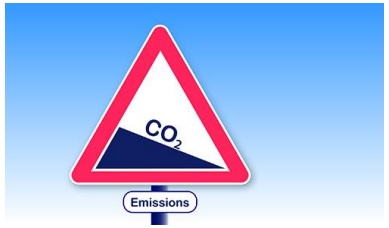
Net Zero: What role for science in policy?

Professor Paul S Monks

BEIS Chief Scientific Adviser

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.

Sixth Carbon Budget

- The report recommends that the UK's pathway to net zero by 2050 **should reduce emissions by 78% by 2035.**

- The CCC identify that their recommendation would require a major investment programme, supporting Covid-19 recovery – including to scale up low carbon markets and supply chains over the 2020s and early 30s, along with support for behavioural change. This includes:

    - considerable **expansion of low-carbon energy supplies**, including further growth in offshore wind

    - **take up of low-carbon solutions** as high carbon options are phased out, e.g. by the early 2030s all new cars and all boiler replacements are low-carbon

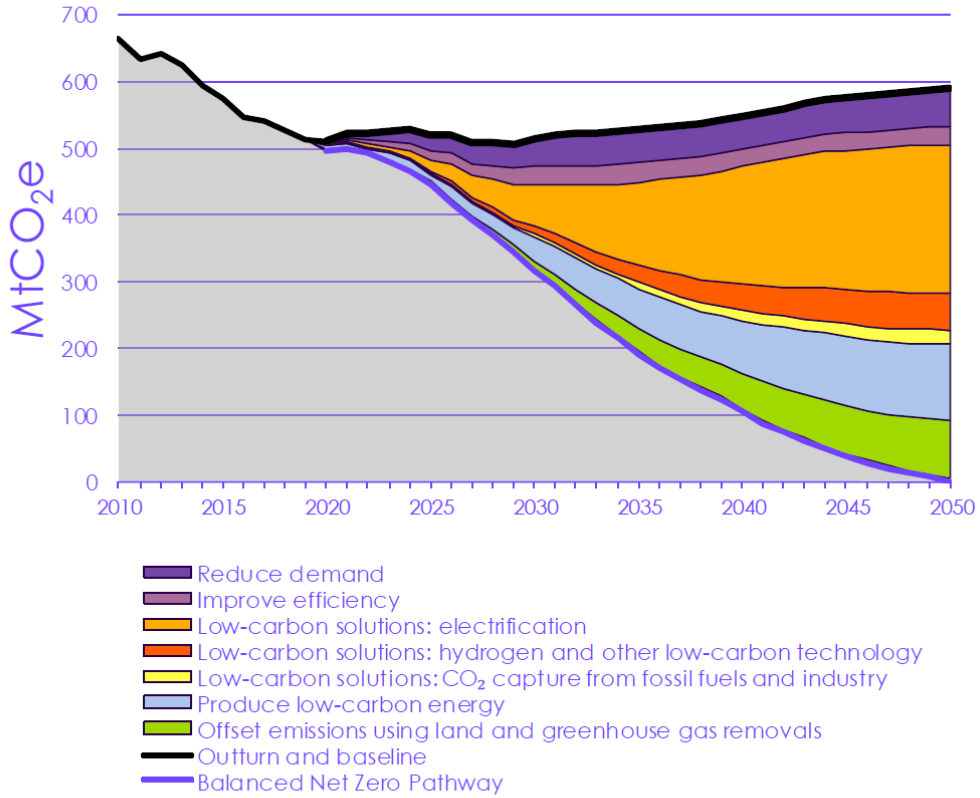
    - **less carbon-intensive activities**, e.g. a national programme to improve insultation and high-carbon meat consumption reducing by 20% by 2030

    - land and greenhouse gas removals, **transforming agriculture** while maintaining same food levels per head, and 460,000 hectares of new woodland by 2035.

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

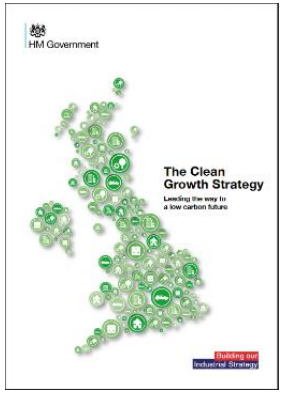


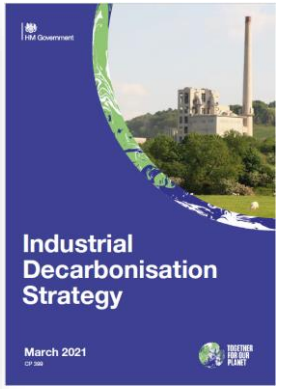
Source: BEIS (2020) Provisional UK greenhouse gas emissions national statistics 2019; CCC analysis.
Notes: 'Other low-carbon technology' includes use of bioenergy and waste treatment measures.
'Producing low- carbon electricity' requires the use of CCS in electricity generation.

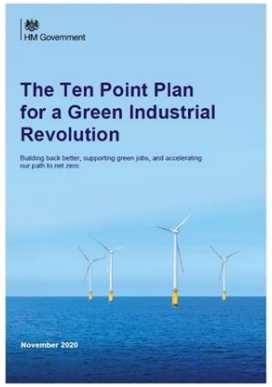
How do we achieve Net Zero?

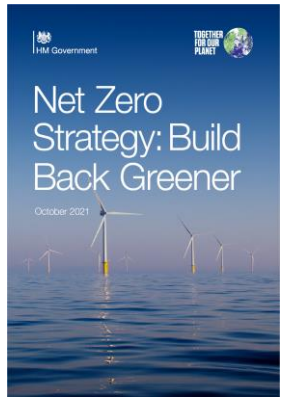
- Ahead of COP26, ambitious new plans to reduce emissions across key sectors of the economy – including **an Energy White Paper, Transport Decarbonisation Plan, Industry Decarbonisation Strategy, Hydrogen Strategy, and Heat and Building Strategy**.

- 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 Strategy

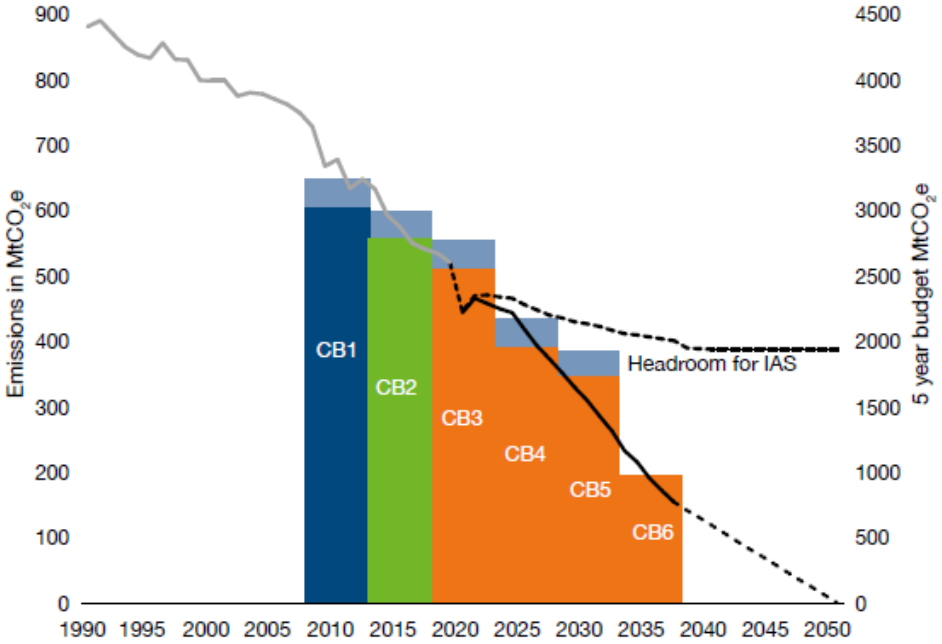
- The Net Zero Strategy outlines measures **to transition to a green and sustainable future**, helping businesses and consumers to move to clean power, supporting hundreds of thousands of well-paid jobs and leveraging up to £**90 billion of private investment by 2030**.

- In all scenarios for 2050, reaching net zero means extensive decarbonisation across **transport, buildings and industry;** increased energy and resource **efficiency**; and use of **greenhouse gas removals**.

- **Action required across all fronts** – scaling up of the **electricity system**, all met from low carbon sources to bring forward the government's commitment to a fully decarbonised power system by 15 years; the development of **new hydrogen production and carbon capture infrastructure**; and roll out of **electric vehicles and low carbon heating** at scale.

- Government is taking a **'systems approach**' to policymaking to help navigate the complexity of the net zero challenge – considering the environment, society, and economy as parts of an interconnected system.

Figure 12: Indicative emissions reductions to meet UK carbon budgets and NDC[10]



2025 – 55% reduction (excluding international aviation and shipping emissions)

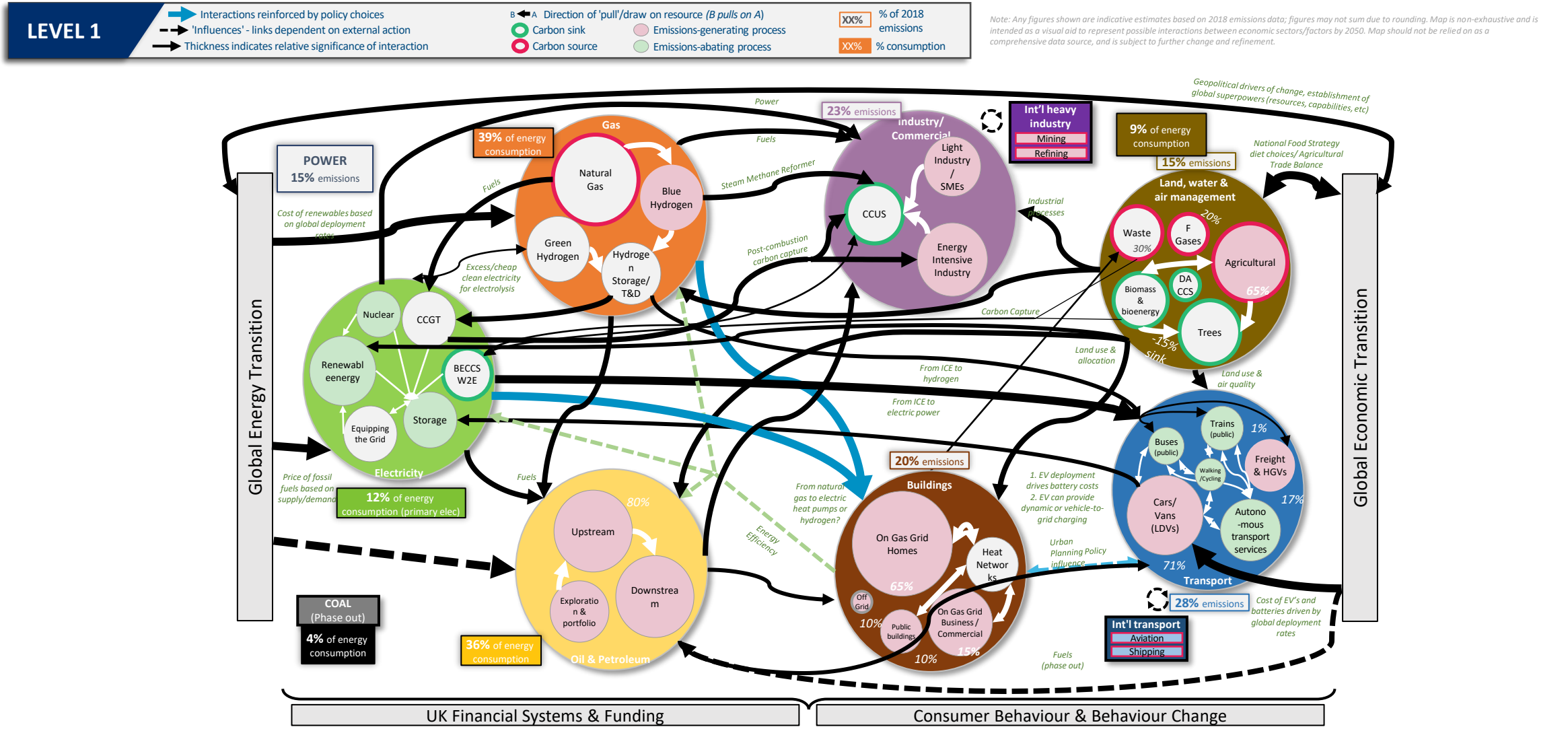
2030 – NDC target for at least 68% reduction (excluding international aviation and shipping)

2035 – 78% reduction (including international aviation and shipping)

2050 – 100% reduction

To meet whole-economy net zero target

Net Zero – Systems Map



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.**

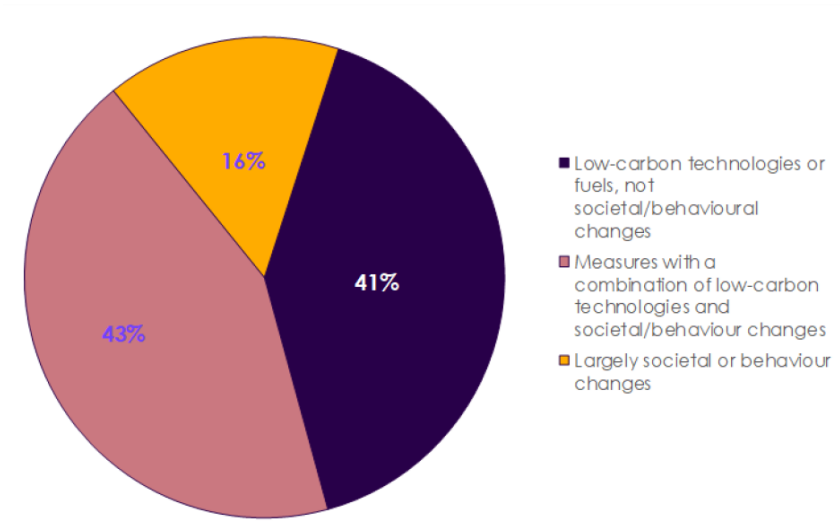
Source: BEIS analysis (drawing on CCC). Figures indicative and reflect one scenario

