Committee on Climate Change

Independent advice to government on building a low-carbon economy and preparing for climate change

Tuesday, 13 September 2017

The role of CCS in reaching UK emission targets up to 2050, and also beyond to net zero

Mike Hemsley

Committee on Climate Change

Overview

- **The Climate Change Act and the Committee on Climate Change**
- Building a low-carbon economy (role of CCS)
- CCS in the UK - context
- CCS in the UK – a strategic approach

Committee on Climate Change

The UK has used the Climate Change Act as a framework to drive change since 2008

The Climate Change Act

1	**A goal**	**2050 Emissions Target**
2	**A pathway**	**Carbon budgets**
3	**A toolkit**	Requirement that Government brings forward **policies**
4	**A monitoring framework**	**Committee on Climate Change** to monitor progress and suggest changes

The CCC brings an independent assessment to identify required action and to monitoring progress

Committee on Climate Change

Lord Deben (Chairman)

Plus ~25 full-time secretariat

Paul Johnson

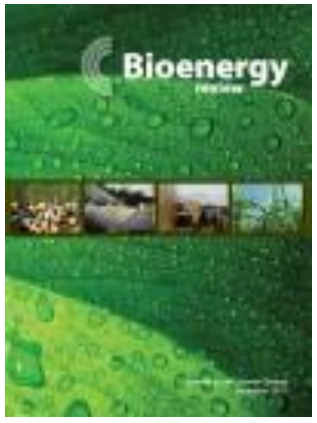
Baroness Brown

Professor Sir Brian Hoskins

Professor Jim Skea

Professor Corinne Le Quere

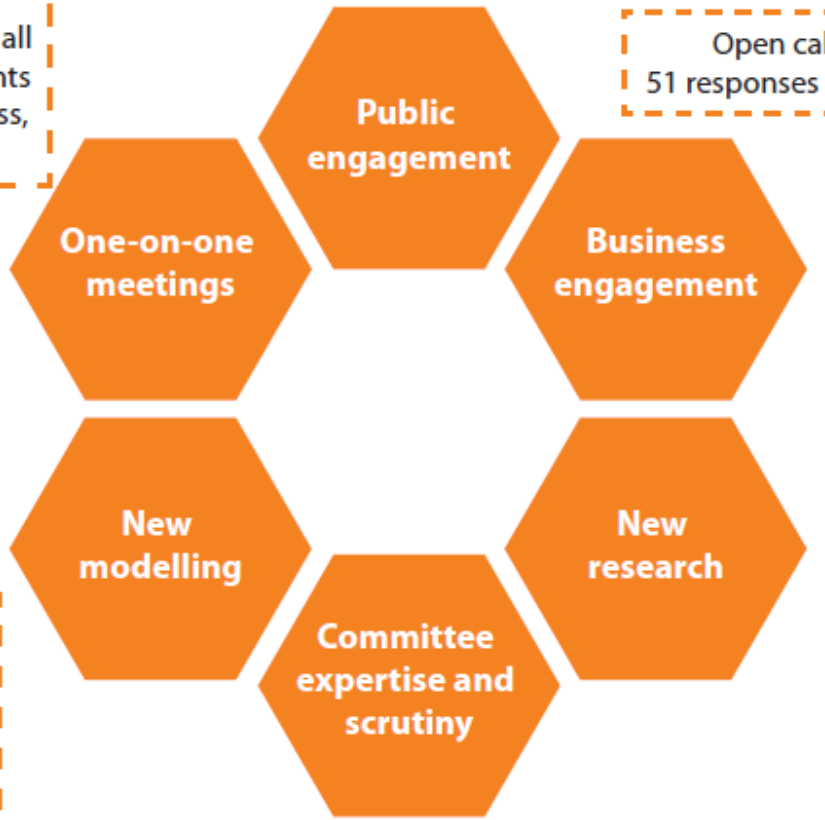
Professor Nick Chater



Committee on Climate Change

The Committee draws on a wide range of evidence to provide its independent view of the best path to 2050.

Over 200 meetings with individual stakeholders covering all sectors and statutory requirements (e.g. fuel poverty, competitiveness, technological progress)



Open call for Evidence, 51 responses covering all sectors

Over 10 roundtables and workshops, e.g. CBI, EEF, Energy UK, financing institutions and 3 wider business discussions

5 independent research projects covering cost-effective approaches in power, heat, hydrogen and agriculture; and overall analysis of uncertainty

Bespoke model runs of key government models: National Transport Model, National Household Model, Emission Projections Model, UK TIMES

Monthly Committee meetings to scrutinise analysis

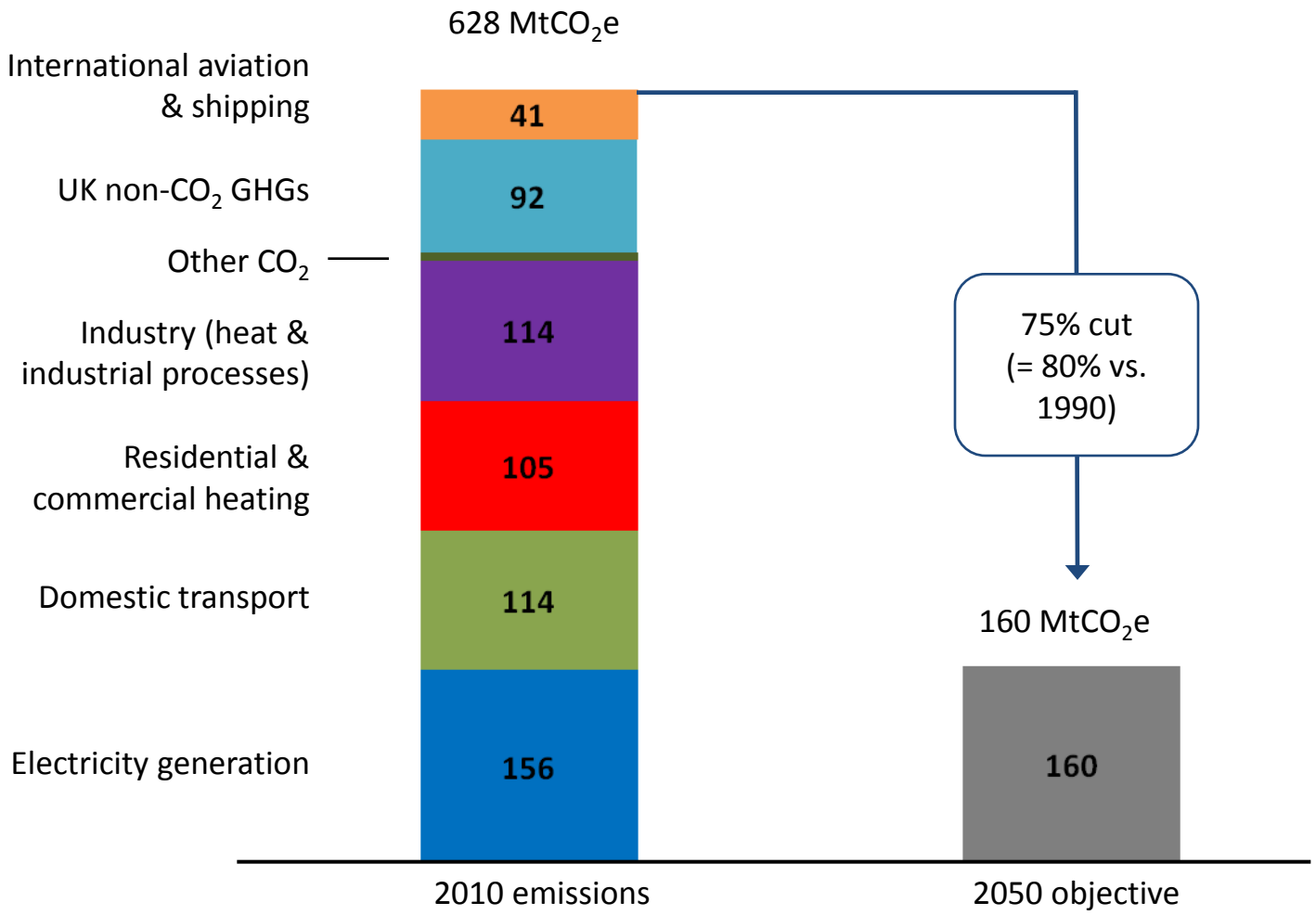
Committee on Climate Change

Overview

- The Climate Change Act and the Committee on Climate Change
- **Building a low-carbon economy (role of CCS)**
- CCS in the UK - context
- CCS in the UK – a strategic approach

