

14th October 2019

The UK's Commitment to Net Zero

The UK's contribution to stopping global warming

Julia, Baroness Brown of Cambridge DBE FREng FRS Vice Chair of the Committee on Climate Change

UK Climate Change Act 2008 Net Zero 2019



Climate Change Act 2008

CHAPTER 27

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PART 1

CARBON TARGET AND BUDGETING

The target for 2050

- Amendment of 2050 target or baseline year Consultation on order amending 2050 target or baseline year 1 The target for 2050
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Committee on

Carbon budgeting

- Carbon budgets Level of carbon budgets

- Amendment of target percentages Consultation on order setting or amending target percentages Setting of carbon budgets for budgetary periods Consultation on caroon budgets Matters to be taken into account in connection with carbon budgets
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Limit on use of carbon units

Proposals and policies for meeting carbon budgets 13 Duty to prepare proposals and policies for meeting carbon budgets 13 Duty to prepare proposats and policies for meeting carbon budgets 14 Duty to report on proposals and policies for meeting carbon budgets 15 Duty to have regard to need for UK domestic action on climate change

11 Limit on use of carbon units

12 Duty to provide indicative annual ranges for net UK carbon account Indicative annual ranges



When: science and global imperative?

How: can it be done?

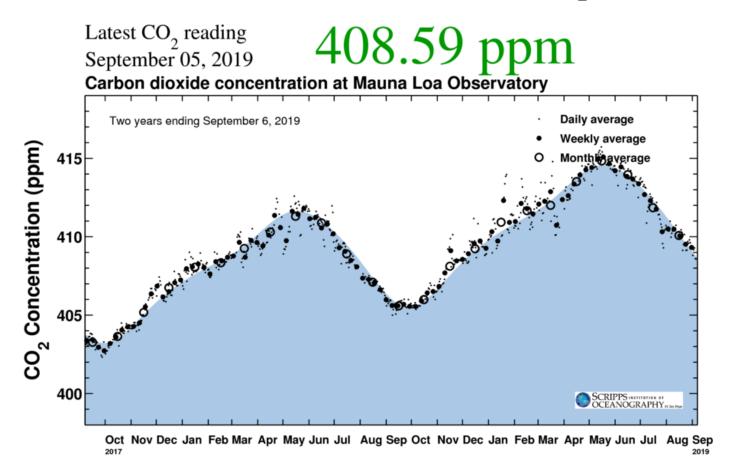
How much: what will it cost?

How big: the scale of the challenge?





CO₂ Concentration – 2017 to 2019

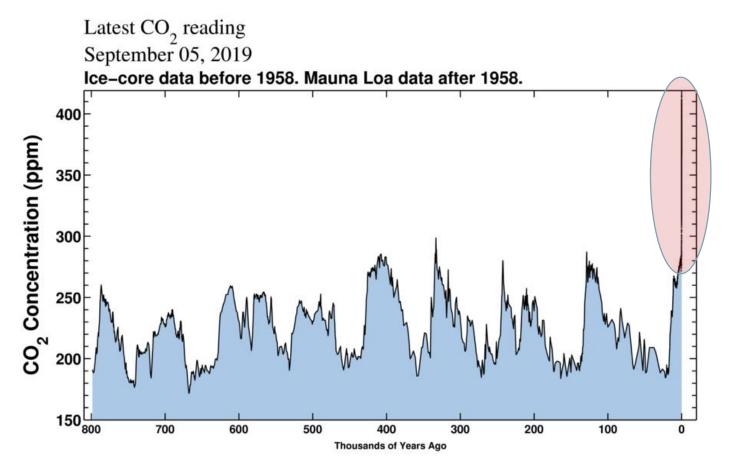


Source: Scripps Institution of Oceonography

Global warming



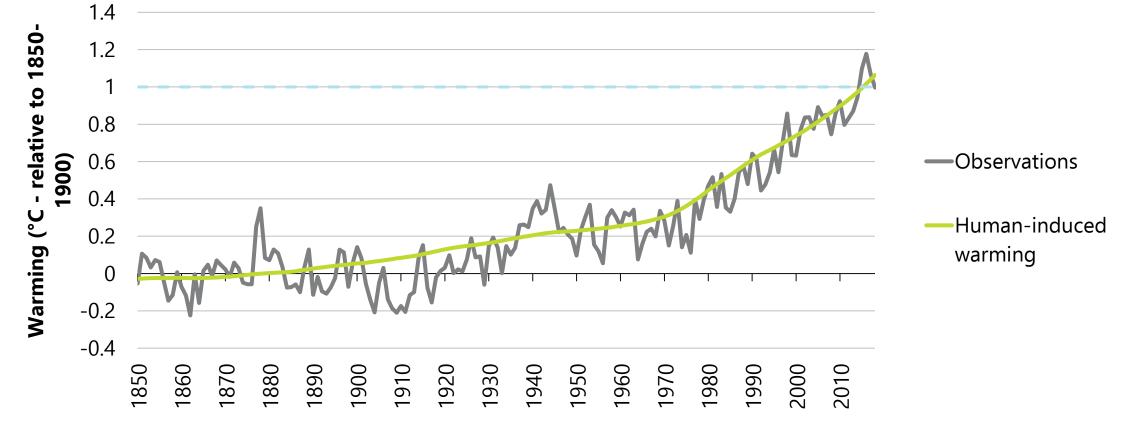
CO₂ Concentration – 800,000 years



Source: Scripps Institution of Oceonography



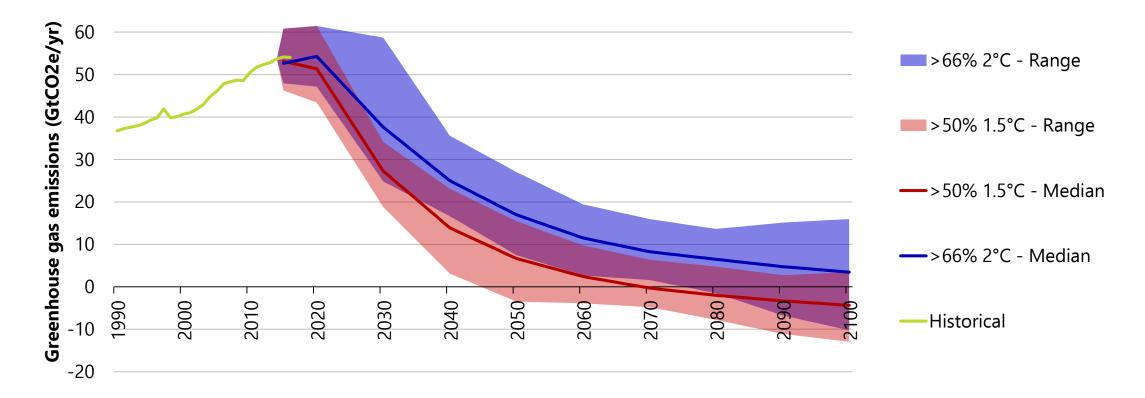
Observed and human-induced warming



Source: HadCRUT4, NOAA, NASA and Cowtan & Way datasets; IPCC (2018) Chapter 1 - Framing and Context.



