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# CO2 sequestration in coal project activity in Australia

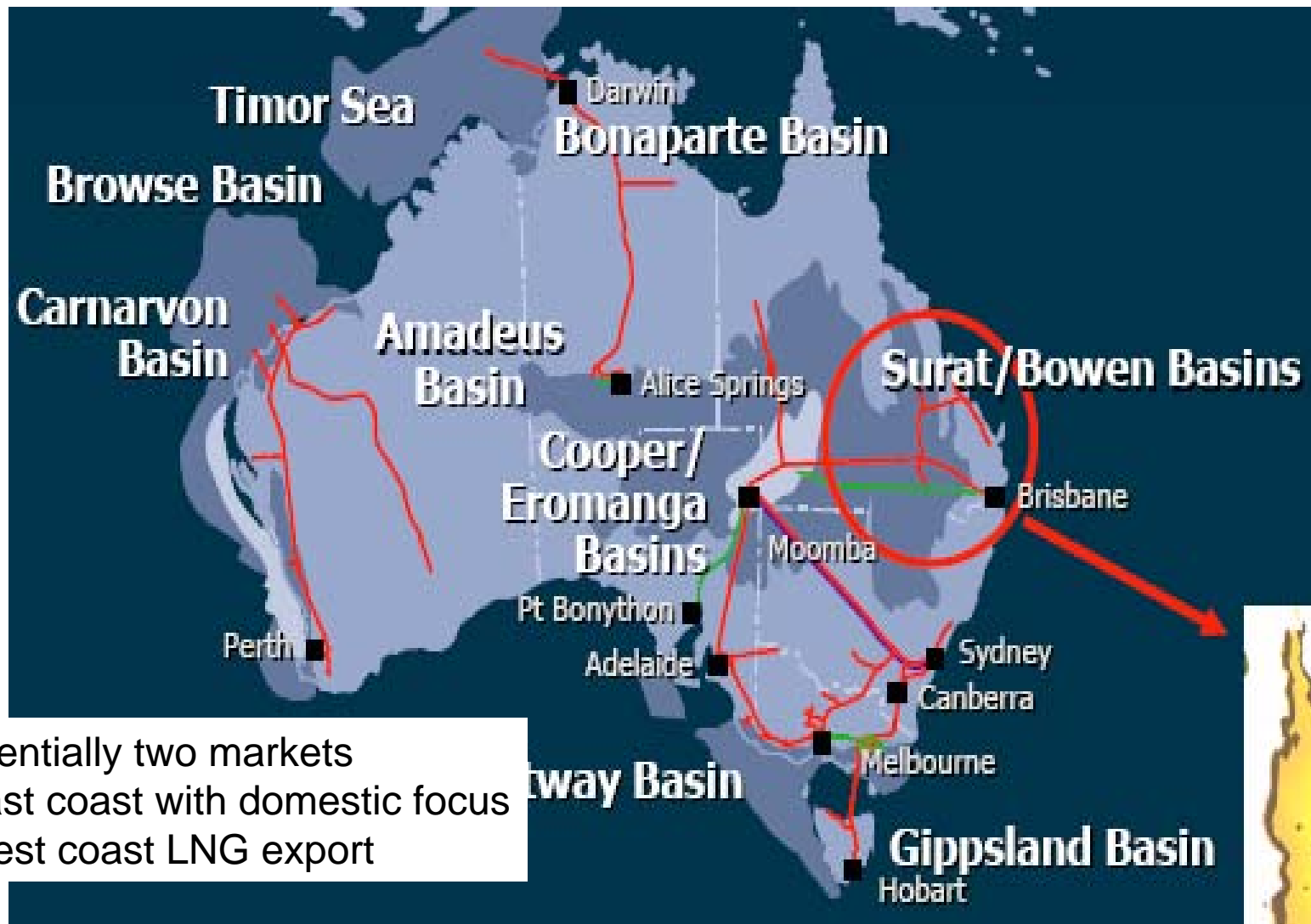
**Luke Connell**  
**Coal seam reservoirs, CSIRO Petroleum Resources, Clayton**  
**10 April, 2008**



