CO2CRC's Capture Facilities (Demonstration)

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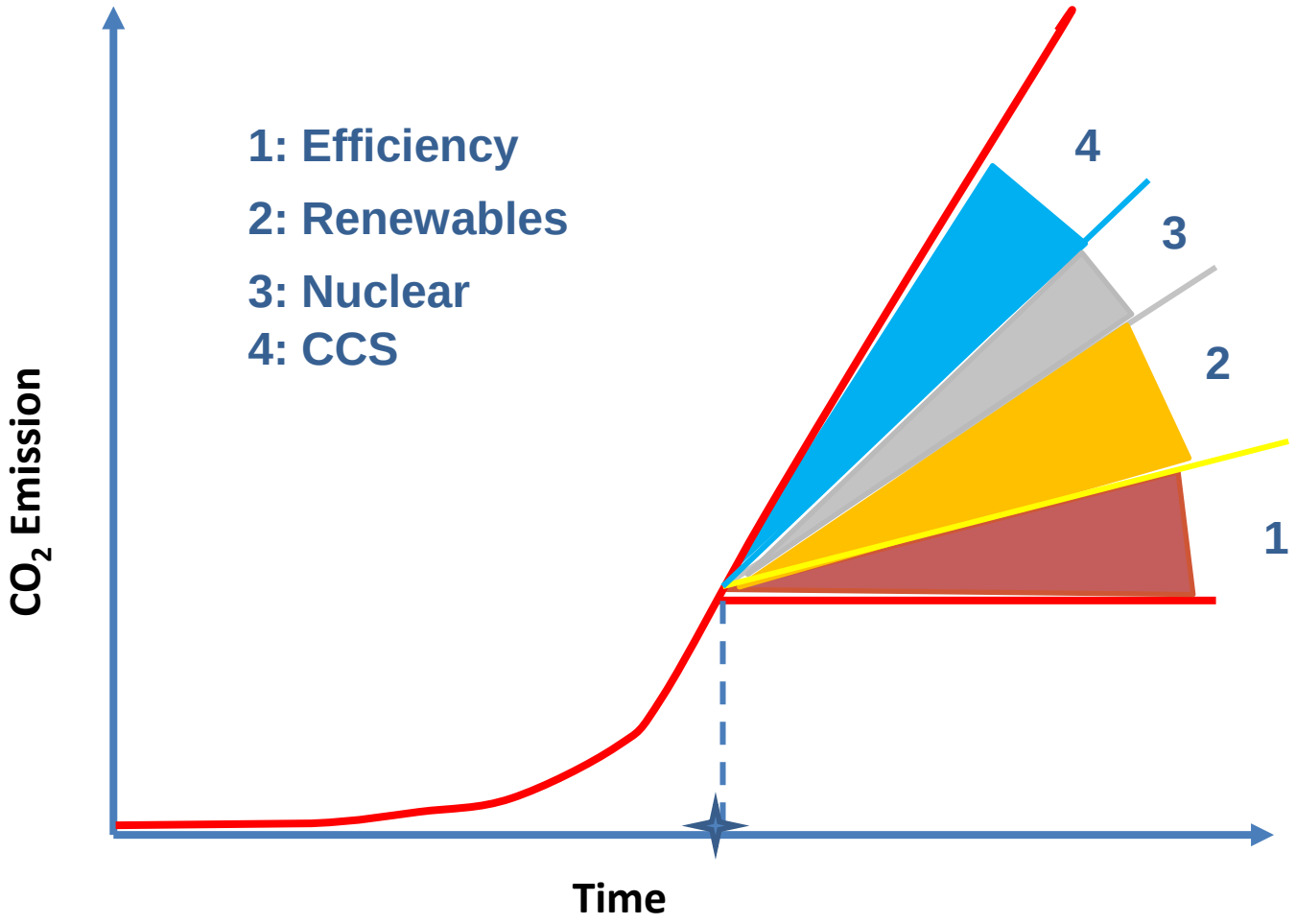
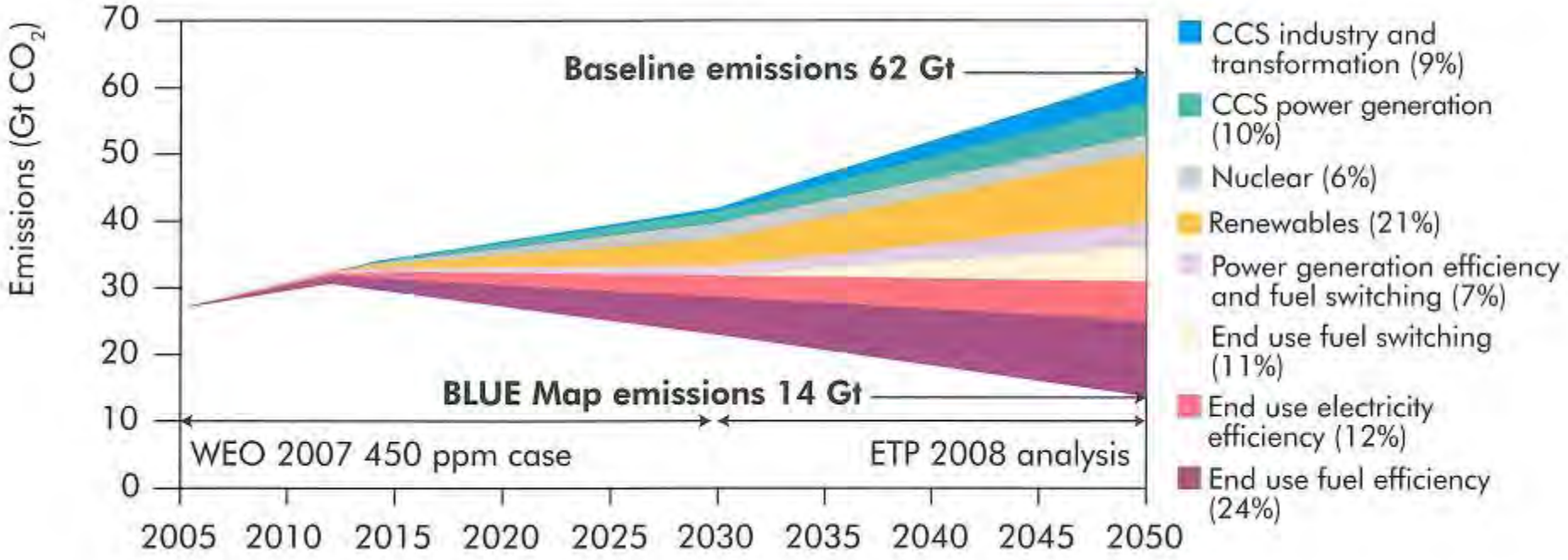
AIE CCS Event,
26 Oct 2012

GHG Reduction Mitigation Portfolio



Wedges Theory of Prof Stephen Pacala (Princeton Univ) in an SBS's Cutting Edge's documentary, "Power-Surge"

CCS - Global Mitigation by 2050



Globally, 20% of 48 Gt reduction from CCS – 10 Gt CO_2 pa

One of the portfolio of options

- IEA – 2008 – ETP: Figure 2.2 Contribution of emission reduction options, 2005-2050.

