Is CCS dead and if not how do we resuscitate it?

Jim Ward

IGEM Annual Conference, 2016
No, it's not dead!

• The core elements of CCS are already in play
  – Transportation: pipeline costs, CO₂ compression and pipeline operations
  – Capture: amine plants (eg at gas terminals)
  – Storage: ex gas fields and saline formations are abundant in UK
  – Several detailed UK FEED studies; plants operational internationally (eg SaskPower, Shell Quest)

• Power generation with CCS provides multiple values
  – Dispatchable power
  – Provides both capacity and green electrons but only needs one subsidy
  – Provides diversity of energy mix and improved security
  – Lower capex than alternatives with short build time

The chain is complex though and we need some time to find the right model
UK CO₂ Storage

Storage Appraisal Project, 2016 (DECC, ETI)

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The UKCS is endowed with a rich and diverse national offshore CO₂ storage resource, key components of which can be brought into service readiness without extensive appraisal programmes thanks to decades of petroleum exploration and development activity.

- 78GT – UKCS potential
- 8.6 GT – All qualified sites
- 7.1 GT – Top 20 sites
- 1645MT – including ETI 2016 study
- 200MT – UK FEED Studies
Lifecycle costs and Unit costs

CO₂ Transport and Storage Lifecycle Costs for Build Out Portfolio Sites

* Costs adapted from UK FEED Study KT deliverables
+ Costs estimated by analogy with Bunter Closure 36

Lifecyle costs in £ millions (Real 2015)

- Goldeneye* - £30/T
- Captain X Site - £10/T
- Hamilton - £20/T
- Viking A - £0/T
- Bunter Closure 36 - £20/T
- Hewett* - £30/T
- Endurance+ - £520 MT
- Forties 5, Site 1 - £300 MT

Levelised Unit Cost
- Transportation
- Storage

Costs adapted from UK FEED Study KT deliverables
Costs estimated by analogy with Bunter Closure 36

Pre-FID  |  Capex  |  Opex  |  Abex  |  MMV
Not long before we have major decisions to make

Retirements by technology to 2030

* Source: Climate Change Committee
Gas Power + CCS
- could have several merits

<table>
<thead>
<tr>
<th>Power Source</th>
<th>Capex (£bn)</th>
<th>Nominal Capacity (MW)</th>
<th>Capex/MW (£m/MW)</th>
<th>Strike Price (2016 rebase) (£/MWh)</th>
<th>Availability (%)</th>
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<tbody>
<tr>
<td>OSW (NNG)</td>
<td>~2.0</td>
<td>445</td>
<td>4.5</td>
<td>121</td>
<td>38%</td>
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<td>Gas CCS</td>
<td>~4.0</td>
<td>3000</td>
<td>1.3</td>
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<td>85%</td>
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<tr>
<td>Nuclear (HPC)</td>
<td>16.0 – 24.5</td>
<td>3300</td>
<td>4.8 – 7.4</td>
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<td>76%</td>
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* Source: National Grid 2015 FES; other data from media reports and industry estimates
CCS Could Be Very Attractive

Levelised costs are in UK£ 2013, capital costs are +/- 40%( EPC *1.4), discount rates are adjusted for risk (range 9-16%). Gas £24/MWht and CO2 emission £31/te. All plants other than first demonstration plant are 860MW net output.
Declines in Potential Annual Fossil Demand

Source: Sustainable Gas Institute data (Budinis, S., Krevor, S., Mac Dowell, N., Brandon, N. & Hawkes, A. (2016). Can technology unlock ‘unburnable carbon’?, Sustainable Gas Institute, Imperial College London), redrawn timescale
Conclusions

- The UK has massive CO2 storage potential; it also has tremendous gas infrastructure (assets and people) to support CCS
- The storage sites closely relate to existing gas industry and power generation locations
- Gas power plant is cheap and quick to build compared to its competition; CCS (on gas) is competitive
- Mid 2020’s sees a need for significant new generation – the market should value reliable, despatchable power
- Gas companies may be sufficiently motivated to develop new long term customers that they may take new risks – storage, capture and transport are all existing gas company competencies
- Gas CCGT with CCS provides both capacity and green electrons – it avoids having to subsidise an OSW plant for green electrons and an OCGT for reserve
- High OSW penetration could be increasingly costly – having CCS as an option will be valuable

Source: Storage Appraisal Project 2016 (DECC, ETI)
Final thoughts - for a gas audience

- Even if the plants don’t get built, CCS/gas can provide competition to other energy vectors, providing value to UK consumers – but we need to advance schemes
- Scale is important in getting the industry competitive; gas companies could usefully collaborate in establishing a market/industry
- By 2025, decisions will need to be made on Heat
  - We could see a move to electrify Heat – or to maintain natural gas – or to use H2; CCS can play a role in enabling more natural gas use by both a) gas-fired generation and b) providing emissions headroom for domestic Heat, especially if coupled with biomass
  - Continued natural gas use for Heat will rely on imports; having a larger gas demand (eg with Gas CCS) will lower unit costs and enable easier provision of the required swing, for example
- Enabling gas-fired power with CCS, with its CfD, provides long-term certainty of demand and improves the planning outlook for UK Gas – as well as long term commercial opportunities to exploit the know-how
- The gas industry has the capital, competence and people to enable initiation of CCS – what we need is to find the right model and get on with tackling the challenge