Demonstrating CCS in Australia
- *The CO2CRC Otway Project* -

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Greenhouse Gas Technologies (CO2CRC)

*INTERNATIONAL ENERGY AGENCY*

_*London, England,_
31 May 2007*
The CO2CRC Otway Project, Victoria, Australia

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2 The concept of the Otway project
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1. CO2CRC

Supporting participants: Australian Greenhouse Office | Australian National University | CANSYD | Meiji University | The Process Group | University of Queensland |
1. The national setting: Projects and potential projects in Australia involving capture and/or storage of carbon dioxide
Low Emissions Technology Demonstration Fund (LETDF)

LETDF established by the Australian Government to support industry-led large scale demonstration of low emissions technologies. Total expenditure approx A$3 B (500M Govt)

Projects currently funded under LETDF include:

- A$ 445M ($75M Govt) Fairview Coal Seam Gas Power Station with PCC and ECBM
- A$370M ($50M Govt) Hazelwood Power Station Lignite Drying with PCC
- A$750M ($100M Govt) HRL Integrated Drying Gasification Combined Cycle Power Station with pre comb capture
- A$1B? ($60M Govt) Gorgon LNG Project with CCS
- A$180M ($50M Govt) CS Energy's Callide A Oxy-fuel Power Station with CCS
- A solar Power plant
Major Australian RD&D Initiatives

• Victorian Energy Technology & Innovation Strategy (ETIS)
  – A$ 161 million research funds for both brown coal and renewables projects

• Qld Clean Coal Fund
  – A$ 300 million government funding for low emission technologies from black coal, including CCS

• Western Australian Low Emission Energy Development Fund
  – A$36.5 million government funding
  – Separately, DF 3 announced by BP and Rio

• NSW Clean Energy Fund
  – A$20 million government funding, details still being developed

Coal21 Fund - A$1B over 10 years through a voluntary levy
2. The Concept:
Demonstrating the Carbon Capture, Transport & Storage Chain
3. The Site

The CO2CRC Project

Victoria

Otway Basin

Gippsland Basin

Bass Basin

Tasmania
The site is in an oil and gas producing area, with lots of small fields and compartmentisation by sealing faults.
Perhaps the only research project anywhere with its own dedicated source of CO\textsubscript{2} - from the Buttress Well
Testing the CO₂ source was a significant issue

Buttress produces 80% molar carbon dioxide and 20% methane, with reserves of approx 250,000 tonnes
4. Accessing the land
Accessing the facilities for the CO2CRC Otway Project, Victoria.

Access to the site and the subsurface was through purchase of the petroleum tenements, negotiations, and through declaration of a “project of state significance”
5. Site Characterisation and due diligence

- Rigorous multi-disciplinary approach based on established oil field processes validated through peer reviews.

- Build detailed reservoir model using current state of the art modelling packages. Availability of seismic data was crucial.

- History match with actual production data to validate model.
Assessing the sequestration options at the site took some time because of technical and financial constraints.

It was finally decided to commence by storing in a deleted gas field the storage options, plus some testing of a low permeability formation if possible.

As funds allow, we will then inject into a shallower saline aquifer.
CO2CRC Geosequestration Research Project (Otway Basin)

**Stage 1**

This involves:

- Production of CO₂ rich gas
- Compression
- Injection into Waarre Fm
- M&V
6. Corporate structure

CO2CRC JV
- Unincorporated entity that provides the umbrella for all R&D and E&T activities.

CO2CRC Management
- Incorporated agent for managing employment, contracts, legal agreements etc.

CRC for Greenhouse Gas Technologies

ICTPL
- Incorporated commercial arm of CO2CRC JV for holding IP & conducting commercial contracts.

CPPL
- Special purpose incorporated vehicle specifically for the operational aspects of the pilot project.
CO2CRC JV and related entities

CO2CRC Management

Incorporated agent for managing employment, contracts, legal agreements etc.

CO2CRC JV

Unincorporated entity that provides the umbrella for all R&D and E&T activities.

CRC for Greenhouse Gas Technologies

Innovative Carbon Technologies Pty Ltd

Incorporated commercial arm of CO2CRC JV for holding IP & conducting commercial contracts.
7. Costs and funding

- **Management:**
  - *Operations*: CO2CRC Pilot Project Ltd (CPPL)
  - *Research*: CO2CRC Joint Venture (JV)
  - *Contracts*: CO2CRC Management Pty Ltd (CMPL)
  - *IP*: Innovative Carbon Technologies Pty Ltd (ICTPL)

- **Cost:** $A 30M plus (Govt funds: $A 20M; Industry: $A 7M; CO2CRC: $A 3M) + $A 20-30 (Stage 2); the structure of some Government funding posed challenges for a “real world” project, but Government funding crucial to the project.

