The White Rose CCS Project:
A Pathway to Regional Decarbonisation

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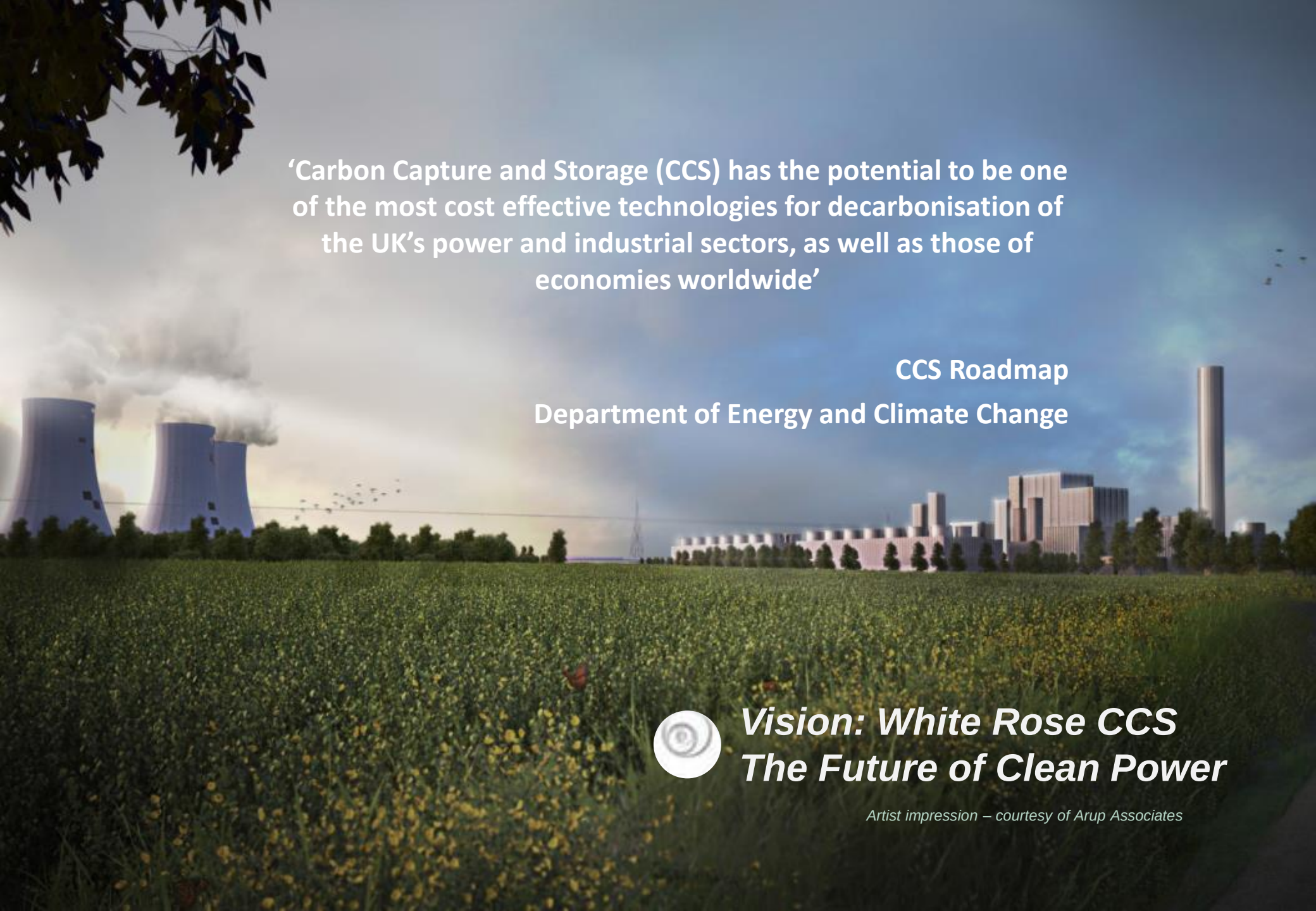
11th EC-EURACOAL COAL DIALOGUE on the future role of coal in Europe and current challenges

