

A photograph of a large industrial facility, likely a coal processing plant, featuring numerous tall, vertical stainless steel pipes and complex piping systems. A prominent piece of equipment in the center has a label that reads "CO2CRC" and "CO2CRC". The facility is illuminated by overhead lights, and the ceiling structure is visible.

**Australia-Japan Coal Technology Workshop**  
*Brisbane, Australia, 26 June 2009*

# **Recent CO2CRC Developments**

**Dr Dennis R Van Puyvelde**

*Technical & International Projects Manager, CO2CRC*

# Recent CO2CRC Developments in Carbon Capture and Storage

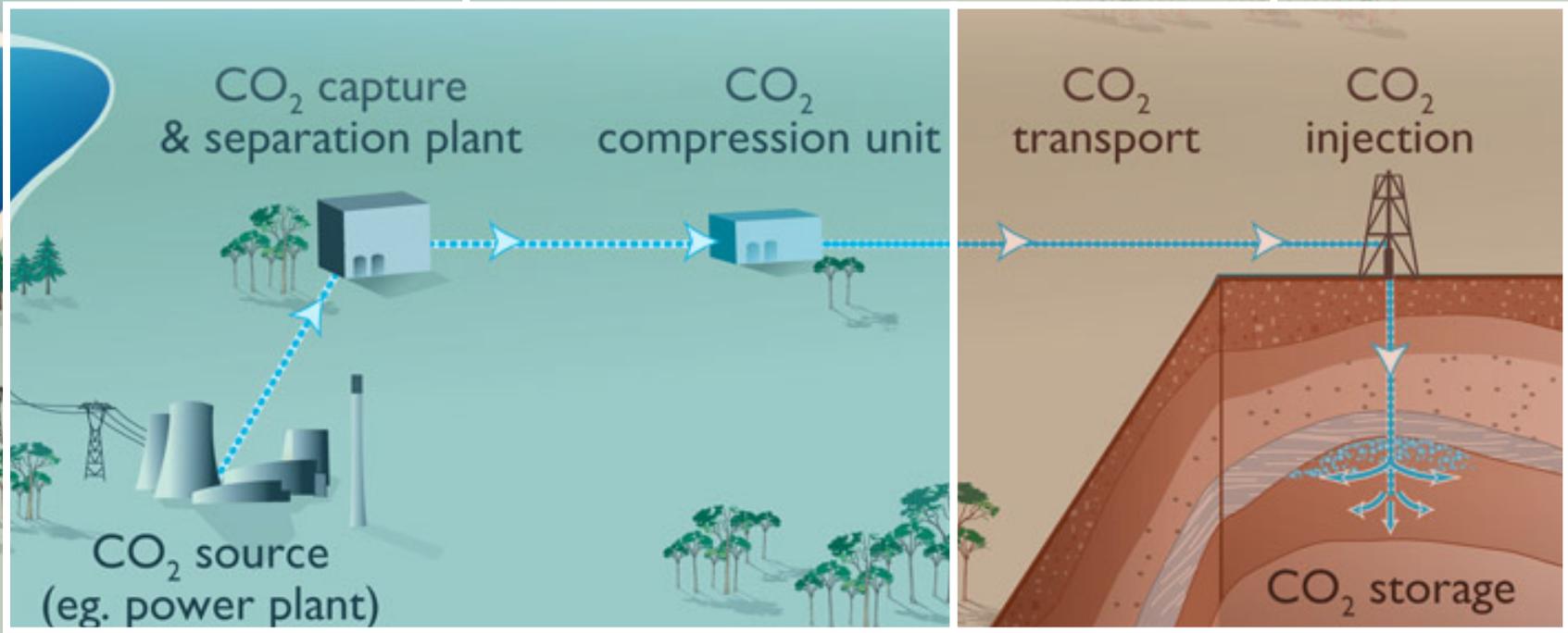


- Background – CO2CRC
- Capture research developments
- Storage research developments – CO2CRC Otway Project
- Collaborations with Japan
- CO2CRC's way forward
- Summary

# CO2CRC

Capture Research & Demonstration

Storage Research & Demonstration



# Heat Integration

- **Challenge:** reduce the energy penalty with CO<sub>2</sub> capture
- **Aim:** to integrate CO<sub>2</sub> capture with brown coal power generation
- **Solution:** pinch analysis on brown coal power station
- **Results:**
  - Base efficiency of 23 %
  - Efficiency with heat integration and CCS of 20%
  - An energy penalty of 24% cf simple CCS penalty of 39%

