



# Strategic Plan Implementation Report

September 2011



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# Report from the CSLF Secretariat

## Capacity Building Projects Moving Forward

A series of meetings of the CSLF Capacity Building Governing Council were held. Locations included May 2011 in Rotterdam, Netherlands; June 2011 in Paris, France; and September 2011 in Washington, D.C. At these meetings, the requests from the developing countries were discussed and decisions were made to go forward with a total of nine capacity building projects in five countries (Brazil, China, India, Mexico, and South Africa). Two remaining requests are being considered by the CSLF Capacity Building Governing Council. A report on CSLF Capacity Building Program Achievements will be presented to the CSLF Ministers at the CSLF Ministerial Meeting in September.

## CSLF Financing Roundtable

On April 7, 2011, the CSLF Financing CCS Task Force co-sponsored a roundtable discussion with the Asian Development Bank in Singapore. The discussion focused on capturing critical trigger points that may allow private investment to flow in the CCS projects. A key factor going forward will be that the use of CO<sub>2</sub> and potential future carbon offset revenues may mitigate some of the higher incremental costs and risks of CCS. An additional meeting is scheduled for September 2011 in Washington, D.C.



*CSLF Storage and Monitoring Projects Interactive Workshop in Al Khobar and Shaybah, Saudi Arabia – March 1-2, 2011*

## CSLF Storage and Monitoring Projects Interactive Workshop and PIRT Meeting

The Kingdom of Saudi Arabia hosted the 2011 CSLF Storage and Monitoring Projects Interactive Workshop and PIRT Meeting from March 1-3, 2011 in Al Khobar and Shaybah, Saudi Arabia. CSLF experts from around the globe shared their experience in implementing carbon capture and storage (CCS) technologies. The workshop was sponsored by the Saudi Ministry of Petroleum and Natural Resources and Saudi Aramco. The workshop included a tour of Saudi Aramco's Shaybah Gas-Oil Separation Plant.

CSLF Recognized Projects featured:

- CO<sub>2</sub> Field Lab Project
- CO<sub>2</sub>CRC Otway Project

- CO<sub>2</sub> Store Project / Sleipner and Snøvit Projects
- Fort Nelson Carbon Capture and Storage Project
- Geologic CO<sub>2</sub> Storage Assurance at In Salah, Algeria

## Upcoming CSLF Meeting

- 2011 CSLF Ministerial Meeting  
Beijing, China  
September 19-23, 2011



CSLF Technical Group Meeting in Edmonton, Alberta, Canada – May 18-20, 2011

- IEA GHG Weyburn-Midale CO<sub>2</sub> Monitoring and Storage Project
- Ketzin Test Site Project (formerly CO<sub>2</sub> Sink Project)
- Lacq CO<sub>2</sub> Capture and Storage Project
- Regional Carbon Sequestration Partnerships
- SECARB Early Test at Cranfield Project
- Zama Acid Gas EOR, CO<sub>2</sub> Sequestration, and Monitoring Project

The CSLF Storage and Monitoring Projects Interactive Workshop was divided into three sessions. The first session was titled “CO<sub>2</sub> Storage Capacity Methodologies and Standards” and identified and described capacity assessment methodologies used by CSLF-

recognized projects, including limits, constraints, and advantages of these technologies. Session two was titled “Behavior of Sequestered CO<sub>2</sub> under Different Regimes of CO<sub>2</sub> Purity, Pressure, Temperature” and explored the reactivity and migration characteristics of CO<sub>2</sub> under varying conditions in differing sequestration applications. The last session was titled “CO<sub>2</sub> Monitoring Experiences and Recommended Paths Forward” and presented descriptions of monitoring practices and provided experience-based recommendations in monitoring CO<sub>2</sub>.

Presentations from the CSLF Storage and Monitoring Projects Interactive Workshop are available at the following link: [http://www.cslforum.org/meetings/workshops/technical\\_alkhobar2011.html](http://www.cslforum.org/meetings/workshops/technical_alkhobar2011.html)

## CSLF Technical Group Meeting

The CSLF held its Technical Group Meeting in Edmonton, Alberta, Canada from May 18-20, 2011. The first day consisted of individual group meetings, including the CCS in the Academic Community Task Force, Risk Assessment Task Force (RATF), and the Projects Interaction and Review Team (PIRT).

The second day featured a welcoming by Sandra Locke, Assistant Deputy Minister, Alberta Energy. Two projects were nominated for CSLF Recognition: Zero Emissions Porto Tolle (ZEPT) Project and the Janschwalde Project. The luncheon included a presentation on the Fort Nelson Carbon Capture and Storage Feasibility Project by Alan Laundry, Director of the Fort Nelson Project, Spectra Energy, Canada. The evening dinner was sponsored by Shell and featured a presentation titled “The Importance of CCS in Addressing Greenhouse Gas Challenges faced by Oil Sands Development” by Ian Silk, Quest Venture Manager, Shell Canada Energy, Canada.

The final day included a site visit to the CSLF-recognized project, the Quest CCS Project. The full meeting summary, along with other documents from the meeting, can be found at the following link: <http://www.cslforum.org/meetings/edmonton2011/index.html>

## CSLF Secretariat Prepares for 2011 CSLF Ministerial Meeting

The CSLF Secretariat is in the final stages of coordinating and preparing for the 2011 CSLF Ministerial Meeting, from September 19-23, 2011 in Beijing, China. All agendas and conference documents for the Policy Group, Technical Group, Stakeholders Forum, and Ministers, have been prepared and are available at the CSLF website. The Secretariat expects a large turnout for this meeting, as over 400 people have already registered.

The first day of the 2011 CSLF Ministerial Meeting will feature meetings of various task forces. During the afternoon of Monday, September 19, the Projects Interaction and Review Team (PIRT) will meet in Jewel Hall A from 3:00-6:00PM. Meanwhile, the CCS in Academic Community Task Force and Financing CCS Task Force will meet in Jewel Hall B from 3:00-4:30PM and 4:30-6:00PM respectively.

Task force meetings will continue on the morning of Tuesday, September 20. The Risk Assessment Task Force (RATF) will meet in Jewel Hall A from 9:00-10:00AM. Afterwards, the Task Force for Assessing Progress on Technical Issues Affecting CCS will meet in Jewel Hall A from 10:00AM-12:00PM. At the same time, the Capacity Building Task Force and Capacity Building Governing Council will meet in Jewel Hall B from 10:00-11:00AM and 11:00AM-12:00PM



*Chang An Street, Tiananmen, Beijing, China*

respectively. After a luncheon sponsored by IEA-UNIDO, the Policy Group and Technical Group will convene for separate meetings from 1:30-5:30PM. The Policy Group will meet in Jewel Hall, while the Technical Group will meet in Le Salon Raffles on the 7th floor.

The morning of Wednesday, September 21, will feature the Opening Ceremony of the 2011 CSLF Ministerial Meeting at 8:30AM in Jewel Hall. The ceremony will include host country remarks by China's Vice Minister of Science and Technology Cao Jianlin. Policy Group Chair Charles McConnell, United States, will deliver the Opening Statement. Afterwards, Vice Minister Cao and Policy Group Chair McConnell will join CSLF Secretariat Director

Barbara McKee in presenting the CSLF Global Achievement Awards. The Policy Group and Technical Group will reconvene for their separate meetings from 9:15AM-12:30PM in Jewel Hall and Le Salon Raffles respectively.

Later that day, the Stakeholder Forum with Exhibition will be conducted in Golden Hall in Building C. Sun Chengyong, Counsellor, Department of Social Development, Ministry of Science & Technology, China; and Jeff Chapman, Chief Executive Officer, Carbon Capture and Storage Association, United Kingdom, will serve as the forum co-chairs. China's Vice Minister of Science and Technology Wang Weizhong will provide a keynote address and welcoming remarks. Philippe Joubert, Deputy Chief Executive



Guardian Lion Statue in the Forbidden City, Beijing, China

Officer, Alstom, France, will provide the second keynote address. Topics for the two sessions during the Stakeholders Forum will be “State-of-the-Art CCS Technologies” and “What Will Make CCS Attractive to Investors?”

Thursday, September 22, will include the Ministerial Roundtable in Golden Hall in Building C. The Open Session with Exhibition of the Ministerial Roundtable will occur during the morning, from 8:30AM-12:30PM, with the Closed Session occurring during the afternoon, from 2:00-4:00PM. Later that afternoon will be the Press Conference in Jewel Hall, with statements provided by United States Secretary of Energy Steven Chu, China’s Minister of Science and Technology Wan Gang, China’s Vice Chairman of the National Development and

Reform Commission Xie Zhenhua, Mexico’s Secretary of Energy José Antonio Meade Kuribreña, and South Africa’s Minister of Energy Dipuo Peters.

On the final day of the meeting, the Joint Meeting of the CSLF Policy and Technical Group will take place on Friday, September 23, from 9:00AM-12:30PM in Jewel Hall. The afternoon will feature a technical site visit to the Huaneng Group Beijing Gaobeidian, a 3000 tons per annum CO<sub>2</sub> capture pilot project.

Additional information about the meeting, including the overall program, agendas, documents, and hotel information, is online at the CSLF website: <http://www.cslforum.org/meetings/beijing2011/premeeting.html>

## CSLF Storage and Monitoring Projects Interactive Workshop



**Al Khobar  
and  
Shaybah,  
Saudi Arabia**

**March 1-2,  
2011**



# CSLF Storage and Monitoring Projects Interactive Workshop



**Al Khobar  
and  
Shaybah,  
Saudi Arabia**

**March 1-2,  
2011**



## CSLF Projects Interaction and Review Team (PIRT) Meeting



**Al Khobar,  
Saudi Arabia  
March 3, 2011**



## CSLF Technical Group Meeting



Edmonton,  
Alberta,  
Canada

May 18-20,  
2011



## CSLF Technical Group Meeting



**Edmonton,  
Alberta,  
Canada**

**May 18-20,  
2011**



# Report from the CSLF Stakeholders

September 2011

*The South African Centre for Carbon Capture and Storage (SACCCS)  
South Africa*

The carbon dioxide geological storage Atlas was launched by the Minister during September 2010 and the Atlas report was released during January 2011. The Atlas is available on the website [www.sacccs.org.za](http://www.sacccs.org.za).