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

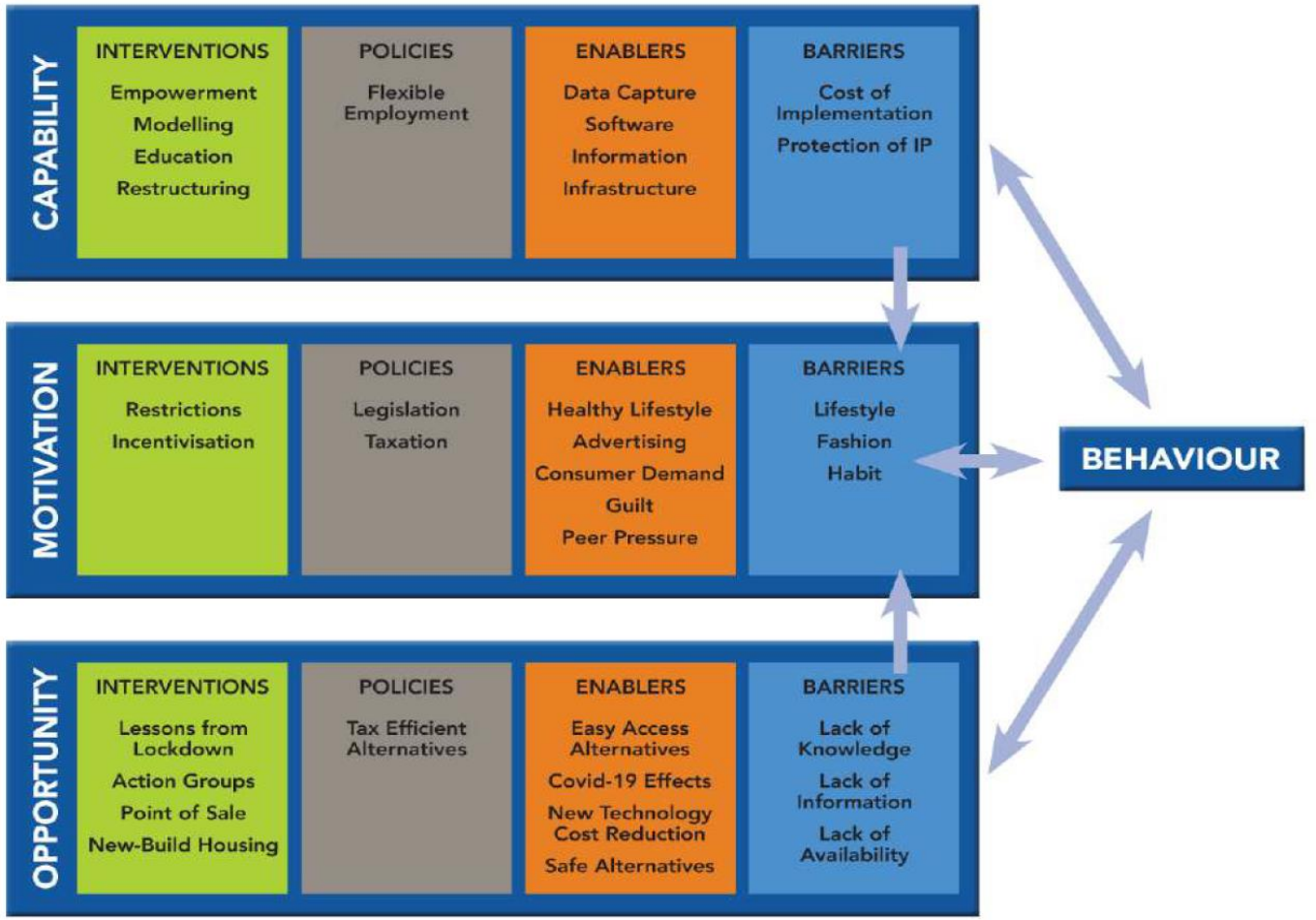
Behavioural Change

CCC Carbon Budget 6

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



Source: CCC analysis.

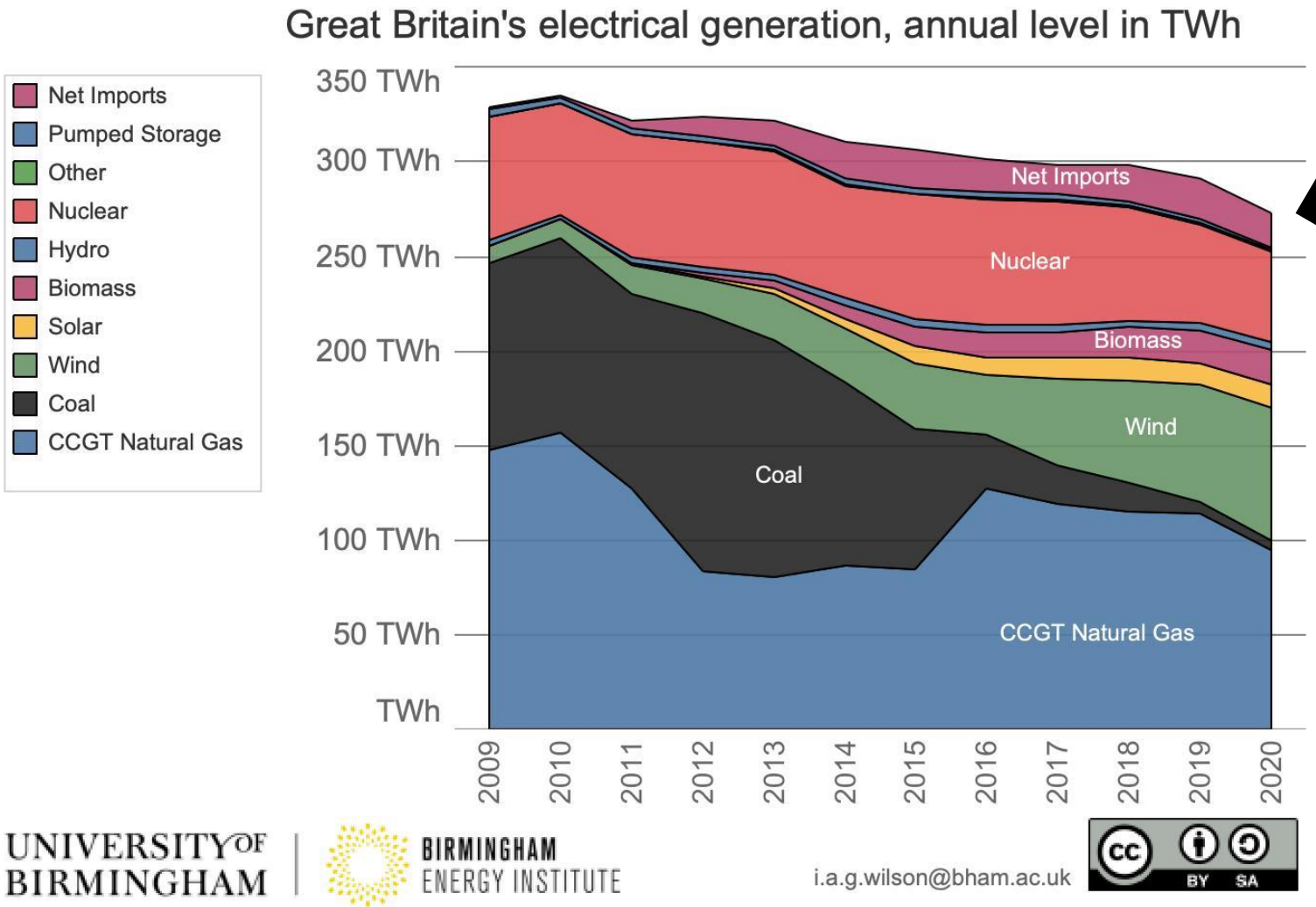


Measures requiring largely societal or behaviour changes needed to reduce demand and improve efficiency. *E.g.*

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

Energy Transition

Reduced electrical demand and changed generation



61 TWh (18%) reduction from 2010 to 2020

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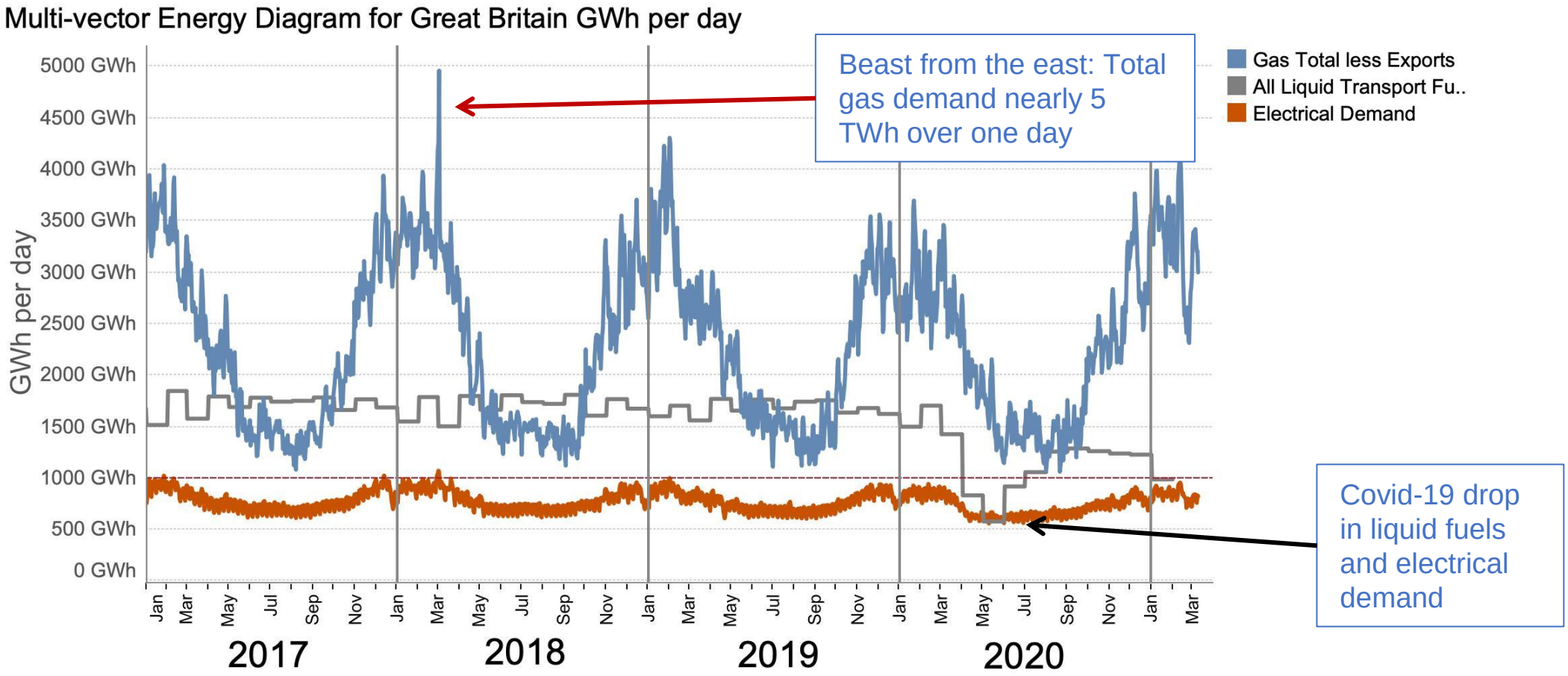
Daily total energy demand



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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
slidepack available from https://doi.org/10.5281/zenodo.3930970

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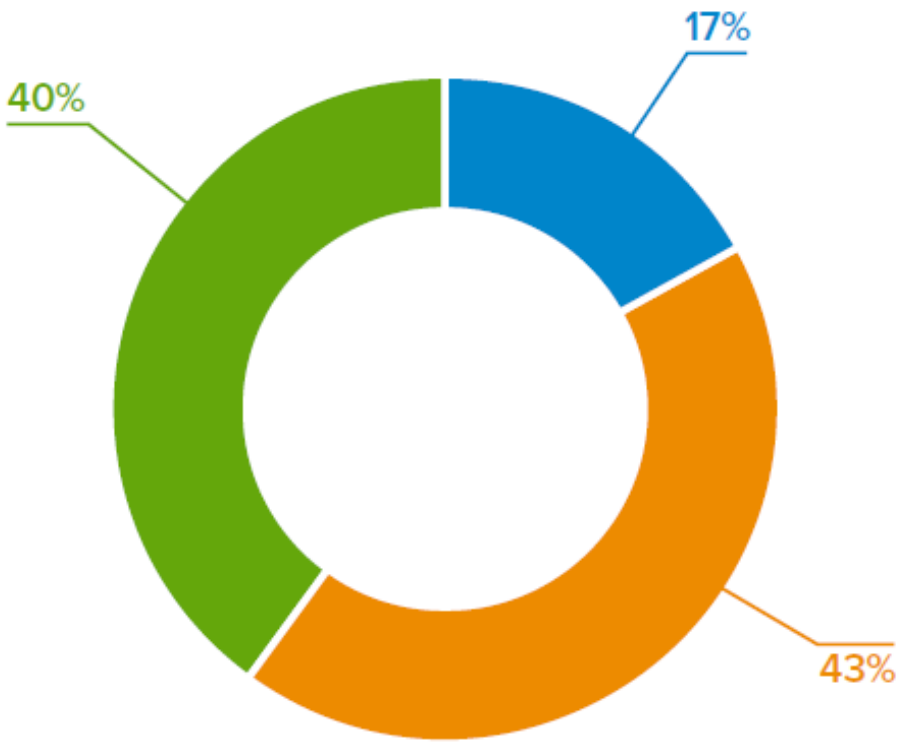
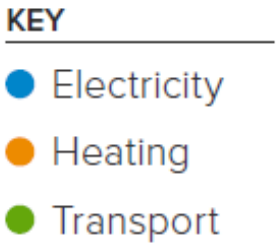
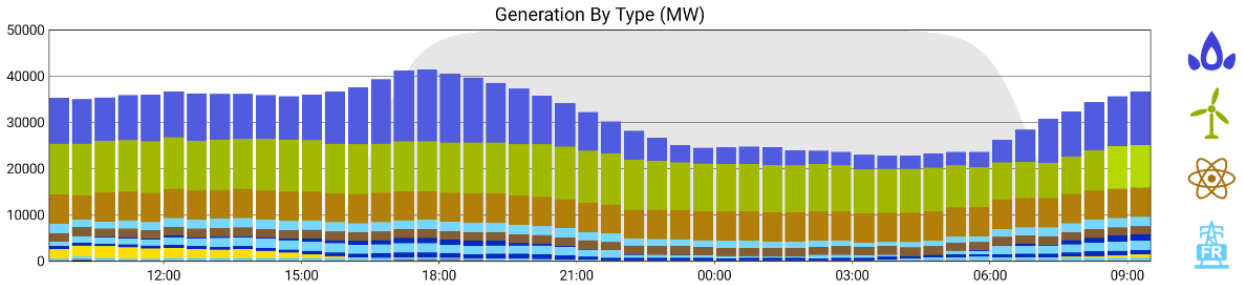
Doubling of electrical generation required with decarbonisation and rapid ability to turn on and off

UK energy consumption in 2018[2].

