



Southeast Regional Carbon
Sequestration Partnership
*A Southern States Energy Board Carbon
Management Program*





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Background

In 2003, the United States Department of Energy (DOE) issued awards initiating seven Regional Carbon Sequestration Partnerships (RCSP) spanning the United States and portions of Canada. Managed by DOE's National Energy Technology Laboratory (NETL), the RCSPs currently represent more than 400 state agencies, universities, and private companies, spanning 43 states, three Native American Organizations, and four Canadian provinces. The Southern States Energy Board (SSEB) received an award on October 1, 2003, which established the Board's overall management and administration of the Southeast Regional Carbon Sequestration Partnership, or SECARB. The geographical region currently includes 13 states and a network of more than 100 stakeholders. The Nation's leading scientists, university researchers, national laboratories, industrial representatives, environmental organizations, and many others have taken a proactive approach at identifying and characterizing the most promising options for technology deployment and geologic carbon dioxide (CO₂) storage for the Southeast. The results obtained during these injections will be important to the future of carbon sequestration and the continued use of coal as a significant energy source in a manner that is environmentally responsible.

Each of the six SECARB project locations is locally coordinated by its own field team. The field teams assume responsibility for the technical scope of work, local education and outreach, permitting, monitoring, verification, and accounting, and maintaining the validation test's schedule and budget. Each team contributes new information to the continued characterization of the region. In addition, a task is dedicated to integrating field data and filling gaps in regional characterization data sets. Data and tools developed in the Continued Characterization task are incorporated into a relational database and geographic information system (GIS).

All field tests, the continued characterization project, and the cross-cutting functions are designed to support the DOE roadmap by validating technologies and identifying locations throughout the region that could support future full-scale geologic sequestration deployment opportunities. Detailed fact sheets for the SECARB projects are available on the SECARB website at www.secarbon.org.

SECARB Program

The SECARB Program is divided into three phases, all three of which are funded by DOE and cost-sharing partners. During Phase I (2003-2005) of the program, SECARB completed an initial screening of potential sources and terrestrial and geologic sinks for carbon sequestration and developed action plans for small-scale geologic carbon sequestration

field demonstrations. SECARB's Phase II Validation program (2005-2010) is implementing the action plans developed in Phase I and conducting three small-scale and diverse field tests in four locations. The 10-year Phase III Development program began in 2007 with a goal to develop an integrated CO₂ capture, transportation, and geologic storage project utilizing post-combustion CO₂ captured from a coal-fired power generating facility. Phase III includes two projects; the Early Test and the Anthropogenic Test.

SECARB Phase II Projects

Gulf Coast Stacked Storage Project

Enhanced oil recovery (EOR) stacked formations along the Gulf Coast are a prime target area for geologic storage of CO₂. Sequestration in these formations can help the United States reach national emissions reduction targets. SECARB's research estimates 31 billion metric tonnes (34 billion U.S. tons) of potential storage capacity in the region's depleted oil and natural gas fields. SECARB's Gulf Coast Stacked Storage Field Test, managed by the Texas Bureau of Economic Geology, began injecting CO₂ in July 2008 and concluded in 2010. The goal of this project is to validate the storage capacity of the stacked formations. It was the first of the RCSP's Phase II program to attain an injection volume of 500,000 metric tons. The site is located in Denbury Resources, Incorporated's Cranfield Oilfield near Natchez, Mississippi.