A project to take the potential storage from a theoretical level to an effective level in the Zululand Basin is underway. A study to undertake a similar study in the on-shore Outeniqua Basin is scheduled to start March, 2011. A Scoping Study for the South African Test Injection Project is scheduled to start January, 2011.

A CCS Week is scheduled for 24-28 October in Johannesburg. The week will comprise a two day conference to disseminate CCS activities in South Africa and four workshops – CCS Projects, Legal & Regulatory, Risk Assessment and Public Outreach.

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*2Co Power (Yorkshire) Ltd*

Powerfuel Power Ltd's IGCC coal fired CCS project at Hatfield has been acquired by **2Co Energy**. The project remains substantially the same, though promising EOR plans have now been added to its strengths (including FEED, location, consents, technology partners, state of readiness, coal supply, etc) The project company has been renamed 2Co Power (Yorkshire) Ltd. and the project itself has been renamed the **Don Valley Project**.

We would expect the next stakeholders' report to focus on issues relating to public funding commitments, timeline and more awareness of and support for EOR where it is an option.

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*Gorgon Project  
Chevron Australia Pty Ltd.  
Perth, Australia*

Construction of the Gorgon Project continues. 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>

# Capacity Building in Emerging Economies Task Force

## CSLF Task Force Strategic Implementation Report September 2011

<p><b>1. Task Force Members</b></p> <ul style="list-style-type: none"> <li>• Saudi Arabia – Abdulmuhsen Alsunaid (Chair)</li> <li>• Australia – Bruce Murphy</li> <li>• Canada – Siddiq McDoom</li> <li>• European Commission – Jeroen Schuppers</li> <li>• France – Bernard Frois, Pierre Le Thiez</li> <li>• Mexico – José Miguel González Santaló</li> <li>• United Kingdom – Louise Barr</li> <li>• United States – George Guthrie</li> <li>• GCCSI – Bob Pegler</li> <li>• World Bank – Natalia Kulichenko</li> </ul>
<p><b>2. Purpose of Task Force</b></p> <p>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.</p>
<p><b>3. Milestones</b></p> <ul style="list-style-type: none"> <li>• Six workshops held (2007-2008)</li> <li>• New Capacity Building Initiative launched at CSLF Ministerial Meeting (2009)</li> </ul>
<p><b>4. Status</b></p> <ul style="list-style-type: none"> <li>• Task Force meeting held in October 2010 (Warsaw, Poland).</li> <li>• 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.</li> <li>• 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.</li> <li>• 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. The Capacity Building Task Force is working to refine and endorse capacity building criteria based on responses received.</li> <li>• The Capacity Building Task Force reviewed requests from Brazil, China, Mexico, India and South Africa. It found that most of the requests meet the capacity building objectives and recommended their implementation by the Capacity Building Governance Council based on fund availability.</li> <li>• A total of nine capacity building projects in five countries have been approved to date and will be conducted by the CSLF. Two remaining requests are being considered by the CSLF Capacity Building Governing Council.</li> <li>• The Capacity Building Task Force also contributed to the organization and deliberations of the CSLF Capacity Building Governing Council, including the final allocation of funds to capacity building projects.</li> </ul>

## **Communications Task Force**

### **CSLF Task Force Strategic Implementation Report**

#### **September 2011**

<b>1. Task Force Members</b>
<ul style="list-style-type: none"><li>• Australia – Margaret Sewell</li><li>• European Commission – Marisa Atienza Morales</li><li>• Mexico – José Miguel González Santaló</li><li>• Norway – Tone Skogen</li><li>• United Kingdom – Jeremy Martin</li><li>• United States – John Grasser (Chair)</li></ul>
<b>2. Purpose of Task Force</b>
Implement a communications strategy to raise the profile of the CSLF and CCS.
<b>3. Milestones</b>
<ul style="list-style-type: none"><li>• Initiated development of an overall CSLF outreach strategy;</li><li>• 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;</li><li>• Initiated the redevelopment of the CSLF information kit;</li><li>• Initiated the establishment of a CSLF daily clipping service to all members;</li><li>• Initiated conceptual redesign of CSLF exhibit with new graphics to mirror web page;</li><li>• Initiated development of CSLF web page linking policy;</li><li>• Initiated development of CSLF conference sponsorship policy;</li><li>• Initiated review and updating of all CSLF materials in advance of Beijing Ministerial for media and public handout, including the full set of “InFocus” CCS message papers;</li><li>• Initiated update of CSLF speech for member use; Initiated update of CSLF power point presentation for member use;</li><li>• Initiated update of DVDs containing CSLF materials.</li></ul>
<b>4. Status</b>
<ul style="list-style-type: none"><li>• Communications strategy now being implemented;</li><li>• Completed development of CSLF web site with improved functionality and graphic presentation;</li><li>• Completed development of CSLF daily clipping service for members/stakeholders;</li><li>• Redesign and printing of new CSLF handout materials ongoing;</li><li>• CSLF exhibit redesign/updating ongoing;</li><li>• Completed development of CSLF web page linking policy;</li><li>• Completed CSLF conference sponsoring policy;</li><li>• Standard CSLF speech updated;</li><li>• CSLF power point presentation updated and distributed to Policy and Technical Groups;</li><li>• Completed development/updating of “Infocus” message papers in advance of Beijing Ministerial;</li><li>• Completed production/update of DVDs containing various CSLF materials for public distribution.</li></ul>

# Projects Interaction and Review Team (PIRT)

## CSLF Task Force Strategic Implementation Report September 2011

### 1. Task Force Members

The PIRT consists of:

- A core group comprising Members of the Technical Group, or as nominated by a CSLF Member country. Current membership consists of representatives from:

Australia	Clinton Foster (Chair)
Canada	Stefan Bachu
Denmark	Flemming Ole Rasmussen
European Commission	Jeroen Schuppers
France	Pierre Le Thiez
Germany	Jürgen-Friedrich Hake
Japan	Ryo Kubo
Mexico	José Miguel González Santaló
Netherlands	Harry Schreurs
Norway	Trygve Riis
Saudi Arabia	Khalid Abuleif, Abdulmuhsen Alsunaid
South Africa	Tony Surridge
UK	Philip Sharman
USA	George Guthrie, Joseph Giove
Global CCS Institute	Kathy Hill

During the period of this report the PIRT Chair resides with Australia.

- An *ad hoc* group of Stakeholders comprising representatives from CSLF-recognized projects.

### 2. Purpose of Task Force

The PIRT has the following functions:

- Assess projects proposed for recognition by the CSLF in accordance with the project selection criteria developed by the Technical Group and 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, and gaps, providing feed back to the Technical Group
- Provide input for further revisions of the CSLF Technology Roadmap (TRM).
- Identify technical, economic, environmental and other issues where it would be appropriate to have CSLF recognized projects.
- 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.
- Ensure a framework for periodically reporting to the Technical Group on the progress within CSLF projects.
- Organize periodic events to facilitate the exchange of experience and views on issues of common interest among projects, delegates, and stakeholders and provide feedback to the CSLF.
- Perform other such tasks which may be assigned to it by the CSLF Technical Group

### 3. Milestones

Near term (next 6 months)

- Identify opportunities for future CSLF Workshops based on knowledge sharing and capacity building.
- Re-examine the CSLF Gaps Analysis Checklist as used in the CSLF Project Submission Form with an aim to simplify the Checklist.
- Develop a schedule for the 2011 update of the CSLF Technology Roadmap, expanded to incorporate the assessment of progress on Technical Issues affecting CCS.
- Streamline and implement the process of obtaining CSLF-Project recognition (see Status below).
- Develop a plan for attracting new projects using input from new project questions.
- Coordinate and progress the CSLF efforts regarding Knowledge Management.
- Complete a reassessment of the members within the Working Groups of the Task Force to Assess Progress on Technical Issues Affecting CCS.
  - Develop a schedule of deliverables for the Working Groups.

*It was agreed at the Edmonton meeting that the reporting line for this Task Force was the Technical Group, and as such it is removed from the PIRT Agenda (see below).*

Long term (next >18 months)

- Complete periodic assessments of gaps and upgrades of the TRM.
- Promote awareness of activities among the CSLF members and stakeholders.
- Project engagement workshops, events, networks.
- Collaboration with other organizations.

All long term activities are in progress.

### 4. Status

- Completed CSLF workshops in Al Khobar, Saudi Arabia (March 15, 2011) with a storage-theme; based on the success of these meetings, further workshops are planned. The format allowed adequate question and answer time and all Delegates were encouraged to, and did, participate in discussions.
- Actions arising from the Al Khobar, Saudi Arabia Meeting of the PIRT Group (March 15, 2011).
  - A schedule for the 2011 CSLF TRM update was agreed.
  - Termination of the technology readiness level analysis of CSLF-recognized projects.
  - Wandoan Project (Australia) was assessed and recommended for CSLF recognition.
- Actions arising from the Edmonton, Alberta, Canada Meeting of the Technical Group. (May 18-20, 2011).
  - Australia in collaboration with the GCCSI will take the lead in coordinating CSLF efforts regarding Knowledge Management.
  - 2012 CSLF Technology Roadmap will incorporate revisions to the “Gap Identification” module and a concise gaps listing will be an input to the Roadmap update process.
  - Task Force to Assess Progress on Technical Issues Affecting CCS will be separated from the PIRT and report directly to the Technical Group.
- Three new projects were assessed and recommended for CSLF recognition at the Beijing meeting. They are:
  - Zero Emission Porto Tolle (ZEPT) Project (Italy);
  - Jänschwalde Project (Germany); and
  - Wandoan Project (Australia).
- Consensus reached to change the CSLF-recognition Project Review process. Newly-proposed projects would provide the majority of information through the Project Submission Form and a presentation at a PIRT meeting. Following PIRT approval, summary of project would be provided to the TG at the next meeting by a TG delegate of the country hosting the project. Following TG approval, the TG Chair would present to the Policy Group in a single summary view chart for final approval.

