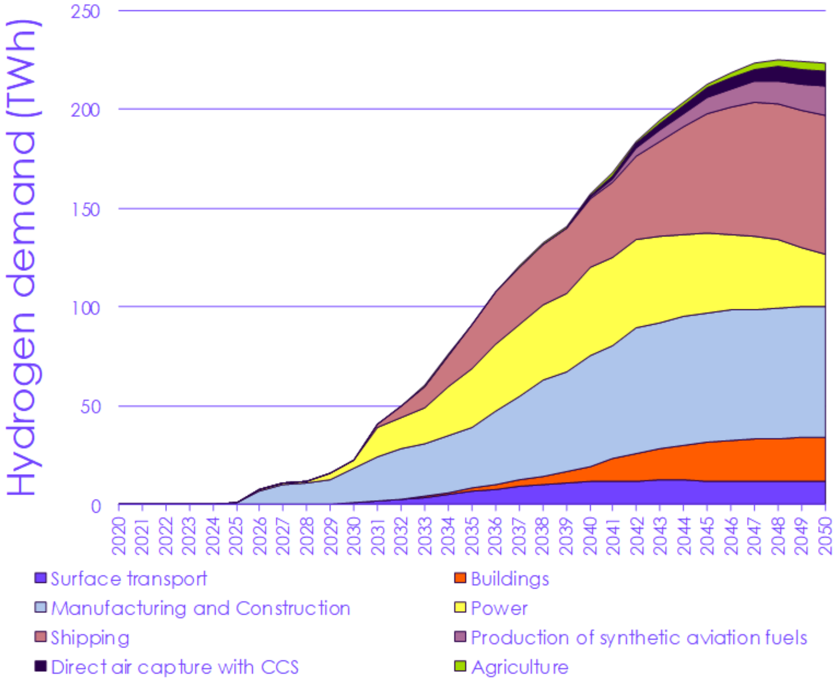
- Demand falls significantly to 2050 for oil (-85%) and natural gas (-70%)
- Petroleum is mainly restricted to the aviation sector,
- Natural gas use is limited to combustion with CCS for power generation and industrial processes and phased out of use in buildings.

Source: CCC Analysis.

Hydrogen supply and demand

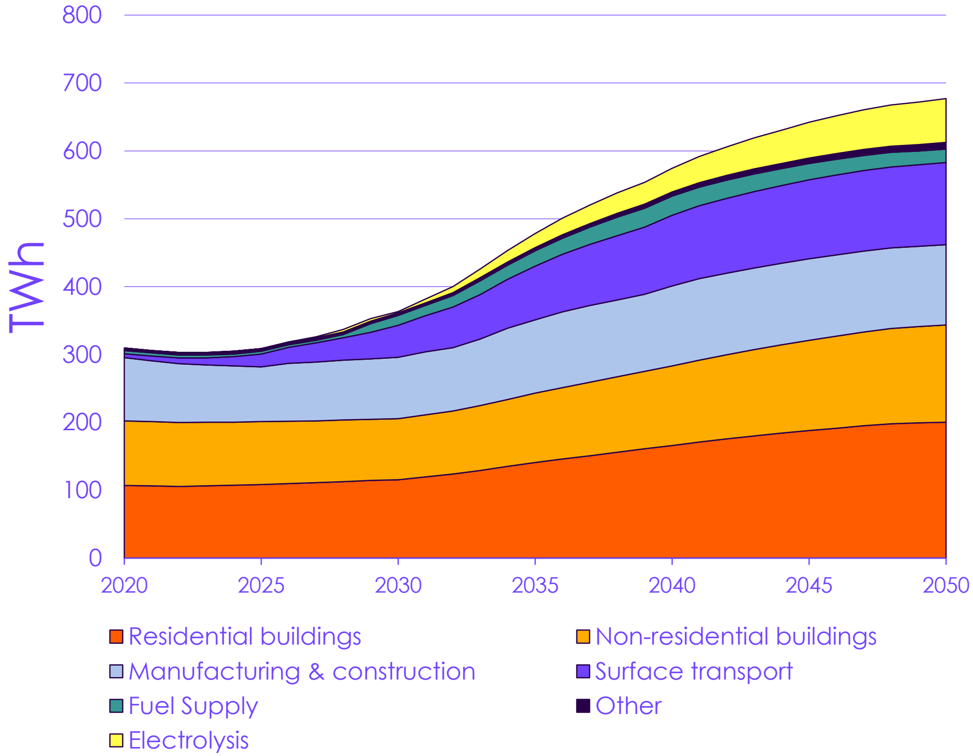
By 2050 the hydrogen economy is comparable in scale to existing electricity use





Source: CCC Analysis.

