

The CO₂ Enhanced Oil Recovery Story

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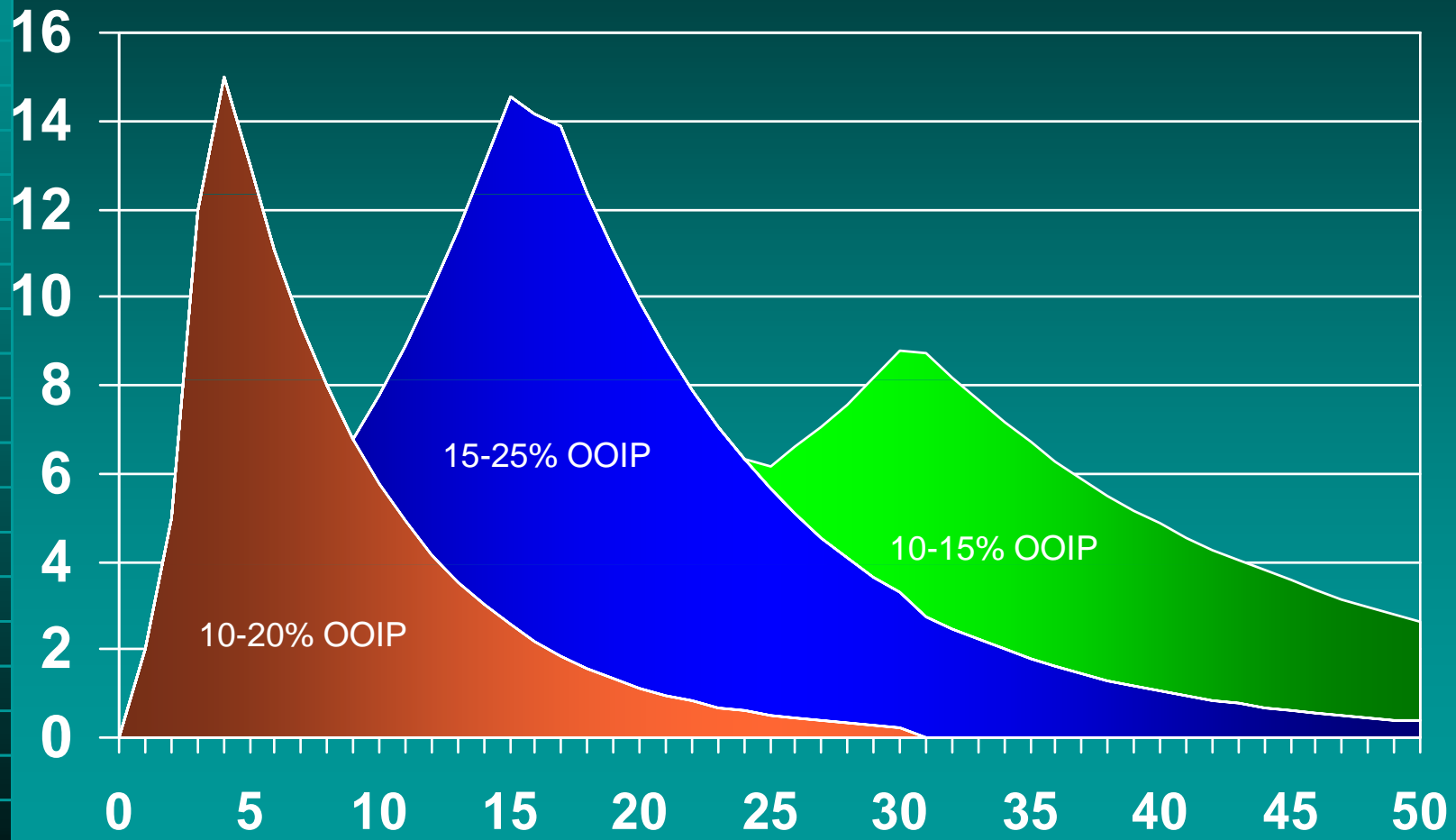
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Outline

1. CO₂ Enhanced Oil Recovery Overview
 - Oil Field Development Sequence
 - US: Current and Future
2. A Deeper Look
 - How it works
 - How its done
3. Safety and Environmental
 - Our Track Record