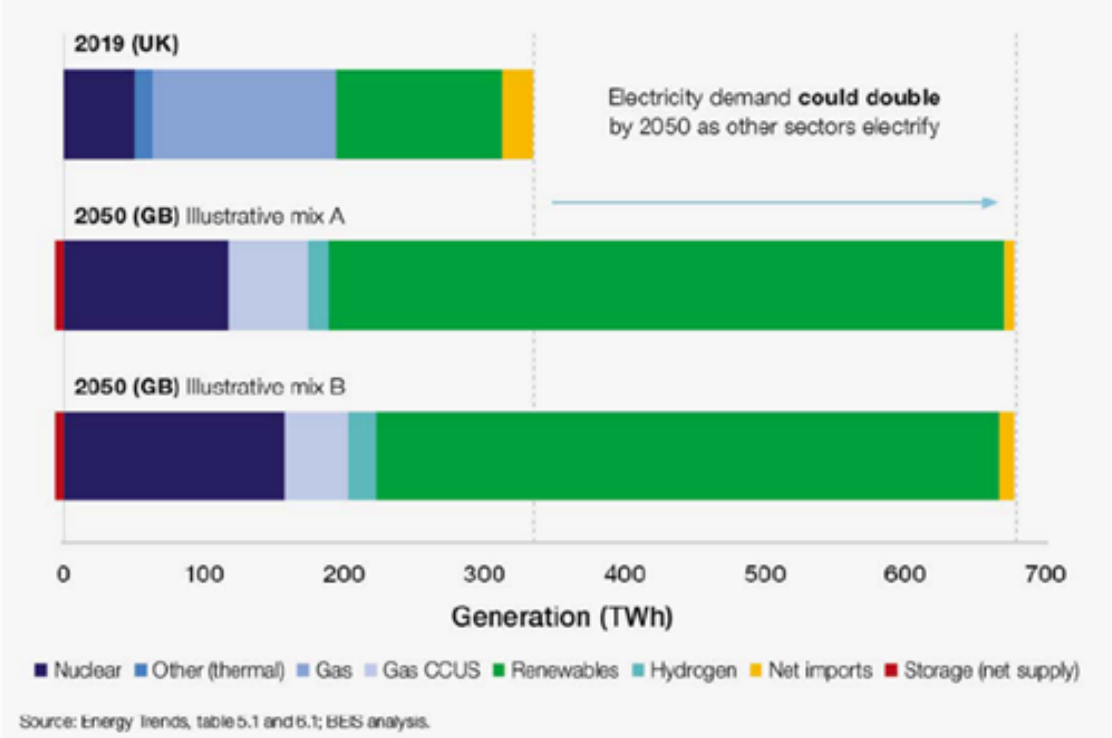




Renewables are intermittent. Today, we manage these fluctuations with gas:



- 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

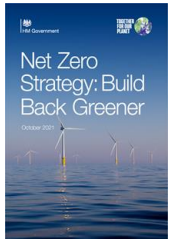


Figure 1: 2019 energy sources and end uses

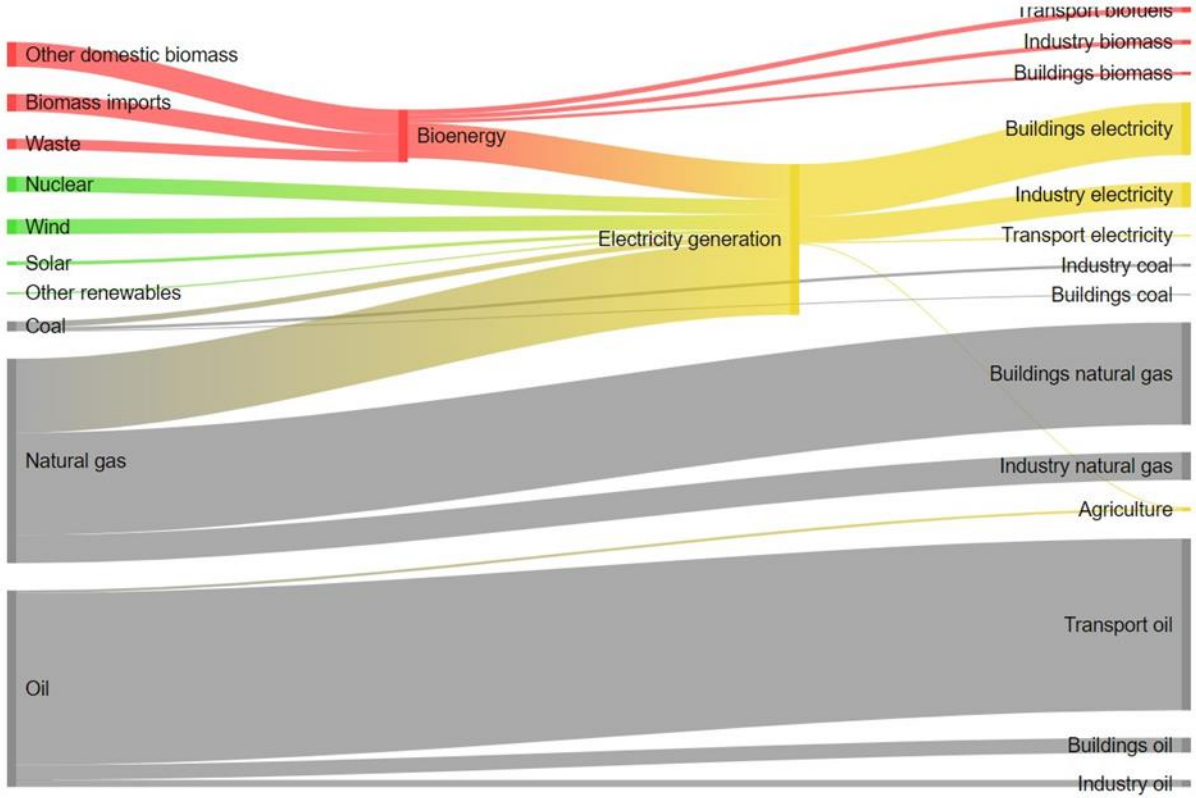
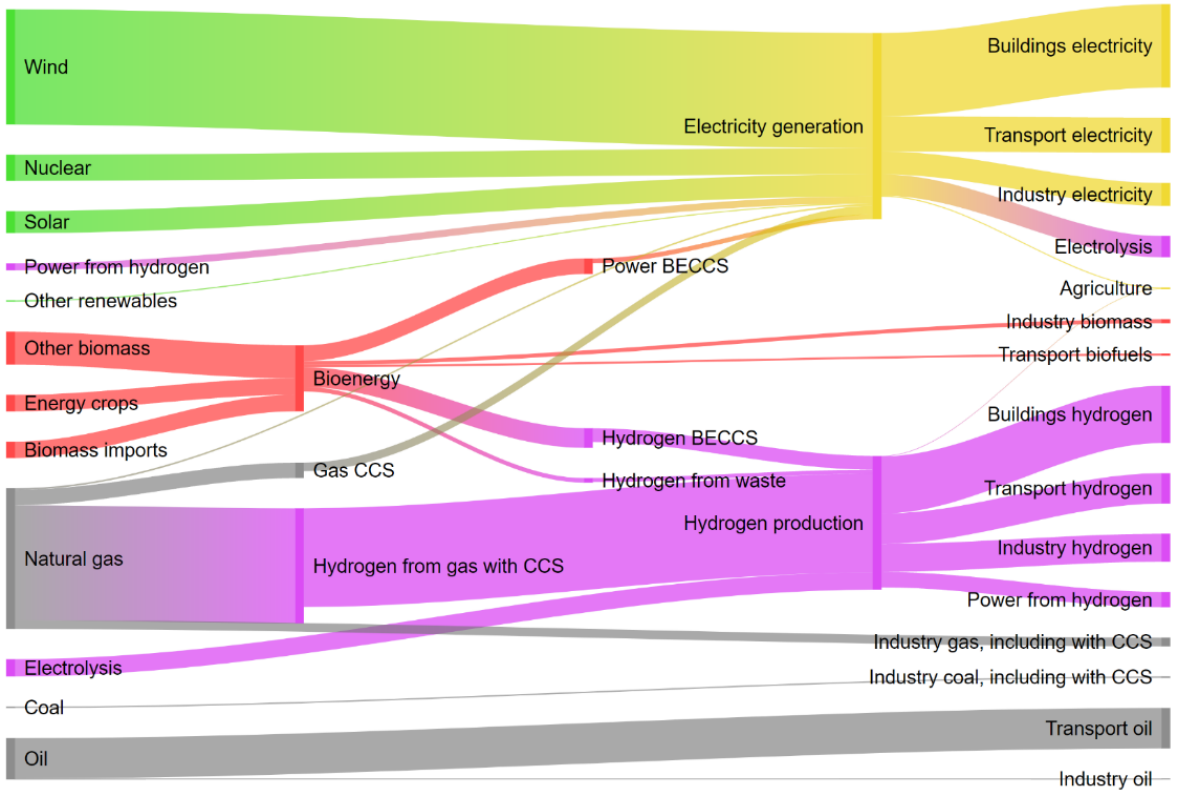


Figure 2: High electrification scenario: energy generation and end uses in 2050



The Role of Science

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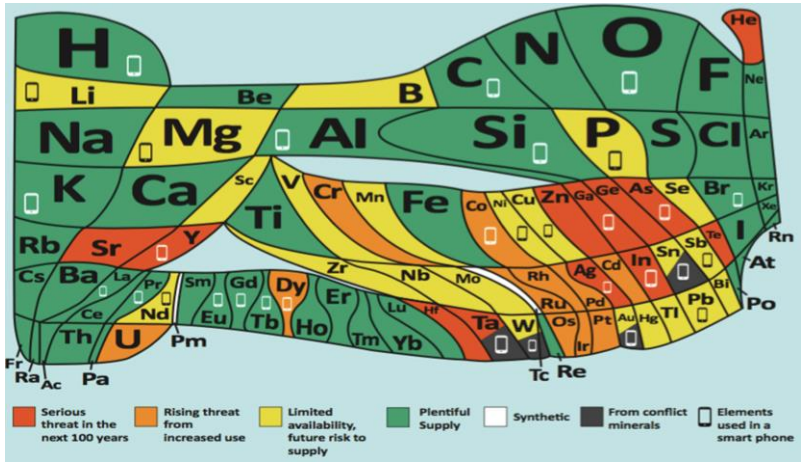
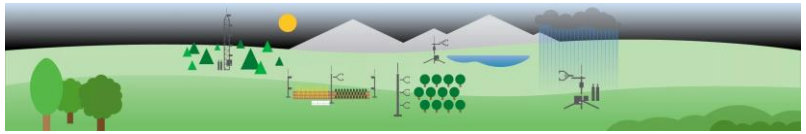
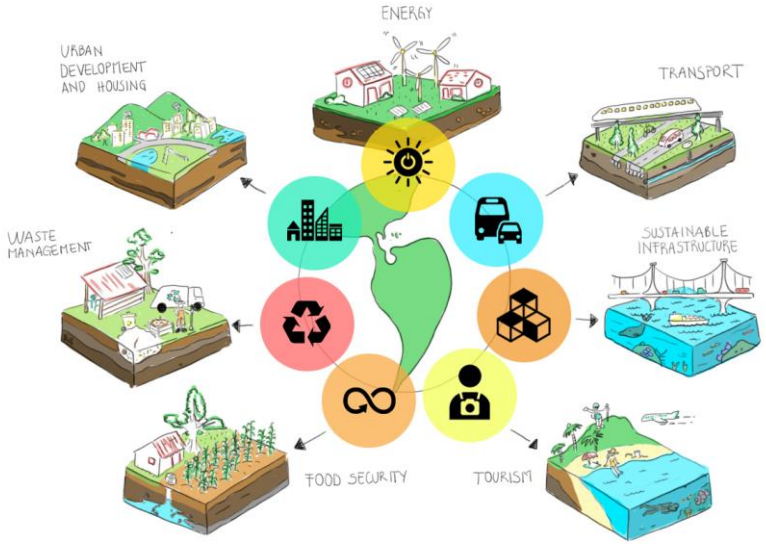
Science and Net Zero

