

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

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Chief Executive

**Cooperative Research Centre for
Greenhouse Gas Technologies (CO2CRC)**

INTERNATIONAL ENERGY AGENCY

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The CO2CRC Otway Project, Victoria, Australia

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- 2 The concept of the Otway project**
- 3 The site**
- 4 Land access**
- 5 Site characterization and due diligence**
- 6 Corporate structure**
- 7 Costs and funding**
- 8 Legal, regulatory and licensing issues**
- 9. Monitoring and verification**
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- 11 Where to from here?**

1. CO2CRC

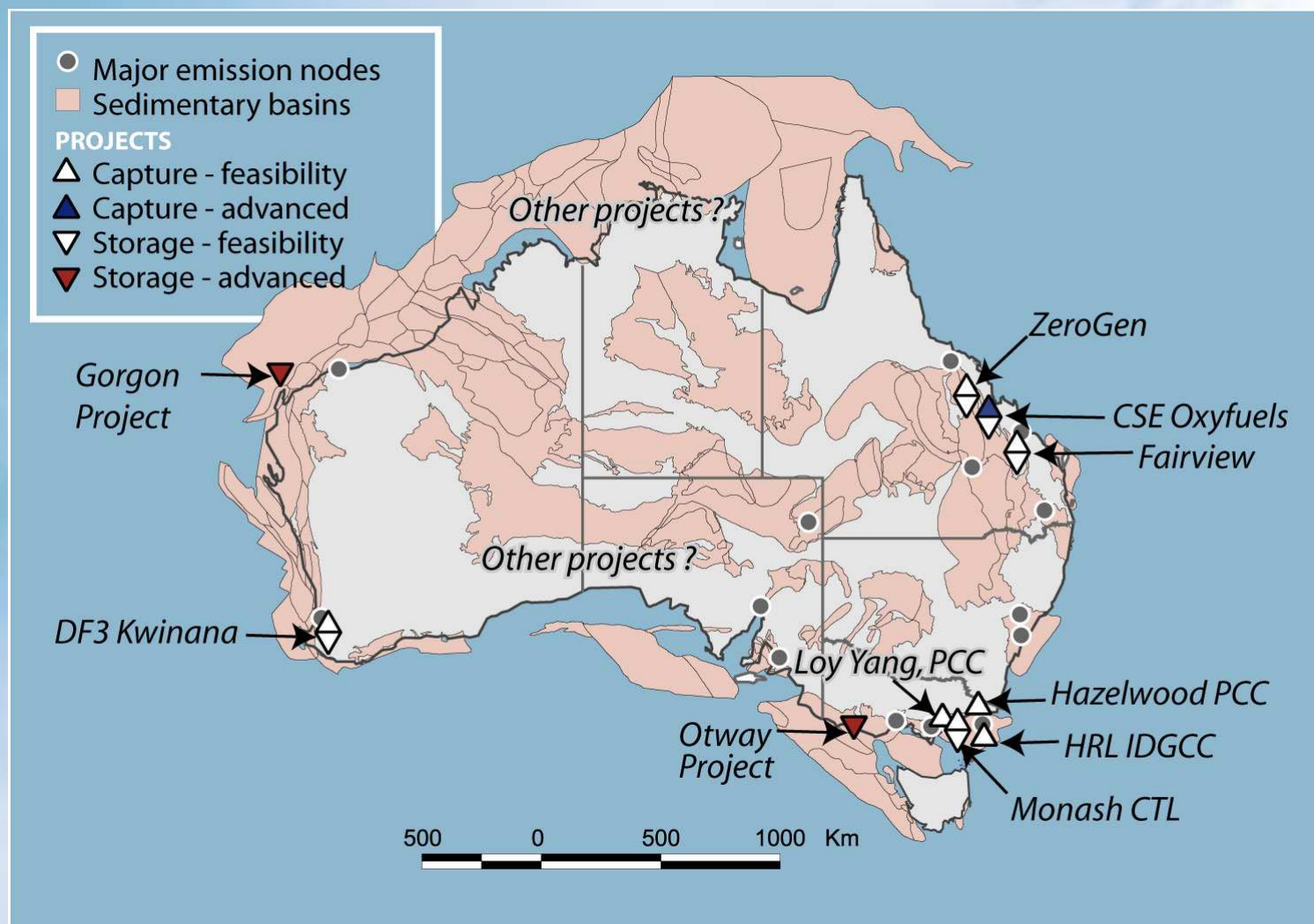


Supporting participants: Australian Greenhouse Office | Australian National University |
| CANSYD | Meiji University | The Process Group | University of Queensland |

www.co2crc.com.au



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:

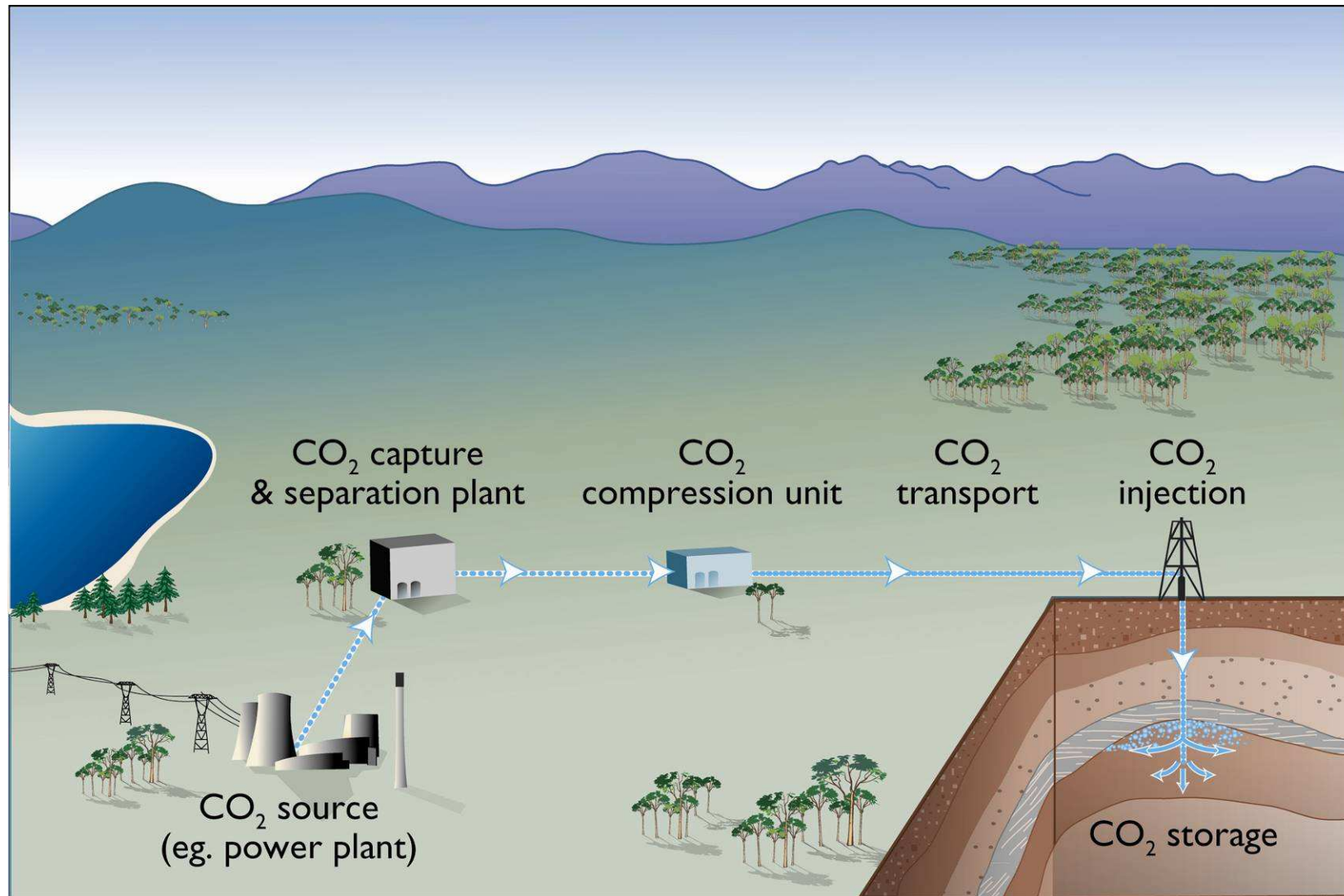
- **A\$ 445M (\$75M Govt) Fairview Coal Seam Gas Power Station with PCC and ECBM**
- **A\$370M (\$50M Govt) Hazelwood Power Station Lignite Drying with PCC**
- **A\$750M (\$100M Govt) HRL Integrated Drying Gasification Combined Cycle Power Station with pre comb capture**
- **A\$1B? (\$60M Govt) Gorgon 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