A Representative Oil Field Development Sequence

■ Primary ■ Secondary ■ CO2 EOR

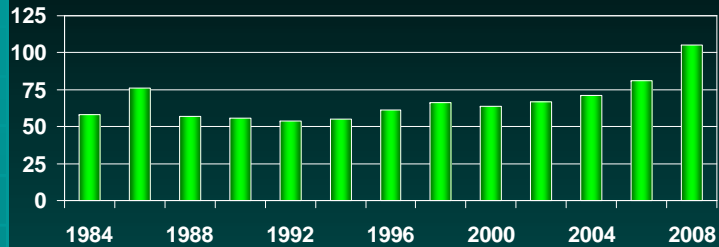


Domestic CO₂ EOR Achievements

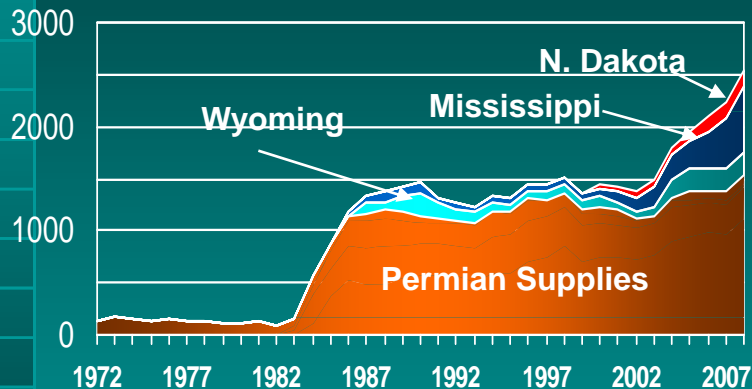
Over the past 30+ years, the oil and gas industry has:

- Produced and injected more than 10.8 TCF of CO₂ from 7 sources.
 - 1.2 TCF of which came from sources that otherwise would have been vented.
- Constructed over 3100 miles of CO₂ mainline pipeline systems.
- Produced in excess of 1.2 billion barrels of incremental oil.
- Secured operating practices of:
 - Corrosion management, Metallurgies, Elastomers
 - Separation, Dehydration and Hydrocarbon extraction
 - Compression/pumping
 - Injection and production well completion and operation