Coal Seam Projects (Central Appalachia and Black Warrior Basin)

Unmineable coal seams are among the most attractive potential CO₂ sinks occurring in the southeastern United States, where a prolific coal bed methane industry, which has produced more than 2.3 trillion standard cubic feet (Tscf) of natural gas, is approaching maturity. CO₂ sequestration in unmineable coal seams can enhance coal bed methane production to help offset sequestration costs. An estimated 82.1 billion metric tonnes (90.3 billion U.S. tons) of potential storage capacity exists in the region's unmineable coal seams. There are two SECARB Phase II enhanced coal bed methane (ECBM) field tests. The first is managed by Virginia Tech, and CO₂ injection of 1,000 tons was completed in February 2009. This test utilized an existing CNX Gas well located in Russell County, Virginia. The second is managed by the Geological Survey of Alabama, and El Paso Exploration and Production has donated a well to the SECARB team for CO₂ injection. Four wells were drilled to monitor reservoir pressure, gas composition, water quality, and the CO₂ plume. The targeted coal seams are in the Pratt, Mary Lee, and Black Creek Coal groups within the upper Pottsville Formation and range from 940 feet to 1,800 feet in depth and from 1 foot to 6 feet in thickness. Two hundred and forty (240) tons of CO₂ was injected between June 15 and August 31, 2010. The site is located near Tuscaloosa, Alabama.



CO₂ injection at the Central Appalachian Coal Seam Project site in Russell County, Virginia.

Photo courtesy of the Virginia Center for Coal and Energy Research, Virginia Tech, January 2009.



Dr. Jack Pashin, GSA, explaining the pressure gauges and gas sampling lines at the 1-South monitoring well.

Photo taken on April 28, 2010, by Kimberly Sams of SSEB.

These projects focus on coal seams with high methane content and unmineable coal seams in the vicinity of existing coal fields extending from the Appalachian Range, southwesterly into the Black Warrior Basin, and towards the Gulf Coast. The objectives for the Coal Seam Projects include the following milestones.

- These field tests will demonstrate injection for ECBM in the southeastern United States and will investigate sequestration in unmineable coal seams.
- A breakthrough concept for sequestering a full range of coal-fired power plant emissions will be investigated.
- This task consists of the following subtasks: Project Definition; Design; Implementation; Operations; and Closeout/Reporting.
- Documentation in accordance with the National Environmental Policy Act (NEPA) will be prepared and submitted to DOE for review and approval; additional NEPA documentation will be prepared as required.

Saline Reservoir Field Test

Saline formations are the primary CO₂ geologic storage option for the SECARB region because of the extensive saline formations that underlie many of the power plants in the region. SECARB's research estimated 1,440 billion metric tonnes (1,584 billion U.S. tons) of potential sequestration in saline formations in the region. Work performed during the Characterization Phase showed that saline formations with favorable sequestration potential underlie Alabama, Florida, Louisiana, Mississippi, East Texas, and Tennessee. Mississippi Power Company's Victor J. Daniel coal-fired power plant is the host site of SECARB's Saline Reservoir Field Test, which is managed by the Electric Power Research Institute. Injection operations were conducted from October 2-28, 2008.



Open House education and outreach event during CO₂ injection operations at the Saline Reservoir Test Center Project at Mississippi Power Company's Plant Daniel in Escatawpa, Mississippi.

Photo taken on October 15, 2008 by Kimberly Sams of SSEB.

SECARB Phase III Projects

Early Test

The Early Test, currently underway in Cranfield, Mississippi, will inject at a rate of 1.5 million tonnes of CO₂ per year for 18 months. In August 2009, the team met a milestone of monitoring an injection of more than one million tonnes of CO₂. In November 2009, the SECARB Early Test was recognized by DOE for furthering CCS technology and meeting G-8 goals for deployment of 20 similar projects by 2010 ([DOE Techline](#)). The Early Test is the fifth project worldwide to reach this CO₂ injection volume and the first in the United States. As of June 30, 2010, the project team has stored over 2.5 million tonnes of CO₂ at this site. The SECARB project team is taking advantage of ongoing CO₂-EOR efforts by the field operator, Denbury Resources, Inc. Research is underway in four areas: (1) the High Volume Injection Test area (HiVIT); (2) the Detailed Area of Study (DAS); (3) the Geomechanical Test area; and (4) the near surface observatory. Following release of a Finding of No Significant Impact on March 17, 2009, Phase III injection started on April 1, 2009 at the HiVIT area and in December 2009 at the DAS.



