Report from Australian

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Cooperative Research Centre for Greenhouse Gas Technologies

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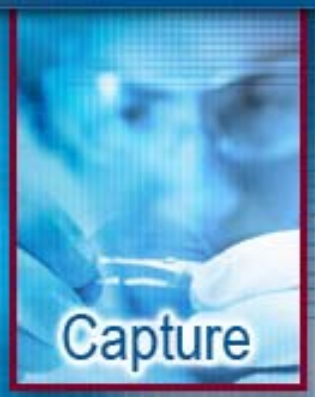
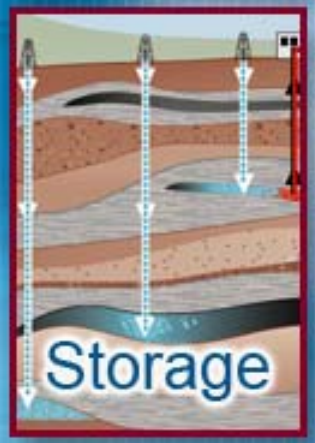
Cambridge, MA
1st Nov 2006

Outline of presentation

- **Cooperative Research Centres – CRC's**
- **Cooperative Research Centre for Greenhouse Gas Technologies – CO2CRC**
- **Australia interest in CCS**
- **Current and recent projects**
- **Major announcements**
  - **NEWS!**





CO2CRC Participants:

CRC AUSTRALIA

Australian Government

Geoscience Australia
Australian Greenhouse Office
Department of Industry, Tourism and Resources

RIO TINTO

xstrata coal

CSIRO

bp

SOLID ENERGY
Coals of New Zealand

STANWELL
CORPORATION LIMITED

THE UNIVERSITY OF ADELAIDE
AUSTRALIA

NZ RESOURCE CONSORTIUM

Chevron

ACARP
Australian Coal Association Research Program

curtin
University of Technology
Western Australia

Victoria
The Place To Be

ANGLO COAL

Schlumberger

MONASH University

UNSW

THE UNIVERSITY OF MELBOURNE

WOODSIDE
AUSTRALIAN ENERGY

bhpbilliton

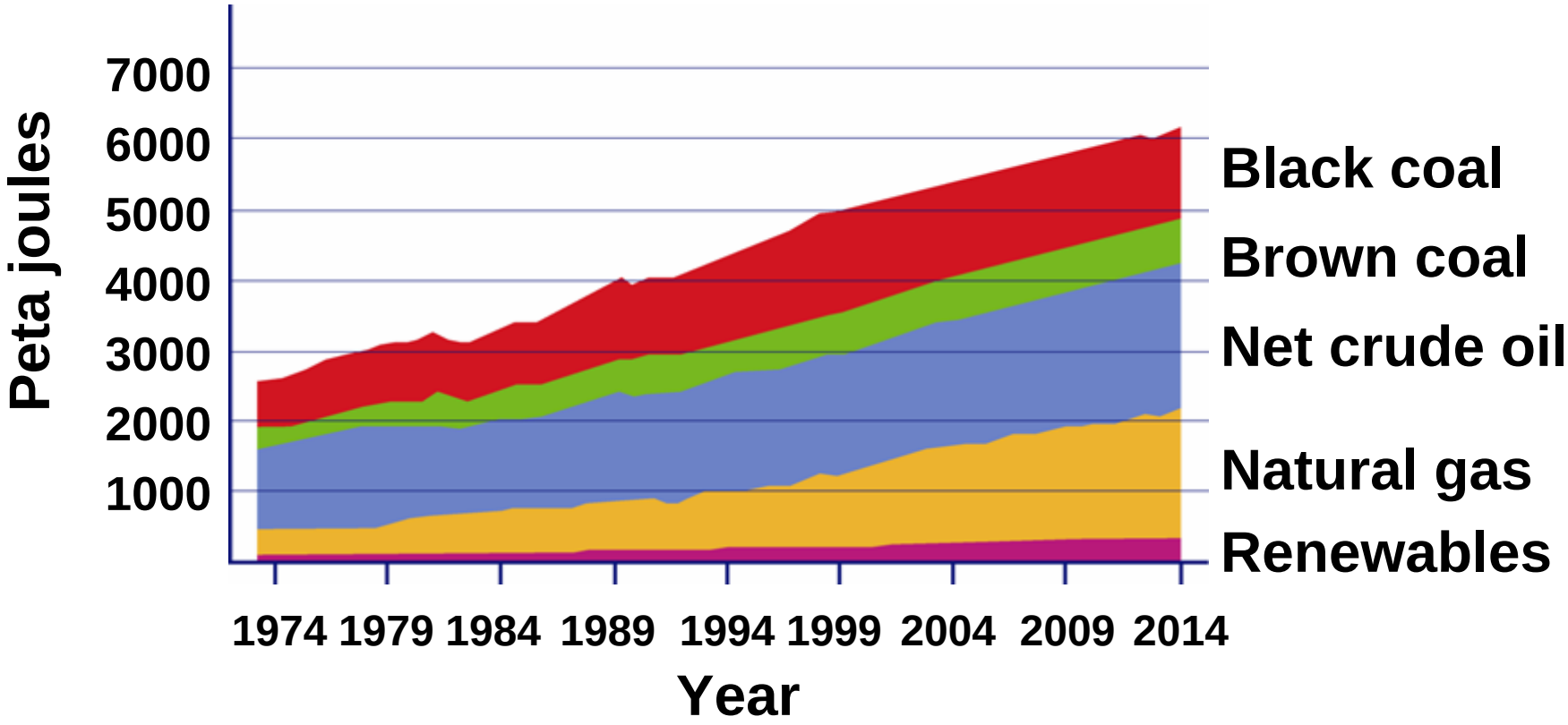
Supporting participants: Australian National University | CANSYD | Meiji University |
| The Process Group | University of Queensland | Whistler Research |

CO2CRC

CO2CRC

Research Providers

Australian Energy Consumption by Fuel



Australian Electricity Generation

Fuel	Generation 1998-99 tWh	Generation 2019-20 tWh	Share 1998-99 %	Share 2019-20 %	Annual Growth over period tWh	Annual Growth over period %
Black coal	**111**	**170**	**55**	**52**	**59**	**2.1**
Brown coal	**50**	**61**	**25**	**19**	**12**	**1.0**
Oil	**2**	**4**	**1**	**1**	**2**	**2.6**
Natural Gas	**22**	**59**	**11**	**18**	**38**	**4.9**
Renewables	**18**	**31**	**9**	**9**	**13**	**2.6**
Hydroelectricity	16	19	8	6	3	0.8
Biomass	1	7	1	2	5	8.1
Biogas	0.4	2	0.2	0.6	1	7.5
Wind	0	3	0	1	3	25.2
Total	**202**	**325**	**100**	**100**	**123**	**2.3**

Australia's future energy use

Australia's energy usage will continue to increase.