Brussels, 08th July, 2015

Disclaimer

Topics

- Project Overview & Update
- UK CCS - Pathway to Regional Decarbonisation



‘Carbon Capture and Storage (CCS) has the potential to be one of the most cost effective technologies for decarbonisation of the UK’s power and industrial sectors, as well as those of economies worldwide’

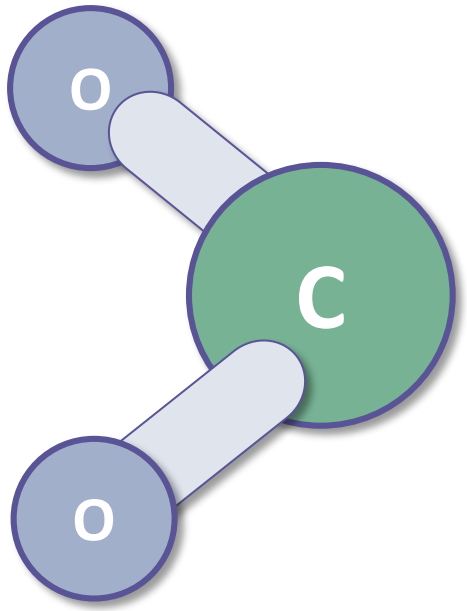
CCS Roadmap

Department of Energy and Climate Change

Vision: White Rose CCS
The Future of Clean Power

Artist impression – courtesy of Arup Associates

Carbon Capture Storage (CCS) Snapshot



- CCS = collection of CO_2 emissions from plants, transportation via pipeline and permanent storage underground
- Capture of emissions from power and industrial facilities
- Main technologies for power CCS: pre-combustion, post combustion and oxy-fuel
- Storage techniques used for several decades for enhanced oil recovery (EOR)
- 27 million t/d of CO_2 are currently being captured and stored around the world

State of the Nation – CCS Deployment

- 22 large-scale CCS projects in operation or construction globally.
  - Capacity to capture up to 40 mill. tpa of CO_2 eq. 8 million cars off the road.
- 14 large-scale CCS projects in advanced planning stages
  - 9 in the power sector, many of which are anticipated to take a FID in 2014/15.
- 1st large-scale CCS project in the power sector went live at Boundary Dam in Canada on 2nd October, 2014
- Abu Dhabi CCS Project in the UAE (expected to come online in 2016) will be the world's first large-scale CCS project in the iron and steel sector
- The next two large-scale CCS projects in the power sector are planned to come online in the US:
  - Southern Company's Kemper County Energy Facility in Mississippi (2016), and the Petra Nova Carbon Capture Project in Texas (2016)
- The US, Canada and China leading the world in the development and deployment of CCS projects
  - Recent US-China emissions agreement likely a catalyst for accelerated CCS deployment.
- The UK is at the vanguard of CCS commercialisation in Europe

(source: GCCSI)

CCS Drivers

Intergovernmental Panel on Climate Change 5th Assessment Report (2013):

"It is *extremely likely* [**>95% certainty**] that human influence has been the dominant cause of the observed [climate] warming since the mid-20th century"[1]

- IPCC recommends reduction of global CO_2 emissions by 50 – 85% by 2050
- IEA recommends CCS contributes to 14% of cumulative CO_2 emissions reduction to 2050
- UK 2008 Climate Change Act – legally binding CO_2 targets (80% cut in CO_2 emission level by 2050)
- ETI indicate cost of reducing CO_2 emission level without CCS in UK would equate to 1% GDP (£30 - £40Bn/yr)

1 IPCC 5th Assessment Report: Summary for Policymakers
2 IEA Technology Roadmap CCS 2013

White Rose CCS - Project Snapshot

- A full-chain integrated CCS project incorporating a new ultrasupercritical Oxy Power Plant, up to 448 MWe (gross)
- Located Drax, North Yorkshire providing >300 MWe clean power, equivalent to the needs of 630,000 homes
- 100% of flue-gas treated, 90% CO_2 capture rate → 2 MTPA
- Biomass co-firing leading to net 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

Images from DECC publication

Delivery Plan

OXY-POWER PLANT (OPP)