Monitoring/Observation Well (CFU 31-F2 #1), located at the SECARB Phase III Detailed Area of Study in Cranfield, Mississippi. Note the various tools on the well, indicating the multiple MVA tools being deployed at the site.

Photo taken on April 10, 2010, by Kimberly Sams of SSEB.

Anthropogenic Test

Information from the Early Test will be applied in Fiscal Year 2011 at the Anthropogenic Test, a fully integrated carbon dioxide capture, transportation, and geologic storage project. Under separate funding, the CO₂ will be captured at Alabama Power Company's Plant Barry, a coal-fired power generating facility located in Bucks, Alabama, and transported by pipeline and sequestered within a saline formation at the nearby Citronelle, Alabama, oil field operated by Denbury Resources, Inc. During the Anthropogenic Test, Denbury will inject approximately 100,000 to 150,000 tonnes of CO₂ per year for up to three years. The SECARB team will deploy an extensive monitoring, verification, and accounting program that will commence pre-, during, and post-injection. The Anthropogenic Test is the first RCSP Phase III large-scale project to utilize anthropogenic, or man-made, CO₂ for geologic storage. To date, the capture unit at Plant Barry is completed, and a characterization well was drilled in January 2011. Detailed geologic analyses of the injection target and the confining units are being conducted and reservoir models are being refined accordingly.



Left: Drilling rig at the Anthropogenic Test CO₂ monitoring well for geologic storage, located in Citronelle, Alabama (January 2010). Right: The team hosts 30 early career professionals on a tour of the future CO₂ injection site on June 11, 2011.

(Photos courtesy of SSEB and EnTech Strategies.)

Complementary Activities

Continued Characterization: Most Promising Geologic Storage Opportunities for CO₂

While the SECARB Phase I project was dedicated to identifying the most promising opportunities for geologic storage of CO₂ in the southeastern United States, characterization efforts continue throughout the life of the program. Within the scope of Phase III, the team has identified a multitude of Cretaceous-age sandstone units (saline reservoirs) of the Paluxy Formation, Washita-Fredericksburg interval, Tuscaloosa Group and Eutaw Formation that are suitable for safe, long-term geologic storage of CO₂. Extensive characterization of core samples taken during well drilling at SECARB sites is ongoing.

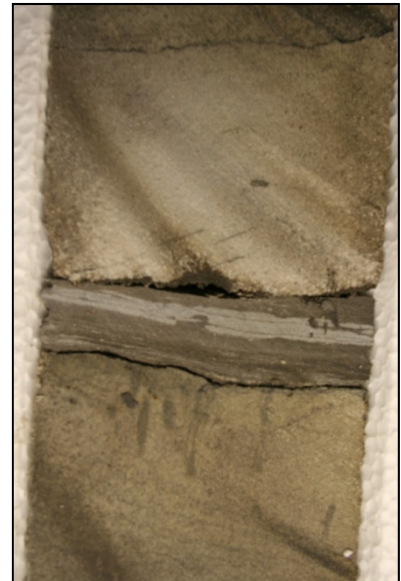
Outreach and Education

The Southern States Energy Board serves as the lead organization for regional outreach and education activities. This work augments the site-specific education and outreach that the field teams conduct. SSEB provides region-wide and, to the extent requested by DOE, national assistance in public education and outreach. SSEB represents the SECARB partnership in DOE conference calls and forums set up by DOE among the regional partnerships.

SECARB's outreach and education activities have been focused on the following four primary tasks:

1. teaching the individuals who will take responsibility for implementing site-specific education and outreach programs;
2. presenting the Regional Carbon Sequestration Partnership and SECARB program to various audiences;
3. developing education and outreach action plans; and
4. identifying the materials and support needed to implement these plans.