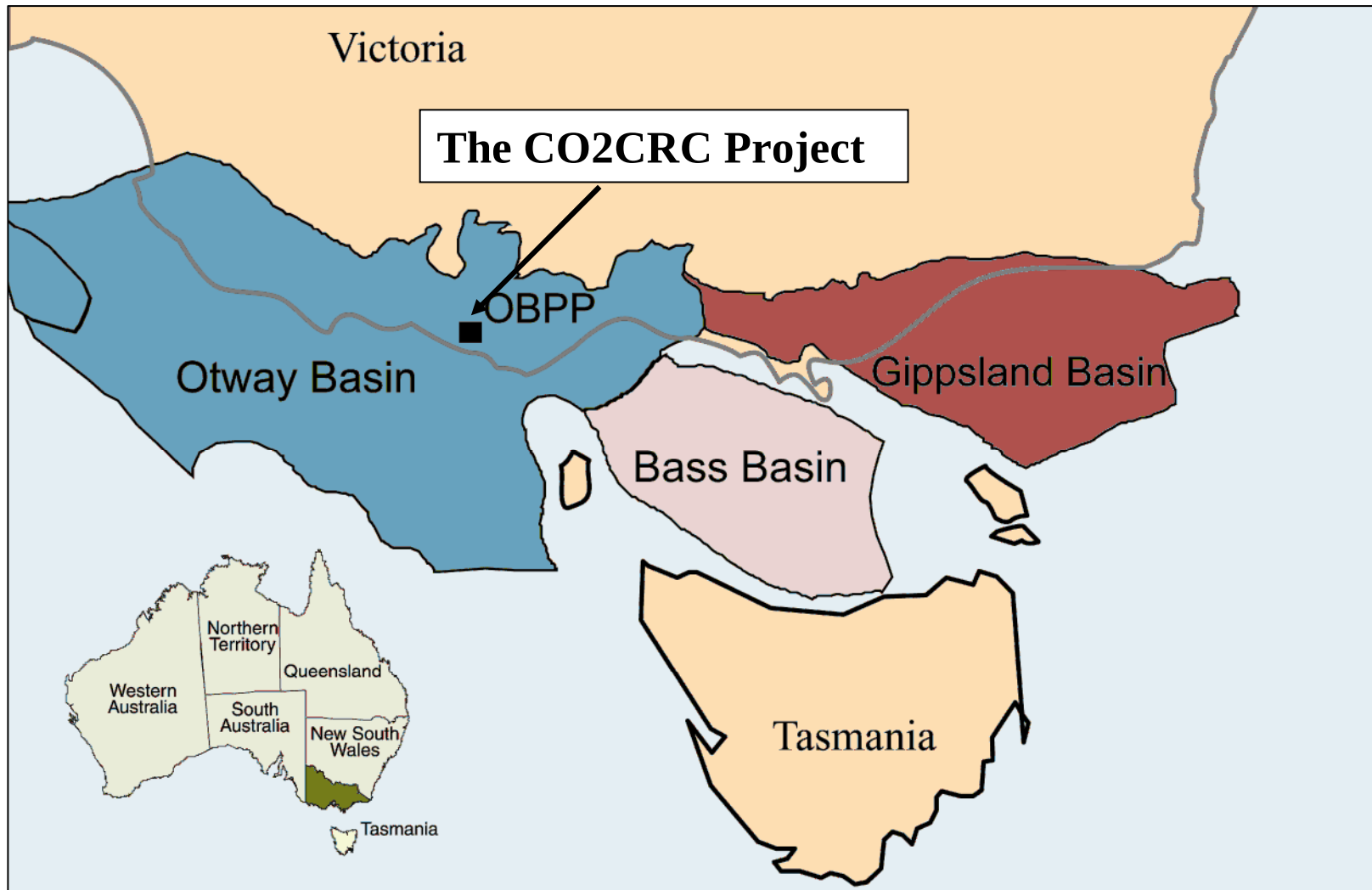
- **Victorian Energy Technology & Innovation Strategy (ETIS)**
 - A\$ 161 million research funds for both brown coal and renewables projects
- **Qld Clean Coal Fund**
 - A\$ 300 million government funding for low emission technologies from black coal, including CCS
- **Western Australian Low Emission 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

