CSIRO PCC pilot plant research in Australia

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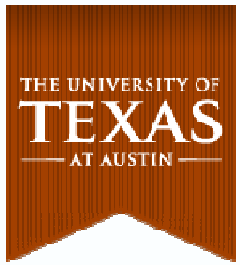
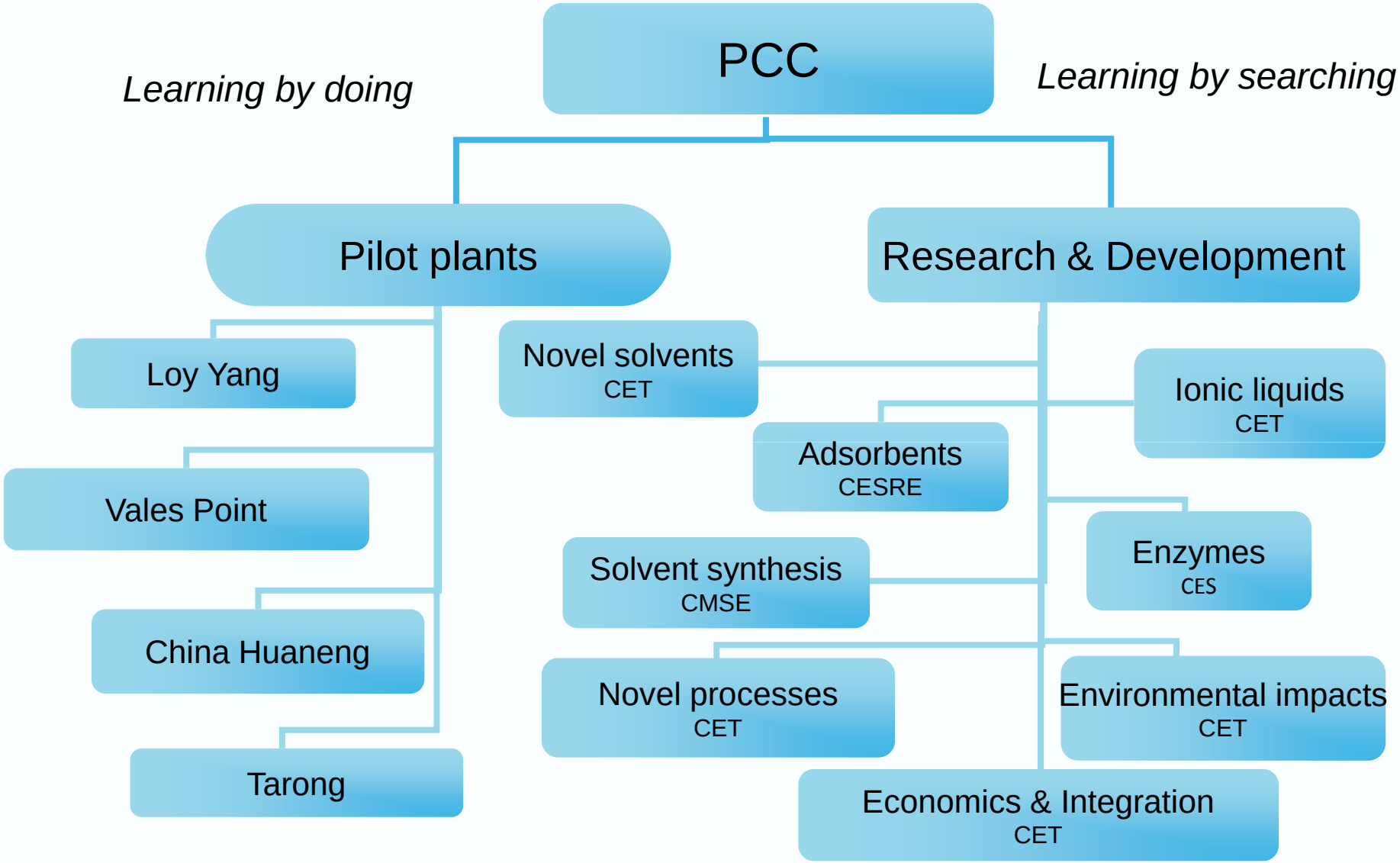


Overview

- CSIRO CO_2 capture pilot plants
- The Tarong pilot plant
- Baseline operation with MEA
  - Column profiles
  - Minimum energy operating conditions
  - Process modification evaluation
  - HSS formation
- Conclusions and future work