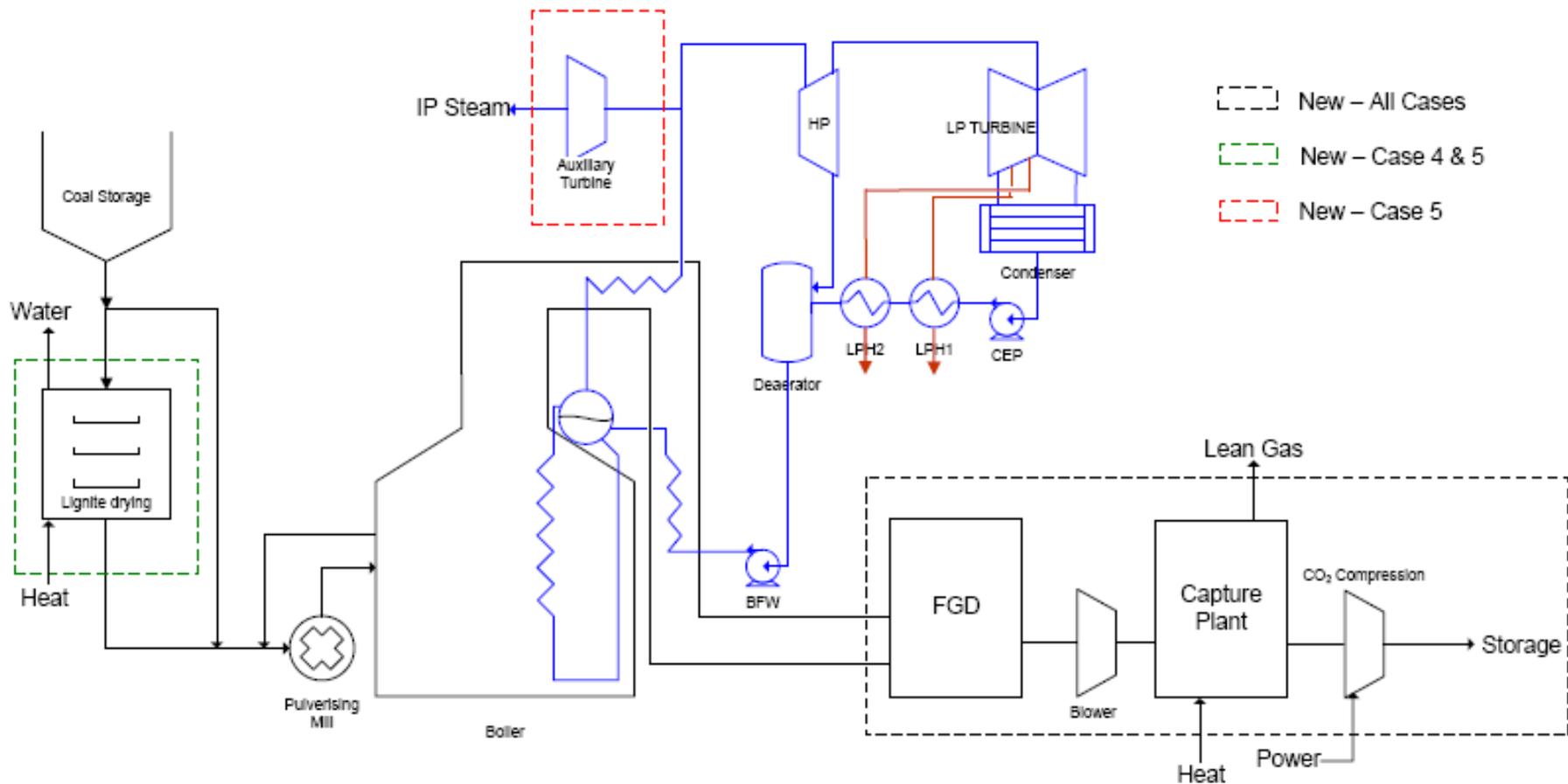
# Heat Integration

- Energy Penalty
- Energy associated with capture and compression

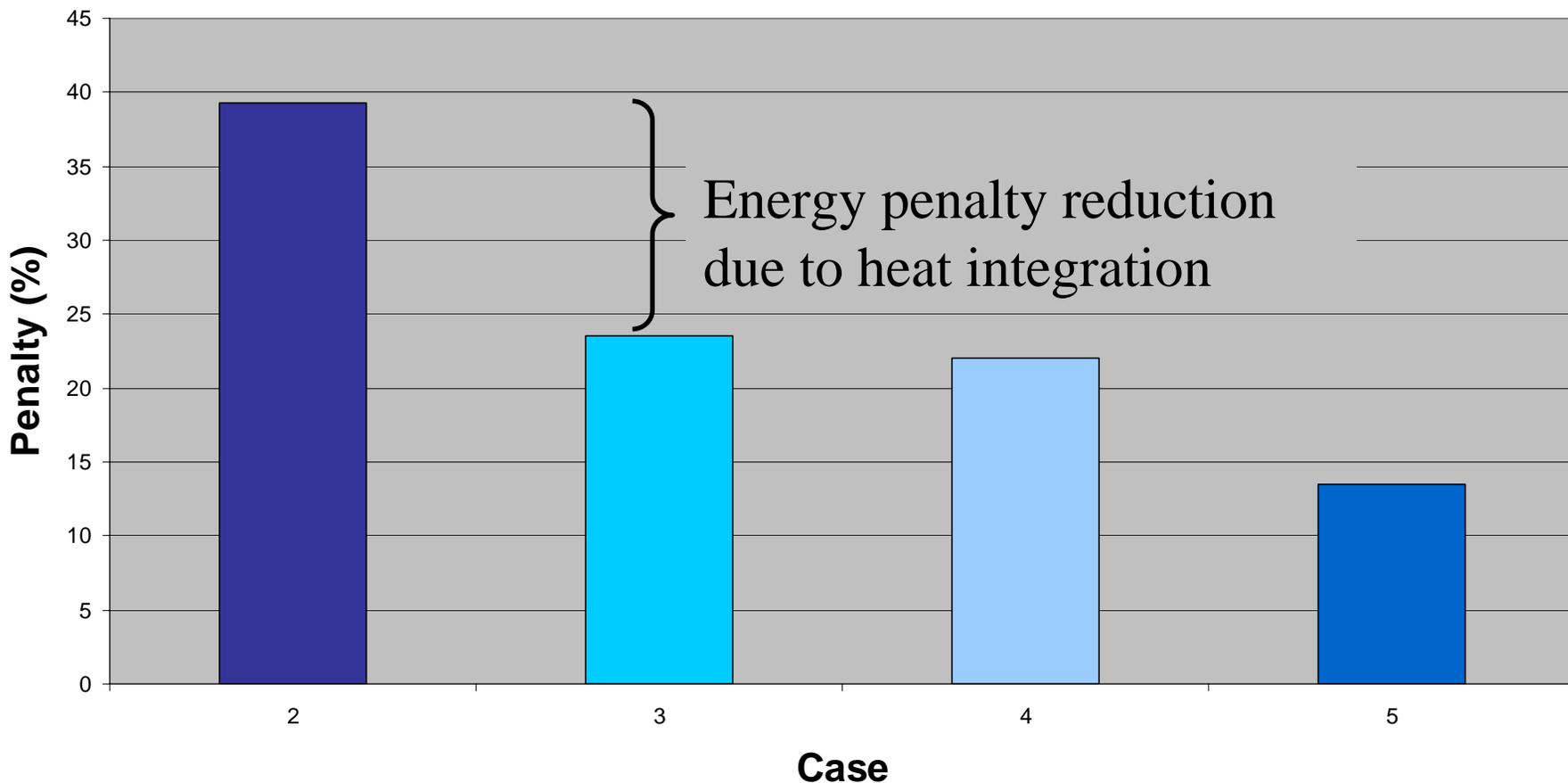
$$Penalty = \frac{(\eta_{ref} - \eta_{CCS})}{\eta_{ref}}$$

PROCESS	ELECTRICITY	PROCESS HEAT
Absorption	Gas blower, pumps	Regeneration
Membranes	Gas compressor	
PSA/VSA	Compression, vacuum	Dehydration
TSA	Gas pumping	Regeneration
Cryogenics	Refrigeration	