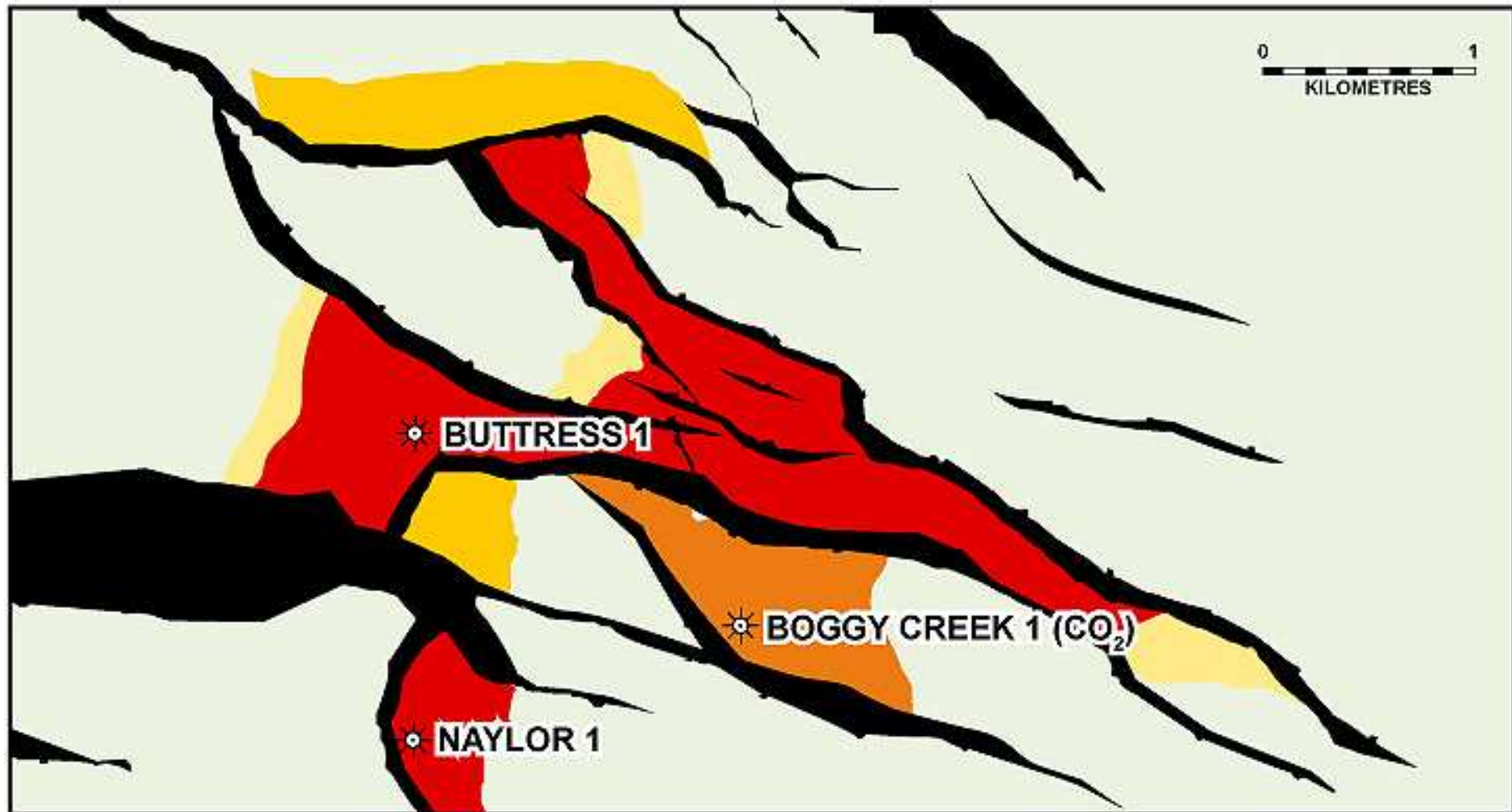
2. The Concept: Demonstrating the Carbon Capture, Transport & Storage Chain



3. The Site



The site is in an oil and gas producing area, with lots of small fields and compartmentalisation by sealing faults



Perhaps the only research project anywhere with its own dedicated source of CO₂ - from the Buttress Well



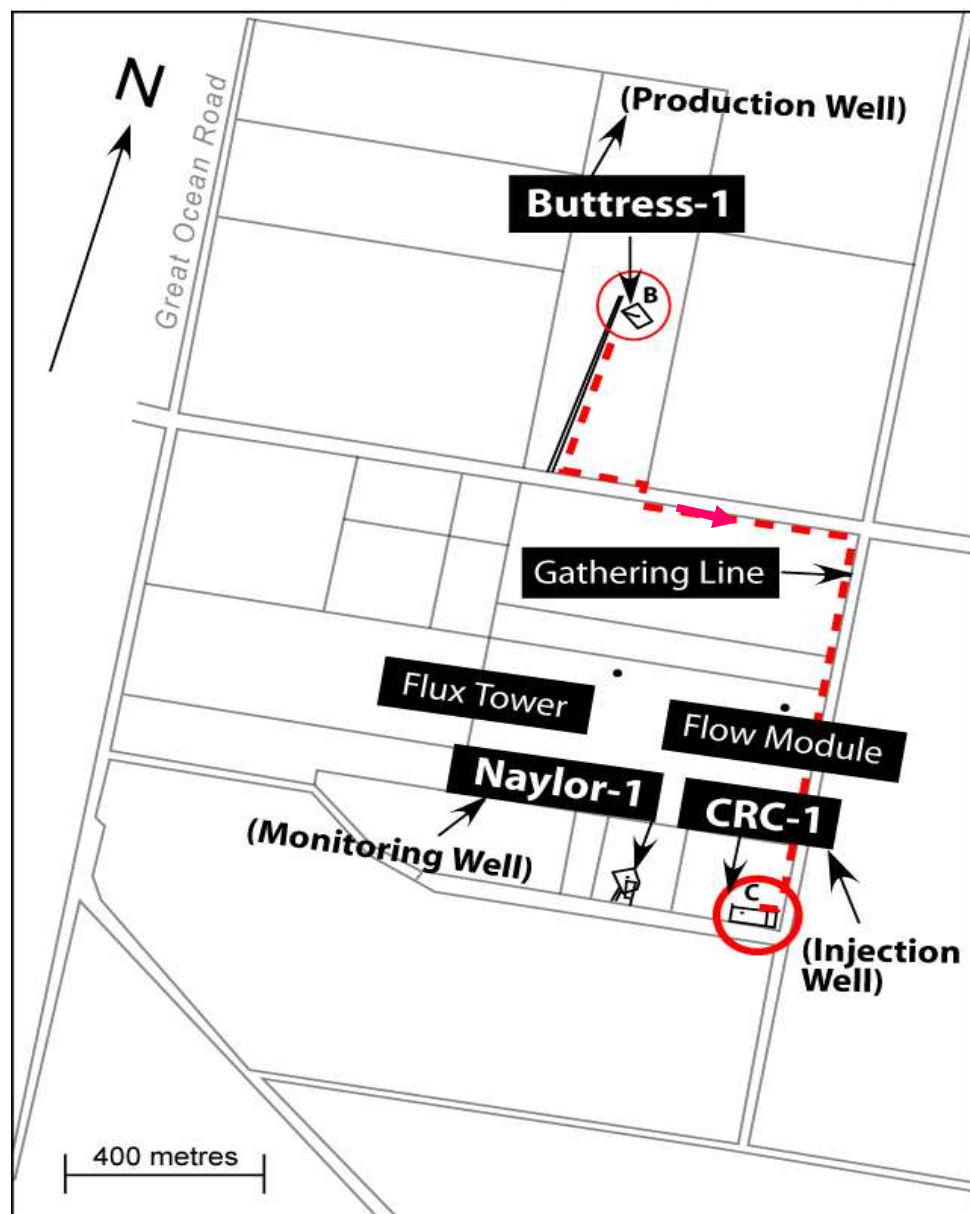
Testing the CO₂ source was a significant issue

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.

