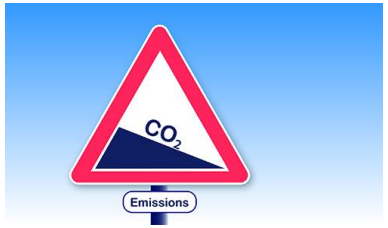
Climate Risks and Decision Making under Uncertainty: Dynamic Contexts for Delivering the UK Energy Transition

Professor Paul S Monks

BEIS Chief Scientific Adviser

Department for Business, Energy & Industrial Strategy

Net Zero

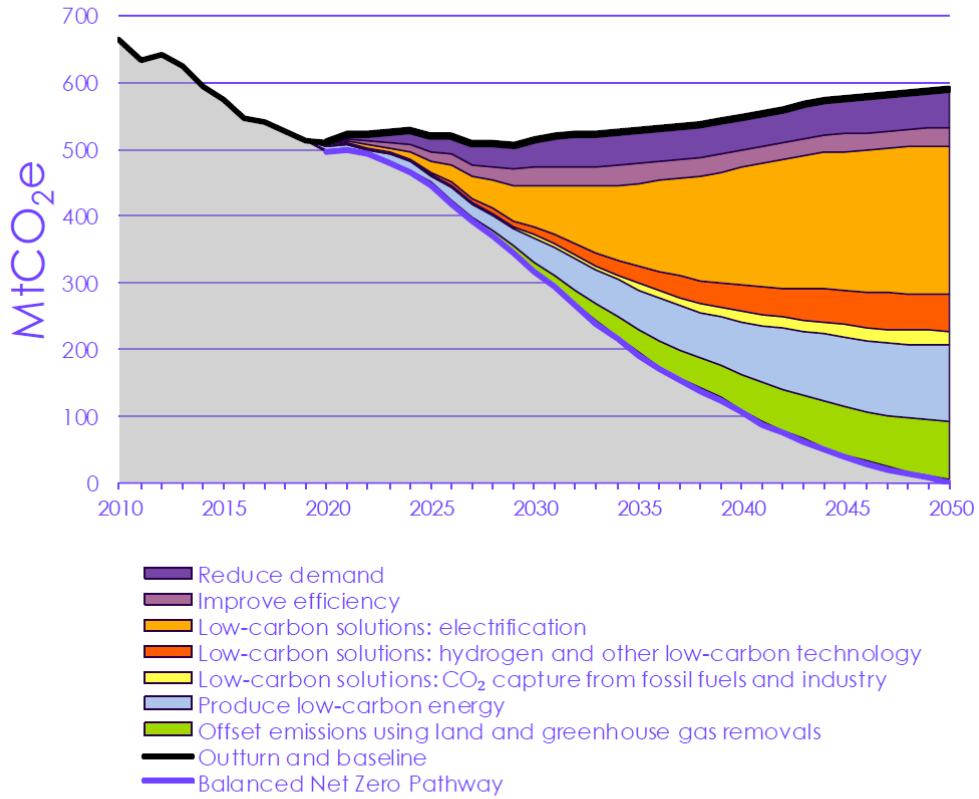


- In 2008, the UK set an ambitious goal of decreasing its greenhouse gas emissions by 80% of 1990 levels by 2050. On **27 June 2019, the Government legislated to increase its ambition, committing to net zero emissions by 2050** (i.e., a reduction of 100% compared to 1990 levels).
- The Climate Change 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.
- While we have made strong progress to date, **UK emissions are currently projected to significantly exceed our legal emissions caps (Carbon Budgets 4 and 5, 2023-32)** and a considerable step change is required.

How do we achieve Net Zero?

- Reduce Demand
- Improve efficiency
- Low-carbon solutions
  - Electrification
  - H_2
  - CCUS
- Low-carbon energy
- Land-use and GGR

Figure 4 Types of abatement in the Balanced Net Zero Pathway

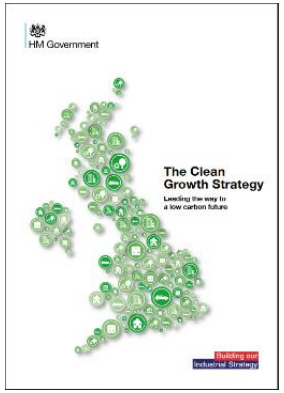


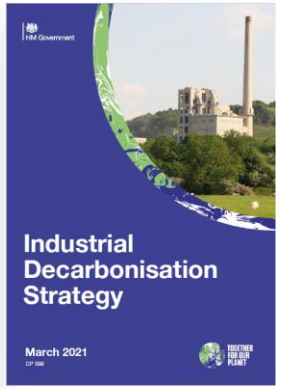
Source: BEIS (2020) Provisional UK greenhouse gas emissions national statistics 2019; CCC analysis.
Notes: 'Other low-carbon technology' includes use of bioenergy and waste treatment measures.
'Producing low-carbon electricity' requires the use of CCS in electricity generation.

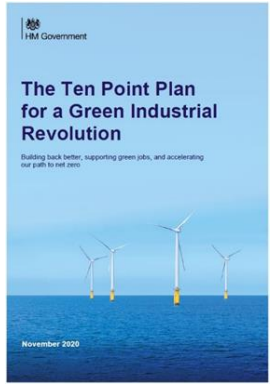
How do we achieve Net Zero?

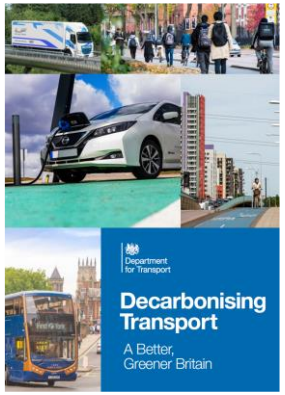
- Ahead of COP26, ambitious new plans to reduce emissions across key sectors of the economy – including **an Energy White Paper, Transport Decarbonisation Plan, Industry Decarbonisation Strategy, Hydrogen Strategy, and Heat and Building Strategy**.

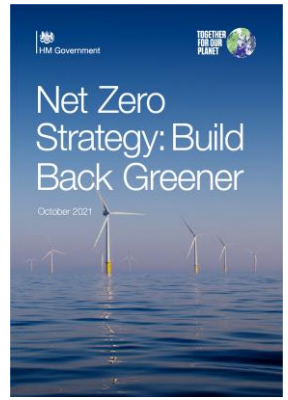
- A comprehensive **Net Zero Strategy**, setting out the government's vision for transitioning to a net zero economy, making the most of new growth and employment opportunities across the UK was published in October 2021. This contains further proposals to put us on track to meeting carbon budgets 4 and 5 and raise ambition as we outline our path to hit our 2050 target.



