THE PIPELINE PROJECT: Analysis of potential pipeline infrastructure, transportation & storage of CO$_2$
Acknowledgement

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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:
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
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
Task Force Composition

- Interstate Organizations
  - IOGCC
  - SSEB

- Federal Regulators
  - FERC
  - US DOE
  - US EPA
  - US DOI

- Industry Representatives
- Environmental Representatives
- Scientists
- Legal Experts
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 CO$_2$ 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 –
  – from IEA Blue Map Scenario
  – And Interstate Natural Gas Association study
Enhanced Oil Recovery

• CO₂ 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 CO₂ pipeline infrastructure services the EOR industry
• In Texas alone there are 183 active EOR projects
PART 3: ANALYSIS

I. Existing CO2 Pipeline Status

II. Business Models vs. Regulatory Options

III. Economic Issues
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 in the Midwest as a function of pipeline length. The graph includes cost categories for Right-Of-Way (ROW), material, engineering, overheads, and AFUDC, as well as 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
CURRENT REGULATORY STRUCTURE
Safety regulation of CO$_2$ pipelines

- Intrastate pipelines regulated by
  - State applying applicable federal standards under the Pipeline Safety Reauthorization Act;
  - If State has not adopted federal standards, then by the Pipeline Hazardous Materials Safety Administration (PHMSA) within DOT

- Interstate pipelines regulated by PHMSA

- OPS sets standards for:
  - Design, construction, pressure testing
  - Used pipe, new pipe, metals, etc.
  - Operation and maintenance
Federal Regulatory Status

- **Interstate Commerce Act** – under the ICA, the Surface Transportation Board (STB) regulates oil pipelines; however in 1980 a predecessor agency (ICC) 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 Pipeline 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></td>
<td>OPS 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</td>
<td>Compact</td>
<td>Compact</td>
<td>Compact</td>
<td>OPS State option</td>
</tr>
</tbody>
</table>
The Impact of Regulatory Scenarios on Business Models

- Regulatory considerations must 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/proration)
  - Could leave CO2 stranded
  - w/o firm off-take capacity
  - Can’t meet compliance obligations
III. Economic Issues

- Financing
- Infrastructure Costs
- Structure of Commercial Transactions
- Regulatory Compliance Costs
- State/Federal Incentives
- Uniform Commercial Code (UCC)
III. Economic Issues Cont’d.

- Cost Forecasting of CO$_2$ pipelines
  - $50,000$ per inch X per mile (estimate)
- Commercial Transactions Involving CO$_2$ Pipelines
  - Sale and purchase agreements
  - Off-take agreements
III. Economic Issues Cont’d.

- Regulatory Compliance Costs
- State Incentives
- Federal Incentives
  - Financial, tax credits, loan guarantees, allowing MLPs etc.
- Treatment under the Uniform Commercial Code
  - Minimizes uncertainty regarding applicable law
  - Disputes resolved under UCC rather than state contract law
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
• Promote market based solutions
• Implement statutes and regulations
• Consider creating separate pipeline authorities, i.e. Wyoming
• Share information about existing EOR structure
Federal Recommendations

• Retain the status quo of safety regulations, leaving siting and rate regulation to the states.

• If role expanded, closely follow natural gas model, which provides dedicated capacity to assure transport for sources to meet potential compliance obligations.

• Encourage private sector build-out for EOR activities.
Offshore Storage Task Force

• Objective
  – Evaluate the potential for $\text{CO}_2$ 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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