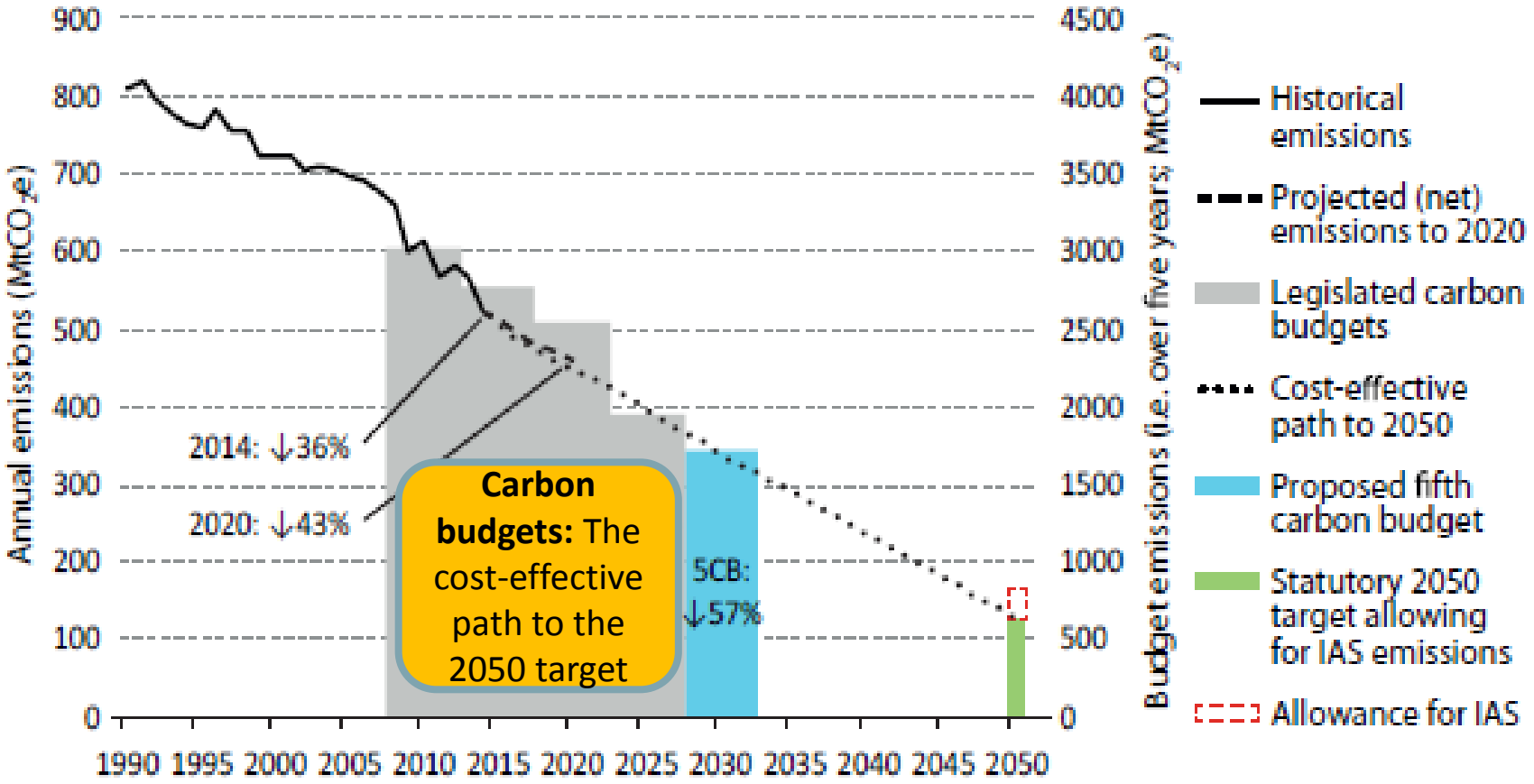
Committee on Climate Change

The UK 2050 target is a tough but achievable challenge



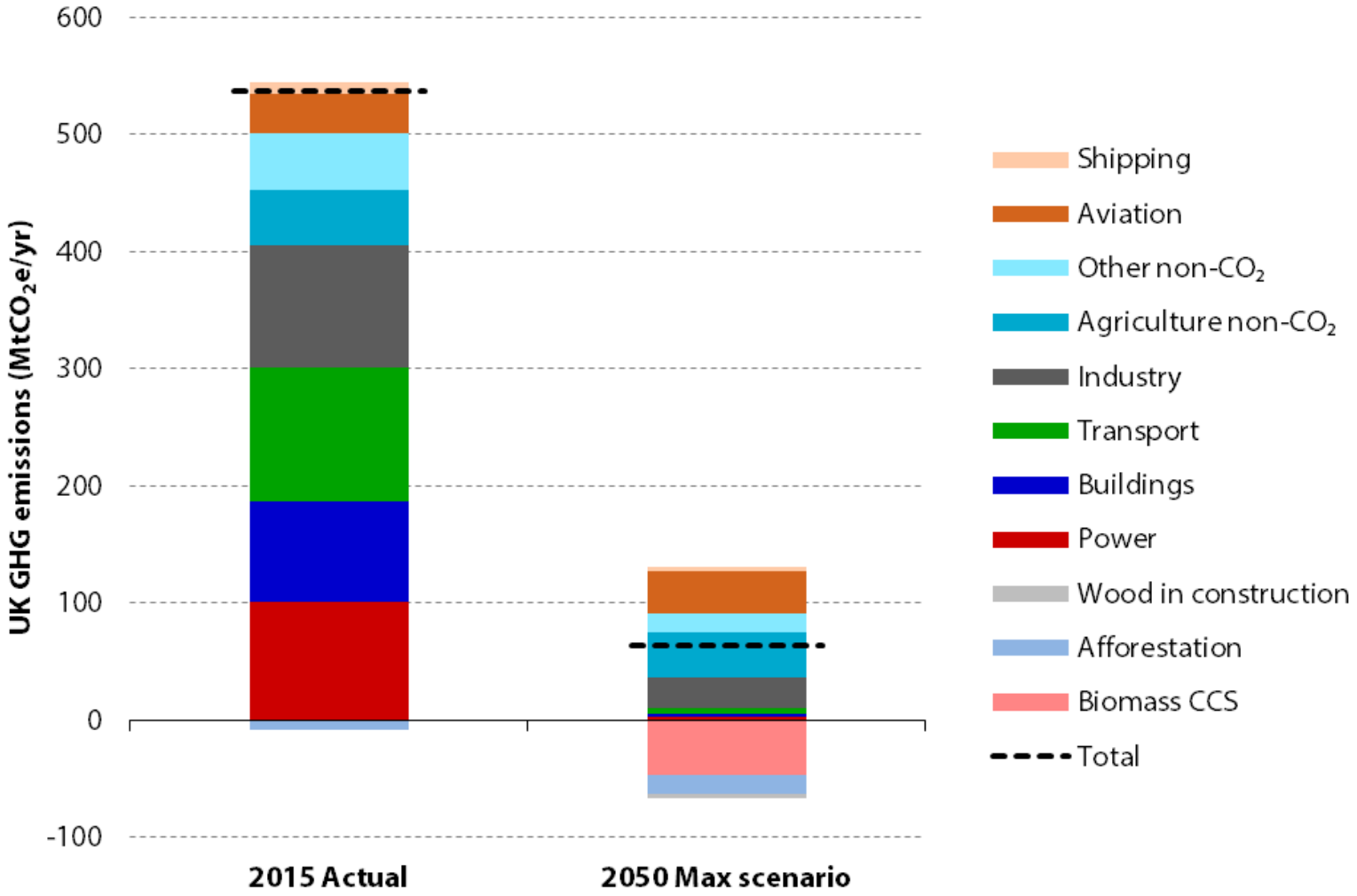
Committee on Climate Change

The carbon budgets provide stepping stones to the long-term target



Committee on Climate Change

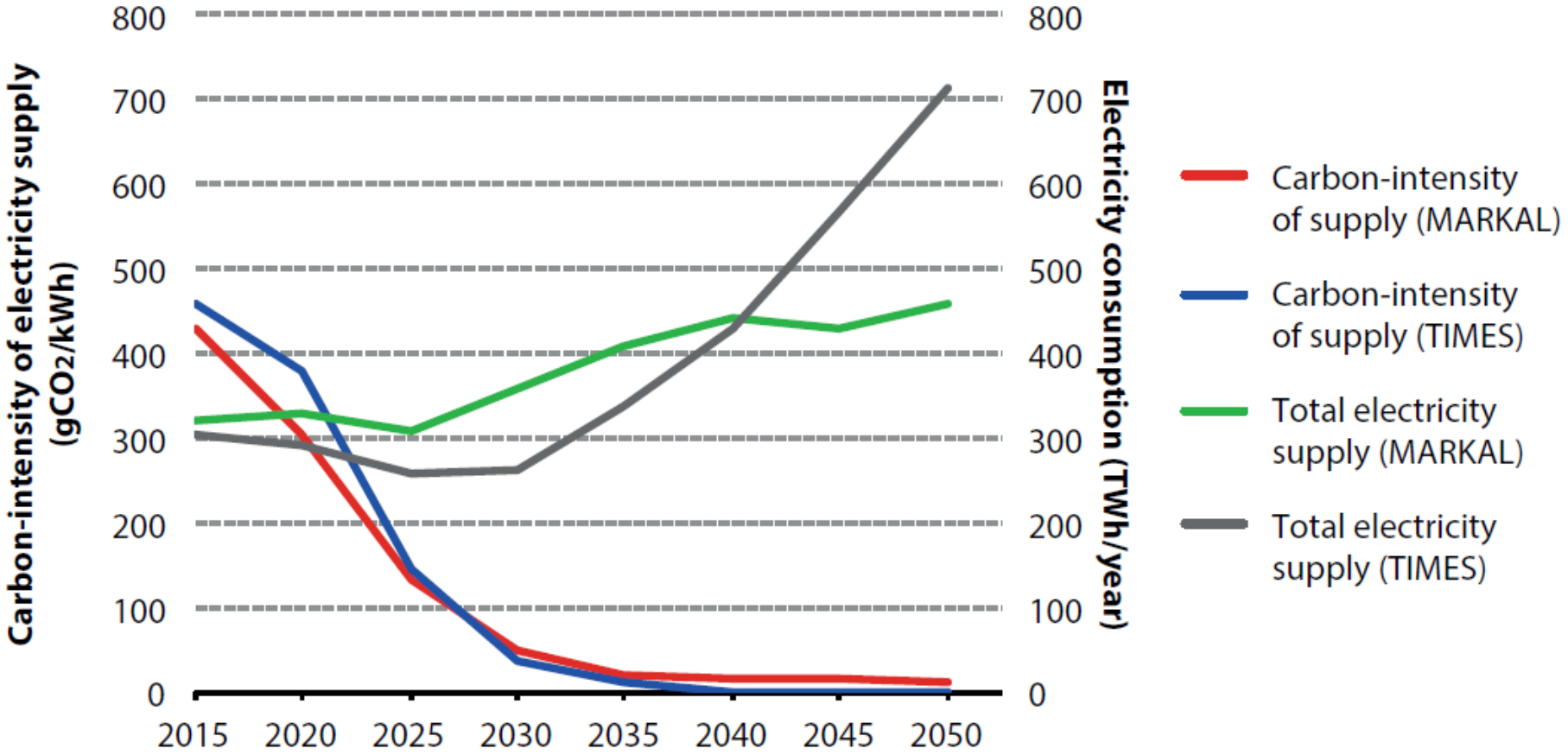
Removals: already expected to play a role to 2050, vital for net zero



Source: CCC

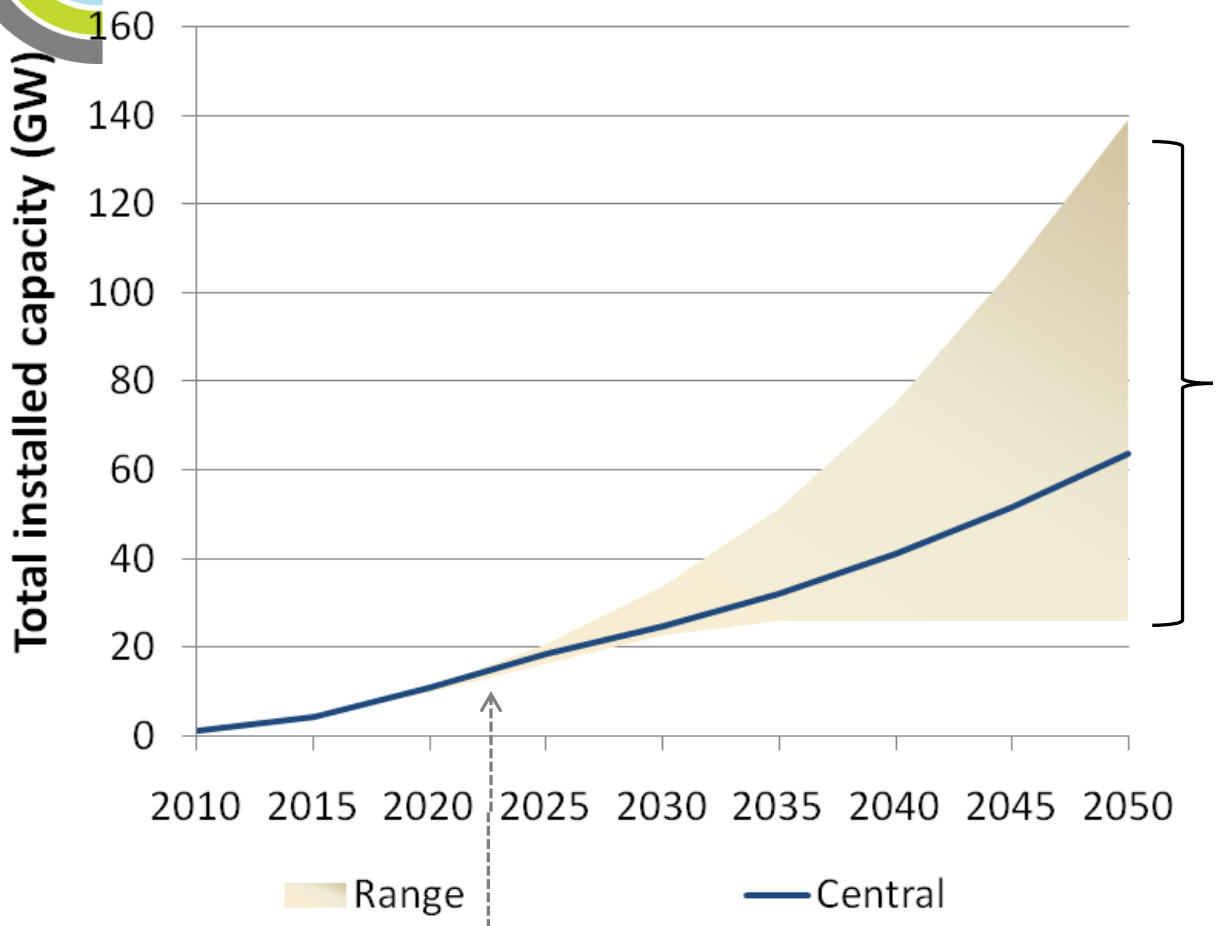
Committee on Climate Change

Energy system model trajectories for the power sector



Our scenarios reflect this need to build options

Committee on Climate Change



'Optimum' level in 2050 is highly uncertain

Near-term deployment should keep that range in play

Committee on Climate Change

Given various risks and uncertainties a portfolio approach is appropriate for power sector decarbonisation

		Economics		Resource	Limitations / Risks
		Current	Future		
Likely to play major role	**Nuclear**	Appeared lowest cost			Sites, waste storage, public attitudes
	Onshore wind			Probably limited	Acceptability (planning) constraints
	Offshore wind		?		
Could play major role, UK deployment important to developing option	**CCS**		Best at low LF ?		Access to storage Subject to demo success
	Tidal stream and wave		?		Subject to demo success
May play role, UK deployment less important to drive down costs	**Solar PV**	Globally driven	?	Probably limited	
	Tidal barrage	Limited scope for costs to fall			Useful option if others constrained/expensive

= favourable outlook = uncertain, potentially favourable

A portfolio approach: Firm minimum commitments on less mature technologies are required (***e.g. 20-25GW offshore, 4-7 GW CCS by 2030***), alongside competitive investment in mature technologies.