Integrated PCC R&D Program



Pilot plant summary

Plant	Loy Yang	Munmorah → Vales Point	Tarong	Newcastle PDF
Solvent	Amine	Ammonia/ Amine	Amine	Ammonia/ Amine
Flue gas source	Brown coal	Black coal	Black coal	Synthetic
Scale	50 kg/hr	300 kg/hr	100 kg/hr	20 kg/hr
Focus	Solvent benchmarking	Ammonia operation	Process optimisation	Process development
Other activities	Emission study	Pressurised absorption	Concentrated piperazine	Cutting edge processes

- Matrix approach helps cover many aspects of PCC as well as providing quicker delivery of information

CSIRO pilot plant at AGL Loy Yang

- Brown coal flue gas, amine based solvents
- Previous experimental campaigns – Focus on solvent evaluation
  - Baseline with 30wt% MEA
  - Completed 7 campaigns with different solvents
- Current work also focusing on detailed emissions measurements and solvent degradation
- Collaboration with EU consortium in the coCAPco project (combined CO_2 + SO_2 control process)

Artanto et al. 2012, Fuel 101, 264-275

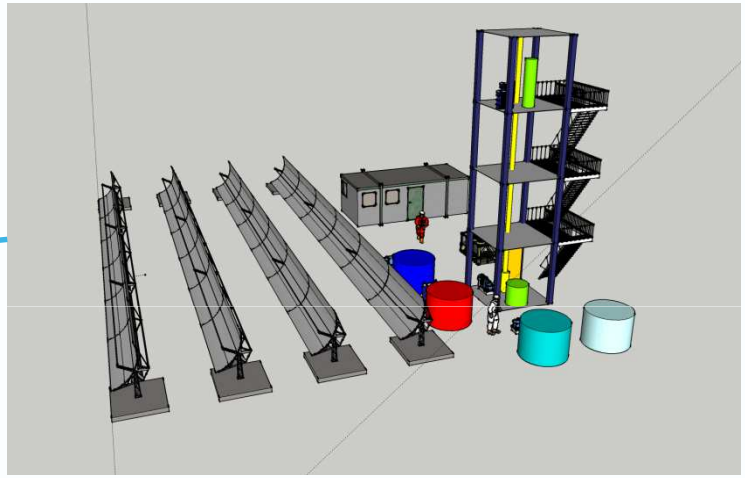
Munmorah/Vales Point pilot plant

- Black coal flue gas
- Evaluated ammonia as a CO_2 capture solvent
- Relocated to Vales Point power station. Currently undergoing commissioning
- NH_3 is an interesting solvent for CO_2 capture, however there are challenges:
  - Ammonia loss
  - Low CO_2 absorption rates
  - Solids formation (condenser)
- Supported by Coal Innovation NSW funding

Yu et al. 2012, International Journal of Greenhouse Gas Control 10, 15-25

Vales Point pilot plant – solar

- Design and construction of a pilot scale solar thermal reboiler for thermal regeneration of liquid absorbents.