Its response to greenhouse concerns will include:

- **Increased use of renewables**
- **Fuel switching**
- **Greater energy efficiency**
- **Enhanced carbon sinks**
  - **forests**
  - **decreased land clearance**

AND

Ongoing use of low cost fossil fuels

accompanied by CO_2 capture and storage technologies

- **especially geosequestration**

Australian CCS activities 2004-2006

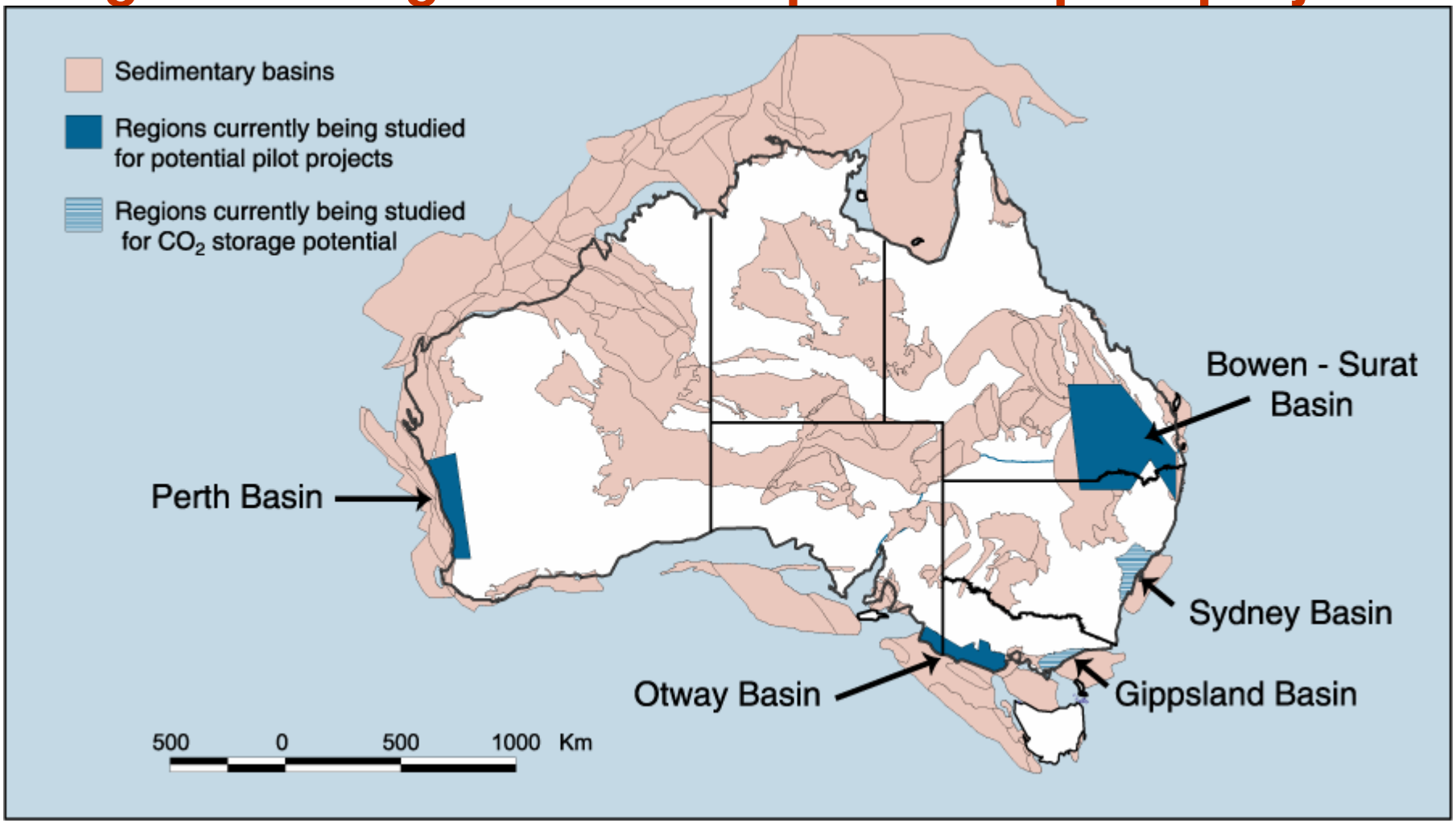
Activity on many fronts

- CO2CRC capture and storage research programs continue at pace
- Involvement in pilot project in Australia and around the world
  - Otway Basin Pilot Project
  - Frio Brine project
- Government and industry groups initiating major funding for CCS
  - Low Emissions Technology Demonstration Fund (LETDF) – Federal Govt
  - Energy Technology Innovation Strategy (ETIS) – Vic Govt
  - Qld Govt
  - COAL21 – Coal Industry Low emissions Strategy
- Major regional reviews
  - Latrobe Valley CO2 Storage Assessment (LVCSA)
  - Perth
  - SE Qld
  - NSW
- Significant engagement in regulatory and legislative review for CCS
- Government reviews across a wide
  - Senate review of Future Fuels – CCS for Coal to Liquids etc
  - House of Representatives review of Geosequestration
  - House of Representatives review of Nuclear power

