CCS in the US

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US Drivers for CCS

- Economy slump—funding difficult to find
- Low cost of natural gas—no new coal in foreseeable future, plant closures, low coal dispatch
- Regulations
  - Non-CCS emissions being tightened
  - New coal plants regulation
  - Existing plant clean power plan
- Low cost of oil—even oil companies have a difficult time supplying funding for projects
- EOR companies resistant to reporting and monitoring requirements
- Saline reservoirs—significant R&D but no commercial locations
Demonstration Projects Overview

- While some U.S. CCS demonstrations have been reported as cancelled (e.g., FutureGen 2.0), several are under construction in pre-combustion capture / integrated gasification combined cycle (IGCC) and post-combustion capture (PCC) – Kemper and WA Parish, respectively.

- Funding for many projects came from government grants (American Recovery and Reinvestment Act [ARRA] and the Clean Coal Power Initiative [CCPI]); Department of Energy (DOE) has also recently funded another set of projects for a new PCC pilot.

- CCS demonstrations and pilots all involve coal flue gas; CCS on gas not thought to be needed for now.

- While several CCS demonstrations in U.S. use enhanced oil recovery to improve economics, some involve geologic storage, which has less public concerns than in the European Union.
  - DOE focused on “transformational” CCS technologies, e.g., fuel cells, chemical looping, Brayton cycle.
  - More large-scale CCS demonstrations are needed to improve technologies and economics; from where will the new funding come?
## U.S. CCS Demonstrations and Pilots

<table>
<thead>
<tr>
<th>Project / Location</th>
<th>Owner</th>
<th>Size, Net MW</th>
<th>Capture Process / % Capture</th>
<th>Cost / Funding (Source)</th>
<th>Status / Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>FutureGen 2.0 / IL</td>
<td>FutureGen Alliance</td>
<td>99</td>
<td>Oxy-combustion / 98%*</td>
<td>$1.65B / $1B (ARRA)</td>
<td>Cancelled?</td>
</tr>
<tr>
<td>Hydrogen Energy California / CA</td>
<td>SCS Energy</td>
<td>288</td>
<td>IGCC / 90% (also producing urea)</td>
<td>$3.9B / $408M (CCPI)</td>
<td>Stalled</td>
</tr>
<tr>
<td>Kemper County / MI</td>
<td>Mississippi Power / Southern</td>
<td>524</td>
<td>IGCC / ~65% of total</td>
<td>$6.4B / $270M (CCPI)</td>
<td>Under construction / 2016 start</td>
</tr>
<tr>
<td>Mountaineer / WV</td>
<td>AEP</td>
<td>20</td>
<td>PCC (Alstom) / 75%*</td>
<td>? / (AEP, Alstom, and EPRI)</td>
<td>Completed / 2013 end</td>
</tr>
<tr>
<td>Plant Barry / AL</td>
<td>Alabama Power, Southern</td>
<td>25</td>
<td>PCC (MHI) / 90%*</td>
<td>? / (Southern, MHI, and EPRI for PCC; DOE, Southern, and EPRI for storage)</td>
<td>Operating / 2016 end</td>
</tr>
<tr>
<td>Texas Clean Energy Project / TX</td>
<td>Summit Power</td>
<td>200</td>
<td>IGCC / 90% (also producing urea)</td>
<td>$2.9B / $450M (CCPI)</td>
<td>Back on track?</td>
</tr>
<tr>
<td>WA Parish / TX</td>
<td>Petra Nova</td>
<td>240</td>
<td>PCC (MHI) / 90% (~35% of total)</td>
<td>$1B** / $167M (CCPI); NRG Energy and JX Nippon, $300M each</td>
<td>Under construction / 2016 start</td>
</tr>
</tbody>
</table>

* Geologic storage
** PCC plant only
US CCS 2nd and 3rd Generation Status

- Question on how these will be progressed to commercialization to provide lower cost processes
- DOE is the main funder
  - Still have funding for lab and bench scale
  - Where will funds for large pilots (>10 MW) and demos come from
  - Where will cost share come from
**CO₂ Storage**

- Demos of large-scale injection
  - DOE Regional Carbon Storage Partnerships
- No commercial storage locations
  - May be significant up-front costs
The National Coal Council provides advice and recommendations to the Secretary of Energy on general policy matters relating to coal and the coal industry.

Fossil Forward – Revitalizing CCS: Bringing Scale & Speed to CCC Deployment

- In order to achieve CCS at commercial scale, policy parity with other low/no carbon technologies is required.
- Technology and funding Incentives must be significantly better coordinated to be effective.
- DOE program goals need far greater clarity and alignment with commercial technology and funding approaches used by industry.
- Funding for CCS RD&D is limited and must be enhanced and focused.
- Public acceptance continues to be a major hurdle.
- GHG control is an international issue in need of international initiatives.
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