Tarong CO_2 capture pilot plant

Tarong Power Station

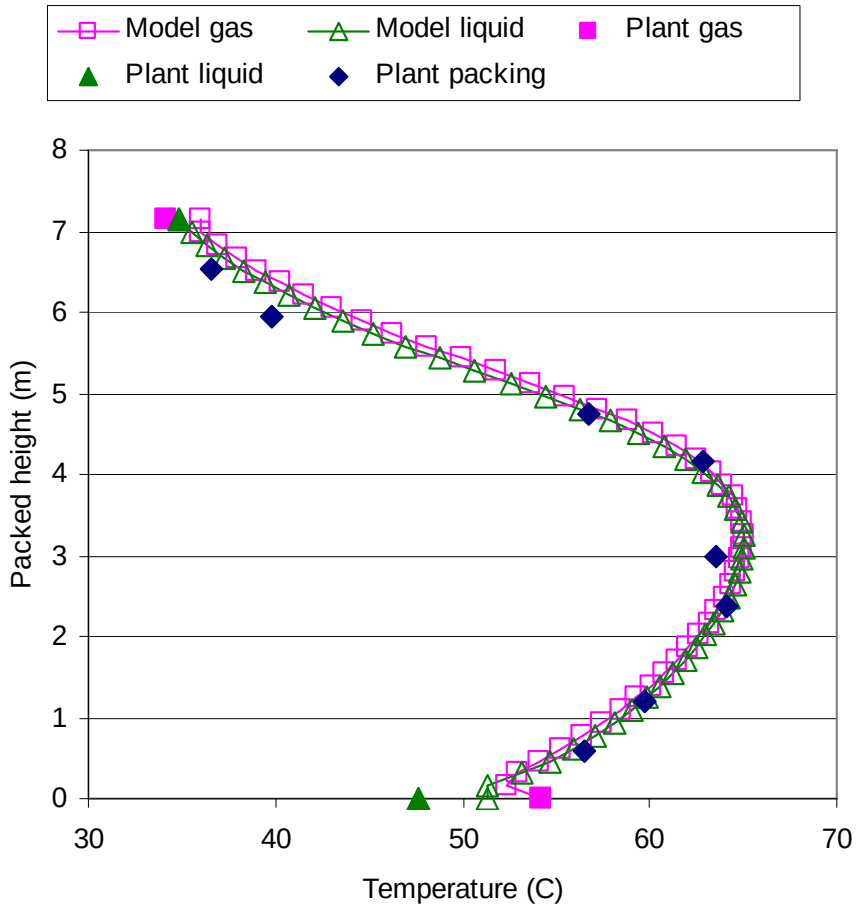
- Sub-critical black coal, built late 1970's
- 4 units, 1400 MW total
- No FGD/DeNox

Operation overview

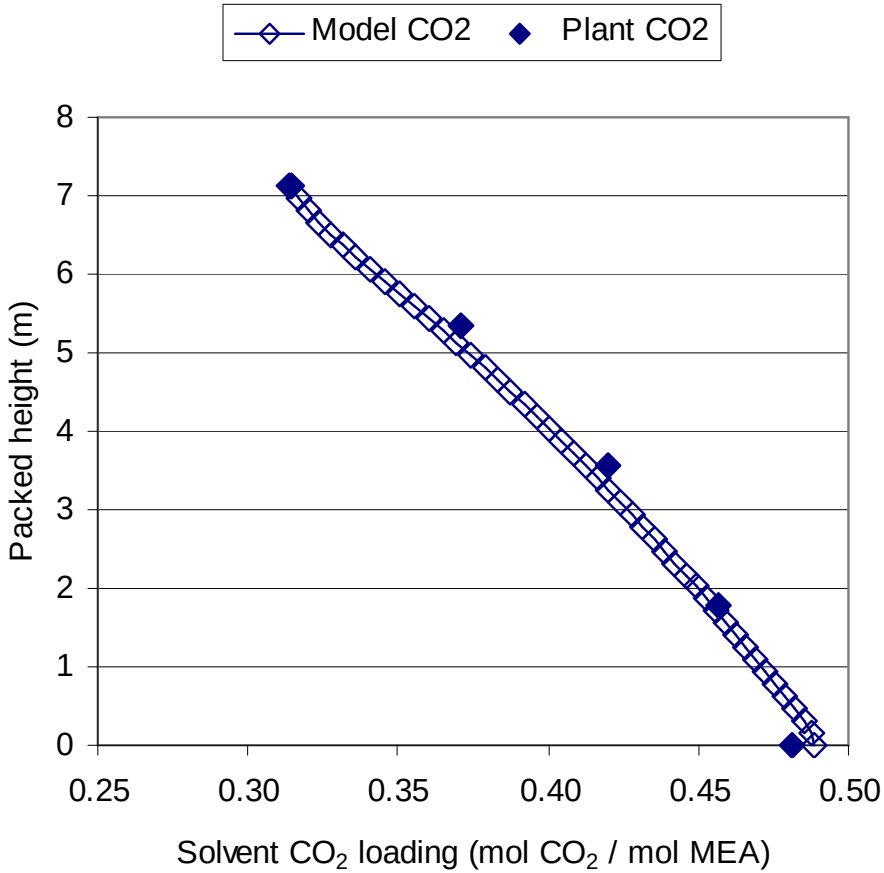
- Construction on site, May – August 2010
- Commissioning, August – November 2010
- Operation with MEA, November 2010 – May 2011
  - Baseline operation (24 hr)
  - Minimum energy operating conditions
  - Process modification evaluation
  - Corrosion coupon analysis
- Initial operation with piperazine, August – October 2011
- APP project completed 2011
- ANLEC R&D project, Evaluation of concentrated piperazine, October 2011 – now