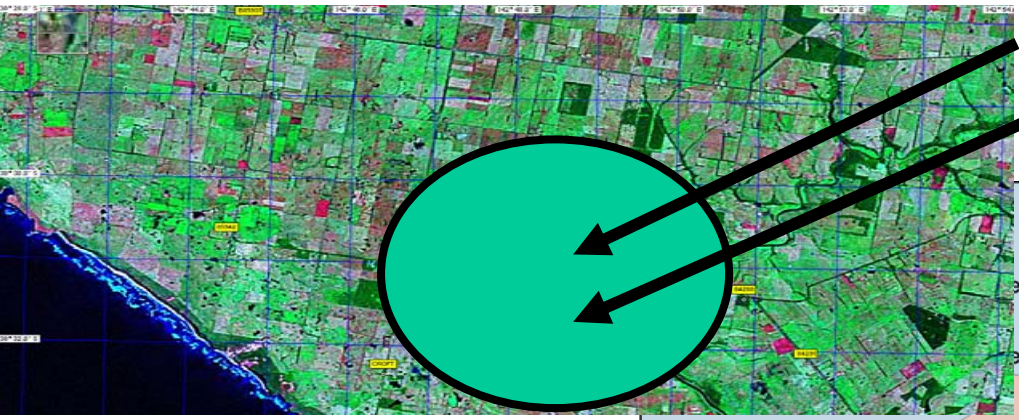
Specific Projects

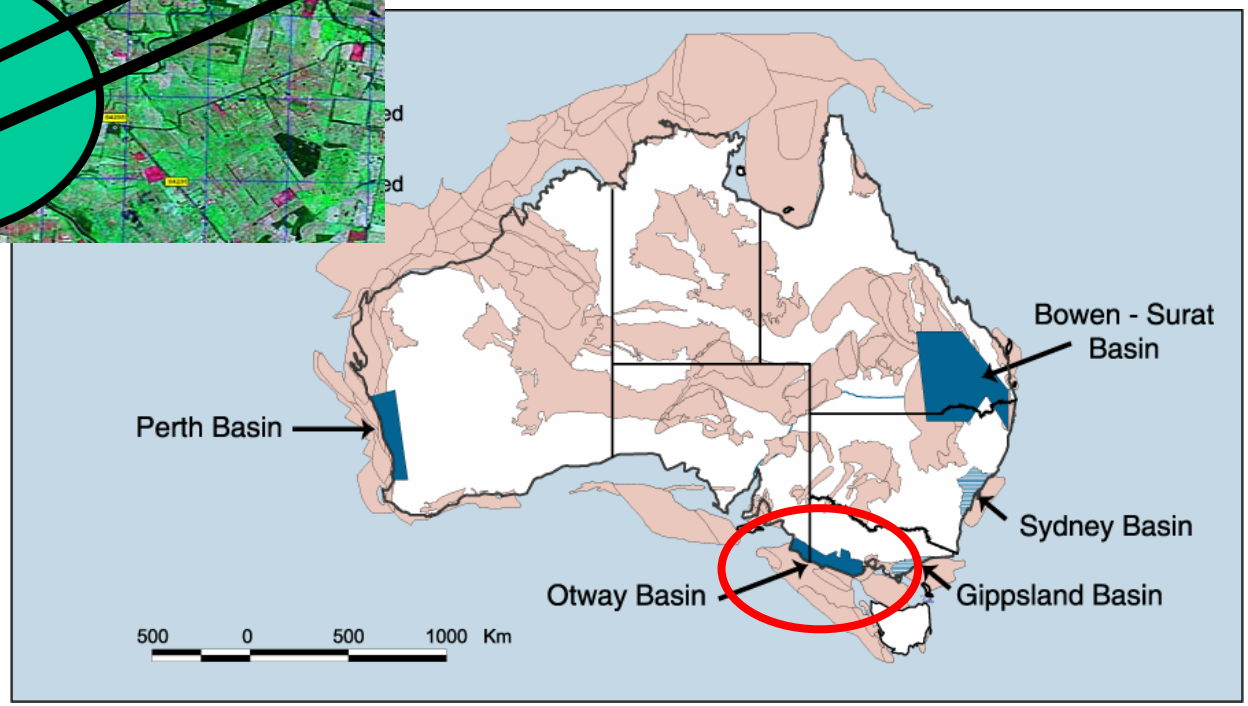
- **Otway Basin Pilot Project**
- **Latrobe Valley CO_2 Storage Assessment**

Regions being studied for potential pilot projects

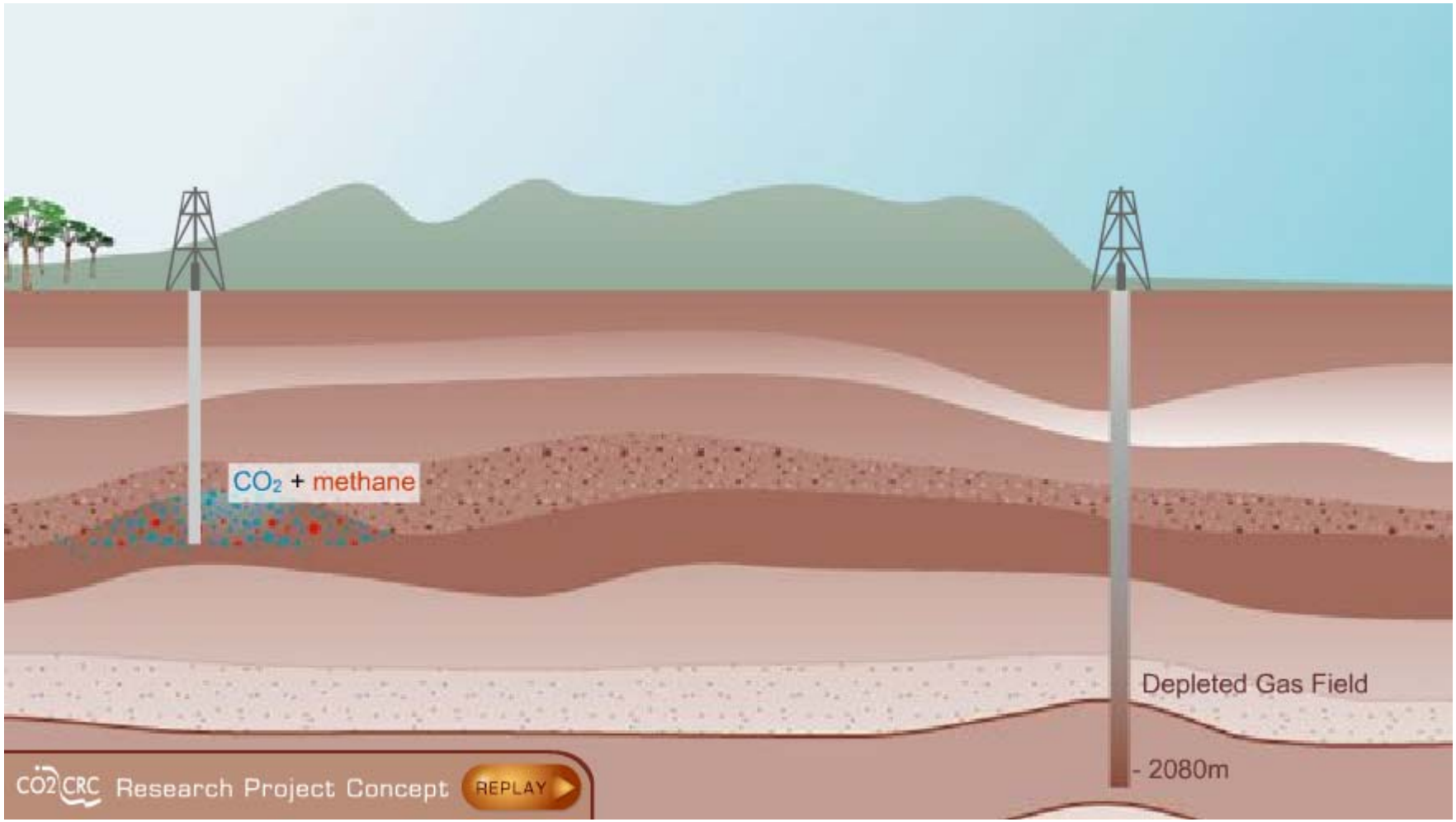


Otway Basin Pilot Project - OBPP





Research Project Concept



Pilot Project Objectives

- **To demonstrate that CO_2 capture and storage is a viable, safe, secure option for greenhouse gas abatement by:**
  - **Concentrating CO_2 from a gas stream**
  - **Safely transporting CO_2 from source to sink**
  - **Safely injecting CO_2 into subsurface reservoirs**
  - **Safely storing CO_2 in the subsurface**
  - **Model and monitor stored CO_2 and confirm effectiveness**
  - **Develop optimal monitoring and verification configurations**
  - **Develop best practice CCS project management**
  - **Build and maintain effective Risk Register**
  - **Safely remove facilities and restore sites**
- **And:**
  - **Communicating to all stakeholders that this has been done**
  - **Conducting the pilot project within approved time and budget (CO2CRC)**
  - **Capturing all research outcomes (CO2CRC)**

Monitoring Technology Options

- Data acquisition programs and frequency of time-lapse measurements
  - Implications and tradeoffs vs completion design
  - Prioritization of relative importance of each measurement to ease decision making

Objective	Criticality	Surface Seismic & VSP	micro Seismic	Water Wells	Atmospheric	Soil Gas	U tube	RST	SFRT	Integrity Logs
Breakthrough detection										
Plume shape										
Plume travel path										
Plume travel speed										
Containment										
CO2 area of accumulation										
Public Acceptance										

Site and Monitoring Technologies Overview

	Geological Data Availability		Baseline data	Reservoir Geochem	Geo-physics	Ground water monitoring		Soil Gas	Atmos	Contain-ment 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	✓	✓	✓		✓					
Proposed OBPP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

