

This document refers to the scope of activities that will be undertaken by the newly formed “UK CO₂ Transport and Storage Development Group” (henceforth refer to as ‘the group’).

Aim

The aim of the group will be to unlock cost reductions through the actions identified in the CCS Cost Reduction Taskforce Final report (‘final report’ published in May 2013) – key opportunities for cost reduction (as outlined in the final report) are attached as [Annex A](#). For example, the group will examine benefits of scale, ideas and options to reduce risks in the CO₂ storage and transport sector (“CTS”), and ways to ensure optimal system configuration that avoids inefficient capital expenditure.

The group should aim to unlock cost reductions; maximise benefits of scale and decrease technical, commercial and financial risk in storage.

Governance and input

This group will be led and coordinated by The Crown Estate, with a steering group including CCSA, OCCS Expert Chair, DECC, BGS & ETI representatives (these will be determined by each organisation subsequent to the first senior-level meeting). This totals 5 or 6 member organisations.

The Crown Estate will provide the secretariat for the development group.

Themes

The steering group will set out the themes requiring examination and will look to a wider member group for expertise in covering these issues. This wider membership will form ad hoc working groups to address issues and take forward specific actions.

Wider Group

This ‘wider group’ (aimed to have a manageable number of active representatives, including steering group participants, of the order of 10 to 12) will consist of organisations that are involved in development of CCS projects, or institutions working on research and development activities that are aligned with the key cost reduction themes.

Consequently membership should include the preferred bidders in the DECC Commercialisation Programme (i.e. Shell and National Grid, and partners as relevant), as well as Scottish CCS and appropriate institutions within the UKCCSRC.

Membership of this wider group will be kept flexible and fit-for-purpose to ensure the best expertise and experience is brought to bear on issues and working group activities. Additional organisations and bodies expected to be involved over time may include:

- Oil & Gas UK;
- Talisman & Premier (EOR);
- Nexun (interaction with the Captain aquifer);
- Centrica (or other gas operators); and
- any of (from a power sector perspective):
 - Vattenfall
 - E.on; or
 - Rwe.

The steering group will determine whether operators of international storage projects (e.g. TAQA, Statoil) should also be involved.

Topics

The steering group will set out the topics for examination, and the timing and regularity of meetings.

Frequency

The steering group is anticipated to meet quarterly (as well as ad hoc), whilst sub-groups / working groups will meet or have a telecom meeting more frequently on an as-needed basis.

The first meeting of the group will be a post-taskforce kick-off meeting and will need to agree the group:

- Scope
- Terms of Reference (ToR);
- Make up
- Meeting frequency; and
- Points of contact

The above will be reviewed annually (or as agreed in the ToR)

Summary of Group Activity

Storage and transport

The group will examine topics / issues in order of importance (to be determined by the group)

The final report flagged that the high priority issues are:

1. A need to prove stores & appraise them – i.e.
 - a. Who pays for the FEED required and what is the scale of cost involved?
 - b. How will funds be created to appraise stores?
 - c. Who will be the key players?; and
 - d. What fields and aquifers should be explored? This theme will also explore the role of CfDs for storage appraisal and delivery;
2. How to enable the development of depleted reservoirs (and the role of decommissioning as a driver) & aquifers (and the need for these to be step-outs from reservoirs);
3. How to kick-start CO₂-EOR & which fields should be targeted;
4. Transport: do we need another £1bn (for example) to build a suitable length of pipeline or will CfDs deliver this or is a semi-regulated model the answer.

The group will also be looking at the above in an EU context and will need to be open to new thinking.

The group will look at the above issues in the context of...

ensuring an optimal UK CCS transport and storage network configuration can be delivered

In addition, the final report stated that the *UK CO₂ Storage Development Group* [would]:

- *conduct industry-led, but potentially government supported, studies to identify options for developing configurations for the UK CCS transport and storage system for both early CCS projects and future CCS projects, in order to minimise long-run costs. This will take into account the likely future development of CO₂ storage hubs and their related pipeline networks.*

- *promote the characterisation of CO₂ storage locations to derive the maximum benefit from the UK storage resource. The group will examine the options for characterisation of both storage areas and specific sites for CO₂ storage in the UKCS, and recommend a way forward to Government and industry. The aim of this activity is to reduce the 'exploration risk' premium, thereby making storage sites bankable both commercially and technically. It is expected that the CO₂ stored database will be of benefit here, alongside existing company data.*
- *ensure funding mechanisms are fit for purpose; although this work is led by the UK CCS Commercial Development Group there will be a need to ensure that information is fed across to the UK CO₂ Storage Development Group so that the structuring, composition and design of CfDs for future projects and financiers are fully understood within the storage environment. In part, this is because the UK CO₂ Storage Development Group will examine options for public and private sector roles in the coordinating/facilitating of the efficient development of CCS clusters.*
- *Incentivise CO₂ EOR to limit emissions and maximise UK hydrocarbon production: the Group will consider potential synergies and the cost benefit of CO₂ EOR with alternative storage solutions. This will critically need to include how an EOR business model will look to deliver suitable projects given that EOR is a topic that has divided opinion in the discussion up to the final report. The output will not be a high-level idea but a realistic process.*

The group will address the above; for example, the group will work together with relevant Industry experts to understand the genuine extent of storage liabilities and to seek reform to the existing arrangements if justified. This will interface with the UK CCS Commercial Development Group given that it will impact on project financing, but it is also a subject that has been at the heart of storage discussions for several years and consequently will require DECC involvement if reform is required.