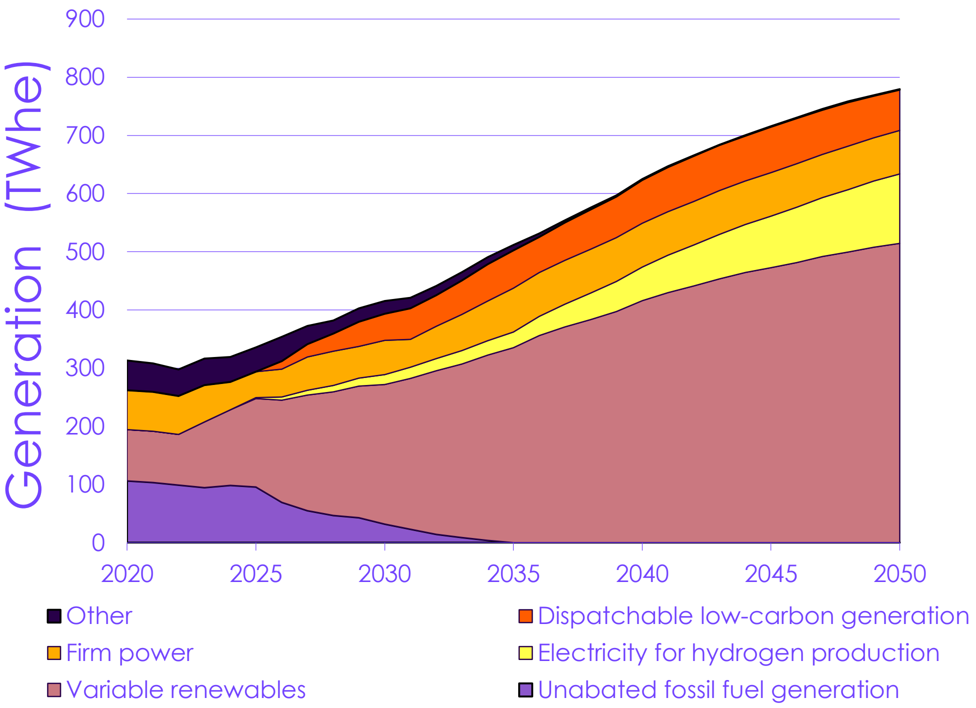
Demand for electricity
Changes from now to 2050



- Current demand for electricity is around 300 TWh per year. Under the Balanced Pathway that increases by 50% to 2035 and doubles out to 2050.
- The Balanced Pathway has an increase in electricity demand from buildings, manufacturing and construction as those sectors partially electrify.
- Significant new sources of electricity demand arise from electrification of surface transport, and for the production of hydrogen using zero-carbon electricity.