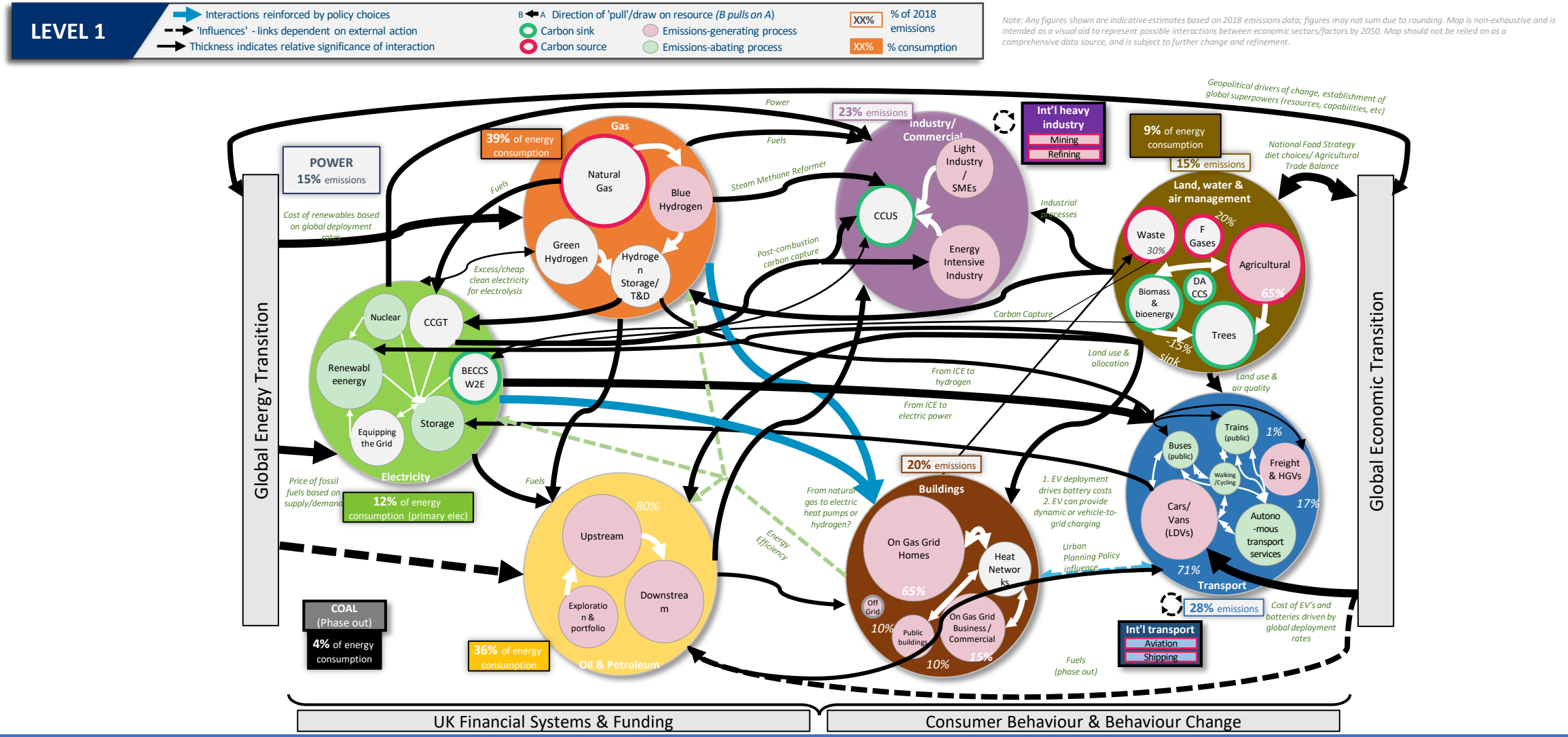








Net Zero – Systems Map



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To achieve net zero **by 2050**, an economy-wide transformation is required

Transport (28% of emissions)	**Industry / Business** (25% of emissions)*	**Power** (15% of emissions)	**Land Use / Nat'l Resources** (15% of emissions)	**Buildings (Domestic)** (15% of emissions)	**Greenhouse gas removals**
					
Department for Business, Energy & Industrial Strategy | Department for Transport	Department for Business, Energy & Industrial Strategy	Department for Business, Energy & Industrial Strategy	Department for Environment Food & Rural Affairs	Department for Business, Energy & Industrial Strategy | Ministry of Housing, Communities & Local Government	Department for Business, Energy & Industrial Strategy | Department for Environment Food & Rural Affairs
EVs: **42m** up from ~200k today **HGVs**: **1.6m** ultra low emission up from <1K today	**CCUS**: Capture **10** MT p.a. by 2030 **Hydrogen**: aim for **5GW** low carbon hydrogen production capacity by 2030 (~ **42TWh**)	**Total Generation**: **2x today** - 550-750TWh **Low carbon generation**: **4x today** - 95% up from 53%	**Woodland**: **3x today** 30kha p.a. up from 9kha p.a. today **Biomass: ~85% increase** for high value demands	**Low carbon heating**: **~25 million homes** from ~200k today **Solid wall insulation**: **~6m homes** >10x today	**Bioenergy with CCS (BECCS)**: **74 MT p.a.** **Direct Air Capture (DACCS)**: **13 MT p.a.**

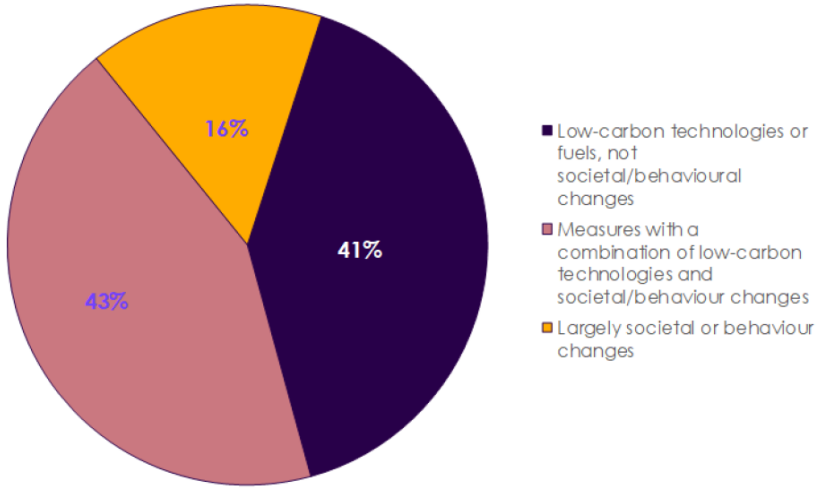
Source: BEIS analysis (drawing on CCC). Figures indicative and reflect one scenario

**Note: Industry accounts for 19% of total emissions (other business emissions are from oil & gas production (4%) and non-domestic buildings (2%))*