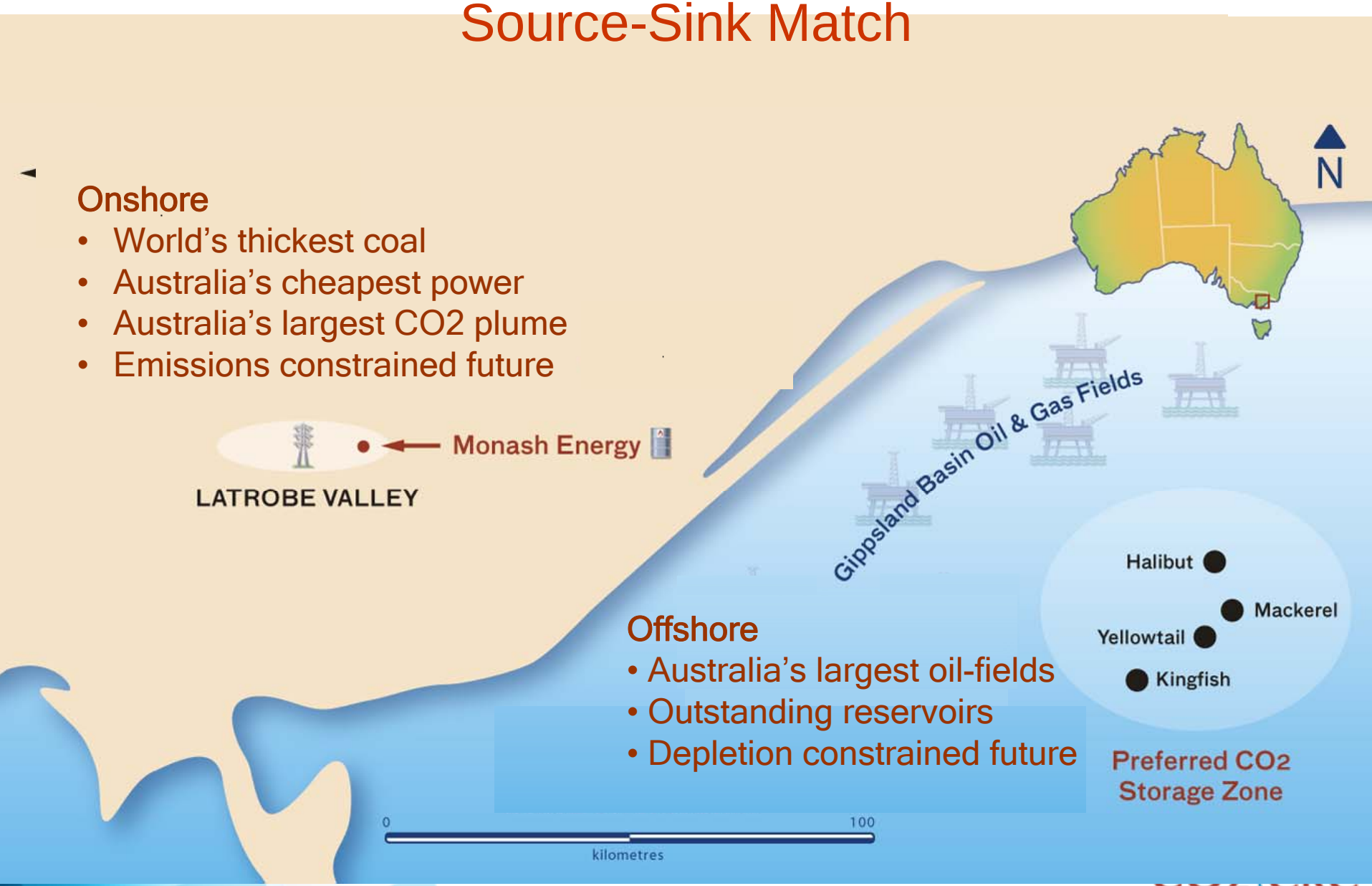
Major regional reviews

- **LVCSA**
- **Perth**
- **SE Qld**
- **NSW**

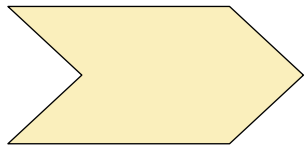
LVCSA Overview

- **Objectives**
  - **Medium to high level techno-economic study for CCS of Latrobe Valley CO2 emissions**
  - **Framework for engagement of stakeholders**
  - **'Pre-feasibility' study of implementation of CCS in Victoria**
  - **Provide context for Govt policy and funding decisions**