Baseline operation – absorber column profiles

Temperature

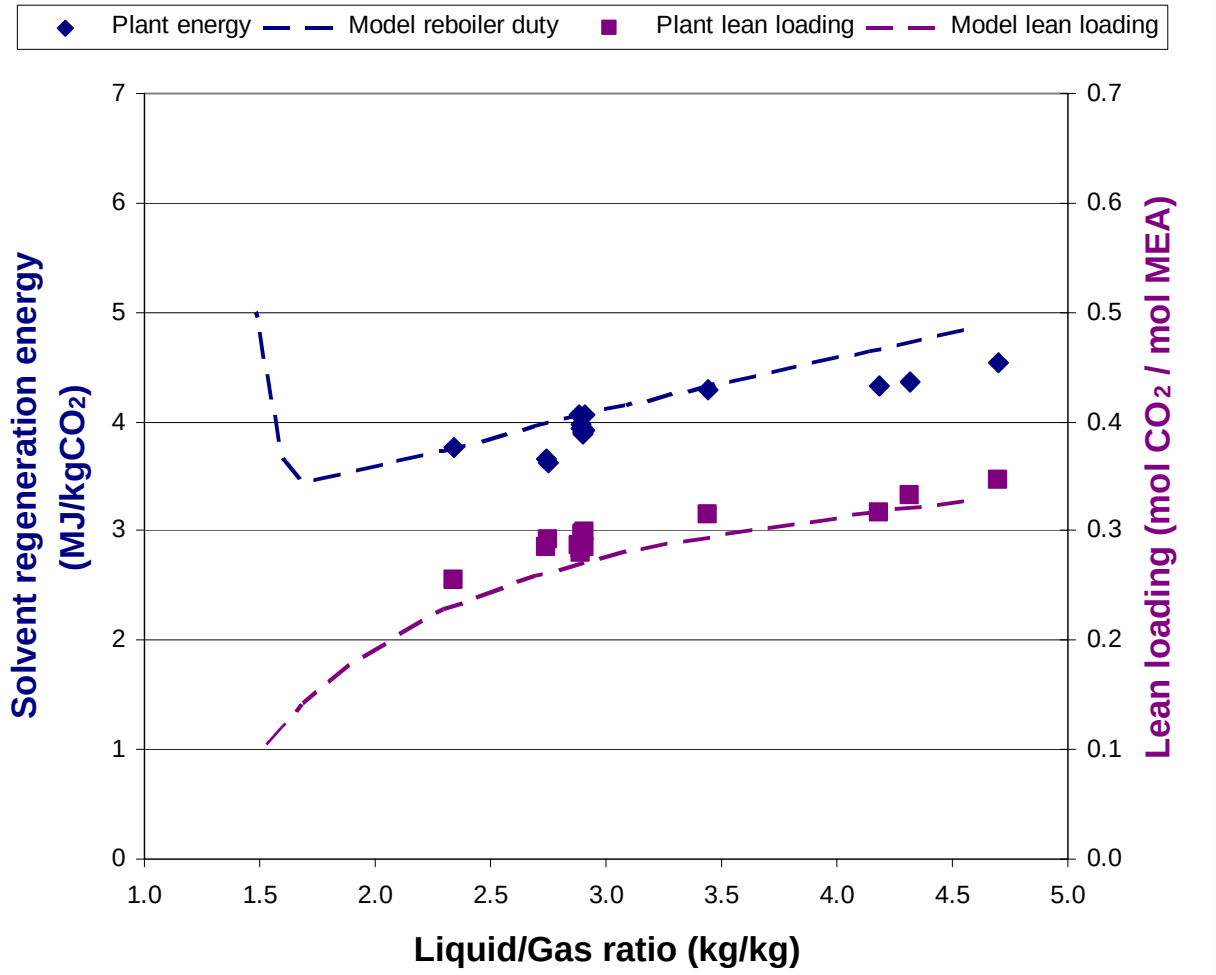


Liquid CO_2 concentration



