



**Southern States Energy Board
Central Gulf Coast Initiative - CO₂
USA Project**

Brian W. Hill
bwh4403@gmail.com **980-322-8122**
Finance and Commercialization Consultant
Southern States Energy Board

March 8, 2017

Acknowledgements

This material is based upon work supported by the U.S. Department of Energy's Office of Fossil Energy through an agreement with Leonardo Technologies, Inc. (LTI-DT0002770). Cost share and research support is provided by SSEB Carbon Management Partners.

Contact Information

Southern States Energy Board

Ken Nemeth
Executive Director
770-242-7712
nemeth@sseb.org

Kimberly Sams-Gray
Managing Director
770-242-7712
gray@sseb.org

Gerald R Hill PhD, Inc.

Jerry Hill
Senior Technical Advisor to SSEB
404-386-6509
gerald.hill.phd@gmail.com

Brian Hill
*Commercialization &
Finance Consultant to SSEB*
980-332-8122
bwh4403@gmail.com

Guiding Principle

“Absent any government regulations on CO₂, all future investments made to capture CO₂ will need to be financially attractive based on revenue generated from the sale of CO₂ and/or revenue generated from oil production through CO₂-EOR”

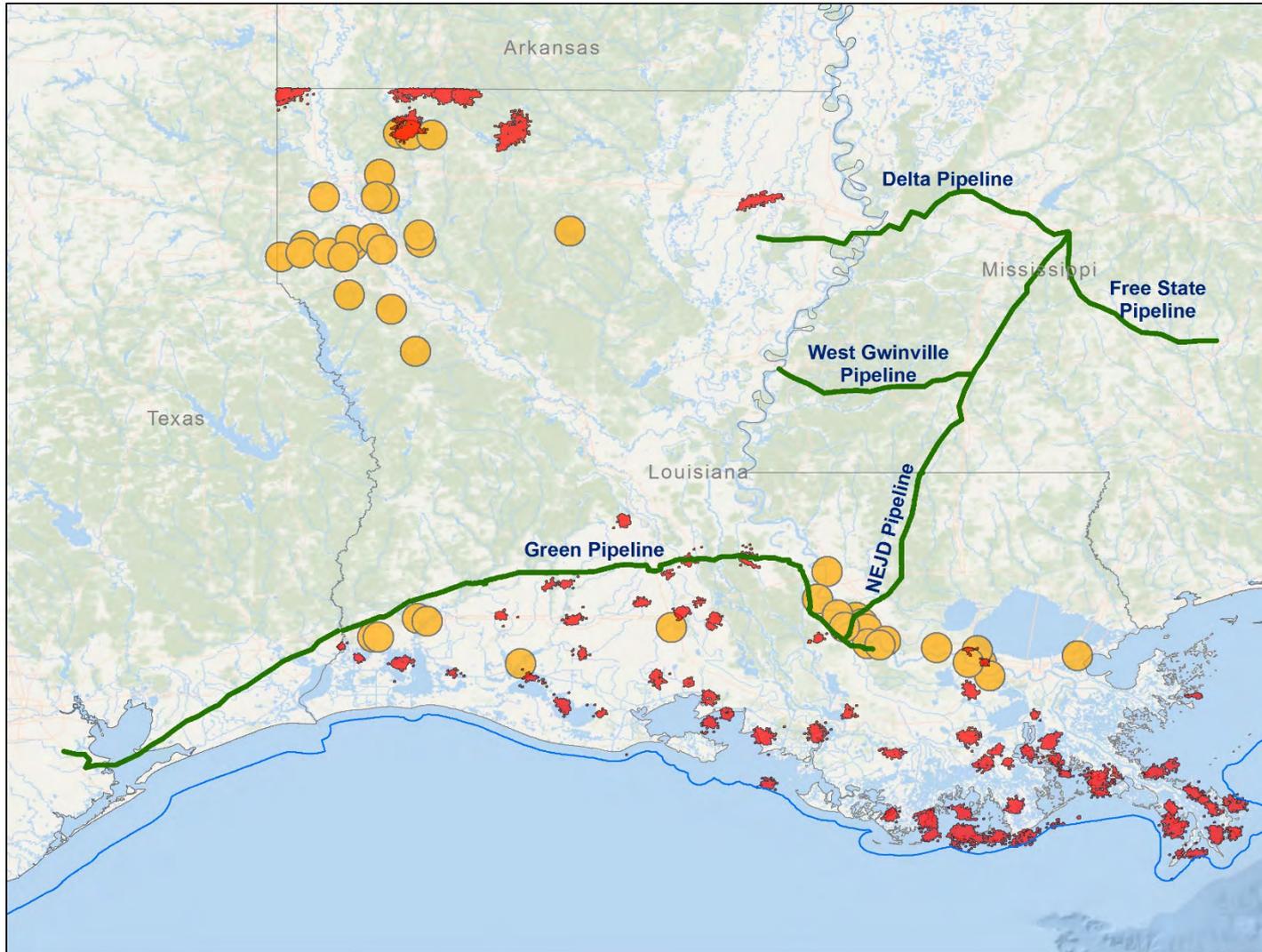
Source: Southern States Energy Board
CO₂ USA – Central Gulf Coast Region