Monash Energy Foundation - World Class Source-Sink Match

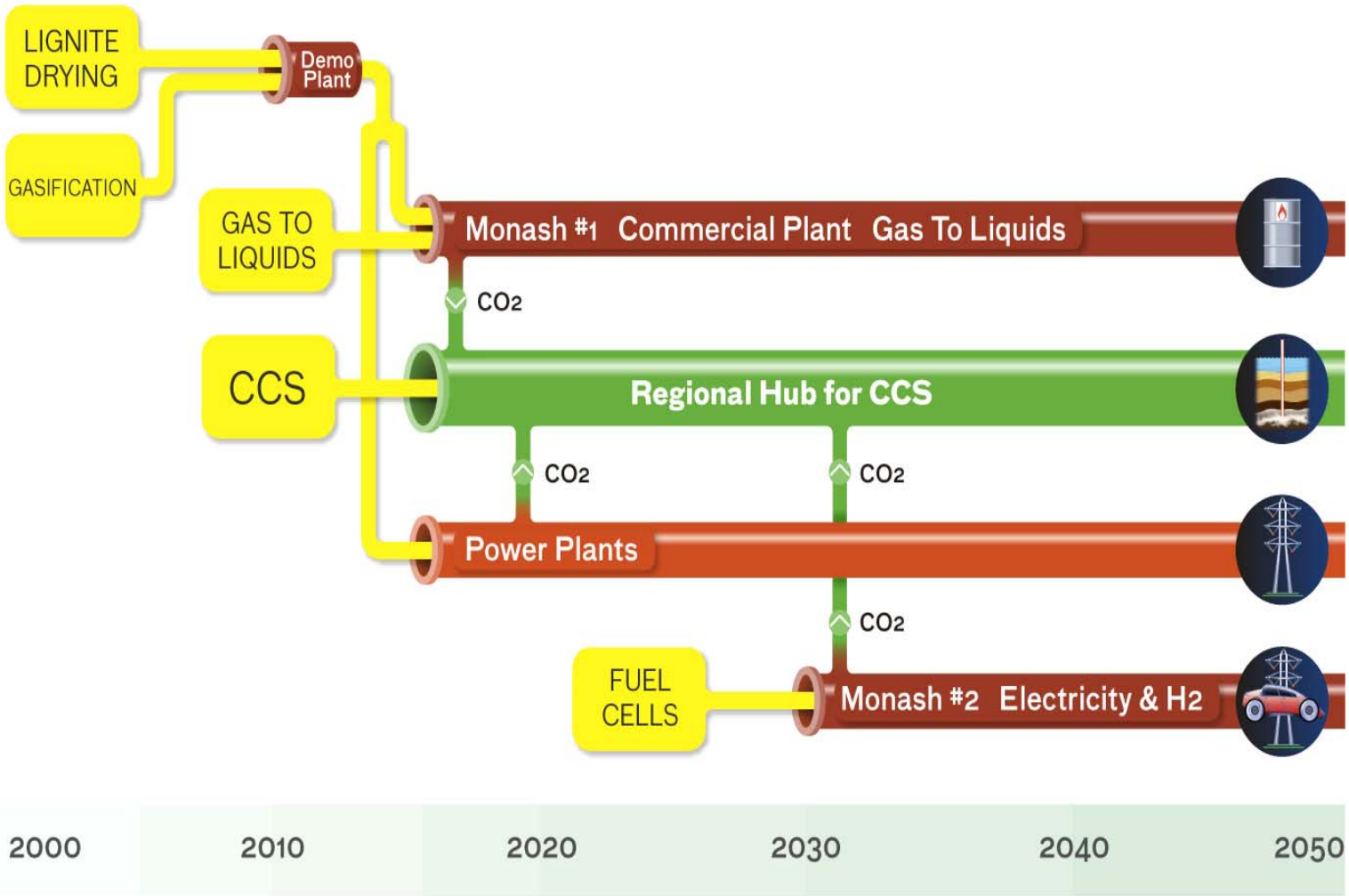


Emissions Reduction and Regional Development Objectives

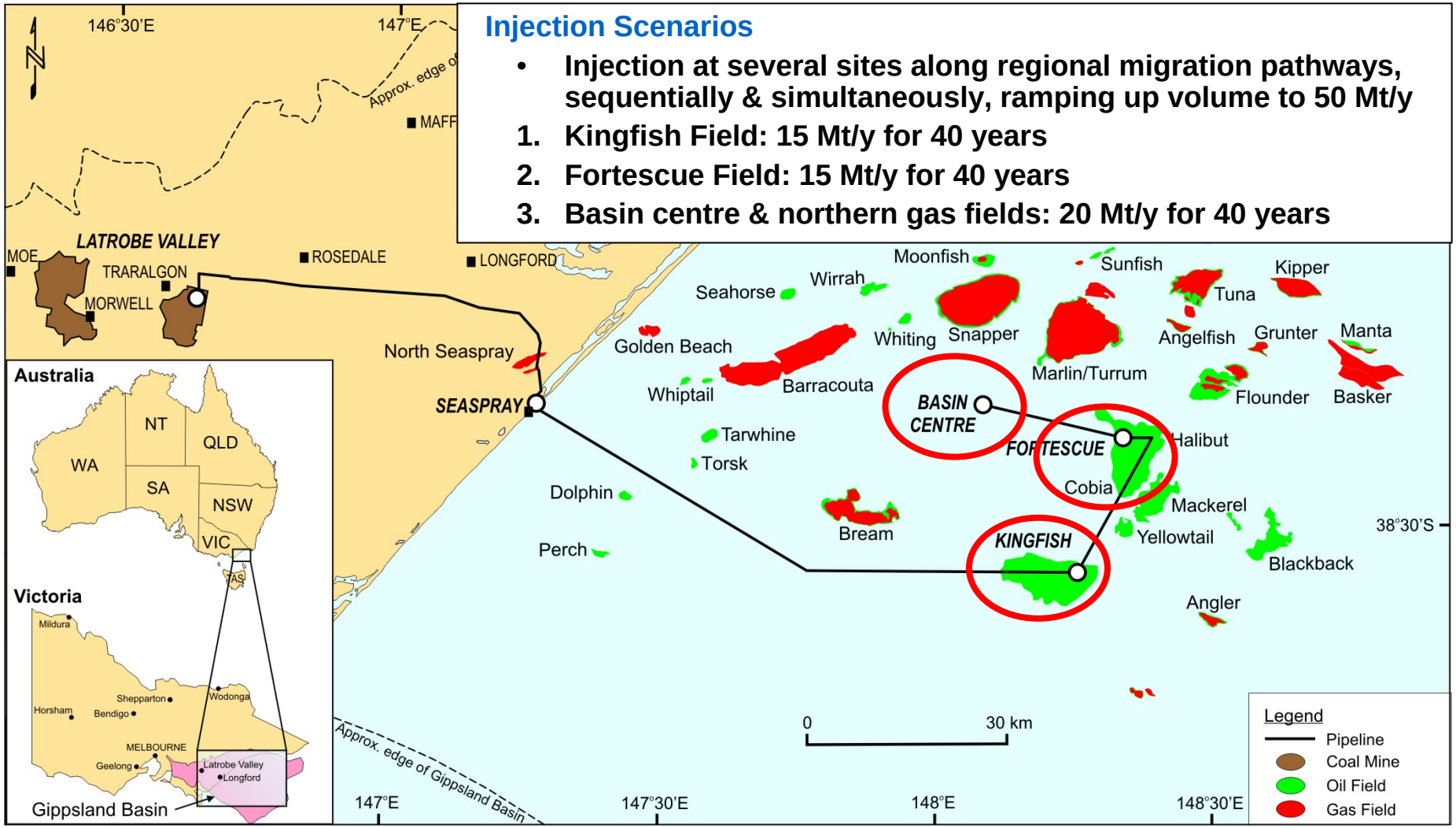


- **Store onshore CO_2 in offshore reservoirs - capacity 50 Mt/year**
- **Virtual elimination of Australia's largest emissions source - 60Mt/year**
- **Remove emissions constraint on coal utilisation**
- **Sustain regional economic growth**
- **Extend coal use to liquid fuels and ultimately hydrogen**
- **Replace depleted domestic oil and transport fuel supply**

