Summary of outcomes for Our Common Future under Climate change CO_2GeoNet-BGS and UKCCSRC side event: What geological CO_2 storage can bring to mitigating climate change - UK research perspective

Date and time: 1st July 2015, 09:30 – 17:30

Location: The Wesley, Euston House, 81-103 Euston Street, London, Greater London, NW1 2EZ

Attendees included representatives from UK Department of Energy and Climate Change, Energy Technologies Institute, Bellona, Shell, Statoil, National Grid, Sonardyne, Fugro GEOS, CO_2GeoNet-British Geological Survey, University of Leeds, University of Cambridge, Silixa, National Oceanography Centre, Plymouth Marine Laboratory, STFC Rutherford Appleton Laboratory, The Crown Estate, Imperial College London, Global Carbon Capture and Storage Institute, Carbon Capture and Storage Association, IEA Greenhouse Gas R&D Programme and UK Carbon Capture and Storage Research Centre.

Main messages from the workshop

The urgent need for climate change mitigation actions:

The urgent need for actions to reduce greenhouse gas emissions to mitigate further climate change has again been highlighted by recent reports. The message has not changed, the evidence is increasing and urgency is imperative. Unless action is taken now, stronger measures will be needed to meet the emission targets necessary to achieve the 2DS (two degrees scenario set out by the IEA Energy Technology Perspectives where global average temperature increase is limited to 2 degrees) and the cost of meeting these targets will be greater. Low carbon pathways need to be planned in the short, medium and long term to ensure policy consistently supports a low carbon future.

Geological storage of CO_2 is an important mitigation option

In order to meet emissions targets, we will need to use all the tools available. The majority of scenarios require Carbon dioxide Capture and Storage (CCS) to achieve 2DS and show it would be extremely challenging to achieve deep decarbonisation without it. A number of studies highlight CCS as a key mitigation option: The Fifth Assessment Report of the IPCC (AR5) presents CCS as a critical part of the portfolio for a low carbon future. Most (85%) of the scenarios set out AR5 could not achieve 2DS without negative emissions including utilisation of bioenergy with CCS (BECCCS), the only large scale negative emission technology currently available. The IEA Energy Technology Perspectives report (2015) includes widespread deployment of CCS in the power and industry sectors (accounting for a third of the additional CO_2 emissions reductions) in order to meet emissions targets. Costs for achieving 2DS without CCS are expected to be higher, for example, AR5 gives mitigation costs for 2015 – 2100 without CCS as 138% compared to the baseline scenario.

CCS needs to move rapidly from demonstration to deployment in order to make significant emission reductions on a timescale conducive to achieving 2DS. The ETI 2050 whole systems modelling report proposes utilising CCS to create ‘headroom’ so that emission targets can be met by reducing emissions in the energy and industrial sectors, leaving space to decarbonise more challenging sectors later.

Gas with CCS could be an important future mitigation option as gas produces less CO_2 than oil or coal and CO_2 produced could be captured and stored with current technology. CCS is flexible as it can be utilised whatever the energy mix.

The EU 2050 Roadmap includes utilisation of CCS to reduce CO_2 emissions from industrial sources. DECC has invested £1m funding for a Teesside industrial CCS study.

Geological storage of CO_2 is a proven technology:

Geological storage has been demonstrated successfully at a number of sites across the world. Currently 27 Mt of CO_2 is captured globally. Storage sites already operational are Sleipner and Snohvit (Norwegian sector of North Sea), ACTL Agrium and Decatur (USA) and Uthmaniyah (Saudi Arabia). The Quest project (Canada) is expected to come online in 2015. Construction of infrastructure for the Gorgon project will start soon, this will be the largest aquifer CO_2 storage project so far in terms of annual injection rate. Over the last 20 years, Sleipner and Snohvit have stored over 18 $MtCO_2$.

Most characterisation techniques applicable to CCS are already used by the hydrocarbon industry, however, there is an increased need to understand how the reservoir rock and fluids will interact with the CO_2 and the injectivity of the reservoir compared to hydrocarbon extraction activities. Current demonstration projects indicate that good injection rates for CO_2 can be achieved but more demonstration projects will improve understanding and confidence.