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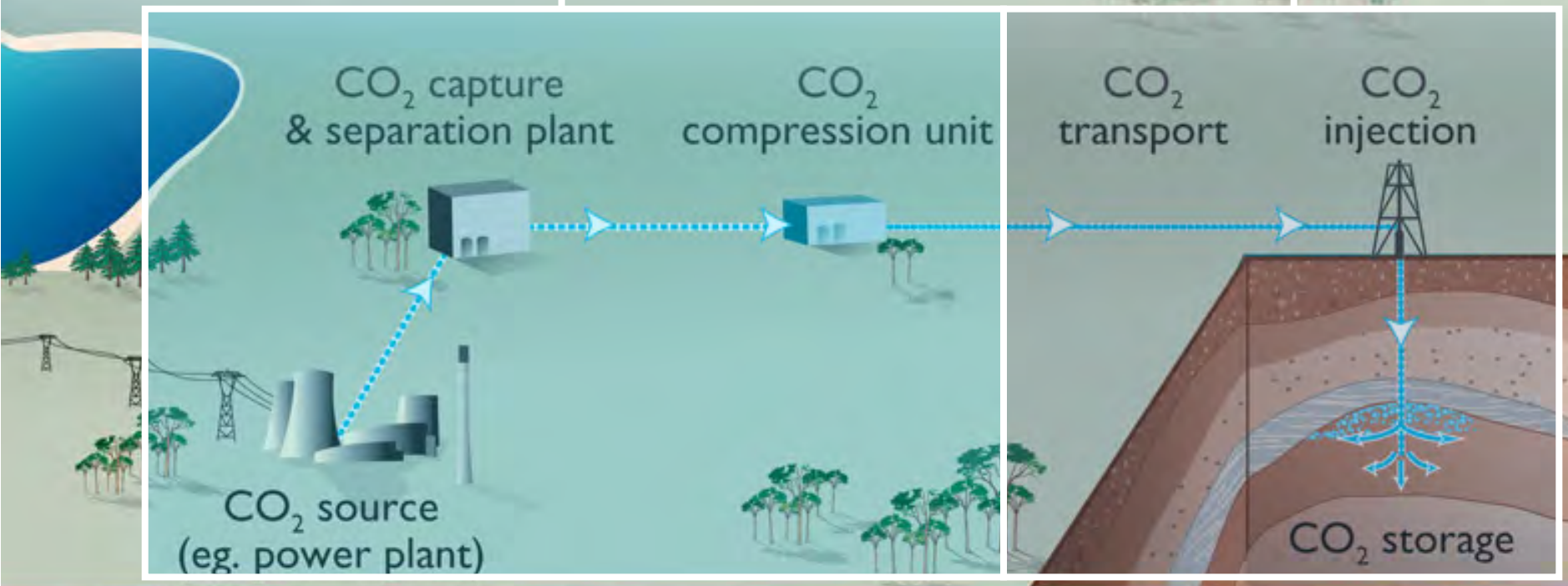
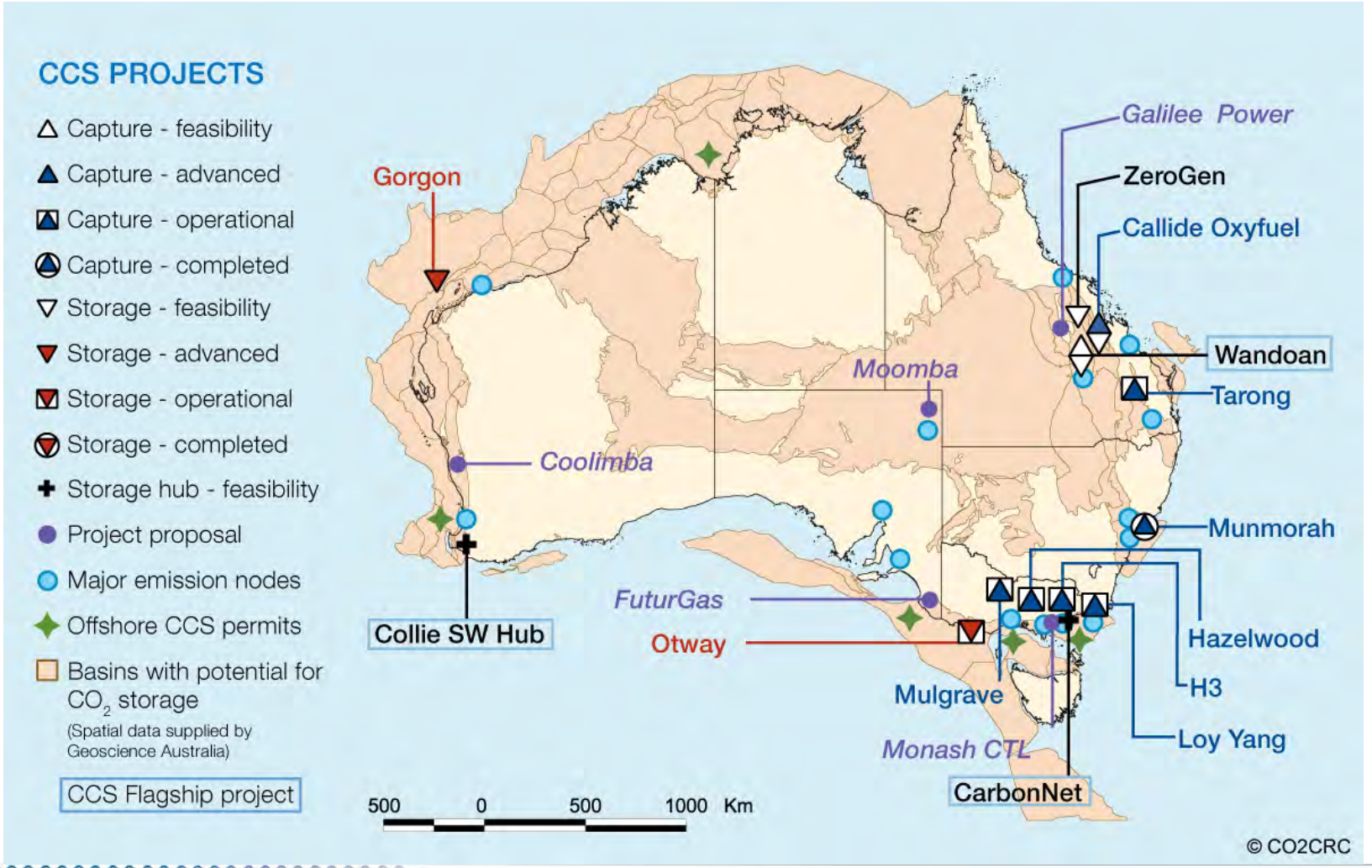
Capture Research & Demonstration

