White Rose CCS Project

Pathways to Commercialisation

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CCSA/IEA GHG meeting
London; 9th November 2015

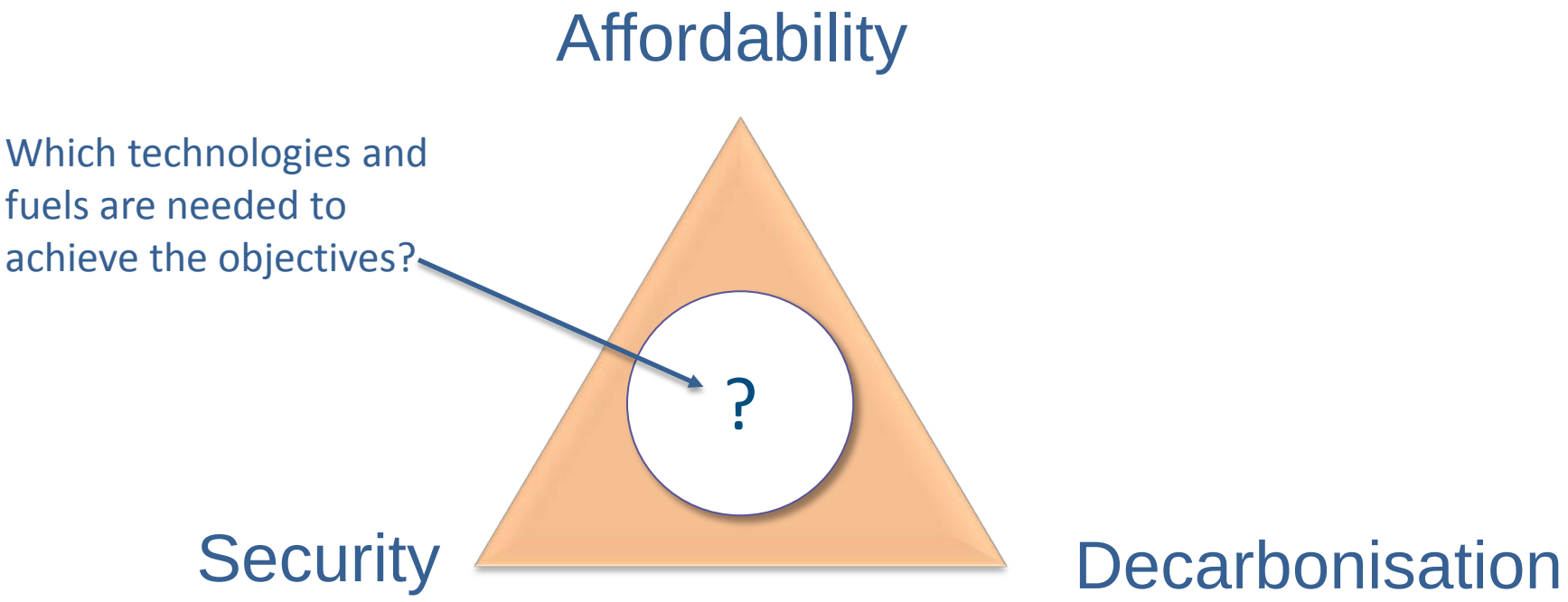
Disclaimer

Topics

- The promise of CCS
- Costs
- White Rose

The UK Energy Trilemma

How does the UK decarbonise whilst ensuring security of supply and affordability

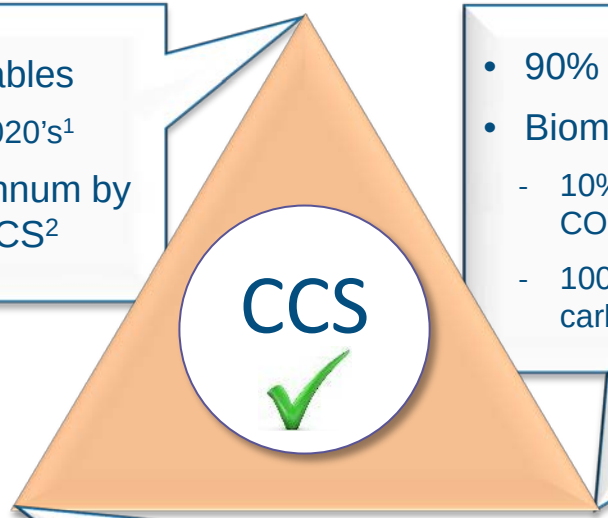


[1] UK CCS Cost Reduction Taskforce - Final Report-May 2013
[2] ETI: A perspective from the ETI's Jo Coleman and Andrew Haslett "Strategy, targets, Technologies, Infrastructure and Investments – preparing the UK for the energy transition.