Committee on Climate Change

Value of CCS in power sector decarbonisation

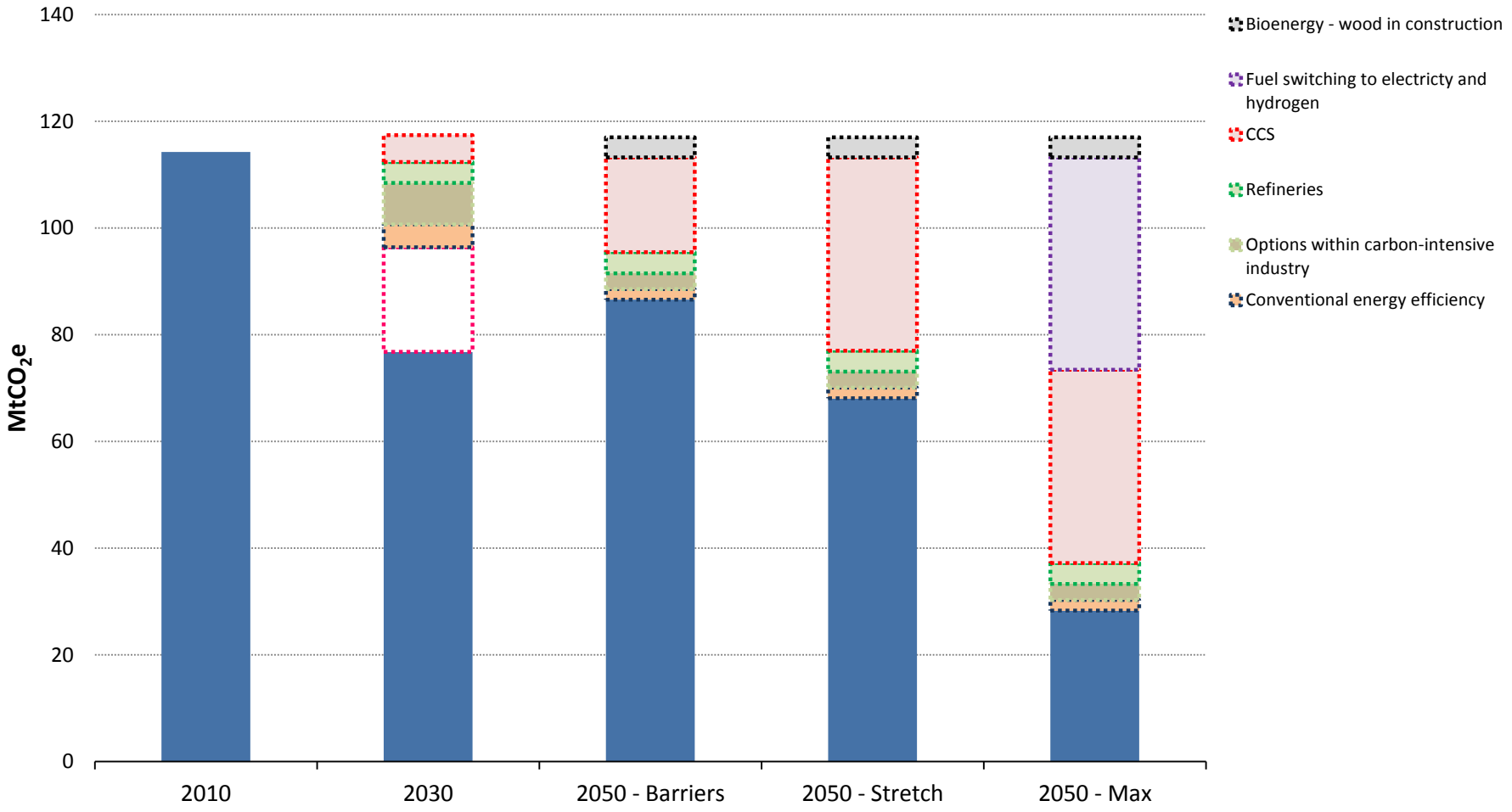
CCS important in power for:

- Flexible low-carbon generator: decarbonised mid-merit plant to complement the variable output of renewables
- Anchor load to support CCS infrastructure, sharing the costs
- Pathway to Bioenergy for electricity generation, with CCS (BECCS)