CAPTURE POWER

- Full-Chain Integration

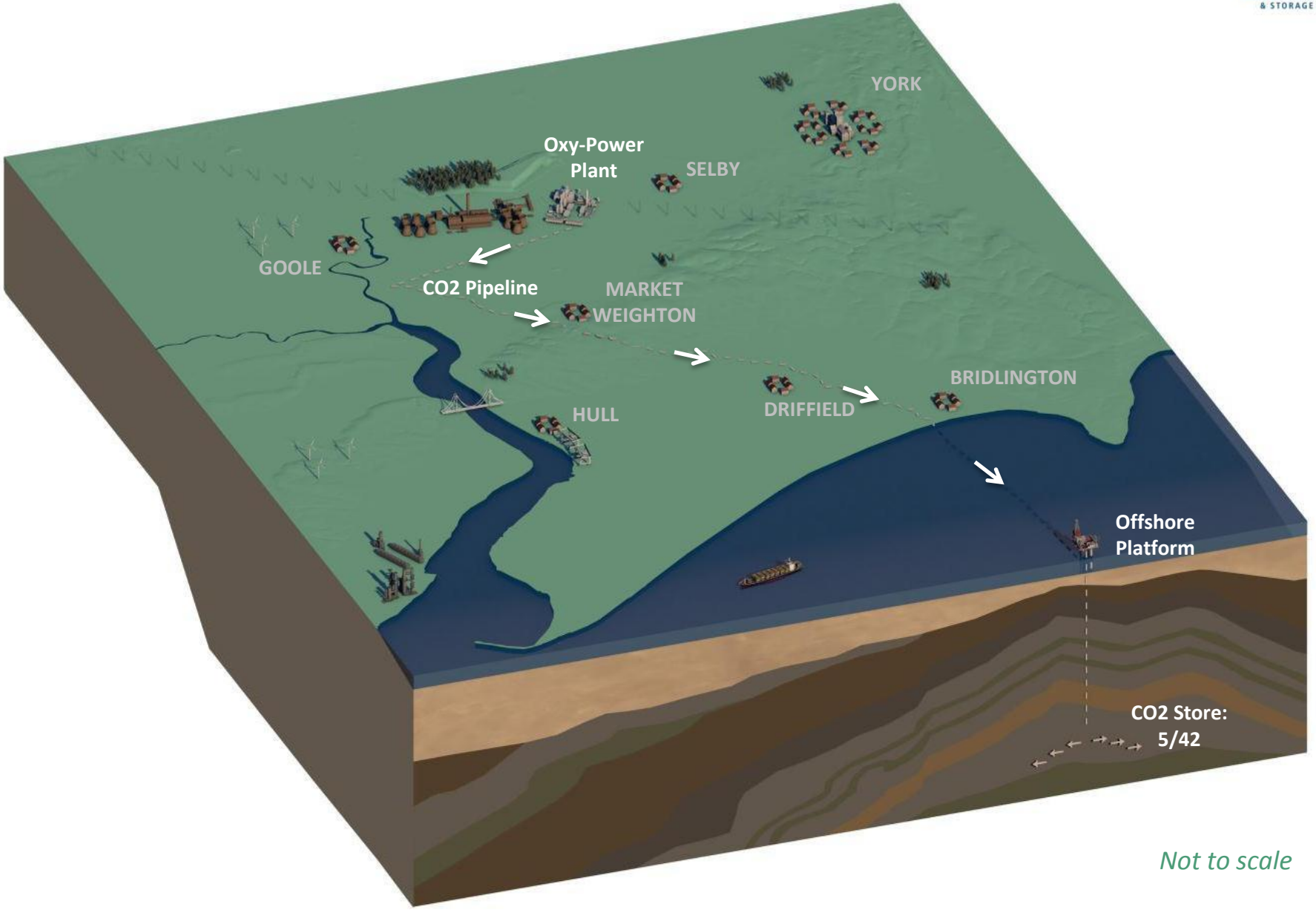
- ALSTOM
  - Delivery of OPP
  - Integration of OPP
- drax
  - O&M of OPP
  - Trading Services
  - Site and Site Services
  - Fuel Supply
  - Electrical Connection
- BOC A Member of The Linde Group
  - Delivery of ASU
  - O&M of ASU