The UK Energy Trilemma – The case for CCS

Affordability

- CCS can be competitive with renewables
  - Strike price £100/MWh from the mid 2020's[1]
- Savings of around 1% of GDP per annum by 2050 across UK economy vs. non-CCS[2]



- 90% CO_2 removal from fossil-fuel generation
- Biomass with CCS reduces emissions further
  - 10% biomass co-firing with coal leads to net zero CO_2 emissions
  - 100% biomass leads to negative footprint creating carbon budget headroom for the balance economy.

Security

- CCS applicable to oil, gas and coal (keeping all fossil-fuels in the mix)
  - Provides fuel options ensuring security of fuel supply (including UK gas and coal)
  - Provides a fuel price hedge
- Flexible generation, complimenting inflexible nuclear and intermittent renewables, ensuring continuity of supply and grid stability.

Decarbonisation

White Rose will demonstrate CCS as the low-cost route to decarbonisation

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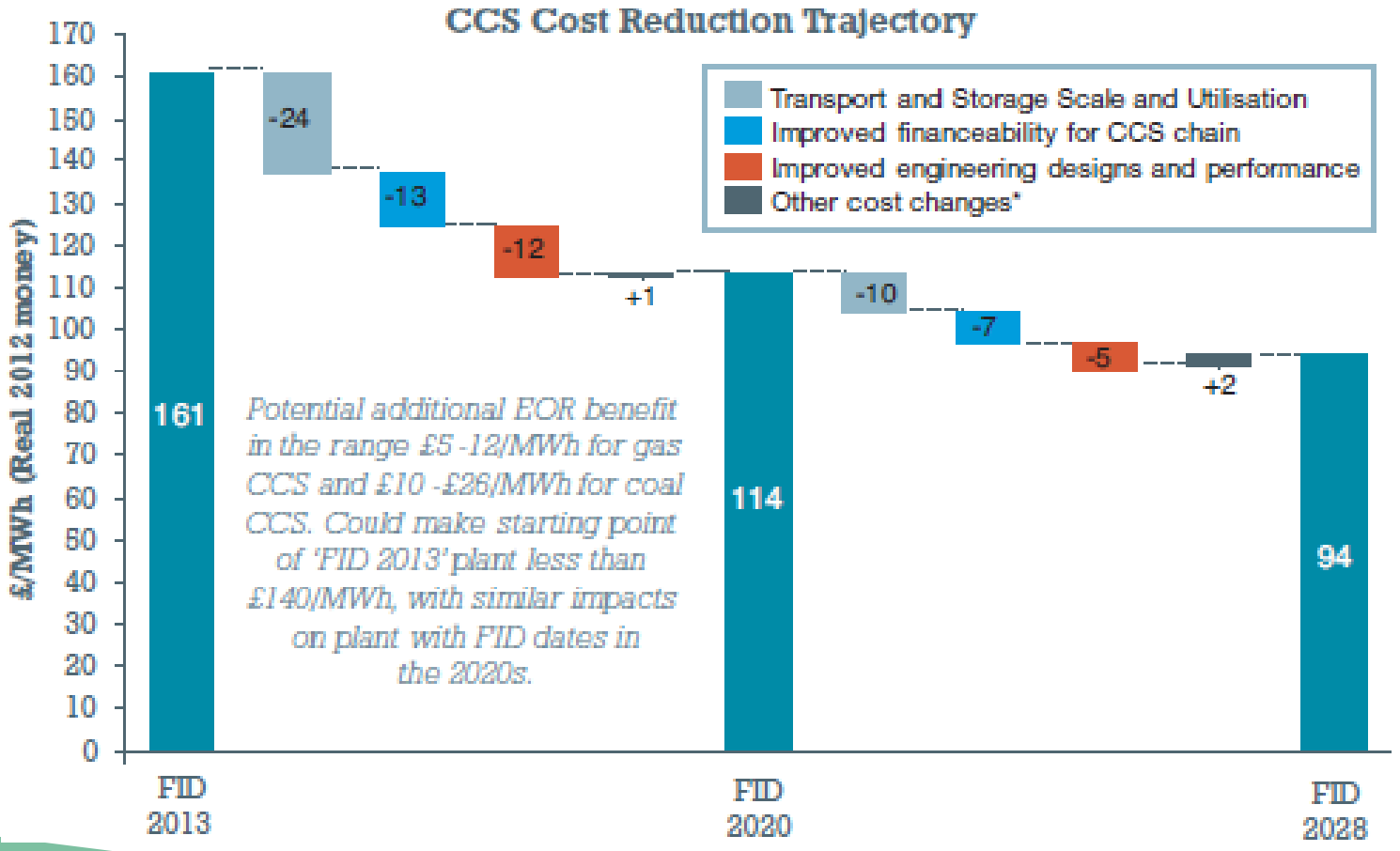
Costs of Delivering CCS

