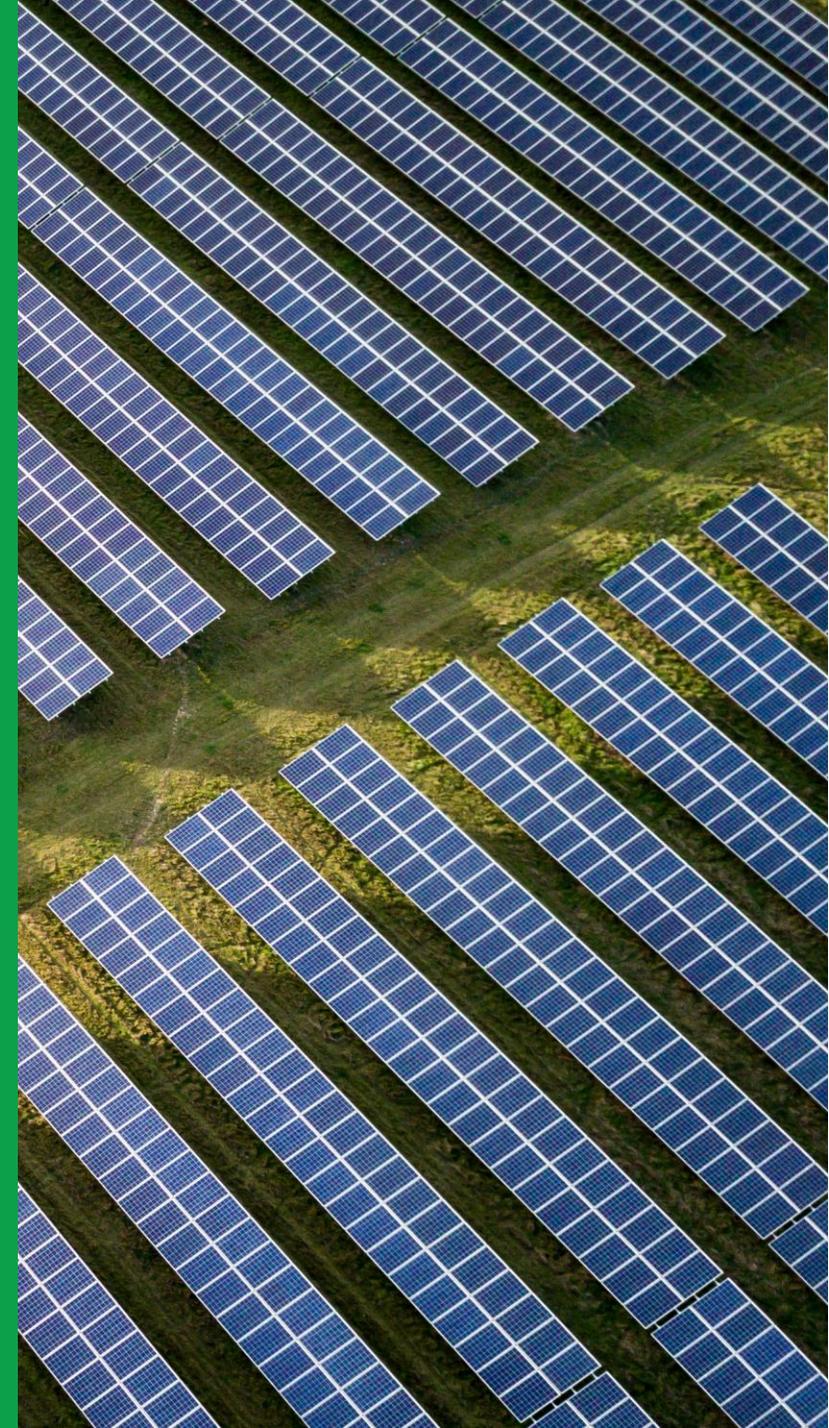




Department for
Energy Security
& Net Zero

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Foundation for Science
and Technology
11 Oct 2023



“for every complex problem there is an answer that is clear, simple, and wrong”

H.L. Menken (1880-1956)

Evidence and Policy ...



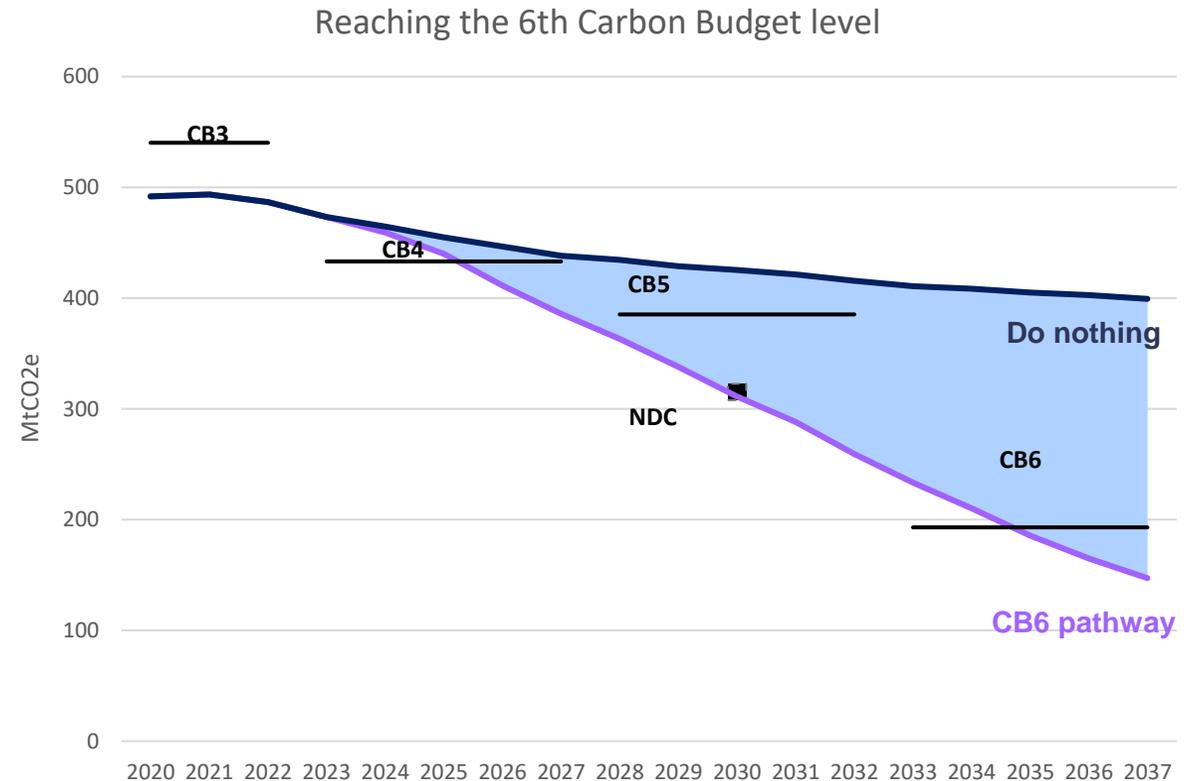
Net Zero

- In 2008, the UK set an ambitious goal of decreasing its greenhouse gas emissions by 80% of 1990 levels by 2050. On **27 June 2019, the Government legislated to increase its ambition, committing to net zero emissions by 2050** (i.e., a reduction of 100% compared to 1990 levels).
- The Climate Change Act also sets legally binding interim targets for five-year Carbon Budget periods. In the short-term, policy decisions aim to meet the 4th and 5th carbon budgets (CB4, 2023-27, and CB5, 2028-32) and the 6th Carbon Budget set (2033-2038) in June 2021.
- Under the Paris Agreement, **each signatory must publish a Nationally Determined Contribution (NDC)** which is a signal of their “highest possible ambition” – and the UK’s 2030 NDC set the tone for ambition at COP26.



