Carbon Sequestration leadership forum

www.cslforum.org

Strategic Plan Implementation Report

January 2010

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Report of CSLF Secretariat

CSLF Strategic Implementation Reporting System (SPIR)
January 2010

The year 2009 was a pivotal year for the Carbon Sequestration Leadership Forum, where progress was made in many key areas.

At the London Ministerial meeting in October 2009, a new capacity building initiative was launched which will assist all CSLF Members to develop the information, tools, skills, expertise and institutions required to implement CCS demonstrations and then move rapidly into commercial operation. CSLF capacity building activities will use a country-led process in which each country defines its own needs. This initiative has received funding from several CSLF Members. The new CSLF Capacity Building Governing Council will oversee financial aspects of Capacity Building Program and will be meeting on 24-25 March 2010 in Oslo, Norway.

A new financing initiative was begun at the San Francisco Policy Group meeting in June 2009. The new CSLF Financing CCS Task Force, formed at the San Francisco meeting, has produced a preliminary report and scoping proposal on "Framework of Risks and Rewards for Commercial Deployment of Projects with CCS" and has commissioned a document on "Framework of Risks and Rewards for Commercial Deployment of Projects with CCS". In September 2009, a "Bridging the Commercial Gap – Financing CCS" workshop was held in New York City, co-sponsored by the CSLF, the International Energy Agency Working Party for Fossil Fuels (IEA WPFF), the Coal Industry Advisory Board (CIAB), and the Global Carbon Capture and Storage Institute (GCCSI). Results from the workshop were a set of recommendations for government actions that are required to help bridge the CCS commercial gap associated with first-of-a-kind CCS projects so that broad commercial deployment of CCS can occur by 2020. The Financing CCS Task Force will be holding roundtables on the "Commercial and Financial Structuring of Commercial-Scale Projects with CCS" on 27 January 2010 in London and on 11 March 2010 in Washington DC to engage the investor community in a dialog on the critical policies and incentives needed to finance and build the initial wave of energy or industrial plants with CCS.

At the San Francisco meeting, a new CSLF Technology Roadmap was finalized that replaces an older version drafted in 2004. The new Roadmap takes account of the significant CCS developments that have occurred during 2004 to early 2009 and identifies key knowledge gaps and areas where further research should be undertaken. It also includes a section that describes ongoing CCS activities for CSLF Members. The new Roadmap is structured to be a "living document" that will be frequently updated as needed.

A new CSLF Strategic Plan was also approved at the London Ministerial meeting. Also, at the London Ministerial meeting the CSLF Technical Group authorized the preparation of a multi-year action plan that would cover Technical Group activities and responsibilities. The Secretariat is working with the CSLF Projects Interaction and Review Team (PIRT) to organize a PIRT meeting on 01-03 February 2010 in Canberra, Australia, that will develop a draft of the technical action plan for consideration by the Technical Group at its next meeting.

One of the high-level recommendations contained in the IEA-CSLF report that was approved by the G8 is "Raising Public Education and Awareness," which is deemed critical to successful CCS deployment. To that end, the CSLF formed a new CCS in the Academic Community Task Force at the San Francisco meeting. The near-term work plan for the Task Force includes developing contacts within academic community and identifying academic perspectives and programs on CCS for universities in CSLF Member countries. Regional reports covering

academic programs in the European Union, Australia, and North & South America are in progress and the Secretariat is working with the Task Force to expeditiously produce these reports.

Ten new projects were recognized by the CSLF at the London Ministerial meeting:

- Lacq CO_2 Capture and Storage Project (nominated by France and Canada)
- European CO_2 Technology Centre Mongstad Project (nominated by Norway and Netherlands)
- Fort Nelson Carbon Capture and Storage Project (nominated by Canada and United States)
- Heartland Area Redwater Project (nominated by Canada and United States)
- CCS Northern Netherlands Project (nominated by Netherlands and Norway)
- CCS Rotterdam Project (nominated by Netherlands and Germany)
- Storage of CO_2 in Limburg Coal and Sandstone Layers Project (nominated by Netherlands and France)
- TX Energy Carbon Management and Gasification Project (nominated by United States, Canada, and France)
- ZeroGen Project (nominated by Australia and Japan)
- Demonstration of an Oxyfuel Combustion System Project (nominated by United Kingdom and France)

The Secretariat worked with the PIRT and CSLF Technical Group on project documentation during the approval process for these projects.

Four projects previously recognized by the CSLF have been completed and were presented CSLF Recognition Awards at the London Ministerial meeting by the Norwegian Minister of Petroleum and Energy, Terje Riis-Johansen, and Secretariat Director, Barbara McKee:

- Alberta Enhanced Coal-Bed Methane Recovery Project
- CO_2 Capture Project (Phase 2)
- Dynamis
- Regional Opportunities for CO_2 Capture and Storage in China

Two visits to CSLF-recognized projects have been scheduled. On 05 February 2010, attendees of the CSLF PIRT Working Session at Canberra, Australia, will visit the CO2CRC Otway Project. On 17 March 2010, attendees of the CSLF Technical Group meeting at Pau, France, will visit the Lacq CO_2 Capture and Storage Project.

Finally, two new Members joined the CSLF in 2009. New Zealand became the CSLF's 23rd Member at the San Francisco meeting and Poland became the 24th Member at the London Ministerial meeting. At the San Francisco meeting, Azerbaijan, Indonesia, Spain, and Turkey were also extended invitations to become CSLF Members. Of these, Indonesia and Spain have indicated they are interested in joining, and the Secretariat is working with Ministerial officials in these countries to pave the way for their entry into the CSLF.

3D-GEO Pty Ltd
Melbourne
Australia

3D-GEO Pty Ltd has been awarded the tender to create a geological 'skeleton' of the Gippsland Basin that can be fleshed out to become a sophisticated 3D model and used by companies to explore for valuable resources. Energy and Resources Minister Peter Batchelor said 3D-GEO was one of nine companies vying for the contract to interpret existing seismic data – acquired by reflecting sound waves off underground structures – to create a framework showing the geology of the basin.

Part of a $5.2 million four-year Brumby Labor Government initiative to undertake geological modelling of the Gippsland Basin, this data will be used by 3D-GEO to map underground structures in a similar way to how doctors use ultrasound to look inside the human body.

3D-GEO's staff have participated in seismic projects in the majority of basins between the Middle East and New Zealand and the company has extensive experience in the Gippsland Basin.

GeoScience Victoria geologists will use the skeleton created by 3D-GEO to build a 3D model of the region. The model will then be used to understand how carbon dioxide, water, oil and gas move through the porous rocks with time. It will be a powerful and cutting-edge tool that allows geologists and exploration managers to visualise different layers of rock and faults, and will assist exploration companies in their search for valuable resource. It will provide a good understanding of how petroleum, groundwater, geothermal and geological carbon storage projects may potentially operate side-by-side in the region.

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Gorgon Project
Chevron Australia Pty Ltd.
Perth
Australia

Following the receipt of all required approvals on 14th September 2009, the Gorgon Project joint venture participants Chevron, ExxonMobil and Shell made the final investment decision to move forward the Project in Western Australia. An integral component of the Gorgon Project is the plan to inject approximately 3.4 million tonnes of carbon dioxide per year into the Dupuy formation approximately 2.5 km below the surface of Barrow Island. Over the life of the project it is anticipated that approximately 120 million tonnes of greenhouse gas emissions will have been avoided because of the Gorgon Carbon Dioxide Injection Project. The Gorgon Project has established a number of world firsts. It is the first project to be regulated under dedicated greenhouse gas storage legislation and is the world's first large scale storage project to have been subject to an exhaustive public environmental impact assessment. Construction of the Project has commenced and it is anticipated that the injection operations will commence in 2014. Further

details on the Gorgon Project and the carbon dioxide injection component of this project can be found at http://www.chevronaustralia.com/ourbusinesses/gorgon.aspx

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CSIRO
Clayton South VIC
Australia

In December the Carbon Storage Taskforce Report was released. Please see (http://www.ret.gov.au/resources/resources_programs/nleci/cst/Pages/default.aspx)

The Carbon Capture and Storage Flagship projects were also announced by Minister Ferguson. Please see (http://minister.ret.gov.au/TheHonMartinFergusonMP/Pages/CCSFLAGSHIPPROJECTSSHORT-LISTED.aspx)

CSIRO release four reports outlining stakeholder perceptions to climate change and energy technologies using a large group process across four cities. Please see:

Melbourne: http://www.csiro.au/resources/Perceptions-of-low-emission-energy-technologies-Melbourne.html