- **Rising costs and non availability of gear and people** during the course of the project was of great concern and led to significant project reconfiguration and delays

- **Funding Partners:** CO2CRC, Governments, industry, SMEs, research providers (additional in kind); DoE/LBNL (approx $2 M); ARC (in kind);

- **International:** CSLF-endorsed project. IEA peer reviewed
Funders
Current Members of CO2CRC Pilot Project Ltd

- bhpbilliton
- Chevron
- Schlumberger
- ANGLO AMERICAN
- RIO TINTO
- SOLID ENERGY
  Coals of New Zealand
- WOODSIDE
  Australian CRC
- xstrata coal
- bp

Other Financial Supporters

- CO2CRC
- USDoe
- CRC
- Australian Government
  Australian Greenhouse Office
- STANWELL CORPORATION LIMITED
- Victoria
  The Place To Be
- ACARP
  Australian Coal Association Research Program
- AusIndustry
8. Legal, regulatory and licensing issues

• A legal regulatory and licensing regime does not exist for CCS – work in progress in Australia onshore and offshore

• Petroleum, environmental, water, planning, R&D regulations all impact on the project

• We work closely with supportive state authorities but inevitably progress is slow, which adds to the cost

• Legal costs have been far in excess of estimates

• But our identification of legal and regulatory impediments is seen by industry as a very important outcome from the project
## Regulatory and licensing issues addressed as part of the Otway Project

<table>
<thead>
<tr>
<th>Activity</th>
<th>Approvals/Permits (Regulator)</th>
<th>Application Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling injection well</td>
<td>Drilling License (DPI)</td>
<td>Well drilled under exploration license.</td>
</tr>
<tr>
<td>Storage of CO₂</td>
<td>Storage Approvals (EPA, DPI, SRW, LA); Biodiversity Act (EA)</td>
<td>- Environment Protection Act 1970: RD&amp;D Approval</td>
</tr>
<tr>
<td>Production of CO₂ (Buttress) Injection of CO₂ (Naylor)</td>
<td>Production Plan Disposal approval, storage plan (SRW, DPI)</td>
<td>- Petroleum Act - Water Act - Compensation agreement, consent to land access</td>
</tr>
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<td>Transport processing of CO₂, (1) compressor, (2) gathering line, (3) other facilities (shed, etc.)</td>
<td>Planning approval, gathering line approval (DSE, DPI, LA)</td>
<td>- Petroleum Act 2000 (DPI) - Ministerial Amendment request of the Planning &amp; Environment Act - Exemption of Pipeline Act - Cultural Heritage Act - Compensation agreement, consent to land access</td>
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<tr>
<td>Monitoring activities: (1) Atmospheric, (2) Water wells, (3) Down-hole Monitoring</td>
<td>Planning approval, compensation agreement (DSE), access rights (DSE, LA)</td>
<td>- Ministerial Amendment request of the Planning &amp; Environment Act 1987 (LA/DSE) - Consent to use water bores - Compensation agreement, consent to land access</td>
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**Note:**
- **SRW**: Southern Rural Water
- **DSE**: Dept. of Sustainability & Environment
- **LA**: Local Authority (Moyne Shire)
- **EPA**: Environment Protection Authority
- **DPI**: Victorian Dept. of Primary Industries
- **EA**: Envir Australia
- **CO₂ CRC**

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For more information, visit the [Otway Project website](http://www.otwayproject.com) or contact the project team at [ProjectTeam@otwayproject.com](mailto:ProjectTeam@otwayproject.com).
9. Monitoring and Verification is a key part of the project
Seismic profiling will be one of the subsurface monitoring methods. It requires access throughout the time of the project.
Atmospheric monitoring requires access & “permanent” facilities

- To detect, attribute and quantify CO2 emissions to the atmosphere
- Measurements of CO$_2$ concentration (continuous)
- Measurements of other gases and isotopes (including tracers)
- Measurements of CO$_2$ fluxes
- Interpretation with transport and dispersion models
- Integration with subsurface work - soil, hydro, geochemistry....

Flux Tower

Lo-Flo*
# International comparison of scope of monitoring

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Note: ☑️ indicates availability ≥ 70%, ❌ indicates availability < 20%, and ✔️ indicates mixed availability.
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Monitoring and verification reassures the community and the regulators.
It validates the models.
It also provides the basis for being able to surrender the tenements at the conclusion of the project.
And it may be crucial to any deal regarding liability.
10. Risk, insurance and liability

- A challenge to provide quantified risk assessment
- Risk is seen as very low, with greatest risk in the operational phase.
- The risk of the project not proceeding because of community opposition was a concern, which is why we put a lot of effort into community consultation.
- Operational risk is covered by insurance but any claim above the cap is covered by CO2CRC Pilot Project Ltd
- Insurance to 10 years after operations cease
CO2CRC Otway Project Risk Assessment demonstrates low risk.
Long term liability

• This has still to be resolved and discussions are underway with the state of Victoria
• Until agreement is reached, we will not be able to commence injection
• So it is a potential show-stopper – but one that will be resolved in the next couple of months!
11. Where to from here?

- Sort out long term liability!
- Commence injection (Sept-Oct 2007)
- Successfully complete Stage 1
- Raise more funding for Stage 2 (injection into a saline aquifer)
- Establish an international geosequestration test centre
I thank the following for their support and contribution to the Project

Tim Besley & the Board of CO2CRC Joint Venture
Mal Lees & the Board of CO2CRC Pilot Project Ltd
Sandeep Sharma (Project Manager)
Thomas Berly (Government Liaison)
The many CO2CRC researchers and their associates in other institutions
LBNL, DoE, CSLF, ARC, IEA,
and other international collaborators and peer reviewers
The Australian Greenhouse Office, AusIndustry, the Victorian Government & regulators
Company sponsors and participants

Victorian coastline
Otway Basin, Victoria