Storage Research & Demonstration

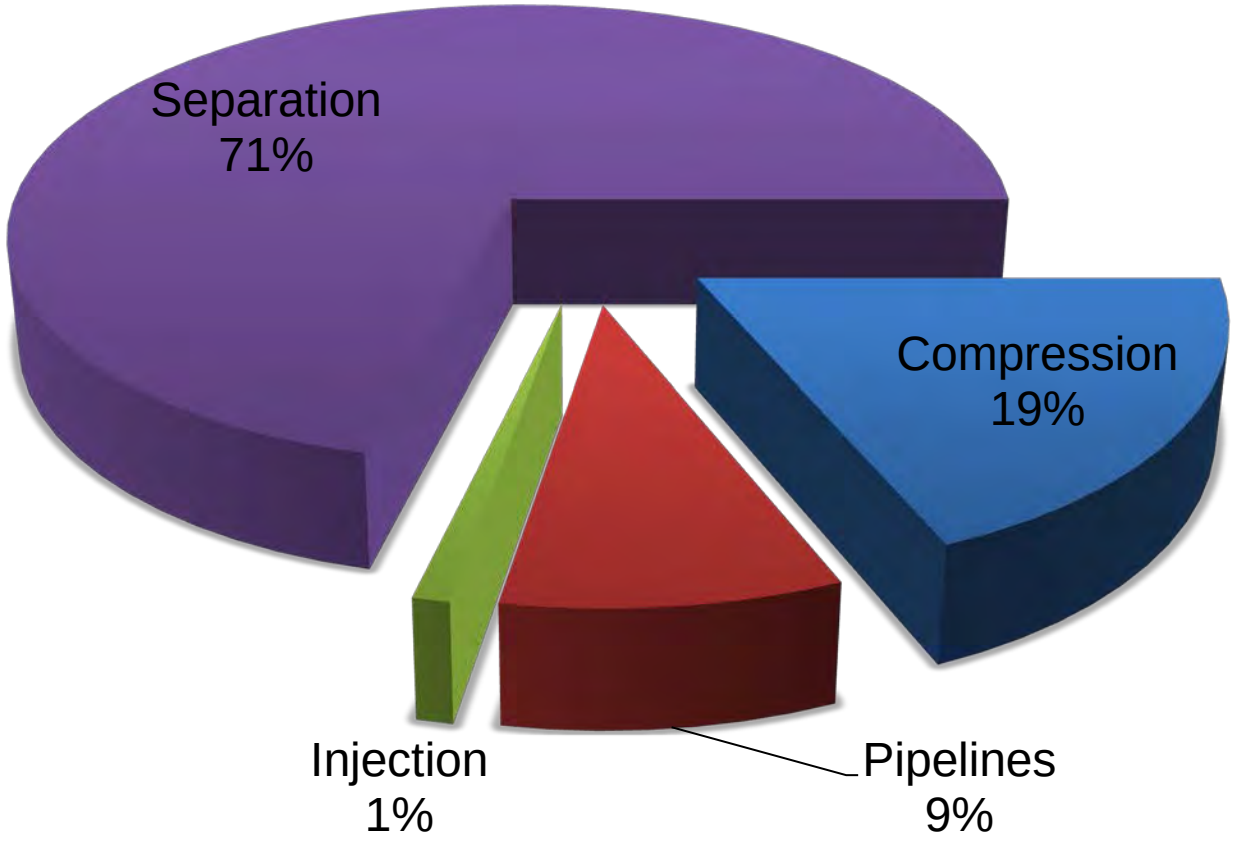


Carbon capture and storage projects in Australia

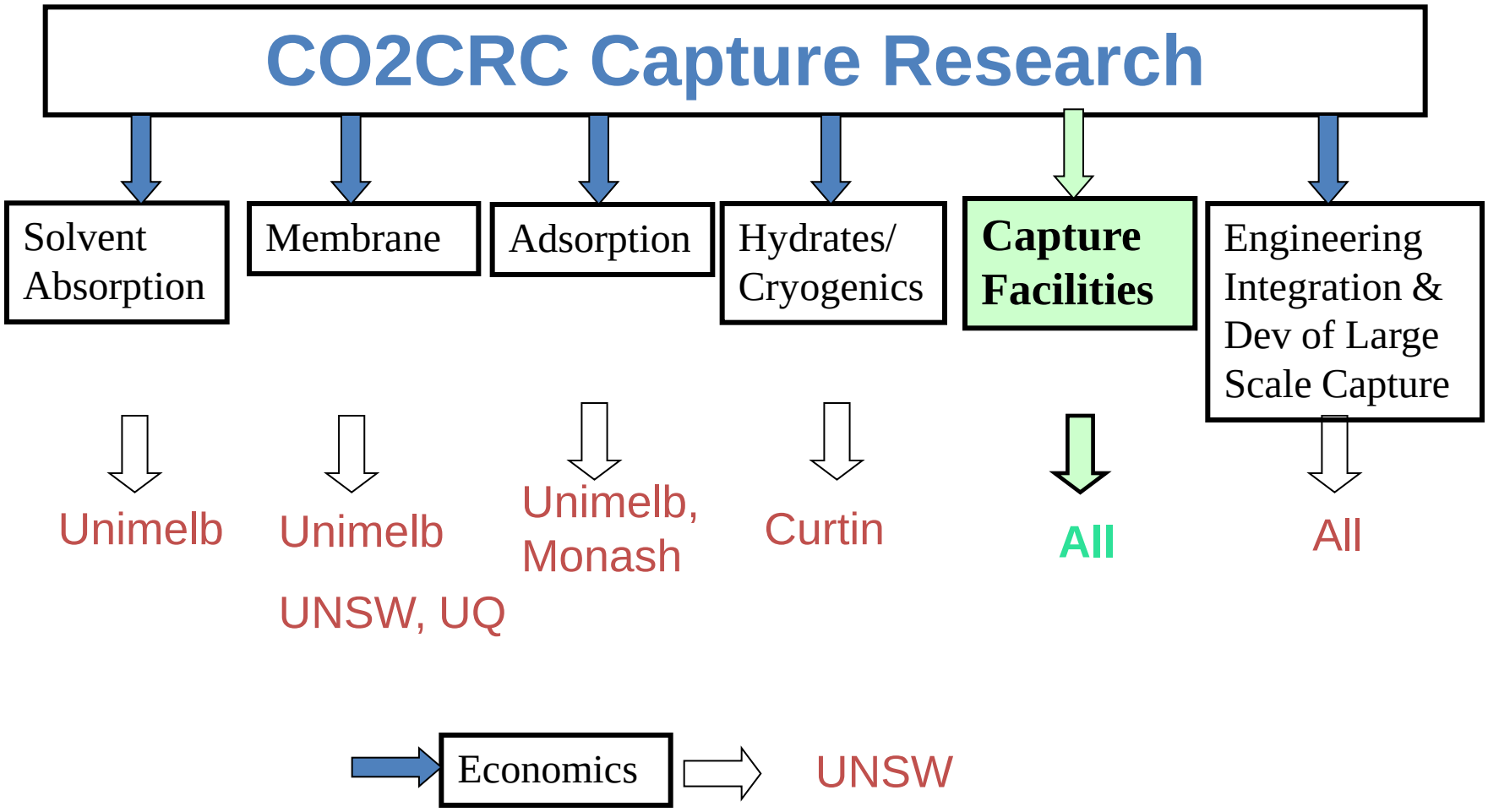


Indicative cost breakdown

(for optimal pipeline routes in SE Qld)



CO2CRC Capture Research



Key Issues for CO_2 Capture for Commercial Application

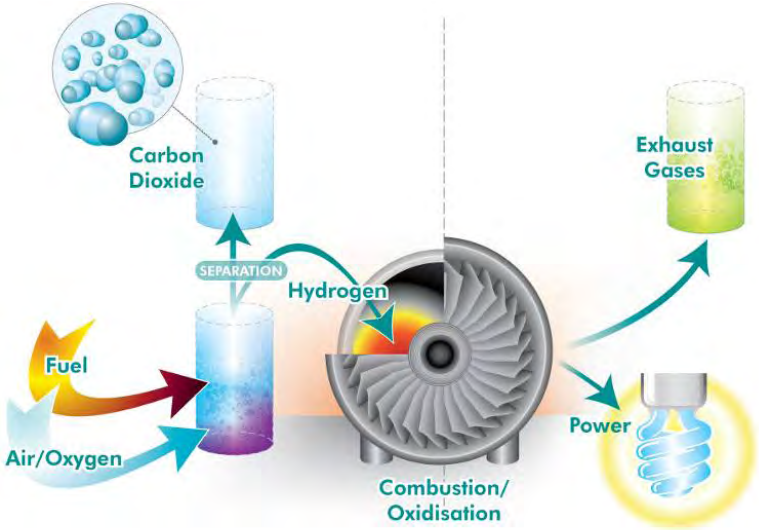
Technical, Cost and Safety

- At what cost and what efficiency?
- how?
- What to do about contaminants?
- Regional hubs?
- Although safety risks are similar as in any other chemical industries, specificity of its application inside power plants is new

Demonstration of Capture Projects

- Background
  - ✓ Brown coal in Latrobe Valley
  - ✓ Initiated by VIC ETIS and supported by BCIA
- Areas: Pre-combustion (~$6.8 M) and Post-combustion (~$ 5.5M), each using 3 diff technologies: **Absorption, Membrane & Adsorption**

