Carbon Capture & Storage Association

Status of CCS in the UK

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The Carbon Capture & Storage Association

Advanced Process Modelling Forum

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Presentation Topics

1. Overview of the CCSA
2. Importance of CCS & global status
3. Status of CCS in the UK – CCS Commercialisation Programme (competition)
4. CCS R&D
5. Electricity Market Reform
6. Wider CCS Issues
7. Conclusion

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1. Overview of the CCSA

- **Set up in 2006 with 11 founding members (now 51 and growing)**
- **Represents the interests of its members in promoting the business of CCS, as well as raising awareness**
- **Solely supported through membership fees**
- **Active in UK, EU and international policy developments**
- **Has become the trusted voice of the CCS industry in the UK and is one of the main points of contact for Government on CCS issues.**

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CCSA Members

2Co Energy
Allen & Overy
Alstom Power
AMEC
BG Group
BOC
BP
Carbon Clean Solutions
CCS TLM
Centrica
Chevron
Clean Energy Systems
CO2DeepStore
CO2 Tech Centre Mongstad
Costain
Doosan Power
Drax Power
EDF Energy
EON
ESB
Gassnova
GDF Suez
Herbert Smith
Howden Group
Linklaters
Lloyd's Register
Maersk Oil & Gas
Masdar
MMI Engineering
National Grid
National Physical Laboratory
Nottingham Centre for CCS
Poyry Energy Consulting
Progressive Energy
Rhead Group
Sasol
Schlumberger
Scottish Carbon Capture & Storage
Scottish Enterprise
Senergy
SGS United Kingdom
Shell
Siemens
Statoil
Tees Valley Unlimited
UK CCS Research Centre
Vattenfall
Zurich

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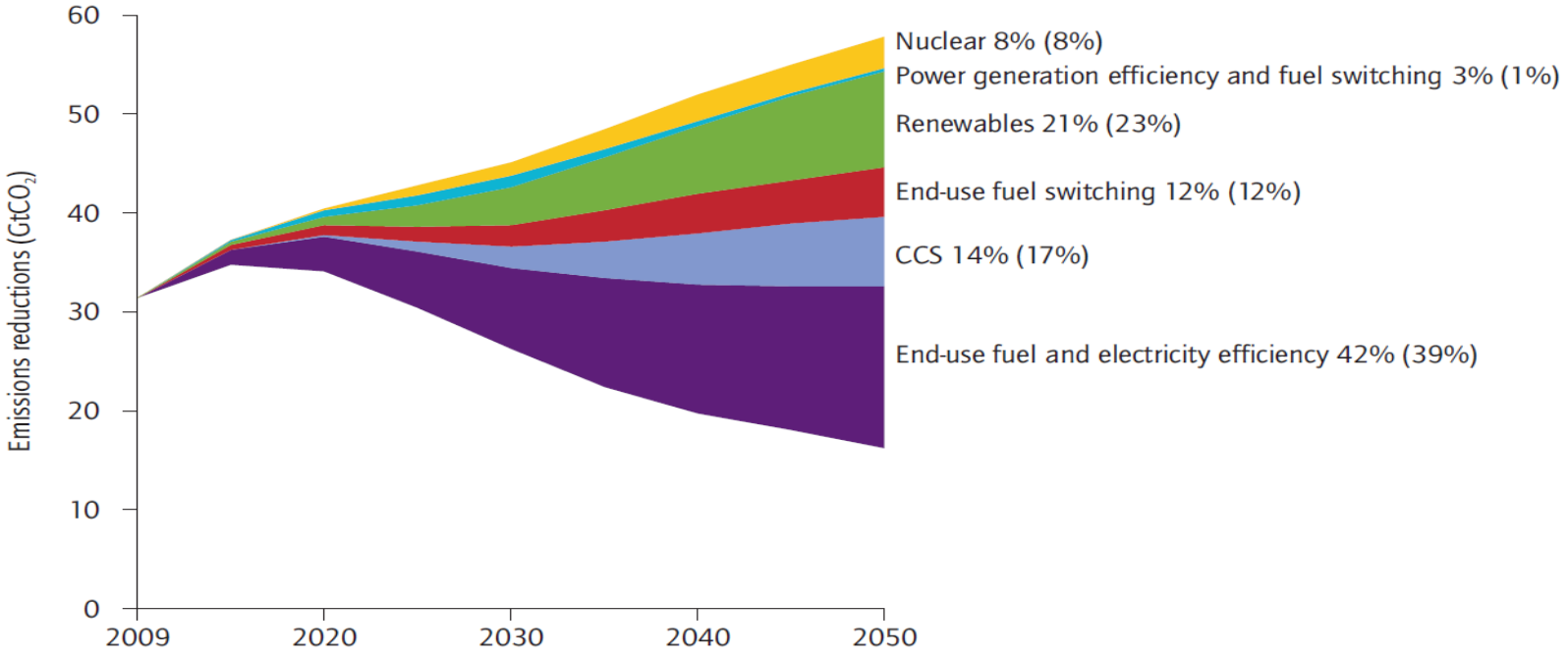
2. Importance of CCS