CCS "has the potential to be cost competitive with other forms of low carbon power generation by 2020s" ***CCS Cost Reduction Task Force***



1 UK CCS Cost Reduction Taskforce - Final Report-May 2013

White Rose CCS - Project Overview

- A new state of the art Oxy-Power Plant, up to 448 MWe (gross)
- Located Drax, North Yorkshire providing >300 MWe clean power
- 100% of flue-gas treated, 90% CO_2 capture rate → 2 MTPA
- Biomass co-firing leading to zero - or near zero- CO_2 emissions

- CO_2 transported c.a. 100 miles by pipeline to off-shore storage
- CO_2 to be permanently stored in a deep saline formation

Project Objectives

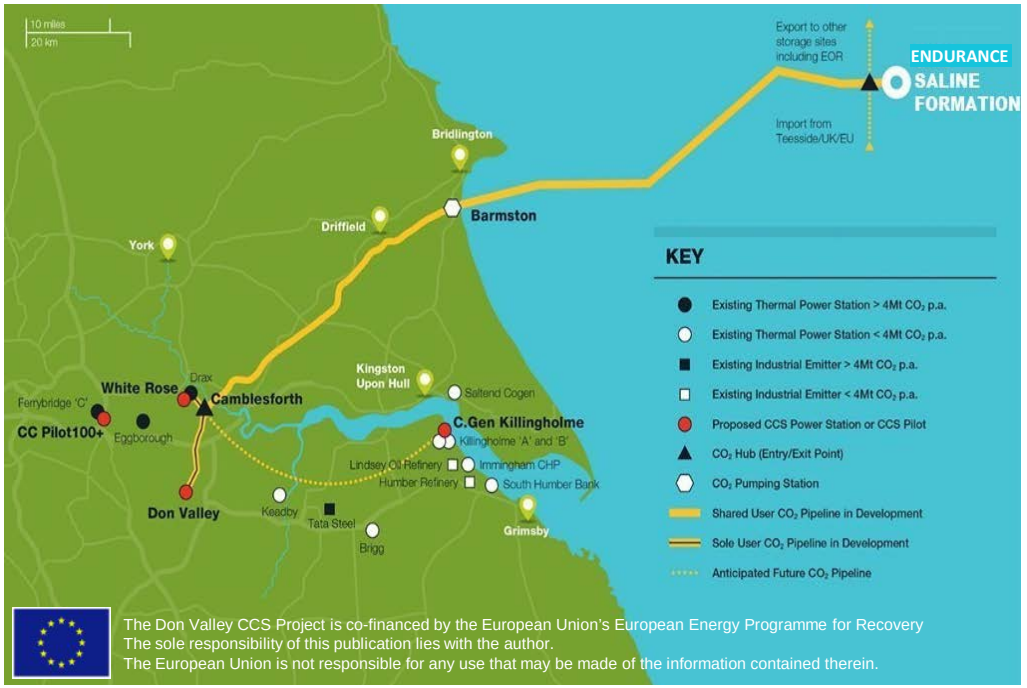
- To demonstrate Oxy-combustion CCS technology as a reliable, flexible, and competitively priced low-carbon technology
- To help reduce CO_2 emissions in order to meet future environmental legislation and to combat climate change
- To improve the UK's security of electricity supply by providing a coal-based low-carbon electricity generation option
- To generate enough low carbon electricity to meet the energy needs of more than 630,000 homes
- To act as an anchor project for the development of a CO_2 transportation and storage network in the UK's most energy intensive region

Cost competitive & deliverable project to establish commercial future of CCS

Full Chain Commercial Scale CCS Project

- Anchor project for regional T&S infrastructure
- Supports follow-on projects for regional cluster
  - Infrastructure sized / enabled for up to 17 MTPA of CO_2
  - White Rose capacity c. 2 MTPA
  - Saline formation store “Endurance”

The Humber Cluster connects one of the largest concentration of CO_2 emissions in Europe with a very large, proximate and available store in the Southern North Sea



Right sizing from start supported by UK Government

White Rose will show that abated fossil-fuel power stations will be able to generate flexible, reliable and affordable power as mid-merit plants, providing security of supply and grid stability complementing base load nuclear generation and intermittent renewables

White Rose CCS – the 'Flag Carrier' for oxy fuel technology

Artist impression – courtesy of Arup Associates

THANK YOU