The UK policy framework enables CCS

Long term regulatory and policy support is essential to enable CCS. The policy and regulatory framework in the UK supports reduction of greenhouse gas emissions and aims to enable CCS. The Policy Scoping Document (Next steps for CCS, 2014) sets out potential pathways from demonstration to deployment.

Policy instruments to enable CCS include the Electricity Market Reform (EMR) with Contracts for a Difference (CfD), Emission Performance Standards (EPS) and carbon price floor of £18 per tonne CO_2 in 2015, expected to increase to £70 by 2030. A CCS specific CfD is expected in 2016. EMR is expected to deliver CCS deployment of 1 to 13 GW (low and high scenarios respectively) with up to 35GW by 2050.

The UK Commercialisation programme is a key step towards deployment

The UK policy supports deployment of CCS through the UK Commercialisation Programme which is providing funding for two FEED studies for two preferred bidders; White Rose (storage in a saline aquifer structure, 5/42) and Peterhead (with storage in the depleted Goldeneye gas field). The results of these studies will be available in late 2015, with a final investment decision expected from the UK government in early 2016. key knowledge deliverables under the FEED support will be available through https://www.gov.uk/government/collections/carbon-capture-and-storage-knowledge-sharing.

CCS research is well advanced in the UK and we now need to learn by demonstration at scale. The UK demonstration projects will pave the way for the next generation of UK storage projects by providing examples of FEED studies and documentation to meet regulatory requirements, proving UK formations for storage, reducing costs through technology development and by building oversize transport and storage infrastructure. Structure 5/42 has potential to store large quantities of CO_2 (4.5 Gt net pore space) and National Grid plan a pipeline and platform with a capacity up to 17 $MtCO_2$ per year, to allow for future expansion of the UK CCS industry so the oversize transport and storage infrastructure transport and storage infrastructure developed through the UK Commercialisation Programme could be utilised for the next phase of deployment of CCS in the UK.

The Don Valley project that received European Energy Programme for Recovery funding is also moving forward, this offers a third possible future demonstration project in the UK. The CO_2 source for this project is located near the oversize transport infrastructure being developed through the UK Commercialisation Programme so could potentially take advantage of this.

Strategic planning for the next phase of CCS deployment is required to avoid stalling after the demonstration projects.

Storage sites need to be identified, characterised and ready to go

The potential for storage has been identified across Europe thanks to successful EU funded projects. This puts the EU in an excellent position to capitalise on that investment and move potential storage closer to operational storage.

Characterisation of a storage site needs to start early in order to be ready in time. This includes considering that not all sites which seem initially promising will be suitable so alternative storage would then have to be studied. Work on detailed pre-FEED characterisation of the next tranche of storage sites needs to begin in parallel with demonstration projects

Early investment in storage assessment and a strategic approach to storage is required. The CO_2Stored database highlights potential storage opportunities. A portfolio of early opportunities has been developed for the UK based on CO_2Stored. The most promising could be studied in more detail to take them to the pre-FEED stage. CCSA has called for £100m in government funding to support storage characterisation. ETI, with £2.5M funding from DECC, has just launched a project with Pale Blue Dot, Axis and Costain to select and work up 5 key stores, the results will be available in the public domain.

Upscaling CCS for deep decarbonisation will be challenging, we have several demonstration projects in operation/ready to go but we need rapid and widespread deployment or it will be too late to mitigate climate change. The speed at which can undertake activities to store CO_2 such as characterising sites and drilling wells depends on availability of drilling rigs, ships and other resources. Strategic planning for a low carbon future is essential.

The business case for CCS

ETI whole systems modelling for the UK indicates that without CCS, the costs of meeting 2050 emissions reduction targets could double. The CCSA report 'Delivering CCS' including analysis by the ETI suggests that "Without CCS the costs of reaching the UK decarbonisation goals in 2050 could double, costing the UK economy and additional £32bn per year or 1% of GDP in 2050".