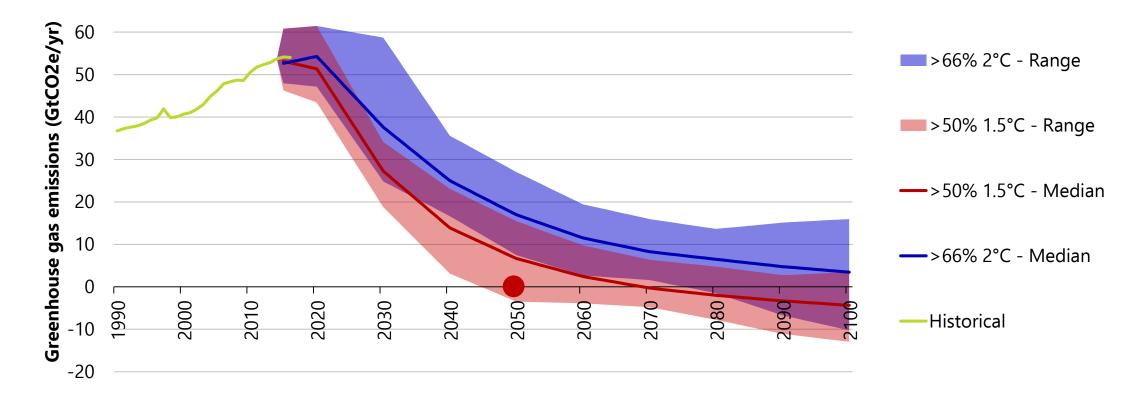
Global emissions pathways consistent with Paris



Source: Huppmann, D. et al. (2018) A new scenario resource for integrated 1.5°C research.



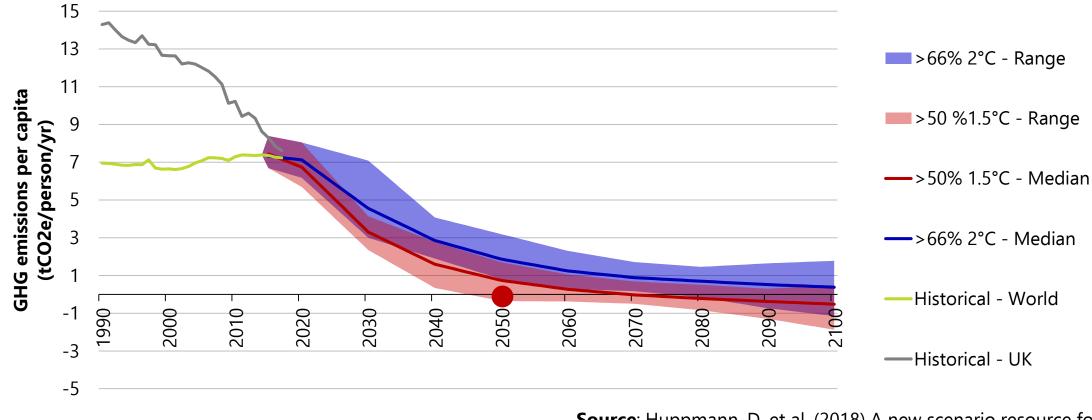
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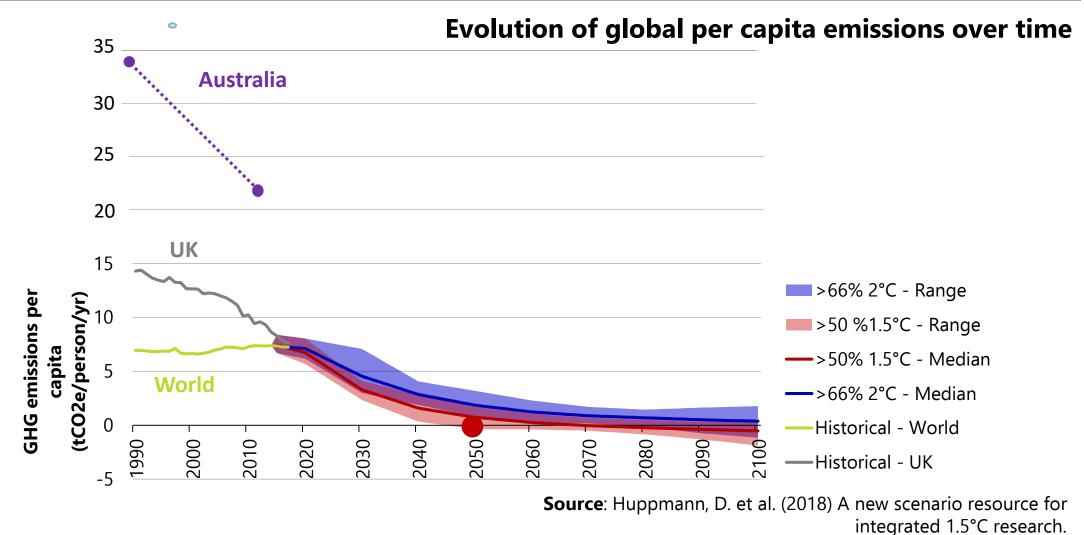


Evolution of global per capita emissions over time



Source: Huppmann, D. et al. (2018) A new scenario resource for integrated 1.5°C research.





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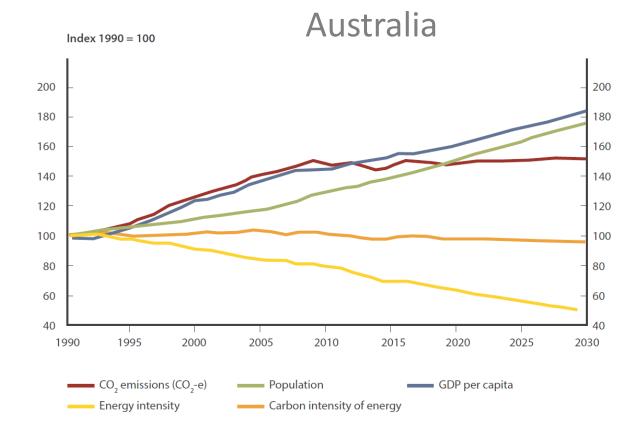
- Paris:
 - Consistent with highest possible ambition
 - Fair and ambitious in the light of national circumstances
- The UK should target net zero early:
 - UK has the **capability** to be more ambitious than the world as a whole
 - Rapidly reduced emissions since 1990 now at the global average per person
 - Has a stable and well supported framework: The Climate Change Act
 - Should contribute more on an **equity** basis
 - 80% from 1990 by 2050 in the Climate Change Act equal per capita emissions basis
 - but the UK has a large historical contribution to climate change
 - and as a result is a rich economy
 - with a significant demand for overseas products a large carbon footprint
 - Should support the global effort
 - increasing effort in rich countries to ease the pace in middle income and developing countries
 - early deployment and cost reduction of new technologies eg offshore wind
 - facilitating technology transfer and institutional development