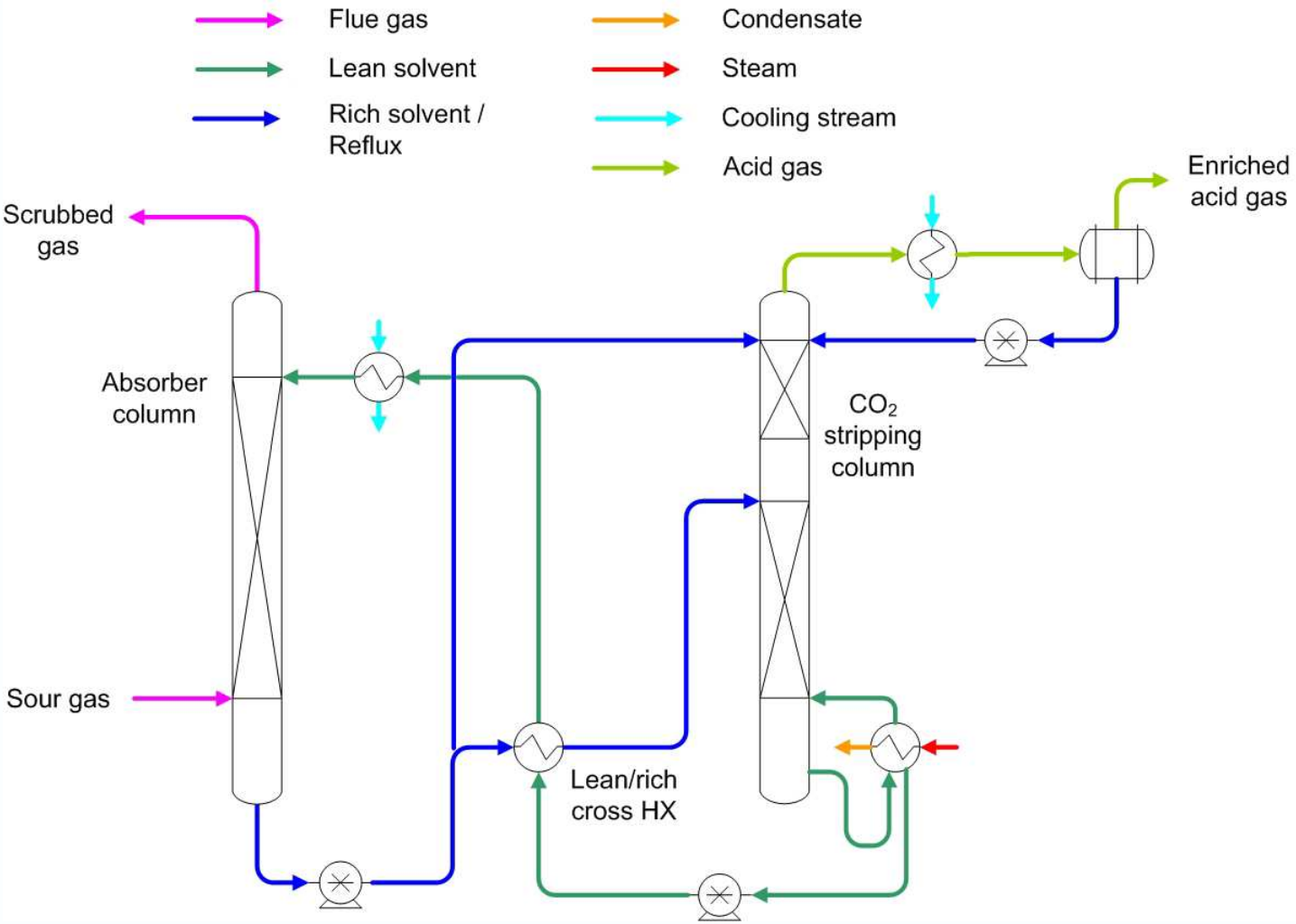
Cousins et al. 2012, Greenhouse Gases: Science and Technology 2, 329-345