In order to move from the supported demonstrations to a CCS market, there needs to be a value for sequestering CO_2, in the USA this includes enhanced oil recovery. We need to consider the next steps after demonstration, if more projects are on the horizon, then CCS will be more inviting to investors. In addition, as more CO_2 is stored, economy of scale and technology advancements will drive down costs. The next phase of projects after demonstration need to be chosen based on the business case. CO_2-EOR can build infrastructure for CCS, reduce costs for capture and produce cleaner oil provided the CO_2 is captured, recycled and stored as the field is depleted. However, it would be critical to ensure that CO_2-EOR did lead to storage, not business as usual.

The CO_2 storage industry could potentially be large, creating and maintaining jobs and attracting new businesses to the UK (estimates of 200-300 jobs for a typical plant during the operation phase are given in the CCSA & TUC report on 'The economic benefits of CCS in the UK'). The North Sea could move from hydrocarbon production to CO_2 storage.

Challenges for CCS arise from establishing a business case, particularly given the large upfront investment required. The gap between expenditure and income is challenging for storage; investment starts with characterisation ahead of storage and continues after injection has ceased (including post-handover to Competent Authority) but there is only income while the CO_2 is being injected. Additionally, at present emitters pay a very low price for venting CO_2 into the atmosphere, but storage comes with costs and risks.

The business case is strongly dependent on a long term vision for a low carbon future with certainty and clarity from the national government on continued support for CCS. Examples from across the world show a robust regulatory framework is required to support CCS. Policies which support the next phase of UK CCS projects and financial support for follow-on projects are needed.

CCS is ready for deployment; the role of research and development is to improve and develop new technologies in an effort to assure safe storage performance at reduced costs in order to facilitate timely large scale deployment

As the North Sea demonstration projects move forward, new challenges that require additional research in order to refine various aspects of geological storage technology emerge. UK research partnerships have a key role to play in responding to these challenges.

Repeat 3D seismic survey data collected at the Sleipner by Statoil site has proved very valuable. Researchers from a number of institutes have utilised these data to improve methodologies for quantifying CO_2 in the reservoir and to demonstrate the CO_2 is securely stored as predicted by models. Shell have developed and tested new technologies around their demonstration projects including fibre optic downhole tools. For example, fibre optic-based Distributed Acoustic Sensing (DAS) VSP provides a lower cost imaging alternative to surface seismic for containment monitoring near injection wells. Fibre optic temperature and potentially microseismic monitoring deliver continuous surveillance without requiring interruption of well operations. New more resilient downhole tools are being developed.. Microseismic monitoring is of interest to the demonstration projects in order to understand behaviour of the storage complex and to alleviate public concern. Monitoring tools utilising lasers to quantify CO_2 in the air designed with storage in mind have been developed and are now being improved.

Reservoir modelling techniques (regional structural model, geological reservoir model, simulation model, geo-mechanical model) need to be integrated to predict how the storage complex will evolve during storage. Following buoyant trapping during injection, it is expected that a significant proportion of CO_2 will be trapped by capillary forces along the migration route.

One option for reducing cost is increased automation of monitoring with reliable, stable and sensitive tools. Flexible platforms that can analyse multiple parameters on the fly offer an opportunity to increase the speed and accuracy of detecting any irregularities that require further investigation.

Modelling and observations of the geochemical composition of the UK territorial waters has highlighted complex natural variability, both seasonally and spatially. Understanding this baseline and appropriately defining the threshold for an irregularity that requires investigation is complex There is a requirement for detailed site-specific observations of near sea floor chemistry as well as models of leakage dispersion to maximise monitoring efficiency and effectiveness.

Technologies being developed for CCS in the North Sea could potentially be marketed to other countries where CCS is being implemented and are also applicable to other energy resource activities across the world, offering a potential benefit to the UK through exportation of expertise and technology.

Increasing dialogue between stakeholders

One of the key aims of the meeting was to connect researchers, Small-Medium Enterprises (SMEs) and industrial players working to accelerate CCS in the UK in order to increase dialogue and to support the creation of new research partnerships. This meeting achieved increased dialogue between researchers, storage site operators/developers and SMEs. Discussions on potential new research partnerships to address the technology improvements presented by the storage operators/developers also took place.