CO₂ Pipelines: Infrastructure for CO₂-EOR & CCS
Denbury Resources Inc.

American Resources. Energized.
DOE/NETL Report:

“CO2 enhanced oil recovery (CO2-EOR) offers the potential for storing significant volumes of carbon dioxide emissions while increasing domestic oil production.”

Approximately 84.8 billion barrels of oil in existing US oilfields could be recovered using state-of-the-art CO2-EOR (In a range of $50-$100/barrel, it is economically feasible to recover 39 to 48 billion barrels)

Next generation technology offers potential for recovering more stranded oil and storing significantly more CO₂

Infrastructure for CO2-EOR can be used for large-scale carbon capture and sequestration (CCS) projects in underlying saline formations
In most US oilfields, about 33% of the original oil in-place is recoverable through primary and secondary methods, increasing to 50-60% with tertiary (CO₂) recovery.

The Gulf Coast (AL, FL, MS, LA)* has an estimated 44.4 billion barrels of identified oil in-place; 27.5 billion barrels are “stranded” and 7 billion barrels are recoverable with current CO2-EOR techniques. *Does not include offshore basins.
**CO₂ Enhanced Oil Recovery (CO2-EOR)**

- **CO₂ PIPELINE** from Jackson Dome
- **INJECTION WELL** Injects CO₂ in dense phase
- **PRODUCTION WELLS** Produce oil, water and CO₂ (CO₂ is later recycled)

**Model for Oil Recovery Using CO₂** is +/- 17% of Original Oil in-Place (Based on Little Creek)

- Primary recovery = +/- 20%
- Secondary recovery (waterfloods) = +/- 18%
- Tertiary (CO₂) = +/- 17%

CO₂ moves through formation mixing with oil droplets, expanding them and moving them to producing wells.
NETL report concludes next generation CO₂ injection will significantly increase CO₂ storage, both in CO2-EOR projects and in potential post-production use for large scale carbon capture and storage (CCS) in underlying saline formations.

Based on current West Texas* projects, CO2-EOR stores ~70% of the CO₂ released by the oil produced; NETL foresees next generation projects storing as much as 160% of the CO₂ released by the oil produced.

*Water Alternating Gas CO2-EOR
Key to Success: CO$_2$ Pipeline Network

- CO$_2$ pipelines operate at higher pressures (2000+ psi) than oil or natural gas pipelines

- CO$_2$-EOR projects require constant supplies of relatively pure CO$_2$ (+/- 95%)

- Denbury’s proposed CO$_2$ pipeline network will connect to both natural and man-made sources, providing flexibility to manage daily supply and demand imbalances
Current U.S. CO₂ Sources & Pipelines

U.S. CO₂ - EOR Production
Approximately 250,000 Bbls/d

Eastern Gulf Coast
10 Fields
+/- 25,000 Gross Bbls/d
Operator: Denbury
CO₂ Source: Natural
Denbury CO2-EOR Projects

Phase 1
86 MMBbls

Phase 2
77 MMBbls

Phase 3
41 MMBbls

Phase 4
31 MMBbls

Phase 5
33 MMBbls

Phase 6
26 MMBbls

Phase 7
Hastings Area
60 - 100 MMBbls (1)

Phase 8
Seabreeze Complex
25 - 35 MMBbls (1)
Potential Denbury CO$_2$ Pipeline Network

CO$_2$ transportation network from both natural and man-made sources
The Future is Now

**Denbury is Already Achieving “Next Generation” Results:**

- The NETL report estimating current CO₂ storage levels was based on projects using Water Alternating Gas (WAG) methods; Denbury uses 100% CO₂ (no water), injecting and storing almost double the CO₂ of WAG methods.
- Denbury’s current CO₂-EOR projects inject from 0.52 to 0.64 metric tons of CO₂ for every recovered barrel of oil (which releases ~0.42 metric tons of CO₂), storing between 24% and 52% more CO₂ than the recovered oil will produce.

**Advancing U.S. Energy Independence:**

- CO₂-EOR can recover billions of barrels of identified oil from existing US oilfields, and offers immediate production without additional exploration and development lead times.
- The environmental impact of every barrel of recovered US oil could be offset by carbon capture and storage (CCS), versus no CO₂ reduction for imported oil.

**Infrastructure for Future CCS Solutions:**

- Denbury’s proposed CO₂ pipeline network will enable large-scale CCS during enhanced oil recovery and in post-production utilization of underlying saline formations.
- CO₂ pipeline networks provide the basic infrastructure needed for development of carbon solutions for environmentally-sensitive industrial developments including innovative gasification projects that could produce power, substitute natural gas, fertilizer and chemicals from plentiful U.S. natural resources.
Growing the Gulf Economy

- Jobs with full benefits: 775
- Annual payroll: $61.3 million
- Annual production tax: $61.4 million
- Annual operating expense: $311 million
- Capital investment for:
  2008 - $1.0 billion
  2009 - $0.8 to 1.1 billion

DRI 2009 Capital Budget

$215 million
$570 million
$45 million

Enhanced Oil Recovery (wells / facilities)
CO2 Development & Pipeline Distribution
Other
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**EXPERTISE:**
- Currently operates 10 active CO₂ enhanced oil recovery projects, and is initiating 3 new projects in 2008-09
- Currently operates 320 miles of CO₂ pipelines, and is in the process of constructing an additional 400 miles
- Currently injects 550 MMcf (32,000+ tons) of CO₂ per day into active projects, and may be the largest injector of CO₂ by volume in the US

**EXPERIENCE:**
- Since 1999, Denbury has produced over 28 million barrels of oil from CO₂-EOR
- The largest oil and gas producer in Mississippi; primarily because of Denbury’s CO₂-EOR projects, the state’s decline in production has reversed and is increasing

**COMMITMENT:**
- World-class Engineering and Technological Innovation
- Safety and Environmental Protection
- Community Engagement and Economic Leadership