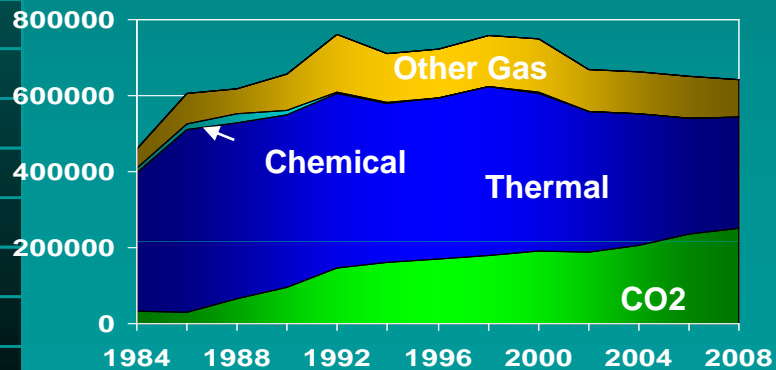
US Active CO₂ EOR Projects



US EOR CO₂ Deliveries, MMCF/d



US EOR Oil Production, B/D



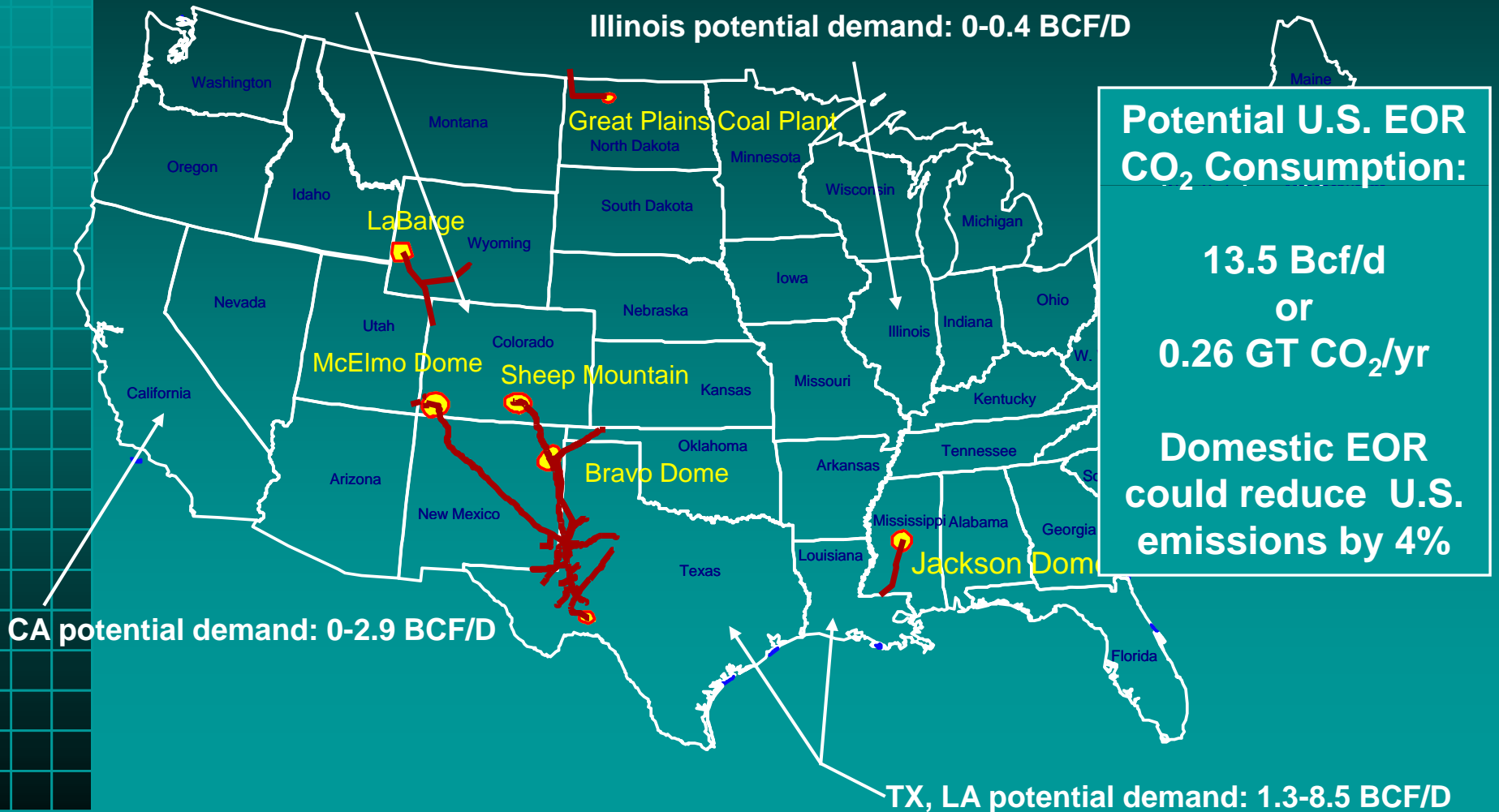
Sources: Oil & Gas Journal, Personal Knowledge