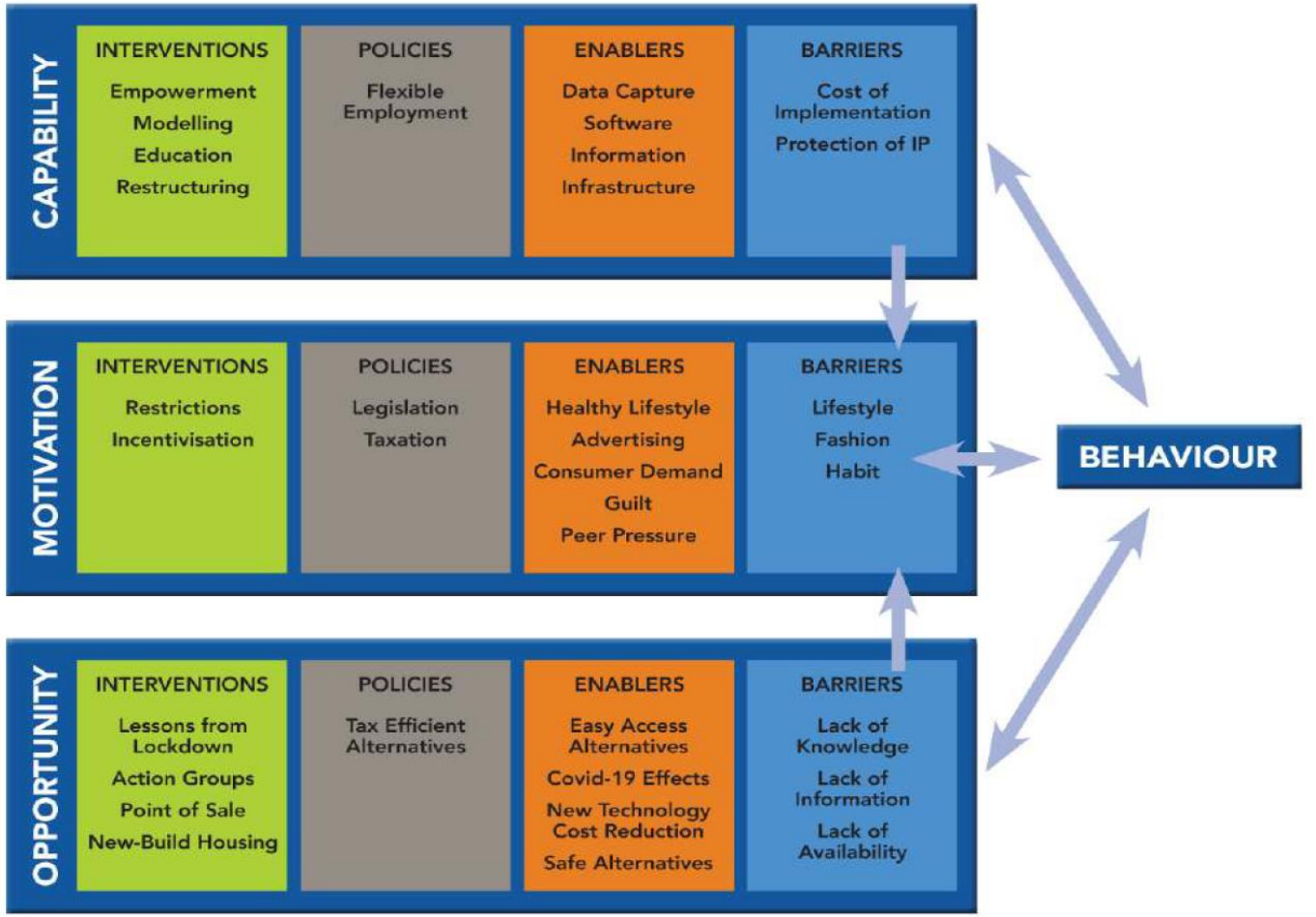
Behavioural Change

CCC Carbon Budget 6

Figure B2.2 Role of societal and behavioural changes in the Balanced Net Zero Pathway (2035)



Source: CCC analysis.



Measures requiring largely societal or behaviour changes needed to reduce demand and improve efficiency. *E.g.*

- Healthier diets
- Reducing growth in aviation demand
- Choosing products that last longer

Energy Transition

Department for
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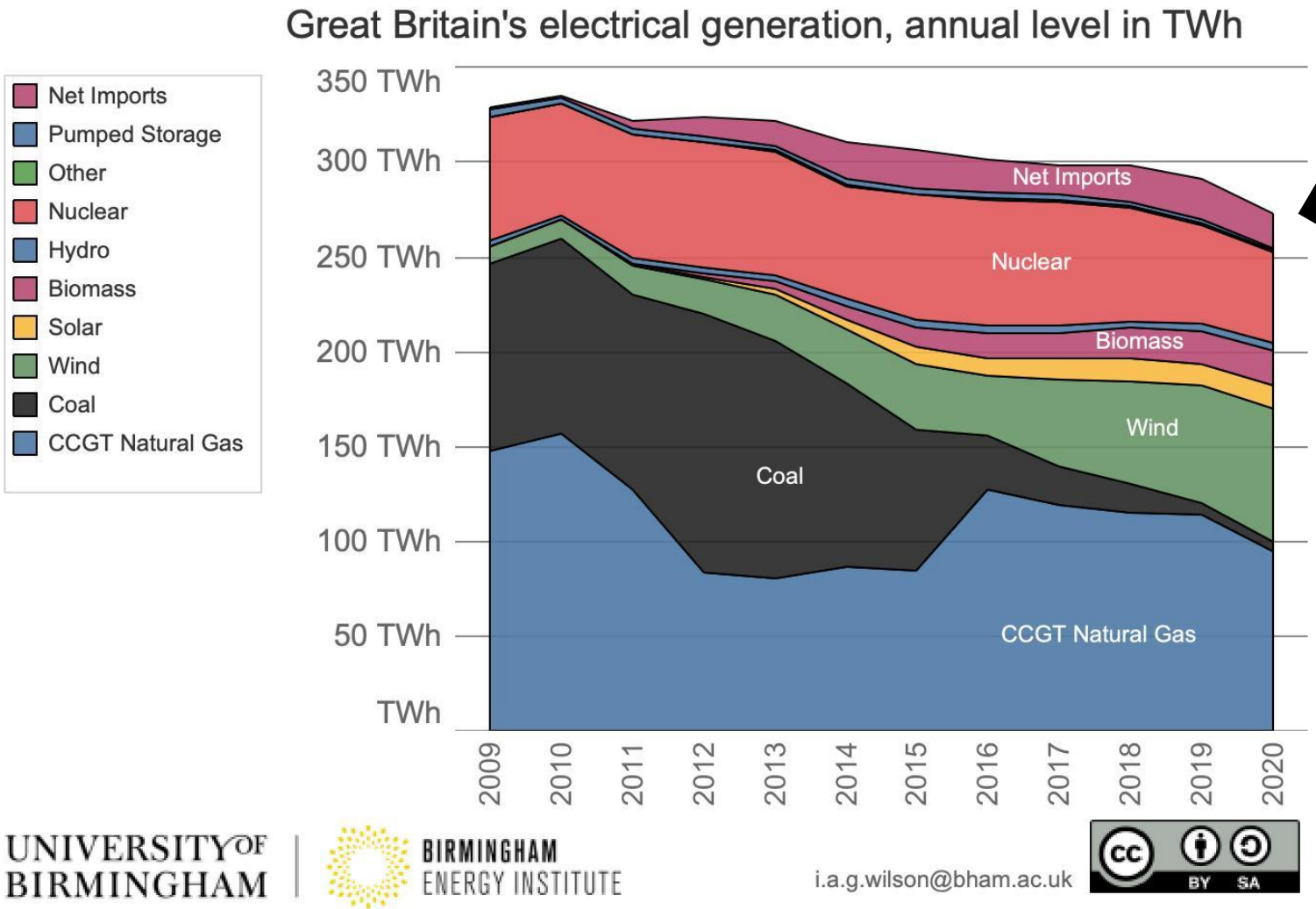
& Industrial Strategy

