DEPARTMENT OF ENERGY & CLIMATE CHANGE

CCS Roadmap

Storage strategy

April 2012


DEPARTMENT OF
ENERGY
&CLIMATECHANGE

Storage strategy

We are:

- Developing a longer-term storage strategy and will publish an update on this by the end of 2012. This will be based on work already underway which includes:
  - Supporting development of commercial-scale storage through the CCS Commercialisation Programme
  - Commissioning work to understand how storage sites could be more cost effectively appraised
  - Undertaking work to help develop a common understanding between experts on storage risks. This work should be useful to the development of third party risk mitigation products (such as insurance)

The Challenge

1.1. A requisite for CCS is the ability to permanently store CO_2 safely. The UK's geology is particularly well suited to storage, and those sites are near to clusters of large point source CO_2 emissions, particularly on the east coast. Potential storage sites include:

- Depleted oil and gas reservoirs,
- Producing oil and gas reservoirs, in combination with CO_2 enhanced hydrocarbon recovery; and
- Deep saline aquifers.

1.2. To meet the 2050 decarbonisation target the UK could need to store between 2 and 5 billion tonnes of CO_2 by 2050, increasing to perhaps 15 billion tonnes by the end of the century. A study recently completed by the Energy Technologies Institute (ETI), concluded that the UK has approximately 70 billion tonnes of potential storage capacity. This is a considerable natural asset which, properly managed, can be used to limit our own atmospheric emissions and also those of other countries in Europe.

1.3. However, there are many challenges to realising this capacity. Storage sites are determined by specific features of geology and their usefulness is a characteristic of what is known about them, their location and whether they are being used for alternative purposes. The UK is fortunate in that many years of offshore oil and gas exploration and production activity means that the UK offshore area is better characterised than equivalent locations elsewhere in the world. At present, more is known and understood about oil and gas fields than saline aquifers but the latter represents over 85% of the UK's

estimated storage capacity. The potential for storage associated with CO_2 enhanced hydrocarbon recovery could provide valuable revenue from the additional production of petroleum but this is untested offshore.

1.4. Turning the UK's potential storage assets into viable opportunities faces a number of challenges:

- Scale – deployment of CCS on the scale that could be necessary to meet the UK's decarbonisation targets requires investment on the scale of the North Sea petroleum industry;

- Understanding – saline aquifers are the most significant and widespread of our geological structures that are thought to be viable for storage. The proving of saline aquifers is essential for CCS to be deployed at the scale thought to be necessary if CCS is to play a significant part in climate change mitigation. The Government will be seeking to address some of this uncertainty through the CCS Commercialisation Programme. Depleted hydrocarbon fields are less uncertain, but may have a high development cost risk if there are lots of existing wells that require remediation; and

- Commercial – at the moment there is an assumption that the commercial model for storage sites will be akin to that of a utility business with characteristics similar to other waste disposal businesses. Yet, many of the skills and capabilities needed are currently concentrated in the oil and gas exploration sector, where risks and returns are generally greater than is the case for waste disposal. An important part of the rationale for the support available under the CCS Commercialisation Programme is to help the value chain for CCS develop on the basis of sustainable commercial arrangements.

1.5. Government intervention in the storage sector is intended to help reduce the uncertainty associated with storage. We will do this primarily through targeted support through the CCS Commercialisation Programme and the R&D and innovation programme, and through other initiatives such as the arrangements being developed by The Crown Estate to make storage and exploration rights available to potential developers.

1.6. A significant challenge is likely to be the unpredictable pace at which infrastructure – and investment – is required. For example, deployment of 10 GW of CCS by 2030 would represent an annual storage requirement of c50Mt/yr[1]. However, a more aggressive deployment of 30GW by 2030 would represent an annual storage requirement of 150Mt/yr. Despite economies of scale in the construction of infrastructure, such differing estimates on the scale of deployment will have a marked effect on prudent levels of investment. To put this in to context, the maximum oil production from the UK North Sea was ~130 Mt/yr (in 1999)[2]. The efficient development of a CO_2 transport infrastructure and the re-use and availability of existing field facilities (e.g. platforms and wells) depends critically on the rate of deployment of CCS as well as when existing facilities become available for reuse, which will in turn depend on external factors like the oil price.

[1] Assumes 5Mt CO_2 per GW per annum
[2] DECC EDU analysis

Progress to date

2.1. A 3 year study by the ETI, part funded by Government, examined nearly 600 potential storage sites using existing data and information. It represents one of the most comprehensive assessments of storage requirements and capacity undertaken anywhere in the world. The study not only confirmed the potential capacity of the UK storage sites, but also highlighted the need for further work.

2.2. The key findings included:

- The UK has storage capacity potential of up to 70 billion tonnes, enough to meet CCS needs of up to 15 billion tonnes over the next 100 years – of the total estimated capacity approximately 9 billion tonnes exist in depleted oil and gas fields and up to 60 billion tonnes in saline aquifer stores;

- Useful storage exists all across the North Sea and in the East Irish Sea. The costs of using the stores identified spanned two orders of magnitude, so selection will play a key role in minimising CCS costs;

- Although there is sufficient potential storage space available this does not mean that all storage capacity is well enough understood for storage permits to be granted – at present hydrocarbon fields are understood better than saline aquifer stores. To unlock the UK's storage potential, further assessment of saline aquifer stores is required;

- It is uncertain when the storage capacity in individual hydrocarbon fields will become available for storage due to the unpredictability of field cessation-of-production dates (which depend on highly uncertain factors like the oil price) and the possibility of other commercial applications for the sites – if one assumes that some sites will not become available when needed, then relying solely on depleted oil and gas fields may impact on the future deployment of CCS; and

- Given this uncertainty over the timely availability of storage in hydrocarbon fields and the long lead times (between 6 – 10 years) required to assess saline aquifer stores, further assessment of saline aquifers needs to begin now – this will help the UK to avoid reaching a pinch point in the late 2020s where insufficient storage capacity is available.