Source: CCC Analysis

Electricity generation mix (Balanced Pathway)
Changes from now to 2050

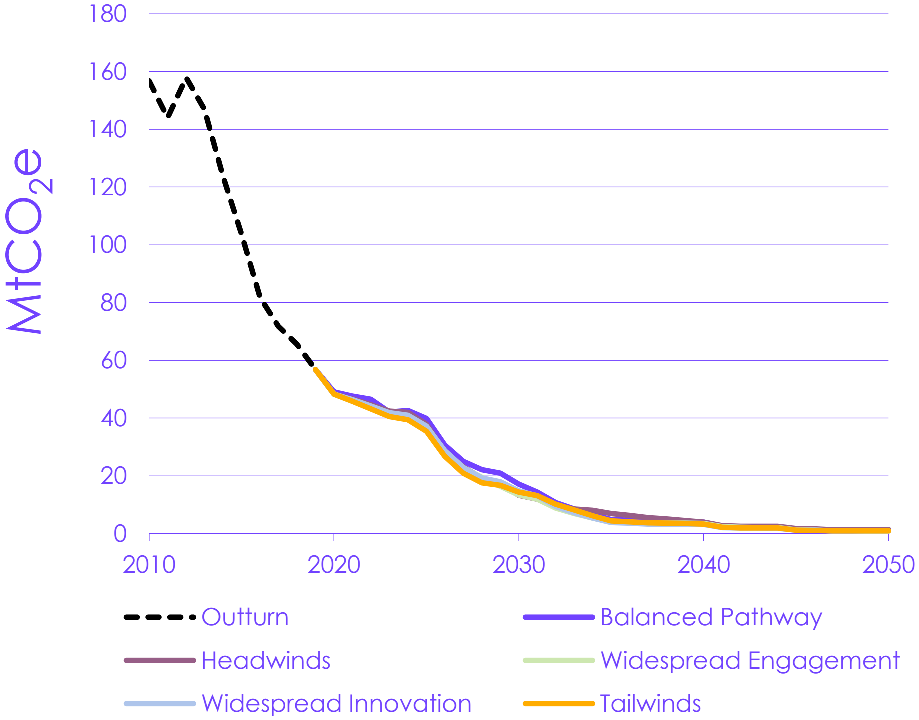


Key features of the Balanced Pathway include:

- Phasing-out of unabated gas generation by 2035
- An expansion of variable renewables, so that it provides 80% of generation by 2050
- Increasing use of surplus generation to produce zero-carbon hydrogen
- New sources of dispatchable low-carbon generation (e.g. gas CCS and/or hydrogen) to balance variable weather-dependent renewables
- An increasingly flexible system, including from demand-side management, storage, hydrogen production, and interconnection

Source: CCC Analysis

Emissions pathways for electricity generation
Changes from now to 2050



- Emissions from electricity generation fell by 64% over the last decade, as coal was replaced by renewables and gas.
- To fully decarbonise electricity generation, the UK will need to move away from unabated gas, replacing that with additional variable renewables, and low-carbon dispatchable generation (e.g. gas CCS and hydrogen) in the 2020s and 2030s.
- In the 2040s the challenge is to continue deploying low-carbon generation to meet new additional electricity demands in a low-carbon way.

Source: CCC Analysis

Role of hydrogen in electricity generation
A source of generation and a potential demand

Hydrogen has a dual role to play in decarbonising electricity, as it can be both a source of low-carbon generation and a potential new demand for electricity.

- **Hydrogen could play a crucial role in delivering flexible low-carbon generation.** By adjusting their output in a short period of time, hydrogen plants can ensure security of supply with low-carbon generation.

- **Hydrogen production.** Hydrogen burned in gas plants can be produced via electrolysis, which uses electricity as an energy input, or methane reformation that relies on CCS.

- **In the 2020s,** methane reformers with CCS are more likely to play a role in providing hydrogen. That is because the cost of electricity would need to be as low as £10/MWh for electrolysis to be cost-competitive with methane reformers that could cost £40/MWh of hydrogen.

- **From the 2030s,** as renewables become a larger share of the generation mix, there could be surplus generation when demand is low but renewable output is high. This surplus electricity could be used to produce hydrogen at costs competitive with methane reformation with CCS, albeit at volumes constrained by availability of these surpluses.

- **In 2050,** the Balanced Pathway has 195 TWh of domestic production of hydrogen evenly split between electrolysis and methane reformation with CCS.

Costs

Variable renewables are the cheapest form of generation

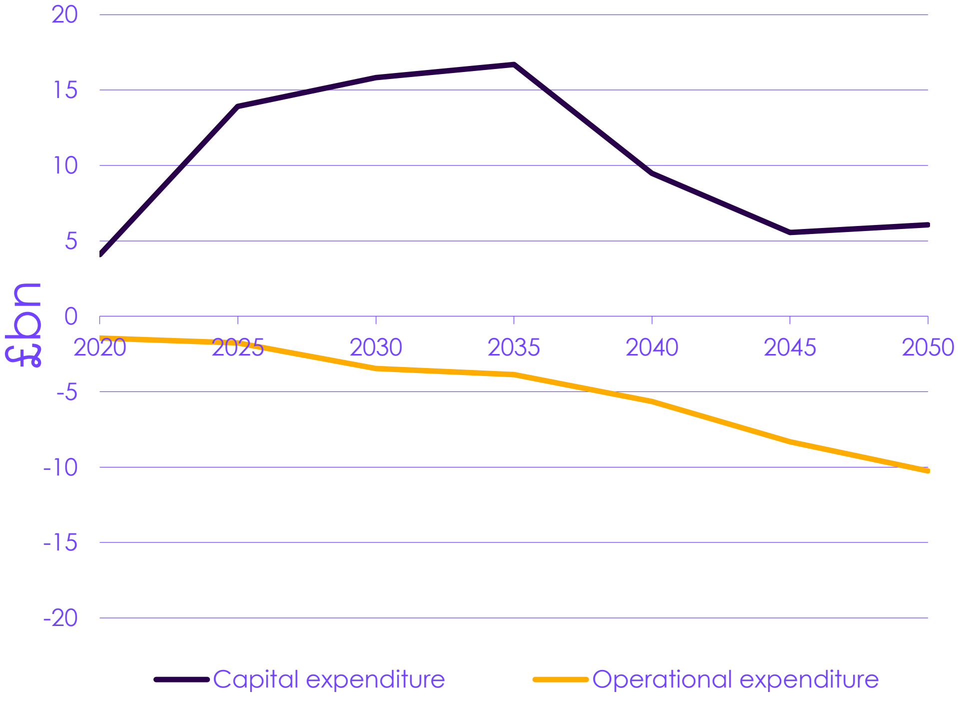
Costs of generation technologies in 2050 (£/MWh)	Balanced Pathway	Headwinds	Widespread Engagement	Widespread Innovation	Tailwinds
Unabated gas plant (excluding carbon price)	60				
Variable renewables	40			25	
Firm power	85			105	
Dispatchable low-carbon power	80-185				