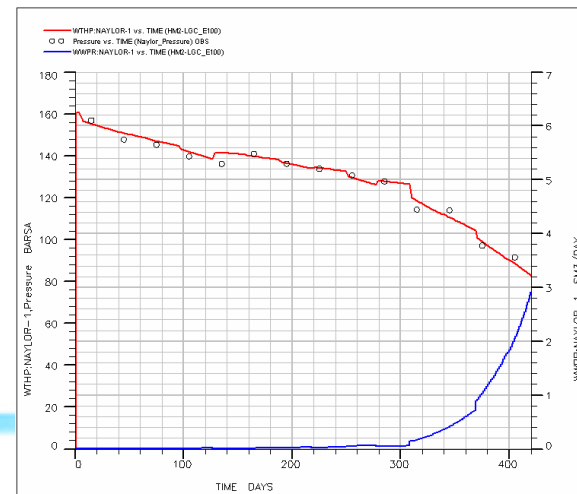
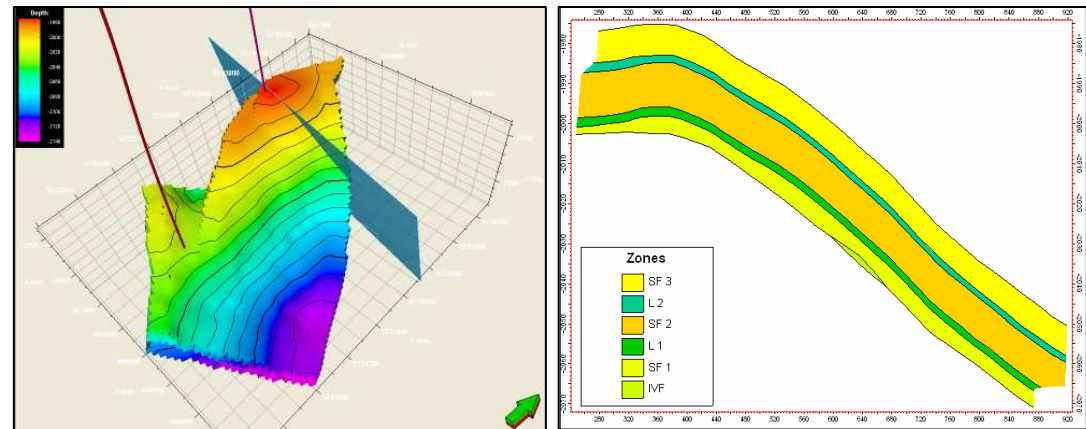
Access to the site and the subsurface was through purchase of the petroleum tenements, negotiations, and through declaration of a “project of state significance”

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.

