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# A Current Picture of Carbon Capture and Storage

Den Gammer



# ETI technology programme areas



## ETI members



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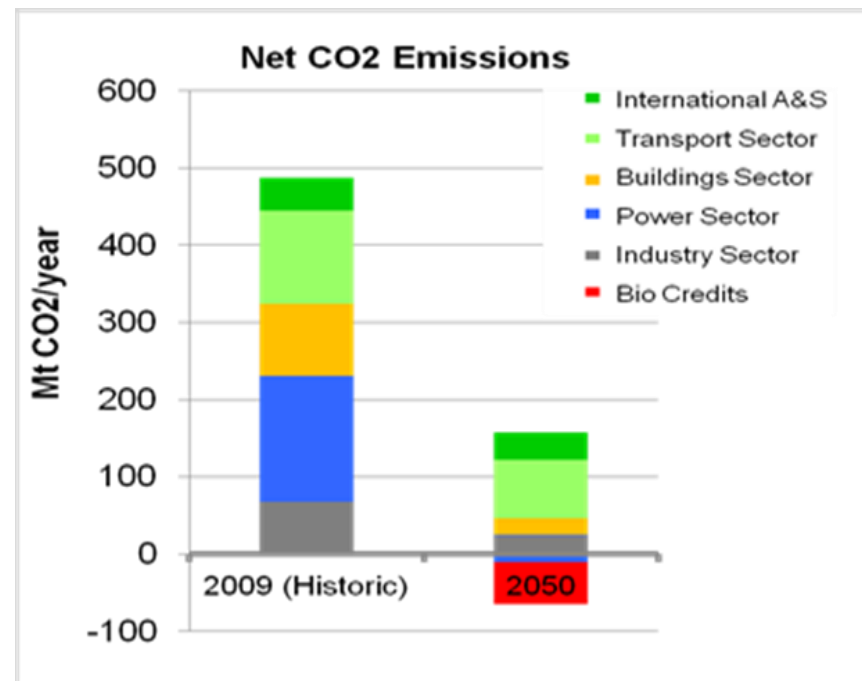
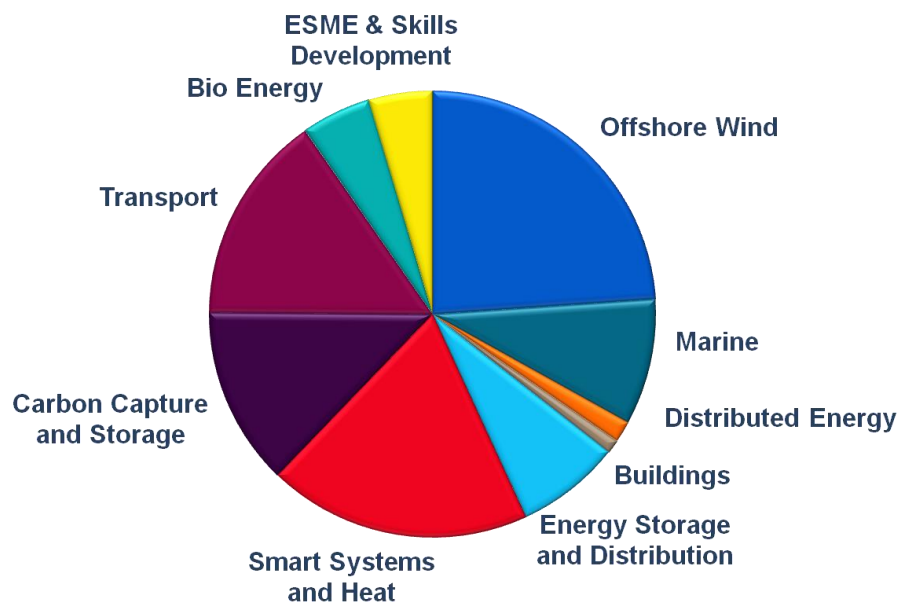
**Innovate UK**  
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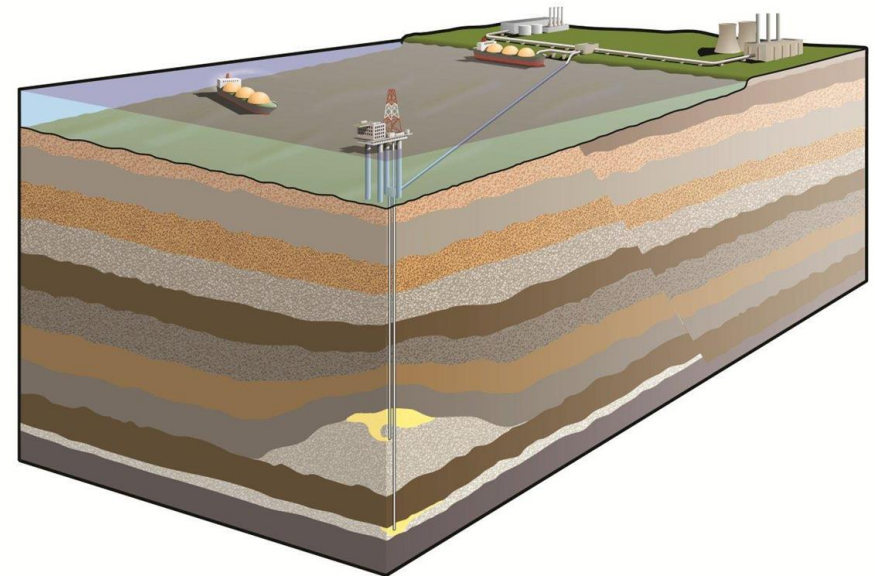
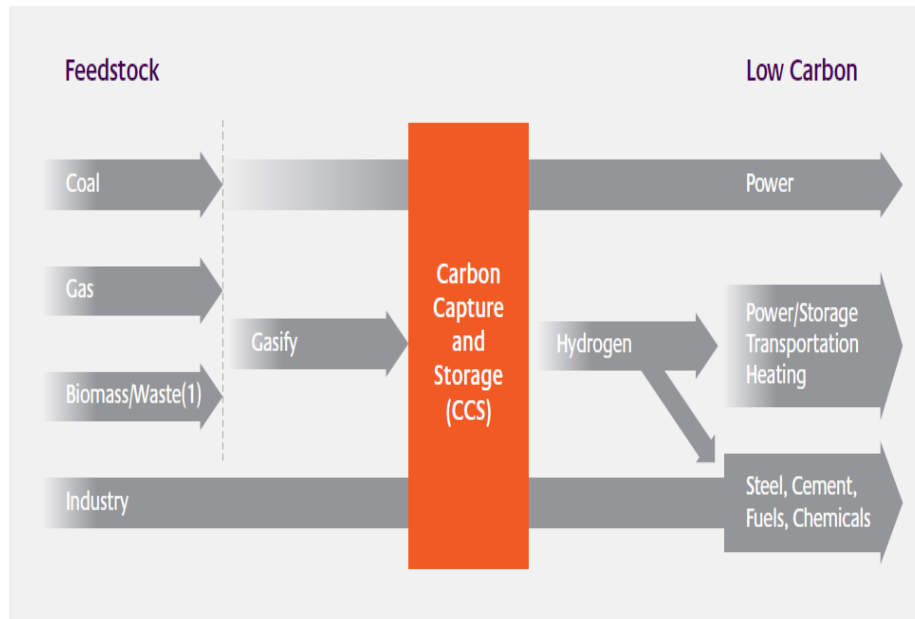