The UK's ambitious carbon reduction targets are built around a strong policy framework

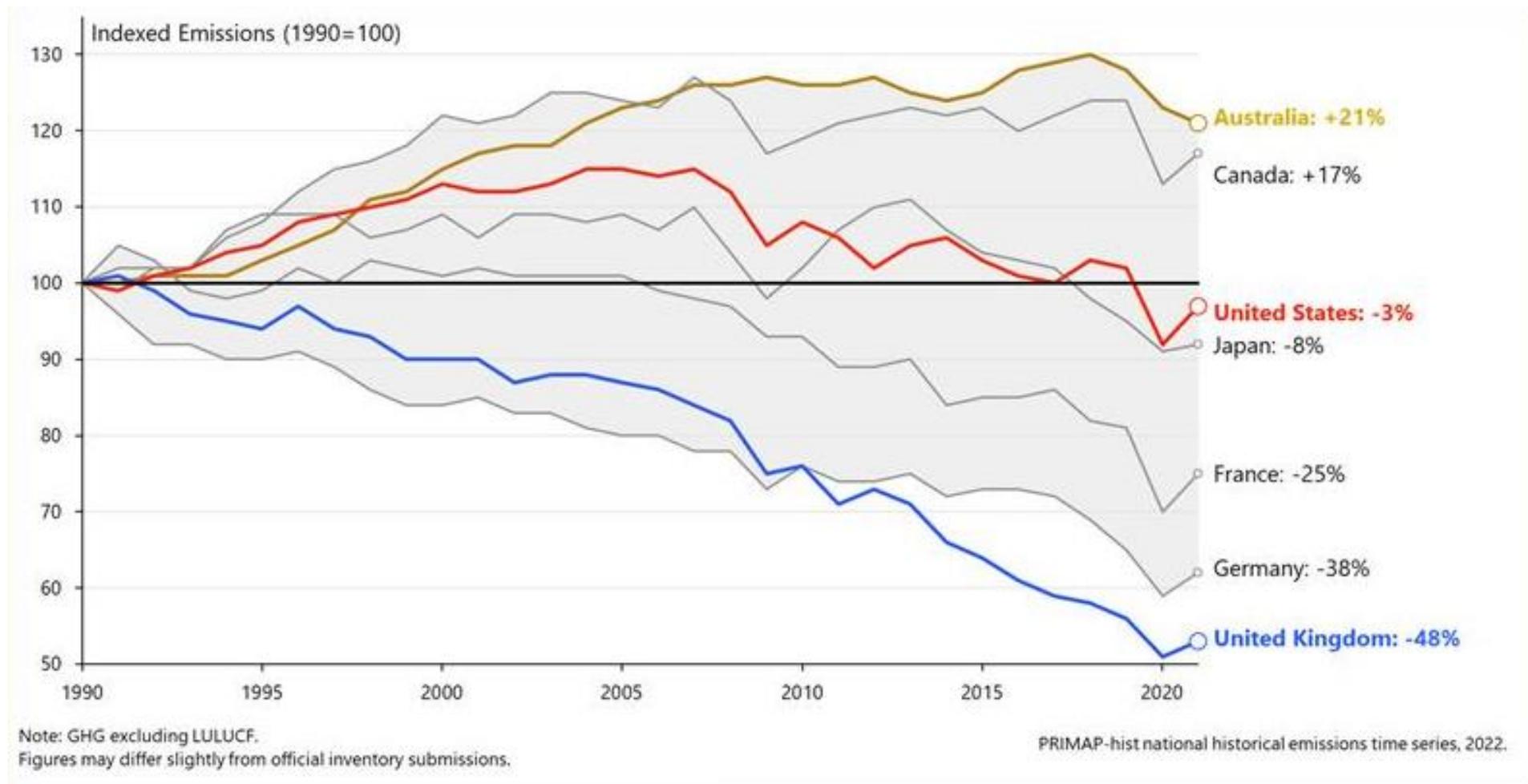
- The 2008 Climate Change Act introduced '**Carbon Budgets**' – a five-year, legal limit on total green house emissions for that period. We are entering Carbon Budget 4 (2023-2027).
- The 2008 Act also established the **Climate Change Committee** – an independent body to provide advice and scrutiny on UK progress against the carbon budgets.
- In 2019, the UK signed **net zero** into law. In 2021 we set stretching targets for **Carbon Budget 6** (78% reduction by 2035). This was the first carbon budget set since we committed to reach net zero.
- **The Net Zero Strategy**, published in 2021, set out policies and proposals to bridge the gap towards meeting this ambition.