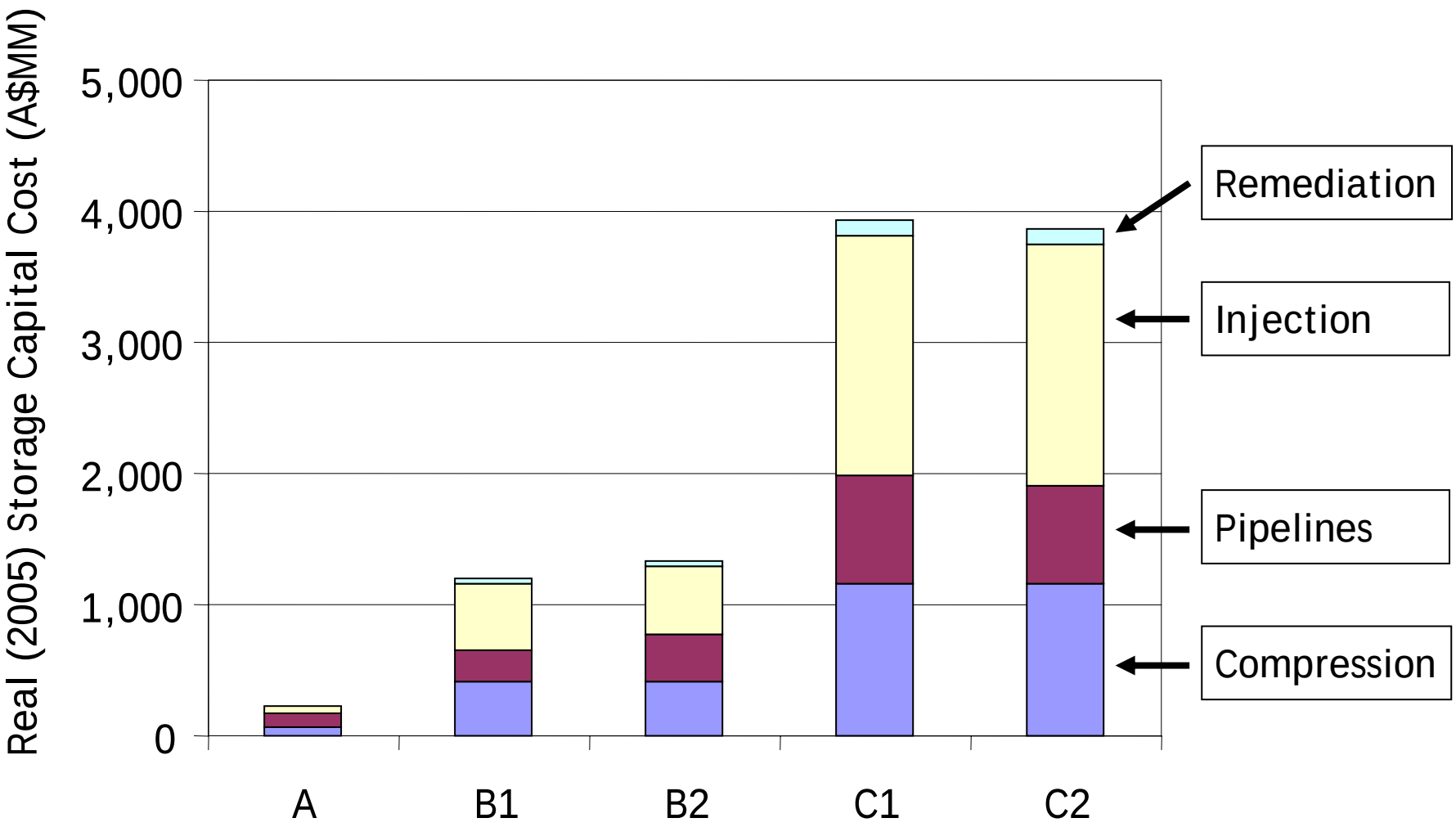
Long-Term Monash Energy Pathway to Low Emissions



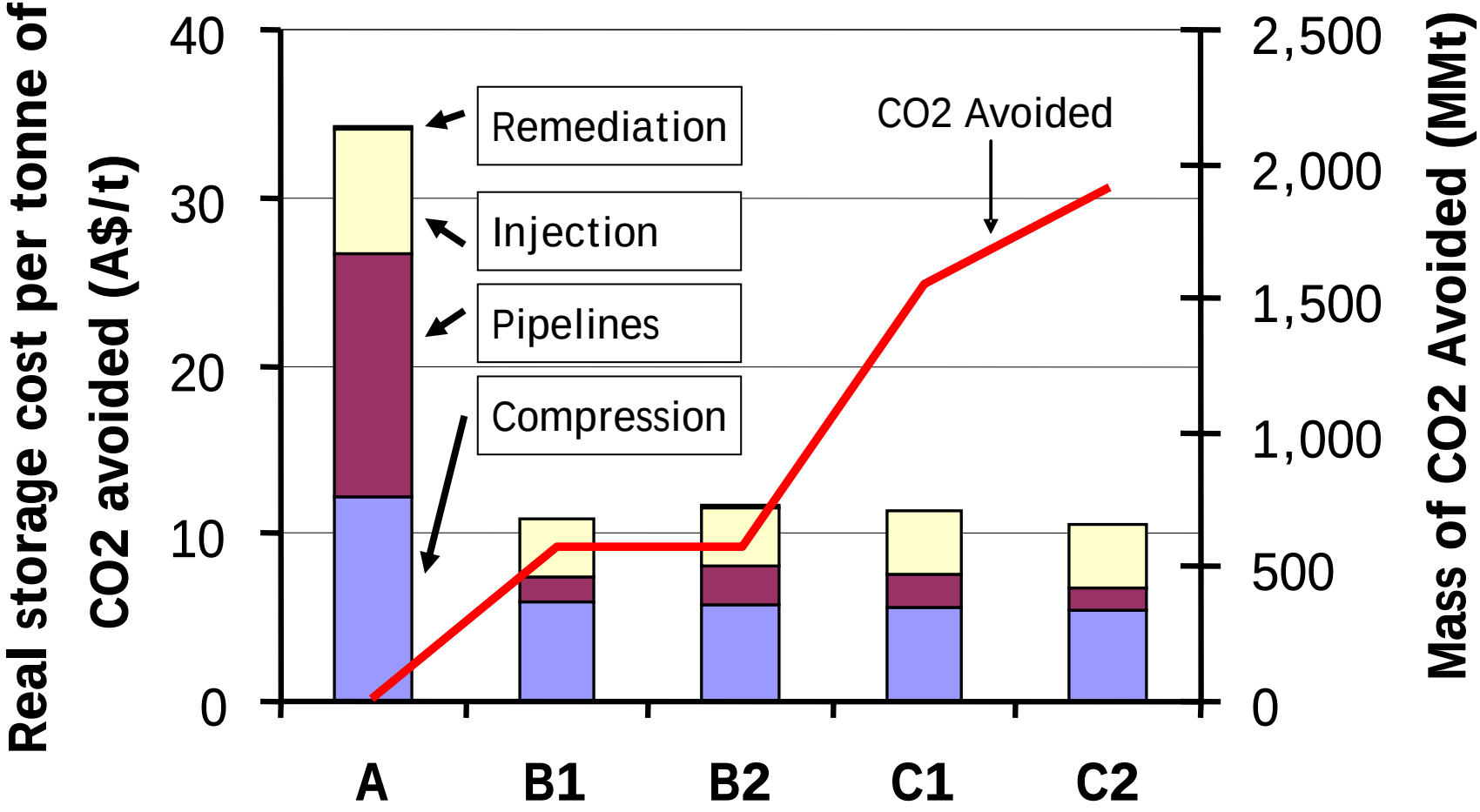
Selected Site Scenarios



Capital Cost of Base Cases



Real (2005) Storage Cost and CO2 Avoided



The findings from the project indicate that:

- the existing oil and gas fields could store more than two billion tonnes of CO2 once depleted;
- the regional seal rock is of good quality to store CO2;
- the geology, chemistry and hydrology are favourable for CO2 storage;
- CO2 will migrate very slowly through the reservoir rock over tens to hundreds of years;
- the unit cost of storage is low by world standards;
- risks are low and can be readily managed by proponents; and
- the targeted offshore injection sites are favourable for geosequestration.