SSEB provides support and guidance in program design and implementation strategies. Many of the partners' education and outreach programs are based on lessons learned from previous field experiences while others programs are designed from the beginning. In both instances, it is imperative that all members of the partnership understand the basic science of all carbon sequestration technologies to be validated by SECARB.



the Saline Aquifer Test Center project in Escatawpa, Mississippi. Note the shale stringer in the sandstone of the lower Tuscaloosa Formation.

Photo Courtesy of the Electric Power Research Institute and Advanced Resources International, March 2008.

Team meetings are important to this process of educating SECARB's program partners. During these meetings, the lead for each field test site presents the technical, financial, and administrative details of their project. These frequent reports reinforce the partners' understanding of the overall SECARB program. Additionally, all members of the SECARB team benefit from this interaction as they design their field validation projects, including their education and outreach approaches.



Virginia Congressman Rick Boucher powers on the drill during the SECARB Central Appalachian Coal Seam Project Groundbreaking Ceremony.

Photo taken on August 19, 2008, by Kimberly Sams of SSEB.

SSEB provides a “partner area” webpage whereby SECARB partners can access and/or download all deliverables, including the monthly, quarterly annual status reports submitted to DOE/NETL, and view the current program fact sheets, recent presentations and many other useful documents. The SECARB website resides at www.secarbon.org.

SSEB representatives and members of each field test site participate in the monthly Outreach Working Group (OWG) conference calls. These calls have proven helpful in familiarizing our team with the level of public knowledge of carbon sequestration and climate change issues on a regional, national and global level. SECARB partners regularly update the OWG participants on the progress of SECARB field team outreach and education activities.

SECARB partners have presented thousands of papers throughout the life of the program. The various audiences reached with this outreach and education activity ranged from technical experts, members of the state and federal governments, industry partners, other regional stakeholders, international conferences, and the media.

Legal and Regulatory Analysis

Throughout the life of the SECARB Phase II program, the partnership led a RCSP Regulatory Working Group. Since the task's closeout in September 2009, SSEB continues to provide all regulatory and permitting cross-cutting support to the field teams, as required. SSEB also

monitors federal and state regulatory and legislative activities and reports significant findings to the field team leads, SECARB stakeholders, and appropriate SSEB members and affiliates. In July 2011, SSEB published ***Carbon Capture and Sequestration Legislation in the United States of America***. This study provides an overview of four key areas identified as necessary elements of a broader comprehensive regulatory framework governing CCS activities. The key areas are Project Authority, Pore Space and CO₂ Ownership, Liability and Financing Sources. The publication is available under the Reference tab of the SSEB website (www.sseb.org).

Pipeline Study

The Pipeline Study task was established on June 1, 2009, to identify barriers and opportunities for the wide-scale construction of pipelines to transport carbon dioxide for the purposes of sequestration, enhanced oil recovery, and other commercial uses. Other objectives are to inform key decision-makers about transportation as it relates to guidelines, legal, regulatory, and liability frameworks for CCS; to facilitate cooperation, collaboration, and communication among key stakeholders involved in pipeline infrastructure planning and development; and to form a basis for continued future planning and communication. The Pipeline Transportation Task Force published its research findings and recommendations on January 31, 2011 (visit secarbon.org to download the report). The Interstate Oil and Gas Compact Commission is participating with SSEB on the study.

Offshore Study

On September 30, 2009, the SECARB partners initiated a Preliminary Evaluation of Offshore Transport and Storage of CO₂ as part of the Phase III program. The objective of this task is to evaluate the potential for geological storage of CO₂ offshore and the existing infrastructure when applicable. The study focuses on two scenarios: (1) where existing oil and natural gas fields are nearing the end of productive life; and (2) where the geologic settings may be suitable but the area has not been subject to oil and natural gas production.

By the end of the 18-month period, the project team will determine if these offshore settings and any existing infrastructure are suitable for a sequestration project. SSEB's partners in this effort include the Bureau of Economic Geology at The University of Texas at Austin, the Geological Survey of Alabama, and the Interstate Oil and Gas Compact Commission.

SECARB

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