Costs includes carbon price

Committee on Climate Change

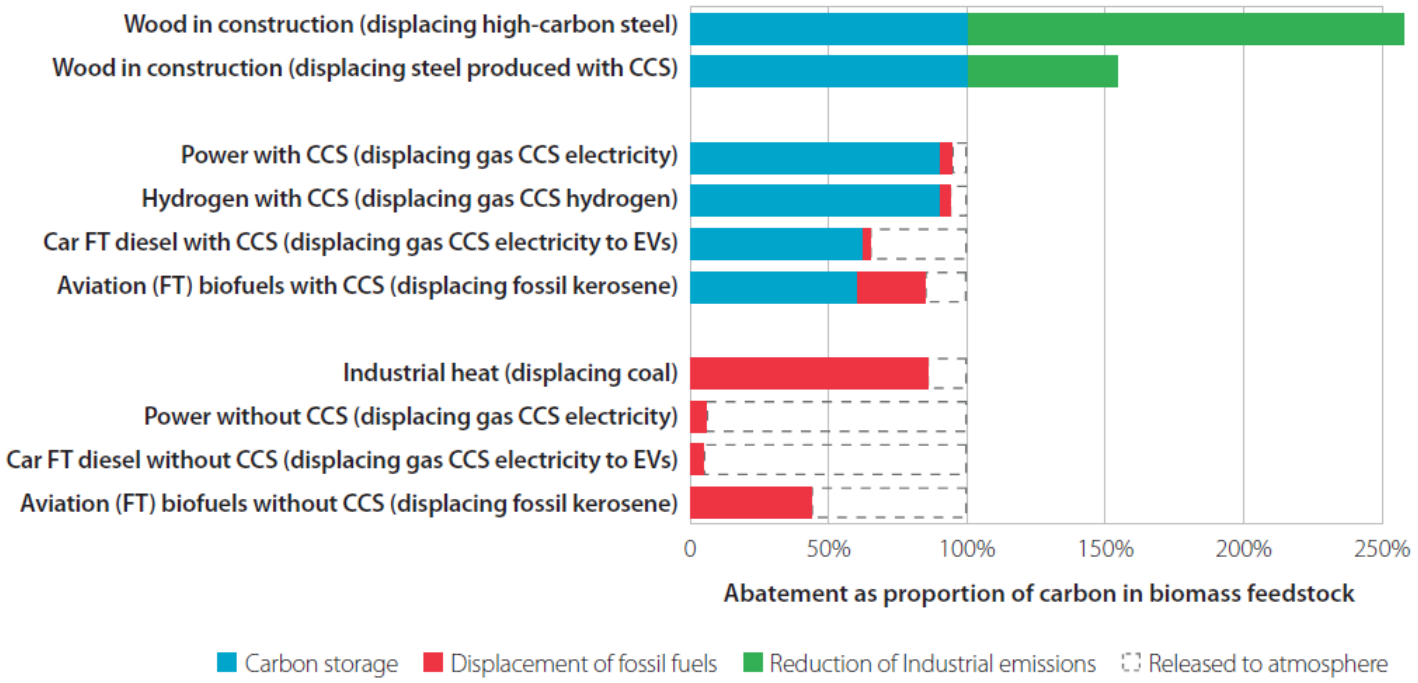
Importance of CCS: industry



Committee on Climate Change

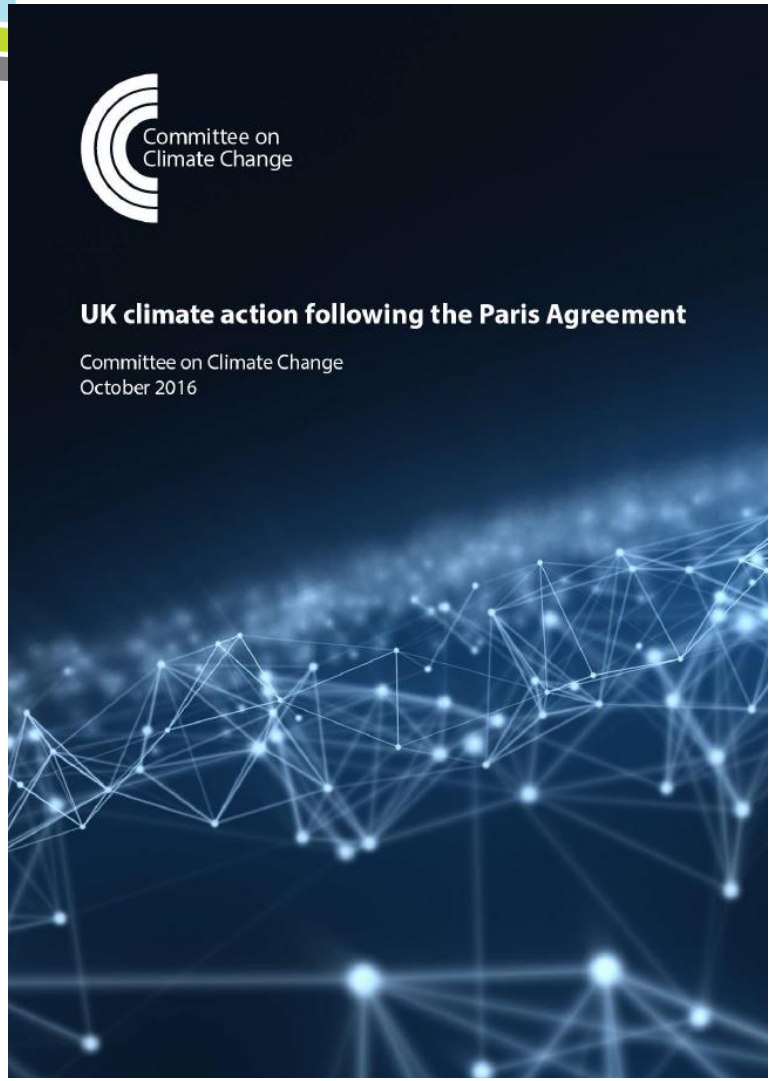
Importance of bioenergy with CCS

Figure B4.2a: Combined benefits from sequestration of carbon and/or displacement of fossil fuels for a range of bioenergy applications in 2050



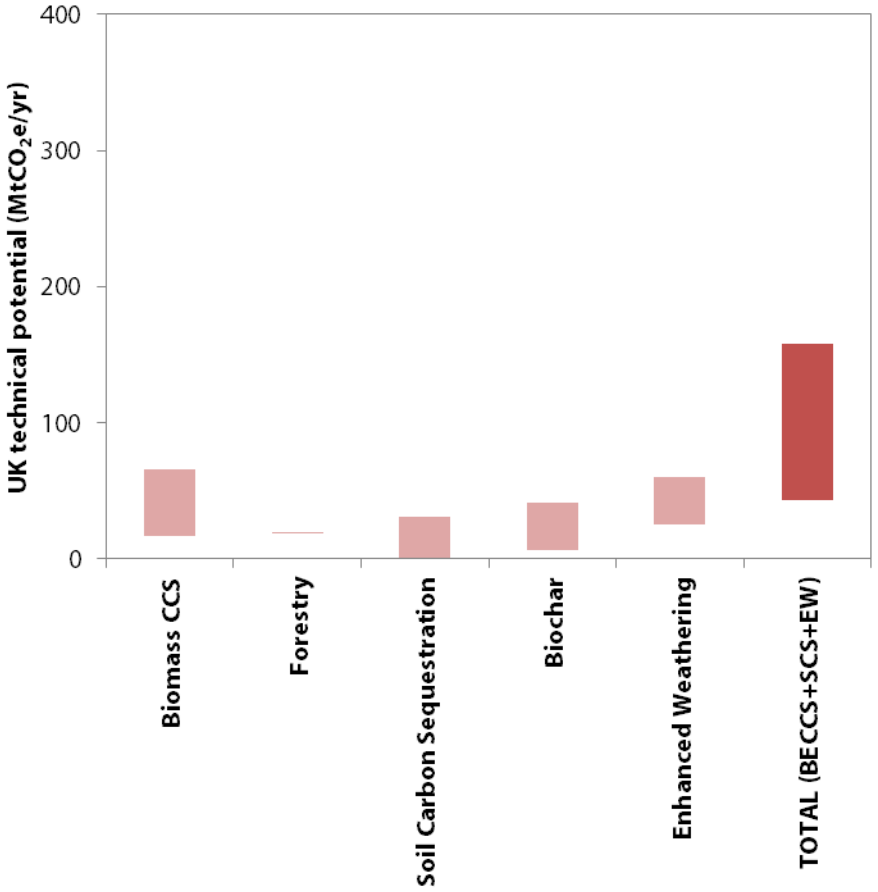
Source: CCC analysis, based on data in model developed by Redpoint Energy and Ecofys.
Notes: Calculations track the carbon contained in solid biomass, assumed to have a carbon-intensity of 356 gCO_2 per kWh of primary energy. Does not include cultivation or transportation emissions; these are likely to be similar for a given feedstock across the range of applications. CO_2 capture rate for CCS applications assumed to be 90% in electricity and hydrogen generation and 80% in biofuel production. FT refers to Fischer-Tropsch biofuel production.

Committee on
Climate Change



https://www.theccc.org.uk/publication/uk-action-following-paris/

UK potential unclear, likely small but significant



- Only two studies (one we did ourselves)
- Technical potential on similar scale to 2050 residual emissions
- More work required on:
  - potential for others, esp. Direct Air Capture (DACs)
  - "real-world" constraints

Source: Smith et al. (2016) *Preliminary assessment of the potential for, and limitations to, terrestrial NETs in the UK*

Committee on Climate Change

Key messages: greenhouse gas removals

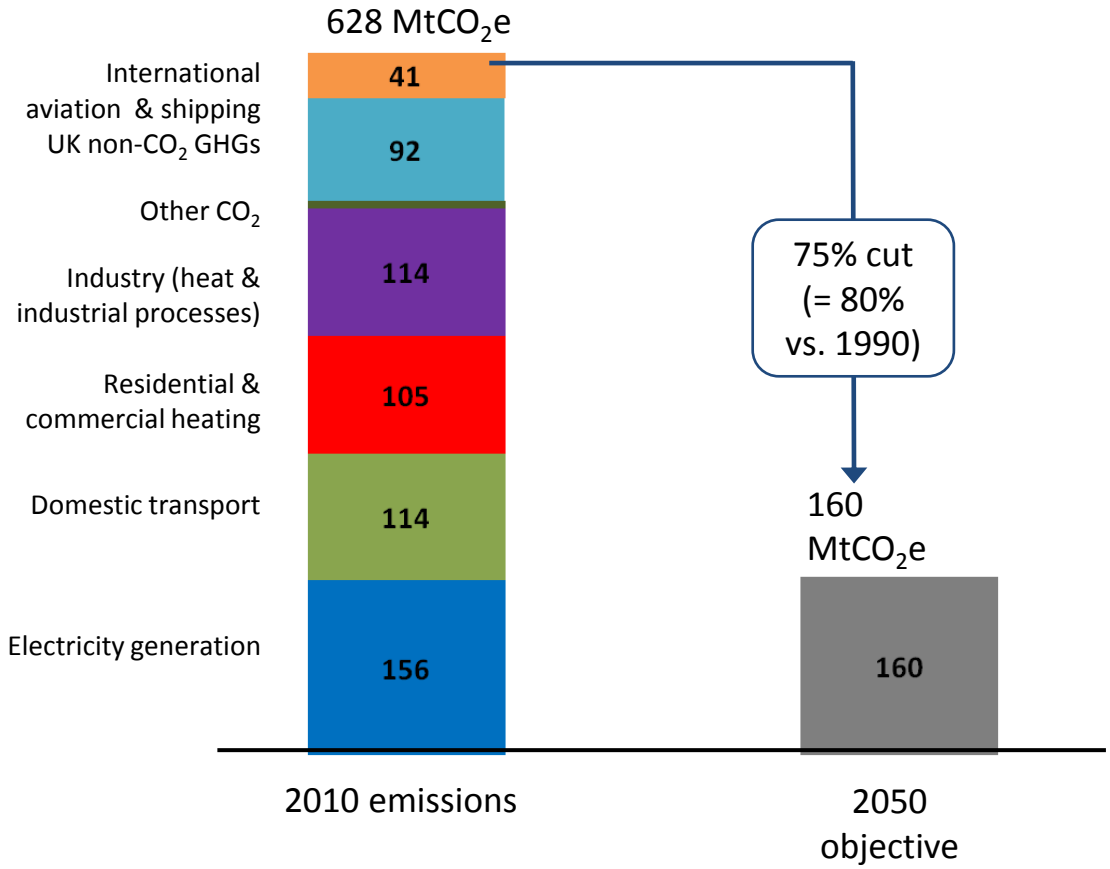
- **Not a substitute for widespread decarbonisation** but necessary to reach net zero emissions.
- **Not just a UK need**, global co-ordination would help pool resources, foster good governance and reflect different options in different locations.