# Structure

- Australia's CBM industry
- Current projects
  - Asia Pacific Partnership project
  - Fairview Power Project

# Australian gas producing basins

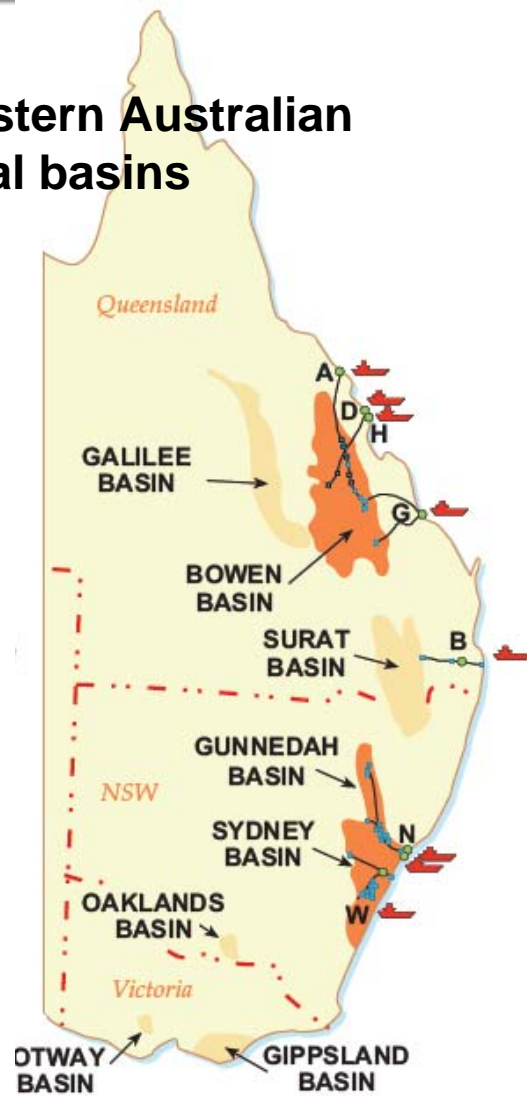


Essentially two markets

- East coast with domestic focus
- West coast LNG export

# Australian Coal Seam Methane

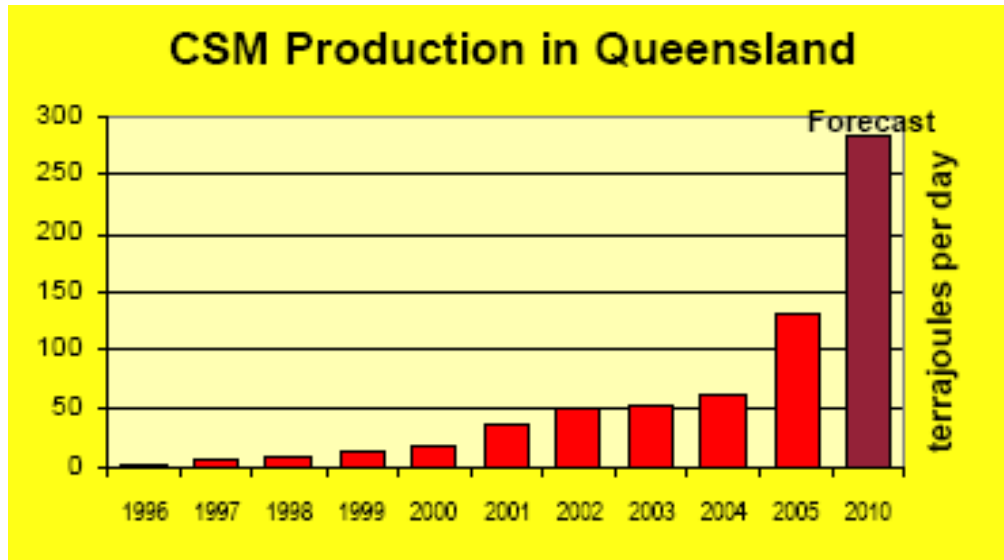
