

White Rose Carbon Capture and Storage Project

November 2013

‘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 for Energy and Climate Change

Project Snapshot

- A new modern ultra-supercritical up to 450MWe Gross Oxy Power Plant
- Clean power generation with the entire flue gas treated to capture 2 Million t/y CO₂
- CO₂ to be stored in a saline formation in the southern North Sea
- Biomass co-firing leading to zero (or negative!) CO₂ emissions
- Located at the Drax Power Station Site, Selby, North Yorkshire
- An anchor project for National Grid's regional CO₂ transport & offshore storage network
- Project development activities on-going
- NER funding application – project nominated for support by UK Government
- UK CCS Commercialisation Programme (DECC) – project is preferred bidder, negotiations on-going to finalise contract for support in 2013

Largest Oxy-combustion CCS Demonstration Project Worldwide

Our Objectives

- To demonstrate Oxy-combustion CCS technology as a reliable, flexible, and affordable low-carbon technology
- To help reduce CO₂ 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 CO₂ transportation and storage network in the UK's most energy intensive region

Project Promoters – A Strong Consortium



ALSTOM

- A global leader in the world of power generation, power transmission and rail infrastructure
- A pioneer in large-scale and efficient CCS technologies



drax

- Owner and operator of the UK's largest, cleanest, most efficient coal-fired power station; meets 7% of the UK's electricity needs
- Produces more renewable power than any other UK facility
- Committed to reducing Drax & UK power generation carbon footprint



BOC
A Member of The Linde Group

- The largest provider of industrial gases in UK
- A member of The Linde Group, a world leading gases and engineering company



nationalgrid

- An international electricity and gas company and one of the largest investor-owned energy companies in the world
- Expert in running high pressure natural gas system in a safe, reliably and efficient manner



Partner Roles

Location: Drax Power Station, Selby, North Yorkshire, UK



Project Promoters

Oxy-combustion Power Plant &
CO₂ Capture

CO₂ Transportation
& Storage

Alstom

Drax

BOC

National Grid

Why Oxy-combustion?

There are a number of different methods of accomplishing carbon capture and storage on a power station, with Oxy-combustion having a number of advantages:

- Quantities of additional gases (NO_x and SO_x) released into the atmosphere are low
- Oxy-combustion is very similar to existing air-fired operation and is developed from well-known systems and processes
- The air and gas separation units have already been developed as part of other industrial processes
- Compared to post-combustion technologies, oxy-combustion does not require large quantities of chemicals
- Oxy-combustion has the potential to be retrofitted to existing plant if sufficient land is available
- The technology has been proven through pilot projects around the world

About Oxy-combustion

The oxy-combustion system for CCS entails:

- Using oxygen mixed with recycle CO₂ instead of air for the combustion process
- This eliminates nitrogen from the system producing flue-gas consisting largely of CO₂ and water
- This flue-gas can then be further treated and compressed before being transported for storage