Perth: http://www.csiro.au/resources/Perceptions-of-low-emission-energy-technologies-Perth.html

Brisbane: http://www.csiro.au/resources/Perceptions-of-low-emission-energy-technologies-Brisbane.html

Adelaide: http://www.csiro.au/resources/Perceptions-of-low-emission-energy-technologies-Adelaide.html

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Powerfuel Power Ltd
Herts.
United Kingdom

- Section 36 permission from UK Government
- Shell gasifier licence in place
- Full FEED study completed by Jacobs Engineering
- Grid connection agreement in place
- Agreement with GE for supply of key equipment
- Licences taken for acid gas and sulphur removal
- O&M agreement signed
- Trading Services agreement signed
- Advanced EPC discussions
- Performance guarantees on key equipment
- Letter of intent with National Grid for development of CO_2 transport

- Letters of intent for development of CO_2 storage in N Sea
- Winning UK project – awarded 180 million Euros from EEPR
- On track for 2013/5 – phase 1/2

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Alberta Energy
The Government of Alberta (GOA)
Canada

- In 2008 the GOA committed $2 billion to Carbon Capture and Storage (CCS) to support the development of 3-5 large-scale CCS projects that are expected to store 5 million tonnes of CO_2 per year by 2015.
- After running a competitive process, the GOA has signed Letters of Intent to allocate the $2 billion Alberta CCS fund to the following four projects:

Quest Project - Shell/Chevron/Marathon Oil Sands

- CO_2 capture at an oil sands upgrader, pipeline transportation and storage of the CO_2 in a deep saline aquifer.
- The Quest Project is planned to commence operations by 2015 and will capture and store up to 1.1 million tonnes of CO_2 per year.

Project Pioneer – TransAlta/Alstom/Capital Power

- A supercritical coal fired power plant will be retrofitted with post combustion capture technology (chilled ammonia). The CO_2 will be transported by pipeline and stored in both depleted oil reservoirs for enhanced oil recovery (EOR) and deep saline aquifers.
- Project Pioneer will capture and store up to 1 million tonnes of CO_2 per year starting in 2015.

The Alberta Carbon Trunk Line - Enhance Energy/North West Upgrading (NWU)

- "The Alberta Carbon Trunk Line" will be a new 240 kilometre CO_2 pipeline that connects the Alberta Heartland Industrial Region to enhanced oil recovery fields located in central Alberta.
- The pipeline will transport 1.6 million tonnes of CO_2 per year from a fertilizer plant and a new oil sands upgrader. The capacity of the pipeline will be about 14 million tonnes per year – excess capacity will facilitate future CCS projects.

SwanHills Synfuels

- SwanHills Synfuels project will build an in-situ coal gasification (ISCG) facility that will tap an unminable coal seam, 1,400 metres below the surface. The coal will be gasified underground to produce CO_2 and hydrogen.
- 1.3 million tonnes / year of CO_2 will be separated, captured, and transported for use in enhanced oil recovery in the area. The hydrogen will be used as fuel in a 300MW generating facility.
- The GOA has announced CCS project that will capture, transport and store 1.3 million tonnes of CO_2 per year starting in 2014.

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World Energy Council
London
United Kingdom

CSLF in conjunction with the World Energy Council held a Stakeholders' Meeting in London on Monday 12 October 2009. This comprised a half-day forum to discuss the most pressing issues facing the energy industry associated with Carbon Capture Storage. The Forum was co-chaired by David Hawkins, NRDC and Jeff Chapman, CCSA and a keynote address by Steven Chu, U.S .Secretary of Energy. Ministerial Address was given by Lord Hunt, Minister, U.K. Department of Energy and Climate Change and Terje Riis-Johansen, Minister of Petroleum and Energy, Norway

Topics included : The Key Issues from Stakeholders Perspective & Agenda for Action for Governments.

At the end of the Forum a Stakeholder Communiqué was adopted – [click on the link below]

http://www.cslforum.org/publications/documents/London2009/CSLF_Stakeholder_Communique.pdf

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Shell International Limited
London
United Kingdom

- In August 2009, Shell joined the ScottishPower's carbon capture and storage (CCS) consortium, which aims to deliver the UK's first commercial size CCS system operating from a coal-fired power station (Longannet). Meanwhile a bid has been made to the UK government's tender for support towards up to four commercial scale CCS projects.
- In October, Shell, on behalf of the AOSP JV, received a Letter of Intent (LOI) from the governments of Canada and Alberta to co-fund the Quest carbon capture an storage project, which aims to capture over a million tons of CO_2 per annum from the Scotford upgrader near Edmonton Alberta and store it in a saline aquifer, from 2014 onwards.
- In November, the Economy and Environment ministers of The Netherlands confirmed that the carbon dioxide capture and storage (CCS) project near the Dutch town of Barendrecht can go ahead in phases. The project has now entered a period of obtaining the necessary permits to proceed.
- In December, Shell and Imperial College completed the making of a film "Carbon Capture and Storage: A bridge to a low-carbon future". This film pulls together a wide range of interviewees from groups as diverse as Princeton and Stanford Universities, WWF UK and the Climate Institute to raise societal awareness of CCS by looking into the CO2 story at existing CCS projects across the world, and at what the future holds. The film can be found on the Shell corporate website: http://www.shell.com/home/content/innovation/managing_emissions/reducing_co2/ccs_eor/ccs.html

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CCS Regulatory Project
United States

The CCS Regulatory Project (CCSReg) recently registered as a stakeholder with the CSLF. The CCSReg project is developing recommendations for regulation of deep geological sequestration of carbon dioxide in the United States. The project is funded by a grant from the Doris Duke Charitable Foundation and anchored at Carnegie Mellon University with collaborators at the University of Minnesota, Vermont Law School, and the law firm of Van Ness Feldman.

In the latter half of 2009 and January of 2010, the project released six policy briefs on regulation of CCS. These briefs are titled:

- *Comprehensive Regulation of Geologic Sequestration*
- *Governing Access to and Use of Pore Space for Deep Geological Sequestration*
- *Compensation, Liability and Long-Term Stewardship for CCS*
- *A Framework for Regulating Carbon Dioxide Pipelines for the Purpose of Transporting Carbon Dioxide to Geologic Sequestration Sites*
- *Learning and Adaptation in Regulation of Geologic Sequestration*
- *Carbon Dioxide Accounting in Carbon Capture and Sequestration*

In addition to these briefs, the project also released an interim report titled *Carbon Capture and Sequestration: Framing the Issues for Regulation*. These publications have formed the basis for a number of briefings to regulators and legislators at the state and federal levels of U.S. government, including a recent Congressional briefing.

Members of the project are drafting model legislation based on the recommendations contained in the briefs and expect to release this legislation in February or March of 2010.

Publications from the project, including those referred to above, are available at http://www.ccsreg.org/

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Fundacion de la Energía (CIUDEN)
Spain

CIUDEN continues to be very active in the CCS field, at national and international levels including the participation in technical events, the formation of consortia with relevant entities focused on CCS, and the construction of the Capture and Storage Technological Development Plants (TDPs) among other actions.

Main activities carried out during the last months include:

- Starting of the construction of the Capture TDP in April 2009. The installation will be in operation by Fall 2010. This is a 50 MWth plant comprising 1) Fuel Preparation unit; 2) Circulating Fluidised Bed and Pulverised Coal boilers operating from air-mode to full

oxymode; 4) Biomass gasification; 4) Flue gas cleaning train for NOx, dust and SOx removal; 5) CO_2 capture: compression/purification unit
- Selection and characterisation of the Storage TDP in Hontomín (Burgos-Spain)
- Agreement negotiations with ENDESA and Foster Wheeler to jointly carry out validation tests and scale-up of oxy-CFB technologies
- Inclusion of the Spanish OXYCFB300 project (the Compostilla Project) in the EC Recovery Package, funded with 180 million euros
- FP7 project FLEXIBURN "Development of High-Efficiency CFB Technology to provide Flexible Air/Oxy Operation for a Power Plant with CCS" kick off
- Membership in the Global Carbon Capture and Storage Institute (GCCSI)-Australia.

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World Energy Council
Komite Nasional Indonesia

Understanding CCS Potential in Indonesia

The assessment of Carbon Capture and Storage (CCS) feasibility in Indonesia has been undertaken by the Indonesia CCS Study Working Group. The Working Group comprises the Agency for Oil and Gas Research Development (LEMIGAS) of the Ministry of Energy and Mineral Resources of Indonesia, Indonesian National Committee-World Energy Council (KNI-WEC), PT PLN (Persero)-Indonesia State Electricity Corporation, Ministry of Environment of Indonesia, Royal Dutch Shell and UK Embassy. The study results were launched on 10 November 2009, followed by IEA/APEC/LEMIGAS Joint Workshop "Carbon Capture and Storage in Indonesia" on 11 November 2009.

