

IOGCC Governor's Roundtable

CO₂-EOR-Storage-A Resource Management Issue and the Opportunities/ Implications

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Interesting Finding on Oil

In WM but not in Boxer-Kerry

- **SEC. 127. OPEN FUEL STANDARD.**
- **17 (a) FINDINGS.— “The Congress finds that—(1) the status of oil as a strategic commodity, which derives from its domination of the transportation sector, presents a clear and present danger to the United States”;**
- *Final version language on page 120. Language found on page 117 of June 19th HR 2454 this language also found on page 115 of the “Amendment in the Nature of a Substitute” 946 page version of HR 2454 not in the May 21, 932 page version but also on page 33 in the Committee report June 5th.*

H.R. 2454 Waxman Markey and also in Boxer-Kerry Bonus Allowances EPA Issue

- (3) BONUS ALLOWANCE VALUES.
- (D) For a carbon capture and sequestration project sequestering in *a geological formation for purposes of enhanced hydrocarbon recovery, the Administrator shall, by regulation, reduce the applicable bonus allowance value under this paragraph to reflect the lower net cost of the project* when compared to sequestration into geological formations solely for purposes of sequestration.

H.R. 2454 Waxman Markey and also in Boxer-Kerry Bonus Allowances EPA Issue

- CRITERIA FOR ESTABLISHING BONUS
- ALLOWANCE VALUES.— *In setting bonus allowance values under this paragraph, the Administrator shall seek to cover no more than the reasonable incremental capital and operating costs* of a project that are attributable to implementation of carbon capture, transportation, and sequestration technologies, taking into account
- (ii) *the reduced cost associated with sequestering in a geological formation for purposes of enhanced hydrocarbon recovery* when compared to sequestration into geological formations solely for purposes of sequestration;

Two Markets for Same Molecule

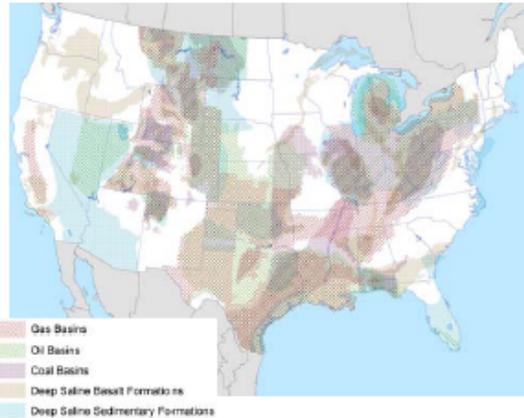
Commodity CO₂ for use in Enhanced Oil Recovery in the US and Globally

Sequestered CO₂ or Greenhouse Gas and resulting tradable offsets or credits

Carbon Capture Storage (CCS) can readily optimize values from both markets

US has the Geologic Capacity

Source: Source: Pacific Northwest National Laboratory Comparing Existing Pipeline Networks with the Potential Scale of Future U.S. CO₂ Pipeline Networks JJ Dooley, RT Dahowski, CL Davidson--Joint Global Change Research Institute Nov 2008



3,900+ GtCO₂ Capacity within 230 Candidate Geologic CO₂ Storage Reservoirs

- ▶ 2,730 GtCO₂ in deep saline formations (DSF) with perhaps close to another 900 GtCO₂ in offshore DSFs
- ▶ 240 Gt CO₂ in on-shore saline filled basalt formations
- ▶ 35 GtCO₂ in depleted gas fields
- ▶ 30 GtCO₂ in deep unmineable coal seams with potential for enhanced coalbed methane (ECBM) recovery
- ▶ 12 GtCO₂ in depleted oil fields with potential for enhanced oil recovery (EOR)



1,715 Large Sources (100+ ktCO₂/yr) with Total Annual Emissions = 2.9 GtCO₂

- 1,053 electric power plants
- 259 natural gas processing facilities
- 126 petroleum refineries
- 44 iron & steel foundries
- 105 cement kilns
- 38 ethylene plants
- 30 hydrogen production
- 19 ammonia refineries
- 34 ethanol production plants
- 7 ethylene oxide plants