U.S. CO₂ EOR Business

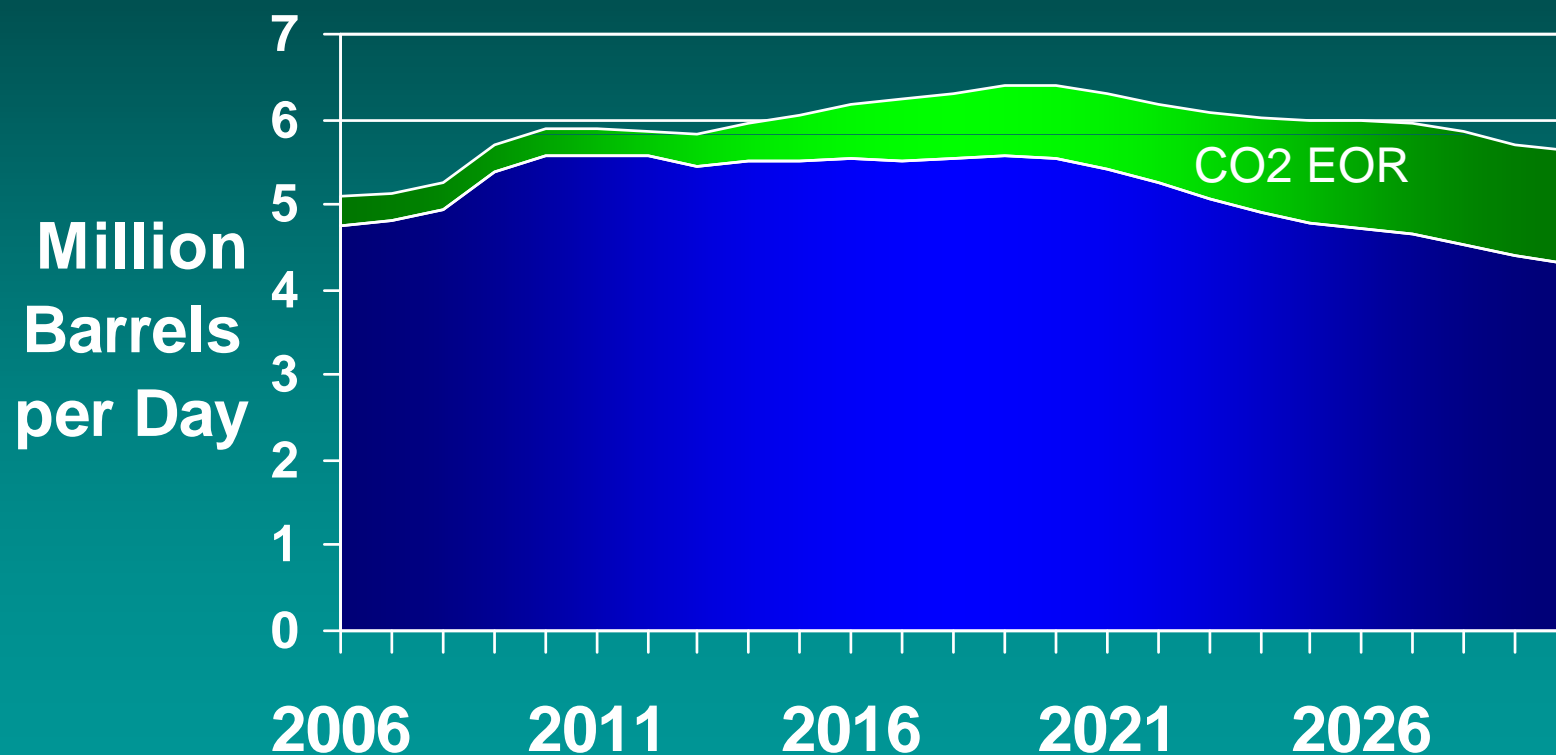
Currently injecting 2.5 BCF/d

Rockies potential demand: 0-1.7 BCF/D

Illinois potential demand: 0-0.4 BCF/D



CO2 EOR Expected to be ~25% of US Oil Production by 2030



Source: AEO 2008

EOR Process Diagram



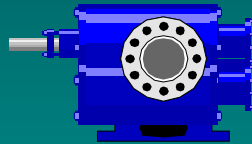
