NETL Carbon Capture, Utilization, and Storage (CCUS) Overview

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37th USAEE/IAEE North American Conference: Energy Transitions in the 21st Century
Roundtable: The Promise of Carbon Capture, Storage, and Utilization
Cost-effective CCS for Emissions Reduction

- Curtailment limits variable renewable energy penetration
- Fossil-based carbon capture and storage (CCS) essential for major emission reductions
- U.S. DOE programs aim to lessen costs
NETL Analysis Across the CCUS Value Chain

- **CO₂ Capture**
  - NETL Cost of Capturing CO₂ from Industrial Sources
  - NETL Baseline Studies for Fossil Energy Power Plants

- **CO₂ EOR Life Cycle**
  - CO₂ EOR Life Cycle (CELiC) Model

- **Onshore CO₂ EOR**
  - FE/NETL Onshore CO₂ EOR Evaluation Tool

- **CO₂ Transport**
  - FE/NETL CO₂ Transport Cost Model

- **Onshore CO₂ Storage**
  - FE/NETL CO₂ Saline Storage Cost Model

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- **Offshore CO₂ EOR**
  - FE/NETL Offshore CO₂ EOR Evaluation Tool

- Portfolio Impacts
  - CO₂ Capture, Transport, Storage, and Utilization Model (CTUS – NEMS)

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<table>
<thead>
<tr>
<th>Dedicated Pipeline System</th>
<th>Cost $/tonne</th>
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<tbody>
<tr>
<td>Capture (0.65 Mt/yr)</td>
<td>18</td>
</tr>
<tr>
<td>Transport</td>
<td></td>
</tr>
<tr>
<td>Route</td>
<td>Diameter in</td>
</tr>
<tr>
<td>E200-FR3A</td>
<td>8</td>
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<tr>
<td>Total</td>
<td></td>
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**Storage**

- Dome: 19
- Regional Dip: 21

**CCS**

- Dome: 193
- Regional Dip: 194

**Dedicated Pipeline System**

- E200-FR3A Route: Diameter in 8, Distance in mi 1,358
- Total Distance: 1,358

**Quality Guidelines for Energy System Studies: CO_{2} Transport and Storage (T&S)**

- Cumulative CO_{2} storage potential for Illinois and Williston basins alone is sufficient to store entire mass of captured CO_{2} emissions projected by the U.S. Energy Information Administration over next century (247 Gt)

**Comparative Analysis**

**Evaluate integrated CCS costs from perspective of CO_{2} source**

- Factors affecting CCS costs include amount of CO_{2}, reservoir quality, and proximity to reservoirs and pipeline system

- Economies of scale in each link of CCS value chain

- Source type/location can impact importance of storage proximity

- Trunklines can reduce transport cost especially for lower-volume sources


Other NETL Onshore CCUS Analyses Examples

Highlighting breadth of types of analyses

- **Colorado CO₂ resource study**
  - Geographic information system-based assessment of CCUS-related resources in Colorado

- **Class VI lessons learned**
  - Review of Class I, V, or VI CO₂ injection well permitting process experience to document lessons learned and identify areas for potential improvement

- **Water production**
  - Assessment of water management and costs in saline-bearing formations

- **Underground Injection Control Class VI post-injection site care (PISC) review**
  - Determine if 50-year PISC timeframe per the U.S. Environmental Protection Agency’s regulatory determination is valid in light of new information in last 10 years

- **Co-modeling with National Risk Assessment Partnership (NRAP)**
  - Collaboration with NRAP team to utilize NRAP model results in the FE/NETL CO₂ Storage Cost Model to assess the cost of an adverse event impacting CO₂ storage operations
NETL Offshore CCUS Analysis Example
Multi-criteria CCUS Screening Framework of Gulf of Mexico Outer Continental Shelf for High-Priority Storage Regions

• Incorporate multiple and disparate CCUS decision making criteria into an analysis framework

• Sites/regions with best combinations of technical and logistical/feasibility-related criteria emerge

Source: NETL*

CO₂ EOR in Deep Water Gulf of Mexico

Utilization of CO₂ from Industrial Sources Onshore Gulf of Mexico

Air Products & Chemicals Steam Methane Reforming
~ One million tons CO₂/year

Petra Nova Parish Holdings
Amine capture from flue gas
~ Up to 5,200 tons CO₂/day

• Repurpose existing infrastructure for CO₂ EOR
• Extend oil production life
• Defer decommissioning

Graphics sources: Air Products & Chemicals, Petra Nova Parish Holdings: NETL; Oil & Gas central processing platform: Adobe Stock (© pichitstocker / Adobe Stock)
Norway’s Northern Lights CCS Project

• Full-scale CCS project with goal of stimulating CCS development*
  • Reach long-term climate targets in Norway and European Union at lowest possible costs

• Project involves*
  • Capturing CO$_2$ from industrial sources in Norway and other countries
  • Transporting compressed CO$_2$ by ship and then temporarily storing it before transporting it via pipeline offshore
  • Storing CO$_2$ permanently in reservoir on Norwegian continental shelf 1,000 – 3,300 meters below sea bed

Thank You!

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