Outputs

In addition to relevant meeting minutes and summary papers for discrete activities, the group will provide, from time to time, summary information (via reports, position papers, etc...) to any government-industry body established for the purpose of information sharing (one of the final report recommendations).

Annex A - Background context extracted from the Final Report to act as a reference scope for the Group

Please note – particular references to activities assigned to the Group are formatted in this way

Underlying sources of cost reduction

The Task Force has confidence in the conclusion from the report because it examined, in some depth, the effect of opportunities for cost savings in aspects of CCS projects:

Storage

In order to finance full “economic-scale” (size will need definition) CCS power stations, power station investors cannot be exposed to significant CO₂ storage risks. The transport and storage system must be very reliable, and its operating regime well matched to the intended operation of the power station.

Uncertainty around the geological and operating behaviour of CO₂ storage sites means that reliable storage providers are likely to require access to more than one proven store, and to be capable of switching stores in order to provide back-up. This leads directly to the concept of proven ‘storage hubs’.

Through the correct configuration of the storage facilities in early projects, it should be possible to structure a highly reliable storage service using storage hubs and multiple storage sites for follow on projects. This will make larger-scale generation and capture projects deliverable and financeable at costs in line with industry norms.

A large part of the cost of CO₂ storage is set by the development costs of the surface facilities for the storage reservoir, which do not vary hugely with the rate of storage. Early projects with low CO₂ injection rates for storage will therefore incur high unit storage costs (unless they can share their storage).

Storage will benefit significantly from scale. Multiple large generation plant supplying CO₂ to a hub will allow the storage development costs to be shared across large volumes of CO₂ stored.

The Task Force has estimated that storage costs can be reduced from around £25/MWh in early projects to £5-10/MWh through investing in a CO₂ storage cluster supplying multiple CO₂ sites, which store volumes of around 5 million tonnes of CO₂ per annum. Lower costs per MWh could be seen in the longer-run, particular for gas based CCS, if higher volumes of CO₂ from multiple large capture plants feed into larger storage clusters.

Transport

A well-designed pipeline network is a key enabler of the storage hub. It allows new storage sites to join the network over time; it allows multiple storage sites to operate together; and it allows operational switching between storage sites when necessary. The configuration of the transport system for early projects should take into account the likely future development of the CO₂ pipeline network, in order to reduce future costs.

The unit costs of transporting CO₂ by pipeline decreases as scale increases. Both use and scale are important. A key conclusion of the 2012 Mott MacDonald report was, and endorsed by the Task Force, that leveraging early CO₂ infrastructure, if designed correctly, can reduce the incremental cost of transport and storage substantially for later projects. CO₂ pipeline transport is a well-established technology and can be expected to have very high reliability, provided pumping reliability is given suitable attention.

The Task Force anticipated that transport costs could drop from around £21/MWh for early projects carrying 1-2 million tonnes of CO₂ p.a., to £5-10/MWh for large, well-used pipelines carrying 5-10 million tonnes of CO₂ p.a. Even lower costs per MWh could be seen in the longer-run, particular for gas based CCS, if still higher volumes of CO₂ from multiple large capture plants were feeding into an interconnected right-sized network.

Characterisation or ‘proving’ of storage

For financial institutions, generation is understood and CO₂ transport has been widely demonstrated in the US. In particular, CO₂ use and storage in the UK are much less familiar to financial institutions.

The Task Force believed that these storage risks are regarded by the finance community as being a major current issue for financing CCS. Without a low risk profile for the storage element of the chain, CCS projects will find it difficult to get low cost (or possibly any) external finance, thereby increasing costs and limiting the scale of any individual CCS power plant (further reducing potential costs savings from power plant scale). Financeable CCS in the early 2020s therefore requires a storage solution that is generally regarded as ‘proven’ and demonstrably fit for purpose in order for financing to be raised, the focus of which will be:

- a) characterisation of storage sites and a track record of storage injectability and CO₂ dispersion behaviour as expected in key localised areas; and
- b) diverse storage options to provide contingency, so that the probability is 'bankable' which requires several proven storage options.

Alternatively, storage will have less impact on overall financing if the financial performance of the rest of the chain is somehow insulated from the storage risk. This could be achieved by a separate storage entity assuming the storage risks although it is not clear which entity could perform that function at present.

The UK CO₂ Storage Development Group will examine options to ensure an appropriate geographic spread of characterised stores and hubs (Central and Southern North Sea, and Eastern Irish Sea). Ultimately, additional steps needed to bring forward investment in storage capacity in line with demand need to be recommended.