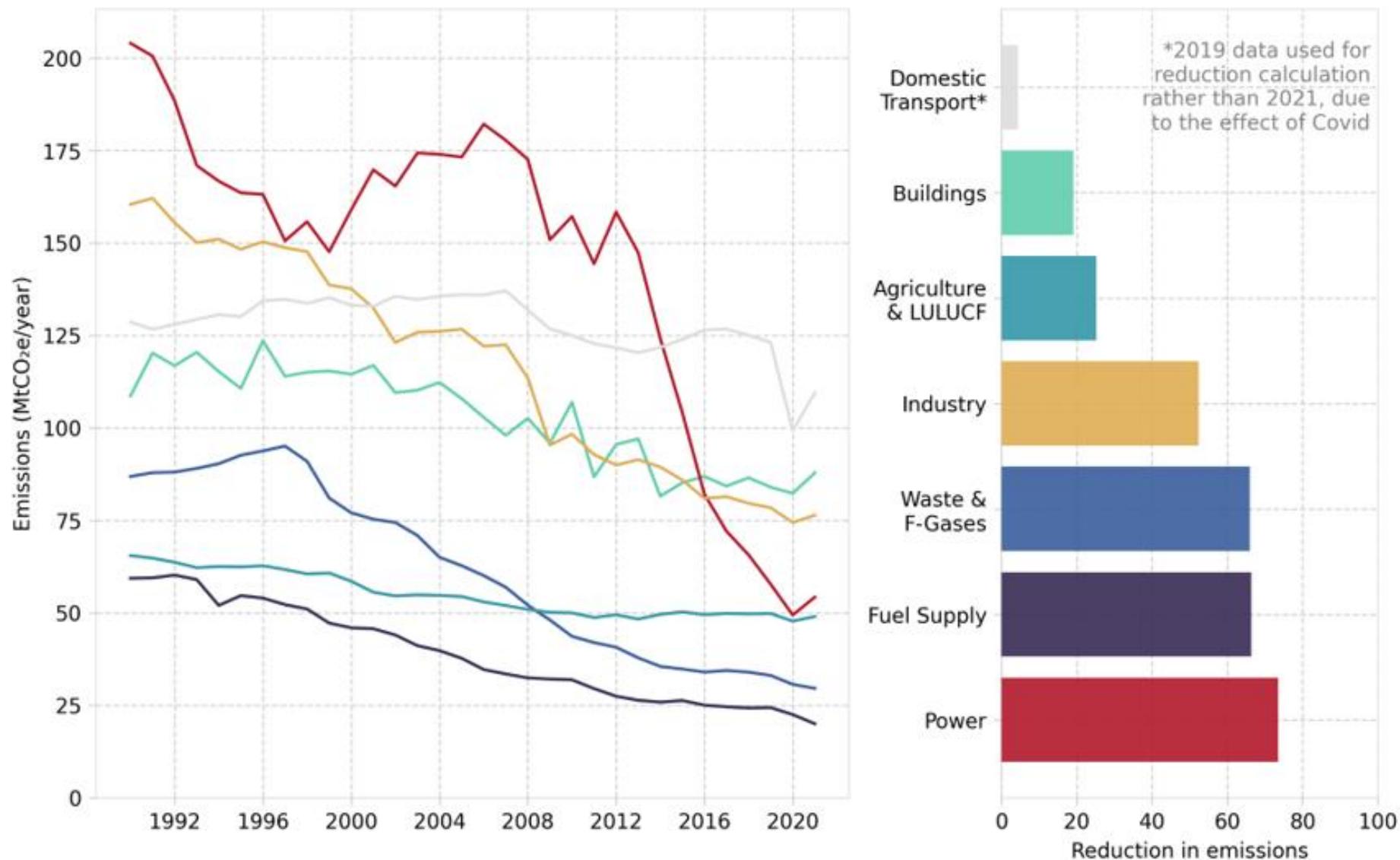
Notes

Carbon budget levels and Nationally Determined Contribution indicatively adjusted to include assumed IAS headroom at CCC levels. IAS only formally included in CB6
Purple line represents the CCC's CB6 pathway

Background: The UK has a strong track-record of decarbonising whilst growing the economy

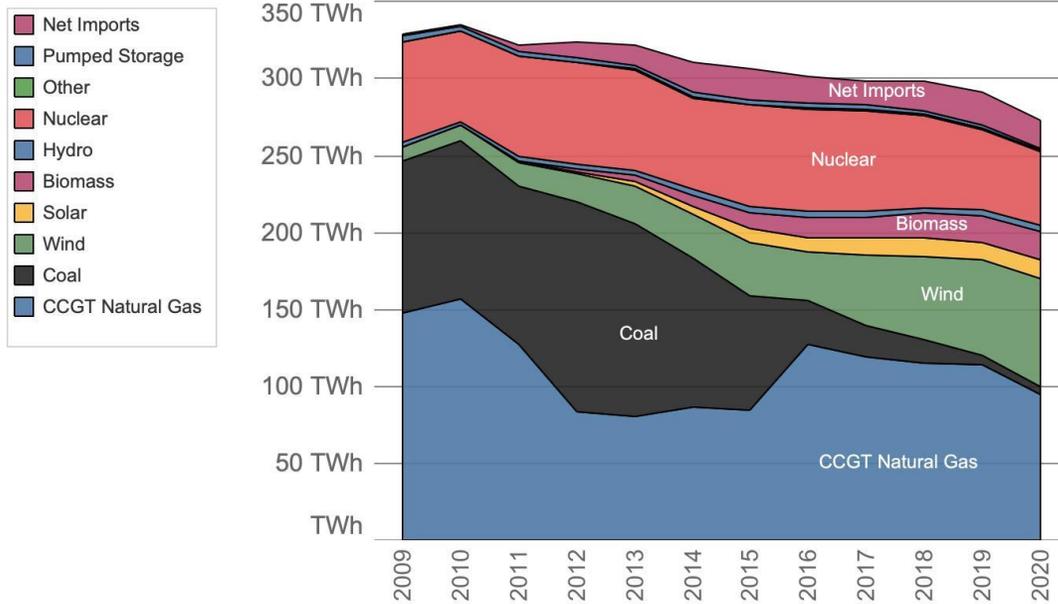


Background: The power sector has driven emissions reductions, with slower progress elsewhere



Reducing fossil fuel use and increasing renewable energy has been key

Great Britain's electrical generation, annual level in TWh



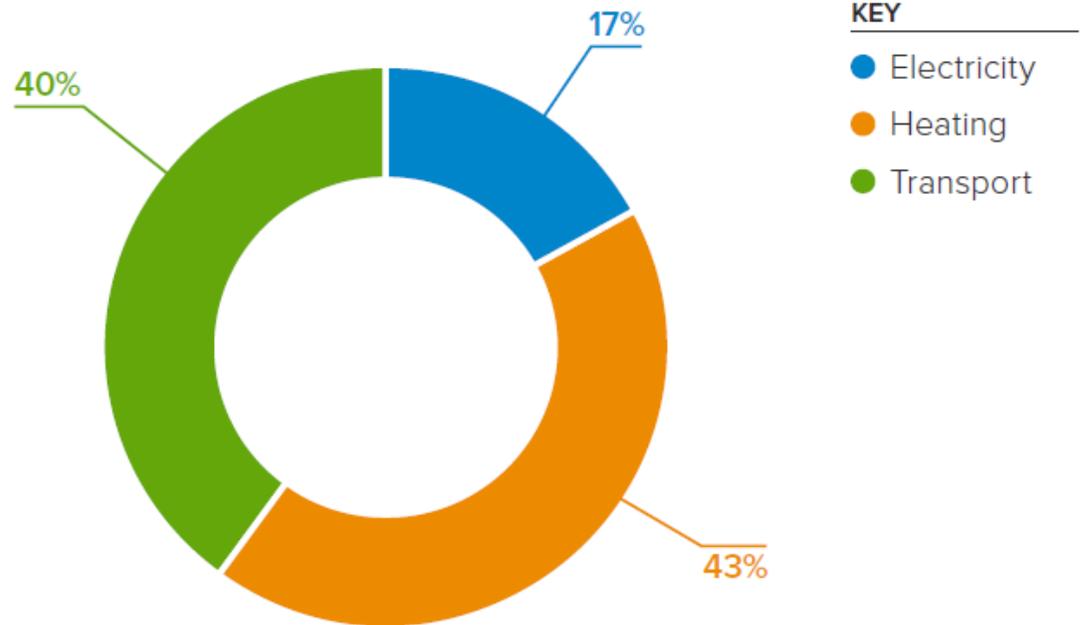
UNIVERSITY OF BIRMINGHAM



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UK energy consumption in 2018².