# Heat Integration



# Heat Integration – Reducing the Energy Penalty

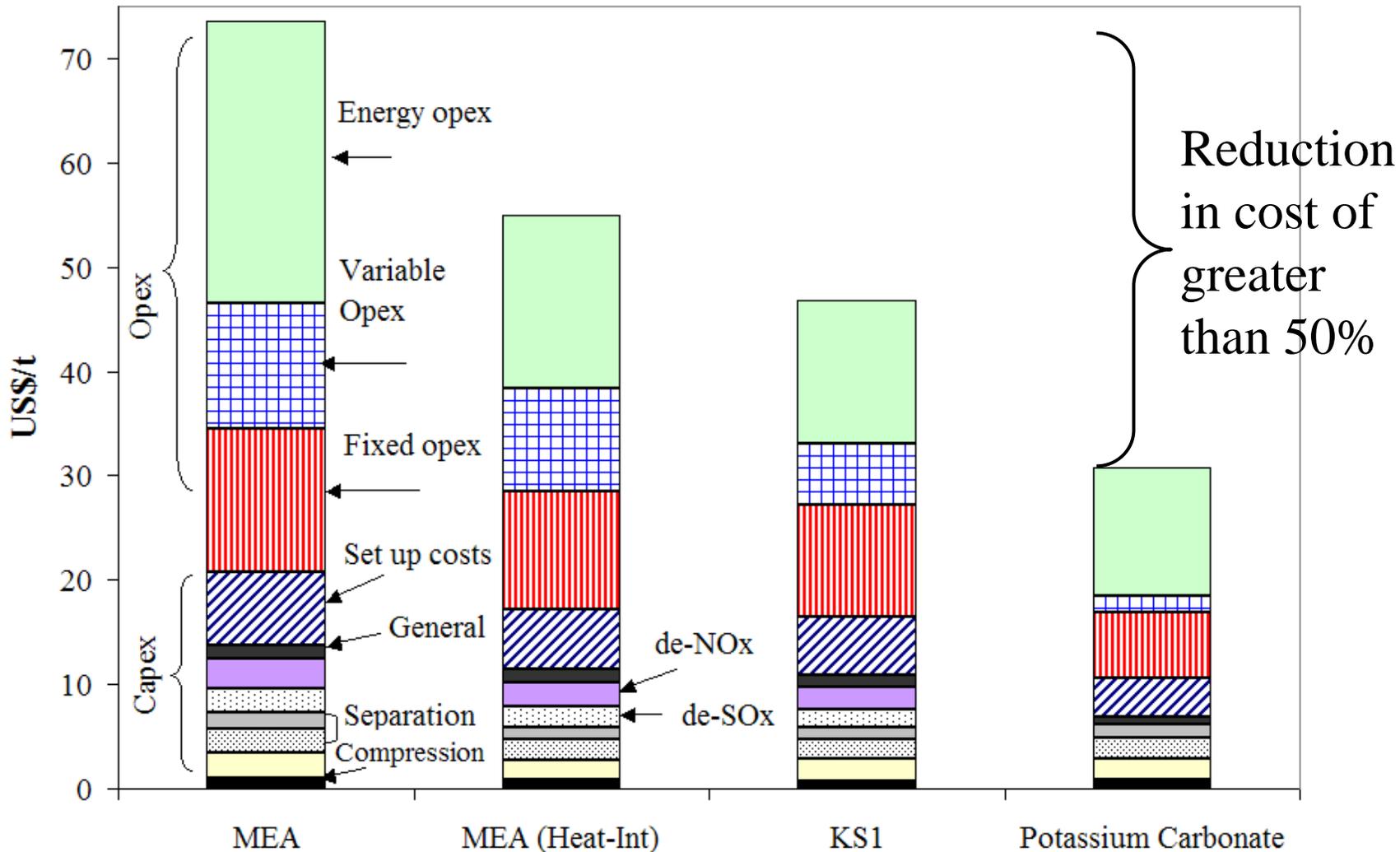


# Solvent Absorption - Carbonates

- **Challenge:** reduce cost of retrofit of capture
- **Aim:** to develop options of using a carbonate to separate CO<sub>2</sub> from flue gases
- **Solution:** K<sub>2</sub>CO<sub>3</sub> with a boric acid promoter
- **Results:**
  - CO<sub>2</sub> absorption rate of  $5.35 \times 10^{-11}$  (cf MEA at  $1.6 \times 10^{-10}$ )
  - No FGD required
  - No deNOx required
  - Significant cost reductions



# Heat Integration + Potassium Carbonate

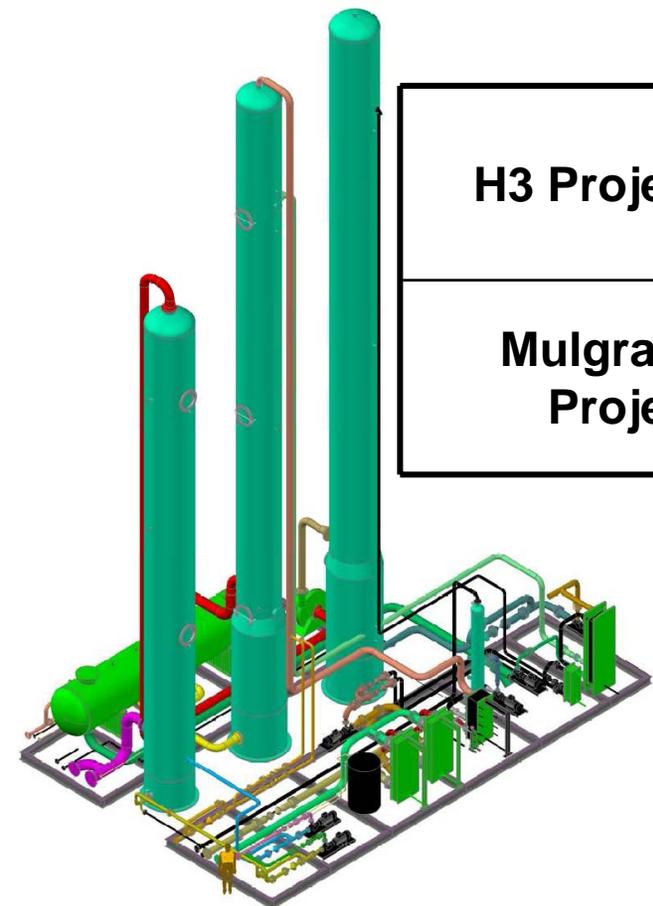


Source: Ho, M. et al., *Factors affecting the cost of capture for Australian lignite coal fired power plants*, GHGT-9, Washington, Nov 2008

