The Opportunity for CCUS in Enhanced Oil Recovery

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Occidental Petroleum Corporation
Agenda

- Occidental Petroleum Permian enhanced oil recovery (EOR) operations overview
- The enhanced oil recovery process
- Biogenic and anthropogenic CO2 sources
- 45Q Tax Credit
- Estimated Value of Potential Incentives on Large CO₂ Pipeline
- Summary
Overview of Oxy’s Permian EOR Operations

- Oxy is the world leader in CO₂ EOR
- Oxy has taken a leadership role by establishing 2 approved MRV Plans
- 33 properties utilizing CO₂ for enhanced oil recovery
  - 0.8 BCFPD fresh CO₂ injected
- 80 properties utilizing water for enhanced oil recovery
- 13 gas processing plants
  - 2.3 BCFPD of gas handled
  - 1.2 BCFPD of CO₂ recycled
- 3 CO₂ source fields
World Leader in CO₂ Enhanced Oil Recovery

- Occidental is the largest handler of CO₂ in the Permian Basin
  - Injects >2.0 billion cubic feet a day
  - Operates 32 CO₂ EOR projects

Source: Oil & Gas Journal 2016 Biennial EOR Update
CO₂ EOR Process

- CO₂ supplied from Pipeline
- Injection
- CO₂ Recycled from Gas Plant
- Produced Gas
- Separate Oil, Gas and Water
- Gas & NGL Sales
- Oil Sales
- Injector Wellbore
- Reservoir
- Producing Oil
- Additional Oil Recovery
- Additional Oil Recovery

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Additional Oil Recovery
Injection Operations: Denver Unit

- CO2 flooding began at the Denver Unit in 1983
- Projected storage through end of operations of 3,768 Bscf (200 MMT)
Biogenic and Anthropogenic CO$_2$ Sources

- The CO2 concentration of fermentation off gas is very high.
- This makes recovery of CO2 less costly than from industrial sources.
- However, the CO2 volume produced by a typical ethanol plant is relatively small.
- Thus, viable projects will need connections to a number of plants.
• Power plants account for 65% of US facility emissions
• There are 37 power plants in Midwest emitting > 11 BSCFD of CO$_2$
• Average plant emits 70 MMCFD at 4-10% CO$_2$
Lower 48 Ethanol Plants

- Ethanol plants emit high purity CO$_2$ (~98%)
- Over 200 ethanol plants emitting 2 BSCFD of CO$_2$
- Average emissions are ~9 MMSCFD
- A pipeline from Midwest to Permian CO$_2$ pipelines would be ~900 miles
<table>
<thead>
<tr>
<th>House: The Carbon Capture Act</th>
<th>Senate: The FUTURE Act</th>
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<tbody>
<tr>
<td><strong>Specifications</strong></td>
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<tr>
<td>• Keeps existing 45Q threshold in place for current projects</td>
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<td>• Credit for EOR and Saline increases to $35. There is only one credit</td>
<td>• Credit for EOR increases to $35 and $50 for saline storage</td>
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<td>• Ramps credit for 10 years</td>
<td>• Ramps credit over 10 years</td>
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<tr>
<td>• Reduces 500,000 threshold to 100,000 - Was 150,000</td>
<td>• Includes stronger transferability provision</td>
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<td>• Authorizes programs for projects that commence construction within 7 years</td>
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<td>• Credit can be claimed for 12 years once placed in service</td>
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<td>• Credit can be claimed for 15 years once placed in service</td>
<td>• Provides eligibility for new forms of CO₂ (algae, Biomass, alternative fuels, etc)</td>
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<td>• Adds language to allow Carbon Monoxide and Air capture to get the credit</td>
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<td>• Credit authorization language is changed to allow projects that “have never received 45Q tax credit before” (NRG/Petra Nova)</td>
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## Estimated Value of Potential Incentives on Large CO₂ Pipeline

<table>
<thead>
<tr>
<th>Potential Incentive</th>
<th>Description</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Estimated Value (US$MM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ross / Navarro Infrastructure Tax Credit Proposal</td>
<td>82% tax credit on equity portion of capital, assuming 5:1 debt to equity</td>
<td>High value impact depending on debt to</td>
<td>Requires legislation. Depend on tax status of investor</td>
<td>$172</td>
</tr>
<tr>
<td>Accelerated Depreciation</td>
<td>MACRS5 schedule vs. MACRS15</td>
<td>Consistent with tax treatment of carbon</td>
<td>Requires legislation. Depend on tax status of investor</td>
<td>$115</td>
</tr>
<tr>
<td>Paul Ryan tax reform</td>
<td>• Full depreciation in Year 1</td>
<td>Additional benefit of 20% CIT</td>
<td>Requires legislation</td>
<td>$290</td>
</tr>
<tr>
<td>Private Activity Bonds</td>
<td>Enable CO₂ pipeline projects to utilize tax exempt bonds</td>
<td>Low cost to government</td>
<td>Interest rate discount only exists for short term bonds</td>
<td>$37</td>
</tr>
<tr>
<td>Federal Loans (LPO or TIFIA)</td>
<td>Allow CO₂ pipelines to qualify for existing federal loan programs</td>
<td>LPO programs exist, money already</td>
<td>TIFIA would need legislation. Requires DOE to apply “innovative” status to pipelines</td>
<td>$117</td>
</tr>
</tbody>
</table>

DISCLAIMER: Subject to numerous assumptions and data from various sources.
Summary

- Occidental Petroleum is the world leader in CO₂ EOR

- Occidental has taken a leadership role by developing and gaining EPA approval for two MRV Plans

- CO₂ produced during ethanol fermentation is relatively easy to recover, but expensive to transport
  - Economy of scale is essential to minimize transport cost

- Occidental is supportive of efforts that enable the rapid deployment of Carbon Capture, Utilization and Storage (CCUS)

- Occidental supports incentives that would accelerate CCUS
  - 45Q extension bills
  - CO₂ pipeline incentives