Gasification – pre-combustion capture

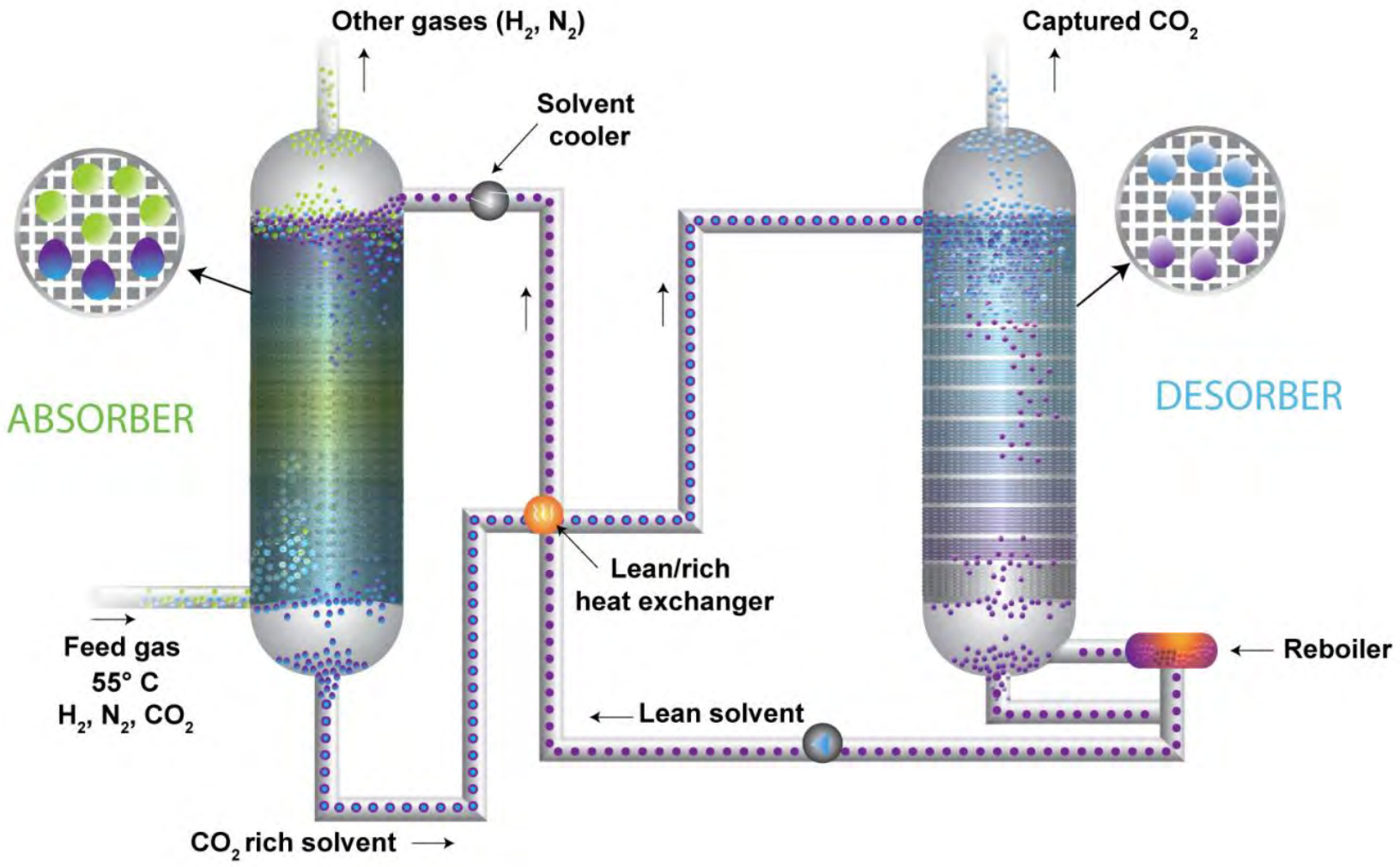


CO_2 Vol% - up to 40%

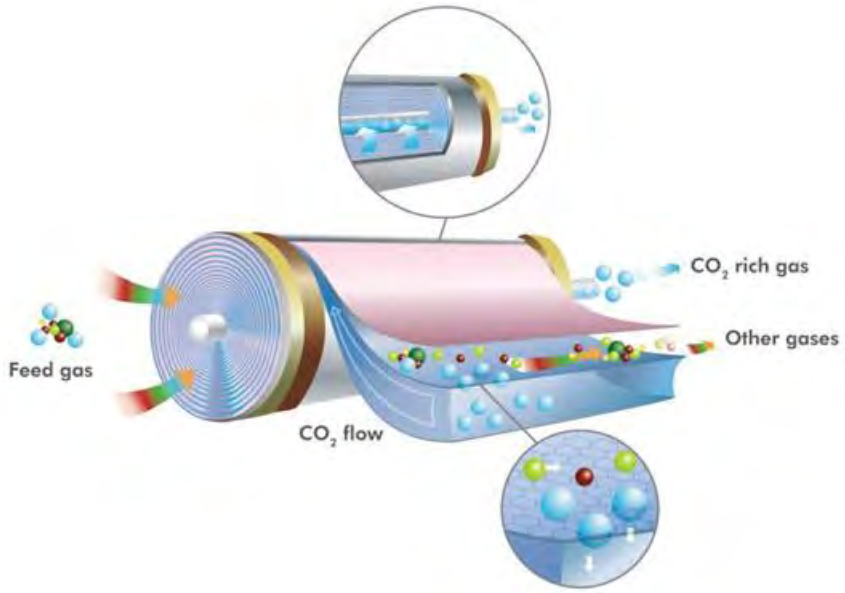
Post combustion capture

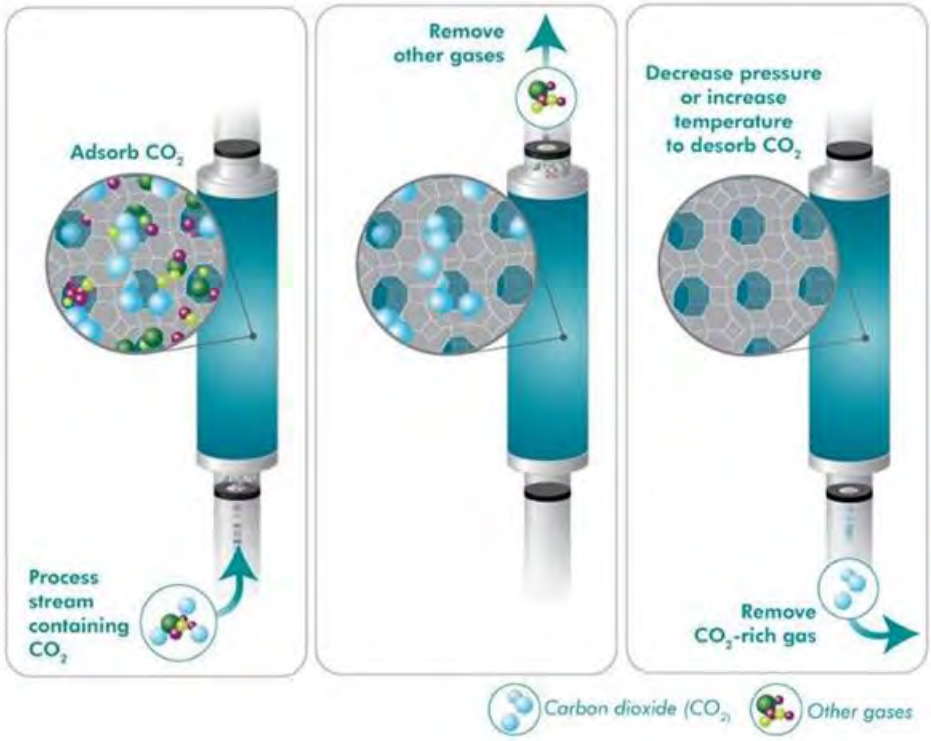
CO_2 Vol% - 12 to 15%

Solvent Absorption Process

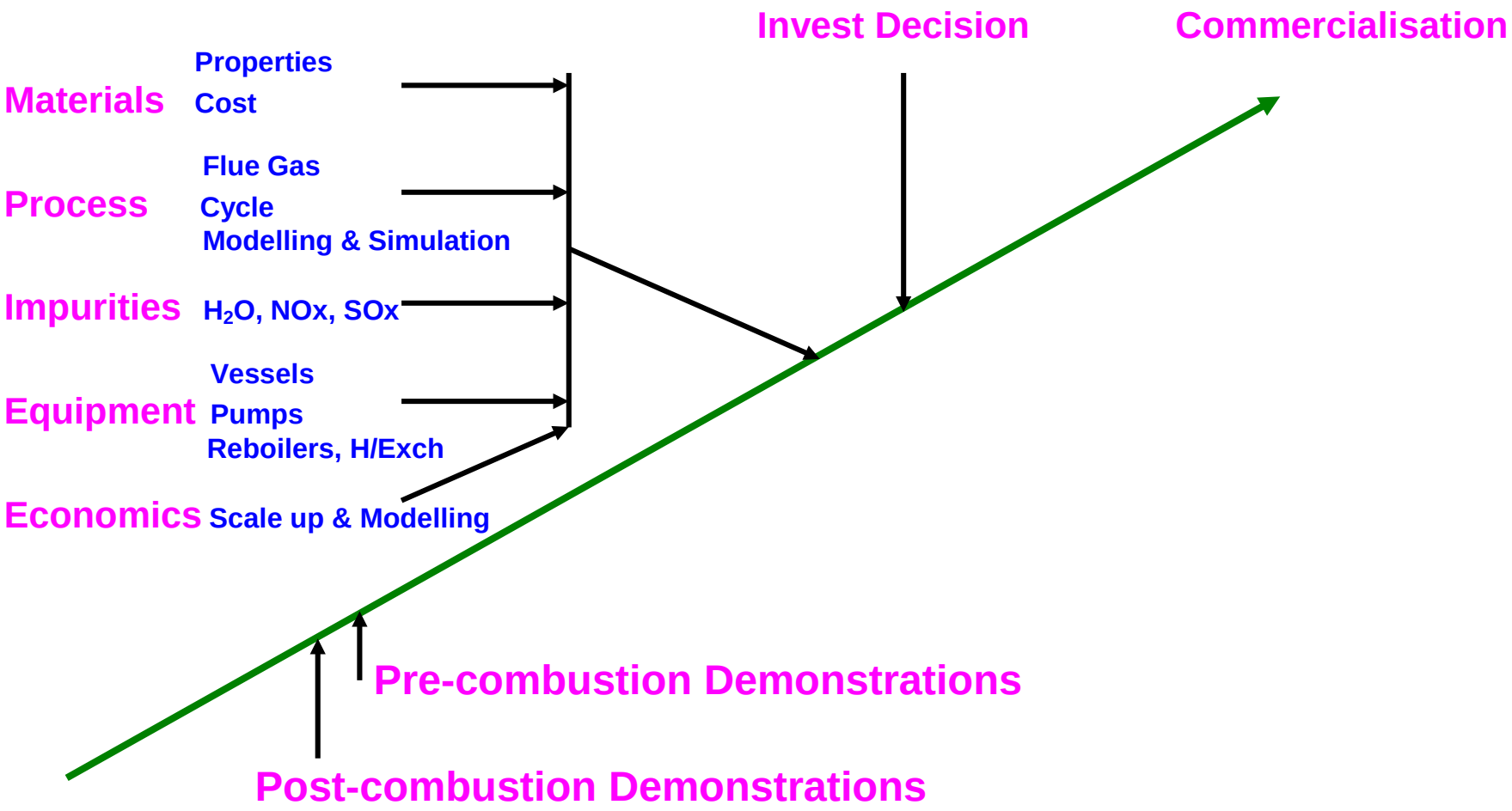


Membrane and Adsorption Process





Broad Research Picture



Demonstration Projects Focus

- develop, operate and maintain CO2CRC's world-class capture facilities
- nurture novel capture opportunities in early stages of development

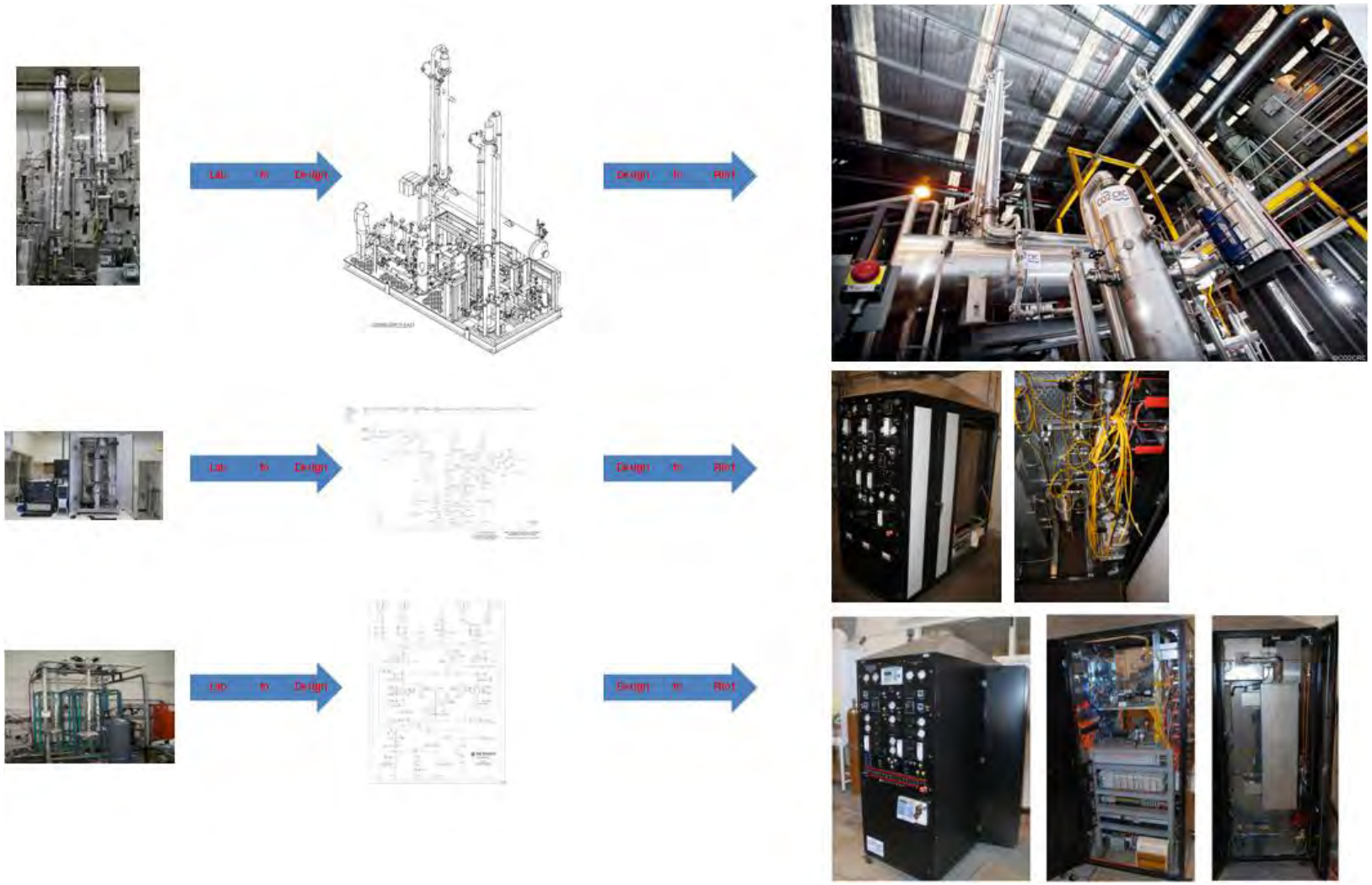
Lab capture program (Research)

- Research on capture technologies: solvent, membrane, adsorbent, and cryogenics
- Develop existing materials / new novel materials, relevant processes and equipment to lower capture cost