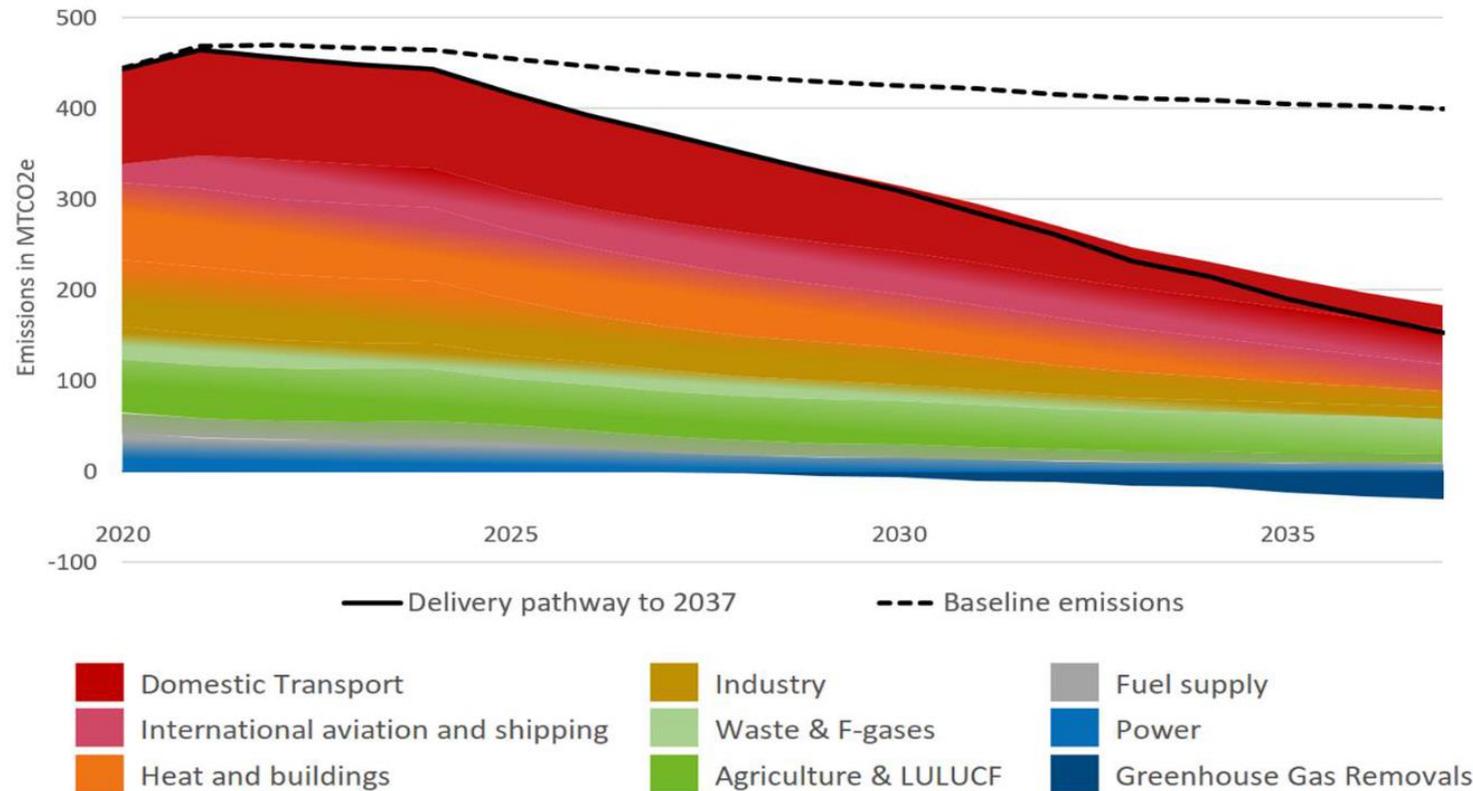
KEY

- Electricity
- Heating
- Transport



Our net zero target means a step change in policy ambition, delivery and green investment

- Our indicative 'delivery pathway' of emissions reductions to meet our targets up to and including Carbon Budget 6 (2033-37) is based on our understanding of the technical potential for each sector to reduce emissions, considering the balance between sectors that is optimal for the entire economy.
- It's inherently uncertain.



1

Our 2050 target is complimented by net zero aligned near-term targets:

- **NDC** - 68% reduction by 2030
- **CB6** – 77% reduction by 2035

2

We estimate that **additional capital investment** must grow from present levels to an average of **£50-60bn per year** through the late 2020s and 2030s.

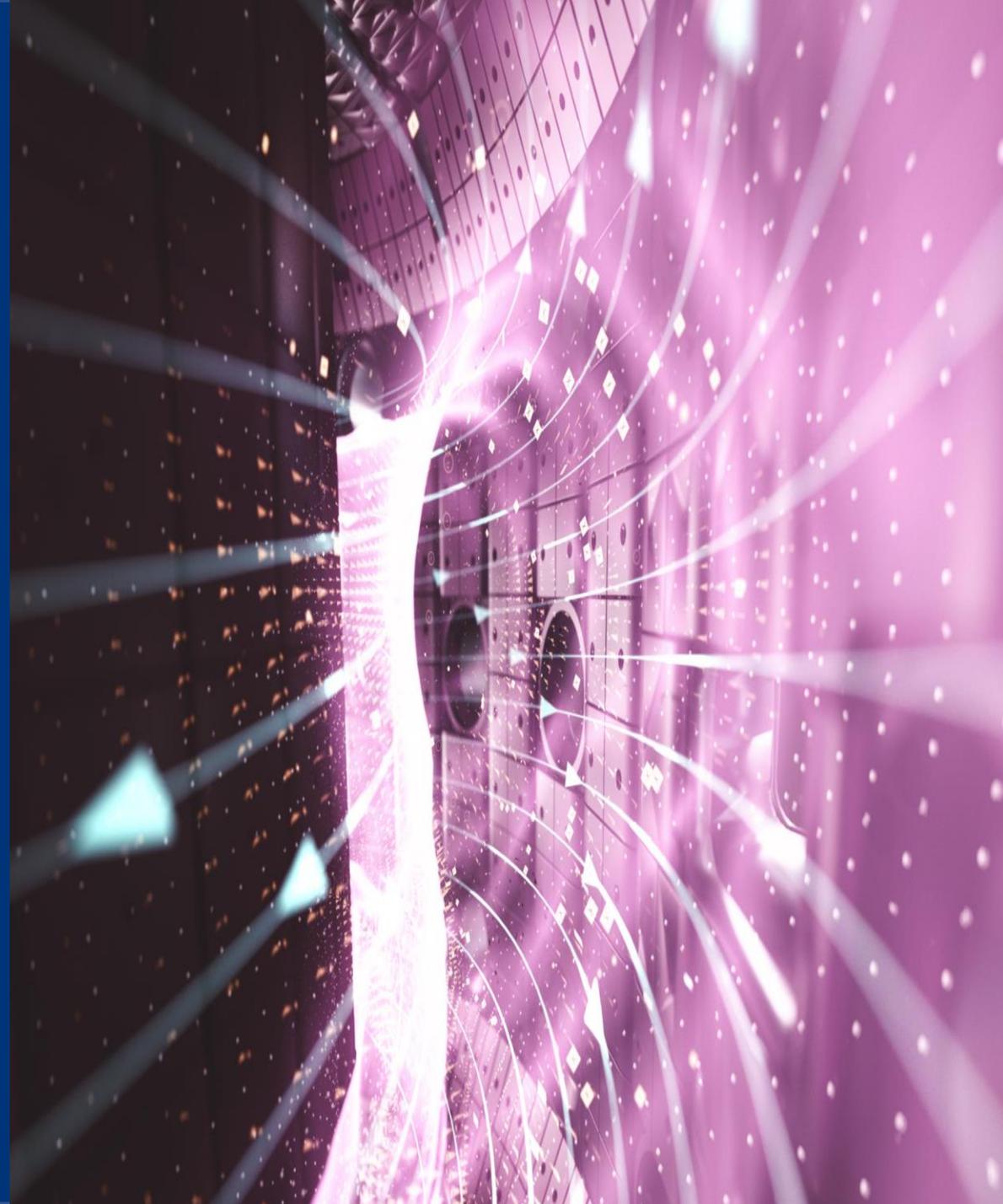
3

The Department of Energy Security and Net Zero will continue to work to develop, implement, and deliver the policies needed to achieve our Carbon Budget and Nationally Determined Contribution targets.



