

Industry perspectives: Addressing long-term CCS challenges through research

*Feedback of some industry views on the
importance and direction of CCS
research*

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Industry Consultation

- APGTF industrial members



- UKCCSRC Future of Coal and CCS Workshop (Feb 2013)



The UKCCSRC is supported by the Engineering and Physical Sciences Research Council as part of the Research Councils UK Energy Programme



- CCSA/DECC joint Cost Reduction Task Force Interim Report – Action List



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Objective is to report the ideas collected (55!), to lead into panel discussion but not reach conclusions

Policy, Social, Economic, Legal (Top Priority?)

- Though not R&D in an HMRC sense, developing ways of solving the commercial problems around CCS must be the highest priority
- How can we present the coal+CCS vs Nuclear risks / benefits to the **public** to see which they prefer
- How can we present the coal+CCS vs Nuclear risks / benefits to **financiers** to see which they would give a lower cost of capital to.
- Does there need to be a firmer and more stringent definition of CCS Readiness, especially around credibility of export routes, storage characterisation and economics.
- Will the public, HSE etc accept dense phase onshore transport of CO₂? How big are the wayleaves?
- Open up the debate about whether EOR is a net carbon sink or a net carbon producer

Policy (continued)

- Flexible generation
 - research to support *flexible* operation
- Potential CCS *clusters involving shared pipelines*, etc.
 - how can the 'Big 6' (+ new entrants / developers) be brought to the level of *collaboration* that would be required to facilitate the cluster infrastructure?
 - Access to *common infrastructure* looks the only feasible way for *non-power industry (iron & steel, cement, refineries)* to implement CCS. This needs to be built in to planning requirements.
- Policy to *link pilots of industrial CCS (e.g. steel) to the pipelines* built for first power CCS Commercialisation programme
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- How to continue to attract industry funding towards 'longer term research' on CCS at the moment?
 - Encourage partnering
 - Encourage knowledge sharing
- How to get the best value out of the first Commercialisation projects by complementary R+D ?
 - Research Block
- How to encourage closer links between researchers, including UKCCSRC, and industry?

Storage (High Priority ?)

- *Characterisation of Storage* facilities needs to be done *ahead* of project development
- *Test injections* needed
- Can fields being (re)developed now be done so in a way that is CO₂ *future-proofed* without undue pre-investment?
- a switch to saline aquifers will be needed in the 2020s
 - National Grid are to be applauded for their decision to drill two wells in SNS.
 - Perhaps government could think about some sort of tax break to reimburse other operators for taking core (in relevant areas) for use in CCS studies.

Storage (High Priority ?)

- *Model validation* may well become an issue in the future. Oil and gas software codes are being used to make predictions of behaviour over extended periods of time where generally there is little or no evidence to validate them. Further work is likely to be required to understand the uncertainty envelope associated with performance predictions.
- Developing a better understanding the geomechanical integrity of storage systems and seals

Transport (Medium Priority ?)

- How can we *get the CO₂ into spec at lower cost* (H₂O, O₂, H₂ etc) ?
 - What are the *materials / coatings* coming through that could give greater flexibility in terms of flue gas and CO₂ specifications, particularly around ducting and pipes?
- How can we do *fiscal metering* of CO₂?
 - “This one is probably a bit too much like stating the obvious but, if we built a CCS equipped power plant tomorrow, I still don't know where I'd go to get a fiscal CO₂ meter.”
- How can we do *tracing of CO₂* in a shared transport / storage system ?
- How can we address the risks / unknowns of doing CO₂ *EOR Off-shore (never been done)* ?

