THE PIPELINE PROJECT:
Analysis of potential pipeline infrastructure, transportation & storage of CO₂
Acknowledgement

• This material is based upon work supported by the U.S. Department of Energy’s National Energy Technology Laboratory.
The Report

Four sections:

1. Overview
2. Background
3. Analysis
4. Recommendations
PART 1: OVERVIEW

- Pipeline Transportation Task Force
- Collaborative Work Group Model
- Task Force Objectives
IOGCC-SSEB CO$_2$ Pipeline Transportation Task Force (PTTF)

- Offshoot of IOGCC’s Carbon Capture and Geologic Storage Task Force
- Southeast Regional Carbon Sequestration Partnership Focus Area
- Collaboration:
Task Force Composition

• Interstate Organizations
  – IOGCC
  – SSEB

• Federal Regulators
  – FERC
  – US DOE
  – US EPA
  – US DOI

• Industry Representatives
• Environmental Representatives
• Scientists
• Legal Experts
IOGCC’s Collaborative Work Group Model

- Peer-led
- Research conducted by members
- Facilitated by IOGCC project managers and contracted specialists
- Consensus-driven
Task Force Objectives

• Examine current legal and regulatory environment
• Identify barriers and opportunities for wide-scale construction of CO$_2$ pipelines
• Issue recommendations
PART 2. BACKGROUND

I. Carbon Capture
II. Geologic Storage
III. Transportation
Carbon Capture and Storage

• CO₂ is separated, pressurized, transported and stored in geological formations
• One of 4 commonly discussed GHG reduction strategies
  – Energy conservation and efficiency
  – Use of renewables, nuclear and fuel switching
  – Terrestrial sequestration
  – Carbon Capture and Storage
I. Carbon Capture

• Only feasible at large point sources:
  • Power plants
  • Large industrial sources
• Pre and post – combustion systems can capture 80% to 90% of CO₂ emissions
• Facility equipped with CCS currently requires 10% to 40% more energy
II. Geologic Storage

• Depleted oil and gas fields
• Deep saline formations
• Coal-bed storage

Geological formations are used to capture / store CO2
III. Transportation

- Current infrastructure developed to support enhanced oil recovery (EOR)
- Approximately 4000 miles of CO$_2$ pipelines in place
- Future infrastructure needs could range from 15,000 to 66,000 miles of CO$_2$ pipelines
Enhanced Oil Recovery

- CO$_2$ is injected into underground formations to produce additional oil following primary and secondary recovery methods
- EOR has been used successfully to increase oil recovery in exhausted oil reservoirs
- Approximately 4000 miles of CO$_2$ pipeline infrastructure services the EOR industry
- In Texas alone there are 183 active EOR projects
PART 3: ANALYSIS
I. Existing Physical and Regulatory Structure in the US

- Pipeline Infrastructure
- Regulatory Structure
- Resource Management Paradigm
- Future Pipeline Build-Out Scenarios
Physical Infrastructure

- Design is similar to natural gas pipelines
  - CO₂ pipelines must withstand higher pressure (1200 to 2700 psi) than Natural Gas (NG) pipelines (200 to 1500 psi)
  - Because CO₂ is typically transported in a supercritical state, pumps are used to move the product (rather than compressors)

- Costs
  - Increases in carbon steel has resulted in higher pipeline costs

- Quality Specifications
  - Today there are no CO₂ compositional standards; composition is determined by contract
  - Common contractual specifications
    - Nitrous Oxide (N₂O) and Methane (CH₄) < 10% in aggregate
    - Oxygen < 10 to 20 ppm
    - Water (H₂O) 20-30 lbs./MMcf allowed
Pipeline Costs

Cost of a 16-inch CO₂ Pipeline of Various Lengths in the Midwest

![Graph showing the cost of a 16-inch CO₂ pipeline of various lengths in the Midwest. The graph plots total capital cost (in million 2014 US $) against pipeline length (in km). The categories include ROW, Material, Engineering, Overheads, & AFUDC, and Labor.]
Regulatory Structure

- Safety regulation of CO$_2$ pipelines
- Regulatory Status under the Interstate Commerce Act and the Natural Gas Act
- Jurisdiction under the Mineral Leasing Act of 1920
- CO$_2$ pipeline regulation under State Law
- Resource Management Paradigm
Safety regulation of CO₂ pipelines

- Intrastate pipelines regulated by
  - State applying applicable federal standards under the Pipeline Safety Reauthorization Act
  - Pipeline Hazardous Materials Safety Administration (PHMSA) within DOT if State has not adopted federal standards
- Interstate pipelines regulated by PHMSA
Federal Regulatory Status

- **Interstate Commerce Act** – under the ICA, the Surface Transportation Board (STB) regulates oil pipelines; however in 1980 a predecessor agency declared that “it lacked jurisdiction over interstate transportation of CO₂ by pipeline”

- **Natural Gas Act (NGA)** – in 1978, FERC found that gas that was not 98% methane was not “natural gas” and therefore not subject to regulation under the NGA

- **Pipelines Crossing Federal Lands**
  - Mineral Leasing Act – if Rights-Of-Way issued by BLM then “common carrier” obligations are imposed
  - Federal Land Policy Management Act – imposes no “common carrier” obligation
## CO₂ Pipeline Regulation under State Law Examples