Reduced electrical demand and changed generation



61 TWh (18%) reduction from 2010 to 2020

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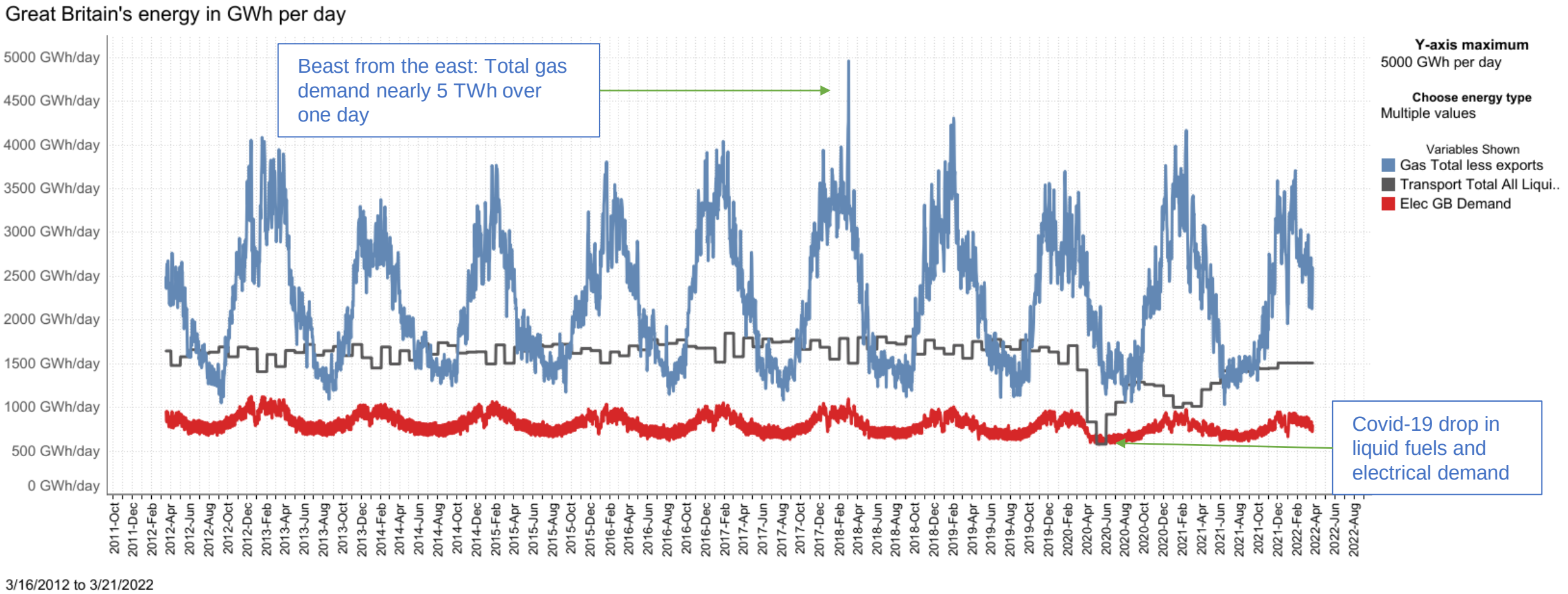
i.a.g.wilson@bham.ac.uk

Daily total energy demand



3/16/2012 to 3/21/2022

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Underlying data are from National Grid, Elexon and BEIS
Figure created by Dr Grant Wilson: i.a.g.wilson@bham.ac.uk
Energy Informatics Group, University of Birmingham

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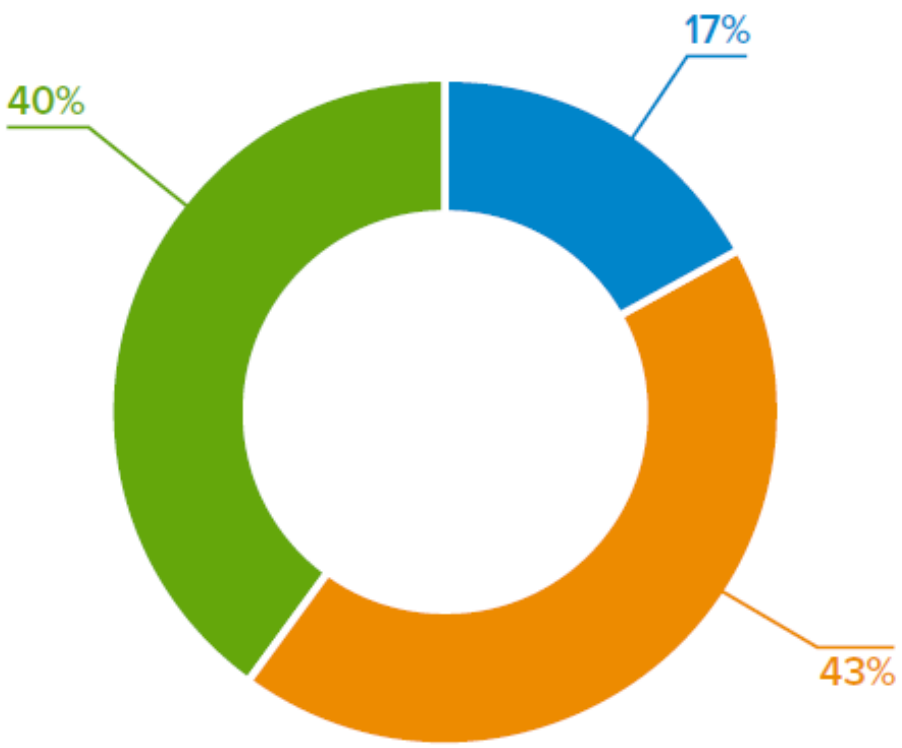
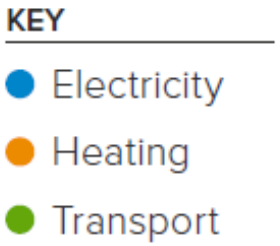
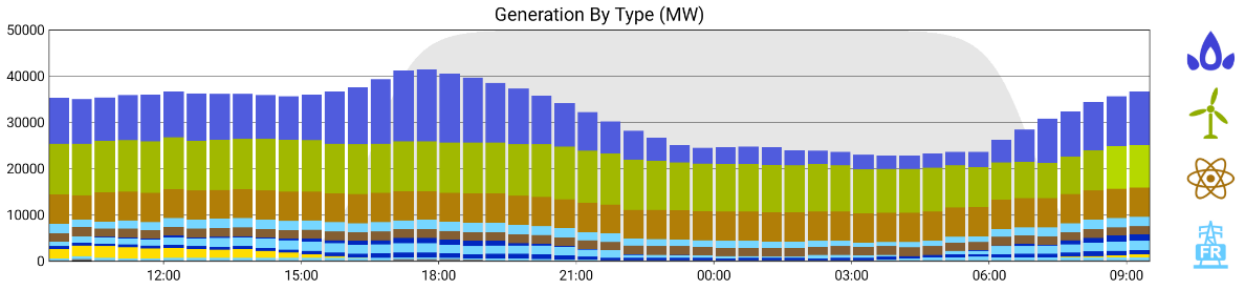
Doubling of electrical generation required with decarbonisation and rapid ability to turn on and off

UK energy consumption in 2018[2].