Department for
Energy Security
& Net Zero

How do we achieve Net Zero?



Net Zero – Systems Map

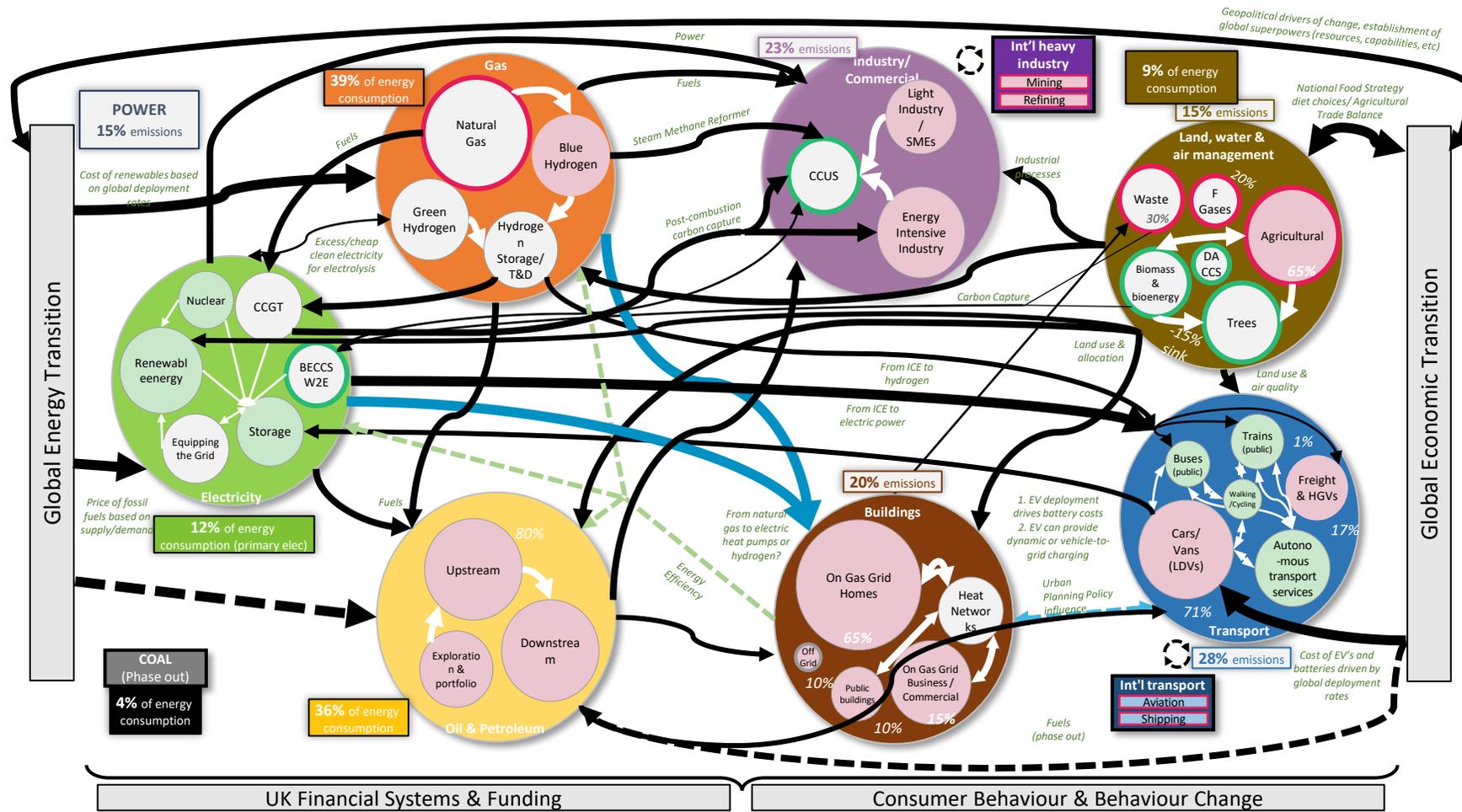
LEVEL 1

- Interactions reinforced by policy choices
- - -> 'Influences' - links dependent on external action
- Thickness indicates relative significance of interaction

- B ← A Direction of 'pull'/draw on resource (B pulls on A)
- Carbon sink
- Emissions-generating process
- Carbon source
- Emissions-abating process

- XX% % of 2018 emissions
- XX% % consumption

Note: Any figures shown are indicative estimates based on 2018 emissions data; figures may not sum due to rounding. Map is non-exhaustive and is intended as a visual aid to represent possible interactions between economic sectors/factors by 2050. Map should not be relied on as a comprehensive data source, and is subject to further change and refinement.

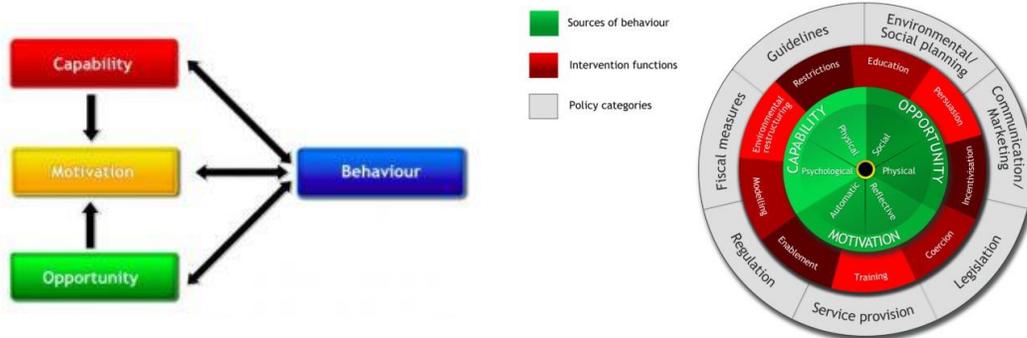
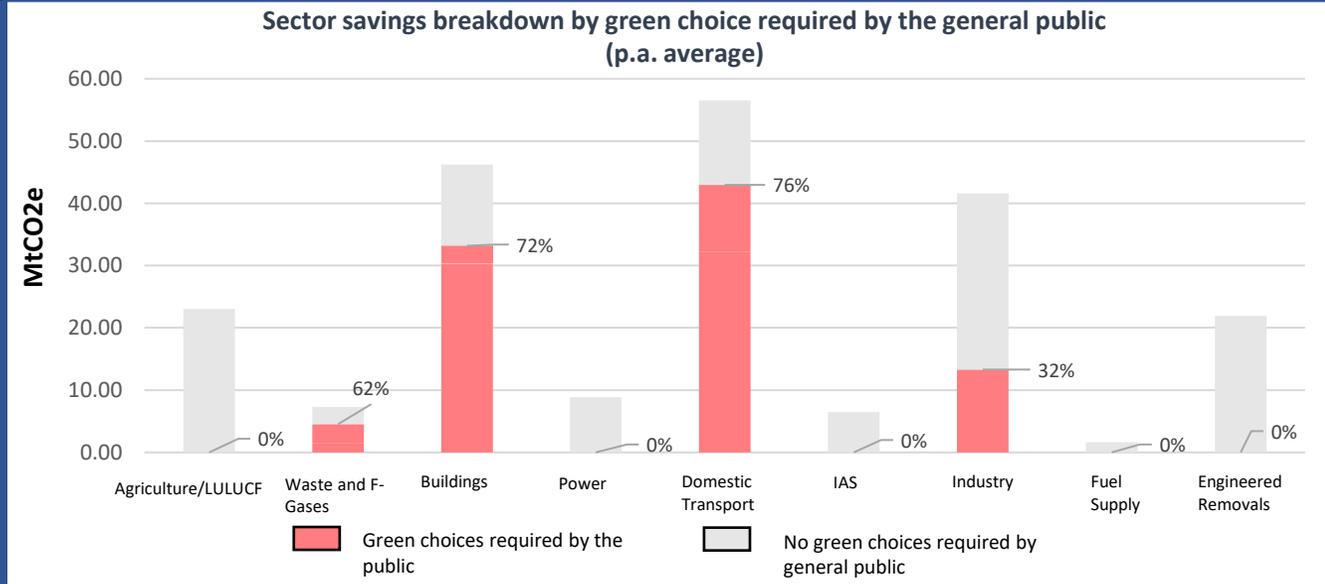


