Overview

- PCC program at CSIRO

- Overview of Australian pilot plant operations and recent results
  - Loy Yang Power Station
  - Munmorah Power Station
  - Tarong Power Station
Integrated PCC R&D Programme (A$30M/4yr)

Pilot plant programme (Learning by doing)
- Hands-on experience for future operators
- Identification of operational issues and requirements
- Testing of existing and new technologies under real conditions

Lab research programme (Learning by searching)
- Support to pilot plant operation and interpretation of results
- Develop novel solvents and solvent systems which result in lower costs for capture
- Addressing Australian specifics (flue gases, water)
PCC Pilot Plant Locations

- Gaobeidian Power Station, Beijing (Operational)
- Munmorah Power Station, NSW (Operational)
- Tarong Power Station, QLD (Construction phase)
- Loy Yang Power Station, VIC (Operational)
Simplified Pilot plant flow sheet
Loy Yang Power Station PCC Pilot Plant
Victoria, Australia

ETIS support
Lignite
Amine based
No FGD/DeNox
Operational May 08
### Typical inlet flue gas conditions (Artanto et al., 2009)

<table>
<thead>
<tr>
<th></th>
<th>INLET</th>
<th>TO ABS COLUMN 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>150 – 170</td>
<td>35 – 45</td>
</tr>
<tr>
<td>$\text{H}_2\text{O}$ (%v-wet)</td>
<td>20 – 22</td>
<td>6 – 9</td>
</tr>
<tr>
<td>$\text{CO}_2$ (%v-wet)</td>
<td>10 – 11</td>
<td>11 – 12</td>
</tr>
<tr>
<td>$\text{O}_2$ (%v-wet)</td>
<td>4 – 5</td>
<td>5 – 6</td>
</tr>
<tr>
<td>$\text{SO}_2$ (ppmv-wet)</td>
<td>100-200</td>
<td>4 – 5</td>
</tr>
<tr>
<td>$\text{NO}_x$ (ppmv-wet)</td>
<td>150-250</td>
<td>150-250</td>
</tr>
</tbody>
</table>
CO₂ balance – MEA single solvent
(Artanto et al., 2009)

Flue gas = 125 m³/h, solvent flow = 0.33 m³/h
MEA exit concentration correlated with lean loading (Without water wash) (Artanto et al., 2009)

- Solvent flow = 7 l/min
- Solvent flow = 5.5 l/min
- Solvent flow = 4 l/min
Temperature profiles in ABS2 – MEA (Artanto et al., 2009)
Temperature profiles in Stripper – MEA (Artanto et al., 2009)

Experiment: Simulation

0.24 m³/h vs 125 m³/h
L/G = 2.3
Munmorah Power Station PCC Pilot Plant
New South Wales, Australia

Delta electricity

APP support
Black coal
Aqueous ammonia based
No FGD/DeNox
Operational Feb 09
Typical inlet flue gas conditions (Yu et al., 2009)

<table>
<thead>
<tr>
<th></th>
<th>INLET</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{H}_2\text{O (%v-wet)}$</td>
<td>4 - 6</td>
</tr>
<tr>
<td>$\text{CO}_2 (%\text{v-wet})$</td>
<td>8 - 12</td>
</tr>
<tr>
<td>$\text{O}_2 (%\text{v-wet})$</td>
<td>6 - 10</td>
</tr>
<tr>
<td>$\text{SO}_2 (\text{ppmv-wet})$</td>
<td>200 - 300</td>
</tr>
<tr>
<td>$\text{NO}_x (\text{ppmv-wet})$</td>
<td>200 - 300</td>
</tr>
</tbody>
</table>
Steady state operation (Yu et al., 2009)

CO₂ mass flowrate at various locations vs time on stream in Test 3 (March 31). 1 wt% ammonia.
Impact of loading on mass transfer

Smaller absorber (low capital cost), high operating cost and high ammonia loss

Large absorber (high capital cost), lower operating cost and lower ammonia loss

Figure 8 - Plot of the overall mass transfer coefficient, $K_G$, as a function of molar CO$_2$ loading.

Data at the same ammonia concentration have the same symbol (square - 1% w/w, triangle - 5% w/w and diamond - 10% w/w) and data at the same temperature have the same colour (blue - 5°C, orange - 10°C and red - 40°C). MEA at 30% w/w and 40°C and 60°C are shown as the thick black lines and black circles.
APP support
Black coal
Amine based
No FGD/DeNox
Under construction (operational early 2010)
CSIRO and our partners have successfully established three operational PCC pilot plants (two in Australian and one in China) in 2008 with a third Australian pilot plant due for operation in early 2010.

The pilot plant operations to date have developed key technical and economic scale-up information for CO$_2$ capture plants based on operation on real flue gas from brown and black coal combustion under Australian conditions.
Our supporters

Australian Government
Department of Resources, Energy and Tourism

Victoria
The Place To Be

LOY YANG
power

TARONG ENERGY

Delta
electricity

CHINA HUANENG

TPRI: Thermal Power Research Institute
The pilot plant team at CSIRO

Aaron Cottrell – Coordinator pilot plant activities

Loy Yang Pilot Plant
Erik Meuleman – Project Manager
James Jansen – Plant engineer
Mick Osborn – Plant engineer
Yuli Artanto – Post doc
Pauline Pearson - Chemist

Munmorah Pilot Plant
James McGregor – Project Manager
Scott Morgan – Plant Engineer
Anthony Callen – Plant Engineer
Hai Yu – Post doc
Andrew Allport - Chemist

Tarong Pilot Plant
Noel Simento – Project Manager
Terence Chow – Plant Engineer
Position Vacant – Plant Engineer
Ashleigh Cousins – Post doc
Dave Coppo - Chemist