Adapting Power Generation Lessons Learned to Industrial CO$_2$ Capture

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CO$_2$ Carbon Management Workshop
December 6, 2016
Midland, Texas
Presentation Outline

• SSEB Background, Regional Policy, and Carbon Management Program
• Southeast Regional Carbon Sequestration Partnership
• Application of SECARB Lessons Learned to Industrial CCUS Project
Through innovations in energy and environmental policies, programs and technologies, the Southern States Energy Board enhances economic development and the quality of life in the South.

–SSEB Mission Statement

- Established 1960, expanded in 1978
- 16 U.S. States and Two Territories
- Each jurisdiction represented by the governor, a legislator from the House and Senate and a governor’s alternate
- Federal Representative Appointed by U.S. President
2016 Adopted Resolutions

• 1.2016 Resolution Supporting the Deployment of Advanced, Innovative Electric Transmission Technology
  Sponsored by: Sen. Eddie Joe Williams, Arkansas

• 2.2016 Resolution Supporting the Development of Advanced Carbon Emission Reduction Technologies for Power Generation
  Sponsored by: Sen. Mark Norris, Tennessee

• 3.2016 Resolution Regarding Protection of the Nation’s Electric Power Grid From Dynamic Cyber Threats

• 4.2016 Resolution Concerning the Combined Impacts of Future EPA Regulations for Coal-Fired Power Plants
  Sponsored by: Rep. Randy Davis, Alabama

• 5.2016 Resolution Encouraging ongoing Bipartisan Efforts to Spur Development of Advanced Nuclear Reactors and Innovative Nuclear Technologies

• 6.2016 Resolution to Encourage Clean Energy Innovations and Applications
  Sponsored by: Rep. Lynn Smith, Georgia; Rep. Weldon Watson, Oklahoma

• 7.2016 Resolution Encouraging Resource Conservation, Preservation and Recovery of Coal Combustion Products
  Sponsored by: Rep. Jim Gooch, Jr., Kentucky

• 8.2016 Resolution Concerning the Stream Protection Rule
  Sponsored by: Rep. Jim Gooch, Jr., Kentucky
Gov. Phil Bryant, SSEB's Chairman-elect, Sends Letter of Endorsement for S. 3459

On October 31, Mississippi Governor Phil Bryant, who serves as SSEB's Chair-Elect, sent a letter to United States Senator John Hoeven (R-ND) commending him on his introduction of S. 3459. Governor Bryant stated, "I endorse the approach of S. 3459. It will correct the legal incompatibility that exists in 45Q that is in direct conflict with decades-old state mineral property and resource conservation laws that have been historically recognized and accepted by the federal government. It will protect these vital property rights administered solely by the States."

S.3459 seeks to amend Section 45Q of the Internal Revenue Code of 1986 by enhancing the requirements for secure geological storage of carbon dioxide (CO$_2$) for purposes of CO$_2$ sequestration or storage. The bill is co-sponsored by Senators Steve Daines (R-MT), Roger Wicker (R-MS), and Mitch McConnell (R-KY). It was read twice before being referred to the Committee on Finance.
SSEB’s Carbon Management Program

- **SSEB manages the following projects:**
  - Southeast Regional Carbon Sequestration Partnership (SECARB)
  - Southeast Regional CO$_2$ Sequestration Technology Training Program (SECARB-Ed)
  - Southeast Offshore Storage Resource Assessment (SOSRA)
  - Industrial CCS/CCUS (ICCS) Working Group
  - Establishing an Early CO$_2$ Storage Complex in Kemper County, Mississippi: Project ECO$_2$S (award negotiation underway, DOE/NENTL CarbonSAFE Feasibility Proposal)

- **SSEB supports the following projects:**
  - Central Appalachian Basin Unconventional (Coal/Organic Shale) Reservoir Small-Scale CO$_2$ Injection Test
    - Lead: Virginia Polytechnic and State University’s Virginia Center for Coal and Energy Research
    - SSEB Support: Project management and outreach/education
  - Offshore CO$_2$ Storage Resource Assessment of the Northern Gulf of Mexico (Texas-Louisiana)
    - Lead: Bureau of Economic Geology at The University of Texas at Austin
    - SSEB Support: Outreach and education
Regional Carbon Sequestration Partnerships

- **Midwest Regional Carbon Sequestration Partnership**
  - **Michigan Basin Project**
    - 596,282 metric tons

- **Southeast Regional Carbon Sequestration Partnership**
  - **Cranfield Project**
    - 4,743,898 metric tons
  - **Citronelle Project**
    - 114,104 metric tons

