SOUTHERN STATES ENERGY BOARD

Transcending Boundaries

Overview of the Southeast Regional Carbon Utilization and Storage Acceleration (SECARB-USA) Initiative

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Southern States Energy Board
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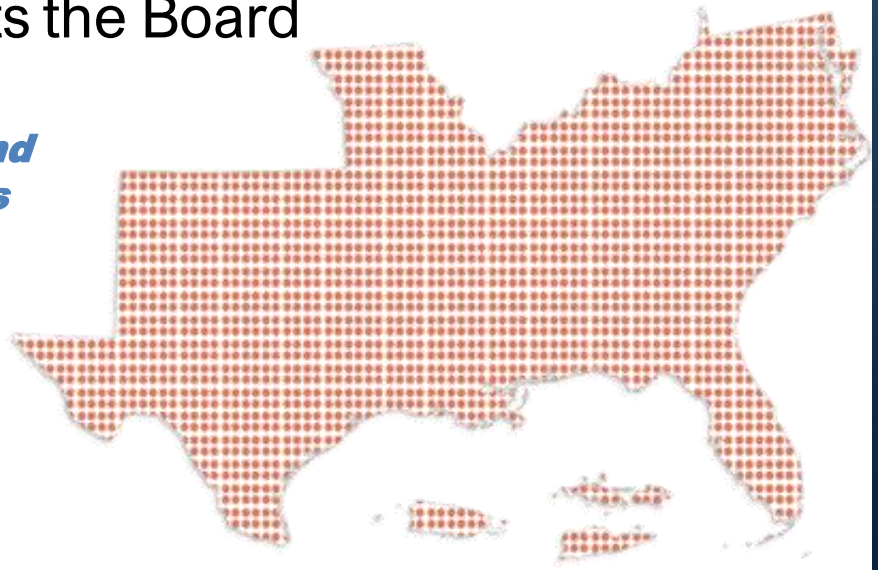
NATIONAL ENERGY TECHNOLOGY LABORATORY

Southern States Energy Board

- Interstate Compact Organization, created by state law and consented to by Congress (PL 87-563, PL 92-440)
- 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
- Secretary, who serves as Executive Director
- Technical staff that supports the Board

"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."