CO_2 TRANSPORT & STORAGE

nationalgrid Carbon Ltd

- Delivery of Transport & Storage network
- O&M of Transport & Storage network

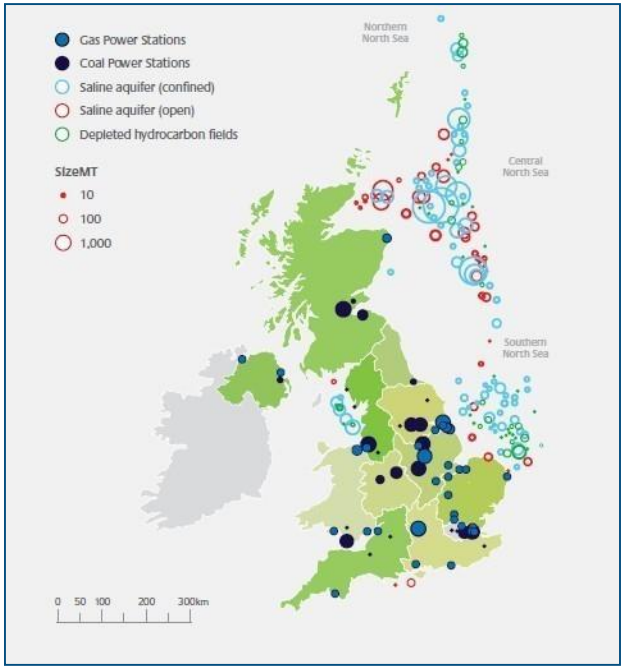
Full-Chain CCS Project

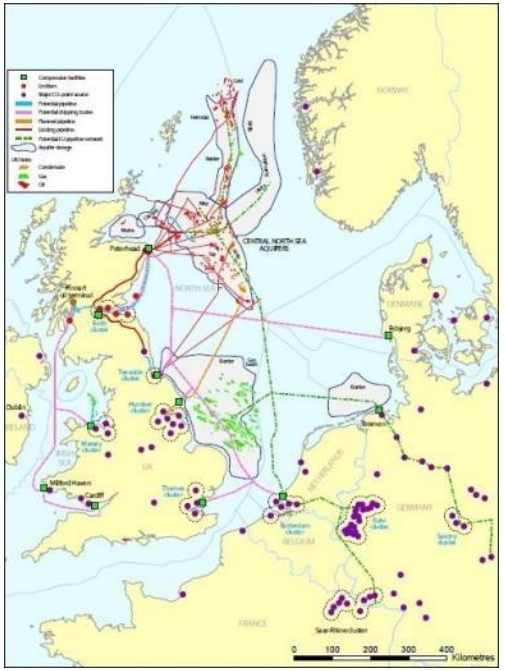


Not to scale

UK CCS Build Out Potential

- UK has tremendous storage potential in the Northern, Central and Southern North Sea as well as the East Irish Sea
- According to ETI, the country has potential storage of 78 G tonnes, well in excess of required storage of 3 G tonnes for the UK industry by 2050
- Transport networks to be planned for current and future CCS





Maps source: 1 Energy Technologies Institute Insights Report, carbon capture and storage potential for CCS in the UK
2 SCCS Unlocking North Sea CO_2 Storage for Europe, Practical actions for the next five years SCCS Recommendations and Conference Report 2013

Project Status

- Preferred Bidder in the UK's £1Billion CCS Commercialisation Programme
- FEED Contract awarded - signed by the UK Government on 20th December, 2013
- FEED underway: detailed engineering, risk reduction and planning programme leading to financial close, FID and construction commencement.
- Planning Process on track:
  - Power Plant Development Consent Order (DCO) planning application accepted by UK Planning Inspectorate in December, 2014;
  - DCO application for CCS pipeline by National Grid accepted July, 2014
- Continuing work with the UK Government (DECC) towards Project Contract and Contract for Difference (CfD)

Topics

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- UK CCS - Pathway to Regional Decarbonisation

CCS: Strategic importance

Security of supply

The UK needs a **diverse energy mix** (incl. coal) and **flexible generation** to support intermittent RE and baseload nuclear

Jobs and growth

Appx 3,300 jobs at WR at peak construction averaging 1,000 jobs pa.