## A mix of “clean” technologies is required





## CCS is flexible



### 1. Burning Biomass and capturing CO<sub>2</sub> actually reduces atmospheric CO<sub>2</sub> levels



# CCS CO<sub>2</sub> Capture Technologies

## 13 large scale CCS operations worldwide

### Power Stations

- Coal, biomass or gas combustion, with CO<sub>2</sub> removal from flue stack by amine solvents (post combustion) - SaskPower (Canada, coal, operational)
- Coal, biomass or waste gasification, with CO<sub>2</sub> removal by solvents (pre combustion) - Kemper County (USA, coal, commissioning)

### Industry

- Natural Gas Purification, with solvents, membranes – Sleipner (Norway, operational since 1996) and many others
- H<sub>2</sub> Production, for use in fuel upgrading - Air Products (USA, operational) and Quest (Canada, commissioning)
- Steel- ADNOC/Masdar (Abu Dhabi, in construction)







# Capture Technologies in Development

**The main challenges for capture technology – high capital cost and added power use**

- Better solvents than today's amines
- Solid adsorbents for CO<sub>2</sub>
- Membranes
- Enzyme catalysed absorption
- Chemical looping
- Oxyfuel processes (no nitrogen)
- Physical separation (e.g. by cooling)
- H<sub>2</sub> cycle improvements
- New power cycles (e.g. Net Power)

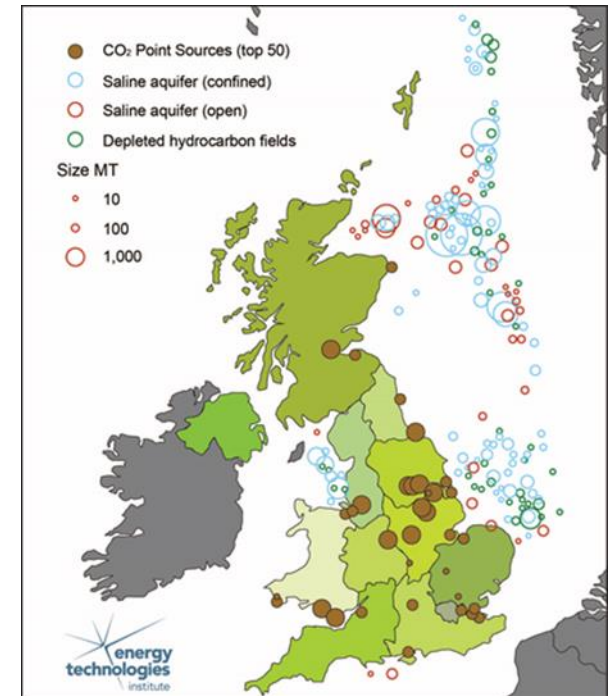


- No major breakthroughs commercialised yet. Everything still to play for at RD&D level. No scientific reason why a better solution cannot be found.
- Significant opportunities for cost reduction with existing, proven technologies to provide cost-effective low carbon electricity: cost of capture is not a barrier to initial CCS roll out.



# CO<sub>2</sub> Transportation and Storage

- Most captured CO<sub>2</sub> is used for Enhanced Oil Recovery in the USA.
- The UK has a large storage potential offshore.
- **Main challenges**
  - appraising new stores is costly, lengthy and may not result in commercialisation
  - pipelines have high economy of scale – need multiple users – planning and complex agreements
  - storage liabilities - high, especially considering risks in getting reward
- Technology required is developed from our oil and gas industry



UK Storage Development is offshore



## What's going on in the UK ?

- Large, organised RD&D - the UK CCS Research Centre
- £125m four year CCS RD&D programme (DECC, ETI, InnovateUK & Research Councils)
- Large pilot plants/demonstration units – Sheffield University (PACT), Ferrybridge Power Station (SSE), Doosan Power System at Renfrew, RWE at Aberthawe and others.
- The DECC £1Bn CCS Commercialisation competition
  1. White Rose Project - Yorkshire
  2. Peterhead Project - Aberdeenshire