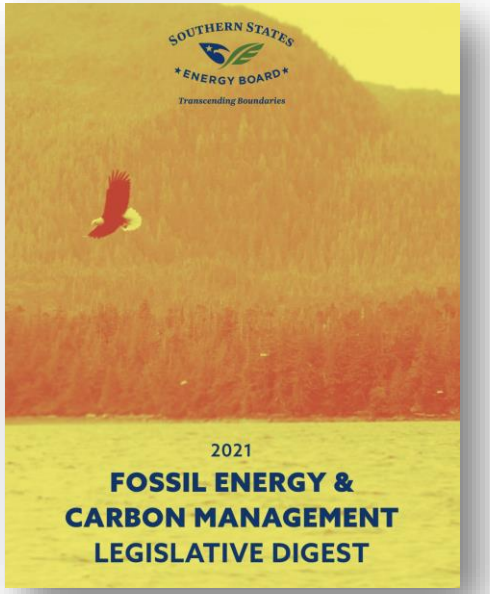
SSEB Mission Statement

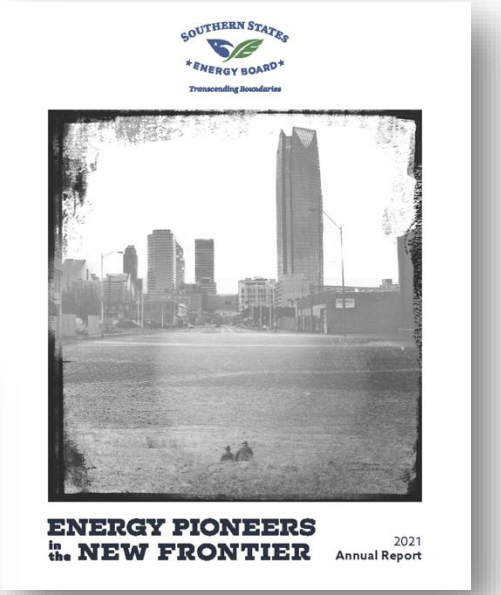


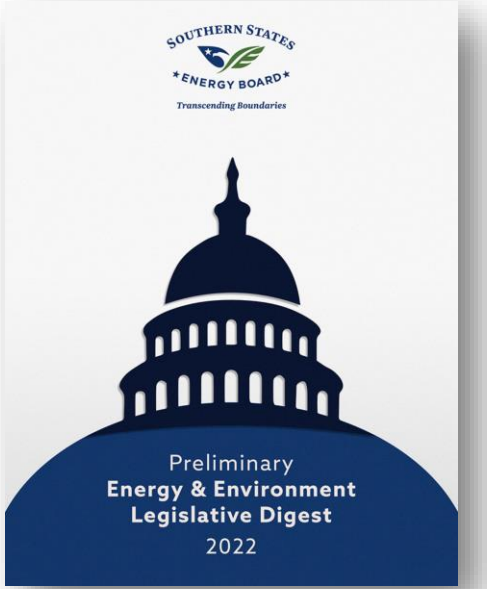
Associate Membership

Knowledge Sharing

- **Liaison with Congress and state legislatures**
  - Tracks the progress of state and federal legislation related to energy and environmental issues
- **Southern Regional Energy Profiles**
- **Energy & Environment Legislative Digest**
  - Over 540 energy & environmental measures
  - Trends - Energy discrimination, Broadband deployment, Electric vehicle infrastructure, Renewable energy
- **FECM Digest**
  - Covers notable FECM bills across all 50 states
- **NETL Best Practice Manuals (contributor and case studies)**
- Visit www.sseb.org for more information







CCS – SSEB Timeline

2000s

Clear Skies Initiative leads to DOE Regional Carbon Sequestration Partnership Program. SSEB Chair Governor Bob Wise establishes Carbon Management program

SECARB Phase I

2003 - 2005

Established the Southeast Regional Carbon Sequestration Partnership. Evaluated storage potential and source-sink matching in the region and **identified field test locations**.

SECARB Phase II

2005 - 2007

Designed and implemented CO_2 injection field tests in Alabama, Mississippi, and Virginia. Goal to **evaluate injection methods and identify operational risks**.

SECARB Phase III

2007 - 2020

Demonstration of integrated CCUS at coal-fueled power plant. Technologies transferred to 250 MW Petra Nova facility. MVA technologies evaluated and **over 5 million tons of CO_2 stored**.

2020s

Five ongoing CCUS R&D projects. Projects include regional assessment of infrastructure needs and risks as well as data gathering and field projects. Also support other projects.

SECARB-USA Partners

Student Activity

Graduate
- Chidera Iloejesi - pore scale and CO_2 trapping
- Jamie Newsome - geomechanical reactivity
- Nora Lopez Rivera – geomechanical reactivity

Post Doc
- Zhuofan Shi - mineral reactivity and reservoir properties

Graduate
- Arnold Aluge - assessing CO_2 storage potential
- Camelia Baluta - digitizing and data control
- Taylor Barnhart - cost of site characterization
- Angela Luciano – reservoir property inventory

Undergraduate
- Colton Hayden - digitizing and data selection
- Amanda Merida Rodriguez - digitizing and data control

Graduate
- Multiple former graduate students supported under this agreement, awaiting foreign national approval for future students