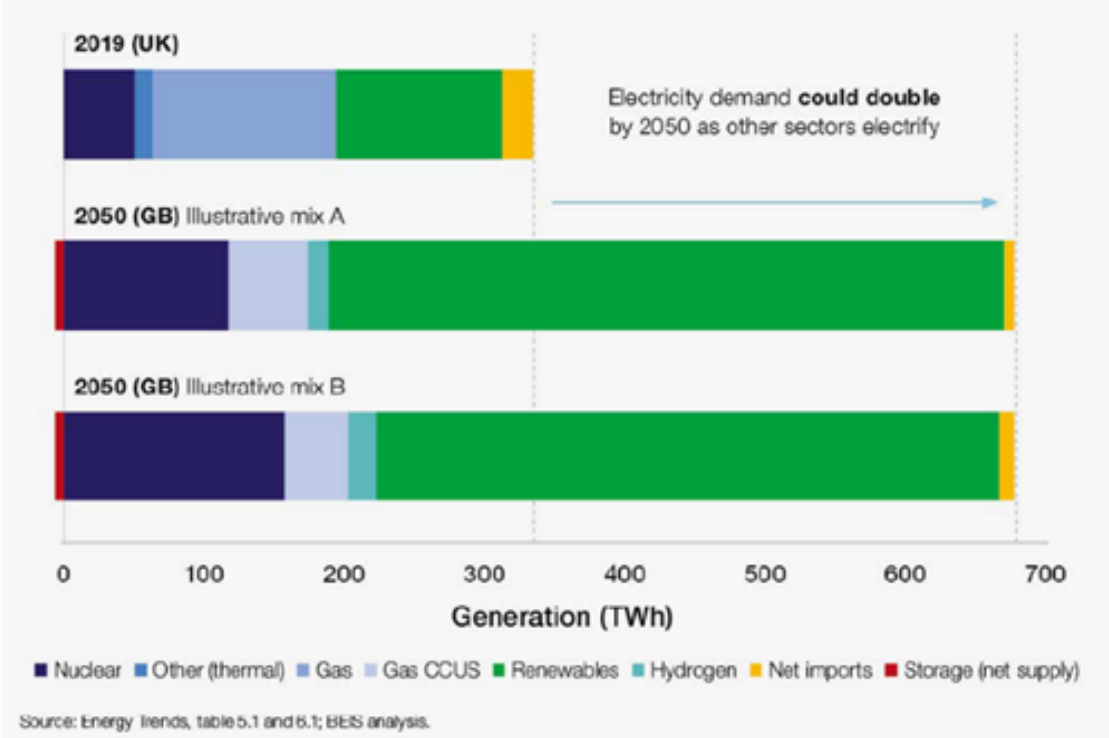




Renewables are intermittent. Today, we manage these fluctuations with gas:



- The cheapest way to ensure we can meet electricity demand in future is to also build a small amount of reliable low carbon power.
- “Gigawatt build” nuclear plants provide baseload contribution (brown above), but do not manage fluctuations well, and cannot be the solution to manage intermittency.
- Gas (blue above) currently manages intermittent fluctuations in electricity demand.



Illustrative mix of energy 2019 to 2050

Journey to Net Zero

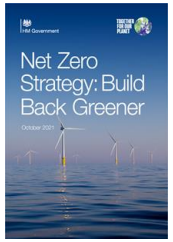


Figure 5: 2019 energy sources and end uses

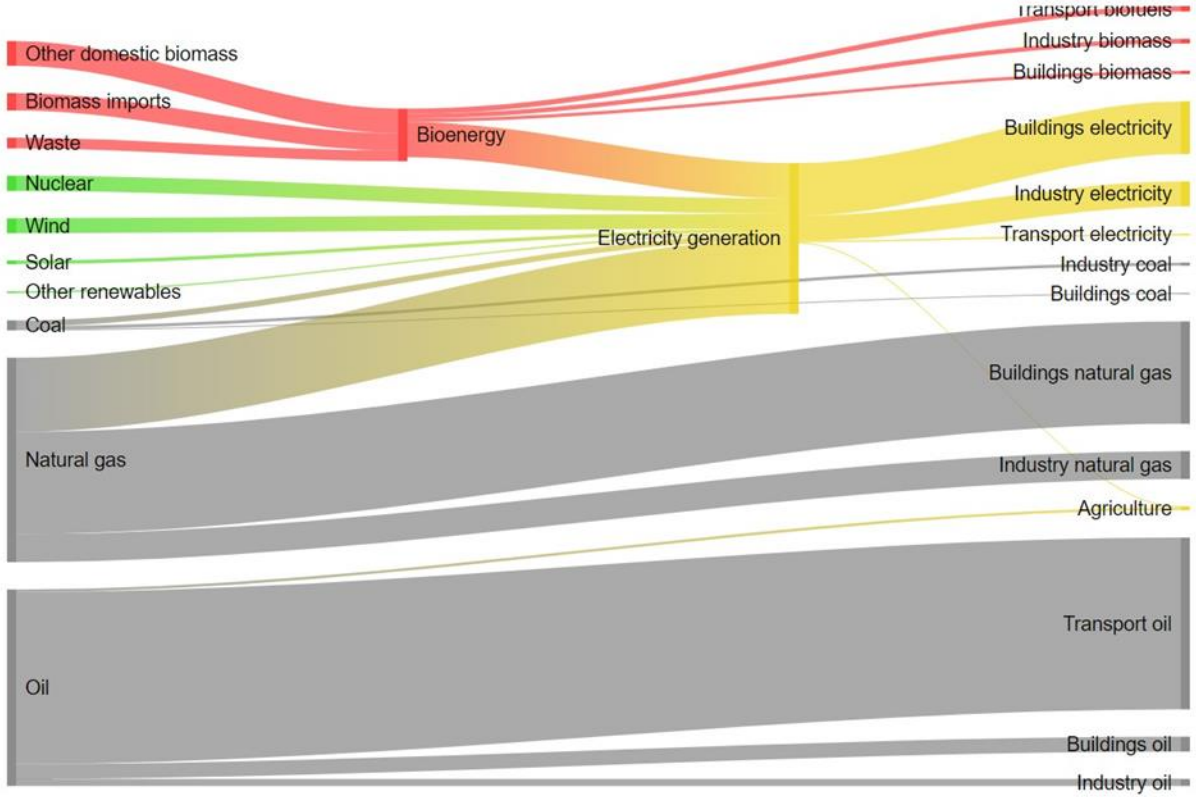
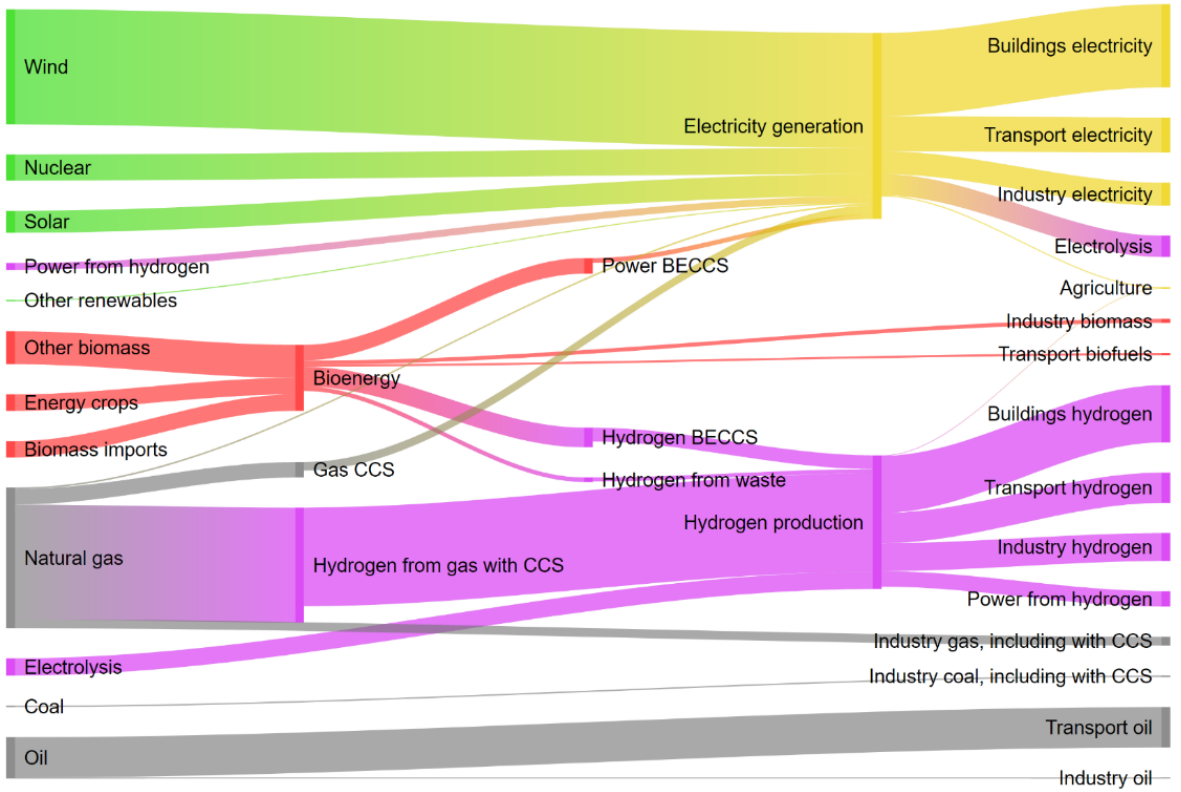