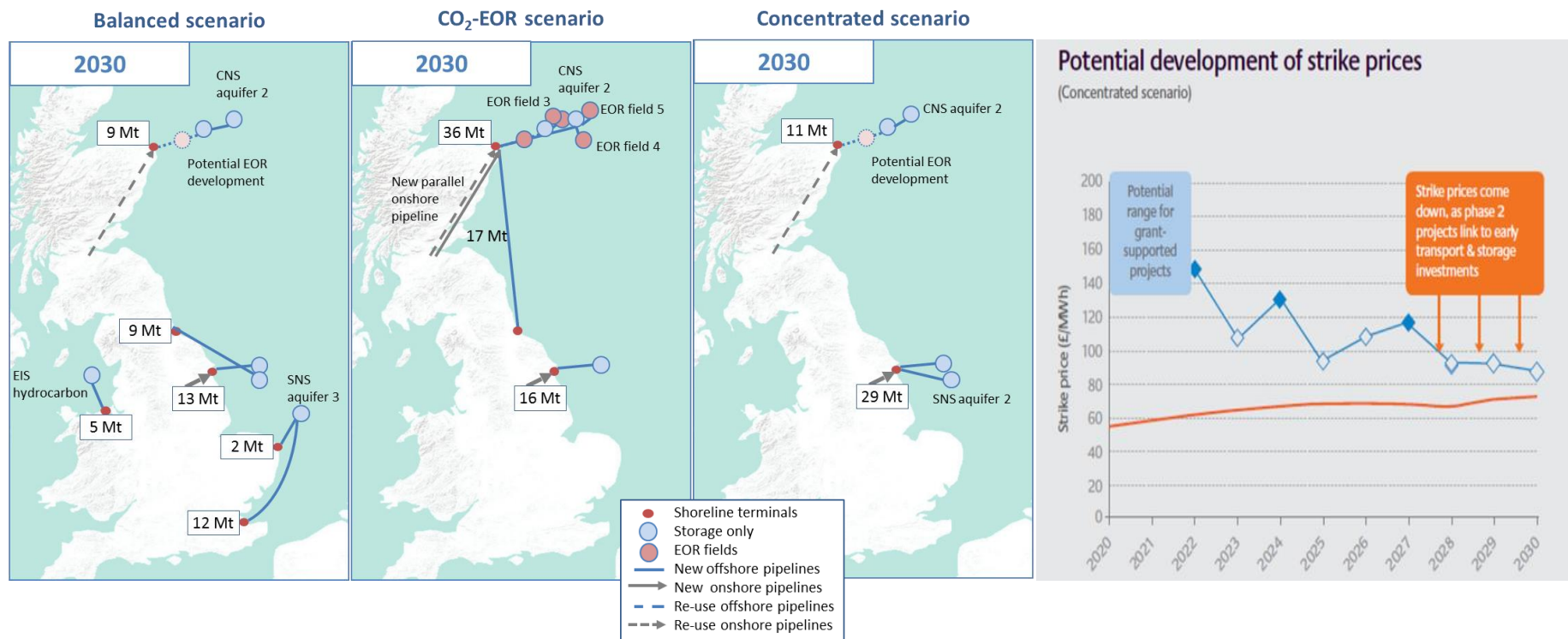
An appraisal well – National Grid / ETI (White Rose)