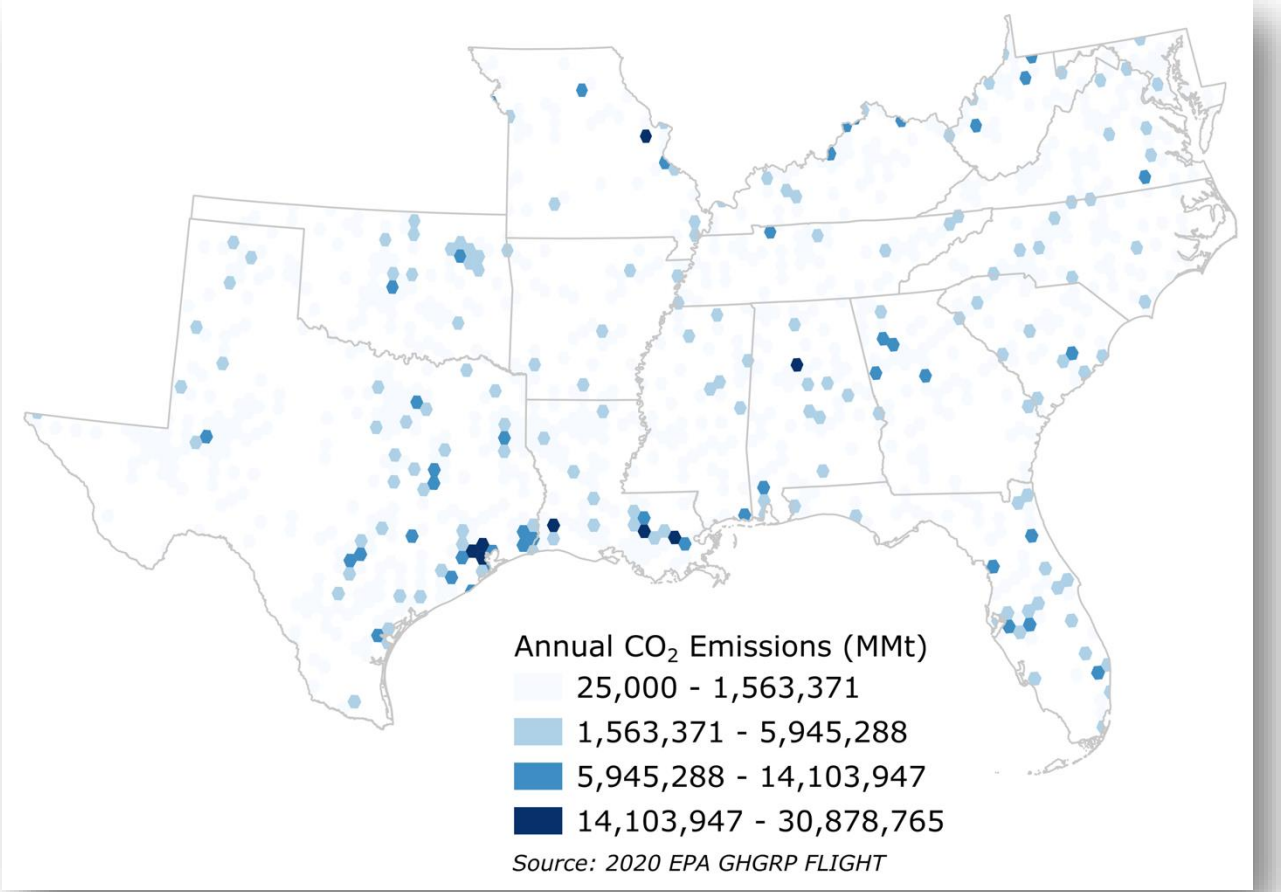
Graduate
- Charles Schlosser – site screening
- Lars Koehn – CO_2 storage modeling

Undergraduate
- Kristen Claye - geologic modelling
- Nick Fowler - literature search on VA basins
- Mary Verne - literature search on VA basins

CCS - Motivation

- Region accounts for over 1.2 billion metric tons of annual CO_2 emissions, or ~ 30% of U.S. annual emissions
  - Utility-scale electric generation
  - Industrial activities
  - Regional importance (jobs, energy security)
- Over 5 trillion metric tons of estimated subsurface storage capacity in the region's saline reservoirs (P_{50}, NATCARB)
- Industry interest in decarbonizing

