Session 3:
Power Plant Capture: Case Studies

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Session 3 Overview

This session will focus on cost estimates for CCS applications in electric power generation, including:

- Retrofits
- Gas-fired generation
- Demonstration plants under construction

The speakers for this session are:

- Des Dillon (EPRI)
- Wilfried Maas (Shell)
- Max Ball (Saskpower, Web Presentation)
Technology Development Assessment
CO₂ Capture and Storage for Power Applications

- PC with Post-Combustion Capture
  - 2nd Generation
  - 1st Generation

- IGCC with Pre-Combustion Capture

- Oxy-Combustion
  - 2nd Generation
  - 1st Generation

- Storage in Saline Aquifer

- EOR for CO₂ Storage

* Pre- and post-combustion capture are considered mature technologies in applications outside of power generation. Using CO₂ for EOR without consideration of storage is also considered a mature technology.

Left end of arrow indicates current status;
Right end of arrow indicates estimated 2030 development level.
Understanding Cost Growth as a Function of Engineering Detail for New Technologies

- For many new technologies the cost estimates increase in value as they become more accurate.
- This generally happens when there are changes in scope.
### Longonnet FEED Study Example

<table>
<thead>
<tr>
<th>Chain Segment (in £m)</th>
<th>Pre-FEED</th>
<th>Post-FEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capture</td>
<td>559.8</td>
<td>656.5</td>
</tr>
<tr>
<td>Transport</td>
<td>198.7</td>
<td>281.2</td>
</tr>
<tr>
<td>Storage</td>
<td>318.7</td>
<td>207.8</td>
</tr>
<tr>
<td>Total</td>
<td>1077.2</td>
<td>1145.5</td>
</tr>
<tr>
<td>Risk &amp; Contingency</td>
<td>102.8</td>
<td>194.8</td>
</tr>
<tr>
<td><strong>Total Project Capex</strong></td>
<td>1180.1</td>
<td>1340.3</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>857 – 1719</td>
<td>1200 – 1519</td>
</tr>
</tbody>
</table>

Post-FEED Total Project Capex increased by over 13%, while uncertainty range decreased by a factor of 3
Power Plant Capture Cost Estimating Challenges

- Power plant projects tend to have the highest cost for incorporating CCS
- The volume of information required to compile a complete capital cost estimate is immense
- Reference plant cost data is often limited for new technologies
- Owners are often in a rush to construct to take full advantage of the project, including incentives, grants, etc.
- A firm design basis is critical to obtaining a good estimate
- Many cost estimates are prepared before the scope is finalized
Challenges for Retrofit Cost Estimates

• Integration into existing, operating power plant
  – Minimizing down time for tie-ins is critical
• Layout constraints often lead to higher costs
  – Ducting, piping, and utility lines can be much longer
• There is no reference plant for most retrofits
  – Every plant has unique features and requirements
• Existing emission control systems are often inadequate
  – Especially for current solvent-based capture systems
• Need to work closely with plant operating staff during design phase
• Retrofit demo plants suffer poor economies of scale
R&D and Learn by Doing are Critical

• Both Research and Development (R&D) and learning-by-doing play an important role in innovation and the cost of energy technologies in the marketplace

• If R&D is not performed, the cost is too high for most plants to install technology or replace with new CCS facilities
  — Learning-by-doing never gets off the ground

• Sharing the lessons learned from early CCS deployments is essential for the long term success of carbon capture

• We need to develop a cost roadmap to get from first-of-a-kind (FOAK) to nth-of-a-kind (NOAK) costs
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