Major Australian Initiatives (1)

- LETDF
  - $500 million funding on 1:2 basis for low emission technologies, including CCS
  - First announcements made
  - Many projects submitted in confidence - a range of technologies widely known including
    - Oxyfuels project
    - 3 gasifier proposals, both air and oxygen blown
    - Coal seam storage projects
    - Post combustion demonstrations
- ETIS
  - $120 million for power generation reduction projects
    - Demonstrations linked to LETDF
    - Research funds for both coal and renewables projects

Major Australian Initiatives (2)

- Qld Clean Coal Fund
  - State government funding
  - $300 million funding for low emission technologies from coal, including CCS
  - Fund recently announced and details being developed
- COAL21
  - Coal industry fund
  - $300 million funding for clean coal technologies, including CCS
  - Fund recently announced and details being developed
- Total $ 1.2 million

Breaking News

- **Initial LETDF project announcements**
  - **$A 1.4 billion**
- **First tranche – Wed 25th Oct**
  - **World's largest Solar power plant**
  - **Repowering of lignite power plant**
- **Second tranche – Mon 30th Oct**
  - **Oxyfuels plant**
  - **Power plant associated with ECBM**
- **More to come**

Project details

- **World's largest Solar Power Plant**
- **$A 420 million ($A 75 million Govt funds)**
- **Solar Systems Pty Ltd**
  - **Boeing**
- **154 MW power plant in Western Victoria**
- **Demonstrating renewables with drive for significant reduction in COE**

Project details

- **ECBM Power Plant**
- **$A 445 million ($A 75 million Govt funds)**
- **Fairview Power**
  - **Santos**
  - **General Electric**
  - **CSIRO**
  - **CO2CRC**
- **100 MW power plant in Queensland, sited adjacent to coal seams stimulated by CO_2 captured from exhaust flue gas**
- **Demonstrating**
  - **Power from coal bed methane**
  - **New drilling technology for cheaper distribution of CO2 and collection of methane**
  - **Sequestration of CO2 in coal seams**

Project details

- Oxyfuel retrofit demonstration
- $A 180 million ($A 50 million Govt funds)
- CS Energy
  - IHI
  - CCSD
  - CO2CRC
- 30 MW power plant in Queensland
- Demonstrating
  - Oxyfuels separation of CO2
  - Future sequestration

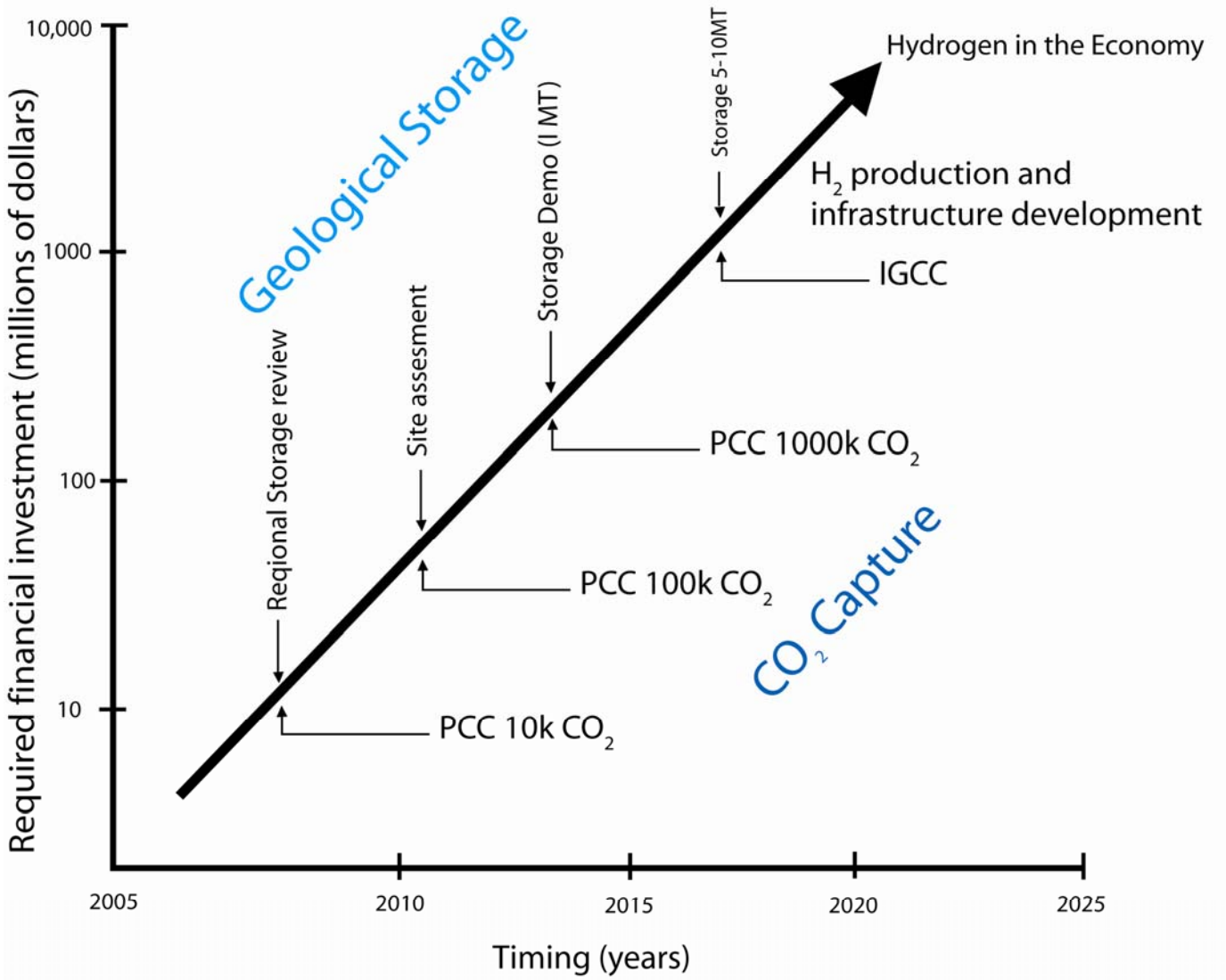
Project details

- Lignite Power Plant repowering, drying and capture
- **$A 369 million total project costs**
  - **(Leveraging $A 80 million Govt funds)**
- International Power
  - Alstom (EPC contractor and combustion technology provider)
  - RWE (Coal drying technology provider)
  - Process Group (EPC contractor for CO_2 capture plant)
  - CO2CRC (Technology support for CO_2 capture plant)
- 200 MW boiler retrofit in Latrobe Valley (1/8 of plant)
- Demonstrating
  - RWE steam fluidised bed drying for 60% moisture lignite
  - 100% firing of dried coal
  - 25/50 tpd CO_2 post combustion capture