To have options at scale by 2050, develop a UK strategy now, with:

- **Support for RD&D** (e.g. measuring land carbon, lifecycle impacts of bioenergy crops and biochar, testing of direct air capture).
- **Support for targeted deployment** (e.g. CCS infrastructure, sustainable bioenergy crops, afforestation, wood in construction).
- **Integration into policy and accounting frameworks** (e.g. inclusion in EU ETS and CAP). Lack of long-term policy support is a key barrier.

CCC work on Hydrogen

- Need to decarbonise heat
- Previously considered electrification the best option, but: costly, disruptive, consumers don't want it.
- Possibility to use existing gas grid with a decarbonised gas (e.g. H2)
- Best method of large-scale H2 production is via Steam Methane Reforming, but need to capture the carbon.



Committee on Climate Change

Implications of not having CCS

Not having CCS likely to require almost full decarbonisation of buildings and surface transport and possibly further action (e.g. constraints on aviation)

CCC and ETI estimate not having CCS would double cost of meeting 2050 target

Could rule out large-scale production of hydrogen for low-carbon heating in the UK

Barriers to CCS mean this needs to be demonstrated in advance of major decisions on decarbonisation pathways

Implies **CCS needs to exist as an option** by 2030

Committee on Climate Change

Overview

- The Climate Change Act and the Committee on Climate Change
- Building a low-carbon economy (role of CCS)
- **CCS in the UK - context**
- CCS in the UK – a strategic approach

Committee on Climate Change

CCS in the UK

2009	Govt set out a framework for CCS demonstration, envisaging: • ~4 demonstration projects operational by 2020 • first project awarded competition funding by end 2010 • first plant beginning operation in 2014
2010	Longannet and Kingsnorth funded for FEED studies Spending Review allocated £1bn capital funding
2011	Collapse of Longannet and Kingsnorth proposals
2012	DECC launched CCS Commercialisation Programme
2013	Peterhead and White Rose selected as preferred bidders
2015	Cancellation of CCS Commercialisation Programme
2016	Oxburgh report

Committee on Climate Change

Cost of CCS

David Cameron's evidence to the Commons Liaison Committee of 12 Jan

> *Why did you scrap the carbon capture and storage investment despite promising to put £1bn into it?*
>
> *"…at the moment the CCS technology is not working. You could spend £1bn, but the technology would not be competitive in the market.*
>
> *The government hoped the costs would come down. But they did not.*
>
> *The CCS would still cost **£170 per megawatt hour**. That compares with nuclear energy costing £90, or onshore wind costing £70."*

Comparison of cost of **demonstrator** with mature technologies

£170 cost includes cost of transport and storage - infrastructure that, once built, can be shared between future capture facilities

Committee on Climate Change

Overview

- The Climate Change Act and the Committee on Climate Change
- Building a low-carbon economy (role of CCS)
- CCS in the UK - context
- **CCS in the UK – a strategic approach**

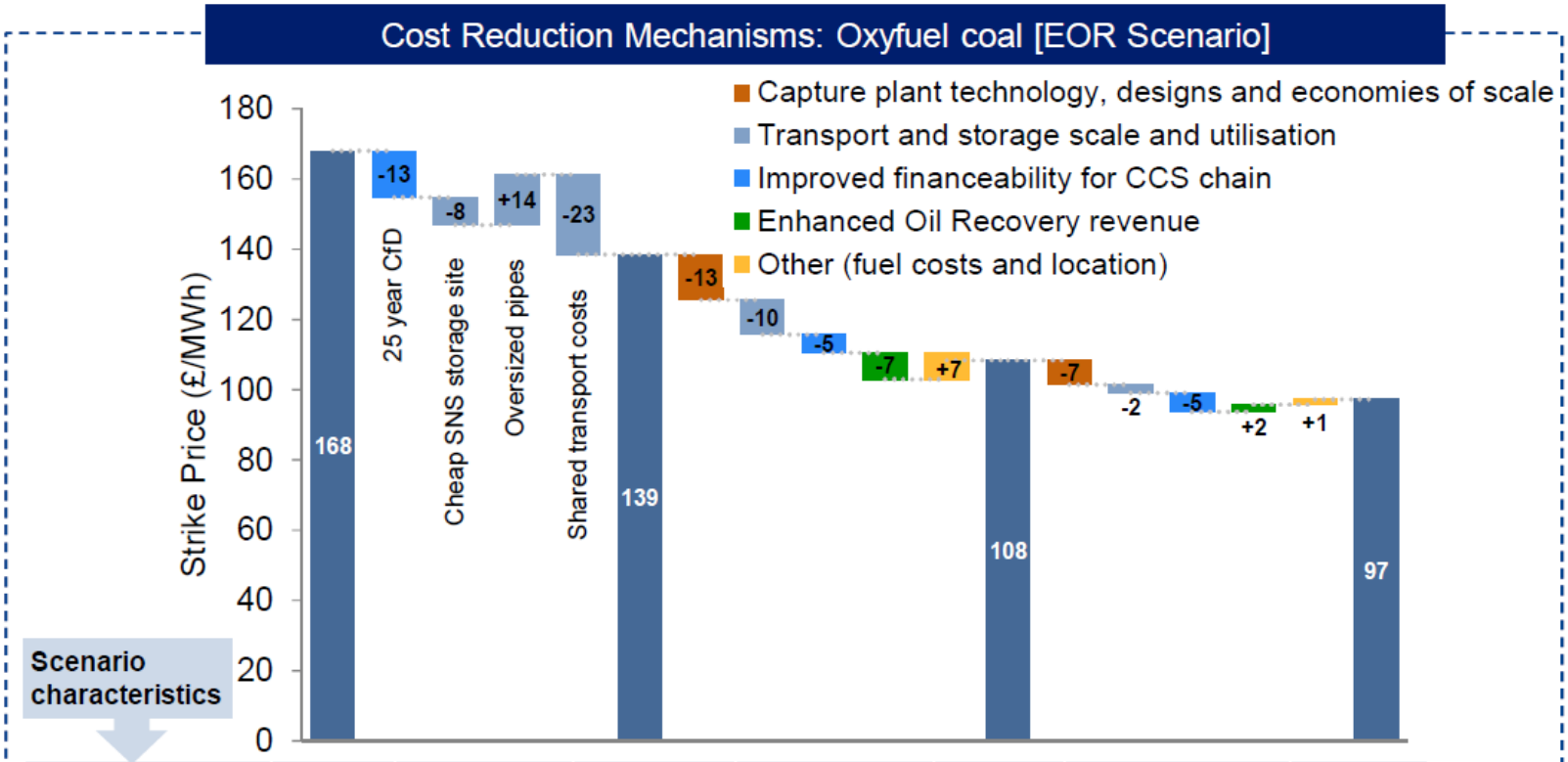
Previous CCC recommendations on CCS

- CCS is important for multiple sectors
- Cost of meeting 2050 target doubles without CCS
- UK deployment is needed to drive cost reductions
- Failure of commercialisation competitions indicates that new business models are needed.