# CO2CRC Capture Demonstration Projects

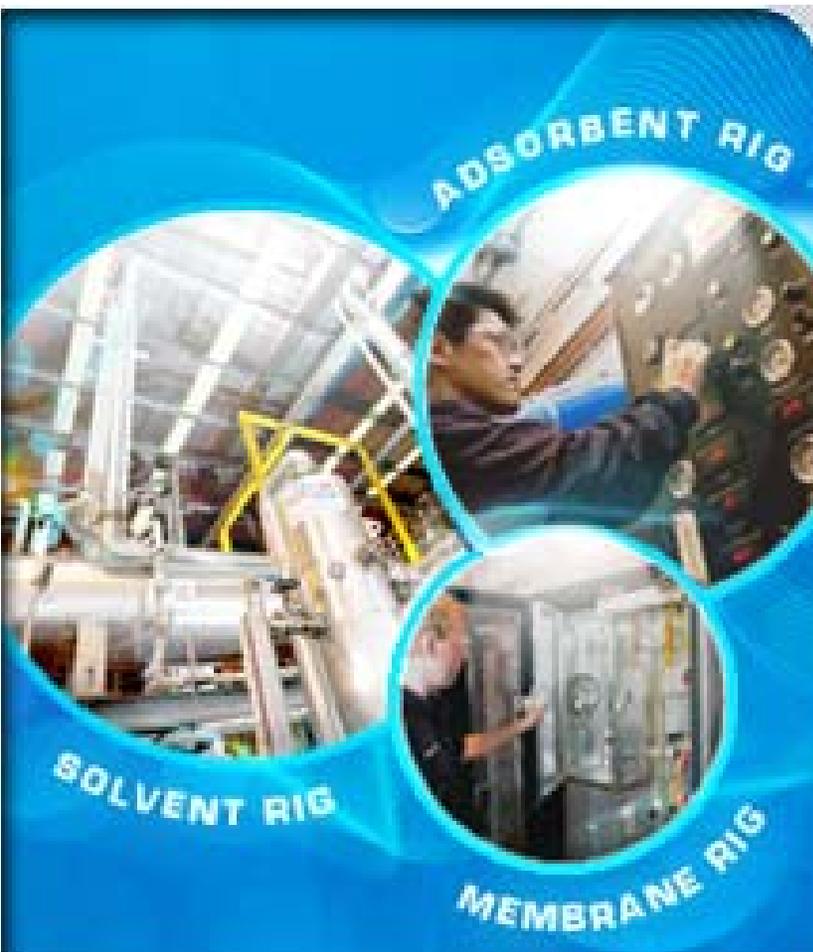


<b>H3 Project</b>			
<b>Mulgrave Project</b>			



# CO2CRC-HRL Mulgrave Project

- **Key objective:** to reduce the technical risk and cost of pre-combustion capture for Victorian coal-fired stations with new coal burning technologies employing gasification



## Experimental program:

- Impact of gas contaminants and water on performance of separation technologies
- Impact of gas temperature and CO<sub>2</sub> concentration
- Develop engineering solutions that can be applied for full scale plants
- Assess energy integration opportunities

# CO2CRC-H3 Capture Project



- 15000 + tpa capture
- Site erected columns
  - Prewash/DCC  
(8.5m x 2.1m dia)
  - Absorber  
(22m x 2-1.5m dia)
  - Stripper  
(23.4m x 1.7-1.4m dia)

# CO<sub>2</sub>CRC Capture Demonstration Projects

**AIM: To demonstrate CO<sub>2</sub> capture in pilot plant settings for a range of CO<sub>2</sub> capture technologies and to support this in the laboratory.**

The overall plan and broad milestones are:

- Year 1

- Design, construct and commission equipment.
- Define test procedures and detail programs.
- Recruit personnel where necessary



- Year 2

- Operate test rigs, perform test program.
- Collect data.
- Ongoing evaluation

- Year 3

- Analyse data, run additional tests where required.
- Ongoing evaluation.
- Detailed evaluation and performance at large scale