"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**







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Science for Solutions

THE ROYAL SOCIETY

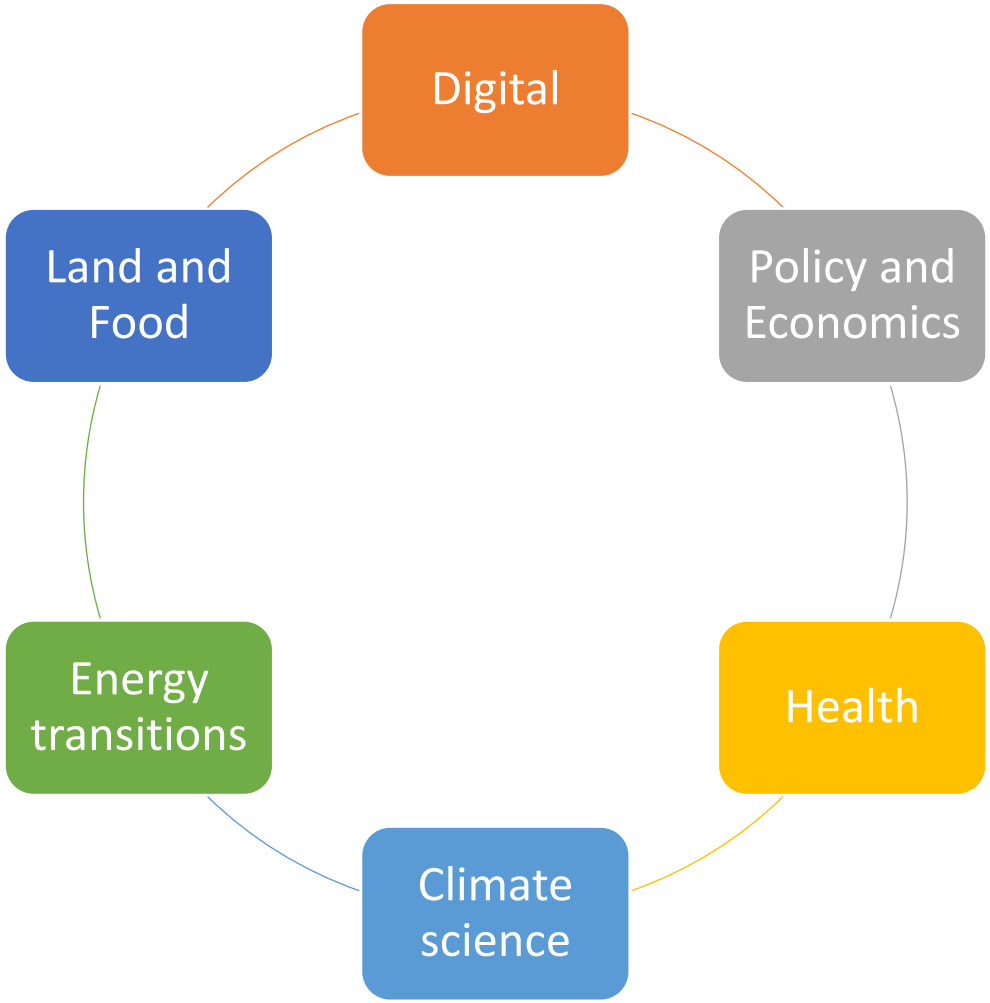
CLIMATE CHANGE : SCIENCE AND SOLUTIONS I OVERVIEW

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.



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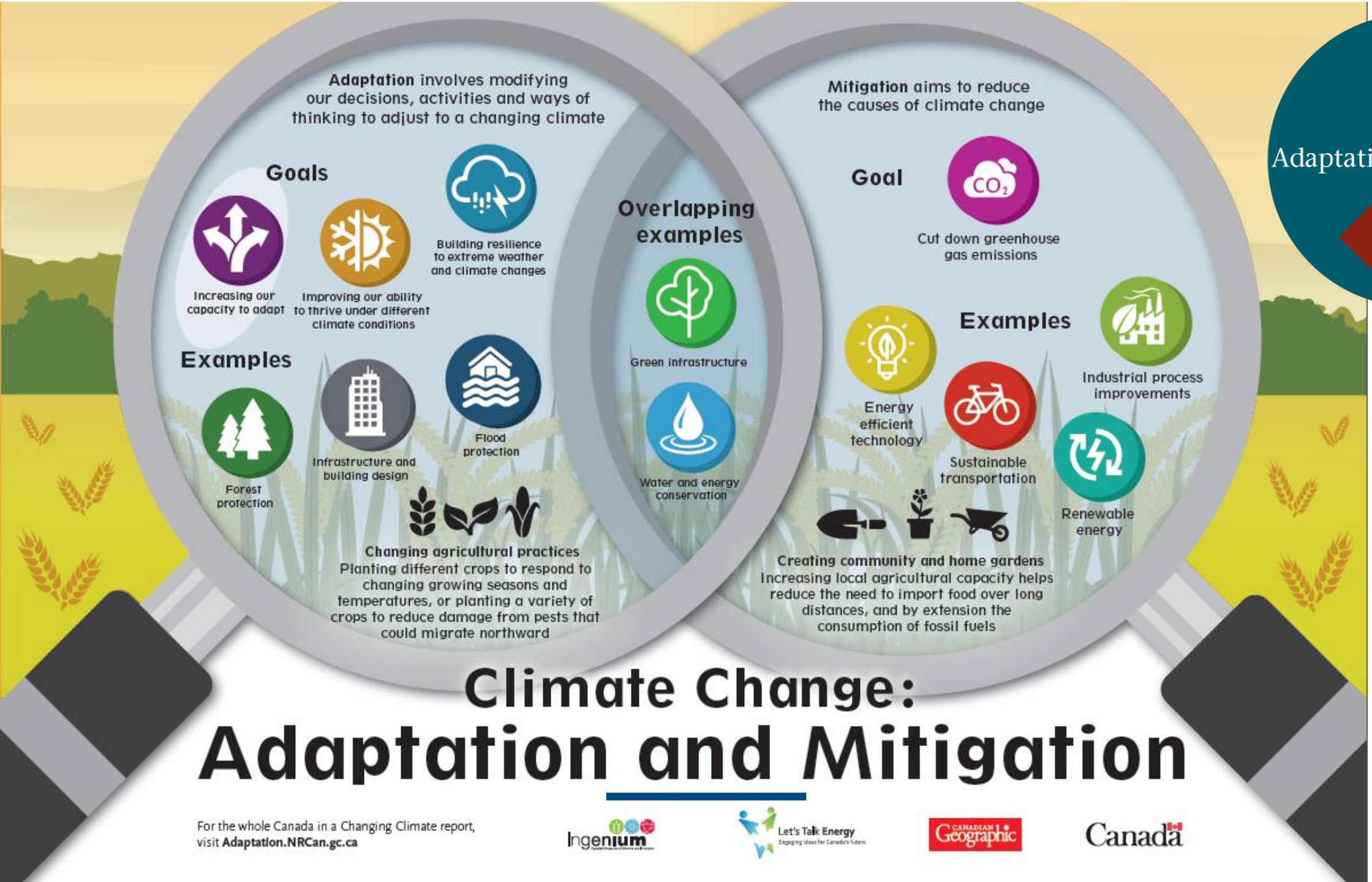
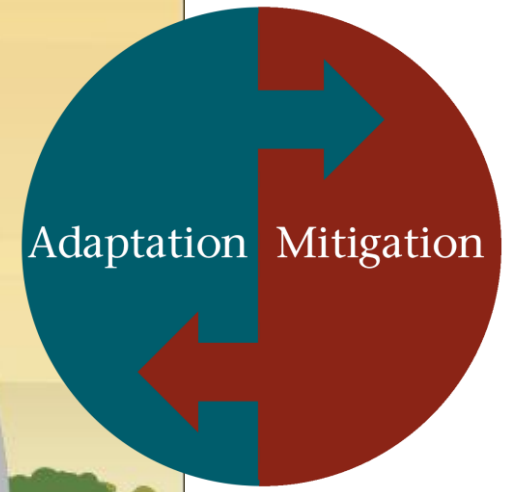


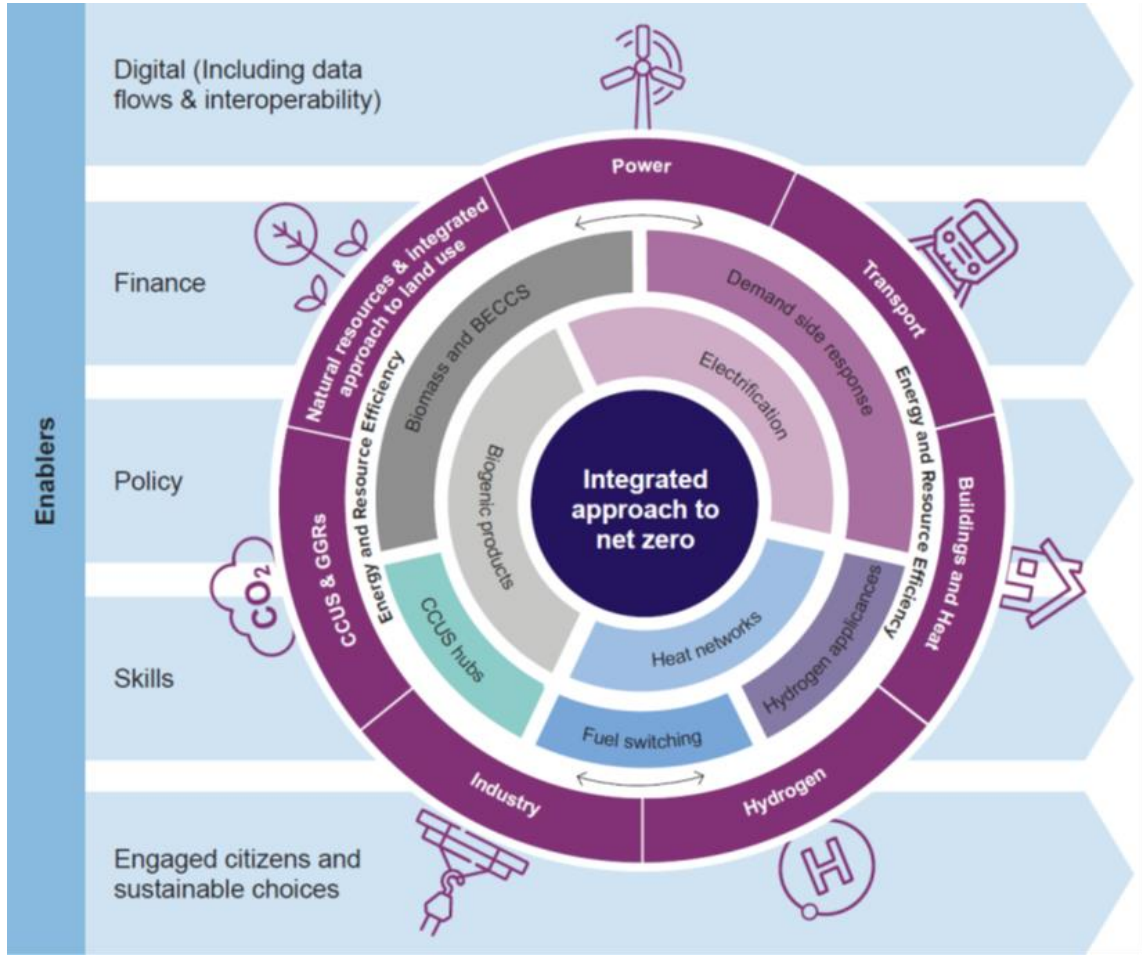
Climate Change:
Adaptation and Mitigation

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

Ingenium · Let's Talk Energy · Canadian Geographic · Canada



What does Research and Innovation for Net Zero look like?