NETL Seven Regional Partnerships

http://www.netl.doe.gov/technologies/carbon_seq/partnerships/links.html

National Energy Technology Laboratory Site Map GO>



THE ONLY U.S. NATIONAL LABORATORY DEVOTED TO FOSSIL ENERGY TECHNOLOGY

- ▶ ABOUT NETL
- ▶ KEY ISSUES & MANDATES

Carbon Sequestration
Regional Carbon Sequestration Partnerships – Websites and Contact Information

	<p>Montana State University http://www.bigskyCO₂.org/</p>
	<p>University of Illinois, Illinois State Geological Survey http://www.sequestration.org/</p>
	<p>Battelle Memorial Institute http://www.mrcsp.org</p>
	<p>University of North Dakota, Energy & Environmental Research Center http://www.undeerc.org/pcor/</p>

	<p>Southern States Energy Board http://www.secarbon.org/</p>
	<p>New Mexico Institute of Mining and Technology http://www.southwestcarbonpartnership.org/</p>
	<p>California Energy Commission http://www.westcarb.org/</p>

DOE-ARI US Oil Basin Assessments

OUTLOOK FOR CO₂-EOR



Recently completed “basin studies” of applying “state-of-the-art” CO₂-EOR in the U.S. indicate:

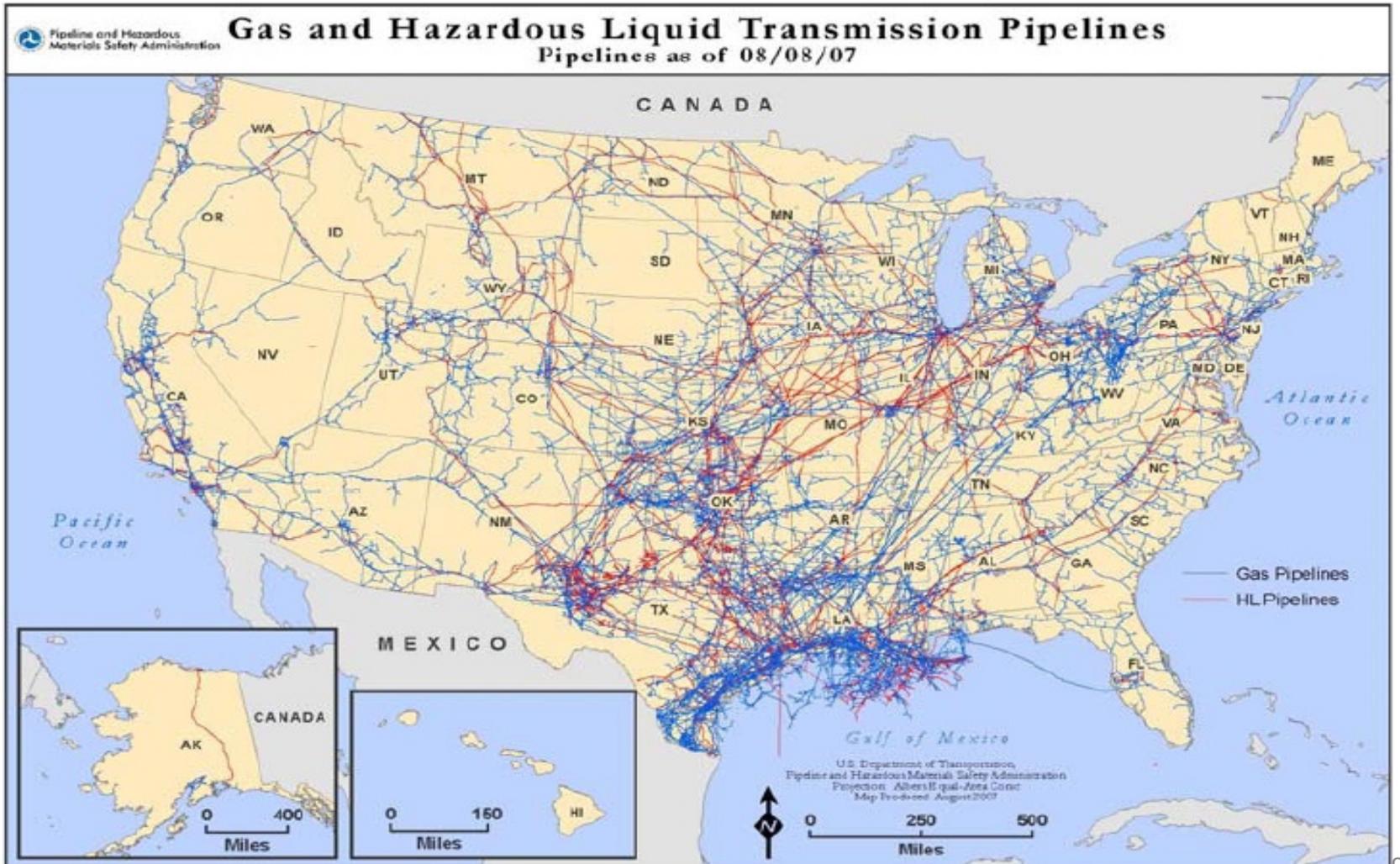
- Nearly 89 billion barrels of technically recoverable resource,
- From 4 to 47 billion barrels of economically recoverable resource.