# Assessing Progress on Technical Issues Affecting CCS

## CSLF Task Force Strategic Implementation Report September 2011

<b>1. Task Force Members</b>
<ul style="list-style-type: none"> <li>The Task Force is chaired by Australia (Clinton Foster) and comprises four Working Groups: Capture (chair US, George Guthrie); Transport and Infrastructure (chair Netherlands, Harry Schreurs); Storage and Monitoring (chair Canada, Stefan Bachu); Integration (chair Global CCS Institute, Klaas van Alphen).</li> </ul>
<b>2. Purpose of Task Force</b>
<p>Technical issues affecting the deployment of CCS are recognized in each of the four working groups: these issues are outlined in the gaps analysis that accompanies the CSLF Technology Road Map. The purpose of the Task Force is to assess the progress closing those gaps; and for those outcomes to be incorporated into the 2012 update of the CSLF Technology Road Map.</p> <p>Two significant challenges have arisen, through the Working Groups, for the Task Force: the level of granularity included in the gap analyses; and the scale at which the technical issue is being addressed. The focus of the Task Force is on issues that affect large scale deployment of CCS.</p>
<b>3. Milestones</b>
<p>Since the establishment of the Task Force in Q1, 2010, progress has been reported: at the Warsaw CSLF Annual meeting (establishment of and composition of Working Groups) and the CSLF Technical Meeting in Edmonton.</p> <p>Future milestones are:</p> <ul style="list-style-type: none"> <li>September 2011, Task Force Report to Technical Group at the CSLF Ministerial Meeting; Beijing;</li> <li>December 2011, Task Force Report and outcomes to inform the 2012 CSLF Technology Road Map update.</li> </ul>
<b>4. Status</b>
<p>Progress across the Working Groups has been variable; although all Working Groups are completing their assessment and updating of the existing gaps analysis as outlined in the CSLF Project Submission Form and Technology Road Map. Initial interest in participation in the Working Groups was high, particularly from stakeholders. At the Edmonton CSLF Technical Group meeting it was recognized and reinforced that the Task Force is focused on technical issues, and that technical expertise and input was required in the Working Groups: the chair of each of the groups was asked to reassess membership. Importantly outcomes of this Task Force will be available to all members and stakeholders.</p> <p>As noted above, two significant challenges arose for the Working Groups, the level of granularity to be included in the gaps analysis, and the scale at which the technical issue is being addressed. Another difficulty, which is not yet resolved, is how to measure progress – which, again, can be an issue of scale. The Task Force will consider progress from CSLF-recognised projects and, dependent upon resourcing, look to projects and results outside the CSLF.</p> <p>The Working Group dealing with Integration is chaired by the Global CCS Institute. The CSLF <i>Integration</i> Working Group will work in collaboration with the Institute's Project Integration Challenges Thematic Group to address the need for whole of CCS project integration, to inform and enable the proponents of early stage project proposals to incorporate key learnings from prior projects into their plans and schedules. This is an effective synergy between the CSLF Technical Group and the GCCSI</p>

# CCS Northern Netherlands Project

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
Groningen Province, Netherlands
<b>2. Project Lead</b>
Desmond de Vries (ddevries@provinciegroningen.nl)
<b>3. Project Objectives</b>
<p>This project will implement a large-scale regional plan for capture, transport and storage of CO<sub>2</sub> off shore around the Eemsharbor complex in Groningen province in the northern part of the Netherlands. The project will capture CO<sub>2</sub> from existing and planned power plants, transport the CO<sub>2</sub> to the storage location, and store the CO<sub>2</sub> safely underground in off-shore natural gas fields. The project represents all elements of the CCS chain (capture, transport, reuse and storage), as well as including different CO<sub>2</sub> capture techniques (pre-combustion and post-combustion). Additionally, the project will develop a communication strategy, engage stakeholders, and work toward developing a legal framework for CCS in the region.</p>
<b>4. Recent Milestones</b>
<ul style="list-style-type: none"> <li>• The Dutch government has earlier this year postponed the on shore storage of CO<sub>2</sub> and has offshore storage marked as the first option.</li> <li>• The recent project proposals from Nuon (Vattenfall) and Essent (RWE) aimed at onshore storage and therefore haven't been sent to the EU NER300 by the Dutch government.</li> <li>• For the second tender of the NER300 companies are expected to alter their proposal to offshore storage.</li> </ul>
<b>5. Status</b>
<p>Projects of Nuon (Vattenfall) en Essent (RWE) are now in preparation for the NER300, round 2. Both power plants are built. In the Netherlands the necessary CCS regulation is being implemented.</p> <p>Because local acceptance has driven politicians to stop plan of onshore storage, companies are now changing their plans to offshore.</p> <p>In the Northern Netherlands CCS is still an issue on local/ regional political agenda as well as part of the public debate. Therefore a broader energy dialogue is planned (without the pressure of concrete projects). This dialogue has two main goals: to disseminate information and broaden the perspective on energy climate issues and secondly to (step by step) pave the way for future energy projects.</p>

# CCS Rotterdam Project

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
Rotterdam, The Netherlands
<b>2. Project Lead</b>
<ul style="list-style-type: none"> <li>• Maarten de Hoog (maarten.dehoog@dcmr.nl)</li> <li>• Hans Knippels (hans.knippels@dcmr.nl)</li> </ul>
<b>3. Project Objectives</b>
<ul style="list-style-type: none"> <li>• Development of CCS in the greater Rotterdam area (Port of Rotterdam)</li> <li>• 2015 annual storage of 3 Mton CO<sub>2</sub></li> <li>• 2025 annual storage of 17,5 Mton CO<sub>2</sub></li> </ul>
<b>4. Recent Milestones</b>
<ul style="list-style-type: none"> <li>• EU-EEPR funding for the EON/Electrabel project. (ROAD) CCS demonstration plant of 250 MW size at the new EON coal fired power plant. Final Investment Decision to be made end of 2011</li> <li>• February 2011, NER300 projects from Rotterdam submitted with the national government. <ul style="list-style-type: none"> <li>– Green hydrogen production by Air Liquide. The proposal includes the establishment of a CO<sub>2</sub> terminal. For this the consortium CINTRA was established. Partners within consortium are VOPAK, Anthony Veder, Air Liquide and Gasunie.</li> <li>– Pegasus project, a zero emission power plant. Build of an oxyfuel power plant. Partners within consortium are SEQ International, AES Transpower, CES, Linde Gas and Siemens</li> </ul> </li> <li>• May 2011, annual progress report on CCS, “CO<sub>2</sub> capture and storage in Rotterdam, A network approach” <ul style="list-style-type: none"> <li>– Presentation of roadmap and network approach. Sharing transport and storage functions will result a decrease in cost for transport and storage.</li> <li>– Factsheets of possible CCS-project in the greater Rotterdam area, including: ROAD, Air Liquide, Pegasus, Shell, Air Products. R3CP, OCAP, CINTRA, TAQA, Maersk, GDF Suez.</li> </ul> </li> <li>• May 2011, decision of Dutch government which projects to forward to Brussels for (Possible) NER300 money. Is was decided to send through the Green Hydrogen project of Air Liquide.</li> </ul>
<b>5. Status</b>
<ul style="list-style-type: none"> <li>• Due diligence of several (three) possible CO<sub>2</sub> storage locations on Dutch Continental Shelf had been performed. Further detailed analysis is performed to have clarity on suitability storage location for NER300 applications</li> <li>• Consortium (CINTRA) Development of the shipping business case, participants, Anthony Veder, Gasunie, VOPAK and Air Liquide for development of CO<sub>2</sub> terminal.</li> <li>• NER300 requirements of EU published. Submission of applications before 9th of February with national government.</li> <li>• Air Liquide and Pegasus applied for NER300 subsidy with the Dutch government. Dutch government decided to forward the proposal of Air Liquide (including CINTRA) to Brussels for final selection.</li> <li>• Additional work done by RCI in period January 2011 – July 2011 to support initiatives of companies. <ul style="list-style-type: none"> <li>– DNV study on the safety of transport and transshipment of CO<sub>2</sub> in the port;</li> <li>– Stakeholder management regarding CCS by Twijnstra en Gudde</li> <li>– Independent Storage assessment phase II by TNO</li> <li>– Economic Impact Assessments of CCS in Rotterdam by Ecorys and CE-Delft</li> </ul> </li> </ul>

# CO2CRC Otway Project

## CSLF Project Status Report

September 2011

<p><b>1. Project Location</b></p> <p>Southwestern Victoria, Australia</p>
<p><b>2. Project Lead</b></p> <p>Matthias Raab – Program Manager, Storage</p> <ul style="list-style-type: none"> <li>• Phone: +61 3 8344 4309</li> <li>• Mobile: +61 417 066 318</li> <li>• Email: mraab@co2crc.com.au</li> <li>• CO2CRC, Room 449, School of Earth Science, University of Melbourne, VIC 3010</li> </ul> <p>Rajindar Singh – Otway site Operations Manager</p> <ul style="list-style-type: none"> <li>• Mobile: +61 418 428 020</li> <li>• rssingh@co2crc.com.au</li> <li>• CO2CRC, Room 449, School of Earth Science, University of Melbourne, VIC 3010</li> </ul>
<p><b>3. Project Objectives</b></p> <p>The Otway project has been designed to demonstrate geological storage and monitoring of CO<sub>2</sub> 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.</p> <p>Stage 1: Continue Monitoring and Verification.</p> <p>Stage 2: Drill well CRC-2(Stage 2a), determine residual gas saturation (S<sub>gr</sub>) of CO<sub>2</sub> from a single well test (Stage 2b) and determine smallest plume size of CO<sub>2</sub> that can be imaged by seismic monitoring by injecting of up to approx. 30,000 tons (Stage 2c) into the Parratte saline water formation.</p>
<p><b>4. Recent Milestones</b></p> <ul style="list-style-type: none"> <li>• CRC-2 well completed on 27th February 2011 (Stage 2a).</li> <li>• Otway site commissioned for Stage 2b (residual gas saturation test).</li> <li>• Stage 2b test commenced with water production 17th June 2011. Now 24/7 operations until 20th August 2011.</li> <li>• Community Reference Group meeting held in April 2011.</li> <li>• Multiple site visits by local and international visitors.</li> </ul>
<p><b>5. Status</b></p> <ul style="list-style-type: none"> <li>• Geochemical U-Tube sampling system installed in CRC-2 well and operational.</li> <li>• Downhole instrumentation for P/T measurements and downhole heating installed in CRC-2 well and operational.</li> <li>• Ongoing U-tube sampling of reservoir data, atmospheric monitoring, ground water sampling and soil testing to continue as part of Stage 1 activities.</li> <li>• Planning for Otway Stage 2c progressing. Experimental design under peer review.</li> <li>• Community is continuously updated on forward plans through public meetings.</li> </ul>

# CO<sub>2</sub> Field Laboratory for Monitoring and Safety Assessment

## CSLF Project Status Report

September 2011

### 1. Project Location

Project is coordinated by SINTEF in Trondheim (Norway). The Field Laboratory is located at the Svelvik Ridge, 50 km south-east of Oslo (Norway).