Progress in reducing emissions

UK GDP +67% G7 GDP +61% Index (1990 = 100)G7 emissions -3% (1990-2015) UK emissions -42%

UK



Source: Department of the Environment and Energy 2017; Department of the Environment and Energy analysis



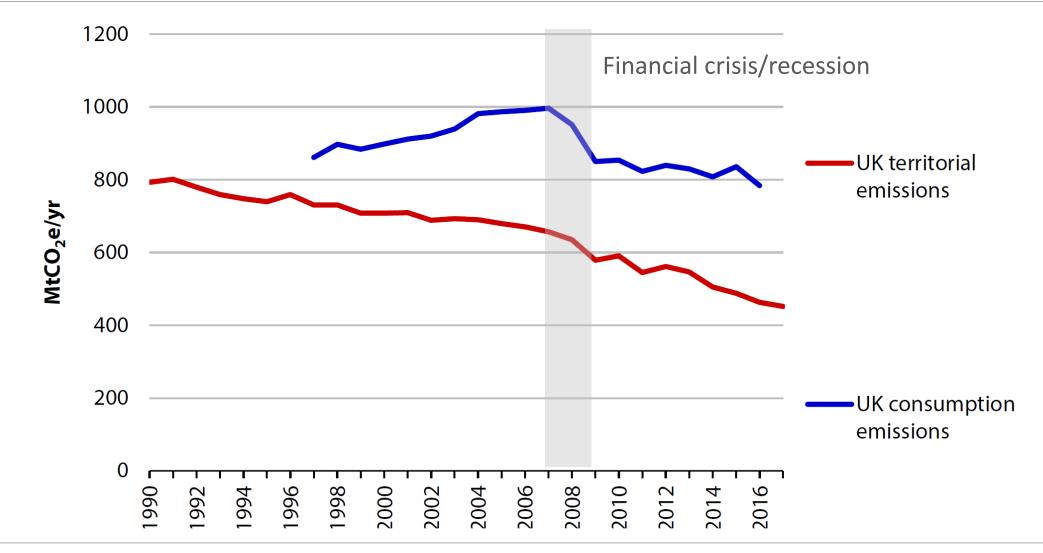
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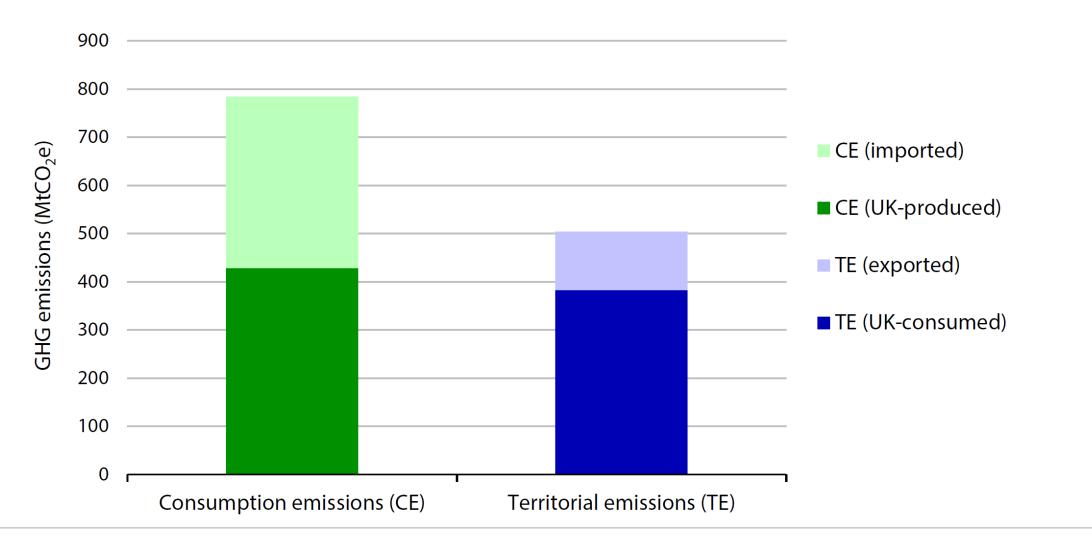
UK Carbon Footprint: consumption emissions



Net Zero – the UK's contribution to stopping global warming CCC 2019. Excludes F-gas emissions and international aviation and shipping



Consumption vs territorial emissions 2016



CCC Progress Report to Parliament 2019 includes international aviation and shipping

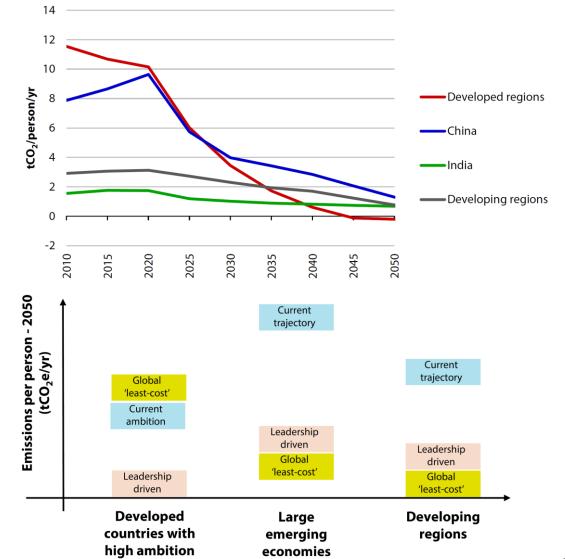


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International pathways: leadership driven scenarios

- Developed regions
 - In line with emerging commitments: achieve or exceed net zero by 2050
- Large emerging economies eg China
 - Improve on NDCs, peak soon, reduce rapidly over next 20 years, reach net zero before the end of the century
 - Efficiency, decarbonising power, electrification, CCS
- Developing regions
 - Leapfrog to low carbon development paths, low per capita emissions, can reach net zero until well after 2050
- Per person emissions from the developed regions in 2050 would be lower than in the rest of the world