Key role in decarbonising **Energy Intensive Industries**

Climate change

Fossil fuels still power over **80% world energy** & expected to continue so CCS has a key role to play

Path to COP21 / 2015 agreement

Affordability

Expected to be **cost competitive** in 2020s

Without CCS climate targets **£30-40bn more expensive** per year

Source slide: DECC

CCS: Strategic importance

Source slide: IEA

Path to Full Commercialisation

By 2030

- **Up to 13 GW of CCS power**
- **Levelised cost of electricity <£100/MWh**

A cost-competitive CCS industry

Full Commercialisation (*Phase 3*)

Transition Phase (*Phase 2*)

£1bn Commercialisation Programme (*Phase 1*)


White Rose CCS Project


Peterhead CCS Project

By 2050

- **CCS could provide up to 20% of the UK's energy**
- **Saving £30 bn**

Source slide: DECC

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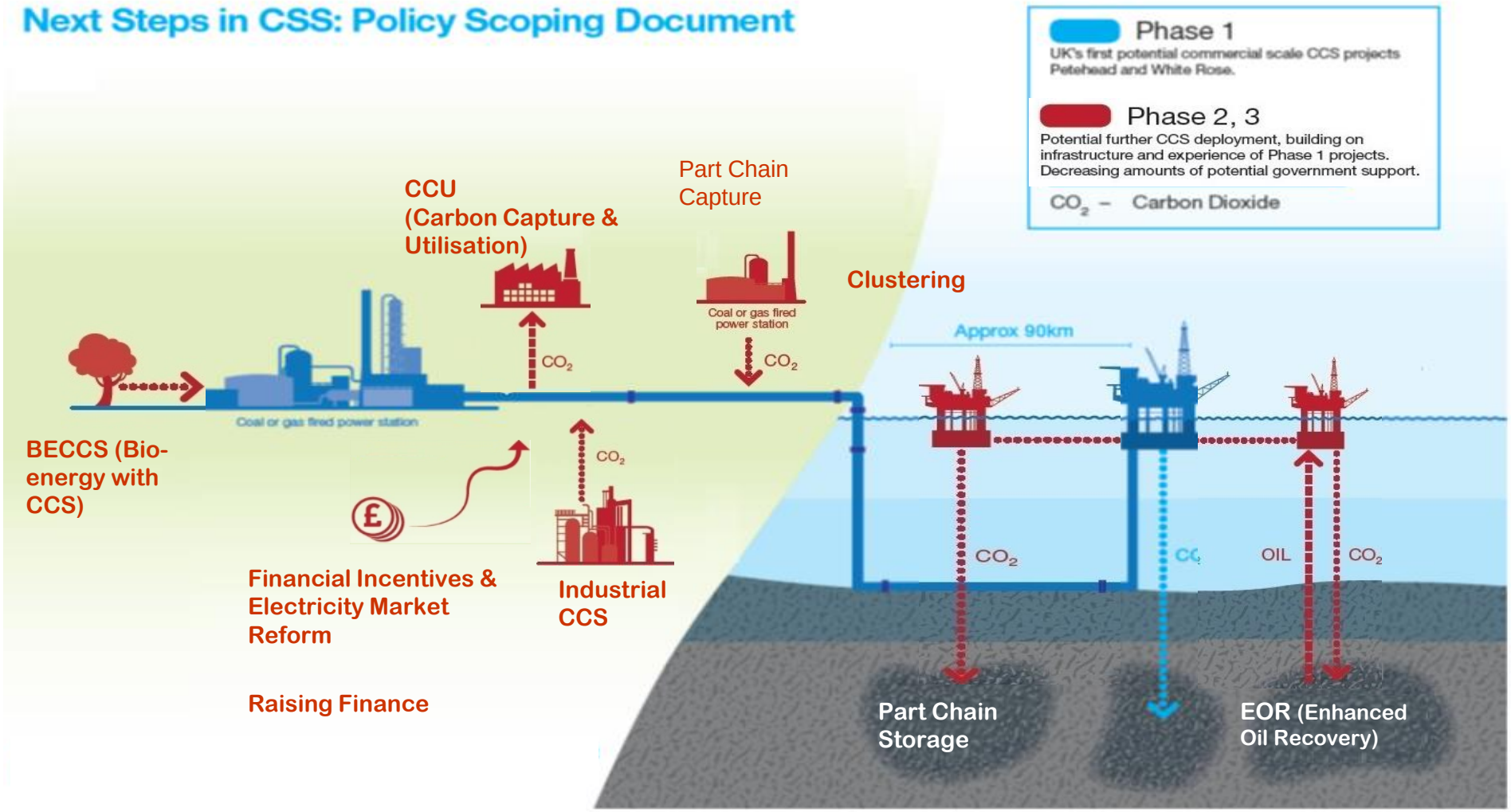
Pathway to Regional Decarbonisation



