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The Kiss of Death

• You never want to hear the words “it was a technical success but an economic failure” about your project
• I’m going to try to help prevent this!!
Practical Business Aspects of the $\text{CO}_2$ EOR Process

Ken Brown

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Alberta Research Council

Society of Petroleum Engineers
Distinguished Lecturer Program
www.spe.org/dl
The World Context
Enhanced Oil Recovery

ENHANCED OIL RECOVERY MECHANISMS

GAS
(Miscible/Immiscible)
- CO₂
- Hydrocarbon
- Nitrogen
- Flue Gas
- Air

THERMAL
- Steam (soak; drive)
- Combustion (in situ)
- Hot water

CHEMICAL
- Polymer
- Alkaline/Caustic
- Micellar/Polymer
- Surfactant (foam)

OTHER
- Microbial
- Seismic
CO₂ Project Locations

Ref: IPCC Special Report on Carbon Dioxide Capture and Storage
Worldwide EOR Production

• Production is currently 2.3 MM BOPD
• Represents 3.3% of the world’s production
• Some projections reach 30 MM BOPD by year 2020
• CO$_2$ floods will be a major contributor
### Active CO₂ Flood Statistics

<table>
<thead>
<tr>
<th>Location</th>
<th>Number</th>
<th>Project BOPD</th>
<th>EOR BOPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>125</td>
<td>373,500</td>
<td>285,100</td>
</tr>
<tr>
<td>U.S.</td>
<td>105*</td>
<td>323,100</td>
<td>249,700</td>
</tr>
<tr>
<td>Canada</td>
<td>8</td>
<td>43,000</td>
<td>28,000</td>
</tr>
</tbody>
</table>

* additional 16 projects in 2008-2009

Oil and Gas Journal April 2008
The Technical Context
The Size of the Prize

- Primary Production - 15% recovery
- Secondary Recovery - 30% recovery
- Enhanced Recovery - 45% recovery
Weyburn CO$_2$ EOR Project

- **Base Waterflood Production**
- **Incremental Vertical Production**
- **Incremental Horizontal Production**
- **Incremental Miscible Flood Production**

Production (kbbl/day)
Current production at 35 year high

Approx. 75% of production comes from EOR area

Graph courtesy of EnCana
What do you need to know?

- Can CO\(_2\) recover incremental oil?
- If yes, at what rate and volume?
- What is the necessary investment?
- What are the ongoing operating costs?
Technical Considerations

• The devil is in the details!!
  – Screen
  – Manage it correctly
  – Study 44
  – Model
  – Pilot
  – Consult experts
Hard Business Issues

- Source
- Transport
- Oilfield
The Source of the CO₂?

- Syncrude/Suncor
- Wabamun
- Exxon LaBarge
- Saskpower
- DGC
- TransCanada
- Hydrocarbon instead
Borsig Compressor
CO$_2$ Pipeline To Canada

Map showing locations of Regina, Estevan, Beulah, Weyburn, Saskatchewan, North Dakota, Montana, and USA.
Pipeline Construction

• 1,080,000 feet of pipe

• Averaged 2-3 miles per day
Surface Facilities for CO₂
Soft Business Issues

- Owners
- Government
- Economic value
- Operational
- Societal
Owner’s issues

• Risk tolerance, cash management and capacity to invest
• Joint Venture agreement
Government issues

- Royalty
- Regulatory
- Environmental
Economic Value Issues

- Price forecasts
- CO\textsubscript{2} credits
- Reserves management
- Risk management
Operational Issues

• Technical competence
• Operations competence
Societal Issues

- Sour gas
- Storage
- Socio economic
Summary

• EOR is not just a Technical challenge
• Business “opportunities" exist with:
  – CO₂ supplier
  – Existing facilities
  – Partners
  – Government
  – Operations
  – Society
• A long term strategic plan to address these “opportunities” is essential
Thank you

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