- **Southwest Regional Carbon Sequestration Partnership**
  - **Farnsworth Unit Project**
    - 490,720 metric tons

- **Big Sky Carbon Sequestration Partnership**
  - **Kevin Dome Project**

- **Midwest Geological Sequestration Consortium**
  - **Illinois Basin Decatur Project**
    - 999,215 metric tons

**Updated October 2016**
Location
- 15 miles east of Natchez, MS
- Oilfield discovered in 1940s and abandoned in 1960s
- Currently owned/operated by Denbury Onshore LLC
- CO₂-EOR injection since 2008, Natural CO₂, Jackson Dome

Current Status
- CO₂ injection over 11 million metric tons
- CO₂ storage over 5 million metric tons
- Site operations discontinued in February 2015
- Final tests conducted and research wells plugged and abandoned in accordance with Mississippi Oil and Gas Board rules
• Carbon capture from Plant Barry (equivalent to 25MW of electricity).
• 12 mile CO$_2$ pipeline constructed by Denbury Resources.
• CO$_2$ injection into ~9,400 ft. deep saline formation (Paluxy) above Citronelle Field.
• Monitoring of CO$_2$ storage during injection and three years post-injection.
Plant Barry Capture Unit: 25MW, 500 TPD
WA Parish Petra Nova
250 MW CCUS Commercial Scale Up (10x Plant Barry)

- Project expanded from 375,000 tons per annum CO₂ to 1.4 million tons per annum
- First EOR field: CO₂ transported 82 miles to Hilcorp’s West Ranch Oil Field.
- Oil production projected to increase from 500 barrels per day to 15,000 barrels per day.

Source: [http://www.nrg.com/] & MIT CCS Project Database
CO₂ Utilization and Storage Acceleration (CO₂-USA)

• Regional initiative of SSEB and DOE in Mississippi, Louisiana, and eastern Texas.
• Market-driven with focus on industrial sources of CO₂ that can be linked to existing oil fields with CO₂-EOR potential.
• Adapting “learning” from the Permian Basin’s rich history of CO₂-EOR.
Plant Barry 25 MW CO₂ Capture Plant

Flue gas demister and outlet

CO₂ absorber (lower) and Water wash (upper) column

Solvent regeneration ("CO₂ stripper") column

CO₂ compression and dehydration unit

Flue gas quench column

Flue gas inlet

Industrial Facility

Low Purity CO₂

Pre-treatment

Capture & Separation

High Purity CO₂

Conditioning

Compression

CO₂ Pipeline
Examples of Industrial CO$_2$ Sources Requiring Moderate (Low Purity) or Minimal (High Purity) Treatment

**Low purity (<90 vol %)**
- Hydrogen (Refinery)
- Iron/Steel
- Cement

**High purity (>90 vol %)**
- Natural Gas Processing
- Ammonia
- Ethylene Oxide
- Ethanol
In the U.S., power generation comprises over 40 percent of overall national emissions.

In Louisiana, power generation comprises about 22 percent of overall state emissions. Louisiana’s primary source of CO₂ emissions comes from industry.

Sources: LSU | Center for Energy Studies (preliminary analysis)
U.S. Department of Energy | Energy Information Administration
Louisiana industrial CO₂ sources, candidate EOR fields and transportation infrastructure
Next Steps

• Finalize Memorandum of Understanding
• Activate “Project Development Team”
• Conduct Technical Assessment and Match CO₂ Producer – EOR User “Hubs”
• Conduct Outreach to Plant Managers, Environmental Directors, CFOs and Bankers
• Complete Phase II Credit Underwriting and Finance Modeling
• Conduct Industrial CCUS Roundtable Spring-2017
Upcoming Events

• Governor’s Summit on Energy Security and Infrastructure hosted by Governor Asa Hutchinson, Current Chairman of SSEB and IOGCC
  February 2017 | Washington, DC

• SSEB Associate Members Meeting
  February 2017 | Washington, DC

• SECARB Annual Stakeholders’ Briefing
  March 2017 | Atlanta, GA

• SSEB Committee on Clean Coal Energy Policies and Technologies
  May 2017 | Kingsport, TN

• SSEB Energy Briefing to Southern Legislators
  July 2017 | Biloxi, MS

• SSEB 57th Annual Meeting
  September 2017
Acknowledgements

• The SECARB material is based upon work supported by the U.S. Department of Energy National Energy Technology Laboratory. Cost share and research support provided by SECARB and SSEB Carbon Management Partners.

• The CO$_2$-USA project is based upon work supported by the U.S. Department of Energy’s Office of Fossil Energy. Cost share and research support provided by SSEB Carbon Management Partners.