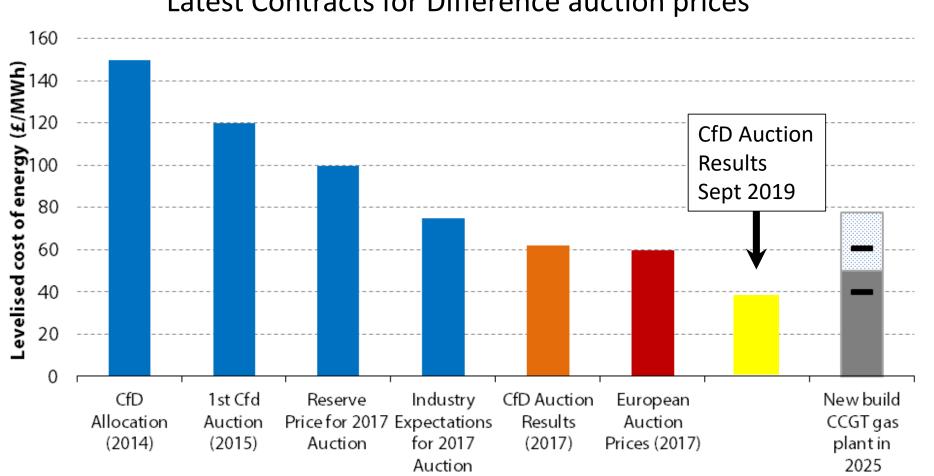


CCC Net Zero 2019: UCL research



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Latest Contracts for Difference auction prices

CCC analysis 2017



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When: science and global imperative?

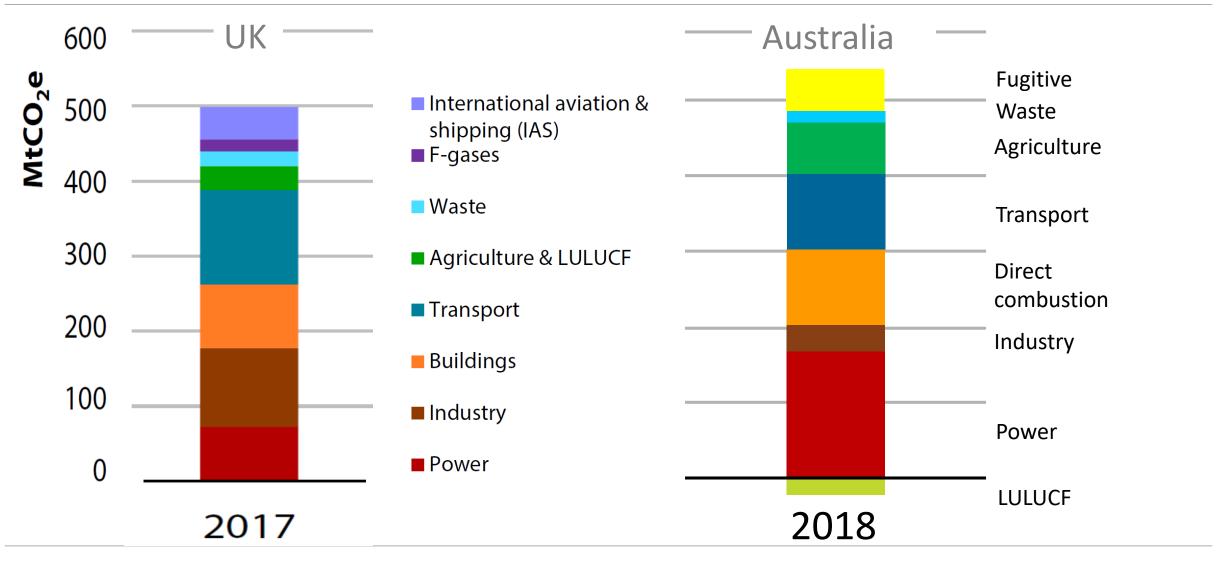
How: can it be done?

How much: what will it cost?

How big: the scale of the challenge?