Integrated systems approach to innovation

Net Zero Research and Innovation Framework

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Research & Innovation Roadmap

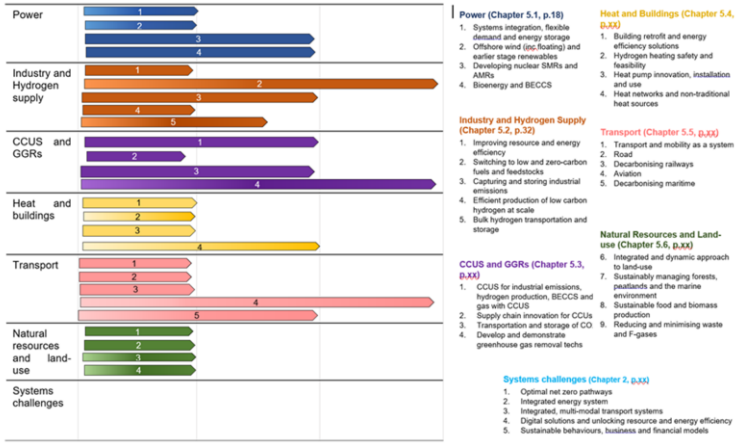

Figure 24: Net Zero Research & Innovation Roadmap for UK

- Research – Technology Readiness Levels 1 - 3
- Development – Technology Readiness Levels 4 - 6
- Demonstration – Technology Readiness Levels 6 - 9

	2020s	2030s	2040s
4.2 Industry	Continuing energy and resource efficiency improvements, especially in heavy industries such as chemicals, cement, steel, and glass manufacture		
	Develop and demonstrate electrification, hydrogen and bioenergy, identifying which solutions are best suited to different industries.	Develop and demonstrate other low carbon fuels including process heat, e.g. from advanced nuclear reactors; support deployment of net zero industrial cluster by 2040	Last mile issues to ensure almost no unabated fossil fuel in use in industry by 2050 (unless combined with CCUS)
	First-of-a-kind CCUS demonstration plants across industrial sources	Scale-up of CCUS, including innovation in alternative means of transport and storage for dispersed sites	

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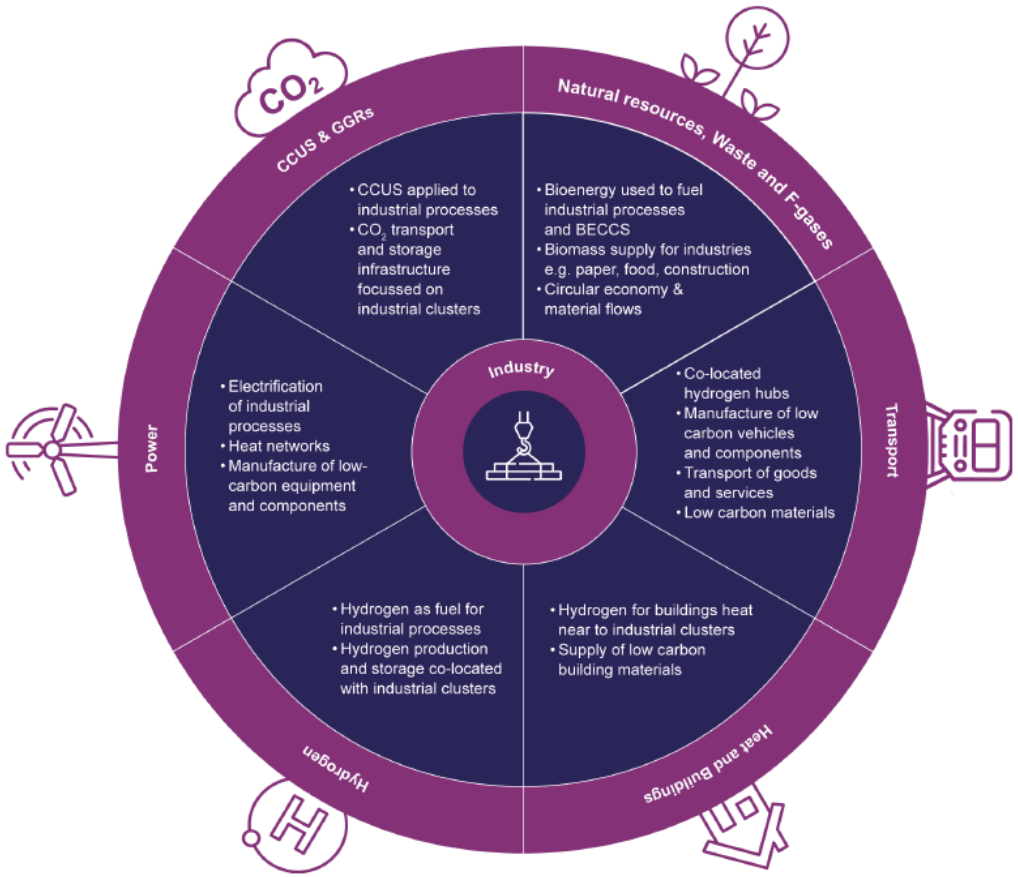
Research & Innovation – Industrial Decarbonisation

- Next decade is critical for trialling solutions best suited to different industries/contexts and to reach maximum energy and resource efficiency levels.

- More expensive decarbonisation options roll out from 2030s onwards with deep decarbonisation becoming the norm across UK industry.

- Three categories of innovation identified:
  1. Resource and energy efficiency
  2. Fuel switching
  3. Carbon Capture, Utilisation and Storage (CCUS)

Figure 12: System interlinkages between Industry and other sectors



Research & Innovation – Industrial Decarbonisation

1. Improving resource and energy efficiency

- Advanced technologies and new manufacturing processes (i.e. green steel) *[2025 – 2030 & beyond]*
- Advanced manufacturing technologies to create lighter, less resource-intensive materials *[2020 – 2030]*
- Business model innovation that supports more efficient use of resources *[2020 – 2030]*
- Reduce use of raw materials & development of alternative, renewable feedstocks *[2025 – 2030s & beyond]*

2. Fuel Switching

- Hydrogen: demonstrate low carbon hydrogen as a feedstock for industrial sectors *[2020 – 2030]*
- Electrification: develop technologies for medium and high temperature heat applications *[2020 – 2030]*
- BECCS: further research on how limited supply sustainable biomass should be used and how supply should be increased *[2020 – 2030]*

3. CCUS

- Heat recovery solutions and integration of the capture process with the wider site *[2020 – 2030]*
- First of a kind CCUS demonstration plants across industrial sources *[2020 – 2030]*
- Improve capture rates, particularly for flue gas streams with low CO2 concentration impurities *[2025 – 2030s & beyond]*
- Research into bespoke CCUS solutions including treatment of flue gas impurities *[2025 – 2030s & beyond]*

*The bullets show examples **of R&I needs** across each industrial challenge. For a full list see Framework:
https://www.gov.uk/government/publications/net-zero-research-and-innovation-framework

Opportunities

- Decarbonisation
- Economic
- Optionality

Major decarbonisation opportunities
Floating offshore wind
Energy storage at scale and system flexibility - enablers of high renewables system
Hydrogen - enabler of industrial fuel switching, heat and some negative emissions
Carbon capture, utilisation and storage for industry - critical for hard to abate areas
Buildings decarbonisation
Land transport, including zero emission road vehicles, rail, light rail and active travel
Aviation and maritime
Agriculture and food
Nature-based carbon removals, e.g. afforestation, domestic perennial energy crops, short rotation forestry, biochar, etc.

Major business opportunities
Transport - aviation, automotive, maritime
Energy storage at scale
Hydrogen
Nuclear - Small Modular Reactors, Advanced Modular Reactors and advanced fuel cycle, particularly in export
Offshore wind - with floating offshore wind potential new area for export and domestic deployment

Creates optionality in net zero pathways
Energy efficiency
Carbon capture, utilisation and storage - major enabler for industry, hydrogen and bioenegry with carbon capture and storage (BECCS)
Innovation within industrial energy sectors - hard to abate and cannot be substituted by other technologies
Sustainable land-use
Negative emissions technologies including Direct Air Capture

Net Zero Innovation Portfolio

£1bn of funding over next 4 years covering 10 priority areas

Live priority programmes

Advanced Nuclear

Bioenergy

Advanced CCUS

Industry

Built Environment (Heat Pumps & Retrofit)

Future Offshore Wind

Greenhouse Gas Removal

Hydrogen

Smart Energy & Energy Storage

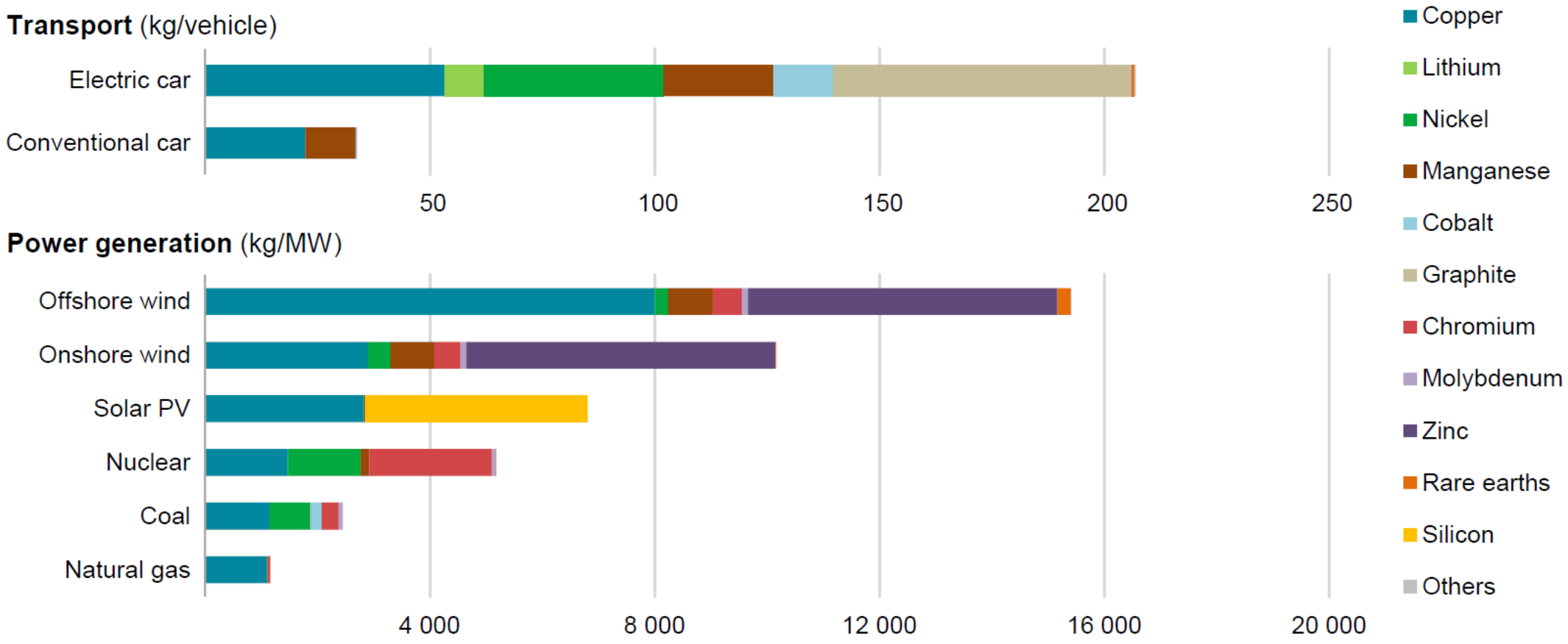
Disruptive Technologies

Important role of science for policy in government

Examples: Critical minerals, Events Research Programme

Department for Business, Energy & Industrial Strategy

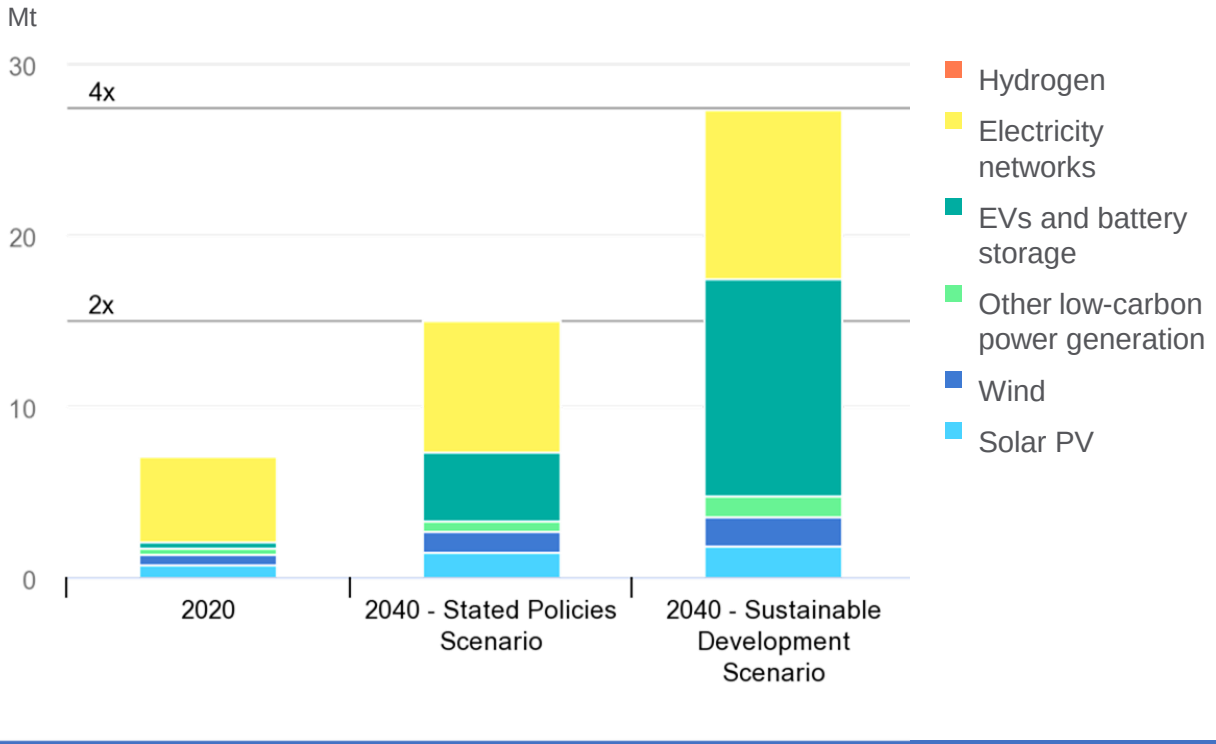
Critical minerals: deployment of clean energy technology implies significant demand growth