Spatial Density of CO_2 Emissions in the Southeast



SECARB-USA: Past Activities

- One of four DOE Regional Initiatives tasked with identifying and removing barriers to the commercial deployment of CCUS
- Developed a needs assessment framework for prospective storage complexes in the region based on Class VI requirements
- Preliminary evaluation of regional storage potential and costs using NRAP and SCO_2T
- Identified prospective sub-basins in the region for CO_2 storage
- Coordinated with industry partners (Clear Air Task Force, Denbury, Southern Company, and others) to develop an inventory of non-technical challenges to the commercial deployment of CCS

Southeast Regional CO_2 Utilization & Storage Acceleration Partnership

SECARB-USA

The Southern States Energy Board (SSEB) is leading a coalition of technical experts to identify and address regional onshore storage and transport challenges facing commercial deployment of carbon dioxide (CO_2) capture, utilization and storage (CCUS) technologies.

The goal of the "Southeast Regional CO_2 Utilization and Storage Acceleration Partnership" (SECARB-USA) project is to help the United States meet its need for secure, affordable, and environmentally sound fossil energy supplies by utilizing the advancements made by the Regional Carbon Sequestration Partnership (RCSP) Initiative to continue to identify and address knowledge gaps.

SSEB and a select network of experienced CCUS project developers and operators will coordinate their capabilities to accelerate CCUS deployment and achieve four primary research objectives: 1) address key technical challenges; 2) facilitate data collection, sharing and analysis; 3) assess transportation and distribution infrastructure; and 4) promote regional technology transfer and dissemination of knowledge.

The SECARB-USA regional initiative encompasses the States of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and portions of Kentucky, Missouri, Oklahoma, Texas, and West Virginia. The Southern States Energy Board is the award recipient.

To date, the project team has made significant strides towards de-risking commercial investment in CCUS technologies. For example, a regional assessment of prospective storage complex subsurface data availability revealed data gaps throughout the region. It was observed that data availability is strongly correlated with historical oil and gas exploration and production. Consequently, less information is available to decision makers in and around the Appalachian fold-thrust belt, the Rome Trough, and the coastal plain of Georgia, South Carolina, North Carolina, Virginia, and Maryland. These observations supported Southern Company's stratigraphic test well drilling in the Valley and Ridge province of north-central Alabama and northwest Georgia. Broadly, the information obtained through field activities will be incorporated into the SECARB-USA knowledge base and may provide potential sinks for emitters in the area.

In addition to the technical activities highlighted above, the project team is actively engaged with industry, regulators (state and federal), legislators, and the public more broadly. In total, 186 separate engagements were documented by the project team over a one-year period (Q2 2021 through Q2 2022). Additionally, the program has supported numerous undergraduate and graduate students at the Auburn University, Oklahoma State University, the University of Texas at Austin, and Virginia Tech.

CARBON STORAGE MAP

SOURCE: NETL (2019)

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Field Test Partners

Primary Sponsors
- US DOE
- NETL
- SSEB

Partners
- Advanced Resources International, Inc.
- Auburn University
- Bureau of Economic Geology at the University of Texas at Austin
- Crescent Resource Innovation (Gerald R Hill PhD)
- Environmental Defense Fund
- Geological Survey of Alabama
- Los Alamos National Laboratory
- Oklahoma State University
- SAS Institute, Inc.
- Virginia Center for Coal and Energy Research at the Virginia Polytechnic Institute and State University

Industry Network
- Clean Air Task Force
- Denbury Resources, Inc.
- Mitsubishi Heavy Industries America, Inc.
- Repsol
- SAS Institute, Inc.
- Southern Company