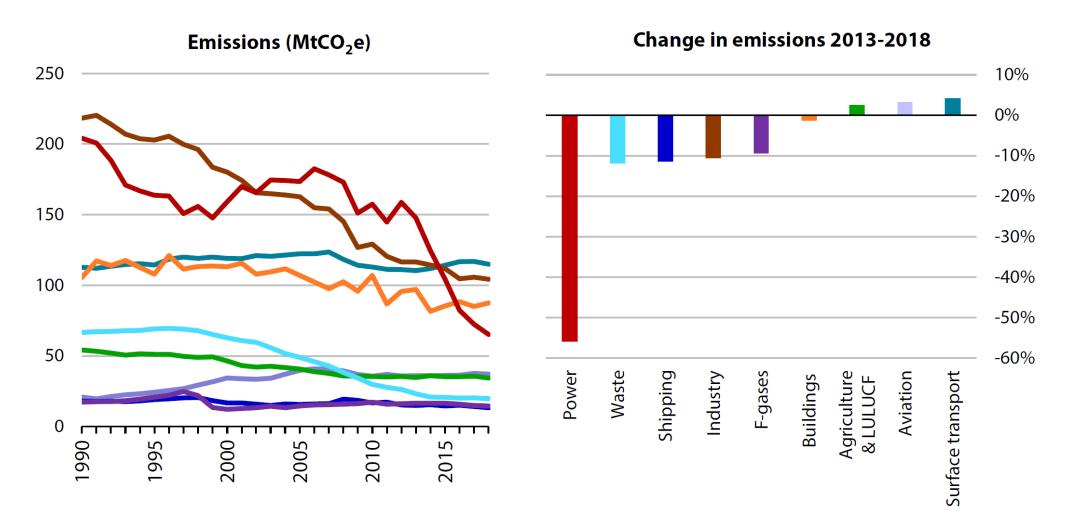


Source of emissions: UK and Australia





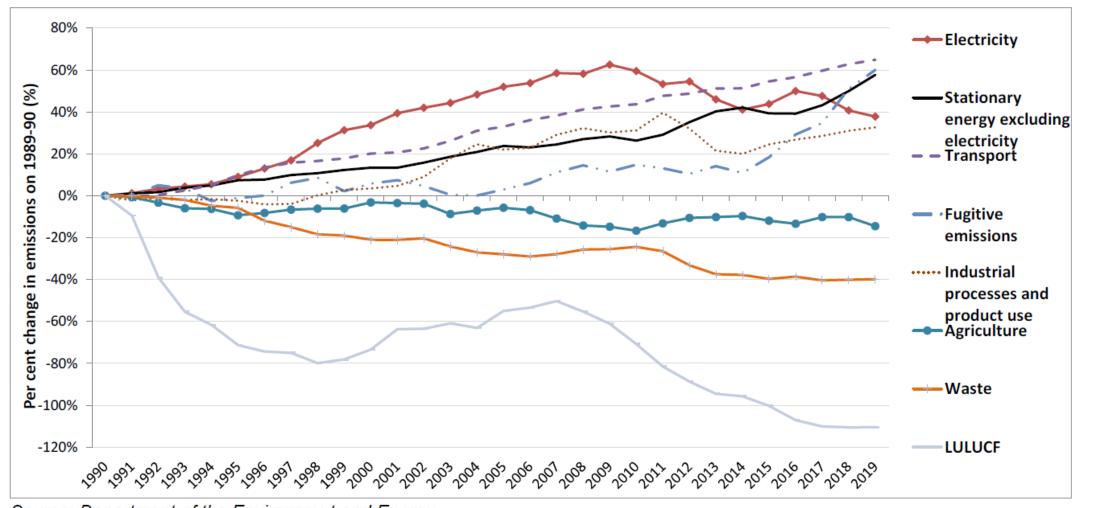
The journey so far



CCC Progress Report to Parliament 2019

Australia: change in emissions by sector

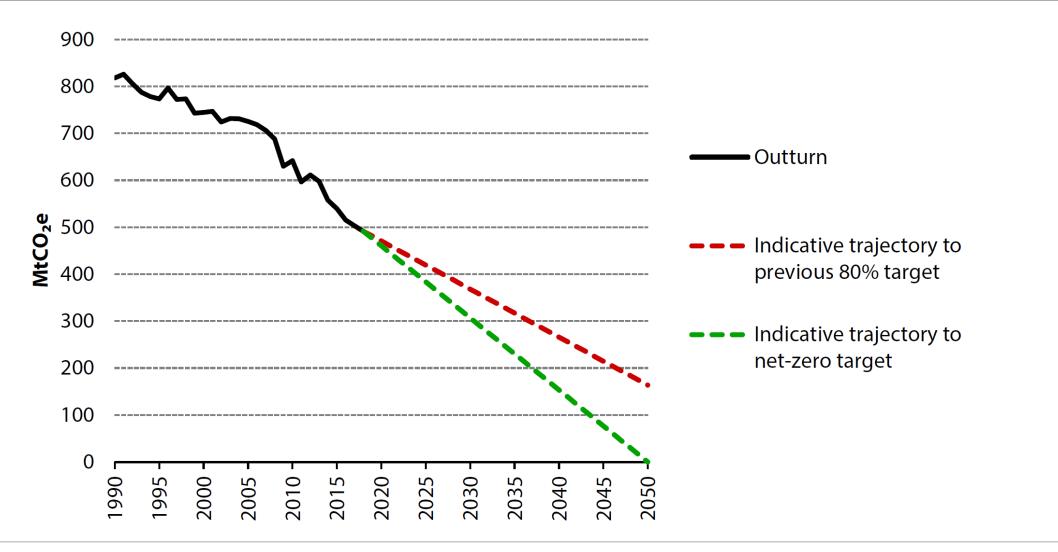




Source: Department of the Environment and Energy



From 80% to 100%



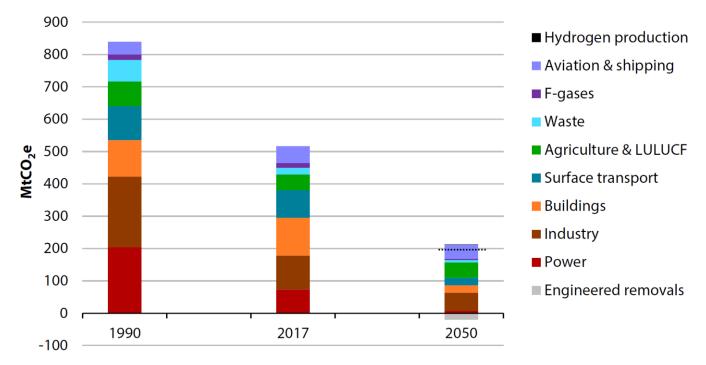
CCC Progress Report to Parliament 2019



Options to reduce emissions 1

Core options: to 77%

- Low cost, low regret, make sense under the current 80% target
- Broadly reflect Government's current ambition
 but not necessarily policy implementation
- eg energy efficiency, electrification, phase out of conventionally fuelled vehicles by 2040, progress with zero carbon power generation, first industrial Carbon Capture, Utilisation and Storage cluster by 2040, wood in construction, limited implementation of BECCS, afforestation 27,000 hectares per annum
- Remaining emissions mainly from industry, agriculture, aviation, heavy transport and heating of buildings
- Carbon prices typically below $\sim \pm 20$ per tonne

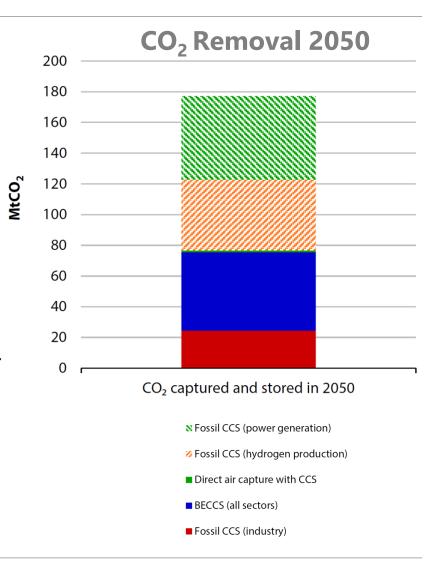




Policies to achieve net zero 1

Further ambition: to 96%

- More challenging, more costly, existing technologies
- Electricity 95% low carbon power, including **hydrogen**
- Buildings 90% low carbon heating including hydrogen
- All cars and vans electric by 2050; HGVs electric or **hydrogen**
- Industry: CCS, hydrogen and electrification
- Waste: 70% recycling, zero biodegradable waste to landfill by 2025
- Shipping: faster implementation of efficiency and alternative fuels
- **Agriculture and land use**: improved livestock breeding and diets; 20% reduction in beef, lamb and dairy, increased yields, 30,000 hectares per annum afforestation; 55% peatland restoration, increased energy crops
- Aviation: 60% increase in demand with further technical improvements
- CO₂ removal: afforestation, wood in construction, BECCS, DACCs small scale; CCS: 175Mt CO₂ captured and stored in 2050
- Carbon price up to £120/tonne industry and heat at top end





- First: energy efficiency
 - use as little energy as possible
- Second: electrification
 - 80-90% efficient
- Third: hydrogen
 - conversion, compression, use... up to 70% efficient
- Fourth: synthetic fuels
 - reversing highly exothermic reactions very energy intensive



- Buildings heat 50 200TWh
- Transport 97TWh
 - HGVs, buses, trains, agricultural vehicles 27TWh
 - Shipping (ammonia) 70TWh
- Industry 70TWh
 - High grade heat 70TWh
- Power 2TWh
 - Peak power back up
 - Mid merit low load factors
- Total 220 370TWh