Generation and Capture (Low Priority ? - since capture is the closest to commercialisation now)

- Further research in Capture on "conventional" solvents and process designs should focus on *improving confidence on long term effects - degradation, corrosion, emissions etc etc*
- Capture research on disruptive technologies to displace "conventional" solvents / designs should continue if
 - a) fundible
 - b) the potential impact is HUGE (say half energy use)
 - c) it can plausibly "catch up" in a TRL sense inside 5 years

Generation and Capture (continued)

- How well are research programmes aligned to industry timescales? What is the next key time window for the introduction of new technologies
- Given the timescales on the UK CCS Commercialisation programme and Boundary Dam it could be 7-10 years before the 'commercial' maturity of CCS deployment - *can any of the next generation technologies be ready for this window?*
- *What would it take to have a large pilot (CCPilot100+ style) up and running within 5 years?*

Future of Coal and CCS Workshop

February 7th 2013, Edinburgh



- The workshop brought together *28 invited experts from industry and academe to discuss the future of coal with CCS in the UK*
- Starting point:
 - UK will continue to pursue Climate change goals
 - There will be an increase of certainty and pace once a global agreement is reached post Kyoto
 - Shale gas will be no more popular than coal mining
 - UK government will require CCS for new coal power plants, and eventually for gas?

Future of Coal and CCS Workshop – Presentations and panels

- Current uses of coal in UK power and industry.
 - Quantities, locations, routes, prices
- Growth of coal use globally for power and industry, including SNG, chemical feedstock, focus on China
- Social and economic importance of coal (+CCS) in UK
- Possible places for coal in UK power mix
 - Baseload or mid-merit
- Available technologies, BAT emission standards, EPS
- Full CCS or CCR ?
- Suitable sites?
- Policy and R+D needed

Workshop on Future of Coal and CCS

R+D needs - Policy

- *Value of coal power option to UK (vs imports of coal or gas)*
- *Economic and social worth of coal/CCS options and actions needed to maintain coal options, including coal power plant sites, opencast mining and deep mining. These studies should also consider the role of government in creating/ facilitating new infrastructure (as it does for road, bridges, railways).*
- *Linkage of CCS infrastructure for power to industrial applications for coal to establish credible pathways to optimum networks of power and industrial projects.*
- *The government (BIS /DECC) should have an **Industrial Strategy for coal /CCS***

Workshop on Future of Coal and CCS *R+D needs –Policy (continued)*

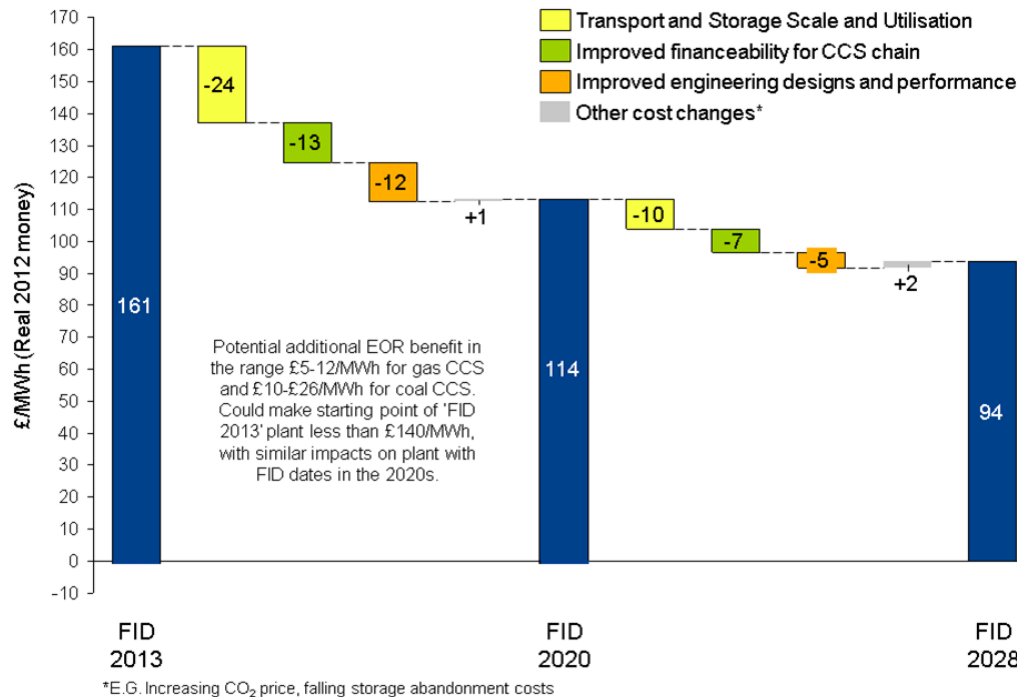
- *Techno-economic studies of power plant, CCS and storage options*
- *How to be more open about what R+D is underway?*
- *Gap analysis (by UKCCSRC ?) of DECC/TSB/ETI and other innovation programmes.*