KEY



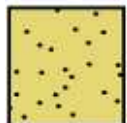
PHASE I INJECTION



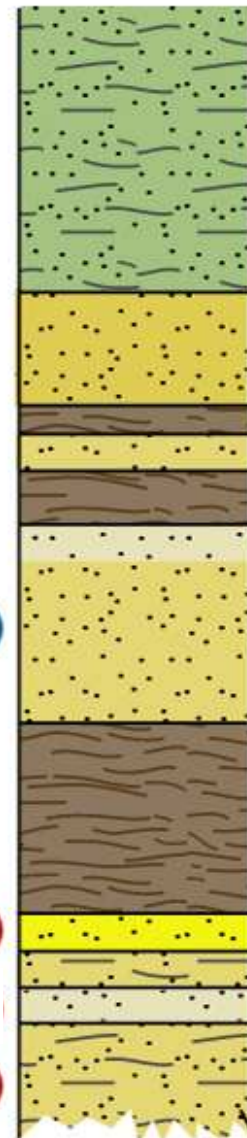
PHASE II INJECTION



SEAL



RESERVOIR



SHALLOW FORMATIONS

DILWYN FORMATION

PEMBER MUDSTONE

PEBBLE POINT

MASSACRE SHALE

PAARATTE FORMATION

BELFAST FORMATION

WAARRE C

WAARRE B

WAARRE A

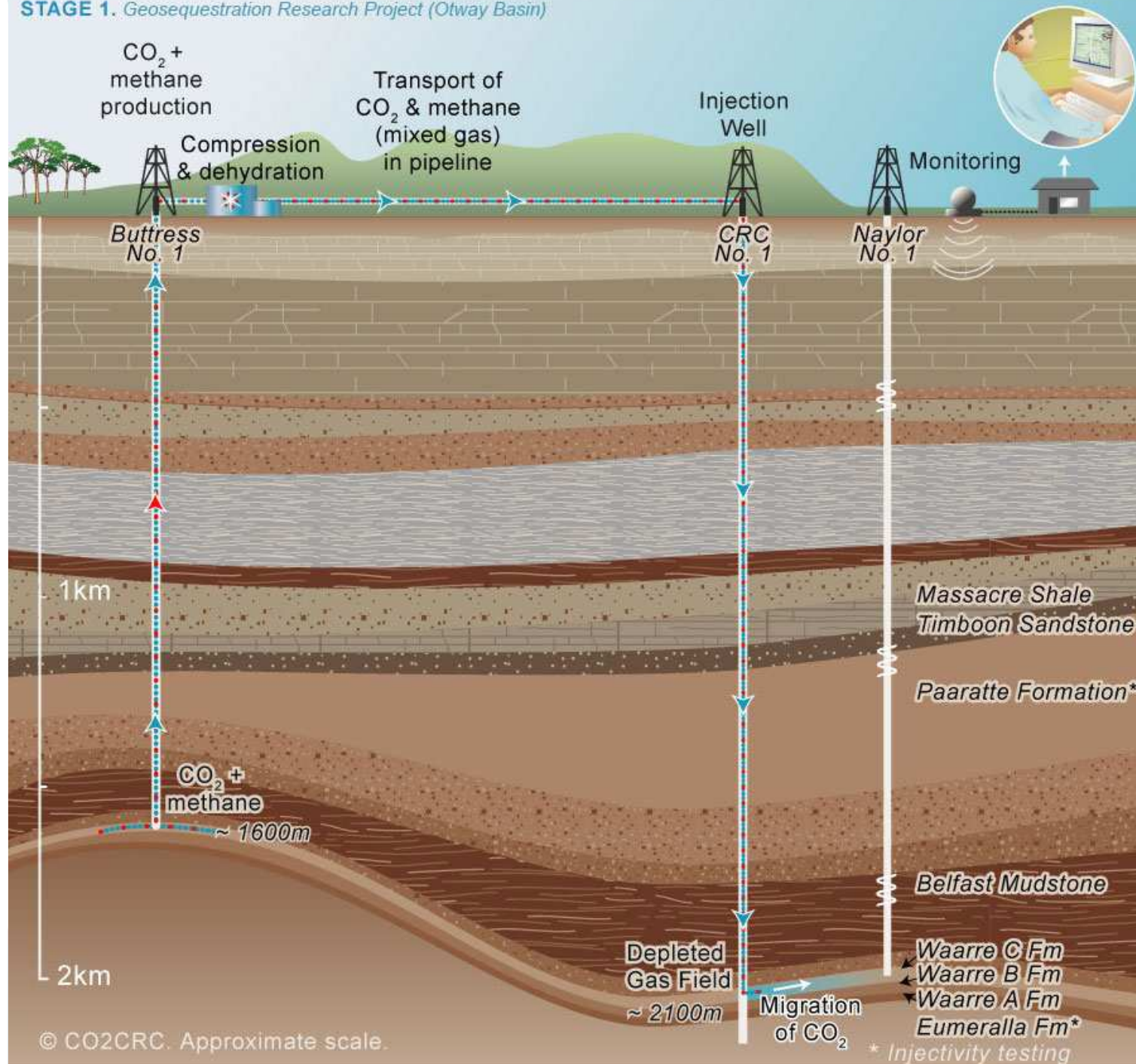
EUMERELLA FORMATION

0m

1000m

2000m

STAGE 1. *Geosequestration Research Project (Otway Basin)*



**CO2CRC
Geosequestration
Research Project
(Otway Basin)**

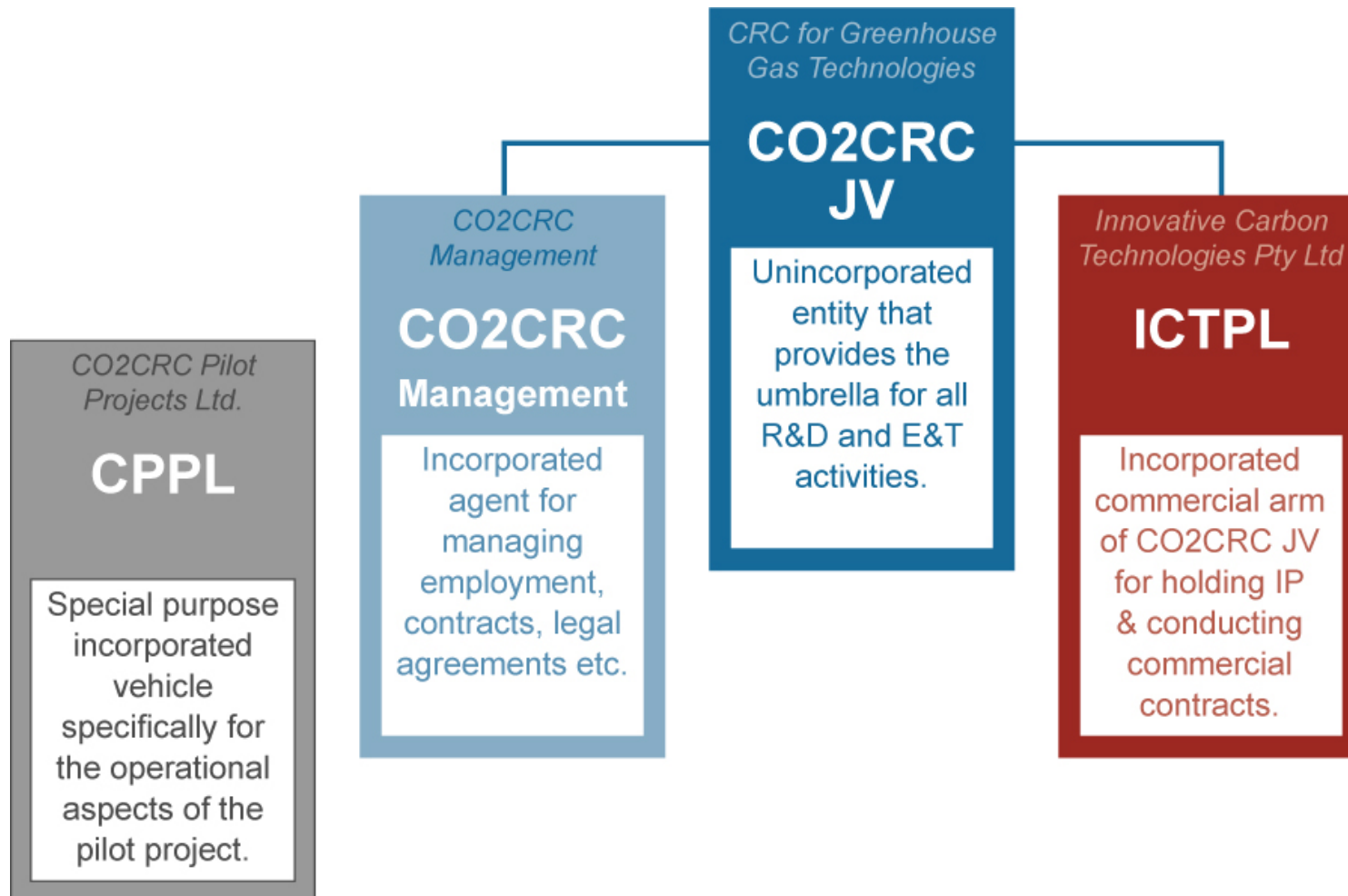
Stage 1

This involves:

- Production of CO₂ rich gas
- Compression
- Injection into Waarre Fm
- M&V



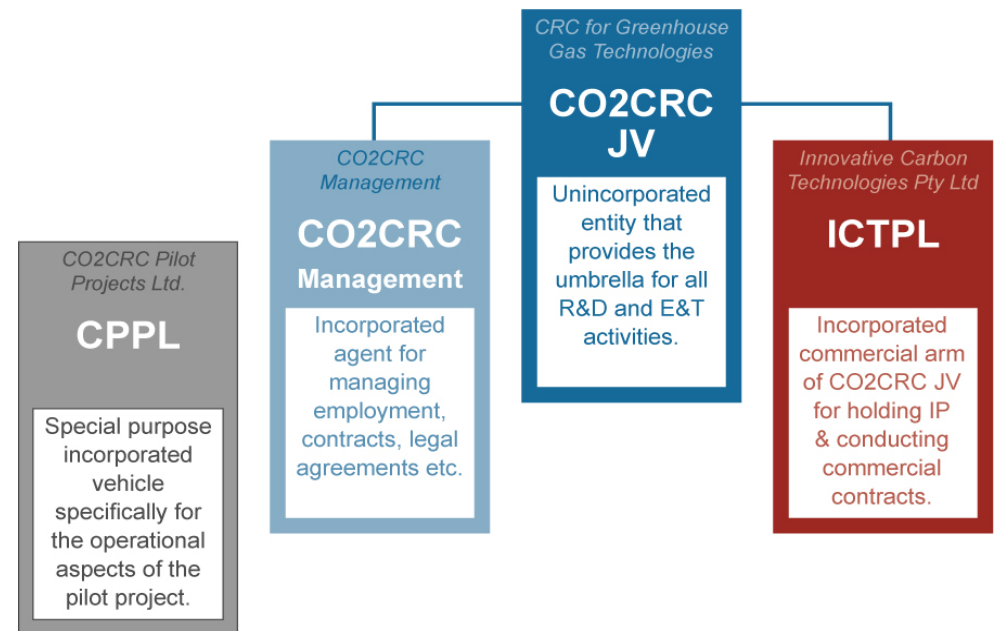
6. Corporate structure



CO2CRC JV and related entities



CO2CRC Pilot Project Ltd (Operating Company)