- Support to pilot plant operation and evolution of results

Capture Demonstration program (in pilot scale)

- Testing of existing and emerging technologies using real flue gas / syngas
- Identification of engineering issues and ways to resolve them
- Hands-on operational experience
- Verification of simulation results and recommend requirements for future test and commercial scale plants

From Lab to Design to Pilot: CO2CRC Mulgrave Capture Project (Pre-combustion)



International Power
GDF SUEZ

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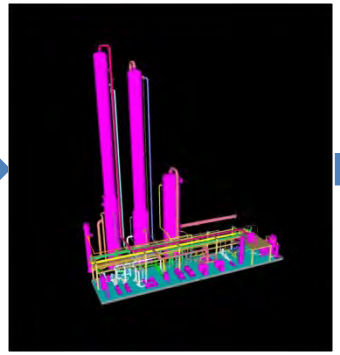
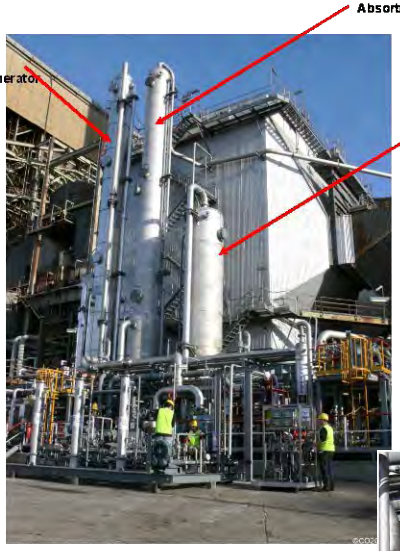
From Lab to Design to Pilot: H3 Capture Project at Hazelwood