## Eastern Australian coal basins



## Resource estimates

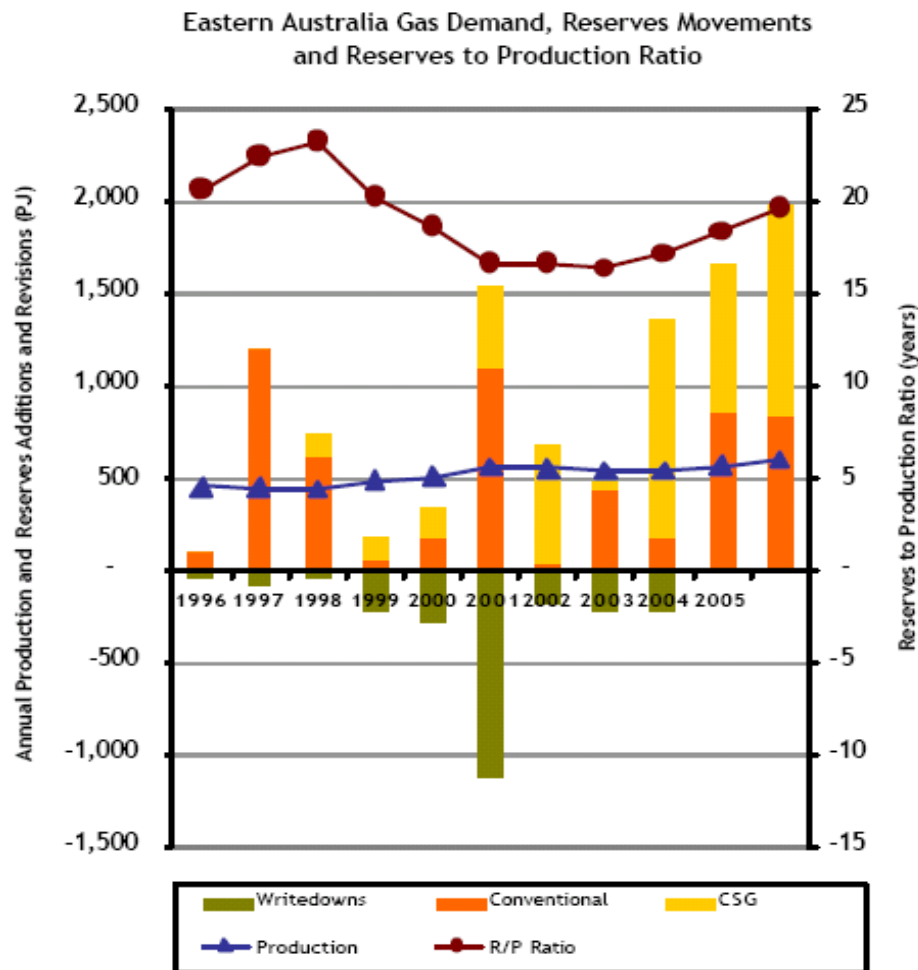
Location	PJ
<b>NSW + Qld Total</b>	<b>274,242</b>
New South Wales Basins	97,242
Sydney	28,576
Gunnedah	27,816
Clarence–Moreton	40,850
<b>Queensland Basins</b>	<b>177,000</b>
Bowen	152,000
Surat	25,000