Figure 6: High electrification scenario: energy generation and end uses in 2050



Key Technologies for Net Zero

CCUS

- Requires the aggregate annual capture and storage of 75-175 MtCO2 in 2050
- Scope for significant cost reduction

Hydrogen

- Increased UK production – 10x to 300TWh
- Used in industry, long distant HGVs, ships and buildings
- UK Government announced new projects in clean steel

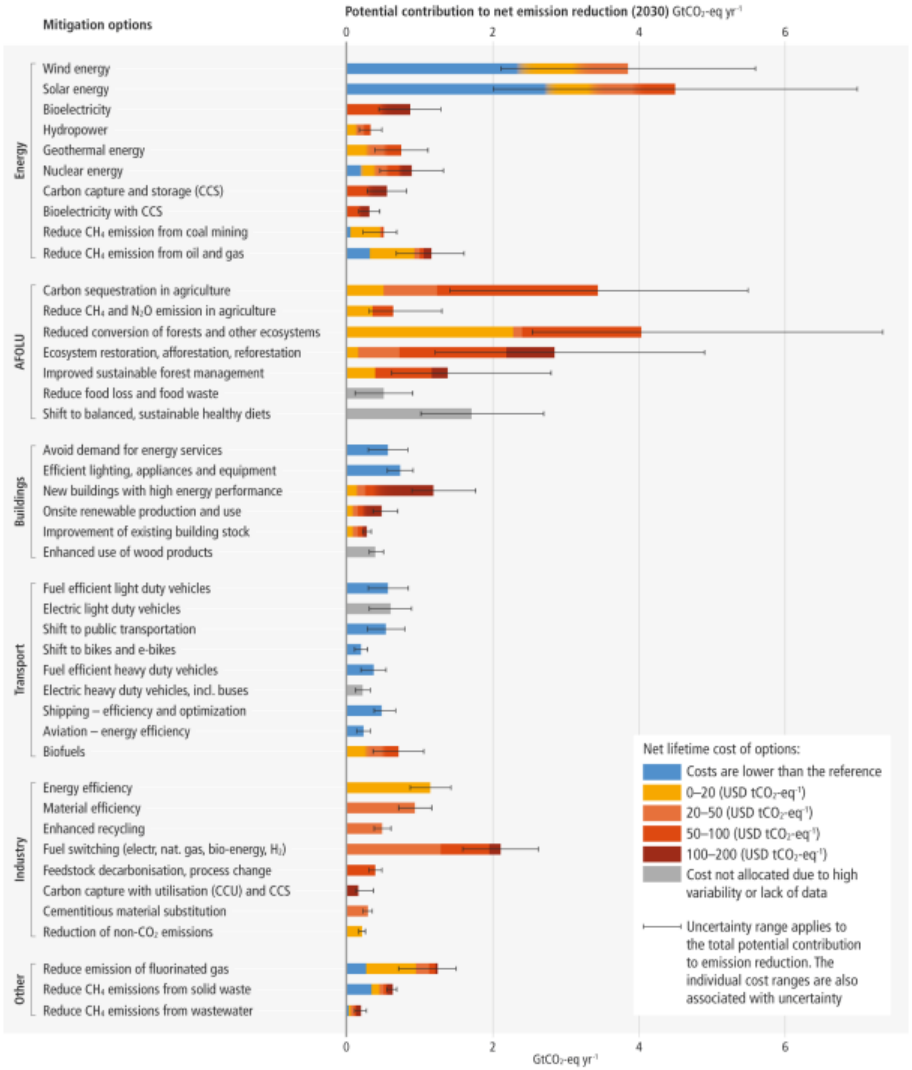
Biomass

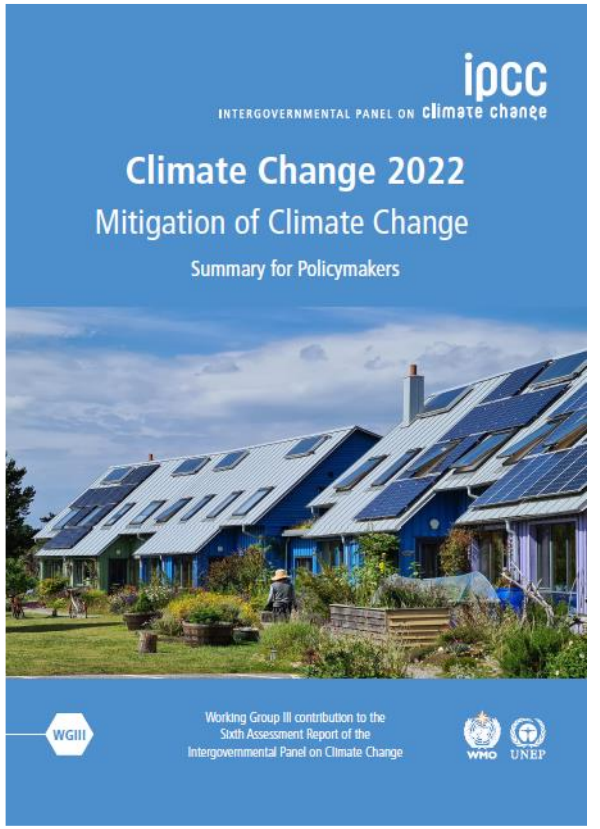
- Likely doubling of today's use
- Planting more bioenergy crops and changing the way we use land

Greenhouse Gas Removal

- 50-90Mt of negative emissions in 2050 from BECCS and DAC.

Many options available now in all sectors are estimated to offer substantial potential to reduce net emissions by 2030. Relative potentials and costs will vary across countries and in the longer term compared to 2030.





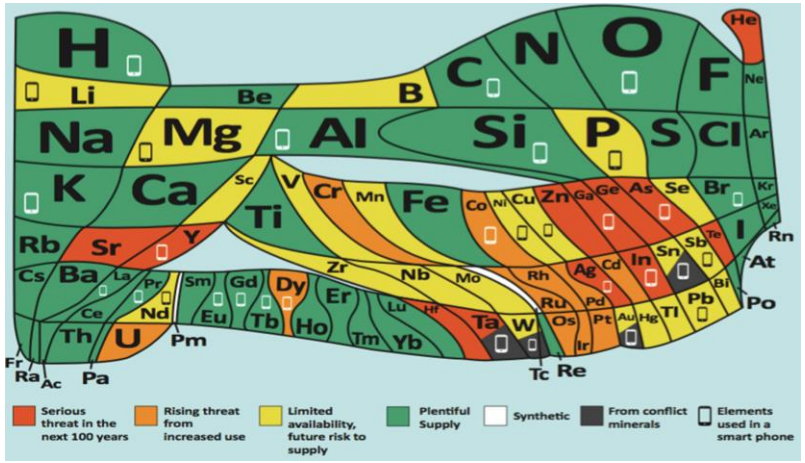
Many options available in all sectors are estimated to offer substantial potential to reduce net emissions by 2030.

