Regional Carbon Sequestration Partnership
Water Working Group

Ground Water Protection Council
Water/Energy Sustainability Symposium
CO₂ Geosequestration

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Regional Carbon Sequestration Partnership (RCSP) Program

- Engage regional, state, and local governments
- Determine regional sequestration benefits
- Baseline region for sources and sinks
- Establish monitoring and verification protocols
- Address regulatory, environmental, and outreach issues
- Validate sequestration technology and infrastructure

Developing the Infrastructure for Wide-Scale Deployment
• Plains CO₂ Reduction (PCOR) Partnership
• Public and private sector stakeholders
• Led by the Energy & Environmental Research Center (EERC) at the University of North Dakota in Grand Forks, North Dakota
RCSP Water Working Group (WWG) Members

- Composed of scientists and engineers representing government, academia, and industry

Mission Statement

- To provide a resource of knowledge, insight, and guidance to stakeholders involved with water and water resources and their relationship to the developing technology of carbon capture and storage (CCS)
The Water and CCS Nexus

Diagram showing the interactions between water management and Carbon Capture and Storage (CCS) technologies. Key components include:

- **Cooling**: Release of hot water.
- **Power Generation or Refining**: Production of CO₂.
- **Capture**: Removal of CO₂.
- **Compression**: Preparation for injection.
- **Injection Well Head**: Placement of CO₂ for storage.
- **Evaporative Loss**: Water vapor loss.
- **Beneficial Use**: Application of water.
- **Treatment**: Water conditioning.
- **Hot Water (may require thermal management)**
- **Carbon Dioxide**
- **Fresh or Comparable Water**
- **Water Requiring Management**

The diagram illustrates the flow of water and CO₂ through various processes, highlighting the nexus between water management and CCS.
Water and Carbon Capture

- Capture
- Compression
- Transportation

- Additional resources
  - Water: cooling, process water
  - Power: replace power diverted to capture and compression
Water and Carbon Capture

Chemical or Physical Absorption

- 15%–30% water increase:
  - Additional cooling
  - Solvent/sorbent regeneration
  - Process-specific subprocesses

Amine Scrubber
Chemical

Selexol Scrubber
Physical
Water and Compression and Transportation

- Compressors represent a considerable additional energy load to a facility (generally 8%–10%).

- Additional cooling for lost power makeup and to cool compressed CO₂ between compressor stages.
  - Adds about 0.01 gal/kWh of energy produced by the power plant to the total water consumption.*

**Water and Carbon Capture Impact**

<table>
<thead>
<tr>
<th></th>
<th>Subcritical pc</th>
<th>Supercritical pc</th>
<th>IGCC – Dry Feed</th>
<th>IGCC – Slurry Feed</th>
<th>NGCC</th>
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</thead>
<tbody>
<tr>
<td>No Capture</td>
<td>0.52</td>
<td>0.45</td>
<td>0.30</td>
<td>0.31</td>
<td>0.19</td>
</tr>
<tr>
<td>With Capture</td>
<td>0.99</td>
<td>0.84</td>
<td>0.48</td>
<td>0.45</td>
<td>0.34</td>
</tr>
<tr>
<td>% Increase</td>
<td>91</td>
<td>87</td>
<td>61</td>
<td>46</td>
<td>76</td>
</tr>
</tbody>
</table>

Optimizing Carbon Capture and Transportation Water Use

• Efficient process design
  – Update existing facilities
  – New technologies (e.g., compression)

• Alternative cooling technologies

• Alternative (degraded) water sources
Water and Carbon Storage

- Storage formations will likely contain water.
  - Not suitable for drinking water (total dissolved solids >10,000 ppm)
  - Potential for additional water resource (extracted water associated with carbon storage)
**Water and Carbon Storage**

- **Storage targets:**
  - Oil/gas reservoirs
  - Coal seams
  - Saline formations

- Each target represents a unique storage environment.
Water and Carbon Storage

• Water resources
  – Protect drinking water sources
  – Minimize brine mobilization

• Proper site characterization and selection along with monitoring, verification, and accounting and appropriate regulatory compliance will ensure these goals are met.
CCS Extracted Water

- Currently, no regulations require water production to occur with carbon storage.
- Water production is also not required for the physical injection of CO\textsubscript{2}.
- Water may be extracted as part of reservoir management strategies including:
  - Increased storage volume.
  - CO\textsubscript{2} distribution and pressure management.
CCS Extracted Water

• Water quality is site-dependent:
  – Influenced by reservoir lithology, regional geology, and the presence of hydrocarbons

• Potential CCS extracted water constituents:
  – Dissolved minerals and salts
  – Trace metals
  – Dissolved organic compounds (including hydrocarbons)

• Management strategies:
  – Reinjection
  – Minimal treatment for beneficial use
  – Substantial treatment for beneficial use
CCS Extracted Water – Beneficial Use Potential

- Cooling Water
- Geothermal
- Artificial Recharge/Subsidence Control
- Irrigation
- Livestock
- Ion Extraction
- Industry

Modified from Solinst Canada Ltd., 2009
WWG Future Products

- Fact sheet on the nexus of CCS and water
- Road map to carbon capture and storage and water
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Visit the PCOR Partnership Web site at www.undeerc.org/PCOR. New members are welcome.