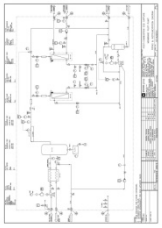
Lab to Design



Design to Pilot

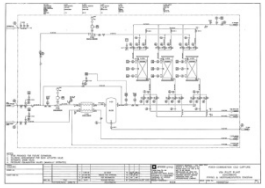


Lab to Design



Design to Pilot

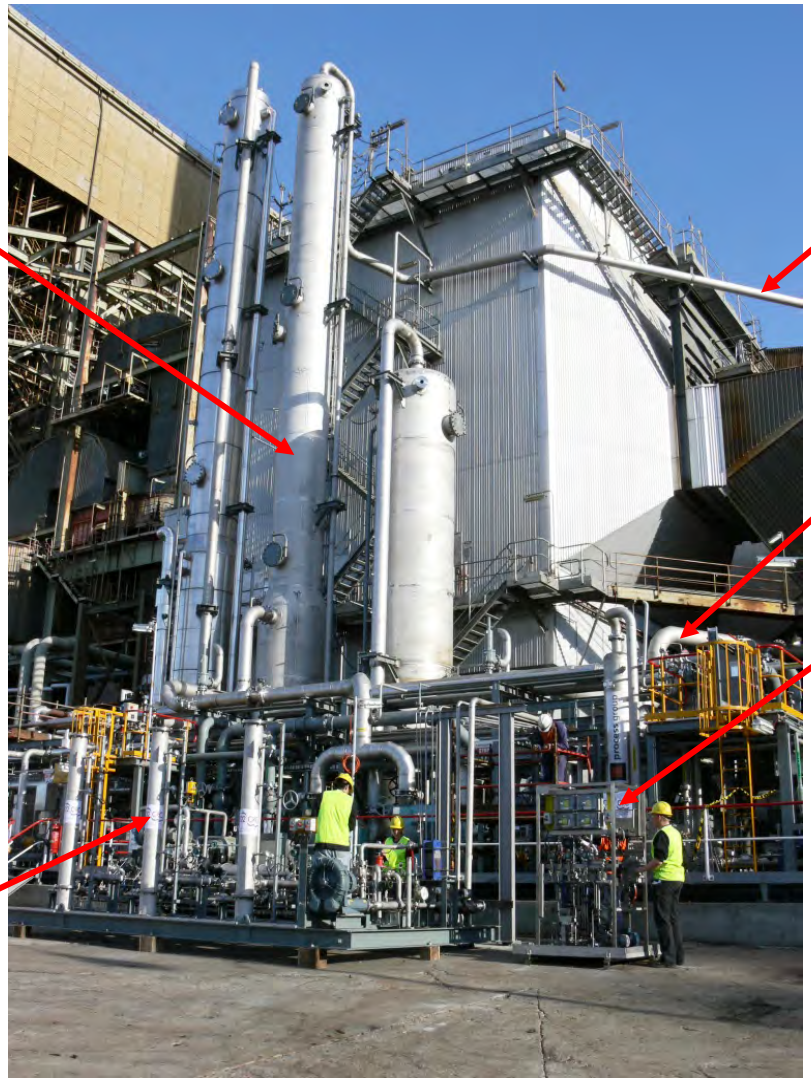
Lab to Design



Design to Pilot

H3 Capture Project at Hazelwood Power Plant

Solvent
(50 tpd)
29.3 x 8.3 x 24



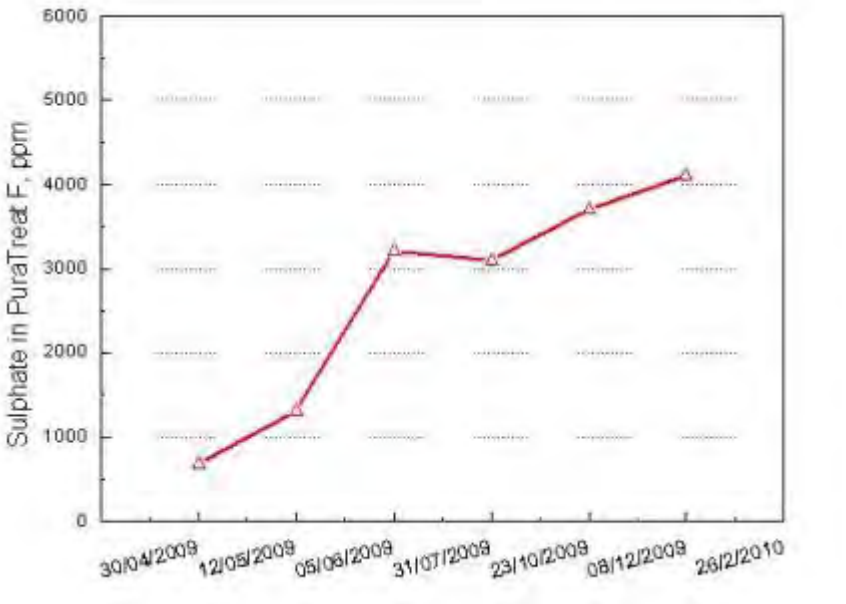
Spent gas out

Flue Gas in

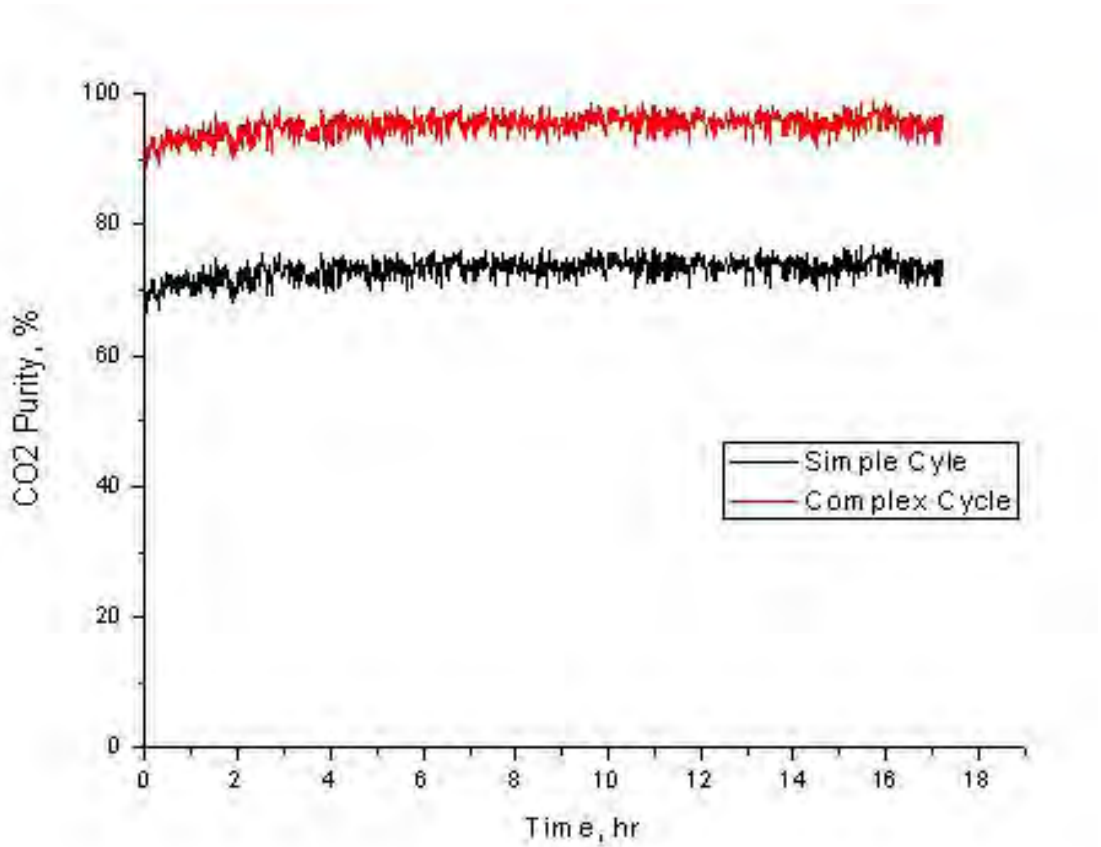
Membrane
(0.04 tpd)
1.5 x 2.5 x 2.2

Adsorbent
(0.5 tpd)
3.0 x 4.5 x 8.0

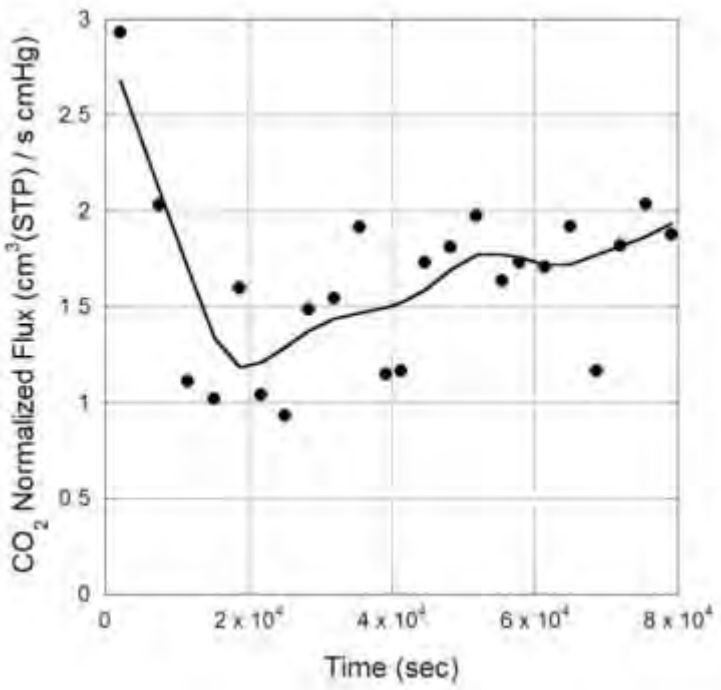
Sulphate build-up in PuraTreat^{TM} F and Precipitation in K_2CO_3