The purpose of this study is to develop an understanding of the requirements associated with deploying Carbon Capture and Geological Storage in Indonesia by addressing technical, commercial and regulatory aspects of CCS deployment to further stimulate the ongoing dialogue on potential application of such technology in Indonesia. This assessment of carbon capture and storage feasibility in Indonesia focuses on a number of factors. These factors include both technical aspects (e.g. geological storage potential, CO_2 capture from industrial sources) and non-technical issues (e.g. regulatory framework on CCS implementation, business opportunity). The report covers the following key topics: CO_2 Emission Sources in Indonesia, CO_2 capture technologies, transportation technology, methodology for site selection, geological potential storage, regulatory framework and enabling policies and conclusions and recommendations. The study recommended key elements that would create the pathway for CCS implementation in Indonesia, notably:

(i) Proactive role from the government in creating an enabling environment for CCS deployment is critical. Such environment must be supported by clear procedures and unambiguous permitting mechanisms in which CCS projects can be deployed in Indonesia as part of a CO_2 mitigation portfolio. National policies can assist in incentivizing public and private investments into more climate-friendly alternatives and optimize the use of available funds by spreading the risk across private and public investors. If the carbon price is not sufficient to deploy CCS project commercially, then financial incentives can be one of the solutions in encouraging investments to address climate change.

(ii) Taking action on developing CCS road map that embodied in national plan to guide and accelerate near and long term CCS deployment.

(iii) Further study will be required to look in more depth the details of individual CCS processes in Indonesia that will lead into a fully comprehensive technical design of a CCS project.

As a part of the effort to build public awareness on CCS, on December 23, 2009, members of the Indonesian CCS Working Group held an informal press gathering to introduce journalists of key media to CCS and related issues, including the latest update from the UNFCCC meeting in Copenhagen. Following the gathering, several newspaper articles on CCS were released with neutral and positive reviews. The gathering highlighted the need for more dissemination of information around CCS to the public through the press under the premise of climate change.

Capacity Building in Emerging Economies Task Force

CSLF Task Force Strategic Implementation Report (TFIR)
January 2010

1. Task Force Members

- Saudi Arabia – Abdulmuhsen Alsunaid (Chair)
- Australia – John Hartwell; Clinton Foster
- Canada – Ian Hayhow; Stefan Bachu
- European Commission – Jeroen Schuppers
- France – Pierre Le Thiez; Claudia Vivalda
- Italy – Pierpaolo Garibaldi
- Mexico - José Miguel González Santaló
- South Africa – Elizabeth Marabwa
- United Kingdom – Ruth Herbert
- United States – George Guthrie

2. Purpose of Task Force

Assist emerging economy CSLF Members to develop the knowledge, skills, expertise and institutions needed to deploy carbon capture and storage (CCS) technologies, develop training and educational resources that all CSLF Members can utilize, build on lessons learned from CSLF-recognized projects, and collaborate with other international CCS initiatives.

3. Milestones

- Six workshops held (2007-2008)
- New Capacity Building Initiative launched at CSLF Ministerial Meeting (2009)

4. Status

- Task Force workshops have evolved and been tailored to meet the needs and inputs from participants. Each workshop has built on the successes and lessons-learned from previous workshops, helping to create a solid CCS knowledge foundation that will carry into the future.
- The Task Force continues to explore creation of standardized, core training modules for capacity building based on materials from the initial workshops. These materials would be aimed at both public and private sector decision-makers.
- The new CSLF Capacity Building Governing Council will oversee financial aspects of Capacity Building Program and will be meeting on 24-25 March 2010 in Oslo, Norway.
- Letters were sent to all emerging country members seeking their input on their needs for capacity building with the view of integrating the responses in the future capacity building programs.

Task Force on Communications

CSLF Task Force Strategic Implementation Report (TFIR)
January 2010

1. Task Force Members
▪ Australia – John Hartwell ▪ European Commission – Marisa Atienza Morales ▪ Mexico – José Miguel González Santaló ▪ Norway – Tone Skogen ▪ United Kingdom – Ruth Herbert ▪ United States – John Grasser (Chair)
2. Purpose of Task Force
Implement a communications strategy to raise the profile of the CSLF and CCS.
3. Milestones
▪ Initiated development of an overall CSLF outreach strategy; ▪ Initiated the rebuilding of the CSLF web so as to have a first-rate site and a communications tool available to help promote the organization; ▪ Initiated the redevelopment of the CSLF information kit; ▪ Initiated the establishment of a CSLF daily clipping service to all members; ▪ Initiated conceptual redesign of CSLF exhibit with new graphics to mirror web page and handout material graphics; ▪ Initiated development of CSLF web page linking policy; ▪ Initiated development of CSLF conference sponsorship policy; ▪ Initiated development of CCS message paper series; ▪ Initiated development of CSLF speech for member use; ▪ Initiated development of CSLF power point presentation for member use; ▪ Initiated development of CSLF event at COP-15.
4. Status
▪ Communications strategy finalized and now being implemented; ▪ Completed development of new CSLF web site with improved functionality and graphic presentation; ▪ Completed development of CSLF daily clipping service for members and stakeholders; ▪ Completed redesign and printing of new CSLF handout materials; ▪ Completed redesign of a new CSLF exhibit; ▪ Completed CSLF web page linking policy; ▪ Completed CSLF conference sponsoring policy; ▪ CCS message paper development ongoing; draft of first papers in series circulated to Communications Task Force and Technical Group for review; ▪ Standard CSLF speech completed and distributed to Policy and Technical Groups; ▪ CSLF power point presentation completed and distributed to Policy and Technical Groups; ▪ CSLF event at COP-15 in Copenhagen successfully conducted.

Financing CCS Task Force

CSLF Task Force Strategic Implementation Report (TFIR)
January 2010

1. Task Force Members

- France (Chair: Bernard Frois)
- Australia (Margaret Sewell)
- Canada (Ian Hayhow)
- European Commission (Jeroen Schuppers)
- Japan (Shinichi Terada)
- Mexico (José González)
- New Zealand (Kate Riddell)
- South Africa (Muzi Mkhize)
- United Kingdom (Ruth Herbert)
- Asian Development Bank (Ashok Bhargava)
- GCCSI (Nick Otter)
- World Bank (Richard Zechter)
- CSLF Stakeholders (Peta Ashworth, Australia; Tomohiro Sembongi, Japan; Monica Lupion, Spain; Luke Warren, UK; Stu Dalton, USA; David Denton, USA; Jeff Jarrett, USA; Jack Parkes, USA; Andrew Paterson, USA; Maria Pineda, USA)

2. Purpose of Task Force

Investigate incentives and investments for CCS in both developing and developed countries, which will allow the CSLF a new means of engaging financial and multinational entities.

3. Milestones

- Creation of Task Force (June 2009)
- Completion of report sponsored by Asian Development Bank for analyzing key policy issues and barriers to CCS (2010)
- Completion of report on "Framework of Risks and Rewards for Commercial Deployment of Projects with CCS" (2010)
- Engage financial community (2009 and beyond)

4. Status

- Task Force meetings held in June 2009 (San Francisco) and October 2009 (London).
- Report on analyzing key policy issues and barriers is underway.
- Executive Summary for report on "Framework of Risks and Rewards for Commercial Deployment of Projects with CCS" is complete, and full report is still in progress.
- Financing CCS Task Force will hold a one-day business case roundtable in London, U.K., on January 27th. This roundtable will engage the investor community on critical policies and incentives needed to finance and implement the initial wave of industrial-scale facilities with CCS, which will lead to recommendations for consideration by the G8 and G20 later in 2010.

Project Interaction and Review Team (PIRT)

CSLF Task Force Strategic Implementation Report (TFIR)
January 2010

1. Task Force Members

The Team consists of:

- A Core Group comprising the Chair and Vice Chairs of the Technical Group, and other delegates as designated by the Technical Group. Current membership consists of representatives from:

Australia	Clinton Foster
Canada	Bill Reynen
Denmark	Flemming Ole Rasmussen
European Commission	Jeroen Schuppers
France	Pierre Le Thiez
Germany	Jürgen-Friedrich Hake
India	Ishraq Ahmad
Netherlands	Harry Scheurs
Norway	Trygve Riis
Saudi Arabia	Khalid Abuleif
UK	Nick Otter (Chair)
USA	George Guthrie

  The chair is performed via a 3 co-lead approach (currently with Australia, E.C., and UK) with 1 person to change on an annual basis, so ensuring continuity, sharing the work load and providing opportunity for change. During the period of this report the chair resides with the UK.
- A Floating Group comprising representatives of CSLF recognized projects with overall management responsibility in the project (e.g. project manager), as well as other subject area experts.