Baseline operation – minimum energy operating conditions



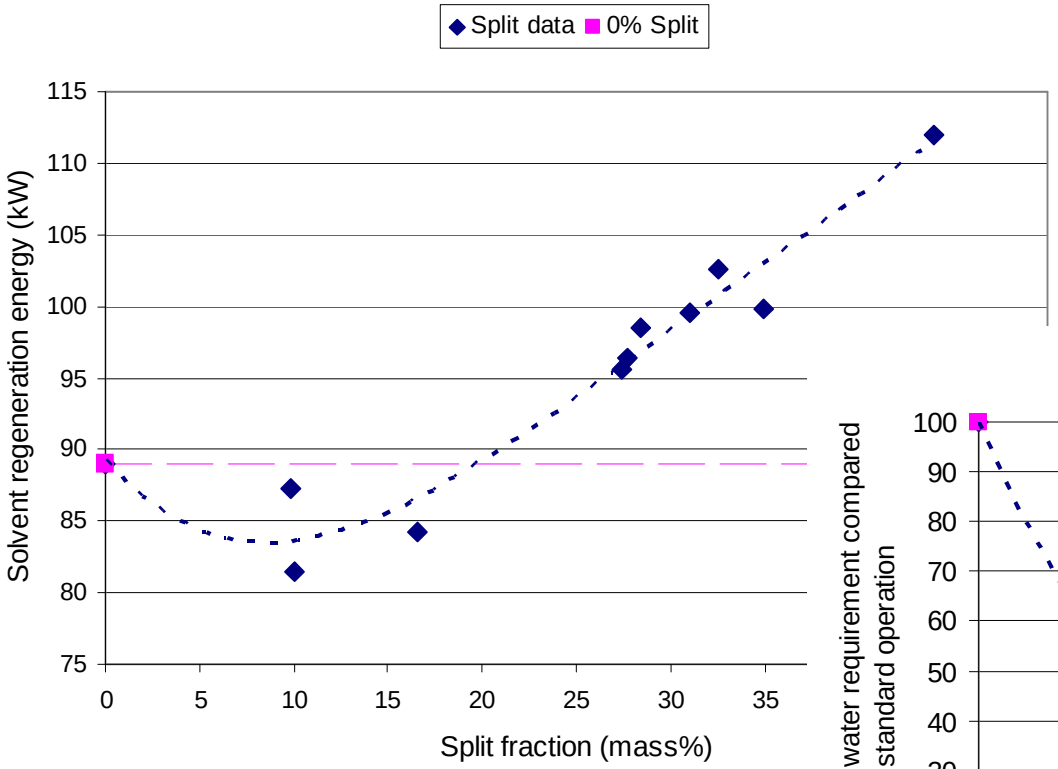
Cousins et al. 2012, Greenhouse Gases: Science and Technology 2, 329-345

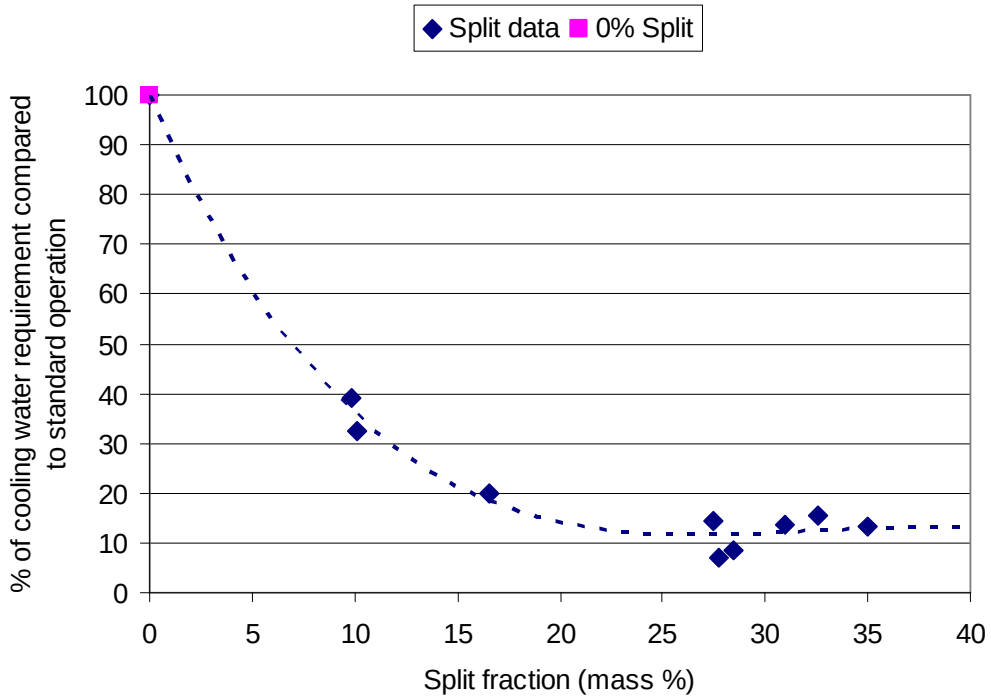
Process modification evaluation – rich split