Source: IEA Energy Technology Perspectives 2012

IEA Conclusions:

- Attempting to address emissions without CCS raises costs by 40% (a total extra cost of $2 trillion over 40 years)
- Milestones: 30 projects by 2020 & 120Gt of CO2 stored by 2050

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Current Global Status of CCS

- 60 large-scale integrated CCS projects globally
- **12 projects currently in operation**

(US, EU, Canada, Africa)

- **9 projects in construction**
- **First 2 projects in power sector starting this year**
  - Boundary Dam (Canada)
  - Kemper County (US)
- **Majority of projects using CO2 for EOR**
- **Majority capturing from industrial applications**

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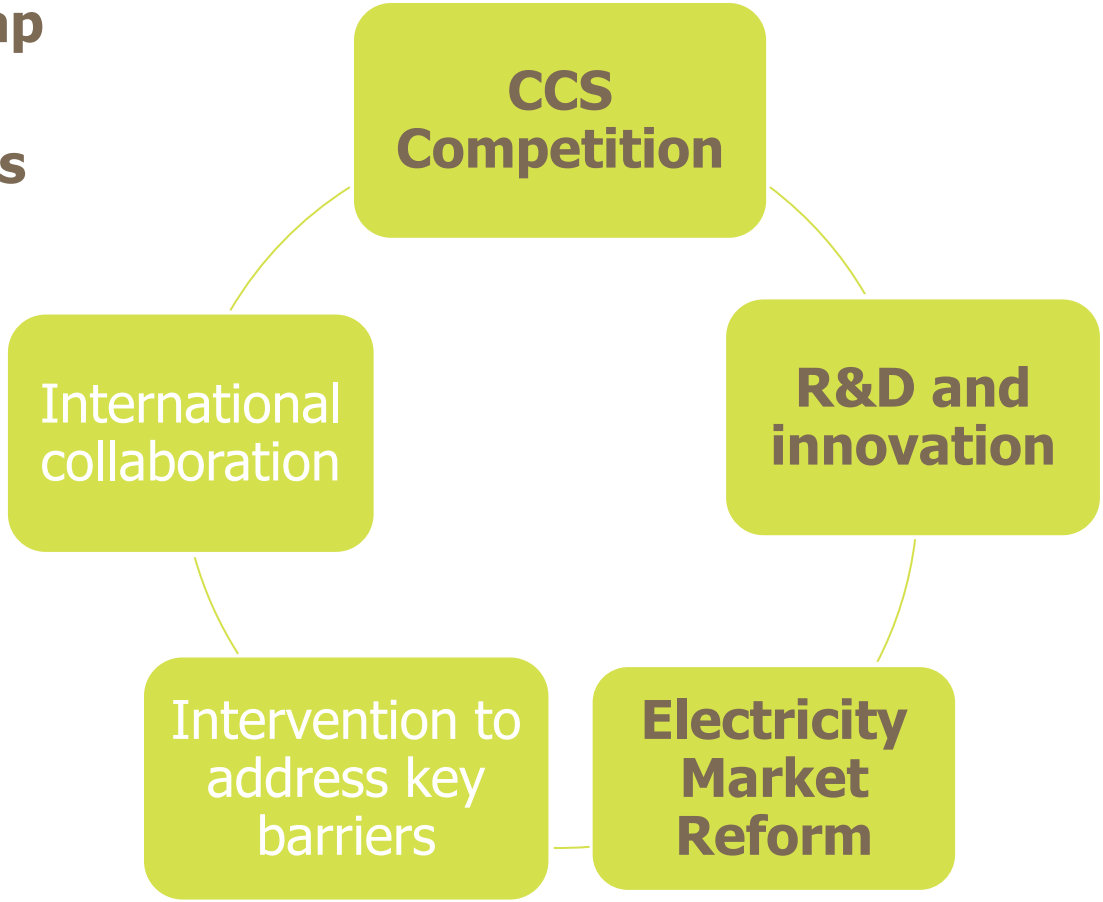
3. Status of CCS in the UK