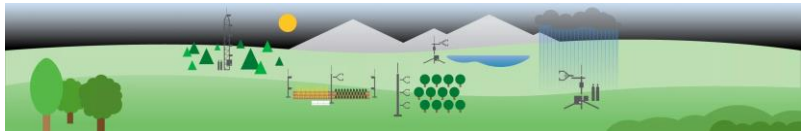
The Role of Science

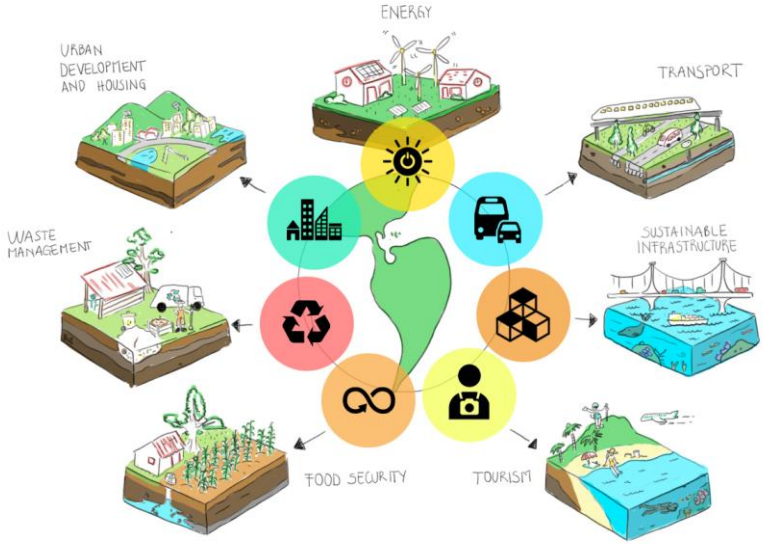
Science and Net Zero

"Beyond the immediate imperative to overcome COVID-19, the greatest challenge facing the UK and the world is that of decarbonising our economies and building resilience to the impacts of climate change."

- **Sustainable Net Zero**
  - Critical Materials
  - Security of Supply
  - Recycling
- **Resilient Net Zero**
  - Systems thinking
  - Technology / Behaviours
  - Economic advantage
- **Measuring Progress to Net Zero**