Aerial photo showing the Svelvik Ridge. The CO<sub>2</sub> Field Laboratory is indicated by the yellow rectangle (150 m × 300 m)



### 2. Project Lead

- Project Manager: Maria Barrio; SINTEF (maria.barrio@sintef.no)
- Project Coordinator: Audun Bakk; SINTEF (audun.bakk@sintef.no)
- Site & HSE Coordinator: Marion Børresen, NGI (marion.borresen@ngi.no)
- Project Advisor: Erik Lindeberg, SINTEF (erik.lindeberg@sintef.no)

### 3. Project Objectives

- Determine the sensitivity of monitoring systems to detect shallow CO<sub>2</sub> subsurface movements & surface seepage
- Combination of appropriate monitoring technologies
- Definition of a monitoring protocol as a tool for certification
- Test and calibrate geo-models in well controlled conditions
- Inform the public about the safety of CO<sub>2</sub> storage by showing the performance of monitoring systems

### 4. Recent Milestones

- September 2009: Project commenced
- April 2010: Completed initial characterization of site including ground penetrating radar, resistivity and seismic survey)
- July 2010: Completed drilling of deep investigation well (333 m)
- July - December 2010: Completed logging of investigation well, geochemical measurements and hydrodynamic measurements
- December 2010: Completed first draft of monitoring protocol
- February 2011: Completed first phase (site characterization) of the project
- June 2011: Commenced drilling of shallow CO<sub>2</sub> injection well

## 5. Status

Project entered in May 2011 its main (injection) phase. Following activities are scheduled in coming months:

- Shallow CO<sub>2</sub> injection
  - Summer 2011: establishment of injection and monitoring facilities for first (shallow) CO<sub>2</sub> injection
  - Fall 2010: injection of (up to) 5 tonnes CO<sub>2</sub> at 20 metres depth
- Deep CO<sub>2</sub> injection
  - Fall 2011: completion of supplementary characterization of the deep formation (200 – 300 m below surface) including a direct injectivity test and a vertical seismic profiling
  - 2012: injection of (up to) 200 tonnes CO<sub>2</sub> at 200 - 300 metres depth
- Dissemination
  - August 2010: information campaign before shallow injection (public meeting, newsletter etc.)
  - Fall 2011: Project dissemination and technical seminars
- Protocol development
  - November 2011: second update of monitoring protocol
- [www.sintef.no/co2fieldlab](http://www.sintef.no/co2fieldlab)

# CO<sub>2</sub> GeoNet

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
Western Europe
<b>2. Project Lead</b>
<ul style="list-style-type: none"> <li>• Coordinator of the CO2GeoNet project: Dr. Nick Riley (British Geological Survey) - njr@bgs.ac.uk</li> <li>• President of the CO2GeoNet association: Dr. Isabelle Czernichowski (BRGM) -i.czernichowski@brgm.fr</li> <li>• Executive Committee Chair: Dominique Durand (NIVA) - dominique.durand@niva.no</li> <li>• Secretary General: Sergio Persoglia (OGS) – spersoglia@ogs.trieste.it</li> <li>• Contact: info@co2geonet.com</li> </ul>
<b>3. Project Objectives</b>
<ul style="list-style-type: none"> <li>• Focus is R&amp;D into geological storage of CO<sub>2</sub> and strengthening the European Research Area</li> <li>• Form a durable integration of the original 13 partners over 5 years, involve more partners</li> <li>• Provide the underpinning science capability and knowledge to help enable deployment of large scale CO<sub>2</sub> storage in Europe as quickly as possible</li> <li>• Collaborate internationally</li> <li>• Be a source of impartial scientific information on CO<sub>2</sub> geological storage for stakeholders</li> <li>• Train existing and new researchers</li> <li>• Develop and share research infrastructure</li> </ul>
<b>4. Recent Milestones</b>
<ul style="list-style-type: none"> <li>• In April 2008, formed a legal entity, “CO2GeoNet Association” – <a href="http://www.co2geonet.eu">www.co2geonet.eu</a></li> <li>• This will enable new strategic partners to join and existing partners to continue working together</li> <li>• In March 2009, the CO2GeoNet project supported by EC under FP6 has been successfully completed and the new Association members continue to be committed to consider CO2GeoNet as mean for open and active collaboration with the other running CSLF projects</li> <li>• Since then, the Association has continued the mutual integration and joint research programming, acting as a virtual institute involving more than 300 researchers from 7 European nations</li> <li>• CO2GeoNet is actually leading (BRGM-CO2GeoNet acting as project coordinator) “CGS Europe – Pan-European coordination action on CO<sub>2</sub> Geological Storage”, a new EC coordination and support action under FP7, aimed at pooling together the expertise of the key institutes for CO<sub>2</sub> storage in each relevant European Member State and Associated Country – <a href="http://www.cgseurope.net">www.cgseurope.net</a></li> </ul>
<b>5. Status</b>
<ul style="list-style-type: none"> <li>• The CO2GeoNet researchers have prepared basic answers to several frequently asked questions, as to how CO<sub>2</sub> geological storage can be carried out, under what circumstances it is possible, and what the criteria are for its safe and efficient implementation. These are in the CO2GeoNet’s new brochure available in Danish, Dutch, French, German, Hungarian, Italian, Norwegian, Polish, Romanian, Spanish (and soon in Chinese, Russian, Arab and other languages), at <a href="http://www.co2geonet.eu">www.co2geonet.eu</a></li> <li>• Co-organisation of the IEA-GHG Workshop on Natural Releases of CO<sub>2</sub> (Maria-Laach, Germany, 2-4 November 2010)</li> <li>• Co-organisation of the EAGE Student Lecture Tour Europe 2010-2011 on CO<sub>2</sub> Geological Storage. Different experts from CO2GeoNet will give lectures in amongst 45+ universities around Europe</li> </ul>

**5. Status (continued)**

- Latest results of research presented at Annual Stakeholder workshop held May 2011. The focus has been this year on the CO<sub>2</sub> storage developments in Europe at different levels:
  1. latest scientific results and studies;
  2. scientific investigations related to CCS demos and pilots in Europe;
  3. scientific issues related to the implementation of the European Directive on CO<sub>2</sub> Storage.
- Contribution to the CGS Europe Knowledge Sharing Workshop “CO<sub>2</sub> Capture and Storage – Response to Climate Change” (13-14 April 2011, Vilnius, Lithuania)
- Contribution to the CGS Europe Knowledge Sharing Workshop “Legal and regulatory issues for the implementation of the EU Directive on the geological storage of CO<sub>2</sub>” (Venice, 11 May 2011)
- Contribution to the CGS Europe Knowledge Sharing Workshop “Natural Analogues” (17 - 19 October 2011 - Maria Laach, Germany)
- Co-organization of two courses: “The technology of CO<sub>2</sub> capture and geological storage” (BRGM-IFPEN-CO<sub>2</sub>GeoNet partnership) - in French - 17-18 November 2011 and ‘Modelling chemical reactivity during CO<sub>2</sub> geological storage” (BRGM-IFPEN-CO<sub>2</sub>GeoNet partnership) - in English - 10-14 October 2011
- Studies performed for IEA-GHG on various aspects of CO<sub>2</sub> geological storage
- Participation as partner to proposals and contracts supported by EC under FP7
- Scientific advice on development of monitoring plans for CCS demo projects
- e-mail: [info@co2geonet.com](mailto:info@co2geonet.com)
- CO<sub>2</sub>GeoNet website: <http://www.co2geonet.com>

# CO<sub>2</sub> Separation from Pressurized Gas Stream

## CSLF Project Status Report

September 2011

<p><b>1. Project Location</b></p> <p>RITE, Kyoto, Japan (membrane module development) DOE/NETL, Pittsburgh, Pennsylvania, USA (module testing)</p>
<p><b>2. Project Lead</b></p> <p>Dr. Shingo Kazama RITE (Research Institute of Innovative Technology for the Earth) E-mail: kazama@rite.or.jp</p>
<p><b>3. Project Objectives</b></p> <ul style="list-style-type: none"> <li>• Development of molecular gate membrane with excellent CO<sub>2</sub> selectivity over H<sub>2</sub></li> <li>• Development of pre-commercial size membrane module</li> <li>• Testing of the module (with NETL, USA)</li> </ul>
<p><b>4. Recent Milestones</b></p> <ul style="list-style-type: none"> <li>• Improvement of membrane performance (2011-12FY)</li> <li>• Production of improved pre-commercial size membrane module (2011-12FY)</li> <li>• Testing of the membrane module (2013FY)</li> </ul>
<p><b>5. Status</b></p> <p>1st duration: 11/2003 – 03/2006 Completed</p> <ul style="list-style-type: none"> <li>• Development of dendrimer composite membrane for ambient gas pressure and its testing</li> </ul> <p><b>References:</b></p> <p>S. Kazama, T. Kai, T. Kouketsu, S. Matsui, K. Yamada, J. S. Hoffman, H. 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)</p> <p>2nd duration: 04/2006 – 03/2011 Completed</p> <ul style="list-style-type: none"> <li>• Development of dendrimer composite membranes, modules for pressurized gas stream and their real gas testing</li> </ul> <p><b>References:</b></p> <p>I. Taniguchi, S. Duan, S. Kazama, Y. Fujioka, Facile fabrication of a novel high performance CO<sub>2</sub> separation membrane: Immobilization of poly(amidoamine) dendrimers in poly(ethylene glycol) networks, J. Membr. Sci., 322 (2008) 277</p> <p>3rd duration: 04/2011 – 03/2015</p> <ul style="list-style-type: none"> <li>• Establishment of research association for accelerating commercial reality (02/2011)</li> <li>• Improving the membrane module performance (2011FY)</li> </ul>