2. Purpose of Task Force

The PIRT has the following tasks:

- Assess projects proposed for recognition by the CSLF in accordance with the project selection criteria approved by the Policy Group. Based on this assessment, make recommendations to the Technical Group on whether a project should be accepted for recognition by the CSLF.
- Review the CSLF project portfolio and identify synergies, complementarities and gaps, providing feedback to the Technical Group and input for further revisions of the CSLF roadmap.
- Identify technology gaps where further RD&D would be required.
- Foster enhanced international collaboration for CSLF projects, both within individual projects (e.g. expanding partnership to entities from other CSLF Members) and between different projects addressing similar issues.
- Promote awareness within the CSLF of new developments in CO_2 Capture and Storage by establishing and implementing a framework for periodically reporting to the Technical Group on the progress within CSLF projects and beyond.
- Organize periodic activities to facilitate the fulfillment of the above functions and to give an opportunity to individuals involved in CSLF recognized projects and other relevant individuals invited by the CSLF, to exchange experience and views on issues of common interest and provide feedback to the CSLF.

- Perform other such tasks that may be assigned to it by the CSLF Technical Group.

3. Milestones

Near-term milestones are:

- Assessment of potential candidate CSLF Projects and make recommendations to the Technical Group as to their suitability. (September 2009)
- Identification of areas that are thought to be appropriate for new projects and to encourage the submission of projects in these areas (September 2009)
- Production of updated version of CSLF Technology Roadmap ready for 2009 Ministerial Meeting. (September 2009)
- CSLF Secretariat is continuing to engage with Member countries to obtain links to current Technology Road Maps for each country, and/or strategic planning documents for CCS that they have generated. This item is in response to the PIRT Action Plan item to have a "Technical roadmap developed for each area including links with member country roadmaps". (Ongoing)
- Review aims and work program of the PIRT to be in line with the CSLF Strategic Plan. (Spring 2010)

4. Status

- Following the Technical Group meeting in Oslo in April 2009, the CSLF TRM was amended in line with the discussions and final version submitted to the policy Group for their consideration at the PGF meeting in San Francisco on 29-30 June 2009. After detailed consideration, and some amendment to the document, the revision of the CSLF TRM was accepted and it was agreed that it should comprise one of the deliverables at the October London Ministerial meeting. It was noted that a substantial amount of the preparation work had been done by the Global CCS Institute under the lead/direction of the UK.
- As part of the lead up to the October Ministerial meeting, the PIRT with support from the Secretariat took the lead in identifying a series of additional projects to be considered for endorsement by the CSLF. This involved encouraging organisations to respond with specific projects that meet and contribute to the filling of the gaps identified by the PIRT in its on-going assessment in this area. The revised TRM contained a substantial section gap analysis. This process resulted in the Technical Group making the recommendation to the Policy Group in October 2009 that 10 new projects be accepted. This allowed a positive announcement to be made at the Ministerial meeting itself.
- The PIRT also contributed significantly to the provision of physical and computer simulated models as part of the exhibition at the Ministerial meeting.
- The aim is now to review the objectives of the PIRT and to ensure that the work program undertaken meets the needs of the updated CSLF Strategic plan. Also that appropriate planning is in place to make the best use of the additional resource now being made available to the CSLF as part of a more integrated approach to the promotion and development of CCS technologies worldwide. It is anticipated that the IEA GHG and the Global CCS Institution will both be part of this process. To this end a working meeting is scheduled for 1-5 February 2010 in Canberra and hosted by GeoScience Australia.

CCS in the Academic Community Task Force

CSLF Task Force Strategic Implementation Report (TFIR)
January 2010

1. Task Force Members

- Brazil (Chair: Marcelo Ketzer)
- Australia (Clinton Foster, Aleksandra Kalinowski)
- Mexico (José González)
- New Zealand (Kate Riddell)
- United Kingdom (Bronwen Northmore)
- IEA (Brendan Beck)
- IEA GHG (Vice Chair: Tim Dixon)
- CSLF Stakeholders (Peta Ashworth, Australia; Tomohiro Sembongi, Japan; Monica Lupion, Spain; Hannah Chalmers, UK; Robert Gentile, USA; Judd Swift, USA)

2. Purpose of Task Force

Develop contacts within the academic community, identify academic perspectives and programs on CCS for universities in CSLF Member countries, and determine the path forward for the CSLF in this area.

The Technical Outreach/Student Body Initiative Working Group is a sub-group to this Task Force. This Working Group is intended to encourage international interaction between students engaged in the study of CCS and to give them a resource for interaction, which could include networking, discussing research, and communicating with researchers in other institutions. The short-term goals of this Working Group are to increase the technical capacity in CCS, encourage student/researcher collaboration, and assemble a directory of student and researcher international activities.

3. Milestones

- Creation of Task Force (June 2009)
- Develop survey of existing academic CCS programs (begun July 2009)
- Determine points of contact for CCS programs at universities (begin January 2010)
- Implementation of website for Technical Outreach/Student Body Initiative Working Group (2010)

4. Status

- Task Force meetings held in June 2009 (San Francisco) and October 2009 (London).
- Regional reports on existing academic CCS programs in the Americas and the United Kingdom are underway.
- Regional reports for Australia and the European Union will be started in early 2010.
- The IEA GHG will develop a website for use by the Technical Outreach/Student Body Initiative Working Group.

CCS Northern Netherlands

CSLF Project Status Report
January 2010

1. Project Location

Groningen Province, Netherlands

2. Project Lead

Desmond de Vries (ddevries@provinciegroningen.nl)

3. Project Objectives

This project will implement a large-scale regional plan for capture, transport and storage of CO_2 around the Eemsharbor complex in Groningen province in the northern part of the Netherlands. The project will capture CO_2 from existing and planned power plants, transport the CO_2 to the storage location, and store the CO_2 safely underground in on-shore and off-shore natural gas fields. The project represents all elements of the CCS chain (capture, transport, reuse and storage), as well as including all CO_2 capture techniques (pre-combustion, post-combustion and oxyfuel combustion). Additionally, the project will develop a communication strategy, engage stakeholders, and work toward developing a legal framework for CCS in the region.

4. Recent Milestones

- Recently, the Dutch government approved the CCS project in Barendrecht. This is a major step forward in the development of CCS in the Netherlands and thus in meeting the Dutch CO2-reduction targets. In fact, the Barendrecht project is an essential step which is required for CCS in the Northern Netherlands as well, e.g. with respect to public acceptance of CCS.
    - http://en.cop15.dk/news/view+news?newsid=2642
- For the CCS project in the Northern Netherlands, a CCS foundation is being formed. This foundation (the participants are: EBN, Energy Valley, Gasunie, Groningen Seaports, NAM, NOM, Nuon en RWE) aims to enlarge the chance of a successful CCS project in the region by preparing the realization of CO_2 transport and storage. The Foundation will be established in January 2010.

5. Status

With the Barendrecht project approved, CCS in the Northern Netherlands is a step closer to realization. The Dutch government wrote in a letter to the parliament that: “With regard to onshore storage: In association with private parties develop a second large-scale demonstration project on shore, preferably in the Northern Netherlands, to make possible the development of CCS in this region with large CO_2-sources. This project should start around 2015”. (Translated from Dutch: “Ten aanzien van opslag op land: Het in samenwerking met private partijen ontwikkelen van een tweede grootschalig demonstratieproject op land, bij voorkeur in Noord-Nederland, om zo de ontwikkeling van CCS in deze regio met veel grote CO_2-emittenten mogelijk te maken. Deze zou ook rond 2015 moeten starten.”)
Source: http://www.ez.nl/pv_obj_cache/pv_obj_id_D19E23CBDB6E1ADCD318453F11F0AC8035D30100

CCS Rotterdam

CSLF Project Status Report
January 2010

1. Project Location

Rotterdam, Netherlands

2. Project Lead

Maarten de Hoog (maarten.dehoog@dcmr.nl); Hans Knippels (hans.knippels@dcmr.nl)

3. Project Objectives

- Development of CCS in the greater Rotterdam area (Port of Rotterdam)
- 2015 annual storage of 5 Mton CO_2
- 2025 annual storage of 20 Mton CO_2

4. Recent Milestones

- September 2009, annual progress report on CCS, "CO_2 Capture Transport and Storage in Rotterdam" available on www.rotterdamclimateinitiative.nl.:
    - Validation of technical feasibility and cost of CCS by key Rotterdam industrial facilities
    - Technical and cost scenario's of a CO_2 pipeline and storage scenario's
    - Shipping of CO_2
    - Comprehensive financial analysis. Financial risk and commercial structure considerations
    - Policy considerations and roadmap
    - Ensuring the implementation of CCS, memo for discussion
    - Including roadmap for large scale CCS in Rotterdam

    Stakeholders involved are:
    - Capture: Eon, Electrabel, Shell/Essent, Air Products, Air Liquide, C-gen, AVR, 3 other companies
    - Transport and storage: Port of Rotterdam Authority, GdF Suez, EBN, TAQA, Gasunie, OCAP, Wintershall and Stedin
    - Shipping and storage : Anthony Veder, Gasunie, GdF Suez and VOPAK
    - Technical validation: Foster Wheeler. Financial analysis and cost validation: Climate Change Capital
- EU-EEPR funding for the EON/Electrabel project. CCS demonstration plant of 250 MW size at the new EON coal fired power plant.

