Lifting the lid on Net Zero

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Committee on Climate Change

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Where do we stand?
Global warming

CO₂ Concentration – 12 months

Latest CO₂ reading
September 20, 2019

Carbon dioxide concentration at Mauna Loa Observatory

Year ending September 21, 2019

Latest CO₂ reading: 408.04 ppm

Source: Scripps Institution of Oceanography
Global warming

CO₂ Concentration – 1700 to Present

Latest CO₂ reading
September 20, 2019

Source: Scripps Institution of Oceanography

@ChiefExecCCC
Global warming

CO₂ Concentration – 800,000 years

Latest CO₂ reading
September 20, 2019

Source: Scripps Institution of Oceanography
Global warming

CO₂ Concentration – 800,000 years

Latest CO₂ reading
September 20, 2019


Source: Scripps Institution of Oceanography
What do we do about this?
Cutting emissions - Science and international context

Global emissions pathways – the need for net zero

Greenhouse gas emissions (GtCO₂e/yr)

Cutting emissions - Science and international context

Global emissions pathways – the need for net zero

Cutting emissions - Science and international context

Global emissions pathways – the need for net zero

Cutting emissions - Science and international context

Global emissions pathways – the need for net zero

Alternatives to fossil fuels – Renewable Power Generation Costs

Reducing emissions in the UK
How UK net-zero scenarios can be delivered

**Buildings: Emissions in 2050**

- **Historical emissions**
- **Buildings in heat dense areas**
- **Heritage homes**
- **Space constrained homes**
- **On-gas homes, no constraints**
- **Off-gas homes**
- **Gas peak demand to hydrogen**
- **Off-gas peak demand to biofuels**
- **Cooking and other**

**Source:** CCC analysis
How UK net-zero scenarios can be delivered

Surface Transport: Emissions in 2050

Source: CCC analysis
How UK net-zero scenarios can be delivered

**Industry: Emissions in 2050**

- Other process emissions
- Off-road mobile machinery
- Cement
- Petrochemicals and ammonia
- Fugitive emissions
- Iron and steel
- Refining
- Fossil fuel production - combustion
- Stationary combustion from other manufacturing

**Source:** CCC analysis
<table>
<thead>
<tr>
<th>Sector</th>
<th>2020s</th>
<th>2030s</th>
<th>2040s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>Largely decarbonise electricity: renewables, flexibility, coal phase-out</td>
<td>Expand electricity system, decarbonise mid-merit/peak generation (e.g. using hydrogen), deploy bioenergy with CCS</td>
<td>Widespread deployment in industry, use in back-up electricity generation, heavier vehicles (e.g. HGVs, trains) and potentially heating on the coldest days</td>
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<tr>
<td>Hydrogen</td>
<td>Start large-scale hydrogen production with CCS</td>
<td>Widespread deployment in industry, use in back-up electricity generation, heavier vehicles (e.g. HGVs, trains) and potentially heating on the coldest days</td>
<td>Widespread electrification, expand heat networks, gas grids potentially switch to hydrogen</td>
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<td>Buildings</td>
<td>Efficiency, heat networks, heat pumps (new-build, off-gas, hybrids)</td>
<td>Widespread electrification, expand heat networks, gas grids potentially switch to hydrogen</td>
<td>Turn over fleets to zero-emission vehicles: cars &amp; vans before HGVs</td>
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<tr>
<td>Road Transport</td>
<td>Ramp up EV market, decisions on HGVs</td>
<td>Turn over fleets to zero-emission vehicles: cars &amp; vans before HGVs</td>
<td>Further CCS, widespread use of hydrogen, some electrification</td>
</tr>
<tr>
<td>Industry</td>
<td>Initial CCS clusters, energy &amp; resource efficiency</td>
<td>Further CCS, widespread use of hydrogen, some electrification</td>
<td>Afforestation, peatland restoration</td>
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<td>Land Use</td>
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<td>Healthier diets, reduced food waste, tree growing and low-carbon farming practices</td>
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<td>Agriculture</td>
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### How UK net-zero scenarios can be delivered

<table>
<thead>
<tr>
<th>Aviation</th>
<th>Shipping</th>
<th>Waste</th>
<th>F-Gases</th>
<th>Removals</th>
<th>Infrastructure</th>
<th>Co-benefits</th>
</tr>
</thead>
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<tr>
<td><strong>2020s</strong></td>
<td>Operational measures, new plane efficiency, constrained demand growth, limited sustainable biofuels</td>
<td><strong>2030s</strong></td>
<td>Operational measures, new ship fuel efficiency, use of ammonia</td>
<td><strong>2040s</strong></td>
<td>Move almost completely away from F-gases</td>
<td>Deployment of BECCS in various forms, demonstrate direct air capture of CO₂, other removals depending on progress</td>
</tr>
<tr>
<td><strong>Waste</strong></td>
<td>Reduce waste, increase recycling rates, landfill ban for biodegradable waste</td>
<td>Limit emissions from combustion of non-bio wastes (e.g. deploy measures to reduce emissions from waste water)</td>
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<td>Hydrogen supply for industry &amp; potentially buildings, roll-out of infrastructure for hydrogen/electric HGVs, more CCS infrastructure, electricity network expansion</td>
<td>Health benefits due to improved air quality, healthier diets and more walking &amp; cycling Clean growth and industrial opportunities</td>
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<td><strong>Removals</strong></td>
<td>Develop options &amp; policy framework</td>
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<td><strong>Infrastructure</strong></td>
<td>Industrial CCS clusters, decisions on gas grid &amp; HGV infrastructure, expand vehicle charging &amp; electricity grids</td>
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<td><strong>Co-benefits</strong></td>
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Central estimates for annual resource cost of meeting a net-zero GHG target (2050)

- Additional cost to achieve net-zero target through GHG removals
- Further Ambition (96% GHG reduction)
- Core (77% GHG reduction)

Source: CCC analysis
Five months on – some observations
Observation one: We don’t have all the answers

Remaining emissions in the Further Ambition scenario

Source: CCC analysis
Observation two: Fossil fuel use continues

Total CO₂ captured and stored due to Further Ambition options in 2050

Source: CCC analysis
Observation two: Fossil fuel use continues

Use and production of Hydrogen in 2050

Source: CCC analysis
Observation three: Innovation has moved the dial

Costs of example low-carbon technologies compared to past projections
Offshore wind (left) Battery packs (right)

Observation three: Innovation has moved the dial

Economy cost of Electric Vehicle switchover

Source: CCC analysis
Observation four: Behaviour policy moves centre stage

Role of societal and behavioural changes in the Further Ambition scenario

- 53% Largely societal or behavioural changes
- 38% Measures with a combination of low-carbon technologies and societal/behavioural changes
- 9% Low-carbon technologies or fuels not societal/behavioural changes

Source: CCC analysis
Observation five: Other approaches are available

Indicative emissions trajectory

Source: CCC analysis
Observation five: Other approaches are available

Indicative emissions trajectory

Source: CCC analysis
Thank you