CCS Roadmap – 5 key interventions



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CCS Commercialisation Programme (Competition)

"As a result of the intervention, private sector electricity companies can take investment decisions to build CCS equipped fossil fuel power stations, in the early 2020s, without Government capital subsidy, at an agreed CfD strike price that is competitive with the strike prices for other low carbon generation technologies"

- Launched April 2012
- £1 billion capital support and funding under EMR (FiT CfDs)
- Bids submitted July 2012 and by end Oct. four projects were selected for further negotiations
- Two preferred bidders now taken forward to Front End Engineering Studies (FEED)
  - White Rose
  - Peterhead

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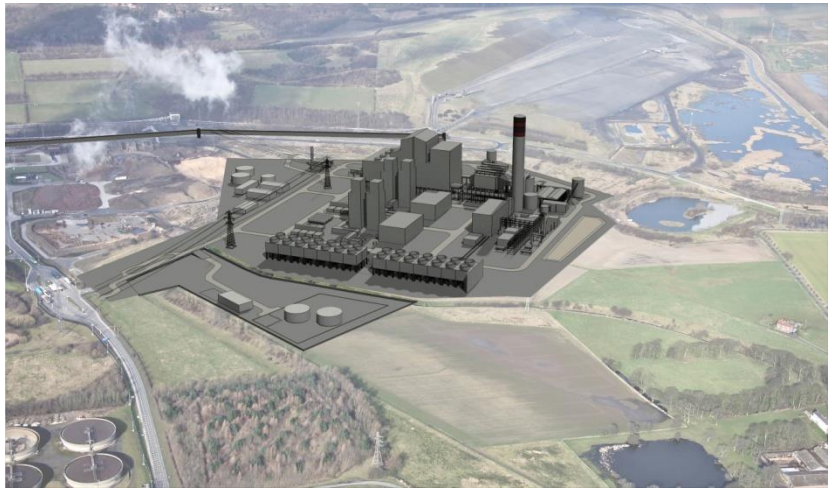
The White Rose Project

- Drax, North Yorkshire, England
- 304MW oxy-fuel project
- Alstom, Drax, BOC, National Grid
- FEED contract signed 20 Dec 2013
- FID in 2015/2016
- Design work on a larger capacity 24 inch "Yorkshire/Humber CCS Trunkline"
  - Birth of Yorkshire CCS cluster



WHITE ROSE CARBON CAPTURE & STORAGE PROJECT

http://www.whiteroseccs.co.uk/

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The Peterhead Project

- Peterhead, Scotland
- 340MW Post-combustion capture plant retrofitted to existing CCGT
- Shell and SSE
- Storage offshore in depleted gas field – Goldeneye
- FEED signed 20 Mar 2014
- First gas-CCS project in the world!

http://www.shell.co.uk/gbr/environment-society/environment-tpkg/peterhead-ccs-project.html

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Non-Competition Projects

Don Valley Project	• 2CO Power • Yorkshire • 920 MW IGCC
Captain Clean Energy Project	• CO2DeepStore/Summit • Port of Grangemouth, Scotland • 750MW IGCC
Teesside Project	• Progressive Energy • 450MW IGCC

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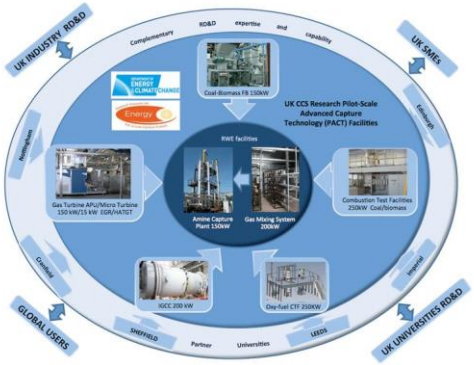
4. CCS R&D