# Coal bed methane production



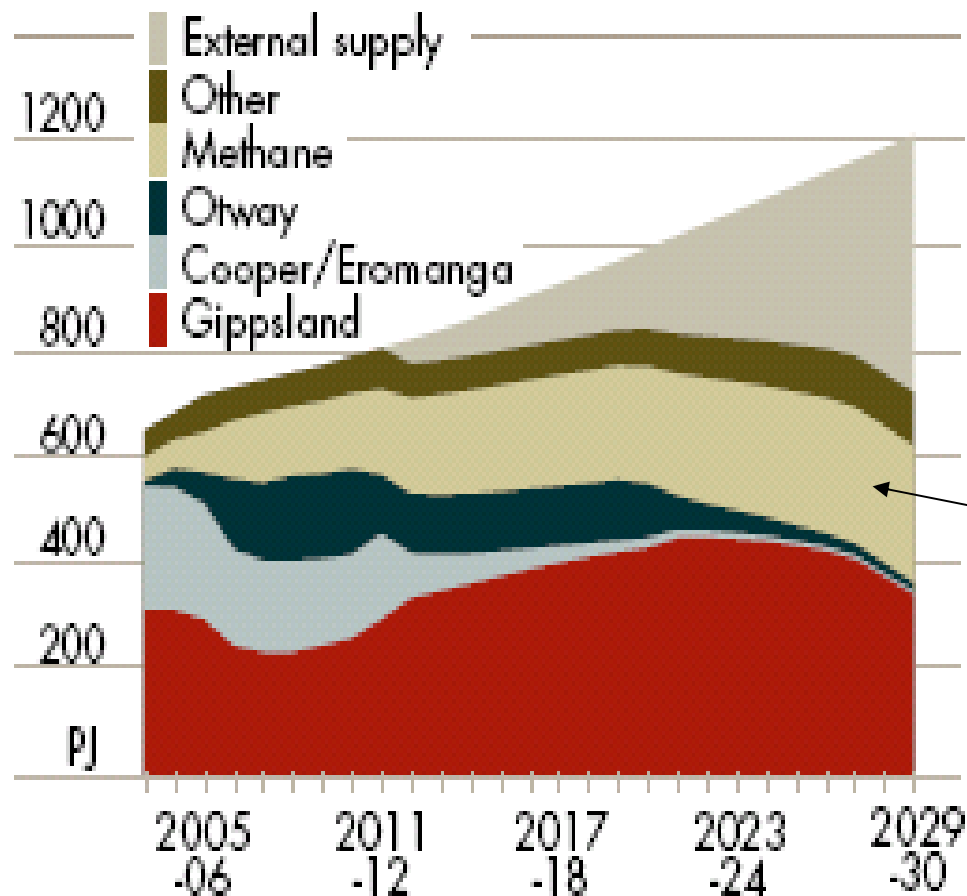
- 2005 53 PJ (or BCF) – 89% growth on 2004
- 2007 103 PJ (12 months to September) 16% of east coast gas production
- Natural gas prices (east coast) are low A\$3-4 /GJ (or MCF) although will trend towards international prices in future (impact of LNG developments)

# Australian coal seam reservoirs



- Coal seam gas has arrested the decline in reserves for eastern Australian gas market
- Total proved and probable cbm reserves currently stand at 7000 PJ

## Eastern Australia's gas supply structure



Coal seam methane

# Current Australian ECBM projects

- **Domestic setting**
  - Emissions trading scheme will commence in 2010
  - Scheme design is currently being considered but to be internationally consistent will be a cap and trade arrangement (i.e. ETS)
- **Two current projects - No field activity yet**
  - Asia Pacific Partnership CO2-ECBM
  - Fairview Power Project

# Asia-Pacific Partnership – ECBM project

- Asia-Pacific Partnership on Clean Development and Climate

- Partnership involving

- Australia, Canada, China, India, Japan, Republic of Korea, and the United States

- Objectives

“accelerate the development and deployment of clean energy technologies”

- A range of projects covering steel, aluminium, power generation etc

- Under the Cleaner Fossil Energy Task Force

- CO<sub>2</sub>-ECBM (CFE-06-13) project led by CSIRO-JCOAL has received funding support

- Builds on JCOAL’s Yubari project

- Funding is a mix of cash from government and industry and in-kind support from project participants – total for Australian field trial ~\$20million

- Objectives

- validate (and if appropriate to modify and improve) the use of CO<sub>2</sub> injection into coal seams to enhance methane recovery.