5. Status

- Development and implementation strategy of CO_2 storage under the North Sea together with ministry of Economic Affairs, ministry of Environment, Gasunie and EBN
- Further development of possible capture projects with industry and subsequent submission for funding from the EU-NER in 2010
- Development of a regional CO_2 collection network in the port of Rotterdam
- Further development of the shipping business case
- Discussion with industry and regulators on the need of additional safeguards for the implementation of CCS (Ensuring CCS)

CO_2 Separation from Pressurized Gas Stream Project

CSLF Project Status Report
January 2010

1. Project Location

Kyoto, Japan (membrane module development)
Pittsburgh, Pennsylvania, USA (testing)

2. Project Lead

Dr. Shingo Kazama, RITE (Research Institute of Innovative Technology for the Earth)
- E-mail: kazama@rite.or.jp

3. Project Objectives

- Development of membrane material with molecular gate function and composite membrane of excellent CO_2 selectivity over H_2
- Development of commercial size membrane module
- Testing of the module (with NETL, USA)

4. Recent Milestones

- Bench membrane module production (2009FY)
- Real gas pre-testing of bench membrane module (2009FY)
- Preproduction sample of commercial size membrane module (2010FY)
- Testing of commercial size membrane module (2010FY)
- Process simulation (2008FY-)

5. Status

- 1st duration: 11/2003 – 03/2006 Completed
- Development of novel dendrimer materials for CO_2 separation
- Fabrication of dendrimer composite membrane modules and their test

References:

Shingo Kazama, Teruhiko Kai, Takayuki Kouketsu, Shigetoshi Matsui, Koichi Yamada, James S. Hoffman, Henry W. Pennline, "Experimental Investigation of a Molecular Gate Membrane for Separation of Carbon Dioxide from Flue Gas", Session 30, Proceedings of Pittsburgh Coal Conference, Pittsburgh, USA (2006)

T. Kai, T. Kouketsu, S. Duan, S. Kazama, K. Yamada, "Development of commercial-sized dendrimer composite membrane modules for CO_2 removal from flue gas", Separation and Purification Technology 63 (2008) 524–530 and so on.

- 2nd duration: 04/2006 – 03/2011 ongoing
- Launch of bench and commercial membrane module production (Jan. 2009)
- Bench membrane module production (Oct. 2009)
- Real gas pre-testing of bench membrane module (Nov. 2009)

CO_2 Storage in Limburg Coal and Sandstone Layers

CSLF Project Status Report
January 2010

1. Project Location
Geleen, Netherlands
2. Project Leads
Harrie Duisters (harrie.duisters@dsm.com) Ben Laenen (ben.laenen@vito.be)
3. Project Objectives
• Pilot project: Store 10,000 tons of CO_2 in the Sandstone layers underneath an ammonia plant • When pilot is successful: Store 2 million tons of CO_2 in the Sandstone layers and combine with ECBM
4. Recent Milestones
• Finished the conceptual engineering phase of the pilot project with cost estimate • Discussed the environmental permitting procedure with the Dutch Authorities • Established a communication team to get maximum public acceptance for the project • Established a steering team for the project consisting of high level representatives of authorities (local aldermen, province deputy, ministry representative) and DSM Agro
5. Status
• Project is still in the engineering phase. Conceptual engineering is finished • Project is slowed down because of : a) many permitting steps that still more or less have to be developed for this type of new project, and b) discussions how the project can best be financially supported by the Dutch Authorities without getting into State Aid procedures.

CO2CRC Otway Project

CSLF Project Status Report

January 2010

1. Project Location
Southwestern Victoria, Australia
2. Project Lead
Sandeep Sharma, CO2CRC, Kensington WA 6151, Australia, - Ph: 08 6436 8736 - Mob: 0412 515 494 - E-mail: ssharma@co2crc.com.au
3. Project Objectives
The Otway project has been designed to demonstrate geological storage and monitoring of CO_2 under Australian conditions. It aims to provide technical information on geosequestration processes, technologies and monitoring and verification regimes that will help to inform public policy and industry decision-makers and assurance to the community.
4. Recent Milestones
▪ Repeat 3D seismic survey data has been processed and images of the plume can be seen. This is a very exciting development as it shows that there is potential of imaging using seismic techniques for cases where CO2 is injected in depleted gas fields. ▪ Geochemical sampling using U-Tube is continuing and an understanding of the plume movement is being built up. ▪ Multiple site visits by local and international visitors. ▪ Over 65,400 tonnes of CO_2 have been injected to date and monitoring is ongoing. ▪ Community open day held on October 15.
5. Status
▪ U tube sampling of reservoir data to continue. ▪ Injection is currently paused pending completion of monitoring data analysis and a new repeat seismic survey planned for January 2010. ▪ Otway Stage 2 progressing and new well CRC-2 is planned for January 2010. ▪ Community has been updated on forward plans through public meetings.

CO_2SINK

CSLF Project Status Report
January 2010

1. Project Location

Ketzin, State of Brandenburg, Germany

2. Project Lead

GeoForschungsZentrum Potsdam, German Research Centre for Geosciences (GFZ)
Telegrafenberg, D-14473 Potsdam; http://www.gfz-potsdam.de
Coordinator: Dr.-Ing. Hilke Würdemann
Tel: +49.331.288-1516; Fax: +49.331.288-1529; e-mail: hilke.wuerdemann@gfz-potsdam.de
Project website: http://www.co2sink.org

3. Project Objectives

- Developing a basis for geologic storage of CO_2 into a saline aquifer
- Establishing the first European in-situ laboratory for onshore storage of CO_2
- Creating a field laboratory with one injection well and two observation wells
- Characterization of flow and reaction processes in geologic storage, including detailed analysis of samples of rocks, fluids and microorganisms from the underground reservoir
- Intensive monitoring of the injected CO_2 using a broad range of geophysical (time-lapse seismic, electrical and thermical), geochemical and microbiological techniques
- Development and benchmarking of numerical models
- Definition and testing of risk-assessment strategies

4. Recent Milestones

- Feb./May 2007: Spud-in of the CO_2SINK injection and observation wells
- June 13, 2007: Opening of the Ketzin Field Lab, CO_2 Storage Site and Info Centre
- Sept. 8, 2007: One injection and two observation wells drilled and cemented (smart wells with electrical and fibre-optical permanent sensors behind casing)
- Feb. 8, 2008: Injection facility installed and tested
- Feb. 29, 2008: Hydraulic testing successful
- June 18, 2008: Final lifting of injection and observation wells; slug injection
- June 24, 2008: Commissioning of injection facility, start of injection test phase
- June 30, 2008: Start of CO_2 injection
- Nov. 17, 2008: Presentation of the CO_2SINK Status Report to GHGT-9, Washington
- April 21, 2009: Presentation of the CO_2SINK Status Report to EGU Vienna

5. Status

- 6-years lifetime 04/2004 - 03/2009; extension of project lifetime was approved
- July 2008: start injection of up to 60,000 tonnes CO_2
- July 15, 2008: arrival of CO_2 at first observation well
- March 2009: arrival of CO_2 at second observation well
- April 2009: 11,500 tonnes of CO_2 injected till now
- November 2009: 25,500 tonnes of CO_2 injected

Completed subprojects:

- Storage site development
- Baseline Storage Site Modeling
- GeoEngineering: drilling, coring, pre-injection logging

Ongoing subprojects:

- Rock/fluid interactions laboratory experimentation
- Economic/ecological analysis and safety concepts
- CO_2 supply, transport, intermediate storage, conditioning and injection
- Geophysical and geochemical borehole and surface MMV of CO_2 storage
- Project coordination and public outreach
- Preparation (permitting and operation) of CO_2 wellbore abandonment and post-injection MMV