Workshop on Future of Coal and CCS R+D Needs - *Capture and generation*

- *Coal power plant efficiency* improvements, including 700deg C steam power plant, but taking into account what will be cost effective compared to improvements in CO₂ capture.
- *Capture plant efficiency improvements* for gas and IGCC, including warm/hot gas clean up.
- *IGCC flexibility* and CO₂ capture *flexibility* for mid-merit operation and peaking
- *Integration of power plant with energy storage* (H₂ or SNG)
- *Coal quality issues for IGCC*, including use of indigenous coal

CCS Cost Reduction Task Force - Interim report - Key Conclusion

"UK gas and coal power stations equipped with CCS have clear potential to be cost competitive with other forms of low-carbon power generation, delivering electricity at a levelised cost approaching £100/MWh by the early 2020s, and at a cost significantly below £100/MWh soon thereafter"



CCS Cost Reduction Task Force - Next Steps

Workstreams on

- **Generation and capture**
- **Transport and Storage**
- **Finance and Commercial**
- **Cross-cutting issues**

➤ ***Phase 2: each workstream moving from identifying sources of cost reduction to how to deliver the necessary actions, including where R+D needed***

- ***Final report: Published spring 2013***
- ***Should be more specific where R+D or studies needed***



Cost Reduction Task Force (CRTF) – Action List: *Generation and Capture*

- **1: *Optimisation of scale* of generation and capture unit size**
- **2: Optimisation of early designs and *reducing engineering design redundancies***
- **3: *Next generation capture technologies***
- **4: Defining and Improving the *flexibility* of generation and capture**



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Cost Reduction Task Force (CRTF) – Action List: Transport and Storage

- **1: *Optimal scale* in transport and storage**
- **2: *Characterisation of storage***

Cost Reduction Task Force (CRTF) – Action List: Financial and Commercial



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- **1: De-risking the CCS chain**
 - CCS in the UK should migrate away from early end-to-end full chain projects to projects more suited to cluster development.
- **2: Ensuring funding mechanisms are fit for purpose**
 - Government to continue to work with CCS Industry to develop the CfD structure, and other relevant EMR instruments, with a view to their widespread use in CCS projects.
- **3: Continued involvement from financial and insurance sectors**
 - Keep a variety of financial institutions, analysts and insurance companies engaged in CCS



Cost Reduction Task Force (CRTF) – Action List: *Cross Cutting Issues*

- **1: Landscape and CCS Location**
- Development of CCS could benefit from a planning framework that has an assumption that CCS will be needed, rather than that CCS might be needed.
- Consider work on an *optimal strategy for locating CCS, to optimise fuel transport, electricity transport and CO₂ transport across the UK.*
- **2: Encouraging EOR**
- Government and Industry to work together to consider *what measures could encourage CO₂ EOR in the UK.*
- **3: Industrial CCS**
- Cost Reduction Task Force to examine *ways to incentive industrial CCS projects.*
- **4: Wider Energy System Benefits**
- Examine value of CCS flexibility (rather than base-load electricity generation).



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Cost Reduction Task Force (CRTF)

– *comments*

APG

TF

- *“The potential cost reductions associated with technology improvement were relatively modest. Perhaps we need to revisit specific unit cost targets to drive the maturation of some of the more promising cost reduction options.”*

- Thank you to the people who provided ideas
- Hope this gives a basis which, with the discussion that follows, could lead on to a new prioritised R+D needs agenda