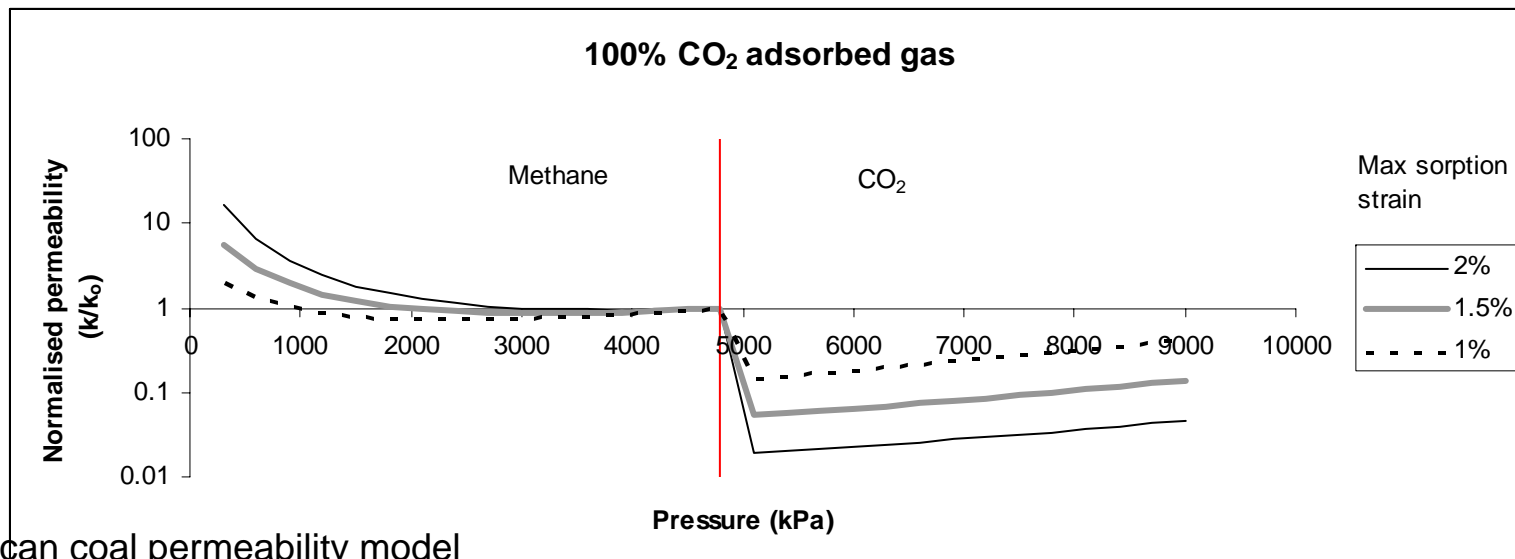
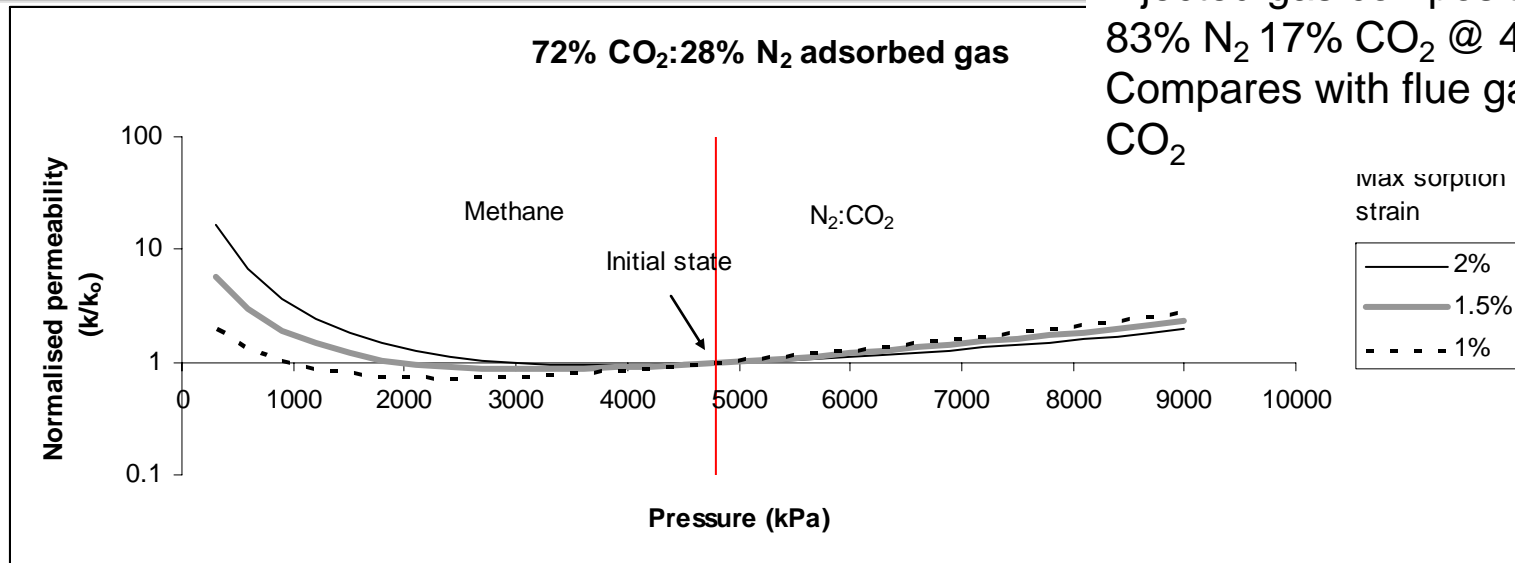
# Asia Pacific Partnership (APP) for Climate Change – CO<sub>2</sub>-ECBM project

