



International Collaboration on Large Scale Saline Injection and Other Potential CSLF Initiatives

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June 2015



U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

Background

- The CSLF is well-positioned to facilitate discussions on global collaboration efforts for large scale CCS projects, whether as new green field projects or by adding additional functionality and value to existing or planned commercial projects.
- CSLF Policy Group at the November 2013 CSLF Ministerial approved an initiative to coordinate development of a CCS project dedicated to testing large-scale CO₂ storage in saline formations.
- An important factor in approving this initiative was the focus of most ongoing large-scale CCS projects on the use of captured CO₂ for EOR. There is a consensus, however, that storing CO₂ in deep saline formations will ultimately be the most important CCS option for achieving major CO₂ emissions mitigation.

Initiative Timing

The scope of this overall effort is divided into two phases:

- Phase I developed a preliminary list of candidate projects evaluated against initial selection criteria, which was discussed at the October 2014 Policy Group meeting.
- Phase II is focusing on the development of:
 - Further information (e.g. geology, CO₂ supply, governance structures, potential CSLF member support) on a limited group of projects identified by the Policy Group.
 - Project selection recommendations for presentation at the Spring 2015 Policy Group meeting with the goal of initiating at least one project in the 2nd half of 2015 following approval at the Ministerial.

Project Selection Criteria

To determine the best initial candidates, the Large-Scale Integrated Projects (LSIP) data base published by the Global CCS Institute (GCCSI) was screened to identify projects:

- That can achieve low-cost capture of sizeable amounts of CO₂ in a relatively near-term timeframe
- With varied geology that could accommodate different country interests
- Where project management and operators are amenable to discussing hosting an international consortium at the site and development of a governance structure.

Applying the Selection Criteria

- The two most restrictive criteria are the amount of CO₂ captured and the near-term timeframe, and the following projects most closely adhered to the criteria.

Project Lifecycle Stage	Project Name	State / District	Country	Volume CO ₂ (mtpa)	Operation Date	Capture Type
Operate	Sleipner CO ₂ Storage Project	North Sea	NORWAY	0.9	1996	Pre-combustion capture (natural gas processing)
Operate	Snøhvit CO ₂ Storage Project	Barents Sea	NORWAY	0.7	2008	Pre-combustion capture (natural gas processing)
Execute	Gorgon Carbon Dioxide Injection Project	Western Australia	AUSTRALIA	3.4-4.0	2016	Pre-combustion capture (natural gas processing)
Execute	Illinois Industrial Carbon Capture and Storage Project	Illinois	UNITED STATES	1	2015	Industrial Separation
Execute	Quest	Alberta	CANADA	1.08	2015	Industrial Separation



A Closer Look at Two Nearer-term, High CO₂ Capture Volume Projects

- It is anticipated that multiple projects will ultimately be identified by the CSLF as candidates for the Large-Scale Saline CO₂ Injection Consortium, and CSLF representatives are encouraged to facilitate investigation of potential projects in their countries.
 - This could include current EOR sites with excess CO₂ and with deeper saline storage potential, and sites with low cost CO₂ capture and saline storage potential
 - Most of the discussions thus far have focused on onshore projects, but offshore options are important given that they may be especially attractive for many countries
- The remainder of this presentation will focus on the Quest and the Illinois Industrial CCS projects, which are carrying out or planning aggressive R&D at their sites, and have indicated an interest in collaboration.

Examples of Potential R&D Collaboration Quest Project

The Quest project has provided a number of additional research topics related to MVA technologies that can be tested at their CO₂ injection site:

- Laser-based atmospheric detection of CO₂ covering large areas, including development of both improved laser technology and software
- Radar remote sensing (Quest has collected nearly two years of calibration data)
- Stable isotope analysis to address containment and conformance monitoring at a CCS site. A number of laboratory experiments and modeling work have already been conducted.