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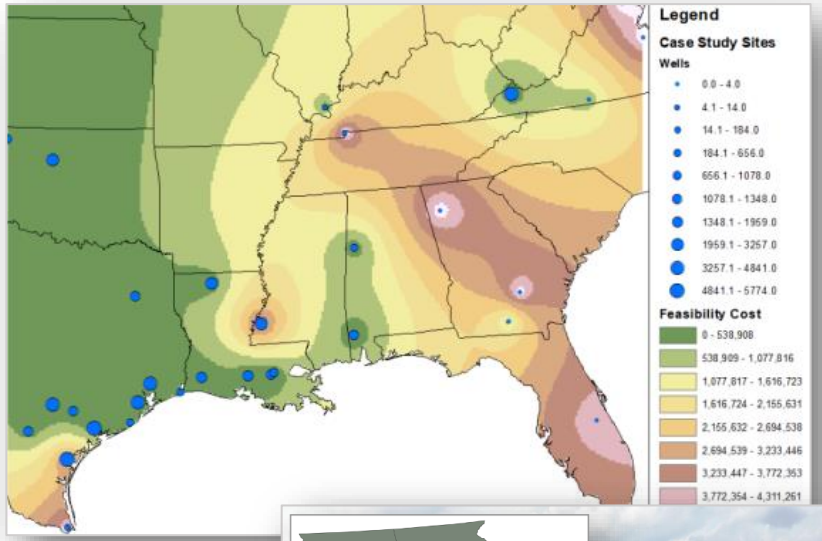
UNIVERSITY OF NORTH DAKOTA
NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

SECARB-USA 2022 Fact Sheet

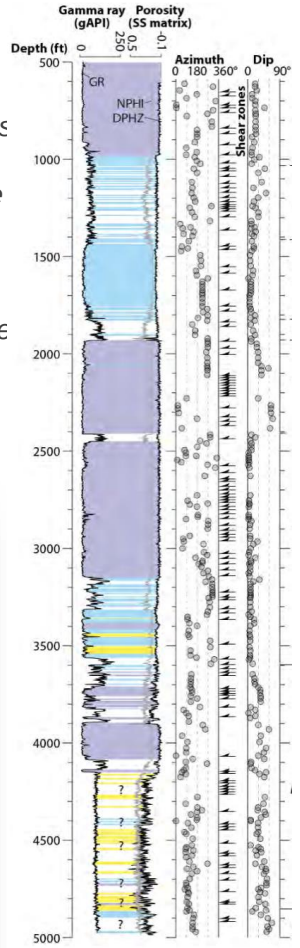
SECARB-USA: Ongoing Activities

- Evaluated subsurface data density according to U.S. EPA Class VI permit requirements (over 40 metrics evaluated per location)
- Purpose: to identify subsurface data gaps in the region and de-risk industry investment
- Test well drilling in AL and GA near large-volume emitting facilities
  - Promising results in northwest GA
  - Cambrian Conasauga Formation
- Focus future characterization efforts



Prospective CO_2 storage sites in the SECARB-USA region and approximate costs associated with characterization at the feasibility level. Costs are broadly correlated with historical oil and gas exploration. Figure courtesy of Sue Hovorka and BEG. Data is from the SECARB-USA team.

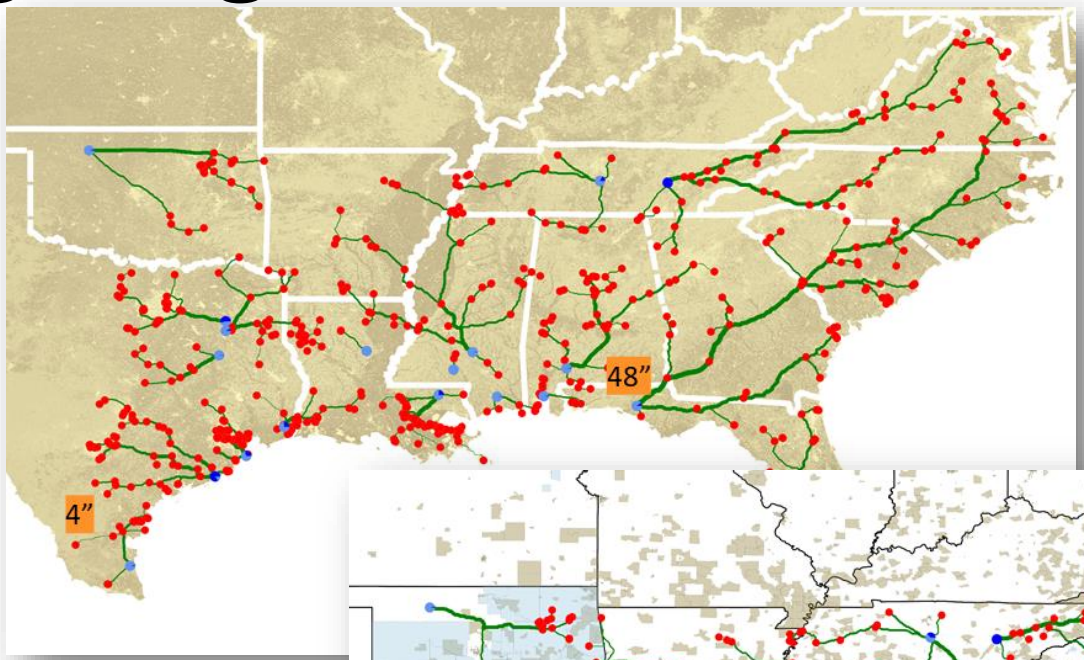
Aerial photograph of the Cassville stratigraphic test well located in Bartow County, GA. Image courtesy of Dr. Randy Kath (University of West Georgia).