Based on patent of Eisenberg and Johnson 1979

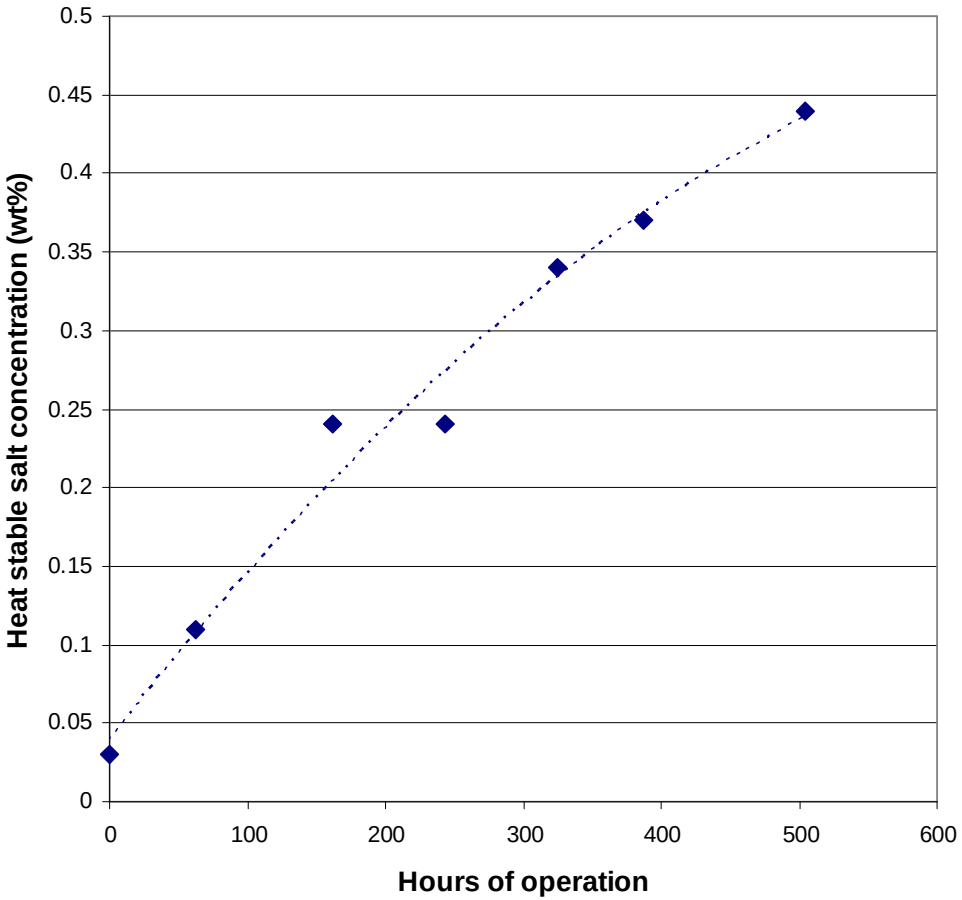
Process modification evaluation – rich split





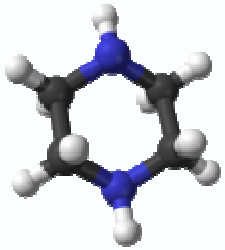
Cousins et al. 2012, Greenhouse Gases: Science and Technology 2, 329-345

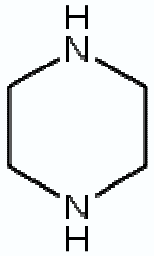
Heat stable salt measurement



- Flue gas after pre-treatment ~
  - 0-5 ppm SO_2
  - 100-220 ppm NO
  - 0-3 ppm NO_2
- HSS content increased ~0.4 wt% after 500 h operation
- Solvent did not exhibit any noticeable decrease in performance

Concentrated piperazine





Why piperazine?

- Potentially lower regeneration energy solvent cf. MEA
- More stable (thermal/chemical)
- Low vapour pressure (reduced environmental emissions)

Concerns when operating with piperazine

- Narrow operating window – solubility issues
- Formation of degradation products

In collaboration with the University of Texas, Austin

Conclusions and future work

CSIRO's pilot plants have provided useful information for evaluating CO_2 capture technologies at Australian coal fired power stations.

Future work:

- Loy Yang
  - Combined SO_2 and CO_2 removal as part of the coCAPco project
- Vales Point
  - Pilot plant will be available for additional projects
  - Development of solar thermal reforming
- Tarong
  - Evaluation of concentrated piperazine funded through ANLEC R&D

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Thank you