# European CO<sub>2</sub> Technology Centre Mongstad (TCM) Project

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
Mongstad, Norway
<b>2. Project Lead</b>
Tore Amundsen; Managing Director. tam@tcmda.no
<b>3. Project Objectives</b>
<ul style="list-style-type: none"><li>• Develop technologies for CO<sub>2</sub>-capture capable of wide national and international deployment</li><li>• Reduce cost and technical, environmental and financial risks related to large scale CO<sub>2</sub>-capture</li><li>• Test, verify and demonstrate CO<sub>2</sub>-capture technology owned and marketed by Vendors</li><li>• Encourage the development of a market for such technology</li></ul>
<b>4. Recent Milestones</b>
<ul style="list-style-type: none"><li>• Amine plant mechanically complete, commissioning starting</li><li>• Chilled Ammonia Plant: mechanical installations ongoing</li><li>• Installation ongoing within Electrical substation building</li><li>• Overall progress June 2011 approximately 80%</li></ul>
<b>5. Status</b>
<ul style="list-style-type: none"><li>• Investment (\$ 1.000 million) approved in May 2010</li><li>• Construction underway (80% progress)</li><li>• Operating organization established and preparing for operations</li></ul>

# Fort Nelson Carbon Capture and Storage Project

## CSLF Project Status Report

September 2011

<p><b>1. Project Location</b></p> <p>Fort Nelson, British Columbia, Canada</p>
<p><b>2. Project Lead</b></p> <ul style="list-style-type: none"> <li>Al Laundry (alaundry@spectraenergy.com)</li> <li>Ed Steadman (esteadman@undeerc.org)</li> </ul>
<p><b>3. Project Objectives</b></p> <p>The primary objective of the Fort Nelson carbon capture and storage feasibility project is to verify and validate the concept of utilizing one of North America's large number of saline formations for large-scale CO<sub>2</sub> injection, proposed to be up to 2.2 Mt a year, of anthropogenic CO<sub>2</sub> for permanent storage. Specific goals include the following:</p> <ul style="list-style-type: none"> <li>Cost-effective risk management and simulation and monitoring, verification, and accounting (MVA) strategies for large-scale CO<sub>2</sub> storage in deep saline formations.</li> <li>Testing and refinement of reservoir modeling intended to predict and estimate CO<sub>2</sub> injectivity (the potential for placing CO<sub>2</sub> into the reservoir). To confirm the practical CO<sub>2</sub> storage capacity for this site, areal extent and mobility of the supercritical CO<sub>2</sub> plume in the reservoir. To demonstrate improved methodologies to ensure that site characterization and MVA results better support risk management objectives and modeling efforts.</li> <li>Testing strategies to predict the effects of CO<sub>2</sub> plume on the integrity of vertical and horizontal sealing formations, including the testing and modeling of key geomechanical and geochemical parameters. Includes assessing impact of injecting a cooler sour CO<sub>2</sub> stream into a hotter in situ saline fluid.</li> <li>Test and model the reactions and fate of entrained H<sub>2</sub>S in the injected supercritical CO<sub>2</sub> stream and impacts on reservoir and containment rocks.</li> </ul>
<p><b>4. Recent Milestones</b></p> <ul style="list-style-type: none"> <li>Risk assessments have been updated using an expert panel approach. The update is based on newly acquired data sets that facilitate a better interpretation of the extent and geometry of the injection target.</li> <li>Laboratory evaluation of reservoir properties has been conducted on core samples obtained from the C61E Test well. Relevant properties including mechanical strength, porosity, permeability, and capillary entry pressures have been obtained.</li> <li>Geologic modeling and simulation have continued in this reporting period. Significant effort is being put forth to obtain a thorough understanding of the pressure regimes in this reservoir. This will lead to an improved understanding of the anticipated migration pathways and ultimate extent of stored volumes of CO<sub>2</sub>.</li> </ul>
<p><b>5. Status</b></p> <ul style="list-style-type: none"> <li>Project areas related to geological interpretation, laboratory evaluations, risk assessment, and planning of MVA activities are all ongoing and progressing.</li> <li>Locations, geometries, and materials for the project's second exploratory well and for an extensive 3-D seismic program are planned for completion in 2012.</li> </ul>

# Geologic CO<sub>2</sub> Storage Assurance at In Salah, Algeria

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
In Salah, Algeria, Africa
<b>2. Project Lead</b>
Iain W. Wright, wrightiw@bp.com BP Alternative Energy, Chertsey Road, Sunbury, Middlesex TW16 7LN, UK
<b>3. Project Objectives</b>
<ul style="list-style-type: none"><li>• Provide assurance that secure geological storage of CO<sub>2</sub> can be cost-effectively verified and that long-term assurance can be provided by short-term monitoring.</li><li>• Demonstrate to stakeholders that industrial-scale geological storage of CO<sub>2</sub> is a viable GHG mitigation option.</li><li>• Set precedents for the regulation and verification of the geological storage of CO<sub>2</sub>, allowing eligibility for GHG credits</li></ul>
<b>4. Recent Milestones</b>
<ul style="list-style-type: none"><li>• Phase 1 completed and documented</li><li>• Phase 2 initiated, with contributions from BP, Statoil, Sonatrach, US DoE, LLNL and LBNL</li><li>• Under evaluation for Phase 2 deployment are: Micro-seismic array, dedicated observation well, INSAR, repeat seismic and further mining of Phase 1 dataset</li><li>• A project website is available at: <a href="http://www.insalahco2.org">www.insalahco2.org</a></li></ul>
<b>5. Status</b>
<ul style="list-style-type: none"><li>• Storing up to 1mmtpa CO<sub>2</sub> in a deep saline aquifer (1900 deep, 2m thick, 10mD permeability). 3.3mmtCO<sub>2</sub> stored to date.</li></ul>

# Gorgon CO<sub>2</sub> Injection Project

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>	
Barrow Island, Western Australia, Australia	
<b>2. Project Lead</b>	
Inquiries in relation to the project should be addressed to: Chevron Australia Pty Ltd John Torkington – Senior Advisor, Climate Change Policy trkn@chevron.com	
<b>3. Project Objectives</b>	
<p>The project aims to demonstrate the safe commercial scale application of greenhouse gas storage technologies at a scale not previously attempted.</p> <ul style="list-style-type: none"> <li>• It is proposed to inject approximately 120 million tonnes of carbon dioxide at rates of between 3.5 and 4 million tonnes per annum.</li> <li>• The Gorgon Joint Venture Participants have given a public commitment to the disclosure of monitoring data associated with the project in order to help inform the community and other project proponents about the progress of the project.</li> <li>• The Gorgon Joint Venture Participants propose the sharing of lessons learned in areas such as site selection, environmental impact assessment, policy and regulatory development.</li> </ul>	
<b>4. Recent Milestones</b>	
1998	Commence detailed site selection studies
2003	Identified the Dupuy Formation as the most suitable injection site
2003	Commenced environmental impact assessment process
2003	Barrow Island Act 2003 (WA) proclaimed. This act includes the world's first greenhouse gas storage legislation
2005	Published the Gorgon Project Environmental Impact Statement / Environmental Review and Management Programme (EIS/ERMP)
2007	Received Western Australian and Australian Government environment approval the Gorgon Project.
2008	Published the Public Environmental Review (PER) for a revised and expanded Gorgon Project
2009	Received Western Australian and Australian Government environment approval of the revised and expanded Gorgon Project.
2009	Project receives final approvals, sanction from Joint Venture participants and moves into construction (September 2009)
2009	Order placed for carbon dioxide compressors (October 2009).
2009	Official groundbreaking on Barrow Island (December 2009).
<p>The project has progressed through its early development stages including site selection, site appraisal, facilities front end engineering and design and has obtained high level approvals including environmental approvals and approval to dispose of carbon dioxide by underground injection. The project is fully funded and construction has commenced.</p>	

## 5. Status

The Gorgon Carbon Dioxide Injection Project is an integral component of the much larger \$43 billion Gorgon Project which involves the development of the several deepwater gas fields and the development of a gas processing facility on Barrow Island. The Australian Government has committed \$60 million to the Gorgon Carbon Dioxide Injection Project as part of the Low Emissions Technology Demonstration Fund (LETDF).

The Gorgon Project is operated by an Australian subsidiary of Chevron and is a joint venture of the Australian subsidiaries of Chevron (approximately 47 percent), ExxonMobil (25 percent) and Shell (25 percent), Osaka Gas (1.25 percent), Tokyo Gas (one percent) and Chubu Electric Power (0.417 percent).

The Gorgon Project aims to export approximately 15 million tonnes of liquefied natural gas annually to east Asia markets and up to 300TJ of domestic gas into Western Australian markets.

In early 2011 the Gorgon Joint Venture Participants announced plans to add a further 5 million tonnes per annum processing train. The proposal is now subject to environmental review.

Achievements as of July 2011 include:

- The Gorgon Project remains on schedule for first gas in 2014. June 2011 marked 18 months of construction on Barrow Island and work continues to focus on constructing accommodation, site preparation and logistics activities.
- Dredging on the project has progressed well and is nearing completion.
- A Horizontal Direction Drilling program, which will bring the feed gas pipelines onto Barrow beneath an undisturbed shoreline, commenced in April 2011.
- More than \$10 billion has already been committed to Australia industry with more than 4,000 jobs created. Over the construction period about \$20 billion will flow to Australian industry.
- Since the Final Investment Decision in September 2009, some 250,000 tonnes of freight had been shipped to Barrow Island, about 10,000 people have received quarantine training, and the on-island workforce has increased to beyond 2,100. At peak construction around 5,000 will be housed on Barrow Island.
- In May 2011, for the second year in a row, the Australian Petroleum Production and Exploration Association recognised the Gorgon Project's environmental custodianship and leadership with its prestigious Environment Award.
- First steel was cut for the Project's major modules in Korea in November 2010. In total there will be 48 modules weighing around 200,000 tonnes. In addition work is also underway on 163 pre-assembled racks (PARs) in China weighing about 40,000 tonnes and another 30 PARs and 26 pre-assembled units comprising about 30,000 tonnes of steelwork, pipe work and equipment in Indonesia.
- In October 2010, the Project received world recognition for its Gorgon Carbon Dioxide Injection Project from the Carbon Sequestration Leadership Forum at its annual meeting in Warsaw, Poland.
- For more details on the latest Project news visit <http://www.chevronaustralia.com>

## 6. Project Photographs

The Gorgon construction village is taking shape.



The Marine Offloading Facility (MOF) foundations begin to extend from the gas plant footprint. The MOF will enable the offloading of materials required for the Gorgon Project.



Natural gas will be delivered to Barrow Island beneath the shoreline, helping to minimize environmental impacts. This image shows the welding of natural gas pipe to be inserted into directionally drilled holes below the shore-crossing holes.