# CO2CRC Otway Project

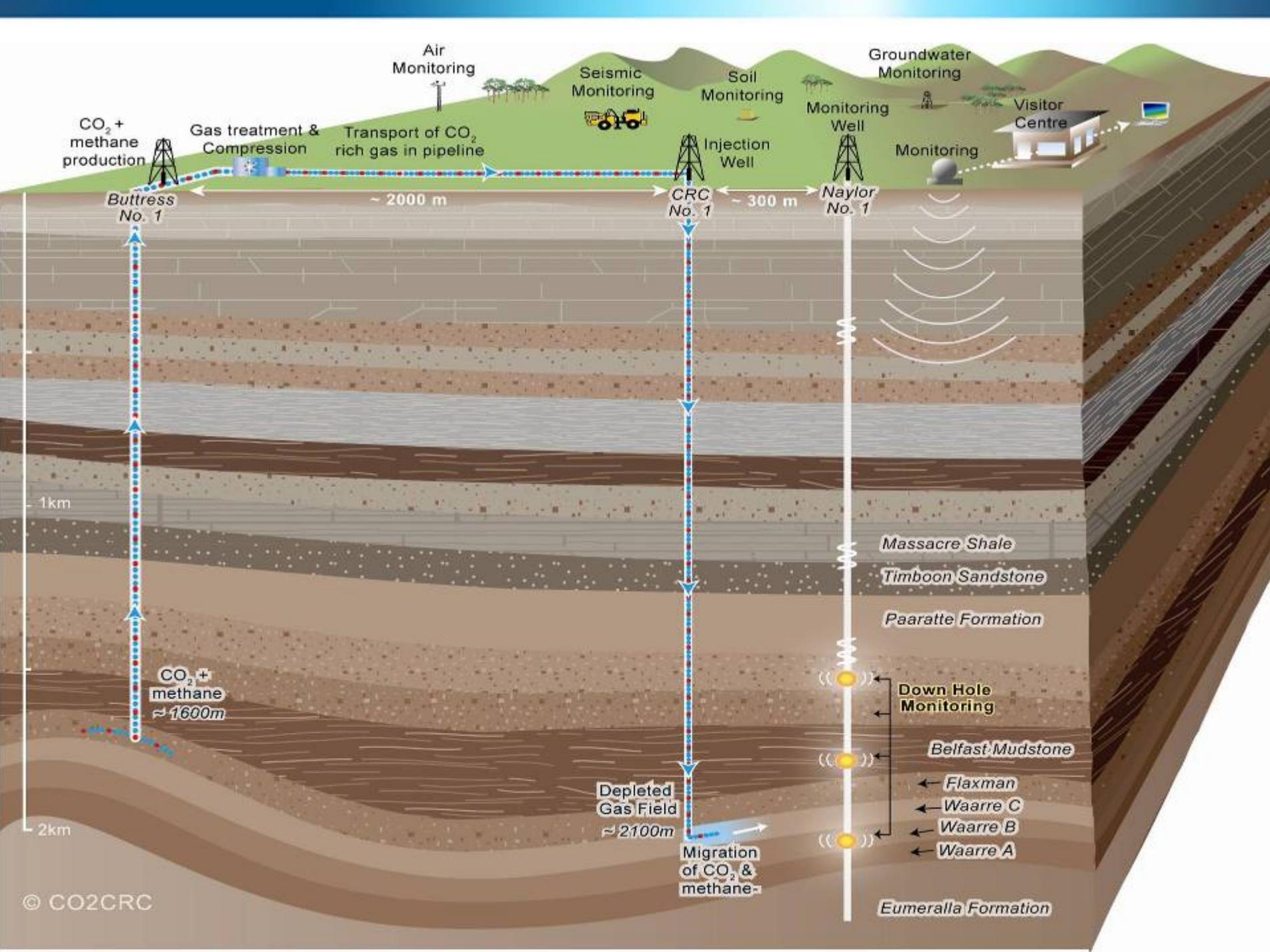


## AIMS

### To demonstrate that:

- CO<sub>2</sub> can be **safely produced, transported and injected** into the sub-surface
- CO<sub>2</sub> can be **safely stored**
- **Subsurface behaviour** of the injected CO<sub>2</sub> can be effectively **modeled and monitored**
- Storage Volume can be verified as far as possible
- **Build public support for CCS** as a mitigation mechanism