DOE/NETL has evaluated and discussed with Quest other potential cooperative areas, including:

- Near-surface leakage MVA activities using a field-ready ¹⁴C isotopic analyzer
- Compact eye-safe scanning differential adsorption LIDAR (DIAL) for spatial mapping of CO₂
- Surface and airborne monitoring technology using low cost infra-red gas analyzers
- Deep controlled source electromagnetic sensing for CO₂ plume detection and leakage based on CSEM (Controlled Source Electromagnetic Method)
- Greenhouse gas laser imaging tomography
- Real-time in-situ CO₂ monitoring (RICO2M) network for sensitive subsurface areas at storage sites
- Pressure-based inversion, data assimilation system (PIDAS) for CO₂ leakage detection
- Scalable, automated, semi-permanent seismic method to detect CO₂ plume extent during injection



Examples of Potential R&D Colaboration

Illinois Industrial CCS Project

ADM is the overall project leader, and has provided a number of research ideas that can be tested at their CO₂ injection site:

- Advances in CO₂ plume modeling, to include:
 - Improvements in surface seismic data processing that provides enhanced imaging for thin layer (pancake) plume distribution.
 - Improvements in geomechanical modeling that integrate passive seismic monitoring with pressure front and extent of plume monitoring.
 - Development of acoustic source and receiver systems (i.e., sonar) that can be used for monitoring real time changes in the site's acoustic signature.
 - Improvements in seismic monitoring approaches and technologies that allows real time seismic monitoring with enough sensitivity to pick up both P and S waves.
- Advances in reservoir monitoring, long-term CO₂ storage site monitoring and modeling approaches and technologies, especially those that can reduce the cost and time frame for storage site operational and post-operational reservoir monitoring.



Next Steps on Large-Scale Saline Injection

- A decision by the Policy Group is needed as to whether to proceed with the Quest and/or Illinois Industrial CCS projects at this time as part of a saline storage test network.
 - We should determine POC(s) for host countries, host sites, and interested parties.
- CSLF members should be consulted to determine interest in providing support to a test center, and when support could become available.
- Additional candidate sites should be proposed whenever they are considered by the host country to be viable network candidates.
 - We should discuss how to address a (tbd) project in China depending on what materializes between now and the Ministerial.

Discussion please on this topic
before we proceed to something
entirely different.

International CCS Demonstration Project Knowledge-Sharing Network

- There are large-scale CCS demonstration projects that are operational or will be in the near-term, e.g., Air Products in 2012, Boundary Dam in 2014, Shell Quest and ADM in 2015, and Kemper and Petra Nova in 2016.
- Additionally, there are many other projects around the world that are in detailed planning phases or will soon commence construction and operations.
- Similar to the International Carbon Capture Test Center Network, the CSLF could organize a global consortium of demonstration projects that can share best practices and facilitate the next generation of CCS demonstrations by addressing critical issues that can only be recognized through operational experience.

Next Steps on International CCS Demonstration Project Knowledge-Sharing Network

- Contact individual demonstration projects to determine interest.
- Discuss synergies and potential support with GCCSI.
- Communicate results and recommendations to Policy Group and Ministerial Steering Committee.

Other Potential collaborative efforts, perhaps through the CSLF Technical Group or with IEA GHG Programme

- **Saline Storage Test Network** – This could complement activities carried out by the Large-Scale Saline CO₂ Injection Consortium including: 1) sharing knowledge and best practices; 2) comparing and contrasting datasets and MVA technologies from various sites to address common issues and challenges, and 3) designing potential “test beds” or “virtual field sites” to test advanced MVA technologies or techniques, along with next generation modeling and simulation tools.
- **Geomechanics/Induced Seismicity Research Network** – Leverage learnings from large-scale CO₂ injection projects and tie into modeling and risk assessment frameworks and also the regulatory community. This can build upon previous CSLF efforts related to risk management, etc.
- **Offshore Carbon Storage Test Facility** – Once complete, leverage Findings and Recommendations from Technical Group report to develop an offshore storage cooperative effort to conduct field test of new technologies for offshore storage.
- **Non-EOR CO₂ Utilization Research Network** to coordinate knowledge and potential R&D efforts in this area.

Questions/ Discussion