# Heartland Area Redwater Project (HARP)

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
Redwater, Alberta, Canada
<b>2. Project Lead</b>
William Sawchuk (wsawchuk@arcresources.com)
<b>3. Project Objectives</b>
<ul style="list-style-type: none"> <li>• Develop a low-cost, secure and long-term CO<sub>2</sub> storage site in the close vicinity of major CO<sub>2</sub> emitters in the Heartland Industrial Area of Alberta, Canada, that will attain a storage rate of at least 1 Mt CO<sub>2</sub>/year by 2015</li> <li>• 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.)</li> <li>• Support the development of a regulatory framework for CCS in Alberta, including tenure of pore space, long-term liability as well as regulatory permitting and follow-up</li> <li>• Achieve synergies with a CO<sub>2</sub>-EOR operation being developed by the operator in the oil leg of the same carbonate reef</li> </ul>
<b>4. Recent Milestones</b>
<p>Phase II of the project started in August 2009 with the objective 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:</p> <ul style="list-style-type: none"> <li>• Selected the site of the injection and observation wells</li> <li>• Completed a detailed geological and hydrogeological characterization of entire sedimentary succession in an area of 24 × 30 square miles around the proposed pilot site</li> <li>• Completed a hydrogeological analysis and characterization of the aquifers and aquitards in the entire sedimentary succession from the Precambrian crystalline basement to the top of the bedrock</li> <li>• Completed an assessment of the natural seismicity in the area</li> <li>• Executed funding agreements with government and joint-industry participants</li> <li>• Applied to the government agency for access to the required pore space</li> <li>• Received licenses from the regulatory agency to drill an injection well and one observation well</li> <li>• Conducted a risk workshop with research providers aimed at identifying technical risks</li> <li>• Collected two sets of samples for the baseline surface and atmospheric MMV program</li> <li>• Provincial government passed the Carbon Capture and Storage Statutes Amendment Act (CCS Act) and the Carbon Sequestration Tenure Regulation</li> </ul>
<b>5. Status</b>
<ul style="list-style-type: none"> <li>• The project has been terminated because the operator will not be able to complete the project in the defined time period of the government funding Agreements.</li> </ul>

# IEAGHG Weyburn-Midale CO<sub>2</sub> Monitoring and Storage Project – Final Phase

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
Weyburn and Midale Units, Weyburn area, southeast Saskatchewan, Canada
<b>2. Project Lead</b>
<ul style="list-style-type: none"> <li>• Floyd Wist (Saskatchewan Energy and Resources), Chair, Leading Sponsors Executive Committee (LSEC)</li> <li>• Frank Mourits (Natural Resources Canada), Project Integrator / Coordinator Policy Component</li> <li>• Malcolm Wilson (Petroleum Technology Research Centre), Executive Director and Acting Project Manager, Technical / Research Component</li> </ul>
<b>3. Project Objectives</b>
<ul style="list-style-type: none"> <li>• Develop a comprehensive Best Practices Manual for CO<sub>2</sub> geological storage, which will guide all aspects of future CO<sub>2</sub>-EOR storage projects.</li> <li>• Building on the successes of the First Phase, focus the technical research component on site characterization, wellbore integrity, monitoring and verification, and performance (risk) assessment.</li> <li>• Focus the policy component on public communications and outreach, regulatory issues and the business environment.</li> <li>• Ensure integration across technical research and policy components.</li> </ul>
<b>4. Recent Milestones</b>
<ul style="list-style-type: none"> <li>• March 2009 – Public Communications and Outreach work program and budget approved by LSEC. Work on CCS website and outreach activities commenced.</li> <li>• June 2009 – Project Integration and Sponsors Meeting (PRISM-4), Regina, Saskatchewan.</li> <li>• June 2009 – an expert workshop was held in Calgary as part of the ongoing Risk Assessment work.</li> <li>• October 2009 – a workshop was held in Ottawa with researchers involved in modelling tasks.</li> <li>• January 2010 – Project Integration and Sponsors' Meeting (PRISM-5), Ottawa, Ontario.</li> <li>• March 2010 – Completion of a study that clarifies the regulatory framework governing injection and storage of CO<sub>2</sub> in Saskatchewan (second major deliverable under the Regulatory Theme).</li> <li>• January / May 2010 – Additional funding of \$2.2 million by NRCAN and \$3 million by DOE/NETL announced for expanded well integrity program.</li> <li>• The new <a href="http://www.ccs101.ca">www.ccs101.ca</a> website was launched at the 9th Carbon Capture and Sequestration Conference in Pittsburgh (May 10-13, 2010).</li> <li>• June 2010 - Project Integration and Sponsors' Meeting (PRISM-6), Saskatoon, Saskatchewan.</li> <li>• December 2010 – Project Integration and Sponsors' Meeting (PRISM-7), Calgary, Alberta.</li> <li>• March 31, 2011 – Most research completed.</li> </ul>

## 5. Status

- The static geological model has been completed will store much of the data generated within the project.
- A model using the percolation-invasion methodology for determining the long-term fate of CO<sub>2</sub> has been constructed and in the final stages of development.
- The in-field wellbore integrity testing program was completed in March 2011. This entailed performing drilling slots into the cement sheath and performing pressure-transient tests (PTT) to determine communication within the cement. Samples of cement were also collected. The PTT results and cement samples are currently being analyzed.
- A shallow groundwater survey was completed fall 2009. This survey complements similar surveys performed since the inception of the project in 2000.
- Three reservoir fluid sampling monitoring surveys were completed in October 2008, May 2009 and October 2009. Additional surveys were conducted in May and October of 2010 for a total of 16 monitoring surveys for reservoir fluids. No additional surveys are planned within the PTRC program.
- Passive micro-seismic monitoring is ongoing. Surveys to date have indicated very minimal response to CO<sub>2</sub> injection.
- Extensive work is being performed to improve the rock physics model used to assist in calibrating the time-lapse 3D seismic for CO<sub>2</sub> saturations.
- Stochastic modelling has been completed to integrate both geophysical and geochemical databases to understand CO<sub>2</sub> behavior within the reservoir.
- A soil gas monitoring survey scheduled for spring 2011 begun, but due to extreme flooding in SE Saskatchewan some aspects were cancelled and will be conducted in October. Long-term flux measurements are being conducted to determine biogenic activity within the soils.
- The Risk Assessment process is completing biosphere discussions.
- Major work items under the Regulatory Theme have been completed. The Theme Lead will maintain a watching brief to keep the completed studies up-to-date. Presentations on these studies to government agencies, conferences and other events are being made on request.
- Under the Public Communications and Outreach Theme, the now well-established [www.ccs101.ca](http://www.ccs101.ca) website is continually being improved and updated. A display stand with CCS information materials was developed for use at conferences and conventions (e.g. science teachers) as well as Open Houses for large CCS demonstration projects in Canada. Focus group testing activities are being developed for the remainder of 2011.
- Most research was to be completed by March 31, 2011. Most results have been submitted and are in technical review. Several tasks, including new work, will extend beyond this date.
- The project's key deliverable, a Best Practice Manual, is scheduled to be completed by September 30, 2011.
- A special session of integrated presentations of the project's technical results is being planned in conjunction with a CCS conference in the spring of 2012.
- A Technical Monograph is in the planning stage, with the intention of it being released at the GHGT-11 conference in Kyoto.

# Lacq Integrated CCS Project

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
France – South West
<b>2. Project Lead</b>
<ul style="list-style-type: none"> <li>• Jacques Monne : R&amp;D Manager, jacques.monne@total.com</li> <li>• Jean-Pierre Quet : Production Manager, jean-pierre.quet@total.com</li> </ul>
<b>3. Project Objectives</b>
<ul style="list-style-type: none"> <li>• The overall aim of this project is to test the industrial-scale feasibility of an integrated CCS chain within industrials facilities.</li> <li>• To demonstrate the feasibility of converting an existing 30 MW industrial boiler to oxycombustion in order to confirm the following targets of             <ul style="list-style-type: none"> <li>– reduction of capture cost compared to classical post capture technologies</li> <li>– reduction of overall direct and indirect CO<sub>2</sub> emissions if indirect emissions are not captured</li> </ul> </li> <li>• To develop and apply geological storage qualification methodologies, monitoring and verification techniques on a real operational case to prepare future larger scale long term storage projects</li> </ul>
<b>4. Recent Milestones</b>
<ul style="list-style-type: none"> <li>• A work-over has been organized from January to March 2011 for changing the down hole micro seismic arrays. The new system works well. In June 2011, a calibration campaign for this equipment has been organized.</li> <li>• Two campaigns of environmental monitoring have been organized from the beginning of this year.</li> <li>• An injection period extension of 18 months has been requested to the French authorities. This request is currently under study.</li> </ul>
<b>5. Status</b>
<ul style="list-style-type: none"> <li>• Reservoir pressure evolution is as predicted.</li> <li>• No seismic event linked with CO<sub>2</sub> injection has been recorded.</li> <li>• Results of environmental monitoring: no variation recorded compare to the base line.</li> </ul>