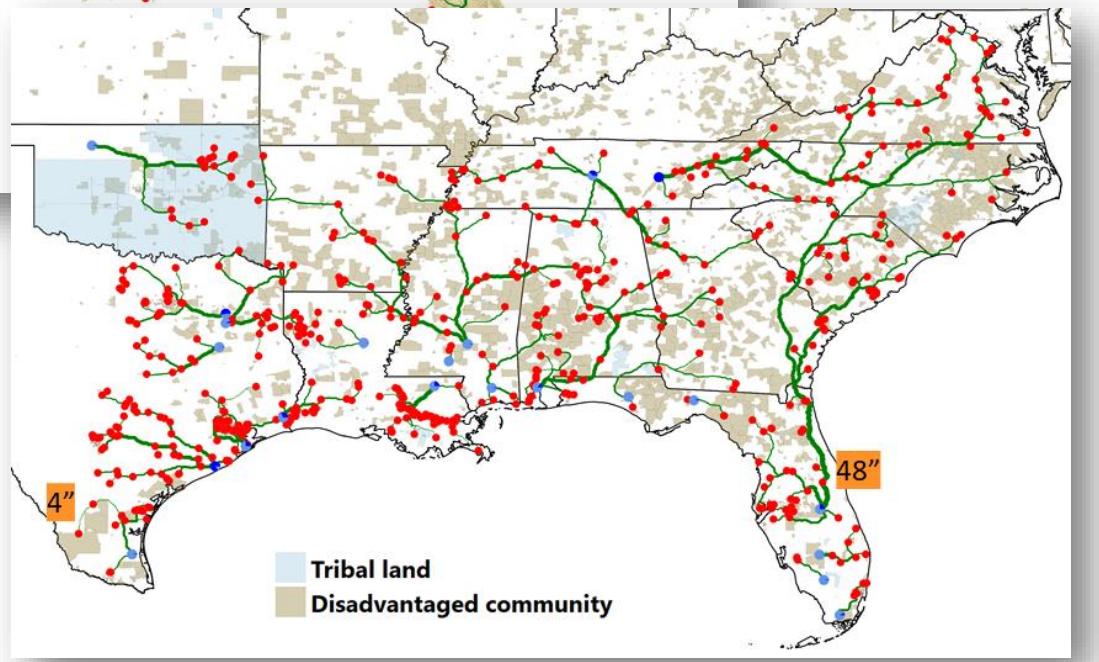
Stratigraphic column with gamma ray, sonic porosity, azimuth, and dip.