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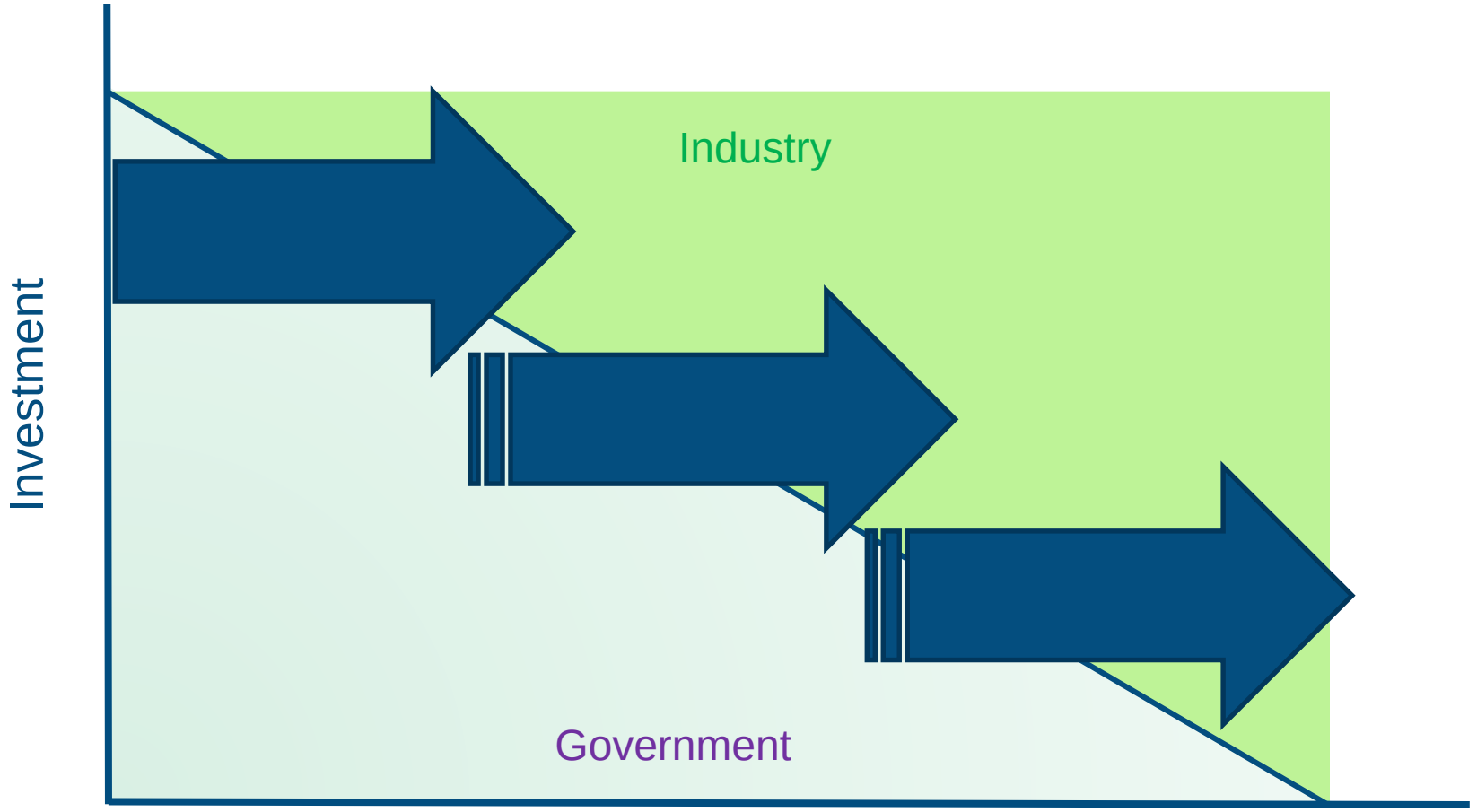