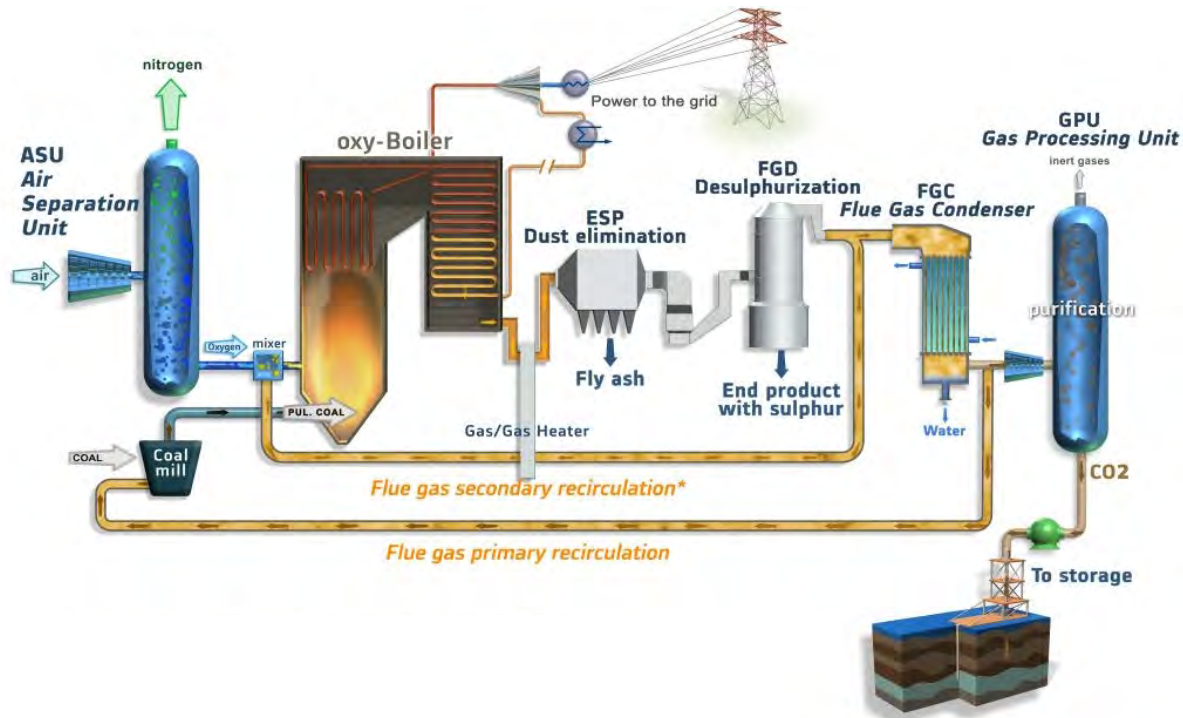
The process requires additional units to those used at conventional coal-fired power stations:

- An Air Separation Unit (ASU) which produces near pure oxygen from air; and
- A CO₂ processing unit, the Gas Processing Unit (GPU) to treat and compress the captured CO₂ to meet pipeline specification

Some modifications to the power plant are also necessary:

- CO₂ rich flue-gas is partially recycled to maintain the required temperature and heat absorption rates in the boiler
- Water is to be removed from the flue-gas before treatment in the GPU
- Air leakage into the boiler and flue-gas system has to be minimised

Oxy-combustion Technology



Oxy-combustion technology already validated at pilot scale

White Rose Project aims to demonstrate commercial viability at full scale

- **Reliable:** Main components already exist, requiring adaptation to power and scale-up
- **Flexibility:** Applicable for all types of boilers, firing systems and fuels
- **Scale-up:** No constraints anticipated for larger commercial units
- **Emissions:** No new chemicals introduced to the power plant

National Grid - CO₂ Pipeline Project Status

Transport Development

- R&D programme
 - Vapour phase programme completed
 - Dense phase programme underway
- Onshore route planning
 - public consultation underway
- Offshore route planning on-going



Storage Development

- Regional assessment completed
- 257 wells assessed in target area
- Key sites shortlisted
- Technical programme to identify prime target (two front runners) developed
- 1st Appraisal well drilling completed (summer 2013)

Project Development Status

- NER and DECC public funding submissions under evaluation and negotiation
 - NER - evaluation will be completed by June 2014
 - DECC - White Rose CCS Project selected as one of two preferred bidders, negotiations are on-going to agree a contract to support a 2 year risk reduction phase leading to financial close in 2015
- Pre-FEED activities on-going for the Oxy Power Plant
- FEED activities expected to commence in 2013
- Permitting process for the Oxy Power Plant underway
- Engaged with National Grid Carbon on the project CO₂ Transport & Storage solution development and on the development of Humber cluster
- Demo project Cost of Electricity calculations confirm expected commercial competitiveness of CCS versus other low-carbon alternatives

End





Why Yorkshire?

A report by CO2Sense highlighted a number of economic advantages to a CCS cluster in Yorkshire and Humberside, including:

- Delivering £1.3bn of investment to the UK and 4,000 skilled jobs
- Increasing Yorkshire and Humberside's economic output by an estimated 0.8%
- Attracting as much as £11bn in foreign investment and a further 11,000 jobs
- A Yorkshire and Humberside CCS cluster has the potential to cut UK carbon emissions by up to 19% and to transform one of the UK's highest emitting regions into one of the cleanest

“This report gives conclusive evidence for the business case for investing in CCS in Yorkshire and Humber. The opportunities for the supply chain – valued at up to £251m – are enormous, as are the potential for inward investment in the area. We want to see the Government back these plans, which will bring so many opportunities for the UK's businesses.”

Barry Dodd, Chairman of CO2Sense