Situation Overview

- The Central Gulf Coast Initiative for CO₂ Utilization and Storage Acceleration (CO₂ USA) is a market-driven undertaking to accelerate the commercialization of carbon capture, utilization and storage (CCUS) technologies within the industrial sector
- Southern States Energy Board, in cooperation with the U.S. Department of Energy's Office of Fossil Energy, is developing a roadmap and toolkit to rapidly implement industrial CCUS applications that value CO₂ as a commodity
- Within the Central Gulf Coast Region, there are many areas that could benefit from CCUS
- Louisiana and its industrial corridor along the Mississippi is uniquely situated to benefit from an integrated CCUS System
 - The State produces a large amount CO₂ from Industrial sources
 - The green pipeline runs across the southern part of Louisiana
 - Many of the existing oilfields could benefit from Enhanced Oil Recovery (EOR)

Louisiana CO₂-EOR Overview

Louisiana industrial CO₂ sources, candidate EOR fields and transportation infrastructure



● Industrial CO₂ Vents

■ Existing CO₂ Pipeline

■ Candidate EOR Oil Fields

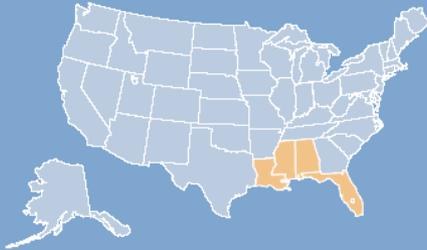
Sources: LSU | Center for Energy Studies (preliminary analysis)

Enhanced Oil Recovery

Prior DOE-funded EOR potentials research: onshore GOM.



BASIN ORIENTED STRATEGIES FOR CO₂
ENHANCED OIL RECOVERY:
ONSHORE GULF COAST



Prepared for
U.S. Department of Energy
Office of Fossil Energy – Office of Oil and Natural Gas

Prepared by
Advanced Resources International

February 2006

Recent DOE study estimated that Louisiana contains **128 onshore** reservoirs that are candidates for miscible CO₂-EOR:

- Under “Traditional Practices” 3 million barrels could be recovered, with estimated royalties of \$10.6 million.
- Under “State-of-the-Art” Technology 129 million barrels could be recovered, with estimated royalties of \$454 million.
- Under “More Favorable Financial Conditions” and “Risk Mitigation Incentives” 1,117 million barrels could be recovered with estimated royalties of \$5.2 billion.
- Under “More Favorable Financial Conditions” and “Low Cost CO₂ Supplies” 1,916 million barrels could be recovered with estimated royalties of \$9.0 billion.