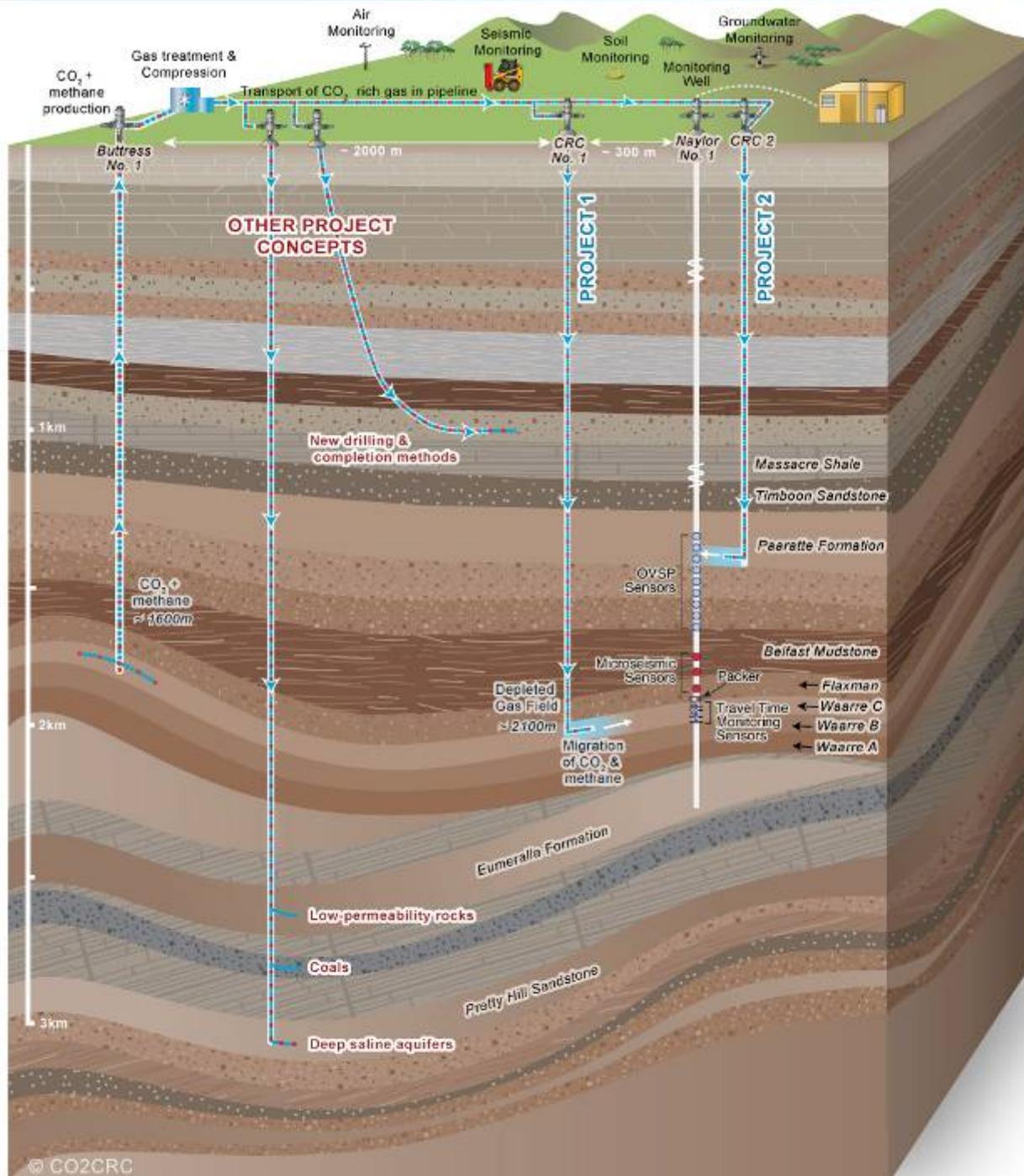


# Otway Project Progress



- Storage regulatory issues advanced
- Baseline monitoring studies completed (Mar 2008)
- Complex monitoring and verification regime developed and installed
- 50 000 tonnes injected by April 2009
  - 5<sup>th</sup> largest injection project worldwide
  - Excellent platform for further international collaboration
- Monitoring of CO<sub>2</sub> confirms results from simulations
- Ongoing monitoring program out to 2014

# Building on CO2CRC Otway Project



# CO2CRC - Japan Collaborations



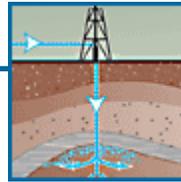
Fuel  
Supply



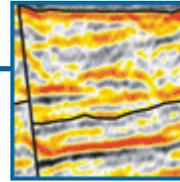
Capture



Transport  
Infrastructure



Storage



MMV



Closure



Long Term  
Liability

**Mitsui & Co and INPEX are participants in CO2CRC**

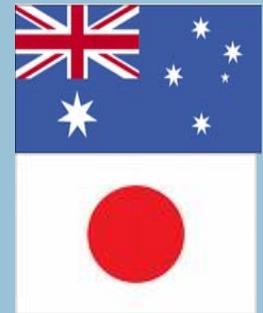
RITE CCS Workshop – September 2008, Tokyo

Marubeni-Itochu Tubulars – equipment supplier for Otway

Chiyoda Corporation & MHI – information exchange

Research Collaborations:

- Solvents & Membranes (University of Melbourne and Tokyo Institute of Technology)
- Solvents and membranes
- Otway project core analysis (RITE and Curtin University of Technology)
- Polymer membranes work (Meiji University and University of Melbourne)
- Exchange of researchers



# CO2CRC Research Plan



1 MT CO<sub>2</sub>  
per annum  
plus  
[single facility]  
2015?

1 MT CO<sub>2</sub>  
per annum  
plus  
[single facility]  
2017?

10 MT CO<sub>2</sub>  
per annum  
plus  
[low emission  
hub?]  
2020?

## VISION:

To accelerate the  
deployment of carbon  
capture and storage  
technologies...

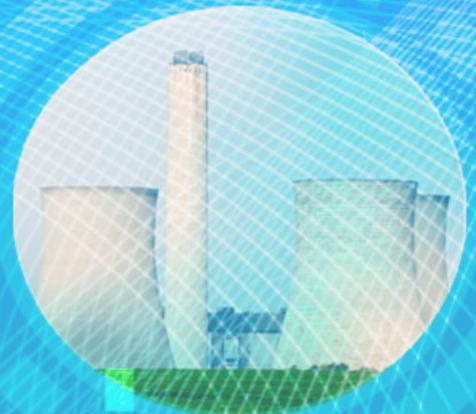
.... through world leading  
collaborative research,  
development and  
application, communication,  
education and training.

