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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 CO₂ EOR Process

Ken Brown
Alberta Research Council
EOR/CCS Options
Outline

• World context
• Technical context
• Hard Business Issues
• Soft Business Issues
• Summary
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
- $\text{CO}_2$ 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>
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<tr>
<td>Canada</td>
<td>8</td>
<td>43,000</td>
<td>28,000</td>
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</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

Production (kbbl/day)

- Base Waterflood Production
- Incremental Vertical Production
- Incremental Horizontal Production
- Incremental Miscible Flood Production
Weyburn Unit Oil Production

Graph courtesy of EnCana
Approx. 75% of production comes from EOR area

Current production at 35 year high

Primary & Waterflood

Vertical Infills

CO2 EOR

Pre CO2 Hz Infills

WF Improv

MB97-03 Forecast

Current production at 35 year high

BOPD (gross)
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
CO₂ Pipeline To Canada
Pipeline Construction

- 1,080,000 feet of pipe
- Averaged 2-3 miles per day
Surface Facilities for CO₂

- CO₂ from DGC
- CO₂ Receiving Terminal
- EOR Oil Satellite
- Conventional Oil Satellite
- Inlet Separator
- Free Water Knock Out
- Treaters (Existing)
- Water Injection Satellite
- Water Injection Well
- Recycle Gas Compressors
- Battery Gas Compressor
- Water Injection Plant
- Gas Sales
- Oil Sales
- Source Water Wells
- Water Injection Wells
- CO₂ Injection Satellite
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
• CO₂ 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:
  – CO$_2$ supplier
  – Existing facilities
  – Partners
  – Government
  – Operations
  – Society
• A long term strategic plan to address these “opportunities” is essential
Thank you

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