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



Other Financial Supporters



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

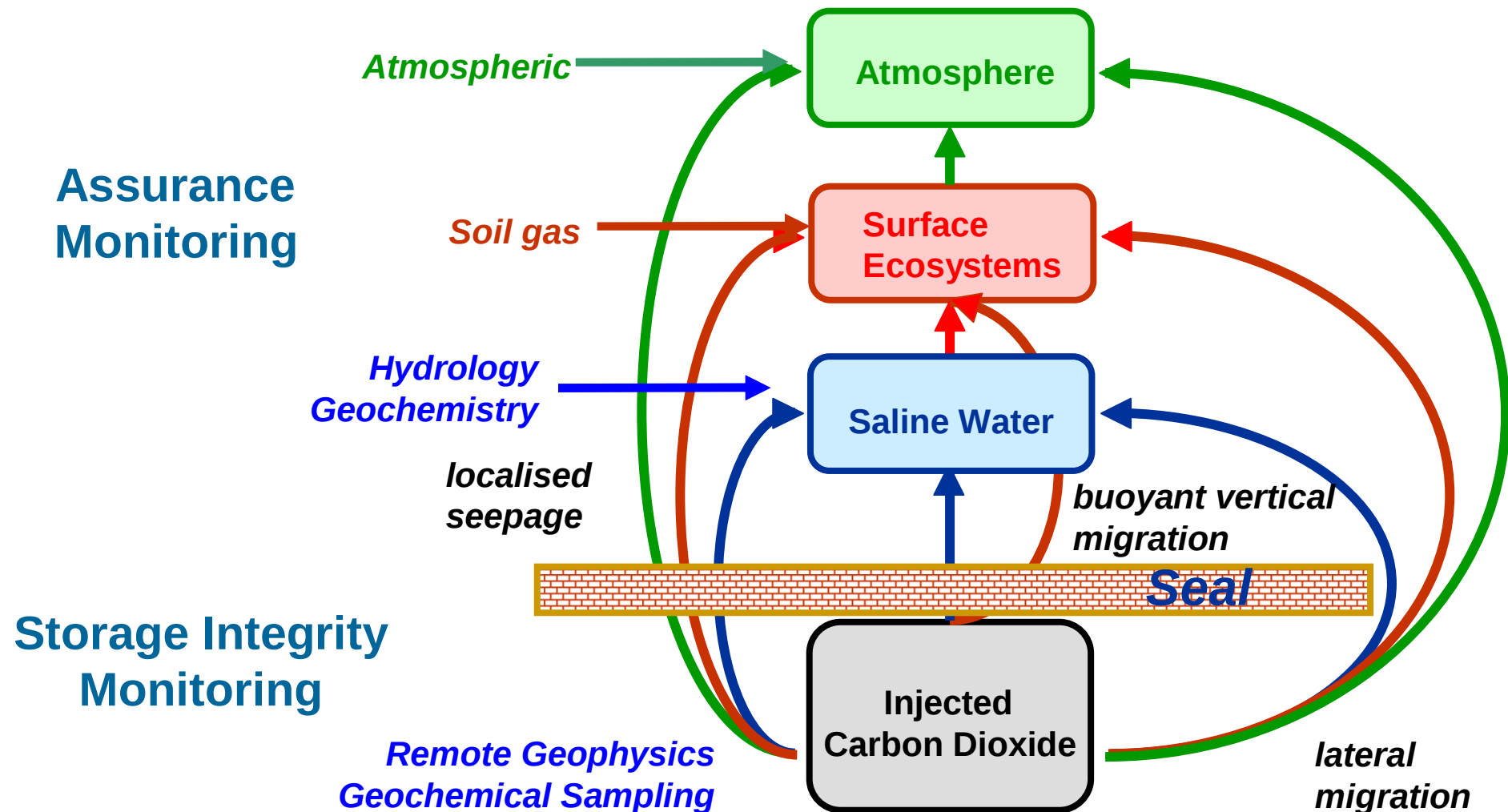


Regulatory and licensing issues addressed as part of the Otway Project

Activity	Approvals/Permits (Regulator)	Application Process
Drilling injection well	Drilling License (DPI)	Well drilled under exploration license.
Storage of CO ₂	Storage Approvals (EPA, DPI, SRW, LA); Biodiversity Act (EA)	- Environment Protection Act 1970: RD&D Approval
Production of CO ₂ (Buttress)	Production Plan	- Petroleum Act
Injection of CO ₂ (Naylor)	Disposal approval, storage plan (SRW, DPI)	- Water Act - Compensation agreement, consent to land access
Transport processing of CO ₂ , (1) compressor, (2) gathering line, (3) other facilities (shed, etc.)	Planning approval, gathering line approval (DSE, DPI, LA)	- Petroleum Act 2000 (DPI) - Ministerial Amendment request of the Planning & Environment Act - Exemption of Pipeline Act - Cultural Heritage Act - Compensation agreement, consent to land access
Monitoring activities: (1) Atmospheric, (2) Water wells, (3) Down-hole Monitoring	Planning approval, compensation agreement (DSE), access rights (DSE, LA)	- Ministerial Amendment request of the Planning & Environment Act 1987 (LA/DSE) - Consent to use water bores - Compensation agreement, consent to land access

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

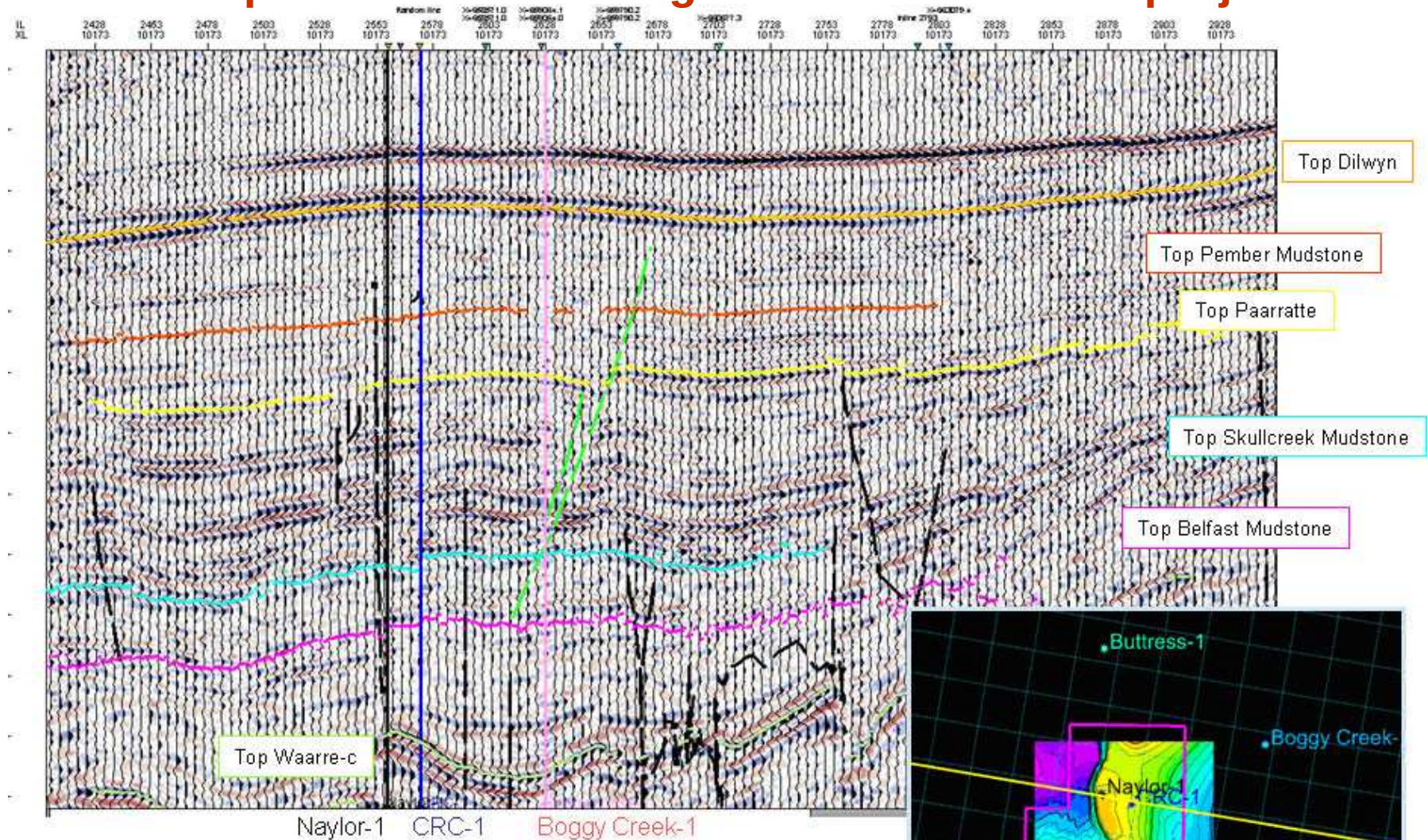
9. Monitoring and Verification is a key part of the project