Results are based on applying streamline reservoir simulation to 1,581 large oil reservoirs (two thirds of U.S. oil production).

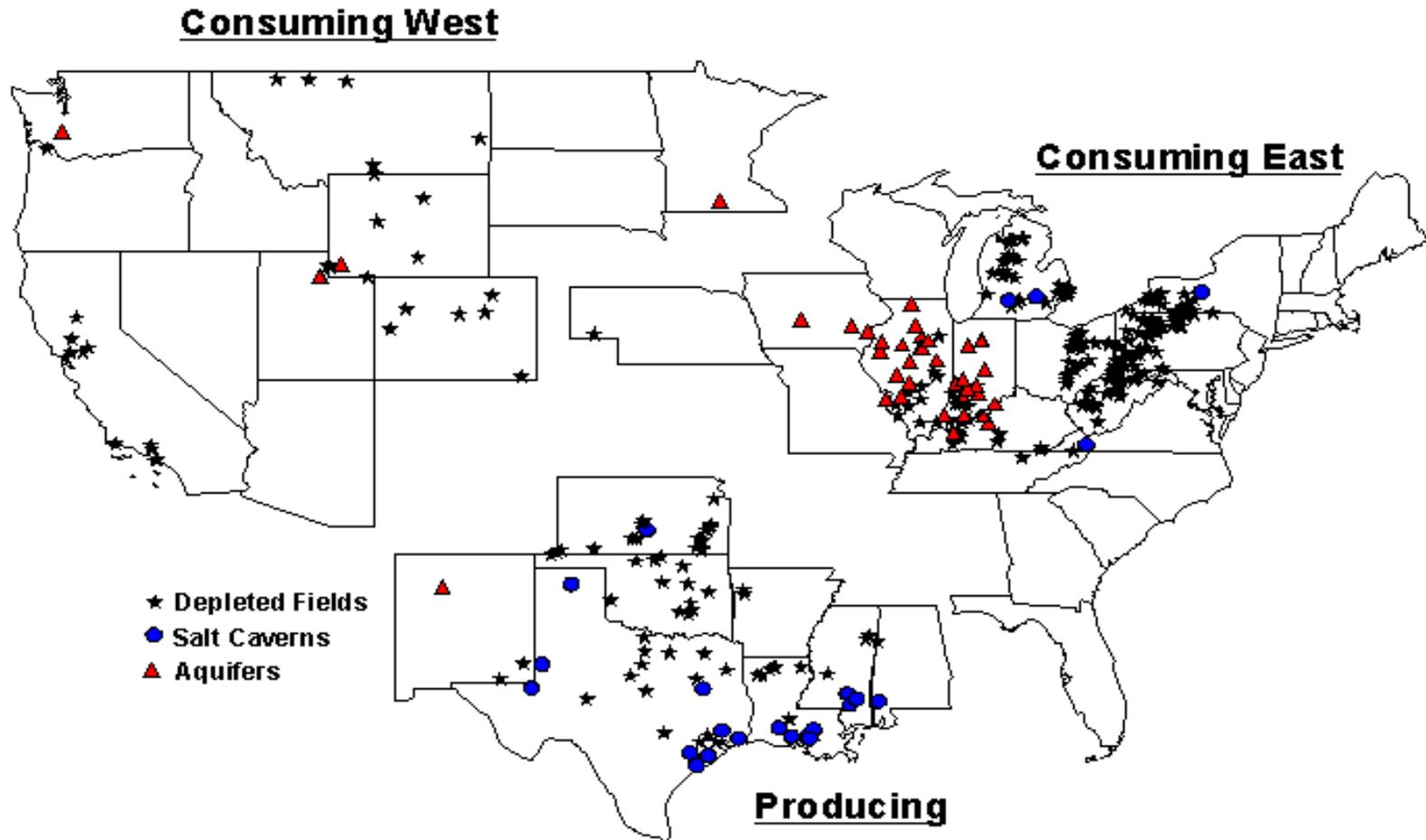
Available on the U.S. DOE web site.