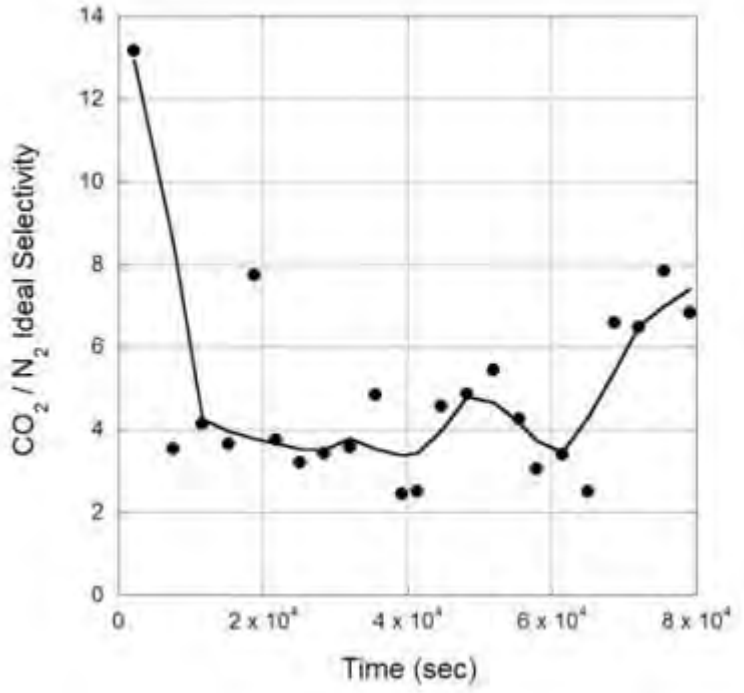


Product Purity – Adsorption Tests



Gas Separation Membrane Tests





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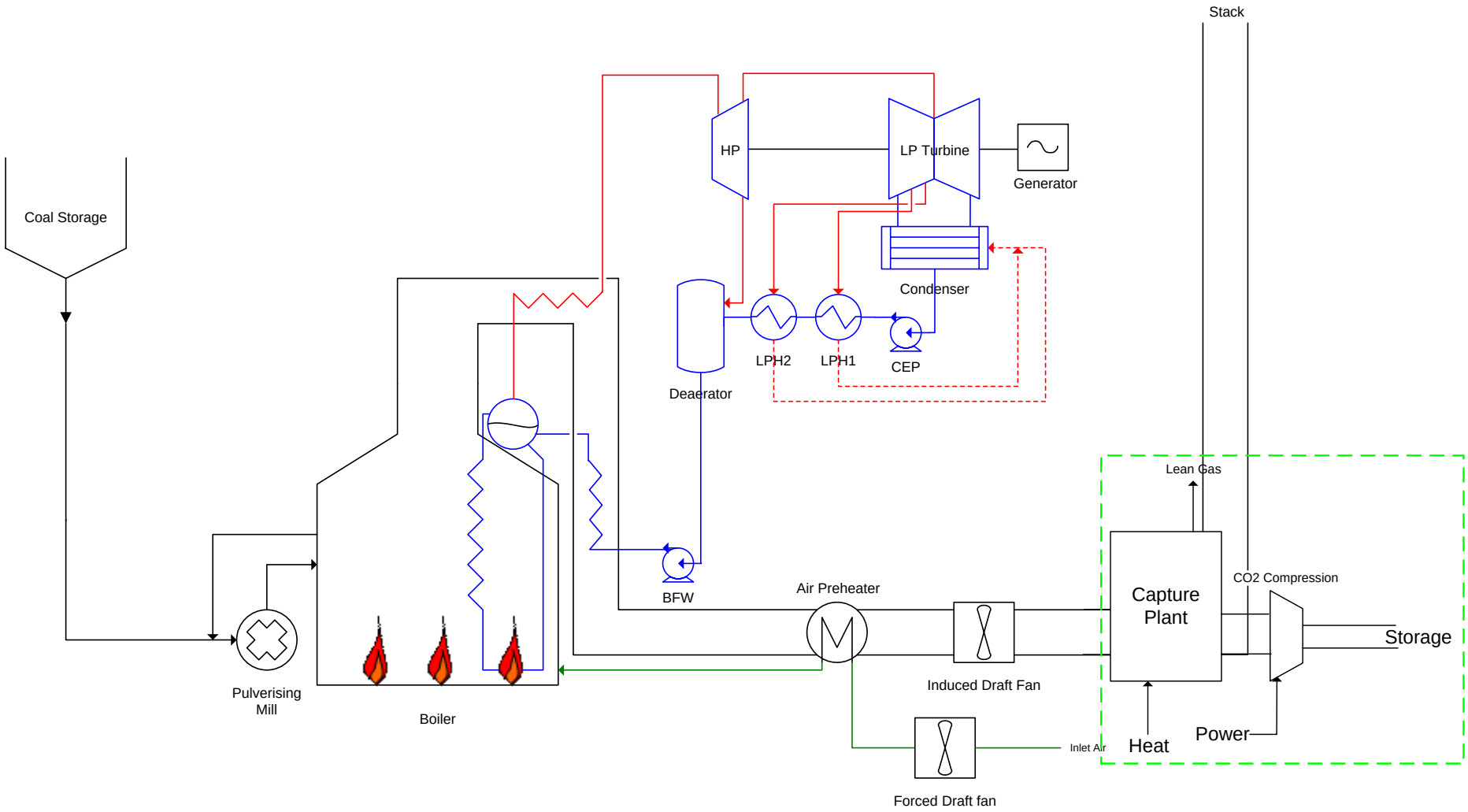
Data Evaluation

Data acquired helped producing information on:

- ✓ **Large scale simulation**
- ✓ **Plant & process improvement (Energy penalty)**
- ✓ **Economics (Cost per tonne of CO_2 avoided, Cost of Electricity etc)**
- ✓ **Comparison between various technologies for commercial scale CCS and confidence in implementing them**
- ✓ **Skill development**
- ✓ **Recommendations for further development**