The present state of the CO_2SINK Integrated Project has been summarized in the Proceedings of GHGT-9 by *Schilling, F. Borm,G. Wuerdemann,H Moeller,F., Kuehn,M.and the CO_2SINK group: Status Report on the First European on-shore CO2 Storage Site at Ketzin (Germany).*

Demonstration of an Oxyfuel Combustion System

CSLF Project Status Report

January 2010

1. Project Location
Renfrew, Scotland, U.K.
2. Project Lead
Sang Hyeun Kim (skim2@doosanbabcock.com)
3. Project Objectives
The specific objectives of the project are: ▪ to demonstrate the successful performance of a full-scale (40MWt) oxyfuel burner firing at conditions pertinent to the application of an oxyfuel combustion process in a utility power generating plant; ▪ to demonstrate the performance of an oxyfuel burner with respect to combustion efficiency, NOx, flame shape, and heat transfer characteristics; ▪ to demonstrate the operational envelope of an oxyfuel burner with respect to flame stability, turndown, start-up, shutdown, and the transition between air- and oxyfuel-firing, ▪ to demonstrate the safe operation of an oxyfuel combustion process under realistic operating conditions; ▪ to generate sufficient performance data from the oxyfuel combustion process to inform future investment decisions; and ▪ to demonstrate the level of technology readiness of the oxyfuel combustion process.
4. Recent Milestones
▪ Completion of first phase oxycoal burner tests
5. Status
▪ 40MWt full oxycoal burner operation including transition from air to Oxyfuel firing was achieved. ▪ Stable flame under oxycoal mode was achieved in both oil and coal. ▪ Parametric testing for oxycoal burner will be carried out from January 2010.

ENCAP "Enhanced Capture of CO_2"

CSLF Project Status Report

January 2010

1. Project Location

Companies and research providers in a number of places in Europe

2. Project Lead

- Leif Brandels, Vattenfall AB, Sweden
  - Tel: +46 8 739 60 40
  - E-mail: leif.brandels@vattenfall.com

3. Project Objectives

- Develop and verify IGCC/IRCC, Oxy-Fuel and Chemical Looping Combustion technologies with CO_2 capture for large scale power plants
- By early 2009 Recommend one of the technology for a demonstration in 350 MW scale
- Develop and test high temperature oxygen production technologies
- Investigate an number of novel CO_2 technologies

4. Recent Milestones

- Reference cases and guidelines for evaluation for a number of large power plants developed. A final version is delivered. The guidelines are used also by other EC sponsored project in Europe and are regarded as an "almost standard" for comparison of Carbon Capture Technologies.
- IGCC/IRCC concepts developed. Technology and costs reported to the ENCAP internal benchmarking group. Knowledge generated that has been part of information for a Power Company to launch design projects by 2008-2009 aimed at large-scale demonstration plants.
- Tests of ALSOM and Siemens developed gas turbines fuelled by H2 rich gas executed.
- Concept developed for large Oxyfuel PF, CFB power plants. Knowledge generated that has been part of information for a Power Company to launch design projects by 2008-2009 aimed at large-scale demonstration plants.
- Successful test of oxyfuel combustion in 20kW and 100kW scale completed. Initial test in a 500kW test facility completed and is under final reporting.
- Chemical looping combustion based on CFB technology developed.
- Three high temperature oxygen production technologies further developed and investigated for integration in power plants with CO_2 capture.
- A number of new technologies possible for CO_2 capture investigated.
- The project entered into phase II and the large scale testing in phase II preparation of tests and performance of a Test Programme for Large Scale testing in the 30MW Oxyfuel Pilot scale.
- ENCAP has delivered results that have the potential for commercial exploitation beyond year 2015.

5. Status

- Project ended 2009-02-28.
- Website address: http://www.encapco2.org/

Fort Nelson Carbon Capture and Storage Project

CSLF Project Status Report
January 2010

1. Project Location

Fort Nelson, British Columbia, Canada

2. Project Leads

Al Laundry (alaundry@spectraenergy.com)
Ed Steadman (esteadman@undeerc.org)

3. Project Objectives

The primary objective of the Fort Nelson carbon capture and storage (CCS) project is to verify and validate the concept of utilizing North America's large number of saline formations for large-scale injection, proposed to be in the 1.3 to 2 Mt per year range, of anthropogenic CO_2 for permanent storage. Specific goals include:

- Cost-effective risk management, simulation, and monitoring, verification, and accounting (MVA) strategies for large-scale CO_2 storage in deep saline formations.
- Testing and refinement of reservoir modeling intended to predict and estimate CO_2 injectivity (the potential for placing CO_2 into the reservoir) and confirm the practical CO_2 storage capacity for this site, areal extent and mobility of the supercritical CO_2 plume in the reservoir, and improved methodologies to ensure that site characterization and MVA results better support risk management objectives and modeling efforts.
- Testing strategies to predict the effects of CO_2 on the integrity of overlying sealing formations, including the testing and modeling of key geomechanical and geochemical parameters.

4. Recent Milestones

During the spring of 2009 through the present, the following activities have been conducted:

- Test well drilled to a depth of 2561 meters into a Devonian age carbonate reef structure.
- Core collected in potential injection target reservoirs and associated caprocks.
- Baseline fluid samples collected and analyzed.
- Initial geological interpretation of injection target and seals.
- Baseline hydrogeological evaluation of the proposed injection target.
- Initial static geological model developed.
- Initial predictive dynamic simulation performed.
- First round risk assessment using expert panel approach—results to be used for MVA planning.

5. Status

- Planning and preparation for winter drilling season are currently the focus of the project.
- All items above are under evaluation and will be revised based upon results of newly drilled wells and/or newly obtained data sets from the existing test well.

European CO_2 Technology Centre Mongstad

CSLF Project Status Report

January 2010

1. Project Location
Mongstad, Norway
2. Project Lead
Tore Amundsen; Managing Director. tam@tcmda.no
3. Project Objectives
• Develop technologies for CO_2-capture capable of wide national and international deployment • Reduce cost and technical, environmental and financial risks related to large scale CO2-capture • Test, verify and demonstrate CO_2-capture technology owned and marketed by Vendors ▪ Encourage the development of a market for such technology
4. Recent Milestones
▪ Admin complex ready for internal construction and installations ▪ Aker CC and Alstom started construction work on their capture plants on site ▪ Concrete foundations for pipe rack to refinery cracker complete ▪ Overall progress by end of 2009 approximately 20% and on schedule
5. Status
▪ Investment ($ 815 million) approved in June 2009 ▪ Construction underway (20% progress) ▪ Operating organization established and preparing for operations

Frio Brine Pilot Project

CSLF Project Status Report (PSR)

January 2010

1. Project Location
South Liberty oilfield, east of Houston, Texas, USA
2. Project Lead
▪ Susan Hovorka, Gulf Coast Carbon Center, The Bureau of Economic Geology, Jackson School of Geosciences, The University of Texas at Austin, USA - E-mail: susan.hovorka@beg.utexas.edu ▪ Tom Daley, Lawrence Berkley National Lab, Berkeley, California, USA ▪ Yousif Kharaka, U.S. Geological Survey, Menlo Park, California, USA
3. Project Objectives
▪ Project Goal: Early success in a high-permeability, high-volume sandstone representative of a broad area that is an ultimate target for large-volume sequestration. ▪ Demonstrate that CO_2 can be injected into a brine formation without adverse health, safety, or environmental effects ▪ Determine the subsurface distribution of injected CO_2 using diverse monitoring technologies ▪ Demonstrate validity of conceptual and numerical models ▪ Develop experience necessary for success of large-scale CO_2 injection experiments
4. Recent Milestones
▪ Second injection competed October 1, 2006 ▪ Confirm no-detect at surface of perfluorocarbon tracers ▪ Post injection monitoring of second injection completed September 2007 ▪ Permission to plug and abandon both wells has been received ▪ First of the CCS projects to attain site closure!
5. Status
▪ Project has been completed ▪ Wells plugged and abandoned; site is closed ▪ monitoring program completed ▪ Final repeat VSP completed ▪ Reports can be found at http://www.gulfcoastcarbon.org/

Heartland Area Redwater Project (HARP)

CSLF Project Status Report
January 2010

1. Project Location

Redwater, Alberta, Canada

2. Project Lead

William Sawchuk (wsawchuk@arcresources.com)