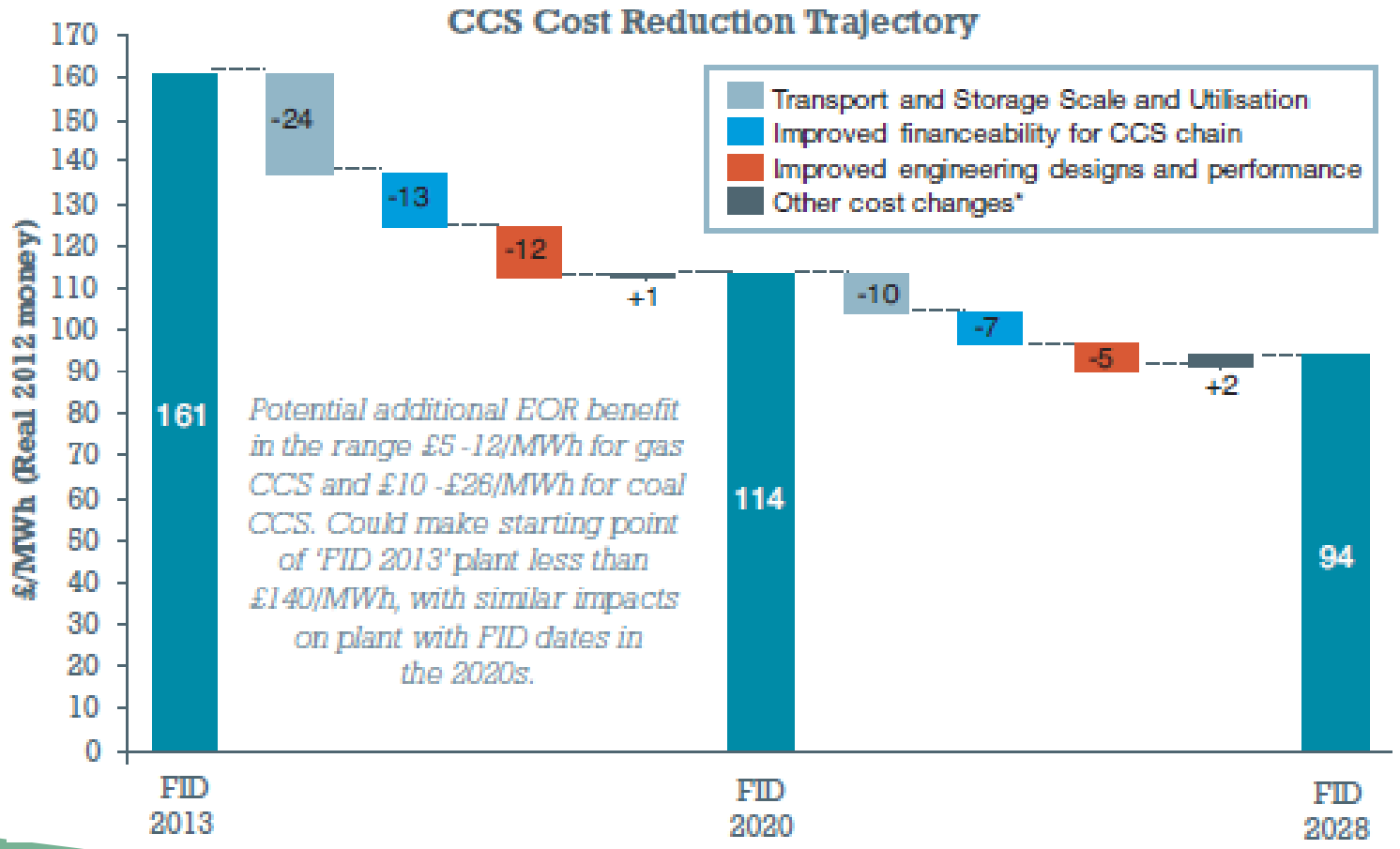
CCS: Strategic importance