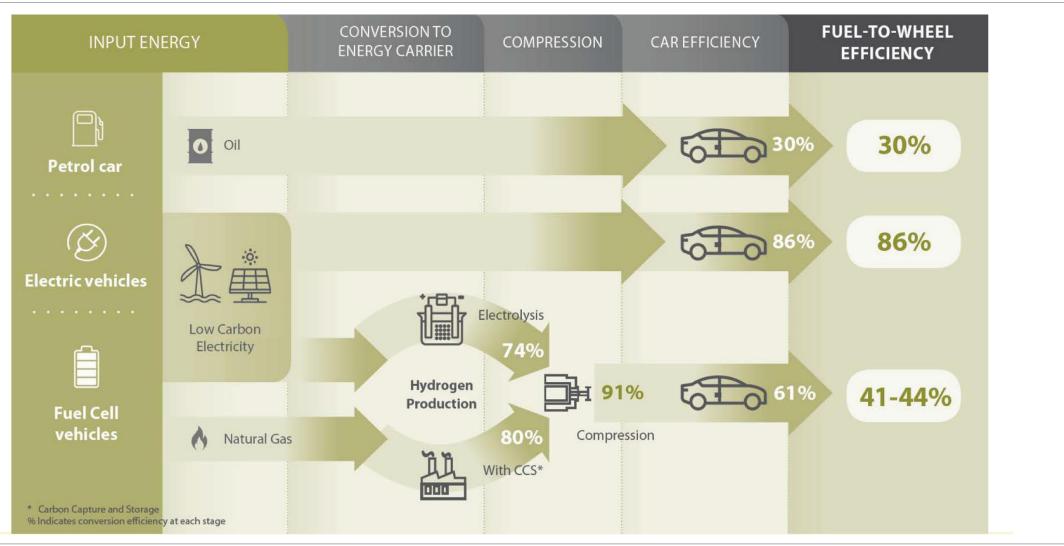






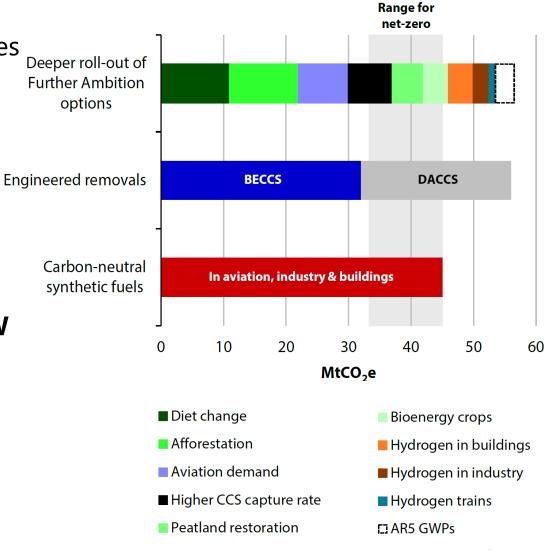






CCC 2018





Speculative options: to 100%

- Low technology readiness; high costs; acceptability issues
- Not all available by 2050, some required for net zero
- Significant societal and behaviour changes:
 - 50% reduction in beef, lamb and dairy
 - No growth in aviation from today
- Afforestation, 50,000 ha/annum, peatland restoration
- More ambitious **BECCS** increased energy crops
- Increased DACCS 14% increase in CCS, +10GW OSW
- Enhanced weathering and biochar
- Synthetic fuels +33% generating capacity
- CCS capture rates at 99%
- Increased use of hydrogen
- Carbon price to > £300 per tonne



How UK net-zero scenarios can be delivered

	2020s	2030s	2040s
Electricity	Largely decarbonise electricity: renewables, flexibility, coal phase-out	Expand electricity system, de generation (e.g. using hydrogen	
Hydrogen	Start large-scale hydrogen production with CCS	Widespread deployment in industry, u heavier vehicles (e.g. HGVs, trains) and p	
Buildings	Efficiency, heat networks, heat pumps (new-build, off-gas, hybrids)	Widespread electrification gas grids potentially s	
Road Transport	Ramp up EV market, decisions on HGVs	Turn over fleets to zero-emission ve	ehicles: cars & vans before HGVs
Industry	Initial CCS clusters, energy & resource efficiency	Further CCS, wide hydrogen, some	
Land Use	Afforestation, peatland restoration		
Agriculture	Healthier diets, reduced food waste, tree growing and low-carbon farming practices		



How UK net-zero scenarios can be delivered

	2020s	2030s	2040s	
Aviation	Operational measures, new plane efficiency, constrained demand growth, limited sustainable biofuels			
Shipping	Operational measures, new ship fuel efficiency, use of ammonia			
Waste	Reduce waste, increase recycling rates, landfill ban for biodegradable waste	Limit emissions from co wastes (e.g. deploy measures to rec		
F-Gases	Move almost completely away from F-gases			
Removals	Develop options & policy framework	Deployment of BECCS in variou air capture of CO ₂ , other remo		
Infra- structure	Industrial CCS clusters, decisions on gas grid & HGV infrastructure, expand vehicle charging & electricity grids	Hydrogen supply for industry & potentiall hydrogen/electric HGVs, more CCS infras		
Co-benefits	Health benefits due to improved air quality, healthier diets and more walking & cycling Clean growth and industrial opportunities			



When: science and global imperative?

How: can it be done?

How much: what will it cost?

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Reaching net-zero emissions in the UK Costs and benefits of meeting a UK net-zero target

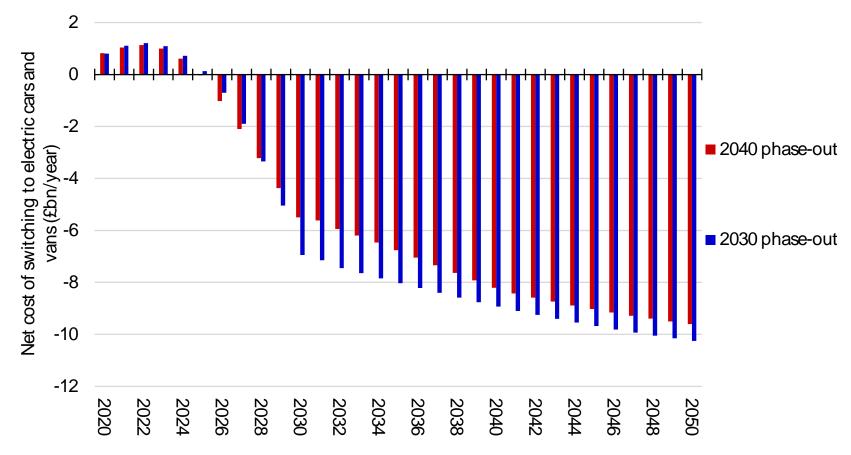
Innovation and falling technology costs are reducing the cost of meeting the target