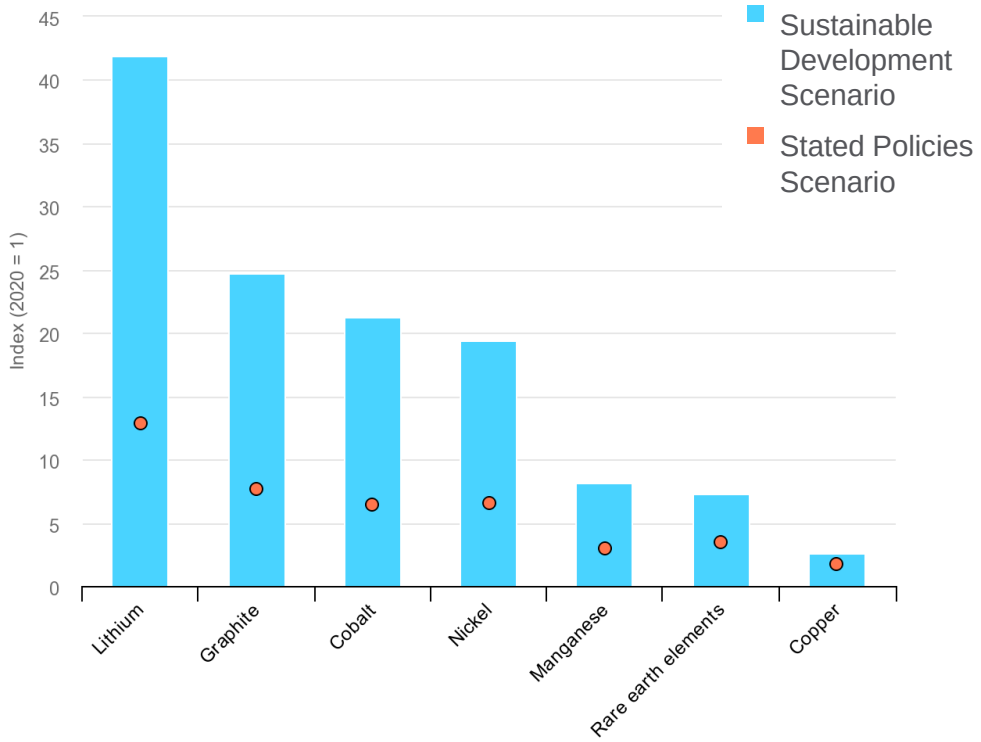
Source: IEA, 2021, The Role of Critical Minerals in Clean Energy Transitions

Rapid critical mineral demand growth in sustainable development scenario (lithium x40 increase by 2040)

Total mineral demand for clean energy technologies 2020 vs 2040



Demand growth for selected minerals from clean energy technologies, 2020 vs 2040



Source: IEA, 2021, The Role of Critical Minerals in Clean Energy Transitions

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UK government to launch 2022 critical minerals strategy

Chapter 4 – **Supporting the Transition across the Economy**

Deep Dive - Critical Minerals, Supply Chains and Net Zero

The transition to Net Zero means new supply chains are becoming critical to the UK's energy production. Critical minerals are metals and non-metals that are vital for a defined economic activity and for the well-being of the country, yet whose supply may be at risk owing to geological distribution, lack of substitutes and/or other factors. Such minerals provide materials essential for components in many of today's rapidly growing clean energy technologies – from off-shore wind turbines to electric vehicles. The World Bank suggests that the production of minerals such as graphite, lithium and cobalt, could increase by nearly 500% by 2050 to meet the growing demand.[21]

The government is committed to working with industry and with international partners to safeguard these supply chains and our future economic resilience. We are actively supporting the adoption of transparent, ethical and responsible mining practices, reflecting environmental, social and governance (ESG) considerations, and are participating in the development of global standards through the British Standards Institution.

We will establish an Expert Committee on Critical Minerals to provide independent advice to government on the scope and content of a critical minerals strategy and will publish an updated list of these minerals to guide investment decisions. We will establish a Critical Minerals Intelligence Centre to provide robust, dynamic analysis on stocks and flows to guide our decision-making.

Going forward, the government will publish a UK Critical Minerals strategy in 2022, setting out our approach to securing the technology-critical minerals and metals aimed at:

- Ensuring the UK has a reliable supply of critical minerals and metals;
- Establishing an enabling environment for growing the sector in the UK;
- Showing leadership through working bilaterally and multilaterally to support work on international standards to extend and strengthen the circular economy in technology-critical minerals;
- Ensuring our work to build critical mineral supply chain resilience supports our international development priorities;
- Using our R&D resource to build a better understanding of markets and prices to help mitigate the impact of supply shocks and demand spikes, and to enable better foresight and early intervention; and,
- Work with UK industry (including SMEs) to consider how private and public sectors can better share risks to promote investment and drive innovation at all levels.

We will support the engagement of the UK's mining sector in new and existing markets, facilitating investment and collaboration in extraction and processing opportunities. We will also champion free and open global trade including through Free Trade Agreements to support this ambition and will explore use of Freeports to support opportunities for the UK to develop as a critical minerals processing hub supplying Europe and beyond.

237

- The UK's Net Zero Strategy committed to publishing a **Critical Minerals Strategy** to ensure the UK's long-term security of supply for critical minerals, and to mitigate risks to supply.
- Strategy will launch in 2022.
- BEIS has convened the **Critical Minerals Expert Committee** to advise on the development and delivery of the strategy.
- **Critical Minerals Intelligence Centre**, due to be launched this year, will continuously monitor critical mineral supply chains and project future supply and demand.

https://www.gov.uk/government/publications/net-zero-strategy

Department for Business, Energy & Industrial Strategy

Example of themes being considered in the critical minerals strategy

Domestic capabilities

Enabling environment for critical minerals capabilities in UK, while protecting communities and environment

Circular economy

Close the loop on UK critical minerals to reduce waste and alleviate pressure on primary sources

International trade and agreements

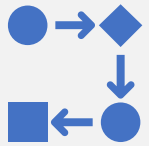
Bilateral agreements and international trade opportunities to secure the supply of critical minerals

International collaboration

Pluri- and multilateral efforts to secure critical mineral supplies with trusted allies

ESG standards

International efforts to drive up ESG standards globally and support a Just Transition



Data transparency

Increased intelligence on critical minerals supply chains

Deep-seabed mining

Strong environmental protection for international seabed

Events Research Programme: Science Insights

Department for Business, Energy & Industrial Strategy

EVENTS RESEARCH PROGRAMME

Department for Digital, Culture, Media & Sport

Roadmap Reviews

The **Events Research Programme** was one of four reviews that the Government announced as part of the Roadmap. The others were:

1. International travel review - A review to " shows how international travel could resume in an accessible and affordable way."
2. Covid status certification review - A review to *"coordinate further work on vaccine and testing certification"*
3. Social distancing review. - A review to *"inform decisions on the timing and circumstances under which the rules on 1 metre plus, the wearing of face coverings and other measures may be lifted"*

Strong overlaps with Covid status certification review and Social distancing review

Covid status certification review

Interdependencies with the Events Research Programme:

- If a first announcement on the Covid status certification review coincides with the beginning of the Events Research Programme, we could use the programme to **test different approaches** to using testing and vaccine data to re-open large events more safely;
- The combined evidence and findings of the Events Research Programme and Covid status certification review can be expected to **inform recommendations and decisions** on step 4 of the Roadmap and beyond.

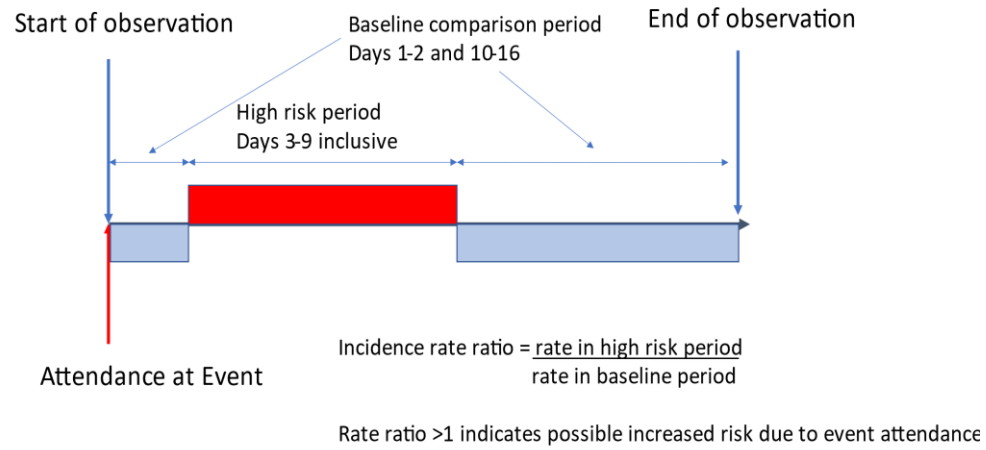
Social distancing review

Interdependencies with the Events Research Programme:

- The findings of the Events Research Programme will contribute to the **evidence base** of the social distancing review;
- DCMS sectors and events organisers will be customers of the findings of the "**business and public settings**" strand of the social distancing review.

Events Research Programme Self-Controlled Case Series

Figure 1: Individual participant study timeline



Research Question and Aims

Within Phase 3 Events:

What is the impact on risk of transmission of events held at, or close to, full capacity without social distancing?

- *Is the risk of SARS-CoV-2 infection increased by attendance at an Events Research Programme event?*
- *Is any increased risk of infection modified by event type/location?*

Events included

Indoor Seated:

The Grange, Leeds Grand (A Little Night Music)
Piccadilly Theatre (comedy)

Outdoor Seated:

Sri Lanka ODI (Durham, Oval, Bristol)
Pakistan ODI (Lords, Edgbaston)
Pakistan T20 (Trent Bridge, Headingley)
Grosvenor Park
RFL Challenge Cup

Outdoor Partially Structured:

Open Golf

Festivals:

Goodwood Festival of Speed
Latitude
Tramlines

People testing positive N	Positive test during high risk period	Positive test during baseline	Rate Ratio (95%CI)
OVERALL			
3,181	2,114	1,067	2.10 (1.95-2.27)
INDOOR SEATED			
Overall n=30	15	15	1.16 (0.53-2.57)
FESTIVALS			
Overall n=2,012	1,543	469	3.31 (2.97-3.68)
OUTDOOR SEATED			
Overall n=607	309	298	1.32 (1.10-1.60)
OUTDOOR PARTIALLY STRUCTURED (Open Golf only)			
532	247	285	0.70 (0.55-0.89)

EVENTS RESEARCH PROGRAMME

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.

@psmonks

COP26 Goals

UN CLIMATE CHANGE CONFERENCE UK 2021

IN PARTNERSHIP WITH ITALY

To secure global net zero by mid-century and keep 1.5 degrees within reach:

- Accelerate the phase-out of coal
- Curtail deforestation
- Speed up the switch to electric vehicles
- Encourage investment in renewables

To adapt to protect communities and natural habitats:

- Protect and restore ecosystems
- Build defences, warning systems and resilient infrastructure and agriculture to avoid loss of homes, livelihoods and even lives

To Mobilise finance – developed countries must make good on their promise to mobilise **at least $100bn in climate finance** per year by 2020.

To work together to deliver:

- Finalising the Paris Rulebook (the detailed rules that make the Paris Agreement operational)
- Accelerating action to tackle the climate crisis through collaboration between governments, businesses and civil society.

COP26 Outcomes

UN CLIMATE CHANGE CONFERENCE UK 2021

IN PARTNERSHIP WITH ITALY

Almost **200 countries agreed to the Glasgow Climate Pact** to keep the goal of limiting temperature rise to 1.5 degrees in sight

Over **90% of the world's economy is now covered by a net zero goal** – up from 30% when the UK took on the COP26 Presidency in 2019.

The UK called for urgent action at COP from Governments and the private sector on **coal, cash, cars and trees to drive down emissions this decade** and keep 1.5 degrees in reach. Significant progress has been made:

- 65 countries have committed to **coal phase out**, including 4 of the world's top 20 coal power generating countries
- Just under 40 countries **ending overseas public financing** for **all unabated fossil fuels**
- 30+ countries and some of the world's largest car makers committed to work together to make **all new car sales zero emission globally by 2040**, and by 2035 in leading markets
- On **cash**, the **$100 billion finance goal will be met** by developed countries by 2023.
- On **trees**, over 140 leaders, representing over 90% of the world's forests, pledged **to halt and reverse forest loss by 2030**, backed by ~£14 billion of public and private funding.

Science & innovation: four new Mission Innovation 'missions' where countries will work together to accelerate the development of clean technologies for cities and industry; new global **Adaptation Research Alliance (ARA)**; a new **Industrial Deep Decarbonisation Initiative**; a new '**Global Checkpoint Process**'; a new **annual climate risk assessment**; and commitments from ~50 countries to build **resilient health systems**.

Science at COP26

UN CLIMATE CHANGE CONFERENCE UK 2021

IN PARTNERSHIP WITH ITALY

Science & Innovation aims at COP26:

- To keep the goal of limiting the global average increase in temperature to 1.5˚C alive.
- Demonstrate the role of science and innovation in providing and delivering solutions for both mitigation and adaptation.
- Focus on “Science & Innovation for all” and ensure we focus on solutions that are affordable and accessible for all.