3. Project Objectives

- Develop a low-cost, secure and long-term CO_2 storage site in the close vicinity of major CO_2 emitters in the Heartland Industrial Area of Alberta, Canada, that will attain a storage rate of at least 1 Mt CO_2/year by 2015
- Develop a characterization and monitoring program that is suited for onshore continental conditions specific to the northern plains of North America (geology, farmland area, four climatic seasons, etc.)
- Support the development of a regulatory framework for CCS in Alberta, including tenure of the pore space, long-term liability as well as regulatory permitting and follow-up
- Achieve synergies with a CO_2-EOR operation being developed by the operator in the oil leg of the same carbonate reef

4. Recent Milestones

- The project started in early 2008
- Phase I of the project was completed in June 2009, consisting of:
  - Geological characterization of the Redwater reef and overlying & surrounding caprock based on existing well, core and seismic data and information
  - Assessment of the hydraulic communication between the Redwater reef aquifer and immediately underlying and overlying aquifers in the sedimentary succession based on existing drillstem tests and water analyses
  - Determination of geomechanical rock properties based on existing data and literature
  - Construction of a 3D static geological model and a 3D reservoir simulation model
  - Review of available data and information for the development of a monitoring program for the shallow potable groundwater aquifers, soil and vegetation
- Phase II of the project started in August 2009 and has the aim of drilling and testing an exploratory well for the collection of specific data about rock mineralogy, flow and geomechanical properties of the injection aquifer, overlying caprock and other relevant units in the sedimentary succession. Achievements to date include:
  - Selection of the well site
  - Meeting with local land owners, communities and counties
  - Meeting with representatives of government agencies for tenure of the pore space and for permitting

5. Status

- The Redwater reef (approx. 600 km^2 in size, up to 275 m in thickness, and 1000 m deep at its shallowest) has been characterized
- The site of the exploratory well has been selected
- The drilling, testing and sampling plans associated with drilling of this well have been completed
- The exploratory well is expected to be drilled in Q1 of 2010

In Salah Industrial-Scale CO_2 Geological Storage Project

CSLF Project Status Report
January 2010

1. Project Location

In Salah, Algeria, Africa

2. Project Lead

Iain W. Wright, wrightiw@bp.com
BP Alternative Energy, Chertsey Road, Sunbury, Middlesex TW16 7LN, UK

3. Project Objectives

- Provide assurance that secure geological storage of CO_2 can be cost-effectively verified and that long-term assurance can be provided by short-term monitoring.
- Demonstrate to stakeholders that industrial-scale geological storage of CO_2 is a viable GHG mitigation option.
- Set precedents for the regulation and verification of the geological storage of CO_2, allowing eligibility for GHG credits

4. Recent Milestones

- High Resolution Repeat Seismic survey acquired over the northern CO2 plume. ¼ million work-hours with zero accidents. Processing and interpretation (both 3D and 4D) currently underway, with results expected in 2Q 2010. Data quality exceeds expectations.
- INSAR program continues to exceed expectations of resolution and reliability.
- Monitoring well KB-5 now fully decommissioned.
- High-resolution tilt-meters being installed over the southern CO2 plume.
- A project website is now available at: www.insalahco2.org
- A proposal for a New Methodology for CCS in the UNFCC Clean Development Mechanism (CDM) was submitted to the UNFCCC (CDM Executive Board) in August, along with a draft Project Design Document (PDD). The proposal responds to requests from the Conference of the Parties to the Kyoto Protocol and demonstrates how a CCS project can comprehensively address the technical issues of "boundaries, leakage and permanence" (that were previously perceived to be barriers to deployment). As of December 2009, there has been no response from the CDM Executive Board.

5. Status

- Storing ~1mmtpa CO_2 in a deep saline aquifer (1900 deep, 2m thick, 10mD permeability).
- The currently funded program ends at end 2010, so options for a post-2010 program are being designed. The project expects to seek co-funding opportunities early in 2010.
- A coordinated roll-out of project lessons-learned in Phase 1 is planned for the IEA's GHGT-10 Conference in September 2010.

Regional Carbon Sequestration Partnerships (RCSP) Project

CSLF Project Status Report

January 2010

1. Project Location

Various locations in United States and Canada

2. Project Lead

National Regional Carbon Sequestration Partnership (RCSP) Initiative Managed by the U.S. Department of Energy National Energy Technology Laboratory (NETL)

- Sean Plasynski, Sequestration Technology Manager, NETL (email: sean.plasynski@netl.doe.gov)
- John Litynski, Sequestration Division Director, NETL (email: john.litynski@netl.doe.gov)
- Traci Rodosta, Regional Partnerships Coordinator, NETL (email: traci.rodosta@netl.doe.gov)

3. Project Objectives

- Coordinate this government/industry effort of seven RCSPs tasked with determining the most suitable technologies, regulations, and infrastructure needs for carbon capture, transport, and storage across areas of the United States and Canada.
- Develop the infrastructure necessary for the future deployment and commercialization of carbon capture and storage (CCS) as a critical strategy mitigation of greenhouse gas emissions and climate change.
- Implement the RCSP program in three phases:
  - Characterization Phase (2003 – 2005): The partnerships completed the initial characterization of their regions' potential to store CO_2 in different geologic formations.
  - Validation Phase (2005 – 2010): The partnerships are validating the most promising regional sequestration opportunities through a series of small-scale field tests. This phase builds upon Characterization Phase accomplishments and begins field testing of geologic and terrestrial sequestration technologies to provide the technical foundation for Development Phase activities.
  - Development Phase (2008 – 2017): The partnerships will implement large-scale field testing involving at least one million tons of CO_2 per project to confirm that CO_2 injection and storage can be achieved safely, permanently, and economically. These tests will include one to three years of site characterization; one to three years of injection; and two or more years of post-injection monitoring, verification, and accounting (MVA).

4. Recent Milestones

- Validation Phase was initiated in 2005 and is scheduled for completion in 2010. A total of 16 out of 21 small scale field tests have been completed and the remaining 5 should be completed by early 2010. Below are the results from the completed tests.

  Completed Saline Formation CO_2 injection field tests:

  Midwest Regional Carbon Sequestration Partnership (MRCSP)

  - Michigan Basin – two injection tests totaling 60,000 tons in the Bass Islands Dolomites completed in July 2009

- Cincinnati Arch – injection of approximately 1,000 tons in the Mt. Simon was completed in September 2009
- Appalachian Basin – injection was completed in September 2008 targeting the Oriskany and Clinton Sandstones

Southeast Regional Carbon Sequestration Partnership (SECARB)

- Mississippi Gulf Coast – injection of approximately 3,000 tons into the Lower Tuscaloosa Formation at Plant Daniel in late 2008.

West Coast Regional Carbon Sequestration Partnership (WESTCARB)

- Colorado Plateau – evaluation completed in Naco and Martin Sandstones in December 2009

Completed Enhanced Oil or Gas Recovery and CO_2 storage:

Midwest Geological Sequestration Consortium (MGSC)

- Illinois Basin – Huff'n Puff test in the Weller Sandstone was completed in March 2007 in Fayette County, Illinois; approximately 43 tons of CO_2 were injected and 93 barrels of oil produced
- Illinois Basin – injection of approximately 8,000 tons into the Bald Unit at the Mumsford Hills Oil Field.

Plains CO_2 Reduction Partnership (PCOR)

- Williston Basin – Huff' n Puff in the Duperow Formation was completed in June 2009 in Williams County, North Dakota; approximately 440 tons were injected producing through September 17th approximately 242 barrels of oil and 1,991 million cubic feet of natural gas
- Zama Oil Field – acid gas (CO_2 and H_2S) injection was completed December 2006 in the Middle Deveonian Keg River Formation at the Alberta, Canada, site in which over 30,000 tons of CO_2 has been injected, producing more than 25,000 barrels of oil

Southeast Regional Carbon Sequestration Partnership (SECARB)

- Cranfield Oil Field – initial injection of 500,000 tons into the Tuscaloosa Formation was completed in July 2008 for enhanced oil recovery, project transitioned into Development Phase and to date more than one million tons of CO_2 has been injected.

Southwest Regional Partnership on Carbon Sequestration (SWP)

- Aneth Oil Field – as of December 2009, approximately 250,000 tons have been injected into the Deep Creek and Ismay Formations within the Paradox Basin for EOR operations
- SACROC – injection of approximately 475,000 tons to date into the Horseshoe Atoll and Pennsylvania Reef/Bank Play in the Permian Basin

Completed Enhanced Coalbed Methane (ECBM) CO_2 tests:

Midwest Geological Sequestration Consortium (MGSC)

- Illinois Basin – the 100 ton injection was completed in July 2008 into the Pennsylvanian Carbondale Formation at 2-3 tons per day, methane gas was produced as a result

Plains CO_2 Reduction Partnership (PCOR)

- Williston Basin – injection of 90 tons into the Harmon Coal in the Fort Union Formation

Southwest Regional Partnership on Carbon Sequestration (SWP)

- San Juan Basin – to date approximately 18,400 tons has been injected into the coals in the Upper Cretaceous Fruitland Formation, and methane has been subsequently produced. Desalination of produced water is being used for irrigating stressed riparian areas near the injection site as part of the SWP Validation Phase terrestrial project.