http://www.fe.doe.gov/programs/oilgas/eor/Ten_Basin-Oriented_CO2-EOR_Assessments.html

480,000 Miles of Natural Gas and HL Pipelines

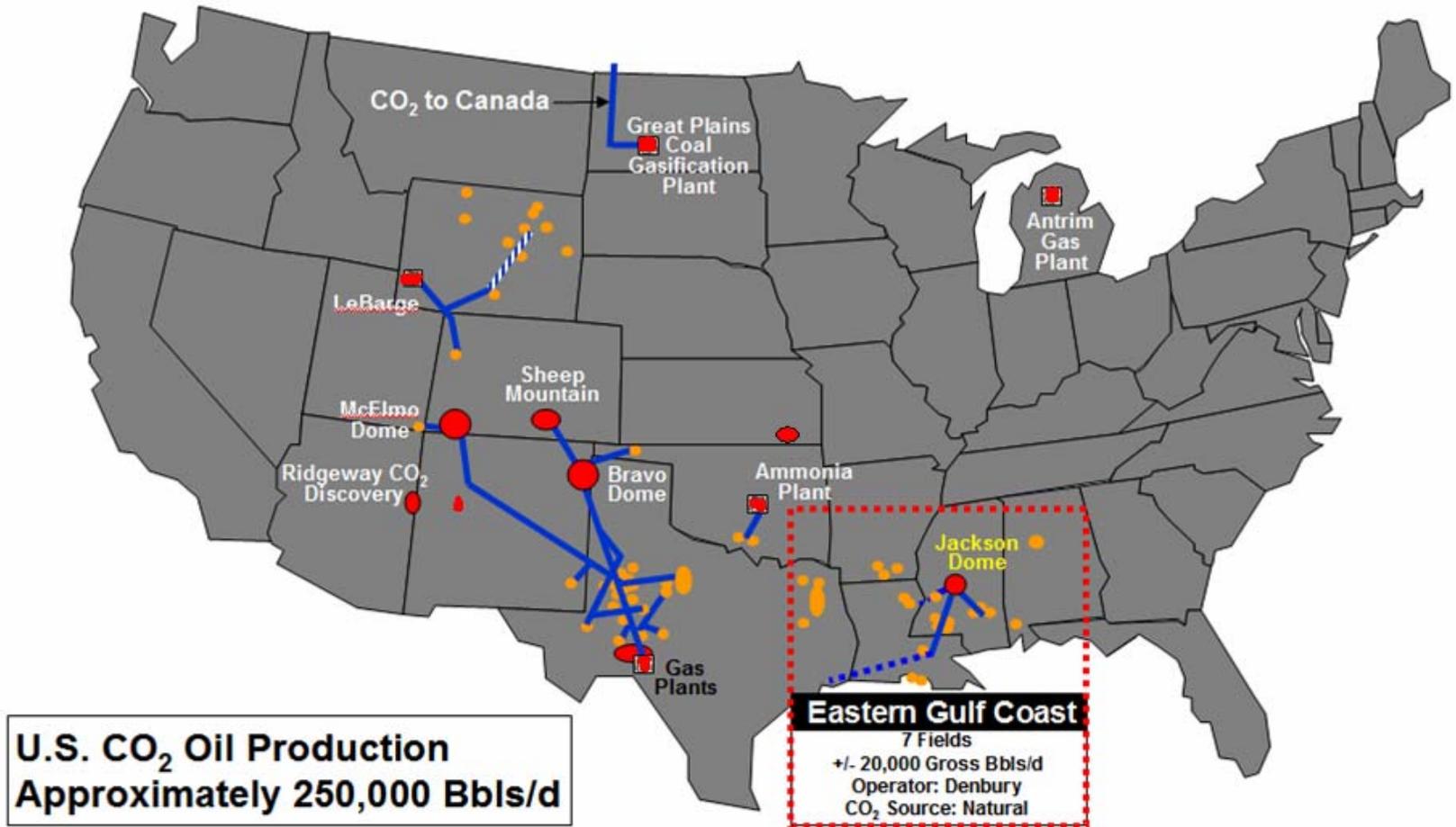


~400 Lower 48 Gas Storage Facilities



Source: Energy Information Administration (EIA), EIA GasTran Geographic Information System Underground Storage Data Base.