# QUEST CCS Project

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
The Quest CCS Project is being proposed at Shell's Scotford Upgrader located near Edmonton, Alberta, Canada.
<b>2. Project Lead</b>
<ul style="list-style-type: none"> <li>• Ian Silk, Quest Venture Manager, Shell Canada i.silk@shell.com</li> <li>• Project Contact Paul Hagel, Senior Government Relations Advisor paul.hagel@shell.com</li> </ul>
<b>3. Project Objectives</b>
<ul style="list-style-type: none"> <li>• The Quest CCS project is being advanced on behalf of the AOSP, a joint venture among Shell Canada (60 per cent) Chevron Canada Limited (20 per cent) and Marathon Oil Canada Corporation (20 per cent).</li> <li>• Quest is a fully integrated capture, transportation, storage and monitoring project, which will capture and store up to 1.2 million tonnes/yr of CO<sub>2</sub> from the Shell Scotford Oil Sands Upgrader in central Alberta, Canada. The CO<sub>2</sub> will be transported via pipeline approximately 80 km northeast of Scotford and stored underground (2000 m to 2300m) in a deep geological formation (Basal Cambrian Sands).</li> <li>• Demonstration by 2015 of technology, innovation and cost for the design, construction and operation of CO<sub>2</sub> capture from steam methane reforming associated with an existing oil sands upgrader</li> <li>• Demonstration by 2015 of technology, innovation and cost associated with the compression, and pipeline transportation up to 80km from the capture facilities to the storage site</li> <li>• Demonstration by 2015 of technology, innovation and cost associated with appraisal, design, construction, operation and monitoring (MMV) of CO<sub>2</sub> storage in a deep saline aquifer (Basal Cambrian Sands) in central Alberta</li> <li>• Demonstration of a significant reduction in CO<sub>2</sub> footprint from an existing oil sands operation through an industrial, commercial-scale CCS application.</li> <li>• Continuous operation beyond 2015 of the commercial scale CCS project associated with the Scotford oil sands upgrader for a minimum of 10 years.</li> </ul>
<b>4. Recent Milestones</b>
<ul style="list-style-type: none"> <li>• June 24th 2011: Shell Canada announces completion of funding agreements with the Governments of Canada and Alberta to invest a total of \$865 million CDN in the Quest CCS Project. The Gov't of Alberta is contributing \$745 million through Alberta Energy (from the \$2 billion CCS Fund) and the Gov't of Canada is providing \$120 million (from the \$795-million Clean Energy Fund). The funding is phased over 15 years (period includes development, construction and 10 years of operations). Quest also received 'Bonus Credits' from the Gov't of Alberta, which means that every tonne of CO<sub>2</sub> captured and permanently stored will be given an bonus credit as well as an offset credit.</li> <li>• May 27th 2011: Quest CCS Project receives pore space tenure, a first in Alberta under the new regulations.</li> <li>• May 27th 2011: Quest CCS Project receives Public Land Approvals for the 5 major water crossings for the pipeline</li> </ul>

## 5. Status

- Regulatory applications for the Quest Project were submitted in November 2010. The signing of the funding agreements represents another important milestone prior to Shell taking a financial investment decision in 2012, subject to the outcome of the regulatory process and economic feasibility.
- With CO<sub>2</sub> injection planned for 2015, the Quest Project will join only a handful of CCS projects around the world that are injecting CO<sub>2</sub> at a commercial scale. Shell is working with governments and other experts globally on both political and technical levels to facilitate the development and wide-scale deployment of CCS and is involved in progressing a number of projects around the world, across a wide range of sectors.
- Shell's stakeholder outreach program continues into 2011 as the Venture team continues to provide information and seek input on the all aspects of project leading up to and beyond a regulatory decision.
- For more information, check out [www.shell.ca/quest](http://www.shell.ca/quest) or contact paul.hagel@shell.com

# Regional Carbon Sequestration Partnerships (RCSP) Project

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
Various locations in United States and Canada
<b>2. Project Lead</b>
National Regional Carbon Sequestration Partnership (RCSP) Initiative Managed by the U.S. Department of Energy National Energy Technology Laboratory (NETL)
<ul style="list-style-type: none"> <li>• John Litynski, Sequestration Technology Manager, NETL (john.litynski@netl.doe.gov)</li> <li>• Traci Rodosta, Sequestration Division Director, NETL (traci.rodosta@netl.doe.gov)</li> <li>• Traci Rodosta, Regional Partnerships Coordinator (Acting), NETL (traci.rodosta@netl.doe.gov)</li> </ul>
<b>3. Project Objectives</b>
<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• Implement the RCSP program in three phases:             <ul style="list-style-type: none"> <li>– Characterization Phase (2003 – 2005): The partnerships completed the initial characterization of their regions’ potential to store CO<sub>2</sub> in different geologic formations.</li> <li>– Validation Phase (2005 – 2011): 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.</li> </ul> </li> <li>• Development Phase (2008 – 2018): The partnerships will implement large-scale field testing involving at least one million tons of CO<sub>2</sub> per project to confirm that CO<sub>2</sub> 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).</li> </ul>
<b>4. Recent Milestones</b>
<ul style="list-style-type: none"> <li>• Validation Phase was initiated in 2005 and is scheduled for completion in 2011. A total of 1.35 million metric tons has been injected in 18 out of 19 small scale field tests. The final test is the Columbia Basin basalt test that is scheduled to be completed in 2011. Below are the results from the completed tests.</li> </ul> <p><b>Completed Saline Formation CO<sub>2</sub> injection field tests:</b></p> <p><u>Midwest Geological Sequestration Consortium (MGSC)</u></p> <ul style="list-style-type: none"> <li>• Illinois Basin – injection site was merged with Phase III site, characterization well was drilled in Phase II.</li> </ul>

**4. Recent Milestones (continued)**Midwest Regional Carbon Sequestration Partnership (MRCSP)

- Michigan Basin – two injection tests totaling 60,000 metric tons in the Bass Islands Dolomites completed in July 2009.
- Cincinnati Arch – injection of approximately 900 metric 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 2,740 metric 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<sub>2</sub> 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 39 metric tons of CO<sub>2</sub> were injected and 93 barrels of oil produced.
- Illinois Basin – Mumford Hills EOR field test in the Clore Formation was completed in early 2010 in Posey County, Indiana; approximately 6,300 metric tons of CO<sub>2</sub> was injected at the rate of 22 to 27 metric tons per day; incremental oil production increased over the pre-CO<sub>2</sub> injection oil rate and current EOR production is 1,590 stock tank barrels.
- Illinois Basin – Sugar Creek EOR field test was completed in 2010 in Hopkins County, Kentucky; approximately 6,600 metric tons of CO<sub>2</sub> was injected at a rate of 22 metric tons per day into the Jackson Sandstone; oil recovery rate did increase despite early CO<sub>2</sub> breakthrough at one well and current oil production is 2,110 stock tank barrels.

Plains CO<sub>2</sub> Reduction Partnership (PCOR)

- Williston Basin – Huff'n Puff in the Mississippian Canyon Formation was completed in June 2009 in Williams County, North Dakota; approximately 400 metric tons (440 short tons) were injected, producing through September 17th, 2009, approximately 242 barrels of oil and 1,991,000 cubic feet of natural gas.
- Zama Oil Field – Since December 2006, acid gas (70% CO<sub>2</sub> and 30% H<sub>2</sub>S) has been continuously injected at a depth of 4900 feet into the Zama F Pool, one of over 800 pinnacle reefs in the Middle Devonian Keg River Formation in the Zama subbasin, Alberta, Canada. Through January 2011, over 80,000 metric tons of acid gas has been injected, resulting in incremental oil production over 50,000 barrels.

Southeast Regional Carbon Sequestration Partnership (SECARB)

- Cranfield Oil Field – initial injection of 627,744 metric 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<sub>2</sub> has been injected.
- Southwest Regional Partnership on Carbon Sequestration (SWP)
- Aneth Oil Field – as of December 2009, approximately 630,000 metric tons have been injected into the Deep Creek and Ismay Formations within the Paradox Basin for EOR operations.
- SACROC – injection of approximately 86,000 metric tons were injected into the Horseshoe Atoll and Pennsylvania Reef/Bank Play in the Permian Basin.

#### 4. Recent Milestones (continued)

##### **Completed Enhanced Coalbed Methane (ECBM) CO<sub>2</sub> tests:**

###### Midwest Geological Sequestration Consortium (MGSC)

- Illinois Basin – the 91 metric tons 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<sub>2</sub> Reduction Partnership (PCOR)
- Williston Basin – CO<sub>2</sub> injection was completed in March 2009 into a lignite coal seam in the Fort Union Formation in Burke County, North Dakota. Injection of 80 metric tons (90 short tons) of CO<sub>2</sub> took place over a period of 16 days.

###### Southwest Regional Partnership on Carbon Sequestration (SWP)

- San Juan Basin –approximately 16,700 metric tons were injected into the coals in the Upper Cretaceous Fruitland Formation, and low amounts of additional methane may have been subsequently produced.
- Southeast Regional Carbon Sequestration Partnership (SECARB)
- Central Appalachian Basin – injection of 907 metric tons into coals in the Pocahontas and Lee Formations was completed in early 2009.
- Black Warrior Basin – injection of approximately 252 metric tons of CO<sub>2</sub> was injected into the Black Creek, Mary Lee and Pratt Coals at the Blue Creek Coal Degasification Field, Tuscaloosa County, Alabama.

Terrestrial Sequestration Projects: Eleven successful terrestrial sequestration projects have been completed during the Validation Phase, and additional projects will continue through 2011. 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 seven to nine large-volume injection tests initiating between 2009 –2014. These injection tests are being conducted in saline and oil/natural gas bearing formations.

##### **Partnership Development Project Status:**

###### Big Sky Regional Carbon Sequestration Partnership (Big Sky)

- Kevin Dome Project. The Partnership is planning to inject one million metric tons over a four year period. The natural source of CO<sub>2</sub> will be extracted from the Kevin Dome and injected into the primary target, Duperow Formation, or a secondary target, Souris River Formation in Northern Montana. The Partnership has injection scheduled for mid 2013.

###### Midwest Geological Sequestration Consortium (MGSC)

- Decatur Project. The Partnership will conduct a large scale saline formation test in the Illinois Basin that will inject 365,000 metric tons of CO<sub>2</sub> per year into the Mt. Simon Sandstone for three years totaling one million metric tons. The source of the CO<sub>2</sub> will be the Archer Daniels Midland Company (ADM), ethanol production facility in Decatur, Illinois. Injection is scheduled to begin in late 2011.

###### Midwest Regional Carbon Sequestration Partnership (MRCSP)

- Michigan Basin Project. The Partnership will conduct a large scale injection test in Otsego County, Michigan Basin, injecting one million metric tons of CO<sub>2</sub> over a four year period. The source of the CO<sub>2</sub> will be Core Energy via natural gas processing facility and the test is scheduled to begin in the 2012 timeframe.

###### Plains CO<sub>2</sub> Reduction Partnership (PCOR)

- Bell Creek Project. The first of the Partnership's two development projects is located in the Powder River Basin in Montana. In partnership with Denbury Resources Inc, the Bell Creek Project will couple EOR and CO<sub>2</sub> storage by injecting over one million metric tons of CO<sub>2</sub> per year into the Muddy Sandstone Formation. The source of CO<sub>2</sub> is the Lost Cabin/Madden Gas Plant operated by ConocoPhillips and injection is anticipated in late 2012 or early 2013.