ILLUSTRATIVE

Green Choices

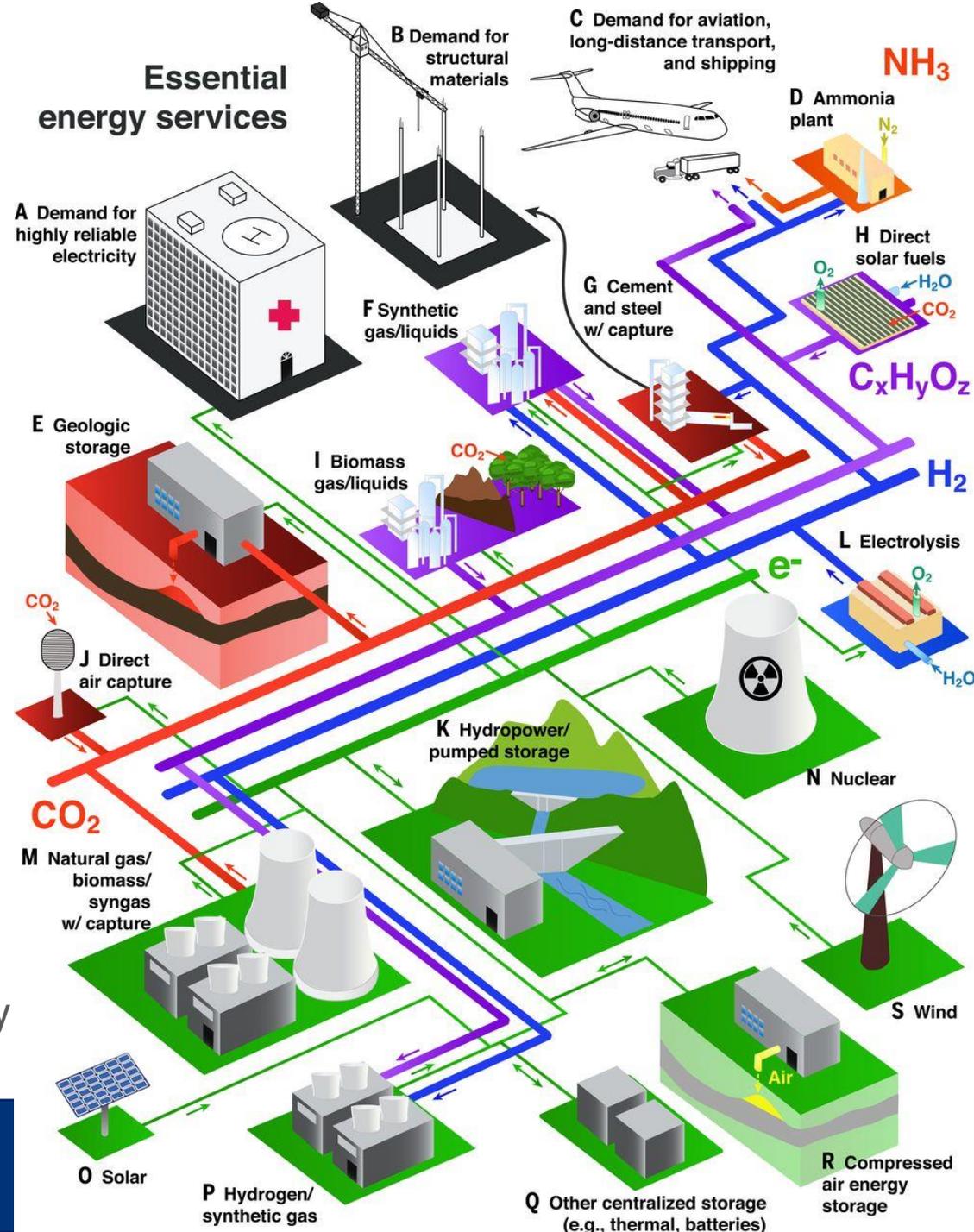
Under HMG's net zero pathway, around **45% of emissions savings will require the public to make green choices** over the Carbon Budget 6 period. Choices and behaviours that impact on net zero broadly fall into 3 categories:

- Adopting new low carbon technologies (e.g. Buying an electric vehicle or heat pump)
- Using energy, technologies or services more efficiently (e.g. using appliances off-peak or repairing products)
- Everyday consumer choices. (e.g. reducing food waste or car sharing)



Use of **behavioural science** tools and expertise are an essential part of supporting the public to make these green choices. Behavioural science supports policymakers to hold realistic assumptions about behaviour and is crucial for increasing the effectiveness and acceptability of any net zero policy which will impact people.