Changes in cost estimates for long-term emissions goals					
GHG emissions reduction target (relative to 1990)	Year and report	Cost range estimated for 2050			
60% reduction in CO ₂ (~55% reduction in GHG)	2003 - Energy White Paper	0.5-2.0% of GDP			
80% reduction in GHG	2008 - Building a low-carbon economy – the UK's contribution to tackling climate change	1-2% of GDP			
100% reduction in GHG	2019 – Net Zero report	1-2% of GDP			



Reaching net-zero emissions in the UK Costs and benefits of meeting a UK net-zero target

A 2030 switchover to electric vehicles would save more money than a 2040 switchover



Source: CCC analysis





• Reducing the impacts of climate change

- Flooding, heatwaves, crop failures, migrants...
- £££££££££££££££££££££££££££££££££
- Economic opportunities
 - Clean growth; fastest growing sector of UK economy
- Health benefits ~ 1.3% GDP
 - More exercise, cleaner air, noise reduction, healthier diets, healthier homes
- Environment
 - More woodlands, hedgerows, wildlife, recreation, water and soil quality...





When: science and global imperative?

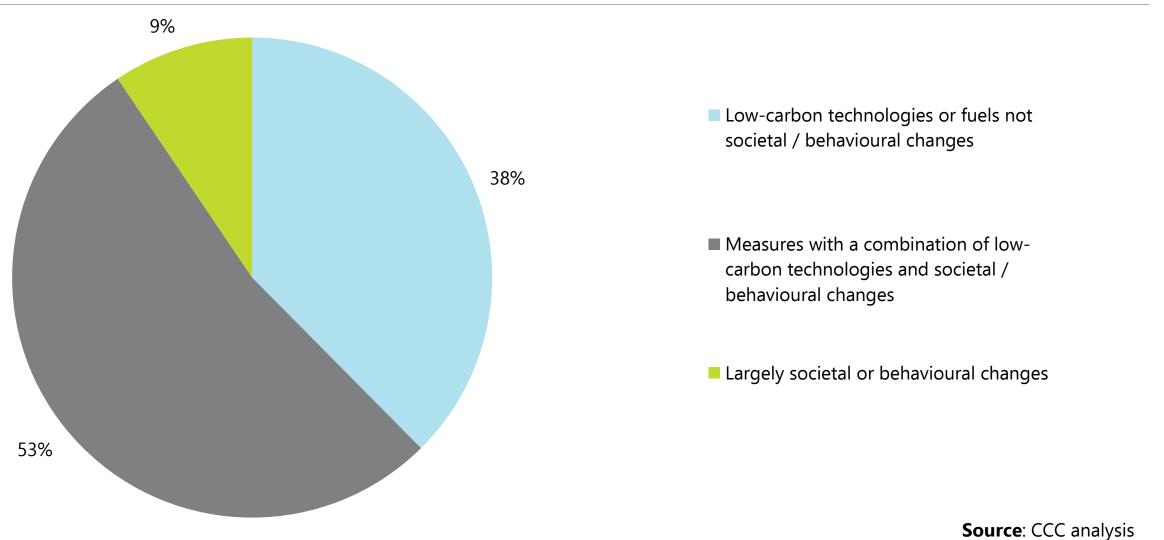
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Societal/behavioural change needed





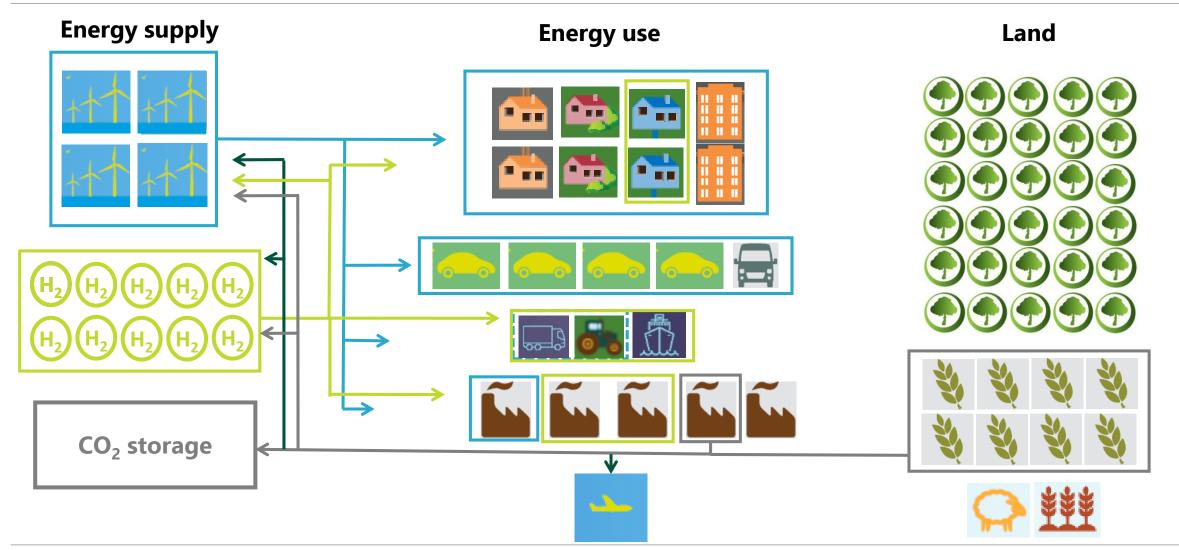
How big? In the next 30 years...

- Electricity system x2 to x4
- Offshore wind 10 GW to 75 100GW
- Hydrogen production 27TWh to 370TWh
- CCS 0 to 180 Mt CO₂
- Afforestation 10,000 to 50,000 hectares pa
- 29 million existing homes installed with low carbon heat
- Zero carbon cars 100,000 to 35 million
- Major changes in agriculture and land use
- Major changes to diet: beef, lamb and dairy consumption halved