**Final Investment Decisions late 2015/early 2016**





# Planning - Three scenarios for CCS in 2030

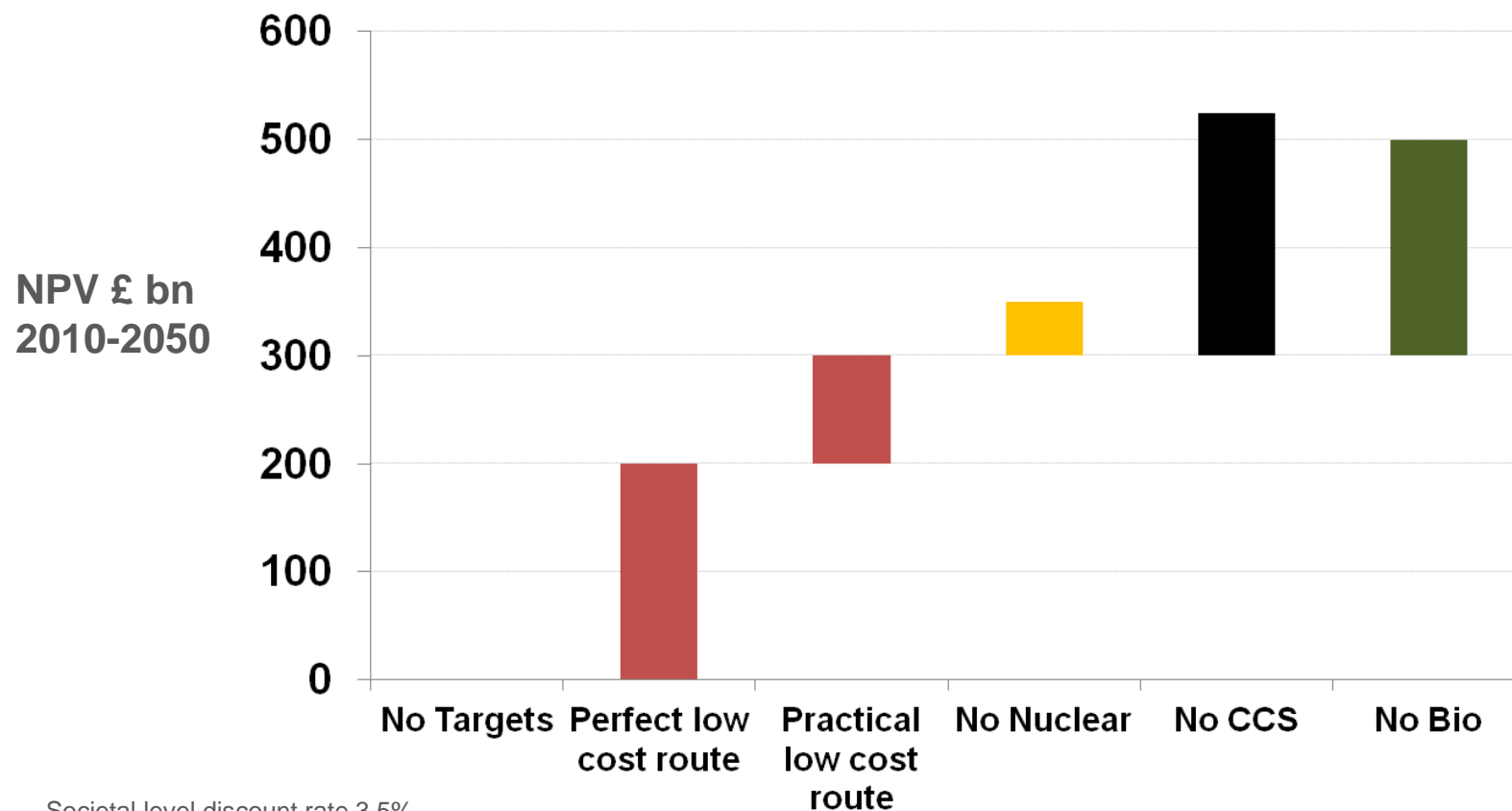


- ETI project to identify how the UK could build CCS to 10GW by 2030
- Three different scenarios
- All scenarios start with build-out from DECC CCS commercialisation projects



# Getting the UK energy system to 2050

Incremental 2010-2050 cost of delivering national energy system which meets CO<sub>2</sub> targets



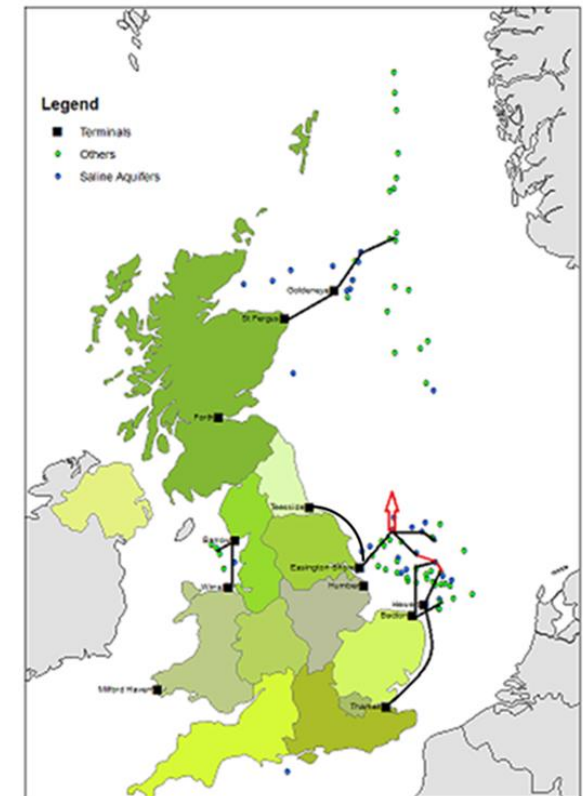
Societal level discount rate 3.5%



## Summary

- A late start, but global rollout at full scale is improving.
- CCS is the UK's most valuable technology opportunity to help it meet its climate change targets.
- UK legislation is advanced – EU Directives, Carbon Floor Price, Contracts for Difference etc.
- Very large investments - £1Bn + , with a large impact on emissions.
- Network of new infrastructure required to achieve economies of scale - planning required to optimise investments.
- 10 GW of clean power could be produced by CCS by 2030.
- Cheap extensions of infrastructure could double capacity by 2050 if required – sufficient storage is available.

...much more – technical and financial at <http://www.eti.co.uk/ETI>



A possible network by 2050



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