Committee on Climate Change

CCS cost reduction mechanisms

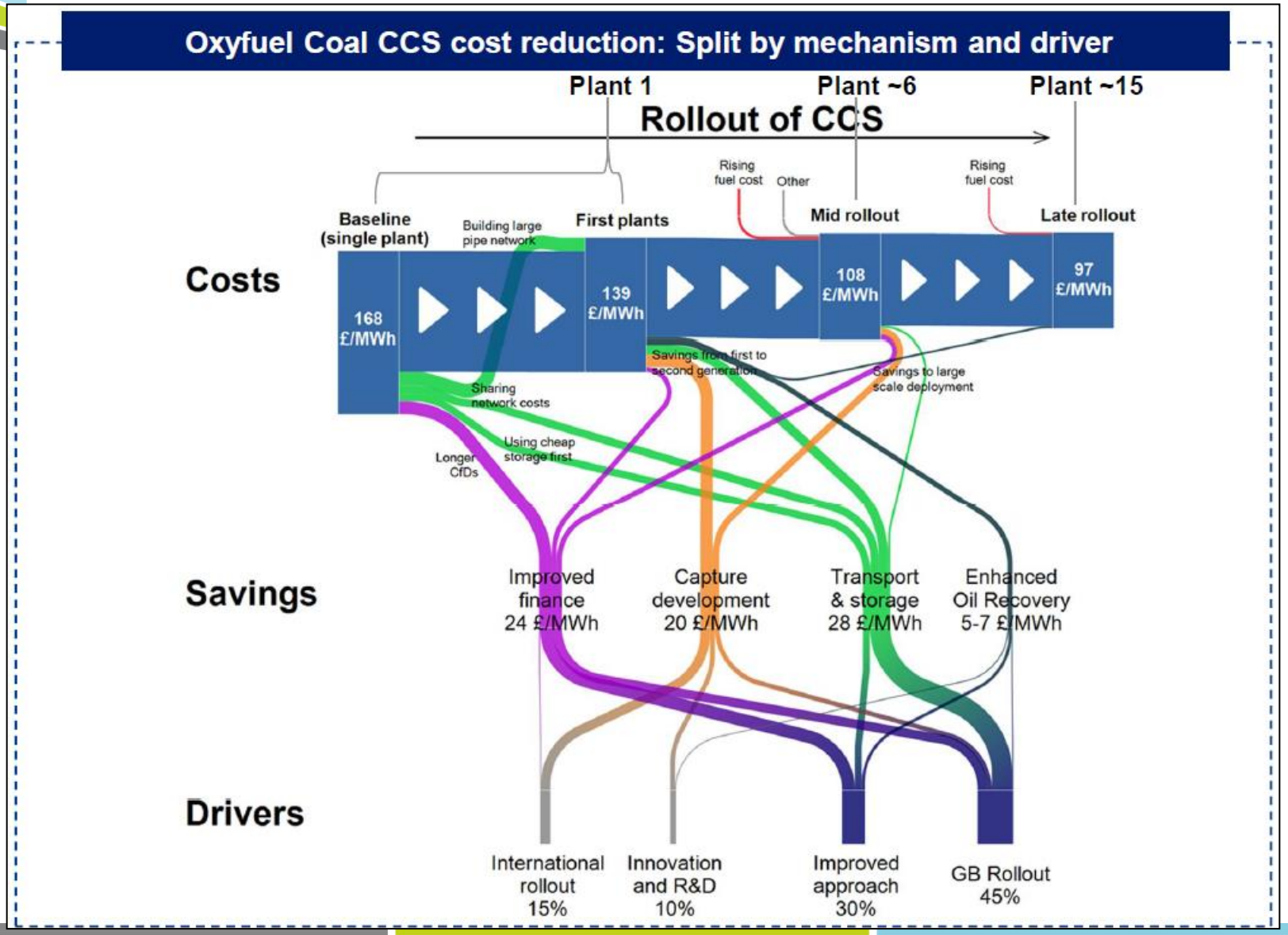
Key cost reductions occur for post combustion gas CCS in concentrated scenario and oxyfuel coal CCS in EOR scenario



Scenario characteristics							
Capture plant gen.	Baseline		ZOAK		FOAK		NOAK
Commissioning Yr	2020		2020		2025		2030
CCS Plant #	0		1		~6		~15
CCS GW capacity	0		~0.4 GW		~2 GW		~10 GW

Committee on Climate Change

CCS cost reduction mechanisms – savings and drivers



Committee on Climate Change

Barriers to delivering CCS

- Costs are currently high
- Supply chain is limited and lacking in market signals
- Lack of familiarity with CCS due to immaturity of sector, risk profile
- CCS-specific risks
  - volume risk
  - cross-chain risk
  - storage liability risk

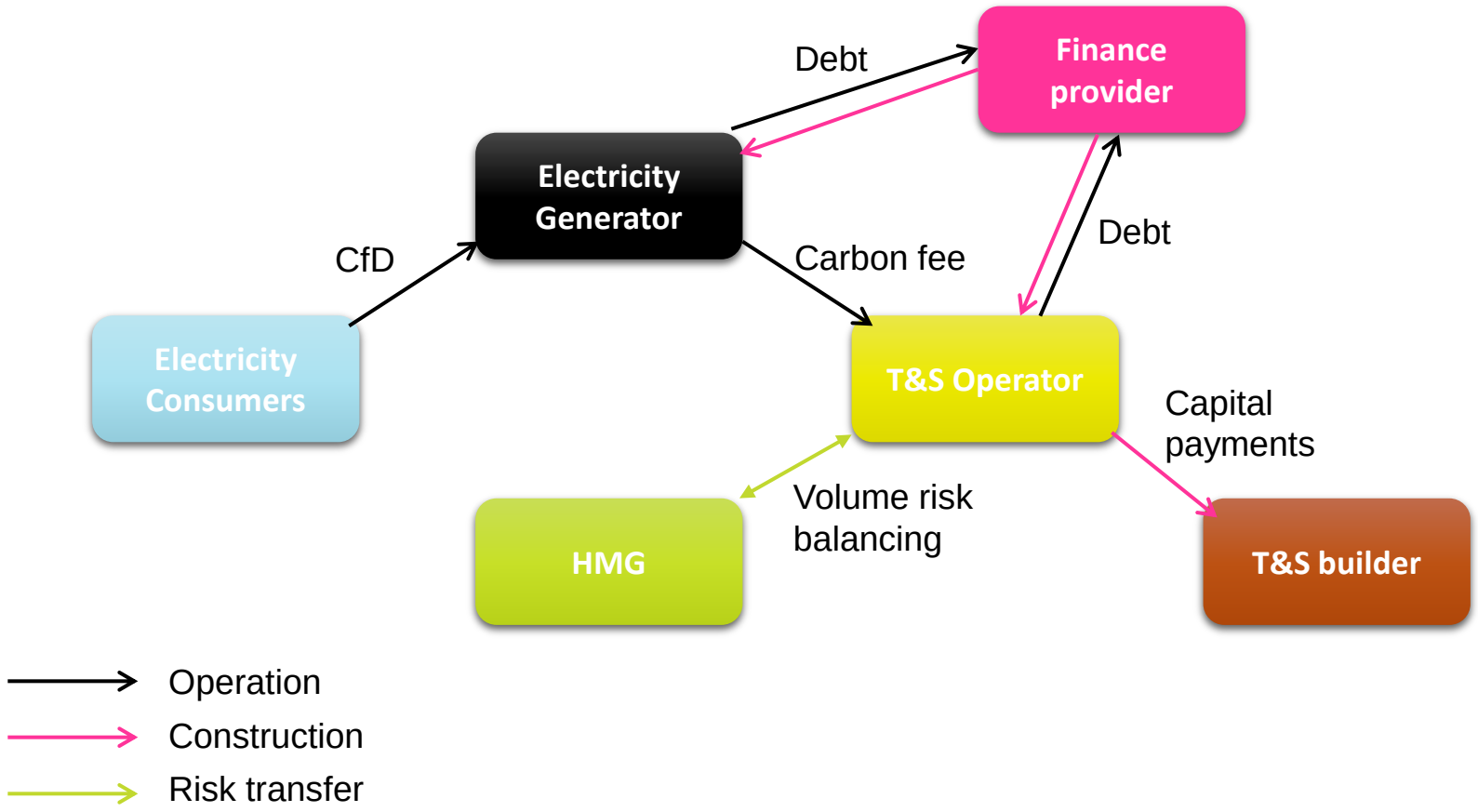
Committee on Climate Change

A strategic approach to delivering CCS

- Clear policy signal
- Develop strategic clusters (prepare for industry CCS, share infrastructure); power-led or power-and-industry-led approach
- "Part-chain" approach: with separate contractual arrangements for capture, transport and storage
- Phased deployment programme
- Minimise initial cost burden
- Benefit later from technology and project learning, economies of scale
- Develop supply chain
- Engage financial community
- Index capture CfDs to fuel prices
- Funding mechanism for industry capture