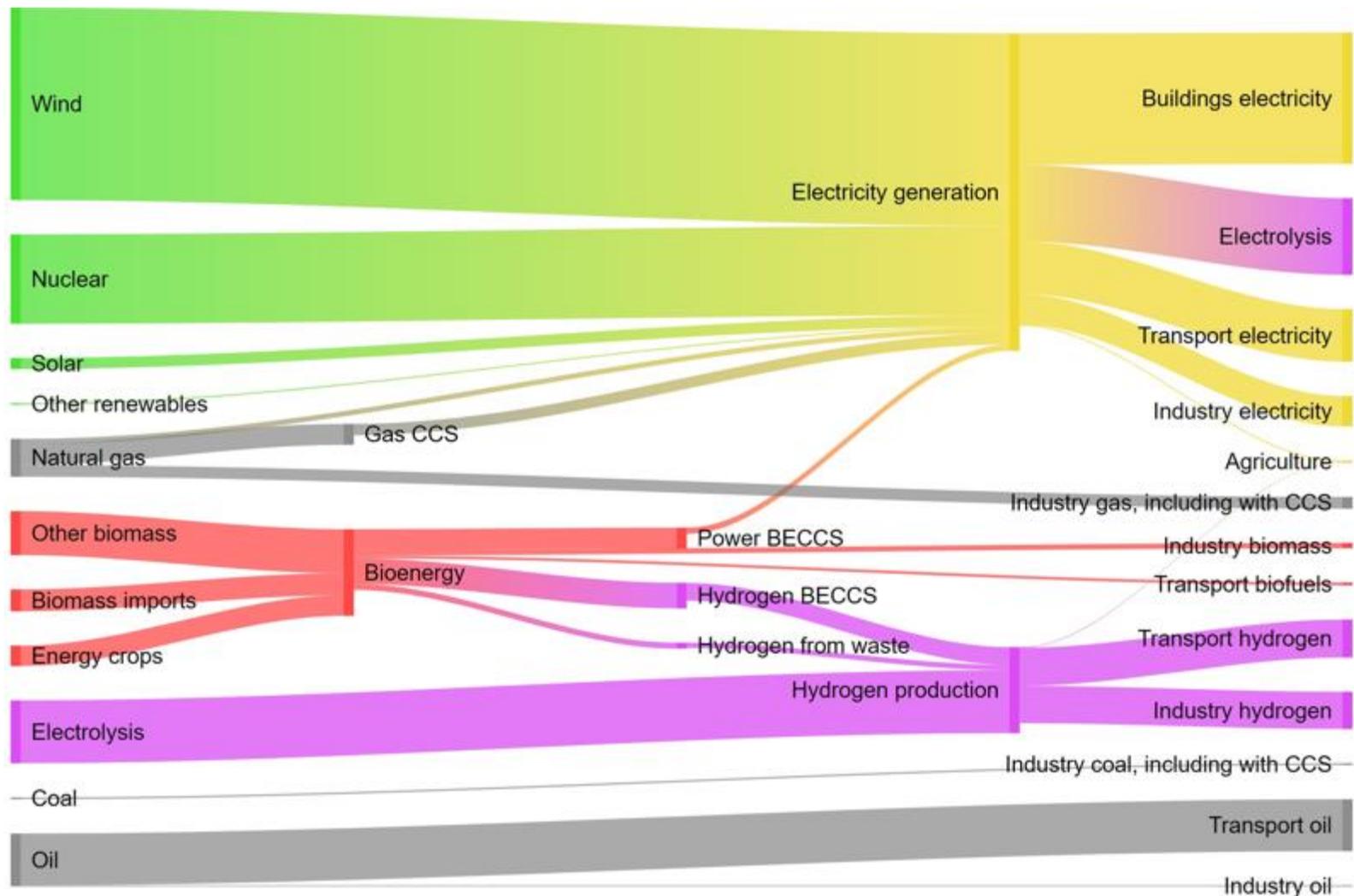
What is the correct mixture of production, storage and use that delivers a net zero energy system?



Steven J. Davis et al., Net-zero emissions energy systems. *Science*, **360**, eaas9793 (2018).

We have committed to decarbonising our energy system by 2035 – subject to security of supply

High electrification scenario: energy generation and end uses in 2050



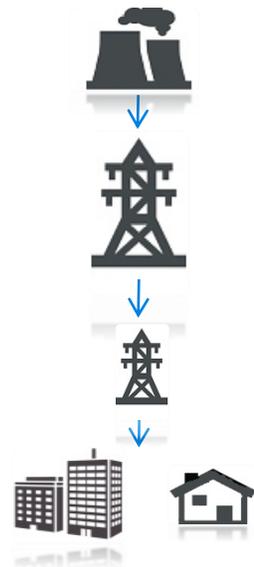
1 In a range of feasible scenarios, extensive decarbonisation is required across buildings, transport and industry, to account for possible residual emissions in agriculture, aviation, and possible limitations to deployment of greenhouse gas removals.

2 By 2035, we expect around 99% or more of our electricity to come from low carbon sources. This requires unprecedented build-out of energy infrastructure, whilst meeting a 40-60% increase in demand.

3 The system will be predominantly powered by low-cost wind and solar, with nuclear providing baseload power and low carbon flexible technologies (i.e. power CCUS, H2 power, storage), to reduce costs and replicate the critical role of unabated gas.

Fundamental Shift

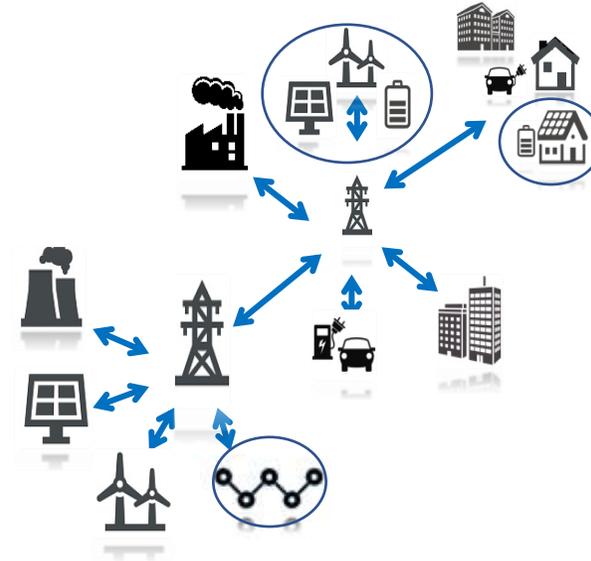
Yesterday



- Carbon intensive
- Centralised generation
- Predictable supplies



Emerging System – increased interactions



- Low carbon
- Interconnectors
- More distributed
- Storage
- Demand side response
- Electric vehicles/heat
- Big data & AI
- Smart grids



What does Research and Innovation for Net Zero look like?