- **Project structure**

- Two field trials – Australia and China
  - Discussions are well advanced with industrial partners in both countries to host the field trials
- Important technical objectives
  - Identify techniques to overcome coal permeability reduction due to coal swelling
  - Measure the gas migration process, CO<sub>2</sub> storage, enhancement effect
- Basic concept
  - Approximately 1 kilotonne CO<sub>2</sub> injection
  - Horizontal injection well
  - Dedicated monitoring wells with multi-level gas/water sampling
  - Injection of a gas mixture CO<sub>2</sub>/N<sub>2</sub> to manage swelling

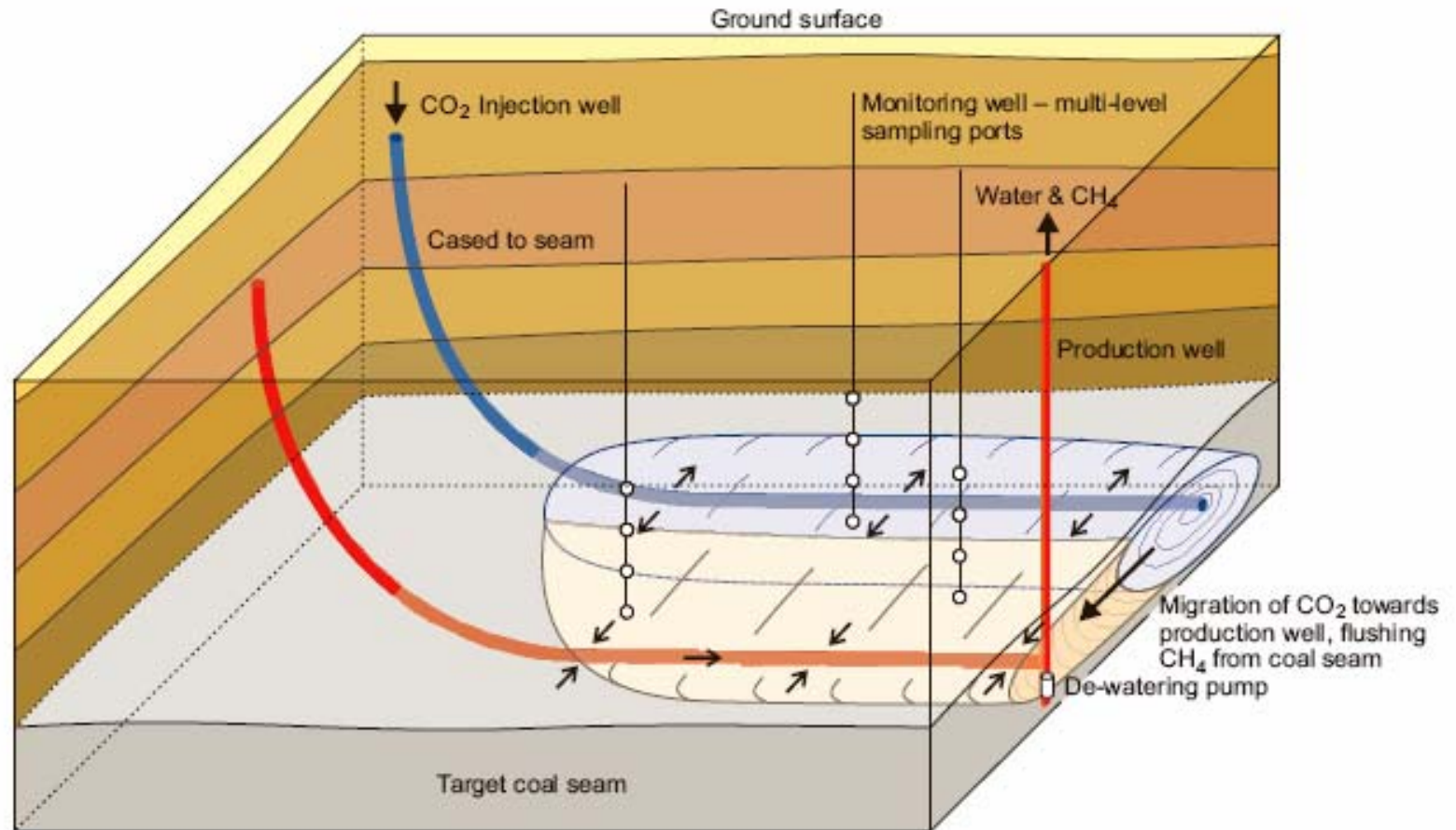
# Permeability with CO<sub>2</sub> adsorption

Injected gas composition  
83% N<sub>2</sub> 17% CO<sub>2</sub> @ 4800 kPa  
Compares with flue gas ~10%  
CO<sub>2</sub>



Shi-Durucan coal permeability model  
Using properties measured from a Sydney basin coal

# APP – ECBM project



# Current status

- Commitment of Australian government funds under APP
- A host and site for the trial have been identified and contracting is underway
- Currently organising legal structure between project core participants (CSIRO-JCOAL- hosts) – will also provide an opportunity for other organisations to be involved through a consortium arrangement

