Ongoing CO₂ Capital and Transport Costs

Gary Loop
Senior VP and Chief Operating Officer
Dakota Gasification Company

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Overview

Carbon capture in place today
- Dakota Gasification Co. coal to gas facility
- Largest carbon capture and storage project in the world

Carbon capture technology cost comparisons
- Pre-combustion (IGCC)
- Post-combustion (SCPC)

Demonstration of post-combustion technology
- Unique opportunity in Williston Basin

Financial incentives to consider
- Tax credits
- Investment tax credits
Dakota Gasification Company’s Great Plains Synfuels Plant

- Operates 14 gasifiers to produce synthetic natural gas (SNG)
- Capture 4½ million tons CO₂ per year
- Delivers 3 million tons CO₂ per year for EOR
- Only commercial scale anthropogenic CO₂ sequestration in western hemisphere
- Largest CO₂ sequestration project in world
Coal Gasification

Diagram showing the process of coal gasification, including stages such as gasification, waste heat exchange, gas cooling, shift conversion, and methanation. The diagram also illustrates the production of synthesis gas, naptha, and CO₂ product to pipeline.
Capture CO\textsubscript{2} from Raw Gas Stream

- Low gas volume
- High % CO\textsubscript{2}
- High pressure
- Capture 95+% of CO\textsubscript{2}
Dakota Gasification Company

World’s Largest Carbon Sequestration Project

Weyburn, Saskatchewan
13 million tons sequestered to date

5 million tons/yr. Pipeline capacity

Current flow rate: 3 million tons/yr.
Capture Technology

Rectisol capture costs

<table>
<thead>
<tr>
<th></th>
<th>Capture $/ton</th>
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</thead>
<tbody>
<tr>
<td>Capital</td>
<td>$4</td>
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<tr>
<td>O&amp;M</td>
<td>$4</td>
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<tr>
<td>TOTAL</td>
<td>$8</td>
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Rectisol capture costs:
- Capital: $4
- O&M: $4
- TOTAL: $8
Integrated Gasification Combined Cycle

- GASIFIER
- PARTICULATE REMOVAL
- SULFUR REMOVAL
- ASH
- COAL
- STEAM
- OXYGEN
- GAS TURBINE
- STEAM TURBINE
- BOILER
Integrated Gasification Combined Cycle with CO₂ Capture

GASIFIER

PARTICULATE REMOVAL

SULFUR REMOVAL

CO₂ REMOVAL

BOILER

STEAM TURBINE

COAL

STEAM

OXYGEN

ASH

NITROGEN

GAS TURBINE
CO₂ Capture - Methodologies

Pre-combustion capture

Post-combustion capture

Amine

Ammonia
Capture CO\textsubscript{2} from Flue Gas

- High gas volume
- Low % CO\textsubscript{2}
- Low Pressure
- Capture 90+% of CO\textsubscript{2}
Carbon Capture Optimization Project

- 5 million tons/yr. Pipeline capacity
- 3 million tons/yr. CO2 pipeline
- Combined flow rate: 4 million tons/yr.
- 1 million tons/yr.

Great Plains Synfuels Plant

Antelope Valley Station (AVS)
Commercial Demonstration of Ammonia CO₂ Capture

- Flue gas stream for 120 MW
- 1 million tons CO₂ removed
- $200 to $300 million in capital
- $25 to $35 per ton CO₂
## Capture Technology

<table>
<thead>
<tr>
<th>$/ton</th>
<th>Ammonia</th>
<th>Amine</th>
<th>Rectisol</th>
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<tbody>
<tr>
<td></td>
<td>high</td>
<td>low</td>
<td>high</td>
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<tr>
<td>Capital</td>
<td>$13</td>
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<tr>
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<td>$12</td>
<td>16</td>
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<td>TOTAL</td>
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Advantages to AVS Post Combustion Demonstration Plant

- DGC facility has established CO$_2$ transport technology within Williston Basin
- DGC facility produces ammonia required for CO$_2$ removal process
- DGC facility has ammonium sulfate production capacity to handle sulfur resulting from CO$_2$ removal
Williston Basin Offers Good Match

- All CO$_2$ currently produced can be stored in EOR sites for over 50 years

- CO$_2$ from burning all coal in basin can all be sequestered in Saline Aquifers within Williston Basin
Timing is Right

- Oil prices are above historical levels and enhance the value of CO\(_2\) as an EOR solvent
- Ammonia technology is ready for CO\(_2\) capture demonstration
- Existing pipeline with excess capacity within basin that can be tapped for connection
Estimated Costs

$5\sim 60/\text{ton}$

$20\sim 35/\text{ton}$

$15\sim 30/\text{ton}$

$25\sim 50/\text{ton}$
### Demonstration Plant Economics

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<td>Capture Cost</td>
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</tr>
<tr>
<td>Transport Cost</td>
<td>($10) ($15)</td>
</tr>
<tr>
<td>Cost of CO₂</td>
<td>($35) ($50)</td>
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<tr>
<td>Revenue</td>
<td>$35 $25</td>
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<tr>
<td>Net Gain (Loss)</td>
<td>$ 0 ($25)</td>
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Financial Incentives to Consider

- Tax credit of $15/ton CO$_2$ can stimulate sites to prove evolving technologies
- 30% investment tax credit for demonstration plant can stimulate sites as well
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Thank you