Bioenergy



Industrial fuel switching



Hydrogen



Carbon Capture Use and Storage



Nuclear Advanced Modular Reactors



Future offshore wind



Smart energy and energy storage



Greenhouse gas removal



Built environment



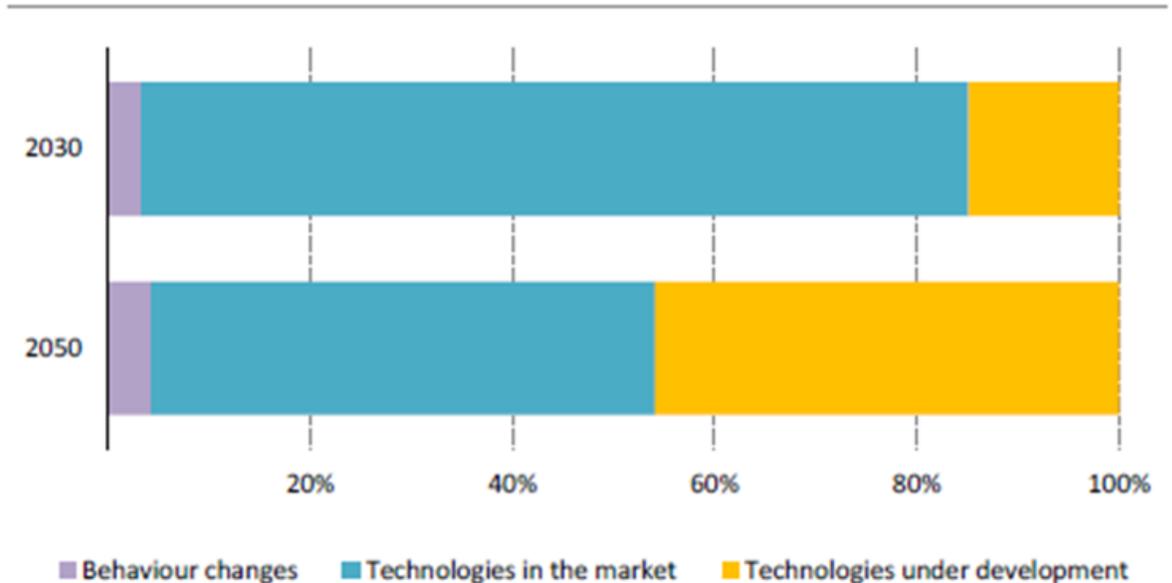
Disruptive technologies



Innovation is critical to drive down costs and develop new technologies

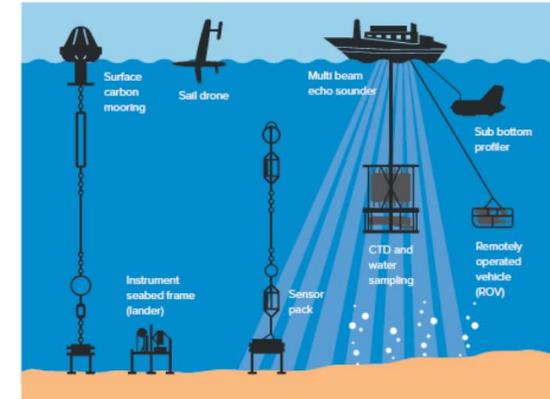
- The **10 Point Plan** and **Net Zero Strategy** set out how innovation is needed to **drive down the costs** of technologies, processes and systems, and explore new **business models, financing, regulatory frameworks** and the role of **consumers**.
- Innovation can enhance mature technology, more rapidly develop emerging technologies, and discover and invent new technologies.
- Technologies needed to deliver almost half of the CO₂ reductions required to reach net zero by 2050 are still in prototype phases (Fig 3).
- Working back from 2050, **major research and innovation challenges must be tackled this decade**.

Annual CO₂ emissions savings in the net zero pathway, relative to 2020



Key Science Challenges (include)

- Hydrogen (production, transport, storage (at scale) and use)
- CCUS
- DAC (Negative emissions)
- Critical Minerals
- Resource and Energy Efficiency
- Sustainable Carbon Feedstocks
- Agricultural emissions
- Adaptation and Mitigation
- Green Choices

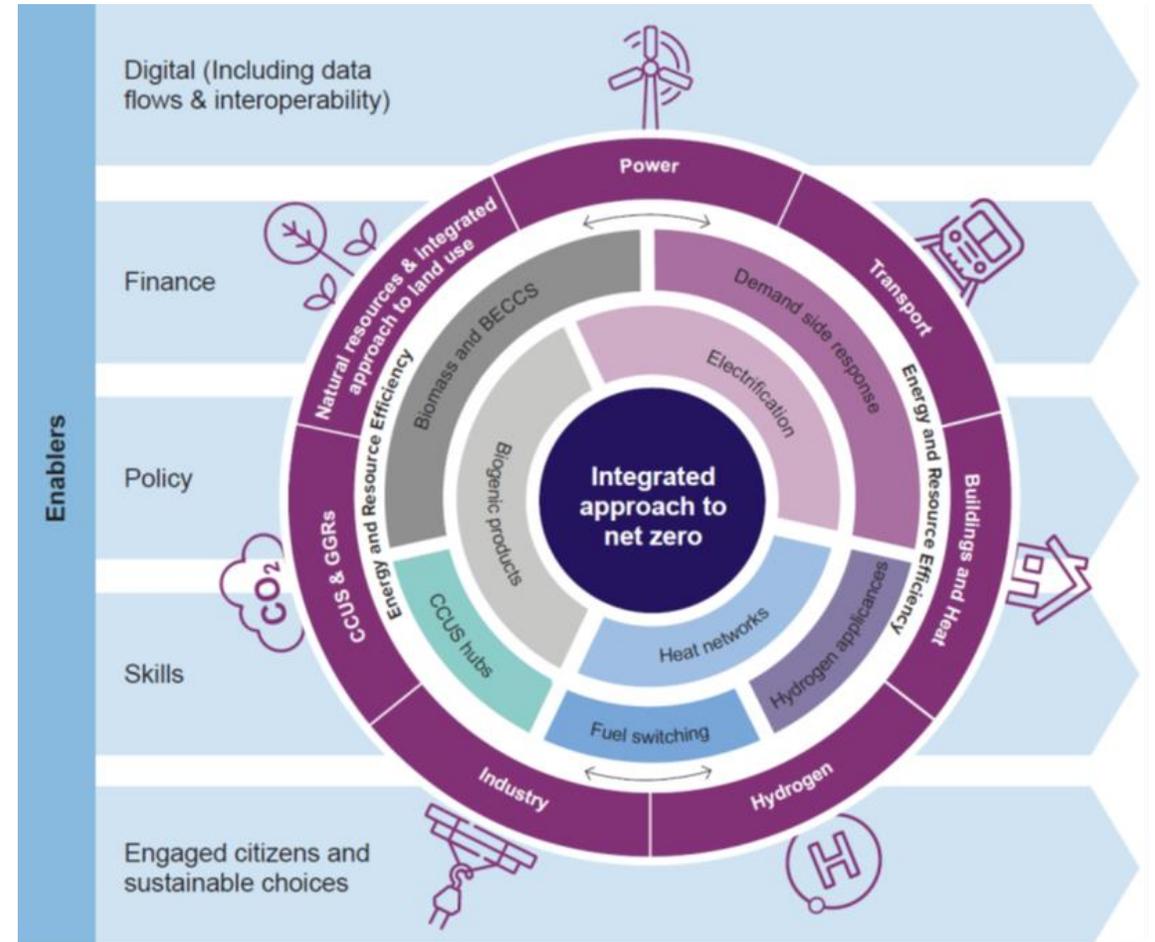


UK Net Zero Research & Innovation Framework

- Sets the strategy and builds on the importance of innovation as an enabler of net zero.
- Outlines key research and innovation challenges that require development over the next 5-10 years to accelerate UK progress to net zero.
- Takes an integrated systems approach to innovation.
- Provides a focus for Government's net zero R&D plans and signals our intent to work with business and researchers to tackle these challenges.
- Set criteria for prioritising government net zero R&D:



- Maximising UK strategic advantage and developing UK energy security
- Expected contribution to delivering the UK's carbon budgets
- Retaining optionality of different net zero pathways



Some take-homes ...



There is a significant challenge presented by Net Zero that is pervasive.

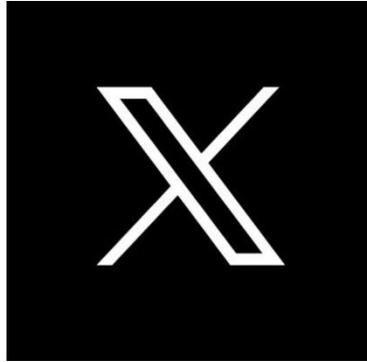


Requirement for a systems approach incorporating behaviour change.



Research and Innovation is critical to deliver the required outcomes.





@psmonks