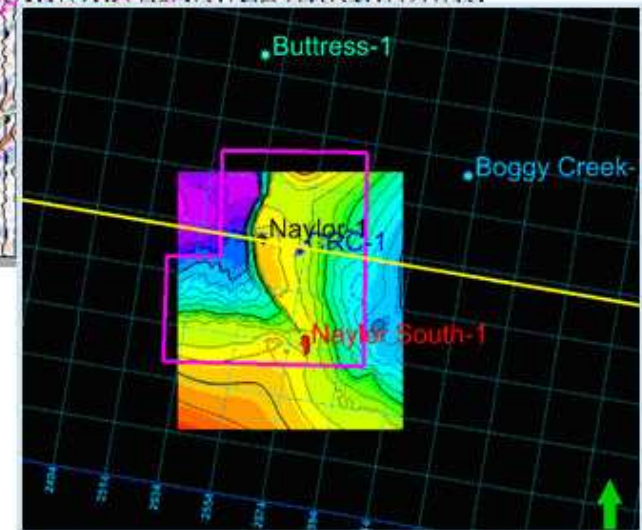
CARBON SEQUESTRATION LEADERSHIP FORUM



**Seismic profiling will be one of the sub surface monitoring methods
It requires access throughout the time of the project.**



Location map: Line xline 10173
Top Waarre structure and PPL 13 boundary



Atmospheric monitoring requires access & “permanent” facilities



Flux Tower

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



Lo-Flo*

International comparison of scope of monitoring

	Geological Data Availability		Baseline data	Reservoir Geochem	Geo-physics	Ground water monitoring		Soil Gas	Atmos	Containment Risk Ass. prior to project start
	Regional	Reservoir				Hydrology	Geochem			
West Texas		Largely confidential		very limited	limited					
Alberta Basin		limited		very limited						
Sleipner		limited	limited							
Weyburn		Largely confidential						limited		
Frio						limited	limited	limited		
Japanese										

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Frio						limited	limited	limited		
Japanese										
CO2CRC										

The background image shows a large, open field under a blue sky with some clouds. In the foreground, two people are working in the field. One person is on the left, wearing a dark shirt and light-colored pants, and is bent over, possibly using a tool. The other person is on the right, wearing a dark jacket and light-colored pants, and is also bent over. In the background, there are some trees and a fence line. The overall scene suggests an agricultural or environmental project.

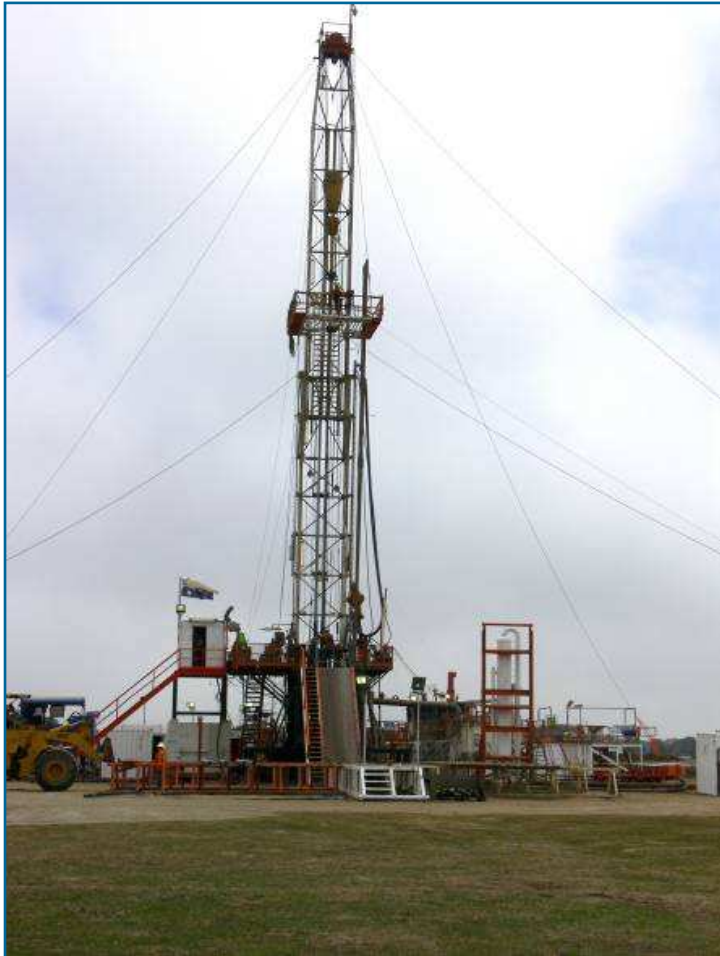
Monitoring and verification reassures the community and the regulators

It validates the models

It also provides the basis for being able to surrender the tenements at the conclusion of the project