Source: CCC analysis based on BEIS (2020) *Electricity Generation Costs*, CCC (2018) *Hydrogen Review*, Wood Group (2018) *Assessing the Cost Reduction Potential and Competitiveness of Novel (Next Generation) UK Carbon Capture Technology*.
Notes: Costs in 2019 prices. Costs based on a central gas price scenario. Variable renewables include wind and solar. Firm power includes nuclear. Dispatchable low-carbon generation includes gas CCS, BECCS, and hydrogen.

Source: CCC Analysis

Costs, impacts, and co-benefits

The Balanced Pathway is cost-saving by 2050



- The Balanced Pathway is cost-saving by 2050, as the lower operational costs of low-carbon technologies more than outweighs the additional investment required.
- Additional investment requirements peak by the mid-2030s, and reduce thereafter as costs of low-carbon technologies fall.
- Investment in low-carbon generation will bring a range of co-benefits including improved air quality, lower electricity prices, and opportunities for industry and a just transition.

Source: CCC Analysis

Key policy recommendations
Decarbonising electricity generation by 2035

The Committee's key recommendations:

- **Deploy low-carbon generation at scale,** including variable renewables (e.g. 40 GW of installed offshore wind capacity by 2030 and sustaining that build rate to support deployment of up to 140 GW by 2050) and dispatchable and flexible generation (e.g. at least 50 TWh of gas CCS and/or hydrogen by 2035) that can balance a system driven by renewables at low emissions.