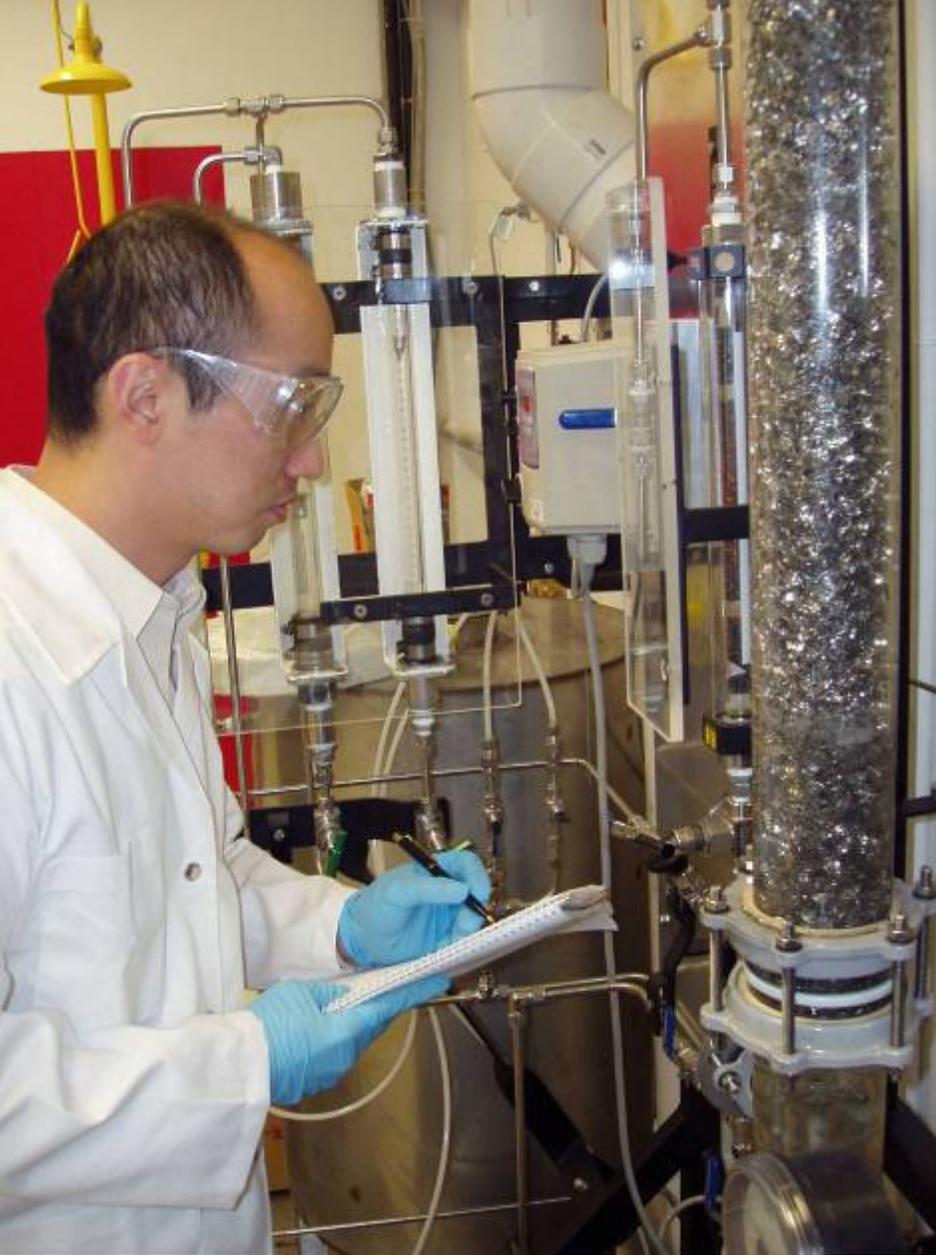
# Major Challenges

1. Identification of suitable storage sites
2. Cost of separating the CO<sub>2</sub> from the flue gases
3. Public concern and the establishment of effective regulatory regimes

## Proposed Research Programs

1. Understanding Storage Resources
2. Making CCS Cost-Effective
3. Facilitating the Deployment of CCS

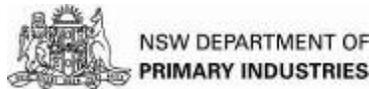




## Summary

- **Carbon Capture and Storage is a part of the global solution to address the greenhouse challenge**
- **Significant cost reductions possible as demonstrated by our work**
- **CO2CRC is active in all areas of CCS Research, Development and Demonstration**
- **International collaboration is required**

# CO2CRC Participants



Supporting participants: [Department of Resources, Energy and Tourism-AusIndustry](#) | [The Department of Environment, Water, Heritage and the Arts](#) | [CANSYD](#) | [Meiji University](#) | [Process Group](#) | [University of Queensland](#) | [Newcastle University](#) |

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