7000 FEET



CO₂ is produced from 8,500' wells in SW Colorado



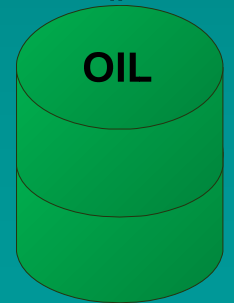
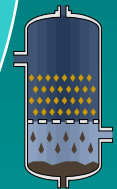
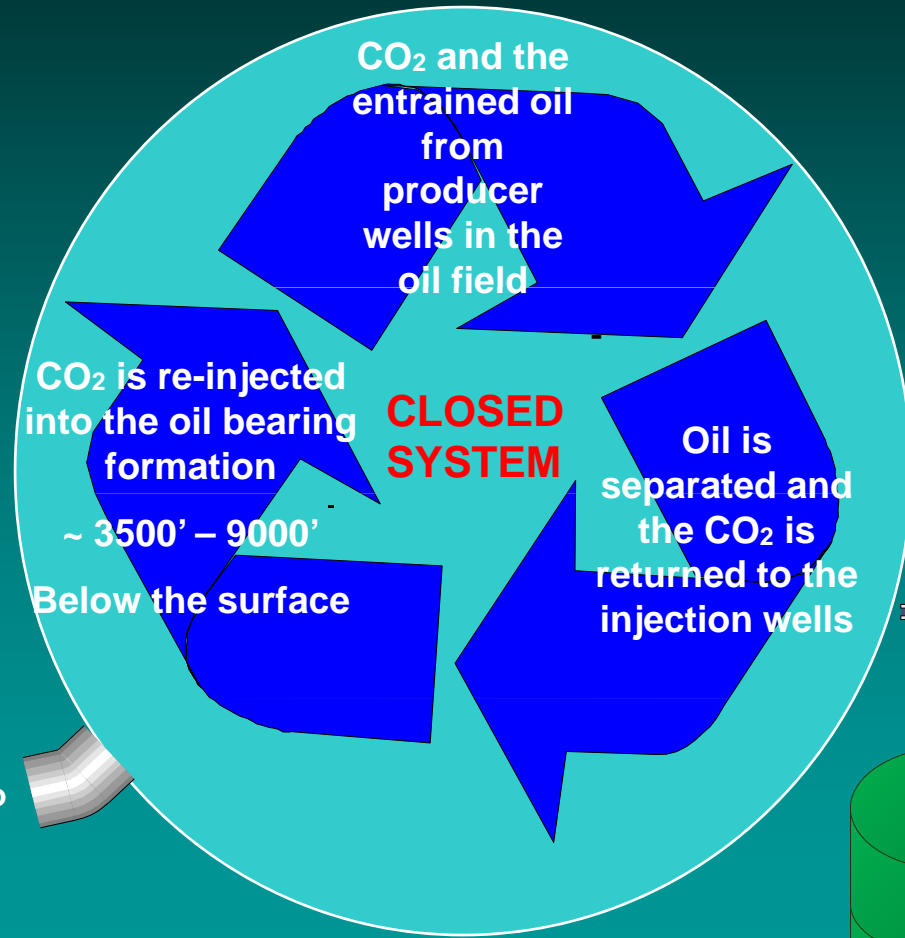
High Pressure & High Purity CO₂ is dried and further compressed until in supercritical phase ("liquid")