£125m 4-year CCS R&D programme

- £62m for fundamental research → UKCCS RESEARCH CENTRE
- £28million to support development and demonstration of CCS components and next generation technologies – e.g. PACT
- £35m for pilot scale projects
- Further £60 million announced in Budget 2014



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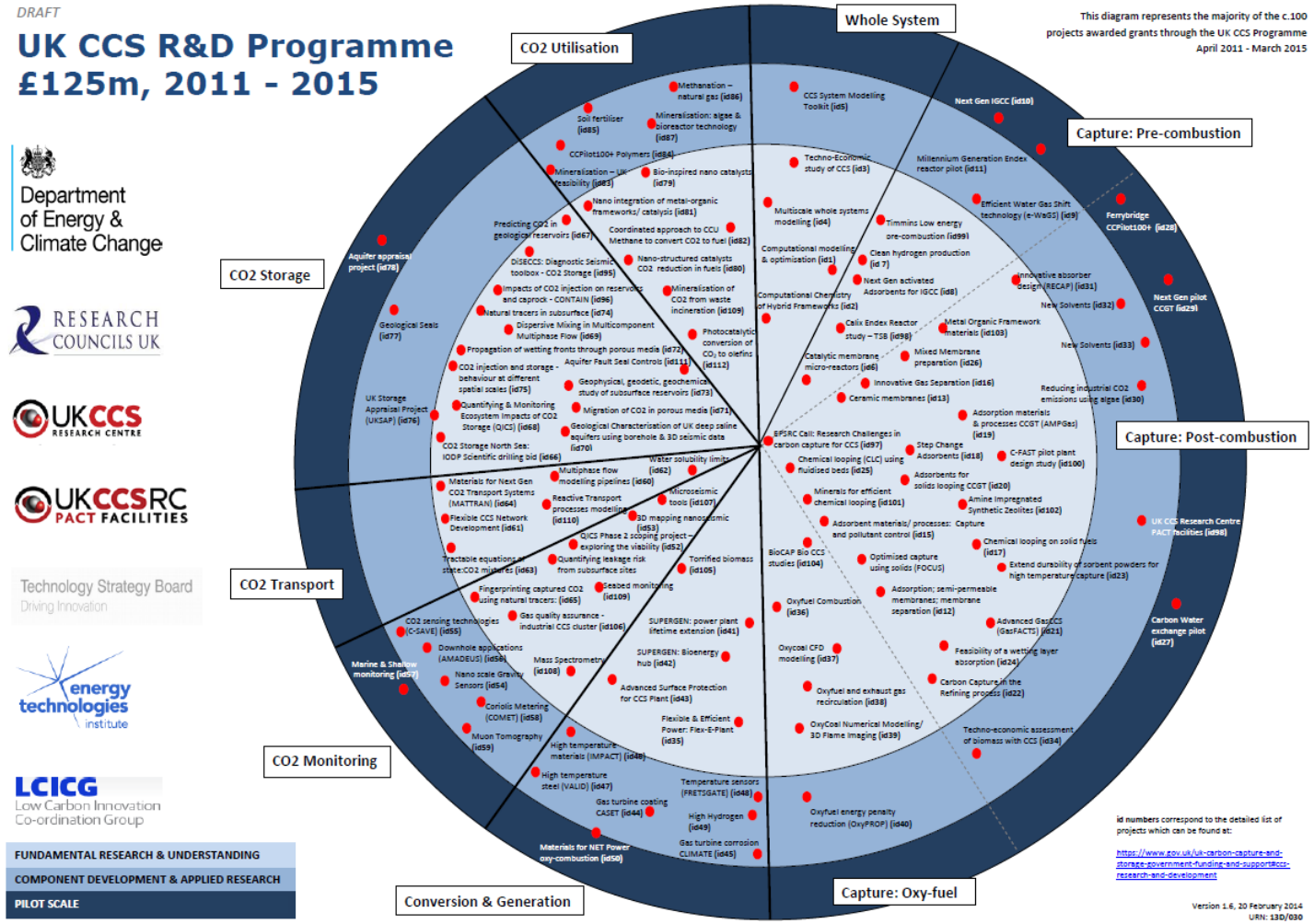
CCS R&D Projects



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5. Electricity Market Reform