All at the same time

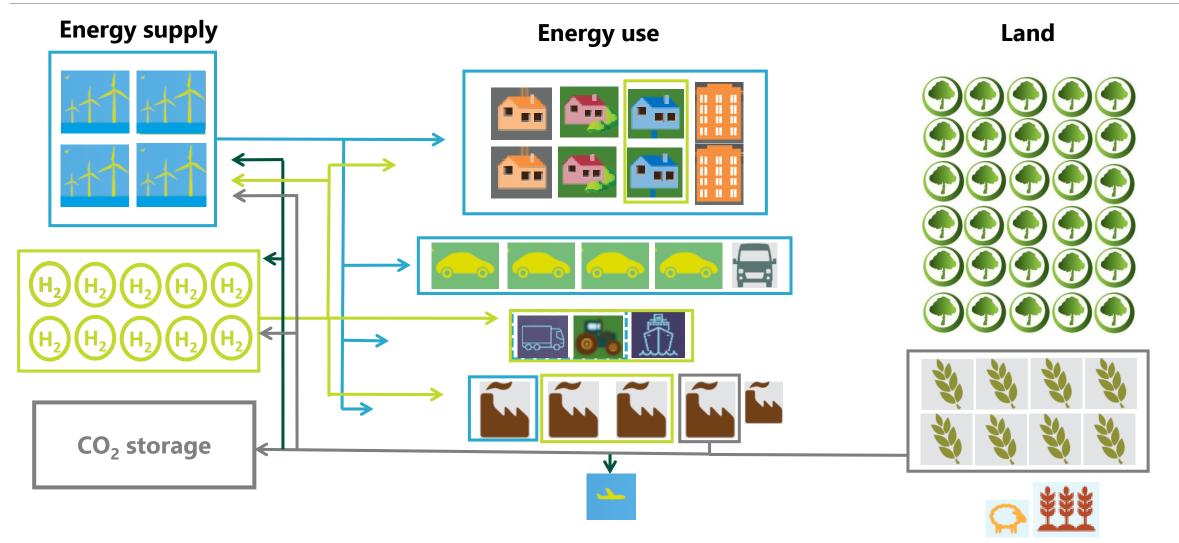


How UK net-zero scenarios can be delivered





How UK net-zero scenarios can be delivered



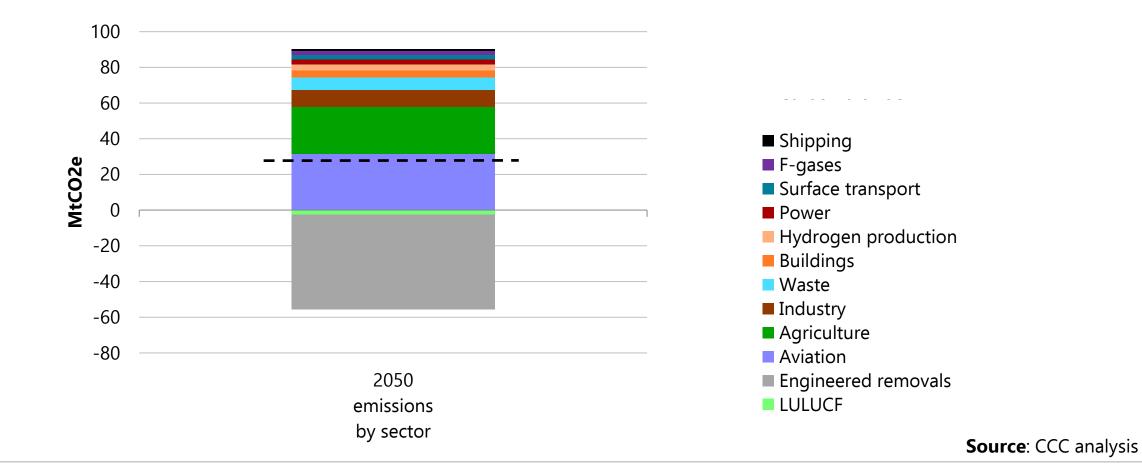


A few final reflections



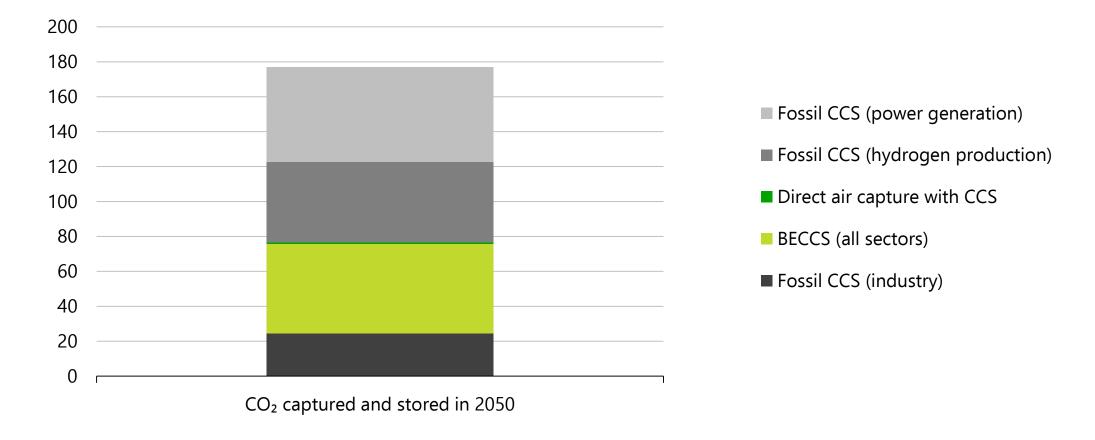
We don't have all the answers

Remaining emissions in the 96% 'Further Ambition' scenario





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

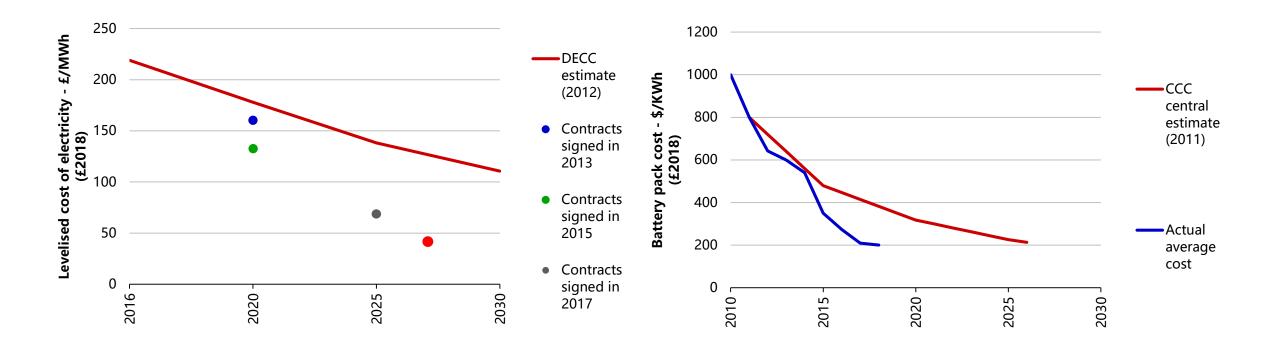


Source: CCC analysis





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



Source: Offshore wind costs, CCC analysis based on DECC (2012) Electricity generation costs and LCCC (2019) CfD register. Battery forecasts, CCC (2015) Sectoral scenarios for the 5th Carbon Budget, outturn costs from BNEF (2018) Electric cars to reach price parity by 2022



We need to get going...

Greta Thunberg

"This needs Cathedral Thinking. We can build the foundations without knowing exactly how we will complete the roof"



Thank you!

www.theccc.org.uk

