Economic Research: Progress & Direction

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Outline

1. Expanded Scoping Coverage & Excel Based Scoping Model
2. A Wyoming CO$_2$ Pipeline Model
3. “In-House” Economic Impact Analysis
4. EOR Related Economic Studies
CO$_2$-EOR Decision Tree

(i) Physical Screening for Suitable Reservoir Properties

(ii) Preliminary Economic Scoping for Profitability

(iii) Business-As-Usual or Different EOR Technology

(iv) Business-As-Usual or Different EOR Technology

(v) Detailed Reservoir Modeling and Simulation

(vi) Development Plan and Detailed Economic Analysis

Final Contracting and Implementation

Delay...
CO$_2$-EOR Economic Scoping

Prior Screening Criteria for CO$_2$-EOR

- Field cumulative oil production > 5 MMbo
- MMP < Fracture pressure
- Oil gravity 22° API or higher

Expanding the Scoping Coverage

- Prior work may only represent 60% of miscible oil
- Expanding the scoping coverage to roughly 98%
  - In progress (with Vanessa Onacki)
  - Working with EORI database and staff to document data sources and missing values
**CO₂-EOR Economic Scoping**

**Economic Scoping Model**

**MATLAB Version**
- Batch Analysis
- Standardized Assumptions
- Basin-by-Basin Results for the State

**Excel Version**
- Individual Analysis
- Close Match to our MATLAB Results
- Tool for Partners
Excel Scoping Model

**Progress**

- Basic format and structure completed
- Verifying agreement with MATLAB results

**Future**

- Work with EORI staff to craft functionality, analog curves, formatting and distribution versions
- Third-party sensitivity analysis tools (Palisade’s @RISK)
### Key Scoping Deliverables

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**Wyoming’s CO$_2$-EOR Potential**

- Report detailing scoping methodology and results with roughly 98% coverage of miscible FRCs

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<table>
<thead>
<tr>
<th>Project Tasks/Deliverables</th>
<th>Start Date</th>
<th>Est. Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expanded Scoping Dataset</td>
<td>May 2011</td>
<td>August 2011</td>
</tr>
<tr>
<td>Excel CO$_2$-EOR Scoping Model</td>
<td>Feb. 2011</td>
<td>Fall 2011</td>
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<tr>
<td>Wyoming’s CO$_2$-EOR Potential (white paper report)</td>
<td>August 2011</td>
<td>January 2012</td>
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Prior Work

- Previous scoping results were used by EORI and the WPA to formulate a hypothetical pipeline model
- Economics Masters Thesis by Mark Newcomb
  - Enhanced Coal-Bed Methane (ECBM)
  - CO₂ pipeline model with pipe dimensions, mileage, pumping stations & cost estimates
Source: Newcomb (2011)
Future Work

• Mark Newcomb, WPA etc.

• Take the expanded scoping results and revisit these CO₂ pipeline models

• Incorporate any other developments (i.e. new sources, sinks, pipeline cost estimates)

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<td>July 2012</td>
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Economic Impact Analysis

What Is EIA

- Simulating future economic effects of policy or economic changes in a region
- Results focus on economic growth, job creation, income/wages, taxes and public services (CO₂ pipeline investments)
- Require input-output modeling software
  - REMI PI+ Model
  - IMPLAN Model
- “Wyoming Oil and Gas Economic Contribution Study" conducted by Booz-Allen-Hamilton (2008)
### Exhibit ES-1. Total Economic Contribution for Oil and Gas Activities in Wyoming (2007$)

<table>
<thead>
<tr>
<th>Type of Impact</th>
<th>Drilling, Completion, and Recompletion</th>
<th>Extraction</th>
<th>Private Mineral Royalty &amp; Lease Payments¹</th>
<th>Extraction Taxes²</th>
<th>Total Economic Contribution</th>
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</thead>
<tbody>
<tr>
<td>Total Economic Output</td>
<td>$3,513,052,106</td>
<td>$11,963,561,646</td>
<td>$231,827,774</td>
<td>$2,908,623,519</td>
<td>$18,617,065,044</td>
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<tr>
<td>Total Employment</td>
<td>26,701</td>
<td>11,765</td>
<td>1,447</td>
<td>33,316</td>
<td>73,229</td>
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<tr>
<td>Total Labor Earnings</td>
<td>$1,458,093,669</td>
<td>$736,813,207</td>
<td>$42,461,473</td>
<td>$1,677,264,966</td>
<td>$3,914,633,314</td>
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<tr>
<td>Earnings per Worker</td>
<td>$54,608</td>
<td>$62,628</td>
<td>$29,344</td>
<td>$50,344</td>
<td>$53,457</td>
</tr>
<tr>
<td>Employment Multiplier</td>
<td>1.67</td>
<td>2.86</td>
<td>NA</td>
<td>NA</td>
<td>3.65</td>
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<tr>
<td>Earnings Multiplier</td>
<td>1.32</td>
<td>1.75</td>
<td>NA</td>
<td>NA</td>
<td>2.57</td>
</tr>
</tbody>
</table>

¹ These payments to households and companies are treated as all secondary induced impacts; that is, these payments are considered income of which a portion is spent in the economy.

² These tax payments to state and local governments are treated as all secondary indirect impacts; that is, these payments are considered downstream beneficiaries of oil and gas activities.
“In-House Capability”

- Developing the ability to conduct these types of studies “in-house”
  - Staffing, ability to collect the necessary input data, training, appropriate models
- Focus more directly on the economic benefits to Wyoming of CO$_2$-EOR operations
- Use the expanded scoping results and CO$_2$ pipeline models as a starting point for EIA analysis
Other Economic Analysis

Goal

• Conduct and publish EOR related research in relevant economic journals

• Some projects partially funded by EORI. Other grant funding from SER, the Paul Lowham Research Fund and the Idaho National Laboratory.

Experimental Work

• Simulated markets in computer labs

• Investigate the impact of subsidy and tax policies or other market features on private negotiations
Other Economic Analysis

CCS/EOR/ECBM

- Klaas van ‘t Veld and Owen Phillips
- CO$_2$ use for Enhanced Coal Bed Methane
- CCS market modeling and economics for sequestration at the Rock Springs Uplift

CO$_2$ Resources

- Transportation of Wyoming CO$_2$ production to out-of-state EOR targets
- Economic insights on the use of policy tools (taxes, subsides, regulations) to influence CO$_2$ source development
Research Overview

- Expanded Scoping Coverage & Excel Based Scoping Model
- A Wyoming CO₂ Pipeline Model
- "In-House" Economic Impact Analysis
- EOR Related Economic Studies
Questions & Feedback