COP26 Headlines & BEIS Outcomes

Glasgow Climate Pact

Keeping 1.5 alive

- Revisit pledges at COP27 in 2022 to close the gap to 1.5 degrees & annual ambition assessment
- First ever inclusion of an explicit commitment to phase down coal use & end inefficient fossil fuel subsidies
- Recognised IPCC WGI report; best available science central to decision making
- Paris rulebook complete, incl Art 6, common timeframes
- Process for post 2025 finance goal
- Loss and damage dialogue
- Increased financial assistance for developing countries

Finance

Mobilising finance and mainstreaming climate

- $100bn goal to be reached by 2023
- Additional financial pledges include Japan $10bn, Italy $1.4bn per year
- Glasgow Financial Alliance for Net Zero - $130 trillion of private finance (40% of assets) committed to align with Paris
- $17tr committed to support coal phase out
- UK to be world's 1st net zero financial centre backed by new transition plan requirements
- MDB joint statement

Energy

End of coal in sight: int. coal finance ceases, new coal phase out/ no new coal pledges; stronger clean power support

- Global Coal to Clean Power statement 78 signatories (>40 countries); incl. 5 of 20 top coal generating states committing to coal phase out.
- >30 countries/finance inst. commit to end intl public support for unabated fossil fuels
- 28 members (7 countries) joined the Powering Past Coal Alliance, total membership to 165
- South Africa Just Energy Transition Partnership ($8.5bn), Indonesia & the Philippines' new ADB partnership to support early coal retirement.
- Major banks end coal finance; China, Japan, Korea, G20 end overseas new coal finance in '22

Transport

Dramatic acceleration on global zero emission vehicle market

- Global ZEV Declaration from a group of government and industry leaders (inc. 33 countries) committing to 100% ZEV car and van sales by 2040 or earlier (2035 for leading).
- Launch of the 2022 ZEVTC Action Plan and US as co-chair with UK.
- Launch of the World Bank facility to leverage $200m for developing countries ZEV transition, incl. initial £4m UK funding
- Global auto market coverage by a manufacturers' commitment to end polluting vehicle sales near 0% to 32% this year

Nature

Significant content provided for Nature day, host of FACT dialogue, driving forest finance pledges and supporting LEAF coalition.

- 134 leaders representing >91% of the world's forests committed to halt and reverse deforestation and land degradation by 2030, backed by £8.75 billion ($12bn) of public funds, alongside £5.3 billion ($7.2 billion) of private investment.
- Over 100 countries supported the '30 by 30' target to protect at least 30% of the global ocean by 2030.
- More than US$4bn of public sector investment will be leveraged into agricultural innovation

Breakthrough Agenda & Glasgow Breakthroughs

Breakthrough Agenda backed by 42 countries covering >70% of global GDP collaborating to make clean tech affordable, accessible & attractive for all by 2030. Glasgow Breakthroughs cover power, road transport, steel, hydrogen, agriculture (>50% of emissions). Could create 20m jobs and add >$16t to global economy. Explicitly welcomed in Glasgow Climate Pact. New initiatives include:

- India: Green Grid Initiative and One Sun, One World, One Grid alliance.
- USA: First Movers coalition (20+ global companies commit to clean tech/material procurement) & AIM4C (US? UAE led effort to accelerate agriculture clean tech innovation & mobilise finance)

Wider Deliverables

Science & innovation: new commitments & partnerships to accelerate innovation and tackle net zero across world; 4 new MI 'missions'; new Industrial Deep Decarbonisation Initiative; new 'Global Checkpoint Process'; new annual climate risk assessment; Gvt Scientific Advisors statement

Business: 60 FTSE100 UK companies sign up to net zero

Gender: UK's £165m addressing gender inequality; co-launch gender-smart climate finance toolkit

Cities, regions and built environment: UK committed £27.5m to Urban Climate Action Programme to pave the way for carbon neutrality in megacities by 2050; launch of Clean Heat Forum

UK Presidency events and pavilion

- Led on twelve Presidency events including the World Leaders Event on Innovation, three Energy day and two Cities day plenaries
- Led UK pavilion programme involving almost 100 events
- Led on wider events, including review of country commitments as part of transparency and reporting process

Additional key outcomes/announcements

- Net zero goals now put forward by >140 countries, covering 90% of global emissions; 80% of world economy improved their 2030 targets.
- India announced 2070 net-zero target and 500GW renewable energy by 2030 (50% of the country's energy supply).
- Global Methane Pledge: >100 countries agreed to cut their emissions of methane by 30% by 2030
- US and China announced a Joint Glasgow Declaration on Enhancing Climate Action in the 2020s

UN CLIMATE CHANGE CONFERENCE UK 2021

IN PARTNERSHIP WITH ITALY

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

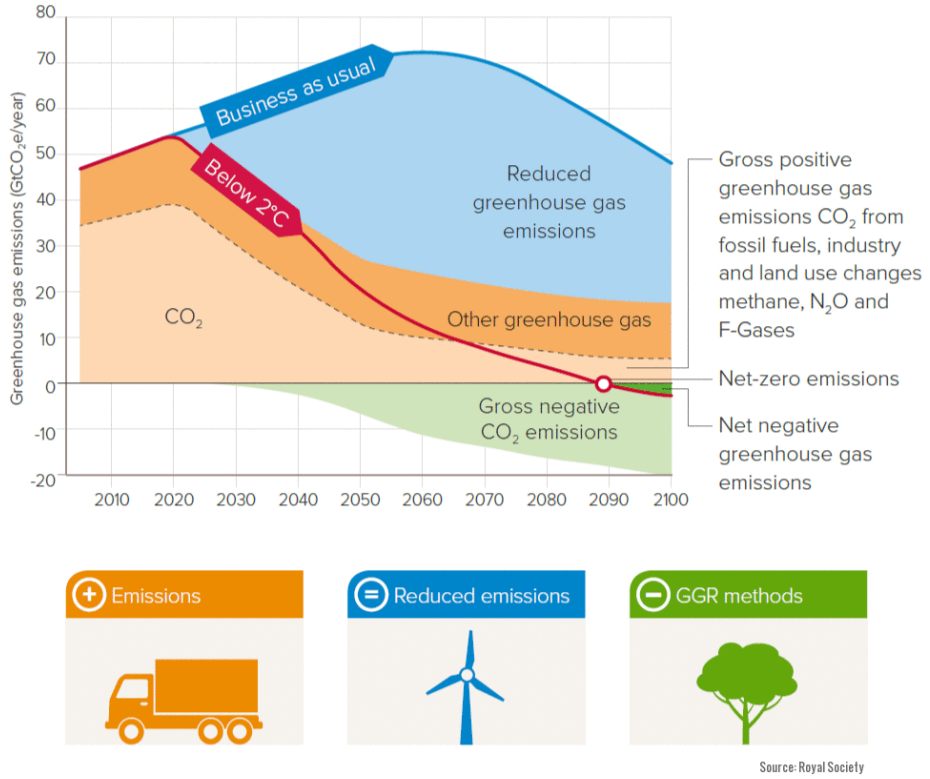
- Likely doubling of today's use
- Planting more bioenergy crops and changing the way we use land

Greenhouse Gas Removal

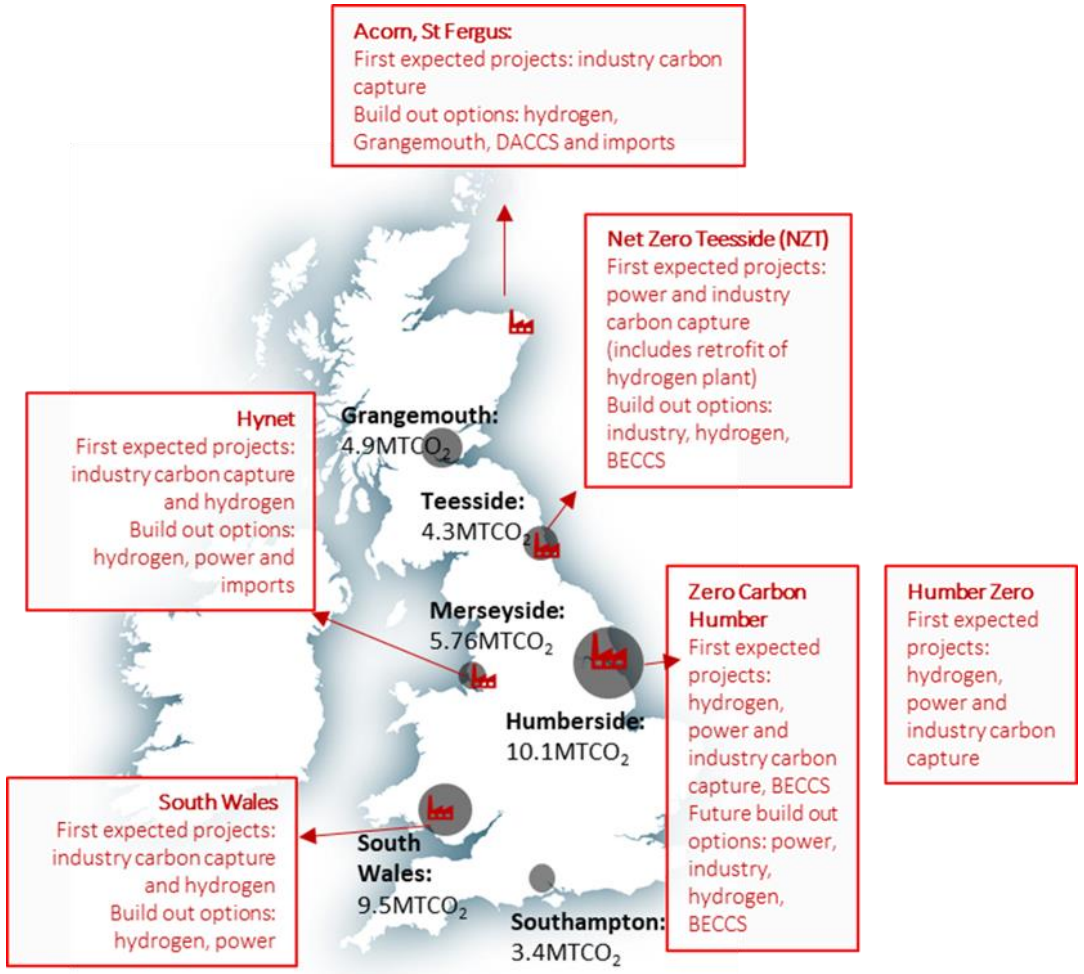
- 50-90Mt of negative emissions in 2050 from BECCS and DAC.

Greenhouse Gas Removal (GGR)

- GGR technologies challenges
  - Resources like land, energy, minerals or water are required placing limits on scale and location of their application.
- Desired level of GGR will be best achieved by using a portfolio of approaches.
- Key Actions for UK Net Zero
  - Rapid ramp-up of forestation, habitat restoration and soil carbon restoration.
  - Establishing an incentive/subsidy system.
  - Encourage changes in building practice.
  - Develop monitoring programmes.
  - Grow and import sustainable biomass.
  - Pursue research into GGR technologies.
  - Capitalise on UK access to suitable reservoirs for CCS.



Possible future CCS Clusters



Illustrative Map

- CCUS – Cluster Sequencing for carbon, capture, usage and storage: Phase 1

Details

The '[Ten point plan for a green industrial revolution]' sets out an ambition to deploy CCUS at scale in 2 of the UK's industrial clusters by the mid-2020s, and a further 2 by 2030.

Phase-1 of the cluster sequencing process will identify and sequence CCUS clusters which are suited to deployment in the mid-2020s. These clusters will have the first opportunity to negotiate for support from the government's CCUS programme.

Phase-1 is open to cluster organisations which:

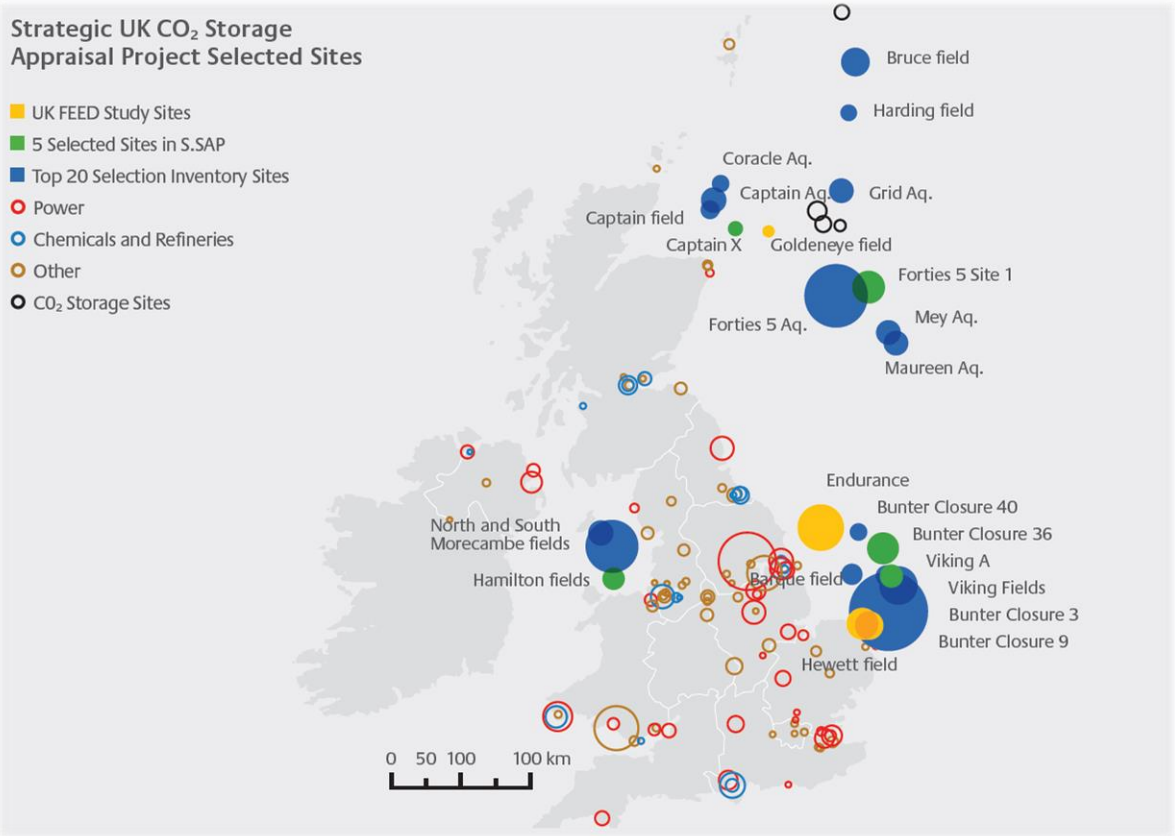
- are located in the UK
- are capable of deploying by 2030
- meet the definition of a CCUS cluster (see the guidance for more information)