process group

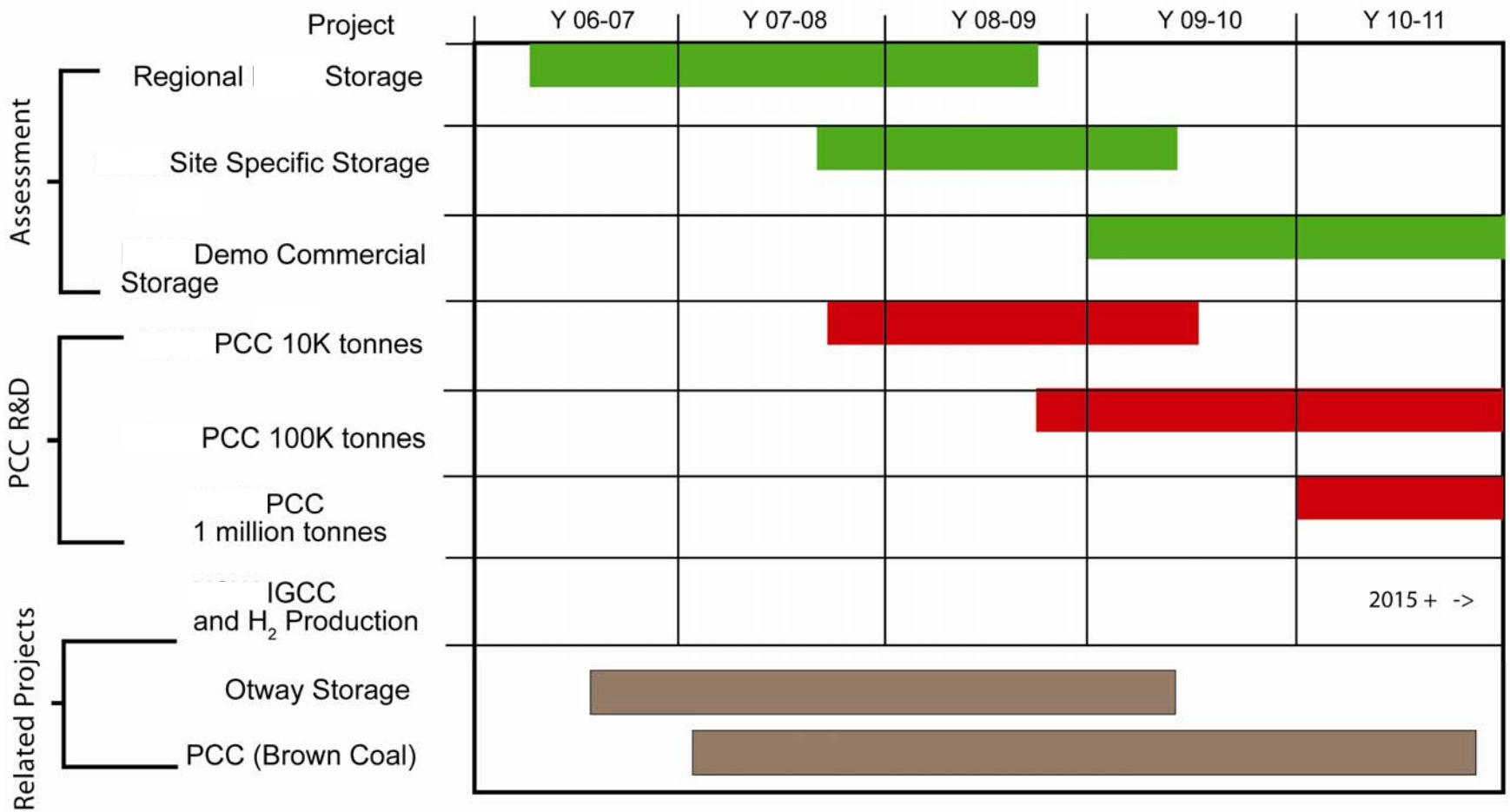
International Power

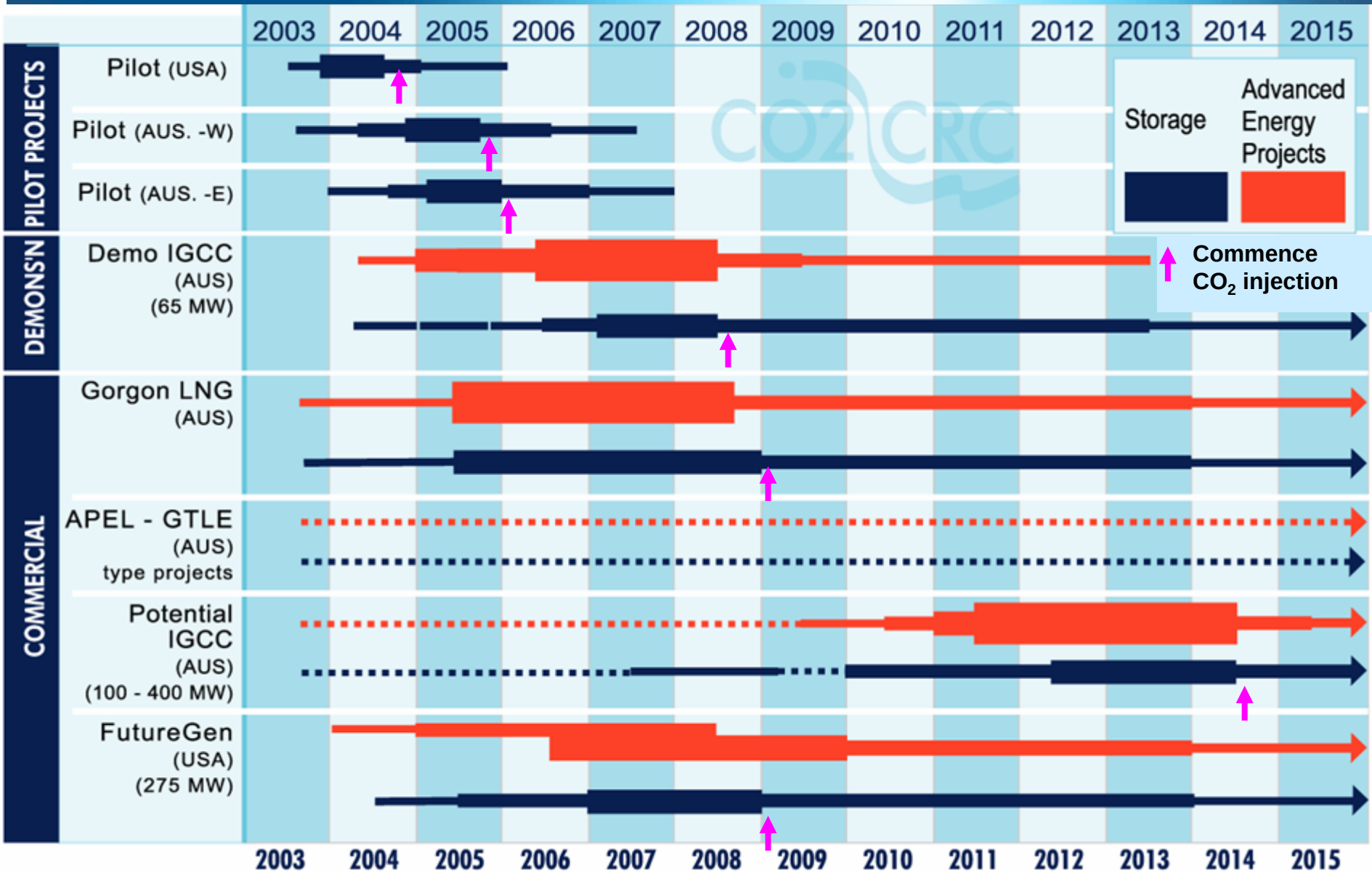
CO2CRC



Technology roadmap for a low emission electricity and the hydrogen economy

Indicative Timetable





Technology roadmap (Level 2) showing pilot (5-10,000 tonnes), demonstration (50-100,000 tonnes) & commercial projects.

Conclusions

- Australia has been, and continues to be, active in the area of geosequestration
- The original roadmapping done through the work of the APCRC in the GEODISC program and now through the CO2CRC is beginning to bear fruit
- Government and industry organisations are putting forward considerable funding to advance the demonstration of the associated technologies with significant announcements imminent
- The CO2CRC has been active in its research and pilot plant activities and continues to examine the large scale and regional opportunities that will be needed as the technology becomes more widely accepted

- Thank you and I welcome questions