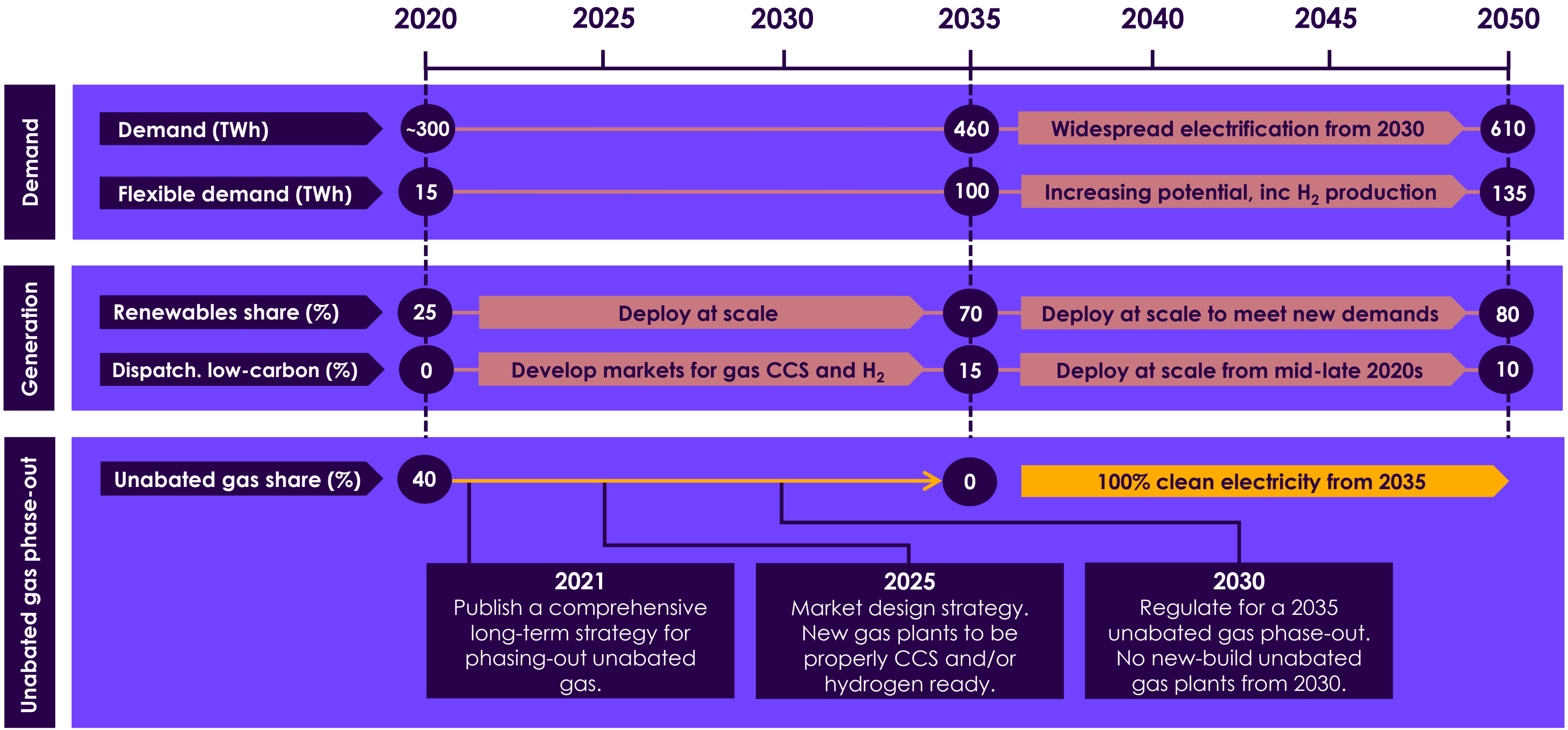
- **Develop an increasingly flexible electricity system,** including from demand-side management (with 20% of demand being flexible in 2035), storage, hydrogen production, and interconnection.

- **Phase-out unabated gas by 2035.** By 2021 commit to phasing-out unabated gas by 2035 and publish a comprehensive long-term strategy on how to achieve that. By 2025 ensure new gas plants are properly CCS and/or hydrogen-ready. By 2030 no new unabated gas plants should be built and the Government should regulate for a firm pathway to zero unabated gas by 2035, subject to ensuring security of supply.

- **Ensure networks are ready,** by delivering plans to ensure they can accommodate future demand levels, and developing a strategy to coordinate interconnectors and offshore networks for wind farms and their connections to the onshore network.

- **Develop a coherent market framework for Net Zero,** publishing a clear long-term strategy as soon as possible, and certainly before 2025, on market design for a fully decarbonised electricity system.

Summary of advice on electricity generation



Source: CCC Analysis

Policy recommendations for hydrogen supply

Strategy	• **Focus hydrogen demand on areas where that cannot feasibly decarbonise without it.** • Pursue proven solutions (e.g. electrification) in the 2020s, in parallel with developing hydrogen. • Set out vision for contributions of hydrogen production from different routes to 2035.
Demonstration / near-term deployment in supply	• **Get on with low-carbon production to establish low-carbon hydrogen supply chains.** • **Blue hydrogen.** Deploy fossil gas CCS early to prove that it can deliver suitable emissions reductions vs. fossil gas (i.e. at least 95% CO_2 capture, 85% lifecycle GHG savings). • **Gasification.** Support commercialisation of biomass gasification with an aim to establish hydrogen production from bioenergy with CCS. • **Electrolysis.** An RD&D programme is required to improve cost & performance of electrolysers.
Incentives	• **Ensure low-carbon hydrogen capacity is incentivised to contribute emissions reductions** (including mixing with fossil gas) at least for power generation, industrial clusters & grid injection. • **Ensure incentives for hydrogen use, together with electricity pricing, don't bias solutions towards hydrogen where electrification is competitive.** • Avoid incentivising electrolysis based on (non-curtailed) grid electricity, as likely to push up emissions – focus on curtailed generation and dedicated renewable electrolysis.

Contact us

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