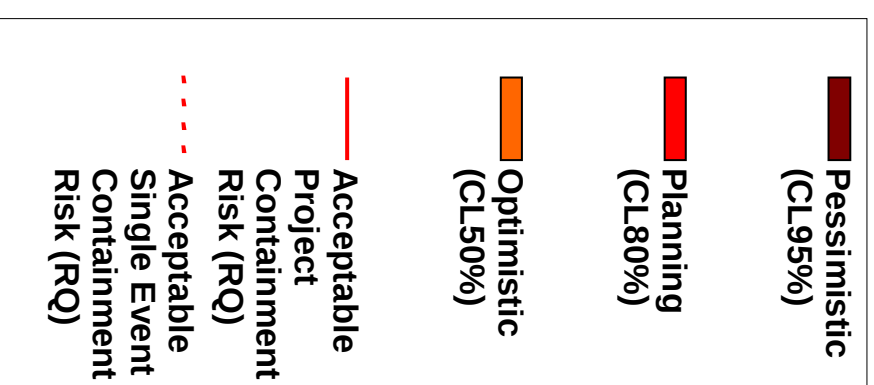
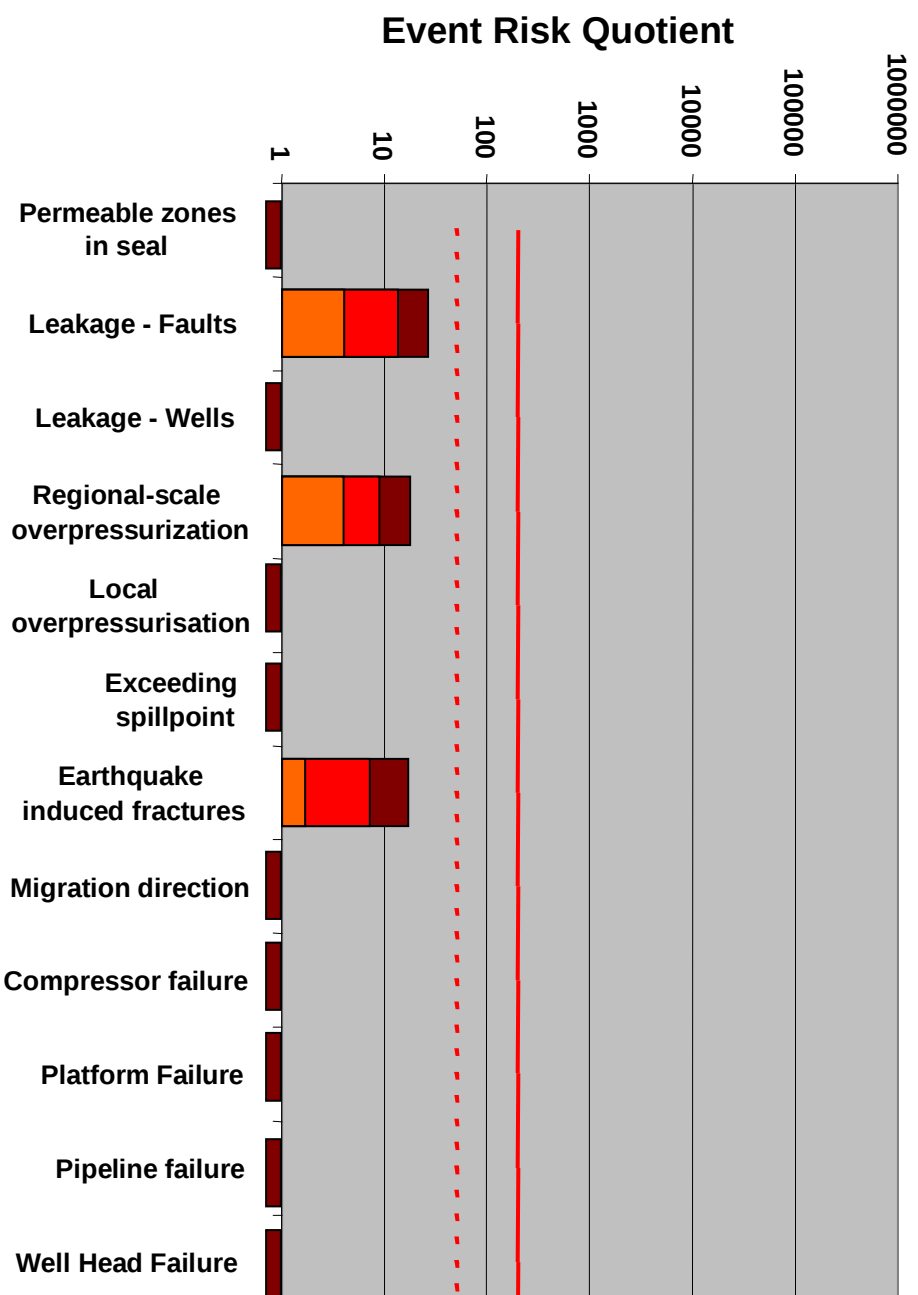
And it may be crucial to any deal regarding liability

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

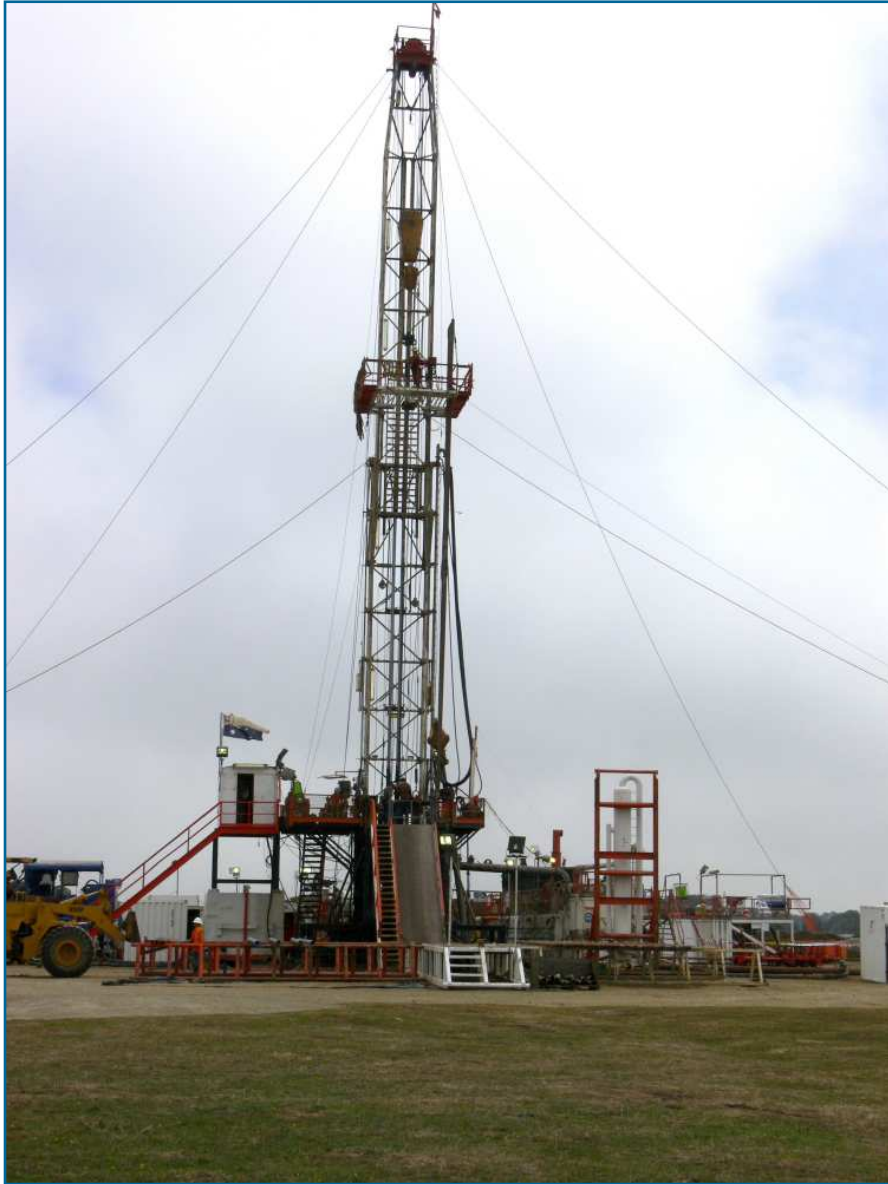


Risk Quotient =
Likelihood X Consequence

CL = Confidence Limit

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)

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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