- **EMR White Paper: published July 2011**
- **Aim: to secure "*the investment needed to deliver a reliable diverse low carbon technology mix*"**
  - Based on the 3 pillars of climate change, security of supply & affordability
- **Support for all low-carbon technologies (CCS, nuclear & renewables)**
- **Technology neutrality – not now, but by mid-late 2020s and beyond**
- **Primary legislation to implement EMR – Energy Act (end 2013)**
- **Secondary legislation by the Summer (consultations ongoing)**

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EMR Structure

Feed-in Tariff with Contract for Difference (CfD)

- Long term contracts which provide revenue certainty to investors in low carbon generation
- World's first mechanism to incentivise CCS beyond demonstrations (opex)

Carbon Floor Price

- £30/tCO_2 (2020)
- £70/tCO_2 (2030)
- Price freeze announced in Budget 2014 (£18/t up to 2020)

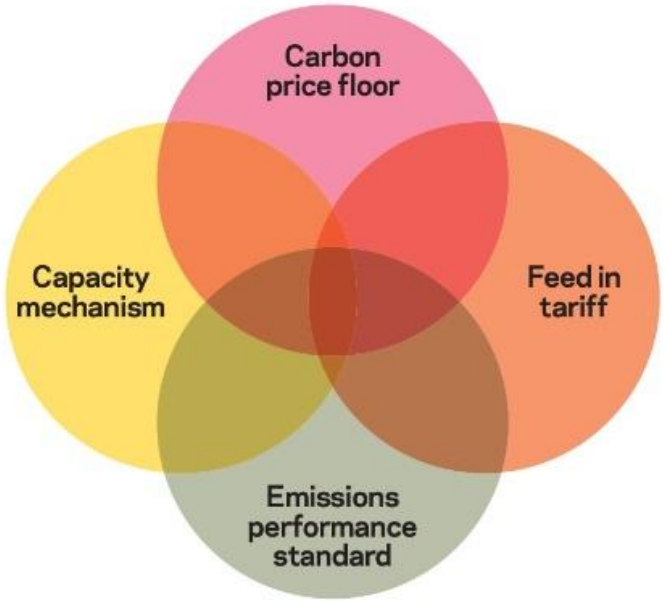
Emissions Performance Standard (EPS)