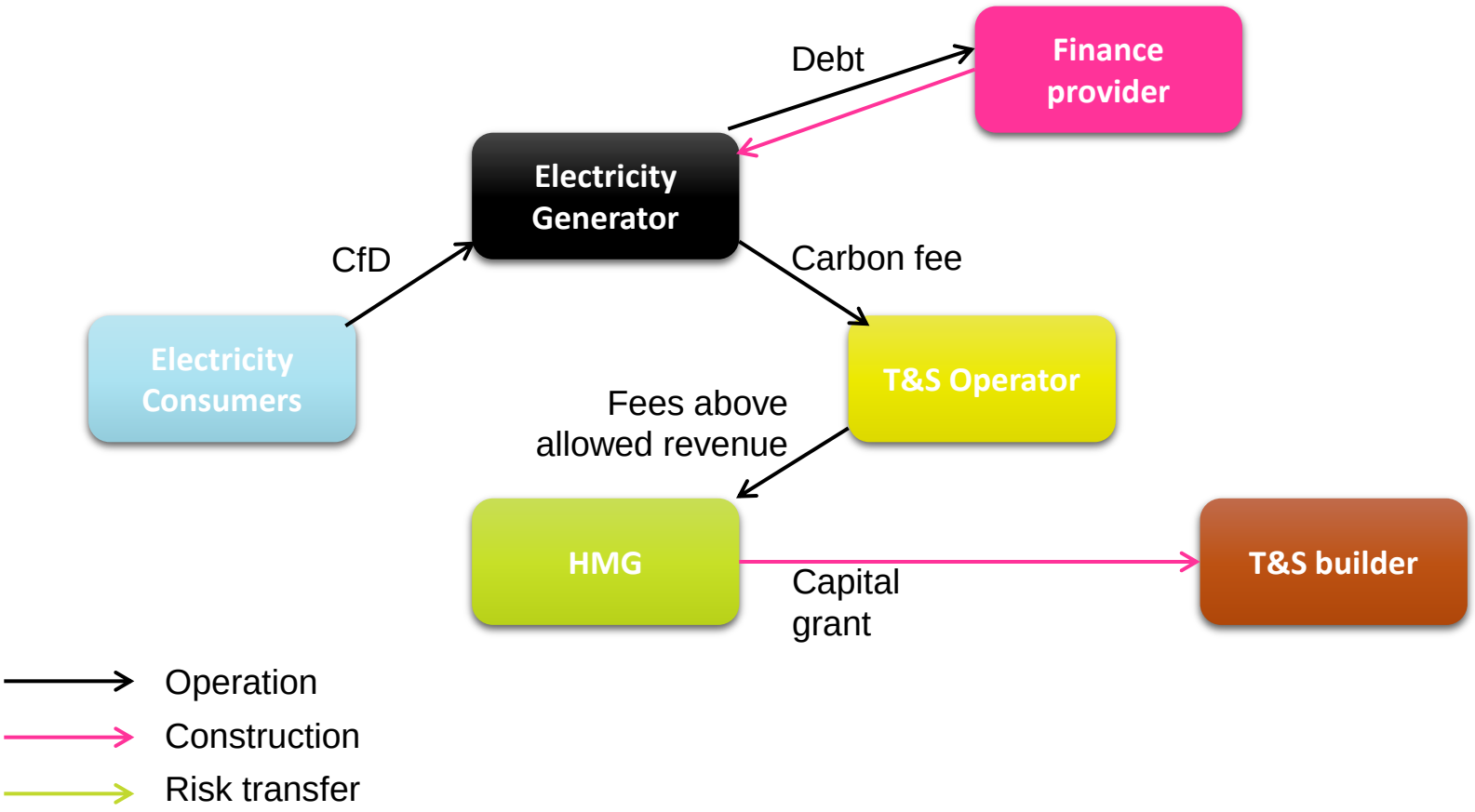
Committee on Climate Change

Example business model (1)



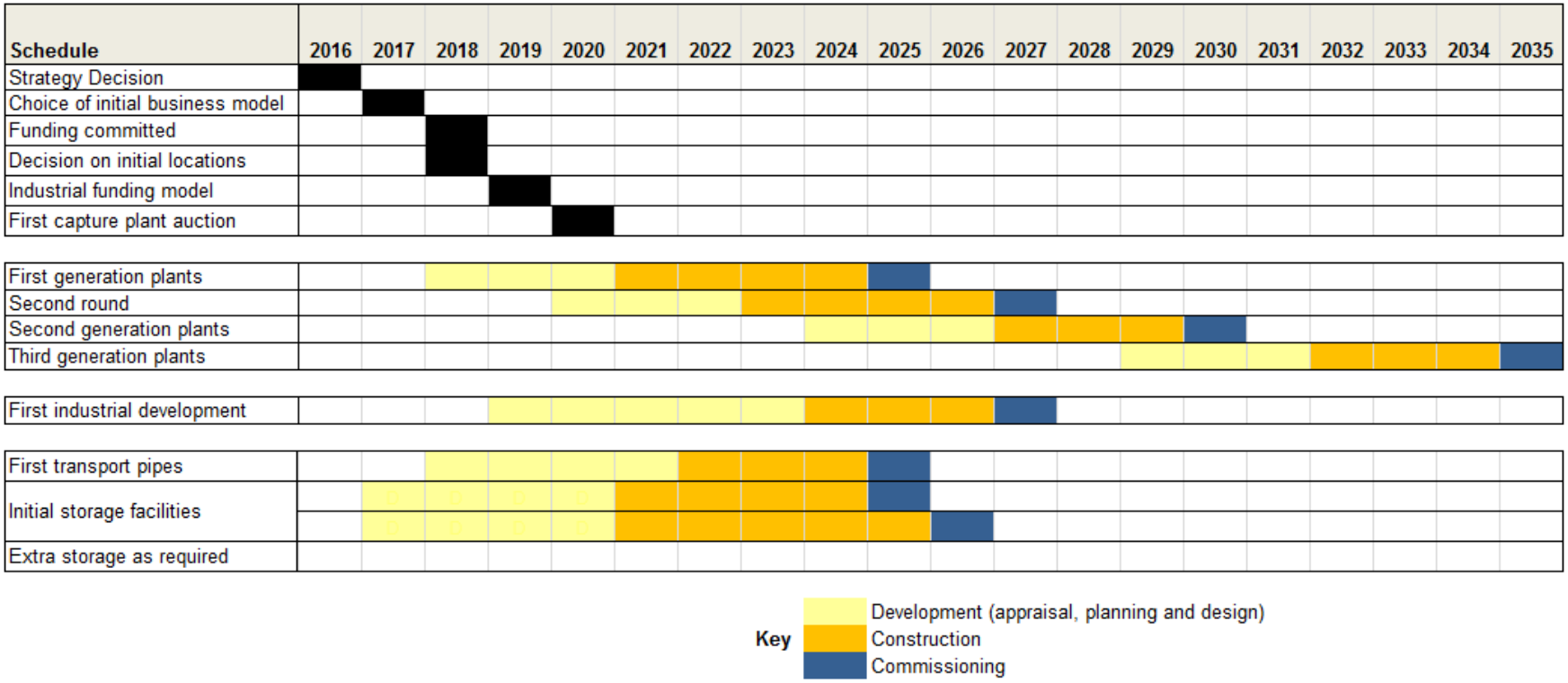
Committee on Climate Change

Example business model (2)



Committee on Climate Change

Possible timeline for development



Committee on Climate Change

Contact us

www.theccc.org.uk | @theCCCuk
mike.hemsley@theccc.gsi.gov.uk