CO₂ is then pumped to 2200 lbs pressure into a 30" pipeline system



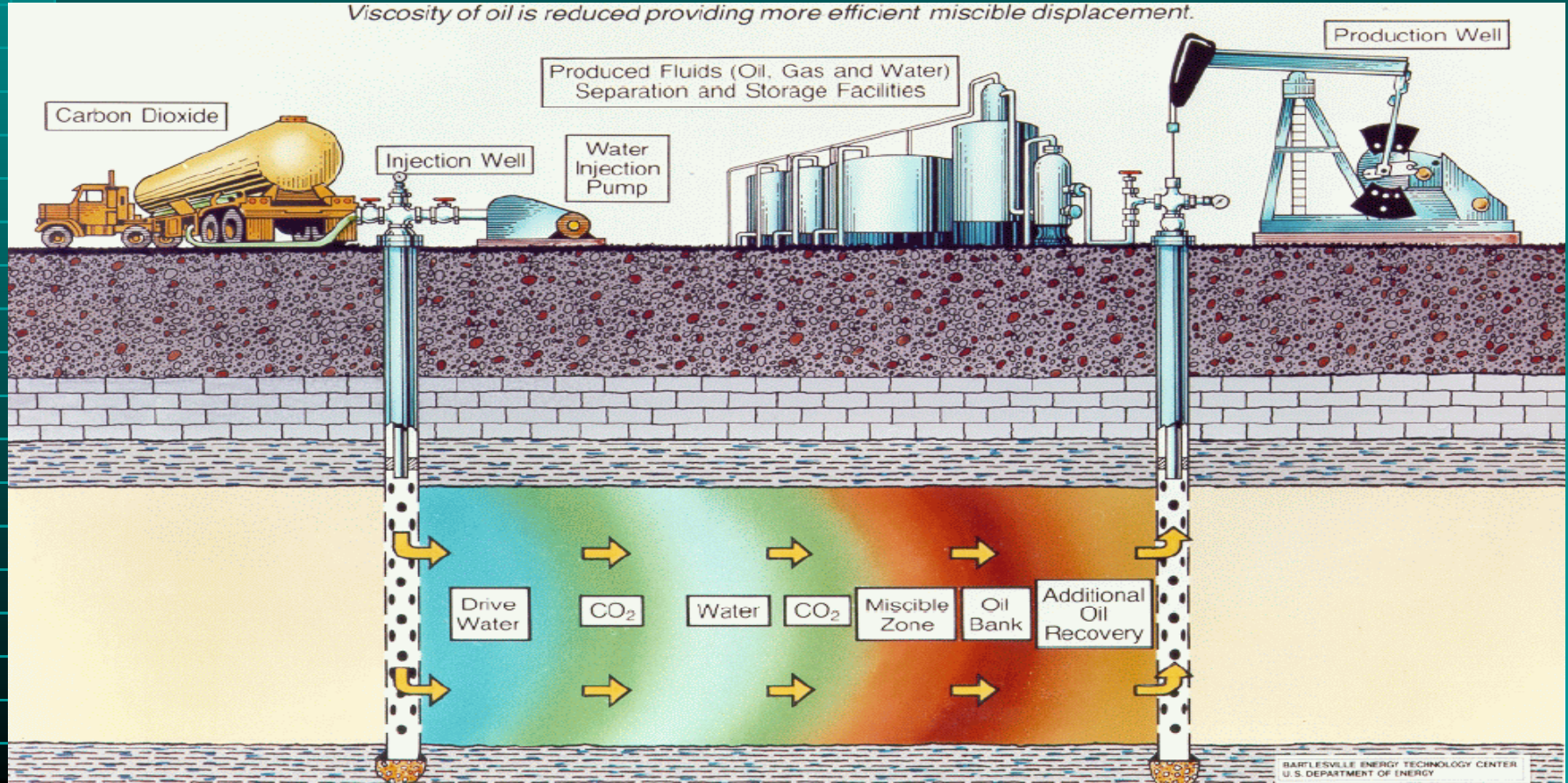
CO₂ is metered into the oil field



CO₂ Enhanced Oil Recovery: Process Schematic

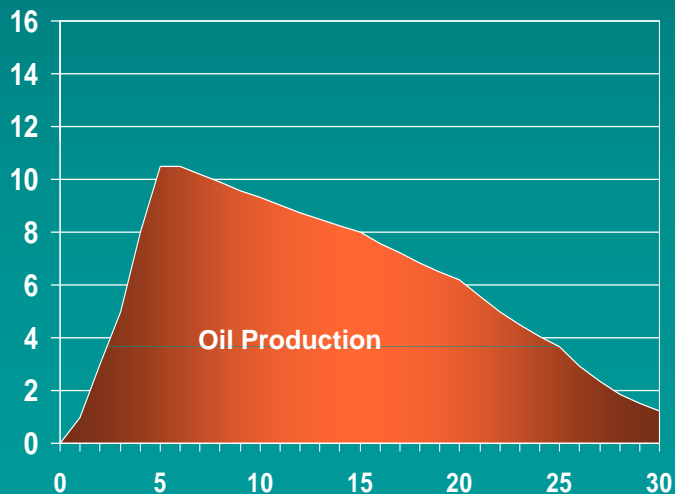
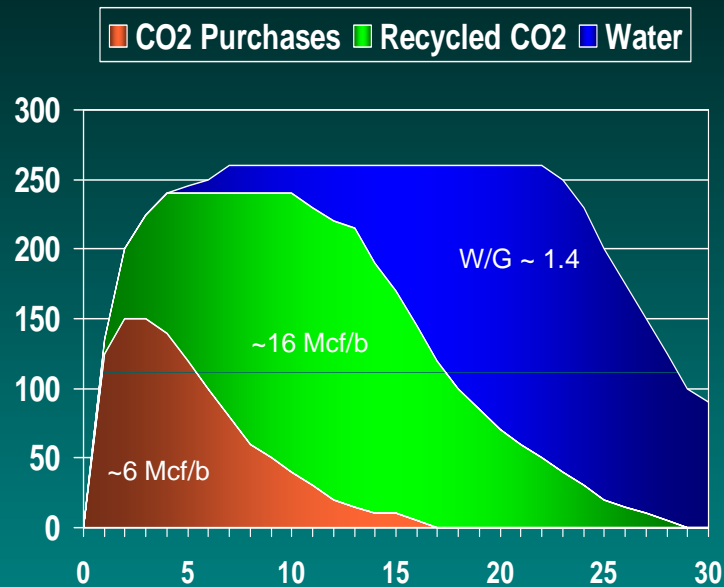
- CO₂ mixes with oil much like turpentine cleans paint from a brush
- Inter-phase mass transfer typically yields NGL rich gas production
- CO₂ produced with the oil is captured, dehydrated, and reinjected - a closed system
- Chase water injection helps control mobility and gas recycle