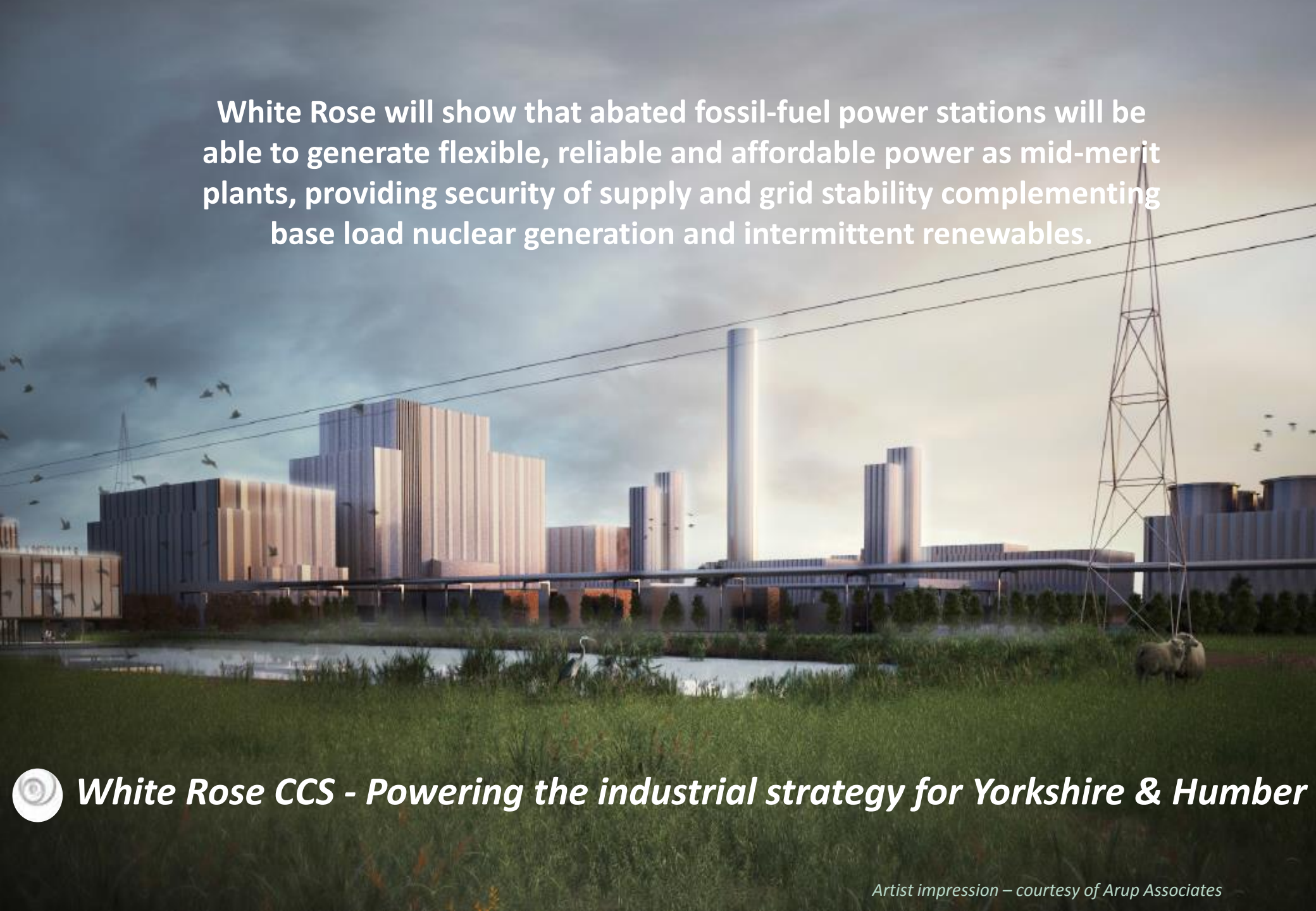
Source slide: DECC

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



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 - Powering the industrial strategy for Yorkshire & Humber

Artist impression – courtesy of Arup Associates

THANK YOU