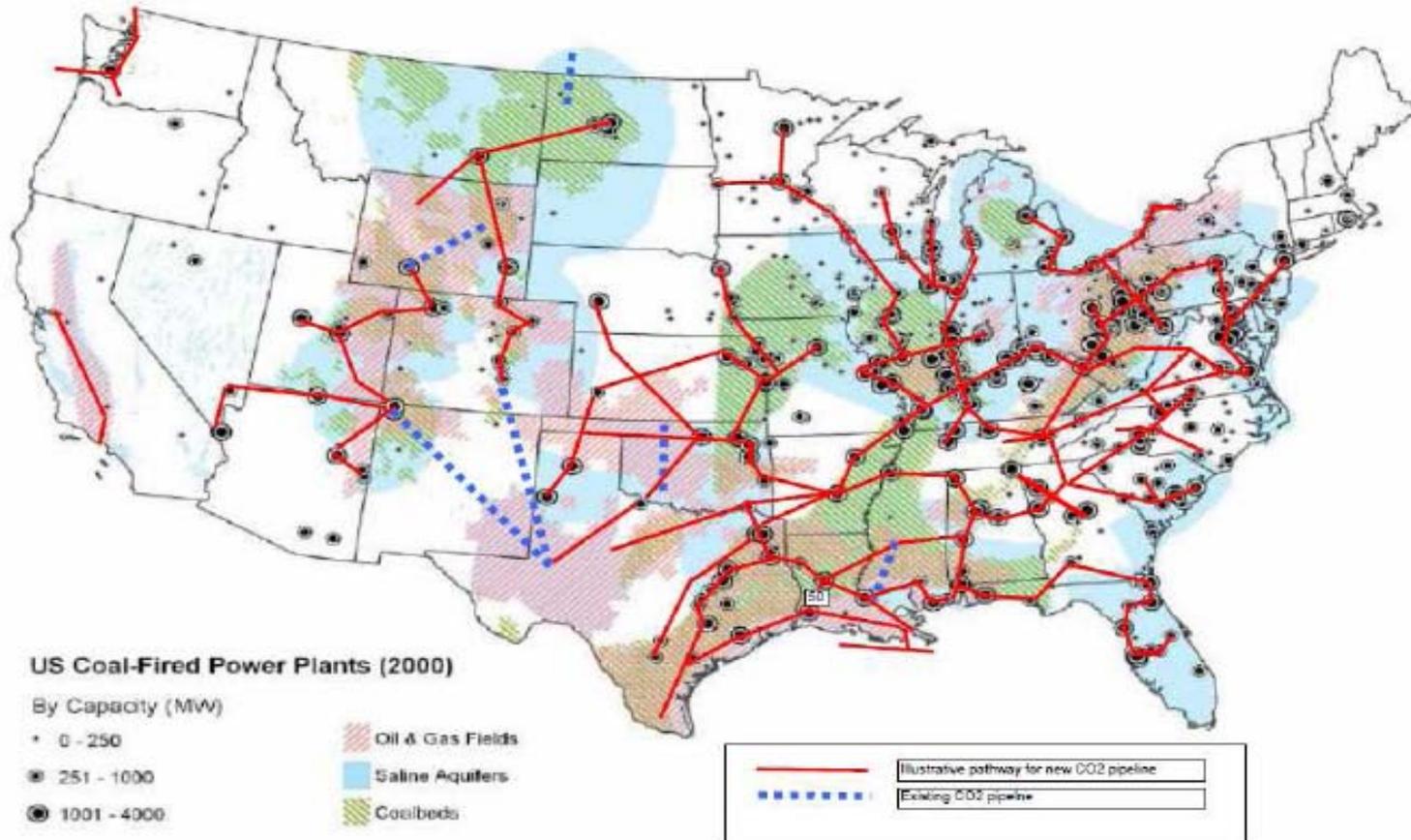
Current CO₂ Pipeline Network



INGAA High EOR CO₂ Pipelines

CARBON SEQUESTRATION & STORAGE: DEVELOPING A TRANSPORTATION INFRASTRUCTURE

Prepared for The INGAA Foundation, Inc. by: ICF International Feb 2009



However

- EOR demand for CO₂ will motivate early movers and infrastructure
- Depleted hydrocarbon reservoirs and brine aquifers will ultimately be the targets for permanent and larger sequestration efforts
- Climate legislation and carbon management requirements would determine the ultimate development of the depleted hydrocarbon and brine reservoirs
- Who pays-who benefits-and how?

States with Geologic Sequestration Legislation and Regulation

- Texas
- Wyoming
- Kansas
- New Mexico
- Oklahoma
- Montana
- Pennsylvania
- Indiana
- Kentucky
- New York
- Washington
- Louisiana
- Michigan
- Mississippi
- North Dakota
- South Dakota
- West Virginia
- Illinois

Issues

- Liability
- Land rights issues:
storage space, mineral rights, surface rights and access
- Regulatory-Federal and State
- Environmental
- Water use and access
- Infrastructure
- Funding
- Human Resources
- Geographic
- Geologic
- Public Acceptance
- Energy

What Does this Mean?

- Carbon legislation could push CO₂ towards mature oil fields in states with favorable regulations from inside and outside those states
- Compliance and monetary opportunity big drivers
- Traditional oil and gas producing states can value pore space, enhanced hydrocarbon production and safe havens for their industries as a resource management issue not an environmental penalty
- Rules and regulations are being crafted to support CO₂-EOR-Sequestration now
- CO₂ Infrastructure requirements being explored and developed
- Long term stewardship/indemnification issues being addressed for sequestration
- Land use issues are looming on the horizon but again the issue is being worked on commercially and legally-natgas storage developers already know the process
- First movers will be motivated to push changes that favor their position

Conclusion

- US leads in expertise and experience
- Provides early carbon mitigation process
- Dollars spent/earned recycle back to state and national economies
- Sources of CO₂ immense but so are the sequestration options
- Job spectrum broad: Mechanical, civil, environmental, materials, chemical and reservoir engineers
- Participants would be broad: Financiers, project developers, project owners, operators, subsurface service providers, land owners, water and mineral rights owners
- Human resources required in: Environmental, planning, regulatory, policy, research, legal, land, E&P, geology and training
- Material resource requirements huge: Capture technology, compression, pipe, valves, fittings, drilling rigs, monitoring equipment, software, support infrastructure, water processing, etc
- Active and depleted hydrocarbon reservoirs have new value proposition
- Brine aquifer resources become a valuable resource
- More domestic hydrocarbon production