Viscosity of oil is reduced providing more efficient miscible displacement.



CO₂ Enhanced Oil Recovery: Animation

A Representative* Permian Basin CO2 EOR Project

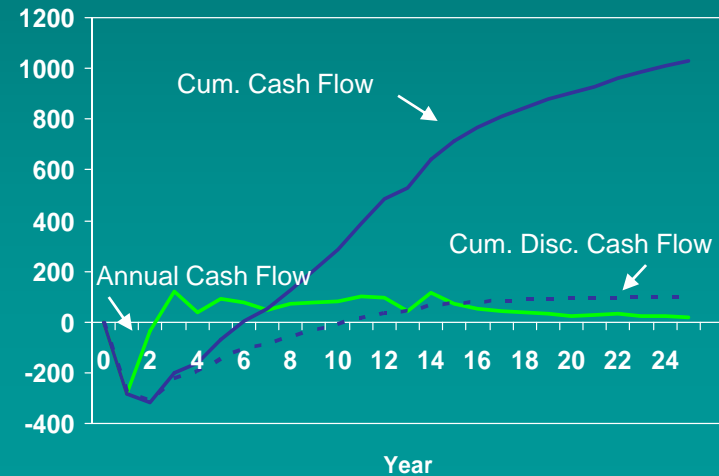


Volumetric Summary

Original Oil In Place: 600 MMB
 67 MMB EOR 11% 400 BCF purchased
 Net CO2 Utilization 6 Gross CO2 Utilization 15.8

Economic Summary

Capex: 8% of oil price per bbl
 CO2 Cost: 2.5% of oil price per MCF
 Payout: 5 years
 IRR: 20%



*Not necessarily typical

Environmental, Health, and Safety:

Myths:

CO₂ is toxic

- Its in the air we breathe and does not explode
- The operating risks include corrosion, high pressure, and asphyxiation – all of which have been successfully controlled by the industry for nearly 40 years

CO₂ EOR results in significant releases to the environment

- Our EOR operations emitted 0.3% of the total volume of CO₂ we handled in 2008
 - Key causes for releases: Routine maintenance and power outages caused by storms
- Our source operations emitted .004% of the volume we produced in 2008
 - Key cause for releases: Routine maintenance
- Our reportable emissions on our 1300 miles of pipe in 2008 was .000035% (equivalent to emissions from 2 vehicles during the same time frame)

CO₂ Enhanced Oil Recovery - Recap

It has reduced oil imports, and could generate ~25% of domestic production in 2 decades

- Uses existing footprint versus green-field developments

The environmental and safety track record in source, pipeline and EOR operations is commendable

- CO₂ releases to the atmosphere represent a tiny percent of the total volume involved

The operating practices to drill and complete wells, install needed piping, and construct required gas processing facilities has been successfully deployed by the industry for nearly 40 years

- The technologies developed since the '70's have paved the way for CCS