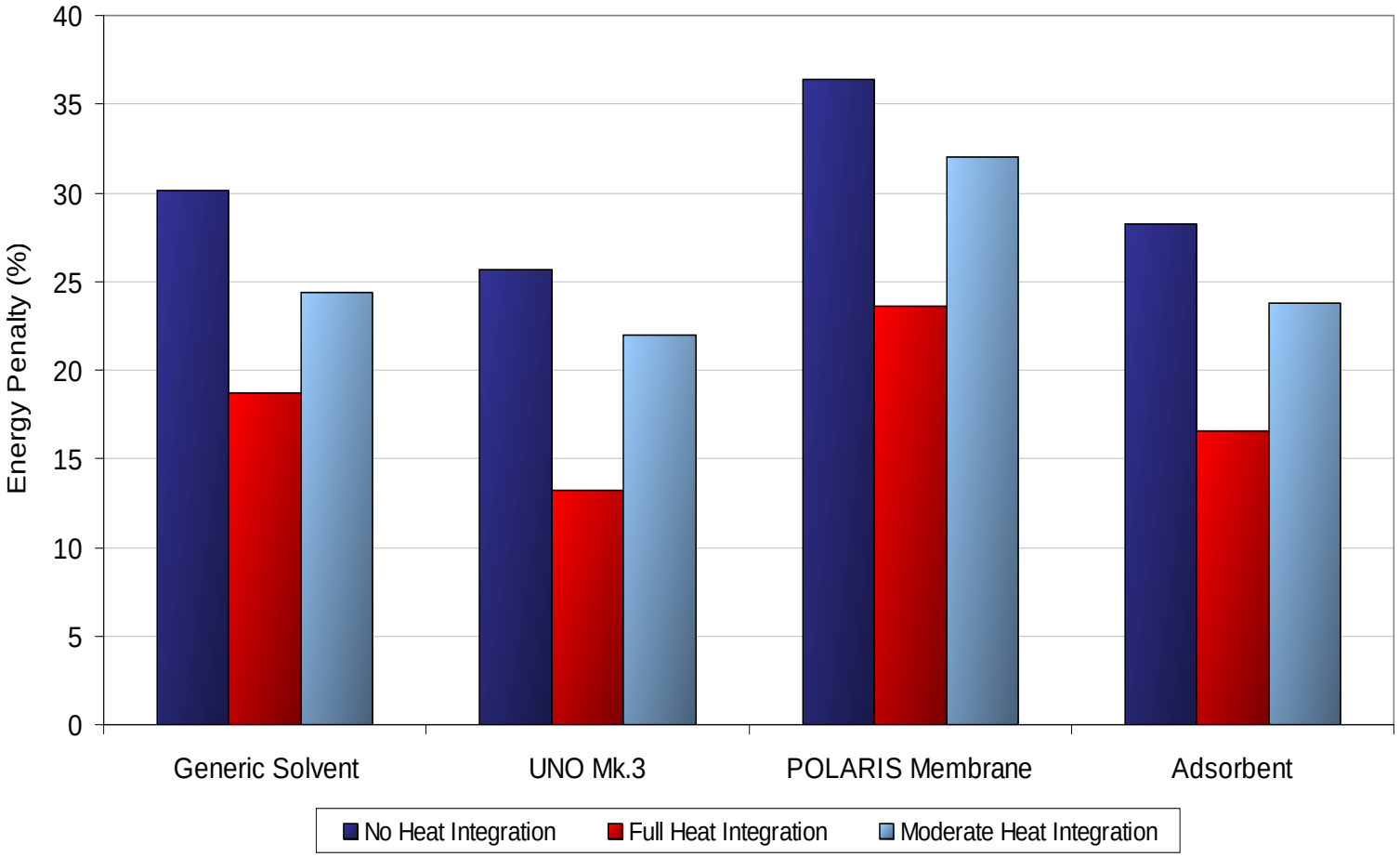
Pulverised Coal Power Generation



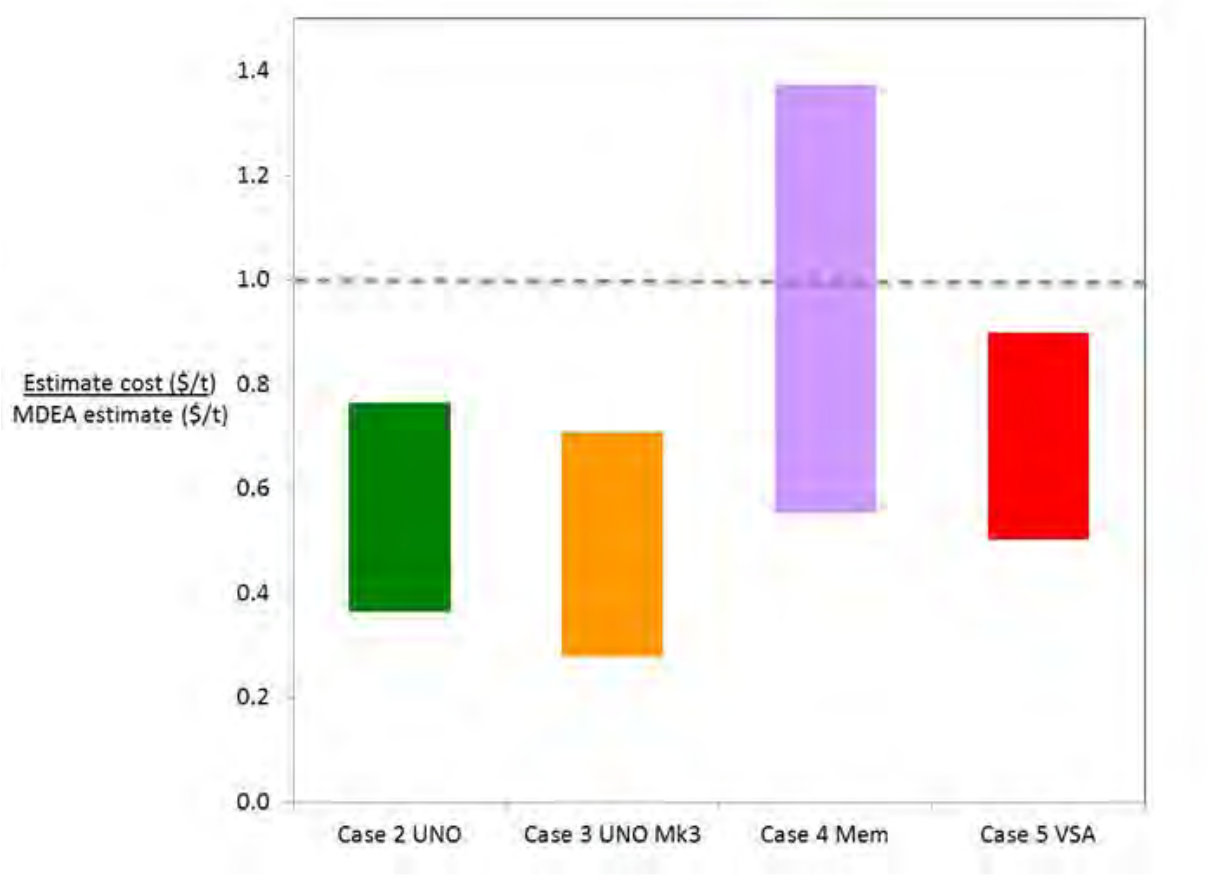
CO2CRC UNO MK3 Solvent Capture Project at Hazelwood (with funding from BCIA)

- 1 tonne per day CO_2 capture plant to test and demonstrate the CO2CRC precipitating potassium carbonate solvent (UNO MK3) process is under commissioning at this stage
- Involves researchers for CO2CRC based at the University of Melbourne and UNSW
- This process is expected to be more efficient and economic than a conventional solvent process

Energy Penalty for the Options Reviewed



Ratio of upper and lower estimate costs for alternative CO_2 capture technologies compared to the estimate for MDEA solvent



Outcomes & Future Status

- **Two capture demonstration projects (total 6 pilot plants)**
  - ✓ **Met objectives and gained confidence in the safe design, construction, erection and the operation of capture plants in power plant set up.**
  - ✓ **First application of the 3 different capture techn in parallel**
  - ✓ **Data towards scaling up: plant & process; handling impurities; heat & process integration; economics**
  - ✓ **Skills development in all areas: over 20 researchers involved**
  - ✓ **Visitors; 150 publs, 35 in refereed journals, ... etc enhanced the cause and awareness of CCS**
- **Authoritative project management established for multi-party, multi-site, multi-objective projects. Careful management with people skills to satisfy various interest groups**
- **Although safety risks are similar as in any other chemical industry, specificity of its application inside power plants is new**
- **Work is underway for the new project funded by BCIA to test/ demonstrate our solvent ppt system (UNO MK 3)**

CO2CRC Participants

Australian Government Geoscience Australia
CSIRO
Curtin University
MONASH University
The University of Adelaide Australia
The University of Melbourne
UNSW The University of New South Wales Sydney • Australia
The University of Western Australia Achieve International Excellence
Anglo American
anlecr&d
BG Group
bhpbilliton
Brown Coal Innovation Australia
bp
Chevron
ministry of science + innovation Te Pūnaha Hiringa Whakaea
GNS Science Te Pū Ao
INPEX
KIGAM Korea Institute of Geoscience and Mineral Resources
NSW Government Trade & Investment
QGR
Rio Tinto
Queensland Government
sasol reaching new frontiers
Shell
stanwell create. generate. innovate.
Total
State Government Victoria Department of Primary Industries
Government of Western Australia Department of Mines and Petroleum
xstrata coal

Supporting Partners: The Global CCS Institute | The University of Queensland | Process Group | Lawrence Berkeley National Laboratory
CANSYD Australia | Government of South Australia | Charles Darwin University | Simon Fraser University