Source: Advanced Resources International on behalf of the US Department of Energy

Initial Project Structure

Element 1 – CO₂ Capture

- CO₂ is captured from a single source and sold to a single end user for EOR
- Revenue generated by the sale of the CO₂ must provide sufficient revenue to meet minimum Commercial Bank underwriting requirements

Element 2 – CO₂ Transportation

- CO₂ is moved via dedicated pipeline from single source to EOR user
- Revenue generated by toll to move CO₂ must provide sufficient revenue to meet minimum Commercial Bank underwriting requirements

Element 3 – CO₂ EOR

- CO₂ is purchased at delivered price based on combined cost of capture and cost of transportation
- Revenue generated by EOR and sale of additional oil must provide sufficient revenue to meet minimum Commercial Bank underwriting requirements

Petra Nova Economics

“All the economics of the Petra Nova project are based on the oil field production,” explains NRG’s Bruce Chung. Capturing CO₂ comes at a substantial cost, and in the absence of an equally substantial penalty for carbon emissions, the only way to make the project financially viable is to employ the captured CO₂ for a productive use”

*Source: Financing Mega-Scale Energy Projects
A Case Study of the Petra Nova
Carbon Capture Project
Paulson Institute*



Government Assistance Remains Important

- Petra Nova Carbon Capture
 - \$167 million grant from United States Department of Energy Clean Coal Power Initiative
- Alberta Carbon Trunk Line
 - Government of Alberta is providing \$495 million
 - Government of Canada is providing \$63 million
 - Like an infrastructure project, Government is taking a long term view of investment
 - Project will generate up to \$15 billion in royalties
 - Direct employment of 2,000 individuals with another 8,000 indirect jobs
 - Providing opportunities for additional CO₂-EOR by overbuilding the pipeline
- Boundary Dam Project
 - \$250 million Government investment in serial number 001
 - Government and private industry partnership
 - Provides roadmap for future projects
 - Cost savings of approximately 30% on Serial number 002

WA Parish - Petra Nova Carbon Capture



Source: <http://www.nrg.com/> and MIT CCS Project Data Base

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

NRG and JX Nippon purchased 50% of West Ranch Oil Field

Alberta Carbon Trunk Line

- The Alberta Carbon Trunk Line (ACTL) is a 240 kilometer 16 inch pipeline capable of moving 14.6 million tons of CO₂ at per year
- The ACTL project encompasses the purification of CO₂ by North West Redwater Partnership (NWR) and the capture of CO₂ at both the Agrium and NWR sites, transportation and storage of CO₂ by Enhance Energy
- 10 year capital expenditures for the ACTL are estimated to be \$1.2 billion
- The Government of Alberta is providing \$495MM and the Government of Canada is providing \$63MM to the integrated project
- Enhance Energy purchased the Clive oil field from Santonia Energy Inc. in September 2013
- By using captured CO₂ for enhanced oil recovery, it is believed that the project will produce up to \$15 billion worth of royalties to the Province
- Construction of the pipeline will create 2,000 direct jobs and in the range of 8,000 indirect employment opportunities in central Alberta

Sources: Enhance Energy www.enhanceenergy.com



Boundary Dam Project



- In the fall of 2014, Boundary Dam Power Station near Estevan, SK, became the first power station in the world to successfully use Carbon Capture and Storage (CCS) technology.
- The \$1.24 billion government-industry partnership between the Government of Canada, Government of Saskatchewan, SaskPower and private industry was a full integration of a rebuilt coal-fired generation unit with carbon capture technology
- Project cost was \$1.5 billion of which \$240 million came from the federal government
 - Capable of capturing up to 800,000 tonnes of CO₂, the equivalent of taking more than 200,000 cars off our roads
 - Capable of reducing the SO₂ emissions from the coal process by up to 100 per cent and the CO₂ by up to 90 per cent
- Cenovus Energy has constructed a 66 kilometer pipeline to transport the CO₂ on behalf of the Weyburn Oil Unit partners. SaskPower owns an onsite disposal well, otherwise known as Aquistore