2.3. Government will be providing targeted support to help meet the cost of the further work needed through the CCS Commercialisation Programme and our R&D and innovation funding.

Taking advantage of our storage assets

3.1. To respond to these challenges the Government proposes to focus its activities on three areas:

- Providing support for reducing the level of technical uncertainties – including work on phase behaviour in CO_2 fluid flow; development of time and cost effective aquifer

appraisal methodology; confirmation of the economics of CO_2 enhanced hydrocarbon recovery offshore; and optimisation of post-injection monitoring, measurement and verification;

- Regulatory issues – including the work described elsewhere in the regulatory framework section of this Roadmap to facilitate the reuse of offshore assets and geological features and the leasing/ licensing approach for CO_2 enhanced hydrocarbon recovery; and

- Commercial/ policy issues – including terms for new parties to secure rights to investigate offshore storage locations in order to demonstrate their suitability for storage, and to develop the Government's approach to the use of the UK offshore area to store CO_2 from other countries.

3.2. Going forward we would expect to address these three areas through (i) commercial-scale R&D through the CCS Commercialisation Programme, (ii) smaller scale R&D tailored to component parts and (iii) targeted regulatory/ policy interventions where these are identified. In each case we recognise the need for more effort to engage the offshore industry and to establish a shared vision of how large scale CO_2 storage could develop. Without these steps there is a danger that availability of "bankable" storage capacity will become a constraint on the deployment of CCS.

3.3. The CCS Commercialisation Programme is thus a key step in providing knowledge and confidence around the performance of CO_2 storage sites. It is the Government's intention that the Programme will support large-scale storage sites, providing essential experience of the steps needed to evaluate, develop and operate such a store.

3.4. It could be considered that a long-term programme of validating saline formation storage sites is necessary to complement the full-scale testing in the CCS Commercialisation Programme, and to ensure that the availability of suitable storage sites does not impede future deployment of CCS.

3.5. DECC will therefore discuss with industry partners what such a programme could entail and publish a further update of this storage strategy by the end of the year.

Liabilities

3.6. For a properly selected and operated store there is a high level of confidence that CO_2 will remain in the store permanently. However, the CCS Directive places obligations to remediate a store in the unlikely event that CO_2 does not remain within the storage site as intended. This includes meeting the cost of any unauthorised discharges if CO_2 is released to the atmosphere. Whilst these liabilities are theoretically very large, they are entirely contingent on a very small probability that CO_2 will leak from the storage site to the atmosphere. The difficulty of estimating the true exposure to this liability is proving to be a major obstacle to investment in storage sites. The Government believes that more factual evidence is needed to help develop a realistic estimate of these risks. We have therefore commissioned work to help develop a common understanding between experts on the true extent of these risks at different stages in the storage cycle. We believe that such evidence will also be useful in helping the financial services sector develop third

party risk mitigation products (such as insurance) as well as informing investment decisions. The initial work is underway and further stages will be tailored to suit the requirements of industry with a view to its conclusion by the end of 2012 and is expected to be incorporated in the solutions developed in the CCS Commercialisation Programme.

Role and focus of The Crown Estate

The Crown Estate's CO_2 transportation and storage programme is responsible for the management of CO_2 storage rights and issuing leases for developers to undertake geological storage of CO_2 in the UK Gas Importation and Storage Zone (GISZ), which includes offshore UK territorial waters and the area beyond the territorial sea to 200 nautical miles (nm), or the midpoint between countries.

UK legislation requires developers to also obtain a CO_2 storage licence and permit from the Secretary of State for DECC or Scottish Ministers, depending upon where the intended storage location has been defined. Consequently The Crown Estate works closely with regulatory agencies – particularly the DECC Energy Development Unit (EDU) and the Marine Management Organisation (MMO) to ensure the licensing and leasing of sites is a smooth process. The Crown Estate is aware that double regulation does not serve the sector. Crown Estate leases will not impose additional burdens of a regulatory nature on developers but will dovetail with the requirements of UK legislation.

The Crown Estate's strategic objective in the CCS sector is to work with Government and industry to facilitate deployment of large scale non-commercial CO_2 transportation and storage projects during the CCS Commercialisation Programme leading to the establishment of a commercial storage market in the 2020s. The Crown Estate has announced a policy of granting lease options to entrants in the EU's New Entrant Reserve and the CCS Commercialisation Programme competitions, and is preparing itself to undertake competitive leasing in the period beyond the early phase of CCS projects.

Activities that The Crown Estate is, or possibly could, become involved with over time include:

- The Crown Estate will develop the framework agreements and processes to be used post-demonstration, when it is anticipated that The Crown Estate would take over the responsibility for selecting storage projects from the EU and UK governments;
- Designing storage site leasing competitions and conducting competitions if required. Investigating subdivision/unitisation of large scale saline aquifer complexes;
- Identifying and leading selection of a portfolio of suitable storage sites for the period beyond the CCS Commercialisation Programme;
- Managing co-location and overlapping uses of the seabed, planning interactions between offshore renewable energy projects and infrastructure and CO_2 transport and storage infrastructure, and cooperating with agencies such as the Marine Management Organisation for implementing government policies in the management of the marine environment; and
- Facilitating leasing of CO_2 enhanced hydrocarbon recovery opportunities in conjunction with DECC EDU.

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URN 12D/016d