- Set at 450g CO_2/kWh at baseload
- Grandfathered until 2045

Capacity Mechanism

- Not applicable to CCS projects

Figure 2: Electricity Market Reform key pricing structure elements



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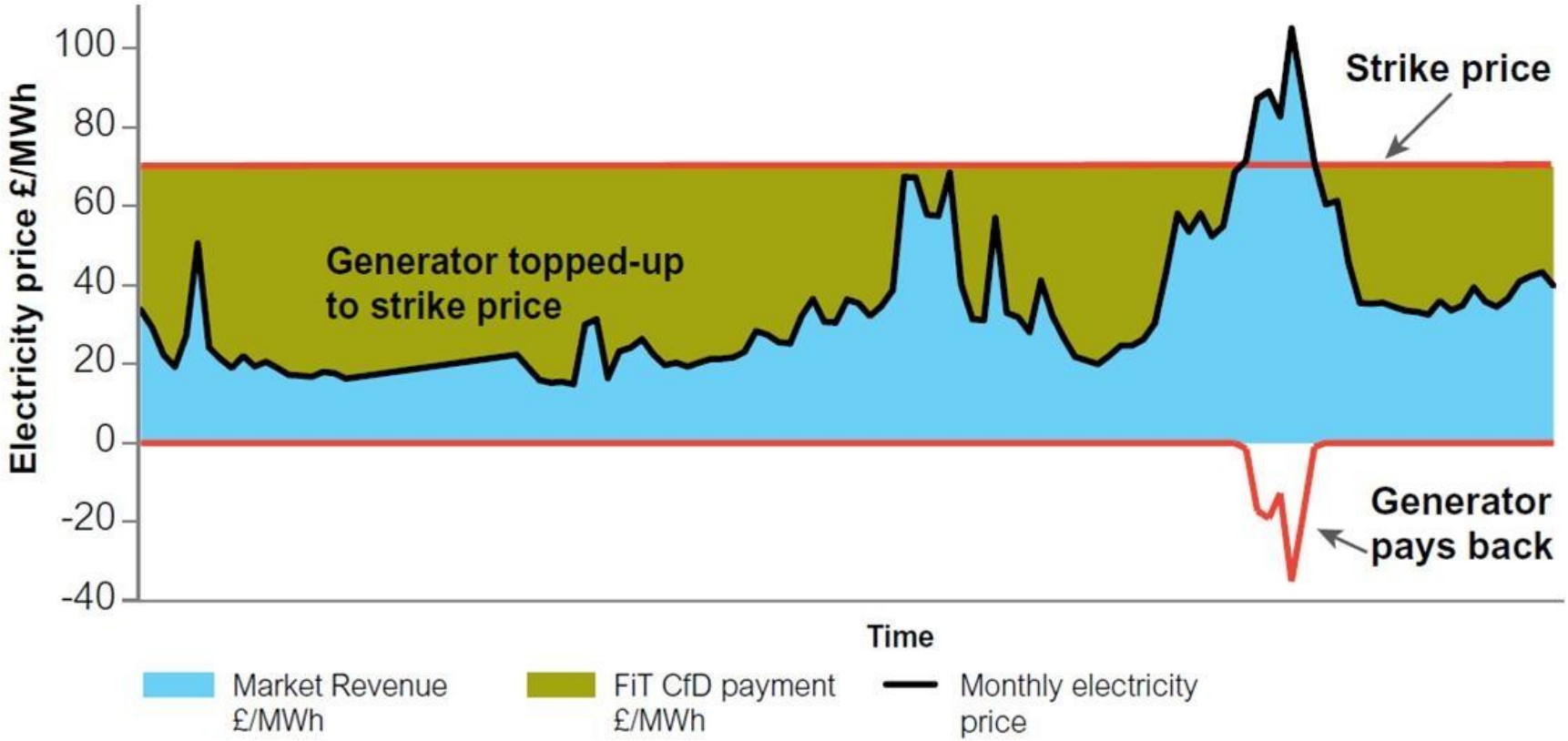
Feed in Tariff Contract for difference (FiT CfD)



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6. Wider CCS Issues - Industrial CCS

- **Many sectors:** Steel, cement, refining, ammonia
- **CCS is only option for decarbonising**
- **Infrastructure is vital**
- **Currently no policy framework – need an 'EMR for industry' to drive industrial CCS**
- **<u>CCS = retention of UK industrial base!</u>**

Tees Valley City Deal

- Announced 13 December 2013
- Boost process industries in Teesside
- Unlock £28m private sector investment
- Tees Valley received £1 million for a pre-FEED study into industrial CCS

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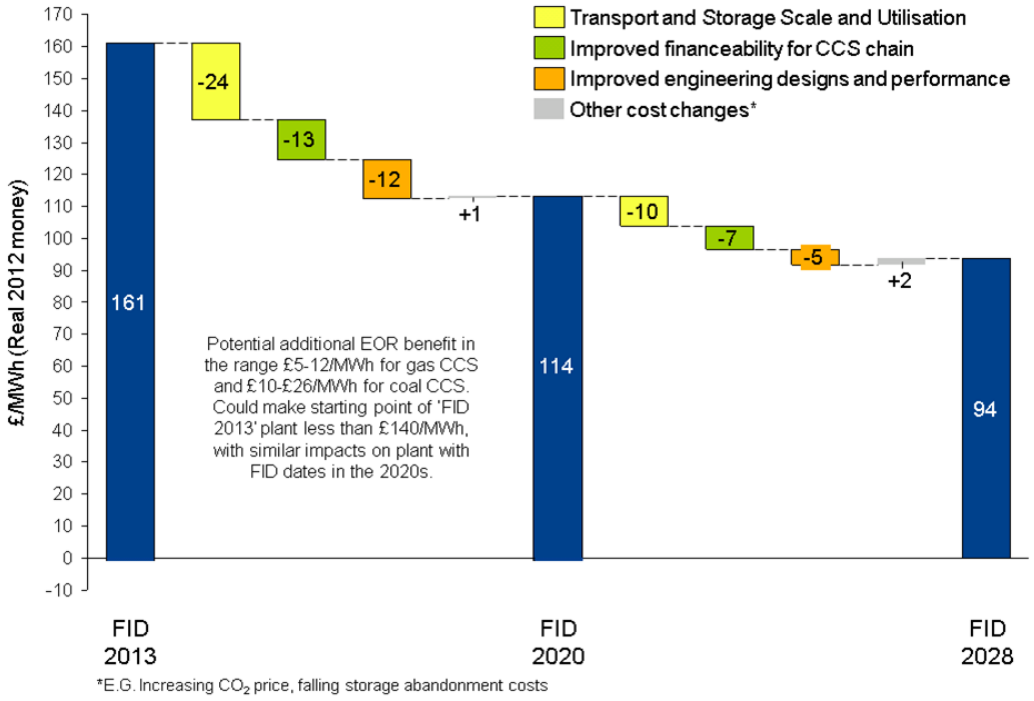
CCS Cost Reduction Task Force

