The commercialisation of UCG

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c. 10,000 billion tonnes of sub-sea coal in UK sector of the North Sea

Scale of the global opportunity
Which sector to target?

Source: NREL/TP-510-34929
Business niche?

• Owner-operator of a few assets?

• International licensor of technology?

• Roving consultancy?

• Some combination of the above?

A diversity of business models with different implications.
Right syngas for chosen sector?

Source: G R Couch, Underground Coal Gasification, IEA Clean Coal Centre
The right coal for the job?
The right coal for the job?

Some coals are easier to deal with than others.

Have you got good separation from sensitive aquifers?
Where is your competitive edge? (and is it protected?)

• Why should someone invest several £100m in your company?

• More gas with less drilling?

• Better syngas quality? Lower gas-processing costs?

• A more environmentally robust proposition?

• A more reliable process?

• Confidence in commercial capability?
Why do demonstrator projects?

• To burn a lot of money???

• To show that you have the right coal for the job.

• To demonstrate that your competitive edge is real.

• To gather data needed for designing the commercial-scale plant.

• To win the confidence of investors, customers, regulators & communities.

NB: Raising money to build a plant that is not designed to make money is hard work!
Scale of investment & risk
US shale gas is now six times lower cost than Asia, leading to a marked difference in Ethylene cost ($316/ton vs. $1,717/ton).
Gas-to-wire

- Mode of running?
- Power Purchase Agreement?
Similar concept to IGCC-CCS

Block Flow Diagram

Note: Block Flow Diagram is not intended to represent a complete material balance. Only major process streams and equipment are shown.
Getting the PR right

Noise & Nuisance
Aquifers
Seismicity
Gas explosions
Wildfire
Metal and organic substances
Pollution migration and leaks

Expect more intense questioning at larger scale
CCS Deployment Timeline (to 2025)

20 Mt CO₂ CCS could be realised by 2025 (c.a. 3-4 GW equivalent)

Speculative Scenario for post UK CCS Competition

- Bankable Storage to be identified (Bunter Sandstone/EOR)?
- Bunter Sandstone (5 – 42 ?)
- Talisman EOR
- Goldeneye

CO₂ Transport Capacity (Mt CO₂/y)

- Teesside (0.5 GWeq) CCS 202??
- Don Valley (1.0 GW) 202??
- White Rose (0.45 GW) 2019
- Peterhead 2018? (0.35 GW)

Humber Trunk Line

1 GW = +/- 5 Mt CO₂ coal based CCS and +/- 2.5 Mt CO₂ gas based

27th Feb 2014 The Westminster Energy Forum - The view from White Rose
Greenhouse gas issues

- What % of CO₂ is captured from raw syngas?
- Starting when?
- Where to store it? When?
- Who is accountable for CO₂ storage facilities?
- Mandatory or voluntary?
- GHG emissions arising in the gas processing plant itself?
- Carbon footprint of your utility supplies eg electricity for the ASU?
- GHG emissions during construction?
- Fate of CO₂ arising from use of the gases that you sell to others?
- Some may wish to draw the boundary much wider than your facility and compare with alternative routes to various end products from different raw materials
Products from CO₂

Figure 2: Estimation of future CO₂ utilisation potential: technology map

- Gas hydrate recovery
- Fuel, e.g. dry reforming (max. 2 Gt overall)
- Microorganisms (value products)
- Polymers
- Biomass, e.g. algae (40 km² area)
- Fine chemicals
- Mineralisation, niche application, logistical restrictions
- R&D
- Pilot plant/project
- Demo plant/project
- State of the art

CO₂ emissions of a 1000 MW lignite-fired power plant

- EGR
- Fuel, e.g. methanol (max. 2 Gt overall)
- Reforestation
- EOR
- Bulk chemical
- Industrial gas
- Fertilisation

- Positive carbon footprint
- Restrictive carbon footprint
- Negative carbon footprint

Conclusion:
- Goal: positive / restrictive carbon footprint
- Potential preferably > 1 Mt of CO₂/a
  But every little helps!

Source: Dr. Johannes Ewers
### SHE management topics (part of licence-to-operate)

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