**4. Recent Milestones (continued)**

- Fort Nelson Project. The second development phase project, the Fort Nelson project, will have the capability to capture more than two million metric tons of sour CO<sub>2</sub> (95% CO<sub>2</sub> and 5% H<sub>2</sub>S) per year from one of the largest gas-processing plants in North America and inject into the Devonian Elk Point Group/Sulphur Point Formation, Horn River Basin. The source of the CO<sub>2</sub> will be Spectra Energy's Fort Nelson Natural Gas Processing Plant, and injection is anticipated in early 2014.

Southeast Regional Carbon Sequestration Partnership (SECARB)

- Cranfield Early Test Project. The first of the Partnership's two development projects began injection in April 2009 and has injected nearly two million metric tons of CO<sub>2</sub> into the Lower Tuscaloosa Formation. The source of CO<sub>2</sub> was Jackson Dome, and it was delivered via Denbury Resources' CO<sub>2</sub> pipeline.
- Citronelle Dome Anthropogenic Project. This second development project the Partnership is conducting is an integrated capture and injection project that will inject 300,000 metric tons of CO<sub>2</sub> over three years into the Paluxy Formation. The source of the CO<sub>2</sub> is a 25 MW flue gas stream from Southern Company's Plant Barry Power Station located near Mobile, Alabama. Injection is anticipated to begin in late 2011.

Southwest Regional Partnership on Carbon Sequestration (SWP)

- Gordon Creek Project. The Partnership plans to perform a large scale injection into the primary target formation, Jurassic-aged Navajo with potential injection into the secondary target, the Estrada Formations. It anticipates over one million metric tons of CO<sub>2</sub> to be injected into the Wasatch Plateau over a four year period utilizing a natural source of CO<sub>2</sub>. Injection is scheduled to commence in the 2012/2013 timeframe.

West Coast Regional Carbon Sequestration Partnership (WESTCARB)

- Development Phase. The Partnership plans to facilitate successful commercial-scale carbon capture and storage (CCS) development through expanded and enhanced regional characterization and R&D to identify and address CCS implementation issues. This includes: (1) working with state agencies and universities to further characterize geologic sequestration potential and capacity; (2) working with industry partners to define promising sites and facilitate the process for developing commercial-scale CCS projects; and (3) working with policymakers and regulatory agencies to identify impediments and solutions to future CCS project development.

**Additional Sequestration Program RCSP Updates:**

- The 2010 Sequestration Project Portfolio is available and includes information on the Sequestration Program, Regional Partnerships, Carbon Sequestration Program R&D Focus Areas (Project Fact Sheets) and American Recovery and Reinvestment Act Sequestration projects. Please see the link below for more information: [http://www.netl.doe.gov/technologies/carbon\\_seq/refshelf/project%20portfolio/2011/index.html](http://www.netl.doe.gov/technologies/carbon_seq/refshelf/project%20portfolio/2011/index.html)
- The third edition of the Carbon Sequestration Atlas of the United States and Canada is now available online ([http://www.netl.doe.gov/technologies/carbon\\_seq/refshelf/atlasIII/index.html](http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlasIII/index.html)). The 2010 Carbon Sequestration Atlas includes an overview of DOE's Sequestration Program, International Collaborations, National Risk Assessment, RCSP Activities, Refined CO<sub>2</sub> Storage and Prospective Storage Resources within the RCSPs, Worldwide CCS projects and regulatory issues and NATCARB's improved databases and GIS system.
- Six of the seven anticipated Best Practices Manuals based on the lessons learned from the RCSP Initiative have been completed and are available online: [http://www.netl.doe.gov/technologies/carbon\\_seq/refshelf/refshelf.html](http://www.netl.doe.gov/technologies/carbon_seq/refshelf/refshelf.html).
  - Monitoring, Verification, and Accounting of CO<sub>2</sub> Stored in Deep Geologic Formations
  - Best Practices for Public Outreach and Education for Carbon Storage Projects
  - Site Screening, Site Selection, and Initial Characterization for Storage of CO<sub>2</sub> in Deep Geologic Formations

#### 4. Recent Milestones (continued)

- Geologic Storage Formation Classification: Understanding Its Importance and Impacts on CCS Opportunities in the United States
- Risk Analysis and Simulation for Geologic Storage of CO<sub>2</sub>
- Best Practices for Terrestrial Sequestration of Carbon Dioxide
- NETL is continuing ongoing collaboration with Interstate Oil and Gas Compact Commission (IOGCC), through SECARB, to evaluate potential for subsurface geological storage of CO<sub>2</sub>, in Federal waters, Gulf of Mexico (GOM), utilizing existing infrastructure, such as wells and pipelines and addressing regulatory, legal and technical issues.

#### 5. Status

- The RCSPs span 43 states and 4 Canadian provinces and include agency participation from six member countries of the CSLF.
- 18 of the 19 geologic and 11 of 12 terrestrial field tests have been completed in the Validation Phase with one remaining to be completed in 2011.
- 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 2010 Regional Carbon Sequestration Partnerships Review Annual Review Proceedings, which include more detailed descriptions of status, are at: <http://www.netl.doe.gov/publications/proceedings/10/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](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](http://www.netl.doe.gov/technologies/carbon_seq/refshelf/subscribe.html)
- DOE/NETL Carbon Dioxide Capture and Storage RD&D Roadmap 2010: [http://www.netl.doe.gov/technologies/carbon\\_seq/refshelf/CCSRoadmap.pdf](http://www.netl.doe.gov/technologies/carbon_seq/refshelf/CCSRoadmap.pdf)
- Carbon Sequestration Atlas of the United States and Canada: [http://www.netl.doe.gov/technologies/carbon\\_seq/refshelf/atlasIII/index.html](http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlasIII/index.html)
- An Introduction to Carbon Capture and Sequestration (video): [mms://prod-mmedia.netl.doe.gov/carbon\\_sequestration\\_sept.wmv](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](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/2010/index.html](http://www.netl.doe.gov/technologies/carbon_seq/refshelf/project%20portfolio/2010/index.html)
- Regional Carbon Sequestration Partnerships Phase I Accomplishments, see: [http://www.netl.doe.gov/technologies/carbon\\_seq/partnerships/phase1/workproducts\\_table.html](http://www.netl.doe.gov/technologies/carbon_seq/partnerships/phase1/workproducts_table.html)

# Southeast Regional Carbon Sequestration Partnership (SECARB) Early Test at Cranfield Project

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
Test area is northeastern side of Cranfield Unit, 16 km east of Natchez Mississippi, USA
<b>2. Project Lead</b>
Susan D. Hovorka, Gulf Coast Carbon Center, Bureau of Economic Geology, Jackson School of Geosciences, the University of Texas at Austin susan.hovorka@beg.utexas.edu
<b>3. Project Objectives</b>
<ul style="list-style-type: none"> <li>• History matching to compare model predictions of fluid flow to observed measurements of fluid flow in a complex rock unit.</li> <li>• Test the effectiveness of standard and innovating monitoring tools in the reservoir, above the reservoir, in the groundwater system, and in the shallow soil zone</li> <li>• This project is hosted by Denbury Onshore LLC; and field serviced are provided by Sandia Technologies LLC</li> </ul>
<b>4. Recent Milestones</b>
<ul style="list-style-type: none"> <li>• One year of monitoring has been completed</li> <li>• Data collected from time-lapse measurements after 1 year injection are in analysis. A clear response to CO<sub>2</sub> is observed in the down-dip part of the field where CO<sub>2</sub> has replaced brine. Signal from emplaced CO<sub>2</sub> is more variable in the regions that contained oil and gas.</li> <li>• 2.5 million metric tons CO<sub>2</sub> from Jackson Dome (natural source) have been injected</li> </ul>
<b>5. Status</b>
<ul style="list-style-type: none"> <li>• Post-injection 3-D seismic survey, VSP survey and cross well seismic survey, and cased hole logging has been completed with Lawrence Berkeley National Laboratory and Schlumberger as lead collaborators</li> <li>• Lawrence Livermore National Laboratory has documented the response of an Electrical Resistance Tomography array to a CO<sub>2</sub> flood</li> <li>• An in-zone geochemical monitoring program with Oak Ridge National Laboratory and USGS Menlo Park as major contributors has been completed</li> <li>• A near surface monitoring program has been conducted with University of Mississippi and Mississippi State University as major collaborators</li> <li>• Project website; gulfcoastcarbon.org. See 'bookshelf' for reports.</li> </ul>

# Zama Acid Gas Enhanced Oil Recovery, CO<sub>2</sub> Sequestration, and Monitoring Project

## CSLF Project Status Report

September 2011

<b>1. Project Location</b>
Zama City, Alberta, Canada
<b>2. Project Lead</b>
<ul style="list-style-type: none"><li>• Ed Steadman, Energy &amp; Environmental Research Center, Grand Forks, North Dakota, USA E-Mail: <a href="mailto:esteadman@undeerc.org">esteadman@undeerc.org</a></li><li>• Jim Sorensen, Energy &amp; Environmental Research Center, Grand Forks, North Dakota, USA E-Mail: <a href="mailto:jsorensen@undeerc.org">jsorensen@undeerc.org</a></li><li>• Rob Scammell, Apache Canada Ltd, Calgary, Alberta, Canada E-Mail: <a href="mailto:robert.scammell@apachecorp.com">robert.scammell@apachecorp.com</a></li></ul>
<b>3. Project Objectives</b>
To validate the sequestration of CO <sub>2</sub> -rich acid gas in a depleted oil reservoir.
<b>4. Recent Milestones</b>
<ul style="list-style-type: none"><li>• Laboratory work has continued with the following experiments:<ul style="list-style-type: none"><li>– Wellbore casing steels are being exposed for durations of 15 and 28 days to mixtures of CO<sub>2</sub> and H<sub>2</sub>S. Experiments are carried out at reservoir conditions analogous to Zama (2100 psi, 160°F). Analytical work is focused on deriving the nature and rates of degradation observed.</li><li>– Rock samples are also being exposed under the same conditions to determine if mineralogical changes are observed. If observed, rates and quantification of change will be determined.</li></ul></li><li>• Modeling and simulation have continued on the injection and production reservoir. This model will be used to better understand the sweep efficiency of the reservoir and to calculate the overall storage potential of this and similar pinnacles in the field.</li></ul>
<b>5. Status</b>
<ul style="list-style-type: none"><li>• Over 80,000 tons of acid gas has been injected through January 2011.</li><li>• Approximately 55,000 incremental barrels of oil has been produced using this technique.</li></ul>