"UK gas and coal power stations equipped with CCS have clear potential to be cost competitive with other forms of low-carbon power generation, delivering electricity at a levelised cost approaching £100/MWh by the early 2020s, and at a cost significantly below £100/MWh soon thereafter"



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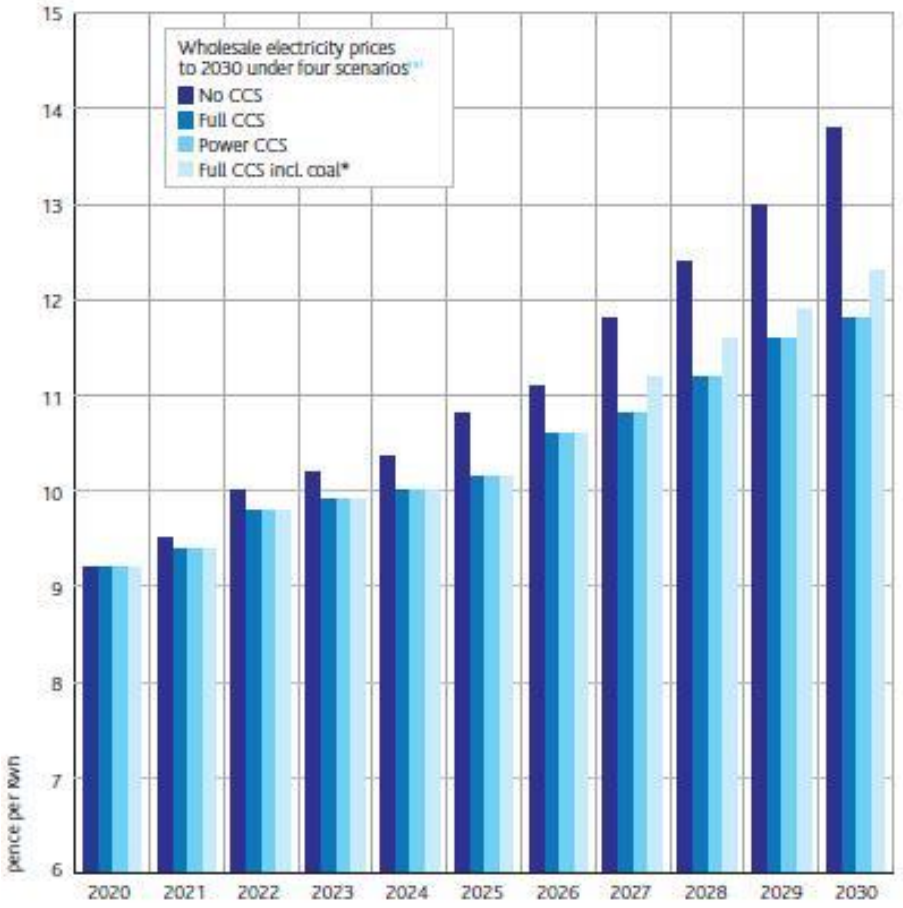
Economic Benefits of CCS in the UK

- **Joint CCSA/TUC report – published 4th February 2014**
- **Based on ETI ESME Modelling** – without CCS, costs of a low-carbon energy mix in the UK will increase by £30-40bn per year (1% of GDP!)
- **With CCS:**
  - **Wholesale electricity price reduced by 15% by 2030**
  - **Household electricity bills £82 lower per year by 2030**
  - **15,000-30,000 jobs annually by 2030**
  - **Market value of £15-£35bn**

Figure 3. Electricity prices without CCS will increasingly outstrip prices where CCS is allowed to play its part



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