Key Enabling Technology for Net Zero

UK CO_2 Storage Potential

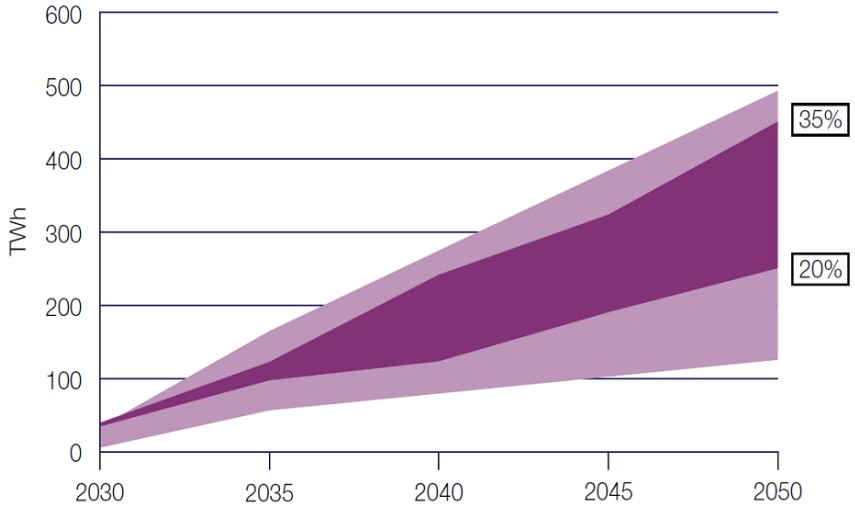
- According to the UK Oil and Gas Authority, the UK Continental Shelf has enough CO_2 storage capacity to fully support the UK's demand for hundreds of years.

- The UK has a unique opportunity. With the potential to store more than 78 billion tonnes of CO_2, the UK Energy Technologies Institute estimates the UK can be a world leader in CO_2 storage services.

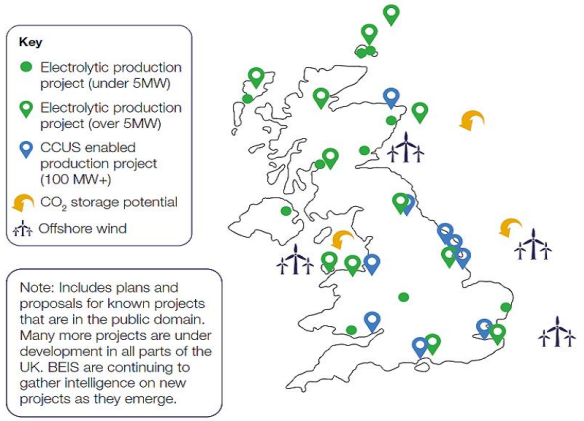


Hydrogen Strategy

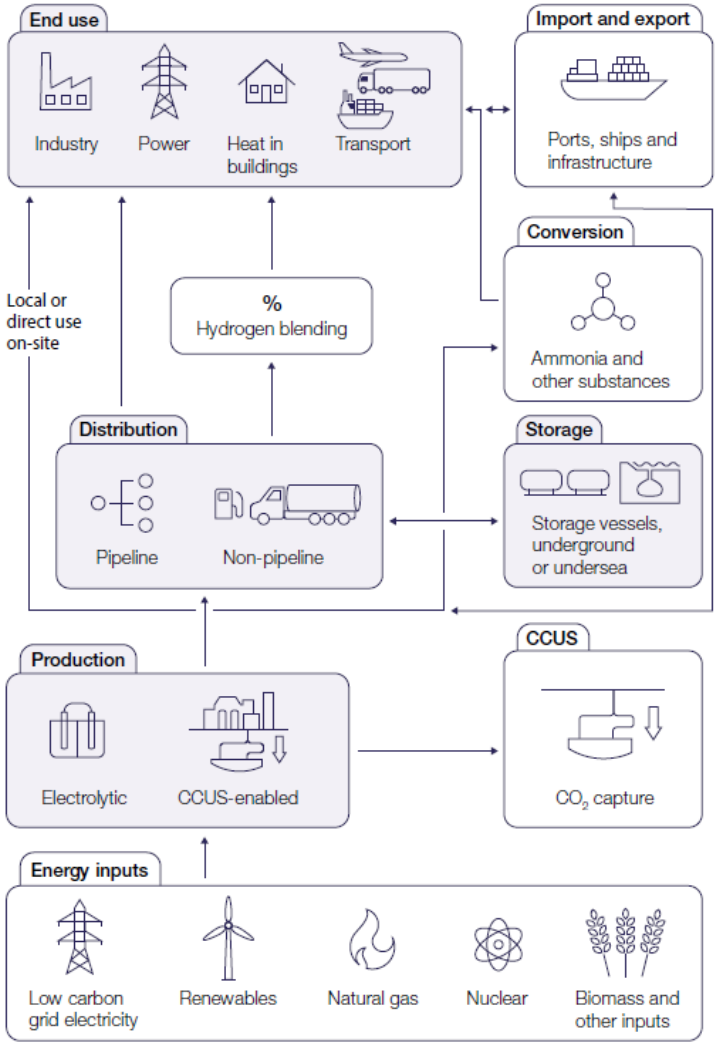
- Low carbon hydrogen essential for achieving net zero and meeting our CB6 target.
- BEIS analysis for CB6 suggests 250-460TWh of hydrogen could be needed in 2050 making up 20-35 per cent of UK final energy consumption.
- ‘Twin track’ approach allows production of large quantities of both electrolytic ‘green’ and CC(U)S-enabled ‘blue’ hydrogen.



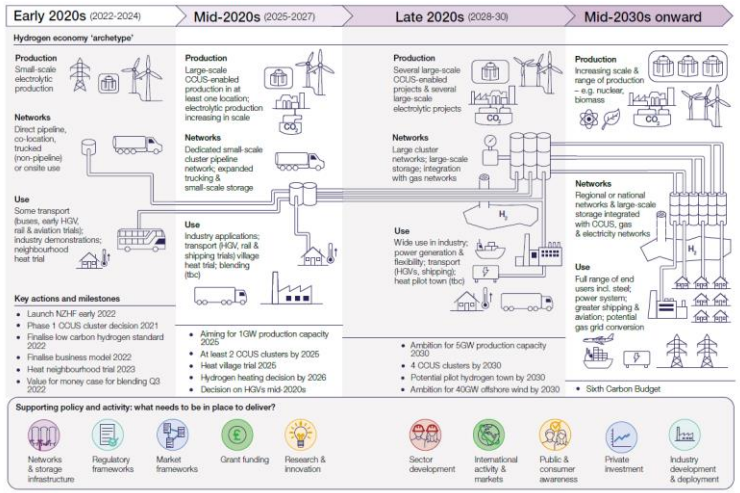
% = hydrogen as proportion of total energy consumption in 2050



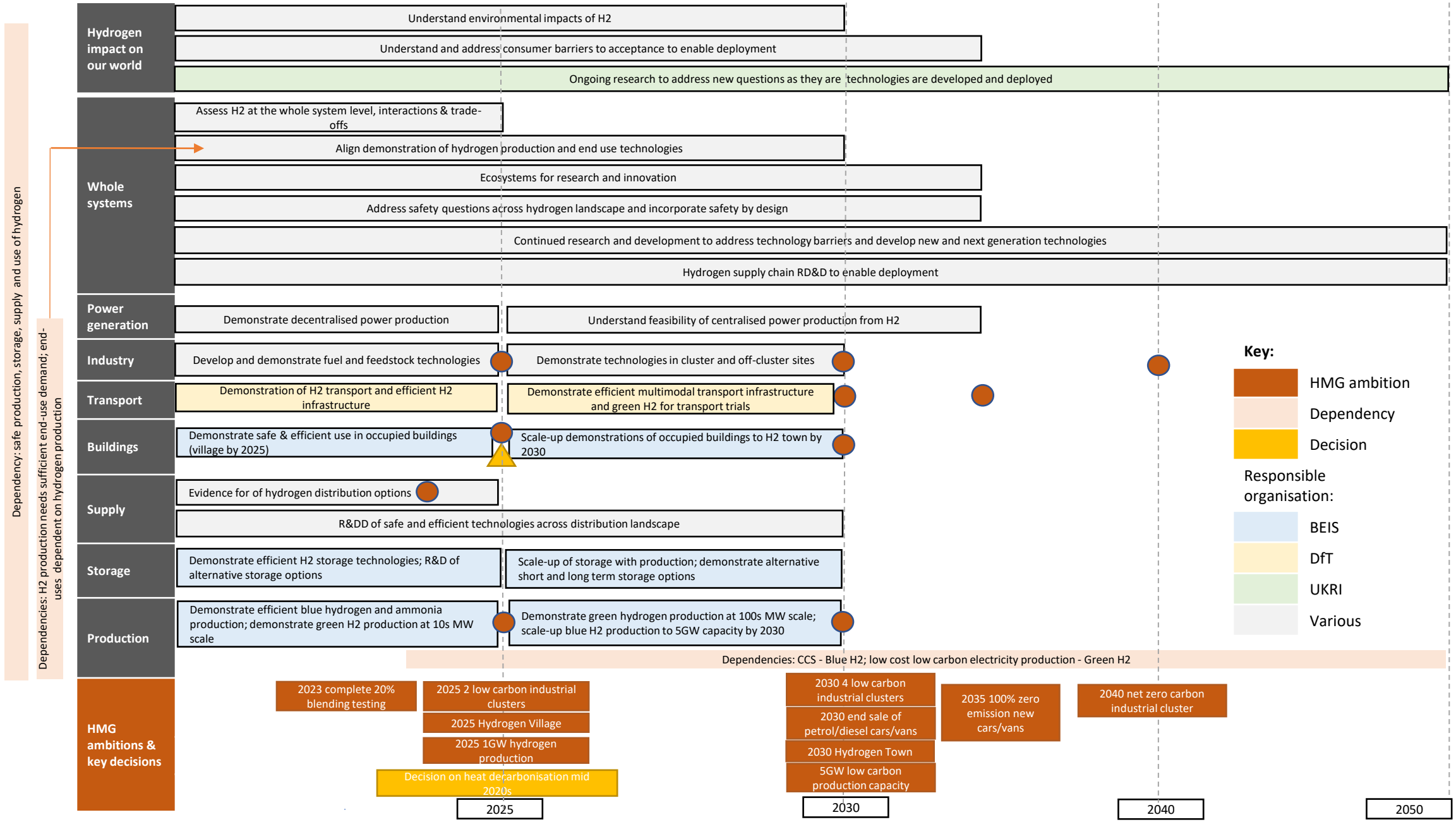
Hydrogen Strategy



- 10 point plan has 5GW of low carbon hydrogen production capacity by 2030.
- Aim to establish CCUS in four industrial clusters by 2030 supporting ambition to capture 10Mt/CO_2 per annum.
- Network demonstration – Hy4Heat and Tees Valley Hydrogen transport hub.
- R&D Roadmap being developed.



Department for Business, Energy & Industrial Strategy


Dependency: safe production, storage, supply and use of hydrogen
Dependencies: H2 production needs sufficient end-use demand; end-uses dependent on hydrogen production
Hydrogen impact on our world
Understand environmental impacts of H2
Understand and address consumer barriers to acceptance to enable deployment
Ongoing research to address new questions as they are technologies are developed and deployed
Whole systems
Assess H2 at the whole system level, interactions & trade-offs
Align demonstration of hydrogen production and end use technologies
Ecosystems for research and innovation
Address safety questions across hydrogen landscape and incorporate safety by design
Continued research and development to address technology barriers and develop new and next generation technologies
Hydrogen supply chain RD&D to enable deployment
Power generation
Demonstrate decentralised power production
Understand feasibility of centralised power production from H2
Industry
Develop and demonstrate fuel and feedstock technologies
Demonstrate technologies in cluster and off-cluster sites
Transport
Demonstration of H2 transport and efficient H2 infrastructure
Demonstrate efficient multimodal transport infrastructure and green H2 for transport trials
Buildings
Demonstrate safe & efficient use in occupied buildings (village by 2025)
Scale-up demonstrations of occupied buildings to H2 town by 2030
Supply
Evidence for of hydrogen distribution options
R&DD of safe and efficient technologies across distribution landscape
Storage
Demonstrate efficient H2 storage technologies; R&D of alternative storage options
Scale-up of storage with production; demonstrate alternative short and long term storage options
Production
Demonstrate efficient blue hydrogen and ammonia production; demonstrate green H2 production at 10s MW scale
Demonstrate green hydrogen production at 100s MW scale; scale-up blue H2 production to 5GW capacity by 2030
Dependencies: CCS - Blue H2; low cost low carbon electricity production - Green H2
Key:
HMG ambition
Dependency
Decision
Responsible organisation:
BEIS
DfT
UKRI
Various
HMG ambitions & key decisions
2023 complete 20% blending testing
2025 2 low carbon industrial clusters
2025 Hydrogen Village
2025 1GW hydrogen production
Decision on heat decarbonisation mid 2020s
2030 4 low carbon industrial clusters
2030 end sale of petrol/diesel cars/vans
2030 Hydrogen Town
5GW low carbon production capacity
2035 100% zero emission new cars/vans
2040 net zero carbon industrial cluster
2025
2030
2040
2050