# Project timeline

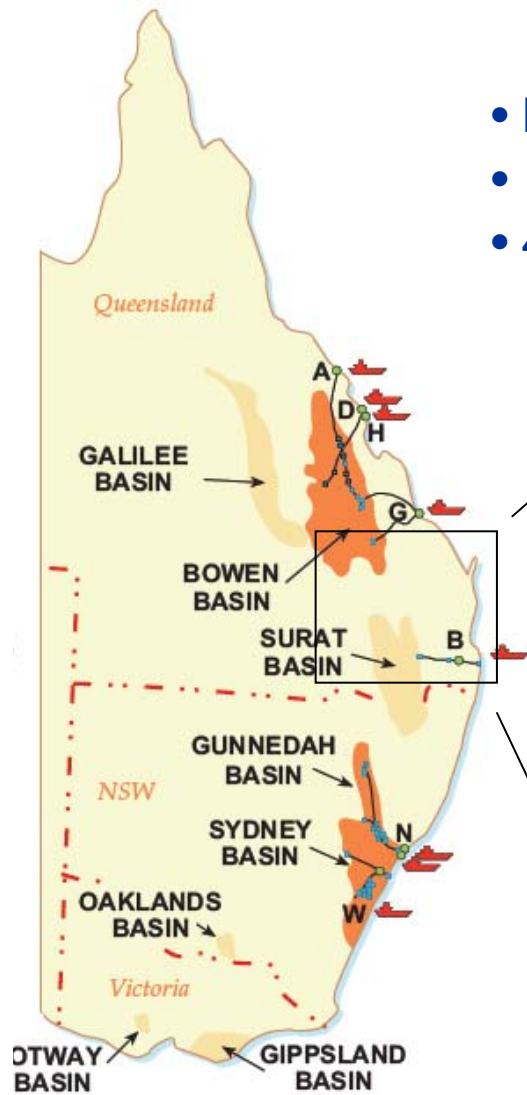
Stage	Phase	Detail	Y1	Y2	Y3	Y4	Y5
<b>1 - Australia</b>	1	Establish Consortium and funding Identify site Preliminary investigation of site	xx				
	2	Site characterisation Coal samples for isotherms, swelling, permeability Reservoir modelling and ECBM well design Monitoring program designed and installed Site works Wells drilled and CBM production begins	x	xx			
	3	CBM production continues Injection of CO <sub>2</sub> , nitrogen for ECBM			xx	x	
	4	Stage 1 concludes Evaluation of data and technology		xx	xx	xx	

# Fairview Power Project (FPP)

- A proposed CO<sub>2</sub> sequestration/enhanced coal seam methane project
  - \$75 million from Australian federal government Low Emissions Technology Demonstration Fund announced in October 2006
  - Subject to commercial, technical and regulatory issues being completed prior to a final investment decision
  - A decision on this project has been pending for some time now – it's possible it has not satisfied business case considerations
- Main components of FPP
  - Existing CBM field, Santos operated Fairview project
  - On-site generation with an GE LMS100 simple cycle gas turbine
    - 100 MW
    - 400kg/MWH
  - Post combustion capture plant using amine CO<sub>2</sub> capture technology
    - 300 CO<sub>2</sub> tpd – total ~ 100,000 tpa (~33% of CO<sub>2</sub> in flue gases)
  - Sequestration into coal seam at 700m depth
- FPP consortium
  - Santos, GE Energy, BHP Billiton, the AJ Lucas Group, CSIRO, CO<sub>2</sub>CRC and Energy Infrastructure and Resources

# Project location

- Fairview is in the Bowen Basin
- ~80 production wells
- 45 TJ/d (as of 2005)



# Fairview

- Advantages of the Fairview site for ecbm
  - coals unlikely to be mined
    - depth, high ash content, unsuitable as coking coal
  - in production for eight years
  - high permeability (several 100 md)
  - net coal thickness 6 to 10m, overlain by siltstones/claystones

# Fairview project characterisation work

- CSIRO has carried out an characterisation program for Santos on Fairview core samples
  - Measurements on
    - Characterisation of Palmer-Mansoori/Shi-Durucan coal permeability models including effects of sorption strain
      - Cleat compressibility, geomechanical properties
    - Sorption strain – unconstrained and under tri-axial stress
    - High pressure adsorption isotherms for CO<sub>2</sub> and CH<sub>4</sub>
    - Sorption time

# Conclusions

- Strong CBM industry in Australia provides a logical foundation for CO<sub>2</sub>-ECBM
- No decision has been announced regarding Fairview Power Project – so not dead yet
- Asia Pacific Partnership project has been funded and will proceed; mostly likely as a mixture (CO<sub>2</sub>-N<sub>2</sub>) injection trial