<table>
<thead>
<tr>
<th>State</th>
<th>Regulatory Status</th>
<th>Condemnation Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mississippi</td>
<td>Private carrier</td>
<td>Yes, limited to EOR use</td>
</tr>
<tr>
<td>Texas</td>
<td>Private/common carrier option</td>
<td>Yes, for common carrier</td>
</tr>
<tr>
<td>Louisiana</td>
<td>Private carrier</td>
<td>Yes, limited to EOR use</td>
</tr>
</tbody>
</table>
Resource Management Paradigm

Regulation that seeks to manage, maintain, and advance the beneficial uses of a commodity while regulating and controlling harmful or deleterious effects of the commodity.
II. Prospective Business Models and State and Federal Regulatory Options

• Leading Business Models
• State and federal regulatory systems
• Potential impact of regulatory systems
Leading Business Models

- **Intrastate Dedicated Pipeline Model**
  - Dedicated pipelines
  - Private or contract carriage
  - Limited third party access
  - Typically condemnation authority not available

- **Intrastate Open Access Model**
  - Provide transportation to multiple users
  - Third party access available
  - Condemnation authority available
Leading Business Models Cont’d

• Interstate Dedicated Pipeline Model
  – Does not involve access to federal lands
  – Similar to Intrastate Dedicated Model

• Interstate Open Access Model
  – May involve access to federal lands
  – Possibly regulated as “common carriers”
  – Similar to Intrastate Open Model

• Government/Public Option Model
  – Public financing and/or ownership of facilities
## Regulatory Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Siting Authority (eminent domain powers)</th>
<th>Rate Regulation</th>
<th>Access</th>
<th>Entry/Exit</th>
<th>Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current CO₂ Pipeline regulatory framework</td>
<td>States</td>
<td>Contractual agreement</td>
<td>Generally by contractual agreement, except where pipeline crosses federal land</td>
<td>States</td>
<td>OPS State option</td>
</tr>
<tr>
<td>Oil Pipeline Model</td>
<td>States</td>
<td>FERC</td>
<td>FERC – common carriage where proration or apportionment is required</td>
<td>OPS</td>
<td>State option</td>
</tr>
<tr>
<td>Natural Gas Model</td>
<td>FERC - § 717f grants eminent domain authority</td>
<td>FERC</td>
<td>Not common carriers; no apportionment; open season required</td>
<td>FERC</td>
<td>OPS State Option</td>
</tr>
<tr>
<td>E.g., Energy Policy Act 2005 “backstop” Option (electric facilities)</td>
<td>States; if state fails to act, FERC may issue permit with associated eminent domain authority</td>
<td>FERC</td>
<td></td>
<td></td>
<td>OPS State option</td>
</tr>
<tr>
<td>“Opt-in” Model</td>
<td>States or new pipeline developers may access federal siting authority</td>
<td>FERC or other federal regulatory authority</td>
<td>FERC or other federal regulatory authority</td>
<td>FERC or other federal regulatory authority</td>
<td>OPS State option</td>
</tr>
<tr>
<td>Multi-State Compact</td>
<td>Intrastate ⇒ States interstate ⇒ Compact</td>
<td>Compact</td>
<td>Compact</td>
<td></td>
<td>OPS State option</td>
</tr>
</tbody>
</table>
The Impact of Regulatory Scenarios on Business Models

• Balance
  – Competition vs. Compliance
  – Centralized vs. Decentralized
  – Small vs. Large

• Status Quo compatible with all Business Models
• Multi-state Compact option compatible
• Natural Gas Pipeline Model compatible
• Oil Pipeline Model not compatible with some of the models (apportionment)
III. Economic Issues

• Financing
  – Project finance and debt financing used to finance existing CO₂ pipelines
  – Government support may be necessary in the future

• Infrastructure Costs
III. Economic Issues Con’t.

- Cost Forecasting of CO₂ pipelines
  - $50,000 per inch per mile (estimate)
- Commercial Transactions Involving CO₂ Pipelines
  - Sale and purchase agreements
  - Off-take agreements
III. Economic Issues Con’t.

Other Economic factors

• Regulatory Compliance Costs
• State Incentives
• Federal Incentives
• Treatment under the Uniform Commercial Code
PART 4: RECOMMENDATIONS
General Recommendations

• No federal oversight required
• Begin with EOR-driven storage
• Allocate public resources for infrastructure should Non-EOR storage be mandated
State Recommendations

• Avoid a one-size-fits-all approach
• Implement statutes and regulations
• Consider creating separate pipeline authorities
• Share information about existing EOR structure
Federal Recommendations

• Retain the status quo
• If role expanded, closely follow natural gas model
• Encourage private sector build-out for EOR activities
Offshore Storage Task Force

- Objective
  - Evaluate the potential for CO$_2$ Sequestration in Sub-Seabed Geological Structures (CS-SSGS)
    - In the Gulf of Mexico
    - Other coastal areas
Offshore Storage Task Force

• Objective cont’d
  – Evaluate CS-SSGS potential
  – Evaluate current legal and regulatory framework
Offshore Storage Task Force

• Task force formed April 2010
  – State Regulators
  – Federal Agencies
  – Researchers
    • Geological Survey of Alabama
    • UT Bureau of Economic Geology
  – Industry representatives
Research Topics

• Geological/Technical
  – Capacity assessment
  – Identify existing infrastructure
    • penetrations and
    • possible re-use
  – Establish guidelines
Research Topics

• Regulatory requirements
  – State Seabed
  – Federal Seabed
  – Water Column

• Legal/regulatory challenges and opportunities
  – Pore-space ownership
  – Property rights
  – Liability/stewardship
Questions?

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