Contact Information

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Additional Information

Natural Gas Storage Leases

- 2008 State of Alabama leased ~24,000 acres of state lands for ~\$124/acre plus ~\$0.025/mcf injection fee for 10 yrs plus four more 10 yr trances
- Specific geologic zones in three adjoining depleted natural gas fields
- Offshore waters-essentially unproven and undeveloped at time for natural gas storage
- First five years prepaid when lease was signed ~\$15 million

Texas's Interest In CO₂-EOR

www.rrc.state.tx.us/divisions/og/statistics/production/ogisopwc.html

www.unconventionalfuels.org/images/CO2EOR_Fact_Sheet.pdf

www.fossil.energy.gov/programs/oilgas/eor/index.html

- 1973 Texas Produced 3,444,000 bbl/d
- 2006 Texas Produced 934,000 bbl/day
- 2007 Texas By CO₂-EOR ~200,000 bbl/day
- National CO₂-EOR recoverables ~89 billion bbls-Texas ~30 billion
- Texas policy makers understand this and are driving legislation

American Clean Energy Leadership Act of 2009-GS Indemnification

- **TITLE III—IMPROVED ENERGY SECURITY -PART III—MISCELLANEOUS -Subtitle F—Carbon Capture Sec. 371. Large-Scale Carbon Storage Program (Energy Innovation and Workforce Development in Summary by Bingaman and Murkowski) SB.1013**
- **Facilitates Carbon Capture, Transportation and Storage**
- ***Carbon capture and geologic storage Indemnification (S.1013) legislation establishes a national indemnity program through the Department of Energy for up to 10 commercial-scale carbon capture and sequestration projects to ensure this energy technology is fully realized for the future.***
- **Up to 10 sites**
- **Geographically agnostic—“sites” may possibly aggregation of individual sites**
- **Industrial sources may be aggregated to make 1 million ton hurdle**
- **Brine reservoirs, active and depleted oil and gas reservoirs and “stacked storage” mediums**
- **First come first served for qualifying sites**
- **Secretary must make a determination within 1 year of application**
- **Must comply with Federal and state regulations including protection of USDW**
- **Minimum 10 yrs post closure and meeting requirements**
- **May be some financial assistance**
- **DOE takes over ownership of lands sequestration if not already on Federal lands**

“Carbon Storage Stewardship Trust Fund Act of 2009”

- Introduced by Senator Casey (Penn). “Carbon Storage Stewardship Trust Fund Act of 2009”
- *To establish a program to be managed by the Department of Energy to ensure prompt and orderly compensation for potential damages relating to the storage of carbon dioxide in geological storage units*
- *Secretary of DOE lead authority, MVA requirements in conjunction with the EPA Administrator*
- *For commercial projects*
- (1) Require private liability insurance for geological storage facility construction, and for carbon dioxide transport, injection, well plugging, site abandonment and post-closure monitoring;
- (2) Establish a Federal trust fund from fees paid for by commercial carbon dioxide storage facility operators that will be used to pay for claims for damages made after storage facility stewardship is transferred to Federal government;
- (3) Establish a Federal program to certify closure of commercial facilities and subsequent transfer of liability for long term stewardship to the Federal government;
- (4) Convey post-closure liability for long-term stewardship of stored carbon dioxide to the Federal government or State upon receipt of certificate of closure; and
- (5) Provide for prompt and orderly compensation for damages or harm from the transport, injection and storage of carbon dioxide in geological storage units.
- Storage site categorized by units
- Not limited by number of sites or volumes
- Storage can be in: saline formations, hydrocarbon formations, basalt formations, salt caverns, unmineable coal seams, or any other geological formation capable of permanently storing carbon dioxide