The History and Current Status of CO2 EOR and a look at Technology Opportunities

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Overview

I. History and Current Status of North American CO2 EOR

II. Wyoming CO2 EOR Status and Developments

III. CO2 EOR Technology Opportunities and Challenges
History and Current Status of North American CO2 EOR
CO₂ EOR Development has Occurred in Phases

Phase 1
- Early 1970s – Late 1980s
  - Proof of Concept and initial commercialization
  - Post Arab Oil Embargo
  - High oil price – windfall profit tax
  - Decline of large conventional reservoirs
  - Natural CO₂ reservoirs
  - Late 80’s price crash interrupts commercialization

Phase 2
- Late 1980s – 2000
  - Economic recovery and technology maturation renews investment
  - Projects commence at increasing rate and peak in ’97
  - Late 90’s: project development slows due to low oil price

Phase 3
- 2000 – Current
  - High oil prices
  - Technology expands beyond the Permian Basin
  - 2009 to present; project development slows due to supply squeeze
CO₂ EOR Project Initialization

Data from O&GJ, 2014 and EIA.gov
North American CO2 Supply for EOR

CO2 Sales (Mt/a)

CO2 Sales (MMcfpd)


- Other
- Dakota Gasification
- MS/Gulf Coast
- Rocky Mountains
- Permian Basin
Global CO2 EOR

- Nth. American CO2 EOR regions
- Sth. American pilots and small scale floods
- International projects planned or under construction
Wyoming CO2 EOR Status and Developments
Rockies Developments

Modified from Murrell, 2013
Wyoming CO2 EOR Supply Developments

- Riley Ridge Unit
- DKRW Medicine Bow F&P
- UCG – Linc & Carbon Energy
- At least 4 others
- Several modular and supplemental CO2 supply technologies
### New Projects

- Denbury/Elk - Grieve
- Denbury - Hartzog Draw
- Denbury - Bell Creek (MT)
- Denbury - Cedar Creek Anticline (MT, ND, SD)
- Linc Energy – Glenrock area fields
- Magellen Petroleum - Poplar Dome (MT)
- Devon Energy – Big Sand Draw
- Elk Petroleum – Singleton Field
Wyoming CO2 EOR Supply

- Lost Cabin EOR CO2 (MMcf/d)
- Shute Creek EOR CO2 (MMcf/d)

Data from WOGCC
Since 1986 CO₂ EOR has produced an incremental **103 million** barrels of oil in Wyoming; **219 million** barrels in the Rockies system.
Wyoming CO2 EOR Incremental Recovery

Data from WOGCC
In 2013, CO2 EOR produced an incremental **7.2 million** barrels of oil in Wyoming; **10.4 million** barrels in the Rockies system.

Wyoming CO₂ EOR Incremental Production

Wyoming CO₂ EOR Incremental Production as % of Total Wyoming Production

Data from WOGCC
Wyoming CO2 EOR Incremental Recovery

Data from WOGCC
Wyoming Production Trends

Annual Production (BOPY)

Year


Data from WOGCC

Conventional Oil
Resource Plays
Pinedale/Jonah
Incremental CO2 Oil

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CO2 EOR Technology
Opportunities and
Challenges
Next generation technologies
better, cheaper, faster, safer, cleaner, smarter

1. Improving Current Flooding Practices

- **Improved Sweep Efficiency**
  - Conformance Control
  - Mobility Ratio Improvement
  - Injectivity

- **Fluids Production & Handling**
  - Lift
  - Separation
  - Compression
  - Recycle

- **Advanced Flood Design**
  - Reservoir Monitoring & Management
  - Reservoir Characterization, Simulation, and Optimization
  - Improved M&C and analytics
Next generation technologies
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Growing the Prize

New Regions
- CO₂ Source-transport-sink systems
- Policy

Tight Oil
- Secondary/Tertiary Recovery
- Mechanisms, Utilization, Economics
- CO₂ Stimulation

Residual Oil Zones
- Presence, Extent, and Character
- Exploitation Methods
Next generation technologies
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The Greatest Challenge - Increasing Supply

Large Scale Capture Technologies

Modular, Supplemental Supply Technologies

Alternative Gases or Mixed Gases

Capture Costs

$/ton