Science for Solutions

THE ROYAL SOCIETY

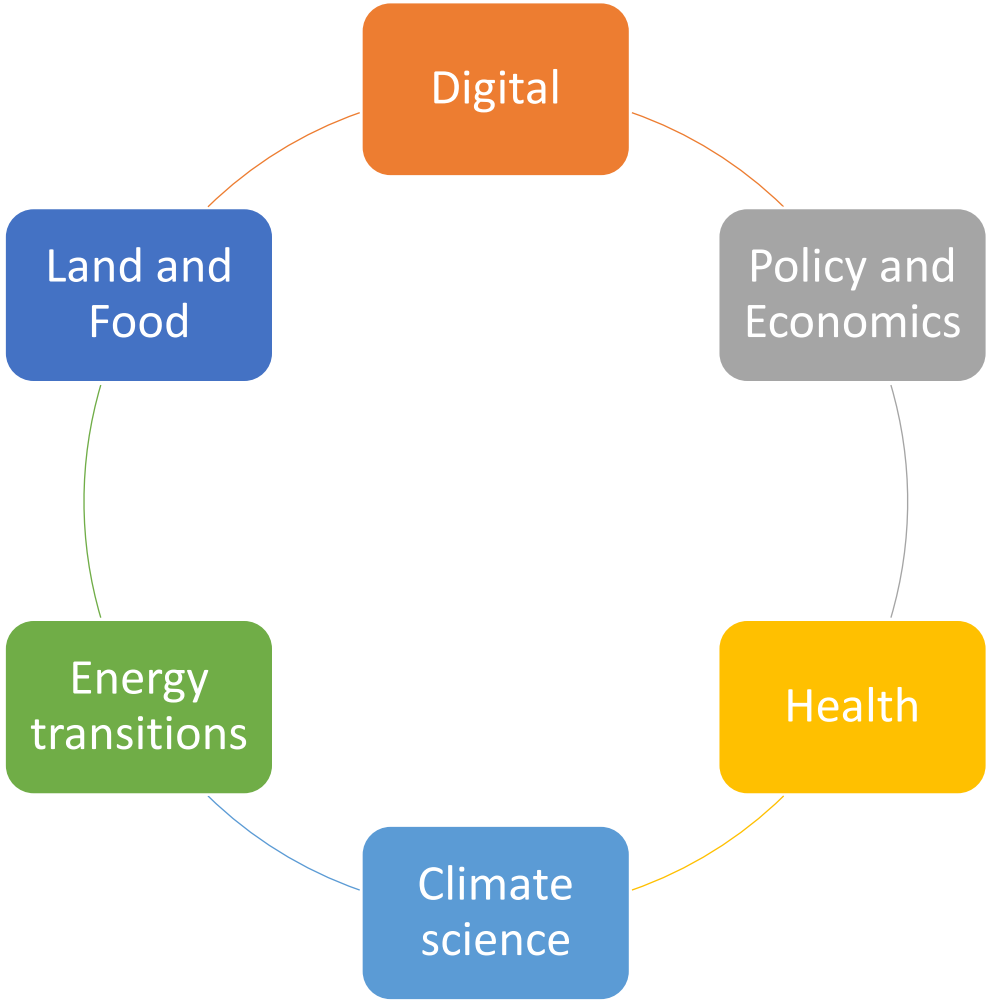
CLIMATE CHANGE : SCIENCE AND SOLUTIONS | OVERVIEW

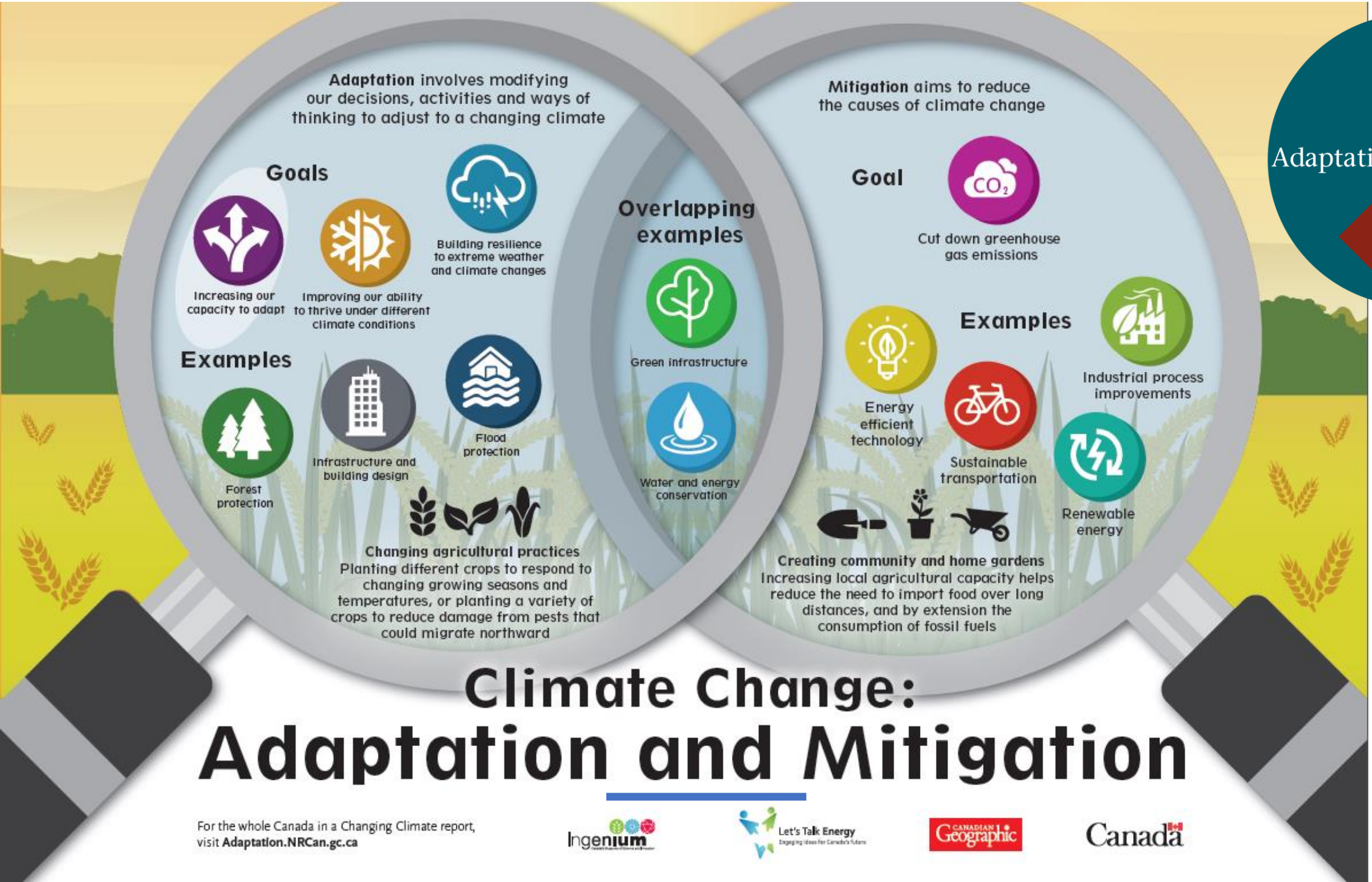
A net zero climate-resilient future:
science, technology and the solutions for change

Speech

The vital role of science in tackling climate change

COP26 President Alok Sharma's opening address on the second day of the Met Office Science Conference 2021: Science for a resilient future.





Climate Change:
Adaptation and Mitigation

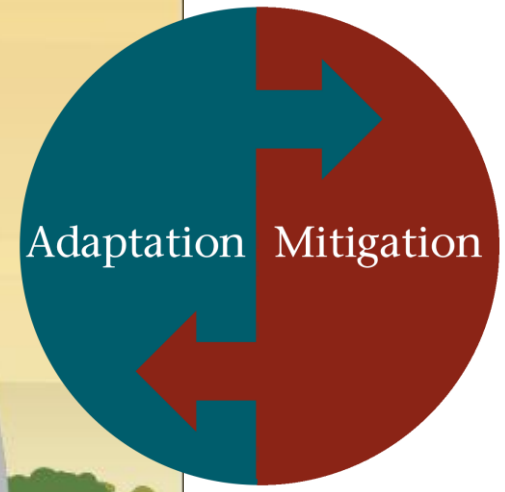
For the whole Canada in a Changing Climate report, visit **Adaptation.NRCan.gc.ca**

Ingenium

Let's Talk Energy

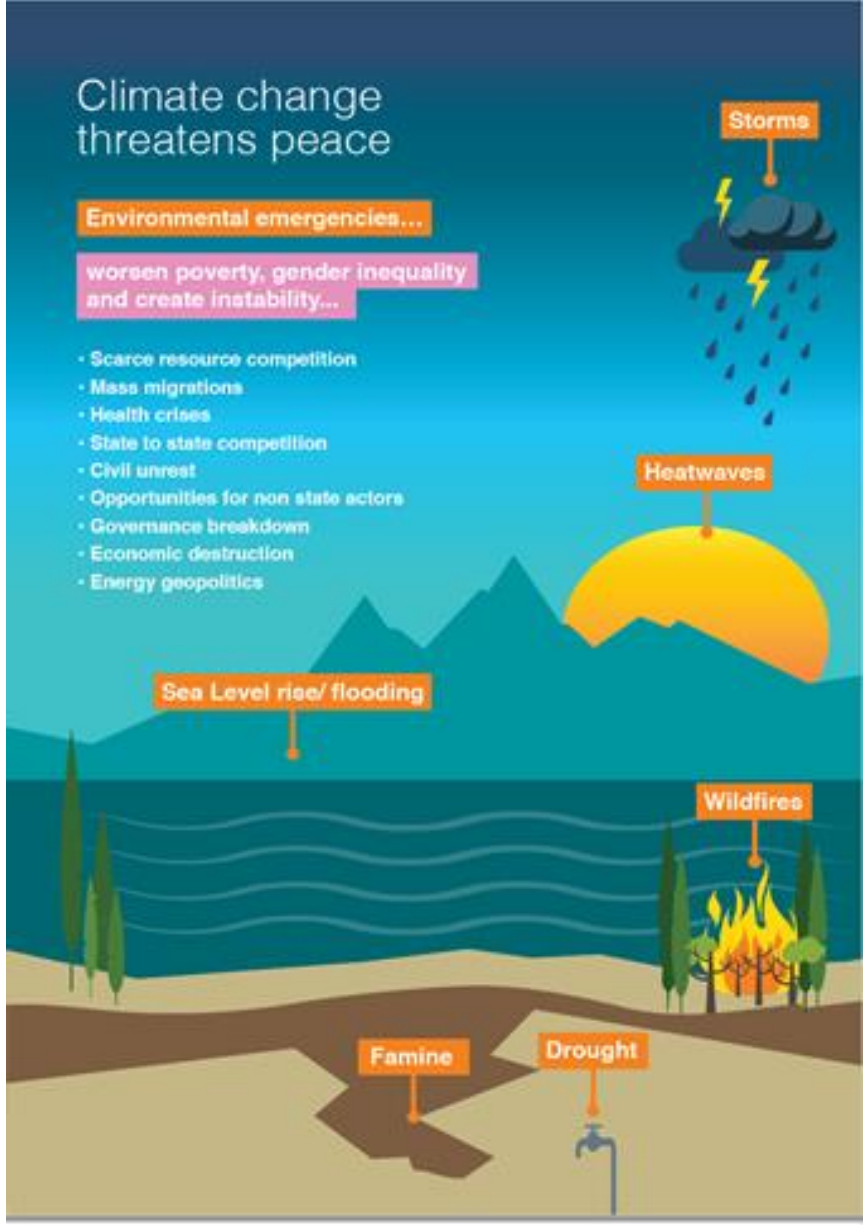
Canadian Geographic

Canada



Climate Security

- The effects of climate change are already being felt in the UK and around the world.
- BEIS is funding research to step up the UK's resilience to the impacts of climate change, such as flooding, heatwaves and extreme weather storms.
- The 4-year, £5 billion "Climate Services for a Net Zero Resilient World" (CS-N0W) programme is one such example.



Some take-homes …

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

Requirement for a systems approach incorporating behaviour change.

Role of science and innovation is critical to achieving net zero in a sustainable and resilient manner.

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