Suggested scope of work includes:

- *Identify/propose a series of shared-cost programme options (three or four ‘straw man’ pre-commercial¹ models, for example, a ‘UK Storage Board’ model and a ‘hub-based’ model).*
- *Work out the pros, cons, and locational implications of each option.*

The UK CO₂ Storage Development Group will examine options for public and private sector roles in coordinating/facilitating the efficient development of CCS clusters, building on the work to develop bankable storage. The group will work in conjunction with the commercial group to develop the CfD structure, the clean electricity definition, and other relevant EMR instruments, ensuring their widespread suitability for use in CCS projects. Industry needs to provide clarity on the characteristics the market has to exhibit.

Optimal strategy for locating fossil power stations for CCS

Undertake activities to develop an optimal strategy for locating fossil power plants for CO₂ capture, to optimise the transport of fuel, electricity, water and CO₂ across the UK.

- *Following on from work already underway, the UK CO₂ Storage Development Group and the UK CCS Commercial Development Group are to agree recommendations on how to develop and implement an optimal strategy for locating future CCS plant (generation, capture, transport and storage). The recommendations will be based on a fuller understanding of the requirements for optimising fuel, electricity, CO₂ and water transport across the UK, in order to minimise the long-run cost of low carbon*

¹ Geographically defined CO₂ storage opportunity that is characterised and publically available (as a data set and a description of overall features) whether or not licences have been granted for all or part of the area.

power generation. This should address whether:

- o policies should promote or prefer particular locations for CO₂ capture (or whether a more balanced option should be developed);*
 - o 'CCS Readiness' criteria should be changed to encourage a cost minimising future path; and whether*
 - o the National Policy Statement for Fossil Fuel Power Generation (which encompasses CCS policy) could be beneficially revised (potentially feed into next steps in CC4 that also pertain to the development of the National Policy Statement).*
- Recommendations will be aimed at future projects (rather than those whose location is already decided). This study should also feed into the work on national plans and potentially future CCR requirements etc. Likewise, this work should complement existing studies that have addressed the issue on a local and perhaps more detailed level, and should be published in 2013.*

Incentivise CO₂ EOR to limit emissions and maximise UK hydrocarbon production

Stakeholders to work together to deliver measures that facilitate CO₂ EOR in the UK.

CO₂-based EOR (and to an extent EHR in general) has the potential to create significant additional value for CCS and the UK as a whole, however, not all fields are suitable for CO₂ EOR campaigns, thus the value of CO₂ EOR is currently uncertain. Uncertainty also exists in likely splits of CO₂ EOR value between government, the CO₂ provider and EOR developer and the ratios are likely to vary between projects.

Current work in progress

- Element Energy for Scottish Enterprise: 'Economic impacts of CO₂-enhanced oil recovery for Scotland' (2012).
- University of Aberdeen: 'The economics of CO₂-EOR cluster developments in the UK Central North Sea/Outer Moray Firth' (2012).
- SCCS et al.: 'Opportunities for CO₂ Storage around Scotland' (2009).
- Element Energy et al.: 'Analysis of fiscal incentives for CO₂-Enhanced Oil Recovery in the UK Continental Shelf' (2013). An independent research project for the CO₂-EOR Joint Industry Project. The study quantified the impacts of a range of tax incentive structures, including dedicated field allowances, on the likelihood of investment by different oil companies at different oilfields.

Gap

Recent studies have identified a number of barriers to the development of CO₂ EOR in the UK. Technical barriers include:

- Matching CO₂ supply with demand in the short term (e.g. in relation to power station operations), medium term (e.g. maintenance schedules) and long term (e.g. storage capacity, lead times for offshore infrastructure and increased CO₂ recycling of mature CO₂ EOR projects).
- Missed opportunities from current decommissioning of oil fields.
- High project complexity and engineering challenges: a requirement for detailed modelling and infrastructure planning and long lead times with parallel but interdependent workstreams. Stakeholder networks required across diverse industries.

Financial and regulatory barriers include:

- A high regulatory burden for CO₂ storage.
- A high level of complexity in clean power commercial arrangements.

- Fragile CO₂ EOR economics, long lead times, high finance rates and weak financial incentives.
- Shared equity ownership of oil fields creates potential commercial tension between partners.
- High oil taxation and complex tax environment:
 - boundaries between oil/gas tax regimes and CCS tax regimes have the potential to distort investment decisions (particularly with regard to decommissioning of infrastructure);
 - tax regime for individual fields can be non-transparent and a barrier to evaluation;
 - tax treatment of decommissioning and change of use arrangements adds complexity; and
 - currently no specific tax benefits available to CO₂-EOR and no industry consensus on preferred taxation structure.

Identified next steps

- Based on work in progress, create the case to treasury for a UK tax regime to support the development of brownfield CO₂ EOR projects in the North Sea [CCSA].

- *UK CO₂ Storage Development Group is to consider potential synergies and cost benefit of CO₂ EOR with alternative storage solutions.*