Southeast Regional Carbon Sequestration Partnership (SECARB)

- Central Appalachian Basin – injection of 1,000 tons into coals in the Pocahontas and Lee Formations was completed in early 2009
- **Terrestrial Sequestration Projects:** Eleven successful terrestrial sequestration projects have been ongoing during the Validation Phase, and some projects will continue through 2010. Project categorization includes agriculture soils, soil reclamation, afforestation, accounting/aggregation and wetlands reclamation.

- Development Phase activities began in 2008 and will continue for approximately 10 years. There are nine large-volume injection tests with injections initiating between 2009 – 2011. These injection tests are being conducted primarily in saline formations with one test being conducted in an oil bearing formation.

Partnership Development Project Status:

Big Sky Regional Carbon Sequestration Partnership (Big Sky)

- The Partnership is currently conducting final site determination activities.

Midwest Geological Sequestration Consortium (MGSC)

- The Partnership will conduct a large scale saline formation test in the Illinois Basin that will inject 365,000 tons of CO_2 per year into the Mt. Simon Sandstone for three years totaling one million tons. The source of the CO_2 will be the Archer Daniels Midland Company (ADM), ethanol production facility in Decatur, Illinois. It is scheduled to begin injection in the 2010/2011 timeframe.

Midwest Regional Carbon Sequestration Partnership (MRCSP)

- Due to business decisions, it was decided to relocate the initial site from Greenville, Ohio. The Partnership is currently conducting final site determination activities.

Plains CO_2 Reduction Partnership (PCOR)

- The Partnership will be conducting two large-volume geologic CO_2 storage projects, one saline and one EOR. The Williston Basin project in North Dakota will couple EOR and CO_2 storage of over one million tons into a deep carbonate formation that is also a major saline formation. The second demonstration, the Fort Nelson project, will capture over one million tons of CO_2 per year from one of the largest gas-processing plants in North America, compress it, and transport the CO_2 via pipeline to the injection site, most likely a Devonian-age Elk Point carbonate rock formation located near the gas processing plant.

Southeast Regional Carbon Sequestration Partnership (SECARB)

- The Partnership will be conducting two injection tests at two locations to assess different CO_2 streams, both injecting in the Lower Tuscaloosa Formation. The first test, or Early Test, was started injection in April 2009 and will inject one and a half million tons of CO_2 over 18 months. CO_2 is from a naturally

occurring source, Jackson Dome, and will be delivered by Denbury Resources' CO_2 pipeline. The second test, or Anthropogenic Test, will inject 100,000 to 250,000 tons of CO_2 per year for four years. The CO_2 will be supplied from flue gas produced at Alabama Power's Plant Barry located near the injection site.

Southwest Regional Partnership on Carbon Sequestration (SWP)

- The Partnership will conduct a large scale saline injection test into deep Jurassic-, Triassic-, and Permian-aged sandstone in the Farnham Dome of Utah. The simultaneous injection of CO_2 into two formations will total 3 million tons of CO_2 over a four-year period. The CO_2 will come from both a natural CO_2 source in the Jurassic-aged Nugget Sandstone, and a second source from a coalbed methane production field northwest of Price, Utah.

West Coast Regional Carbon Sequestration Partnership (WESTCARB)

- Due to business decisions, it was decided to relocate the site. The Partnership is currently conducting final site determination activities.

- NETL is continuing ongoing collaboration with Interstate Oil and Gas Compact Commission (IOGCC), through SECARB, to evaluate potential for subsurface geological storage of CO_2, in Federal waters, Gulf of Mexico (GOM), utilizing existing infrastructure, such as wells and pipelines and addressing regulatory, legal and technical issues.

- The Regional Carbon Sequestration Partnerships', "Public Outreach and Education for Carbon Storage Projects Best Practices Manual" has been completed and scheduled for release online end of December 2009.

5. Status

- The RCSPs span 43 states and 4 Canadian provinces and include agency participation from six member countries of the CSLF.
- 16 of the 21 geologic and 11 terrestrial field tests have been completed in the Validation Phase with the remaining 5 geologic tests being completed in 2010.
- The Development Phase is underway starting 2008, with the first four awards announced in late 2007 and three more large-scale awards announced in 2008.
- The 2008 Regional Carbon Sequestration Partnerships Program Review Proceedings, which include more detailed descriptions of status, are at: http://www.netl.doe.gov/publications/proceedings/09/rcsp/index.html

6. Links to RCSP Programmatic Information

- Carbon Sequestration webpage on the NETL website: http://www.netl.doe.gov/technologies/carbon_seq/index.html
- Carbon Sequestration Newsletter (distributed monthly): http://www.netl.doe.gov/technologies/carbon_seq/refshelf/subscribe.html
- Carbon Sequestration Technology Roadmap and Program Plan 2007: http://www.netl.doe.gov/technologies/carbon_seq/refshelf/project%20portfolio/2007/2007Roadmap.pdf
- Carbon Sequestration Atlas of the United States and Canada: http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlasII/

- An Introduction to Carbon Capture and Sequestration (video): mms://prod-mmedia.netl.doe.gov/carbon_sequestration_sept.wmv
- Carbon Sequestration Program Environmental Reference Document: http://www.netl.doe.gov/technologies/carbon_seq/refshelf/nepa/index.html
- Carbon Sequestration Project Portfolio: http://www.netl.doe.gov/technologies/carbon_seq/refshelf/project%20portfolio/2009/
- Regional Carbon Sequestration Partnerships Phase I Accomplishments, see: http://www.netl.doe.gov/technologies/carbon_seq/partnerships/phase1/workproducts_table.html

Zama Acid Gas Enhanced Oil Recovery, CO_2 Sequestration, and Monitoring Project

CSLF Project Status Report

January 2010

1. Project Location
Zama City, Alberta, Canada
2. Project Leads
• Ed Steadman, Energy & Environmental Research Center, Grand Forks, North Dakota, USA - E-mail: esteadman@undeerc.org • Steven Smith, Energy & Environmental Research Center, Grand Forks, North Dakota, USA - E-mail: ssmith@undeerc.org • Bill Jackson, Apache Canada Ltd, Calgary, Alberta, Canada - E-mail: bill.jackson@apachecorp.com
3. Project Objectives
• To validate the sequestration of CO_2-rich acid gas in a depleted oil reservoir.
4. Recent Milestones
• New work has been initiated to determine: - Interfacial tension between injected acid gas stream and formation brine to better understand how fluids are distributed and retained in porous media. - Threshold intrusion pressure for the Zama acid gas rich brine to better understand leakage potential from the system - Compressive rock strengths of cap rock material prior to and after exposure to acid gas.
5. Status
• Injection is ongoing. Over 40,000 tons of acid gas has been injected to date. • Approximately 25,000 incremental barrels of oil have been produced to date. • The Draft Regional Technology Implementation Plan and Final Reporting have been completed.

ZeroGen Project

CSLF Project Status Report
January 2010

1. Project Location
Emerald, Queensland, Australia
2. Project Lead
Tony Tarr (tony.tarr@zerogen.com.au) Chris Greig (chris.greig@zerogen.com.au)
3. Project Objectives
ZeroGen is part of the national and international collaborative effort to accelerate the deployment of low emission technologies. • Established by the Queensland Government to facilitate the development and accelerated deployment of low emissions coal technology to preserve the State's competitive position in power generation and continued mining, use and exports of its extensive coal resources. • Provide 530MW (gross) IGCC power plant with CCS of up to 3 million tones CO_2 per annum.
4. Recent Milestones
• Extensive prefeasibility study underway, to be completed mid 2010. • Study funded by State Government, Australian Coal Association Low Emissions Technologies Pty Ltd, Mitsubishi Corporation and Mitsubishi Heavy Industries. • MHI agreed to provide EPC wrap for IGCC and carbon capture. • Test injection of CO_2 underway in Northern Denison Trough near Emerald. • Application made to federal government for funding under its Clean Energy Initiative CCS Flagships Program.
5. Status
• Power plant site selection Q1 2010 • Environmental Impact Study to be commence Q1 2010 • Feasibility study commences Q3 2010 • Construction to begin 2012 • Operations commence end 2015