SECARB-USA: Ongoing Activities

- Evaluating regional infrastructure buildout scenarios
  - Major considerations include cost of capture, environmental justice, and environmentally sensitive areas
- Phased infrastructure buildout results in the capture of 1 billion metric tons of CO_2 over four separate phases
- Avoiding EJ communities' results in 11% more pipe and an overall increase in per unit cost ($/t$CO_2$) that is only 7% more than the base case scenario



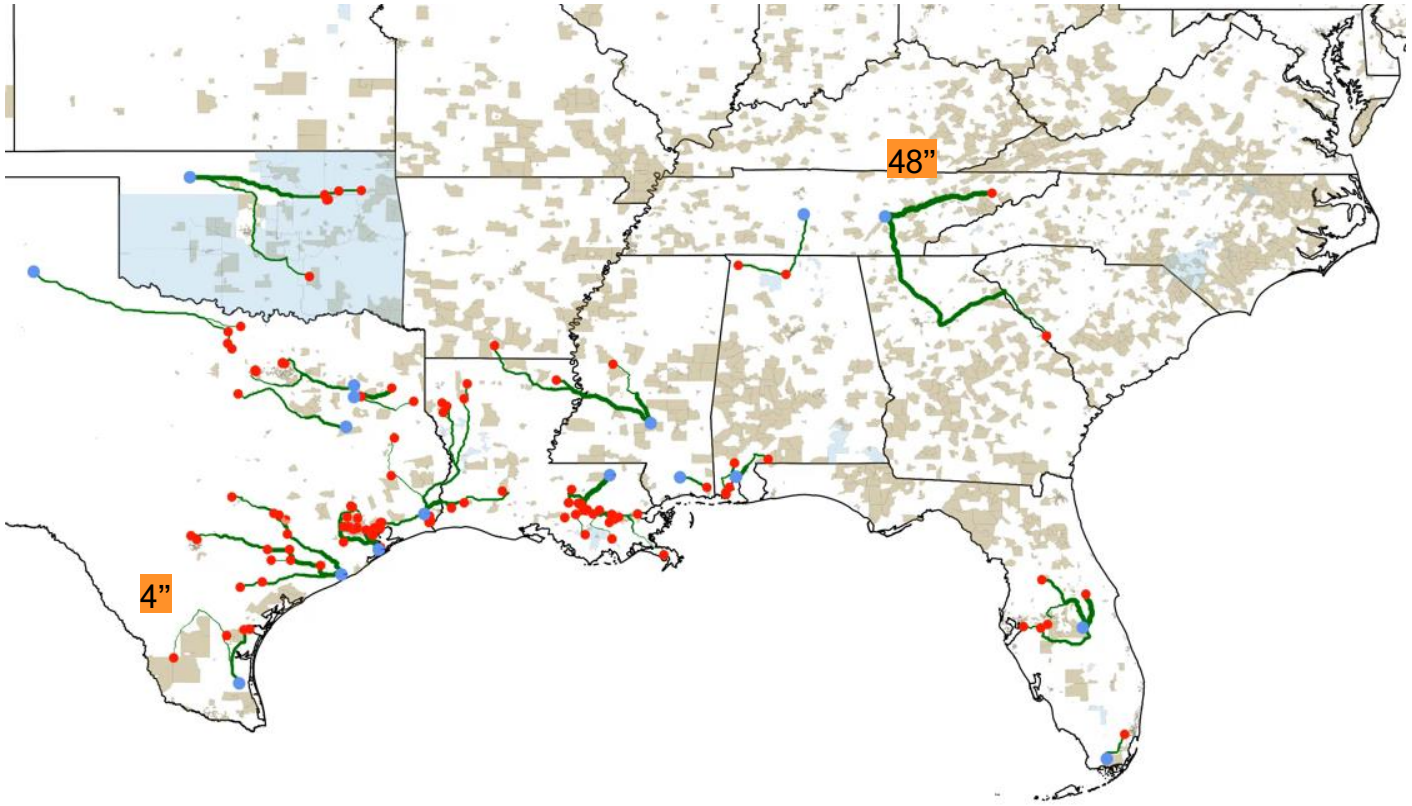
Pipeline optimization without consideration for tribal lands or environmental justice communities. Image courtesy of Los Alamos National Laboratory.

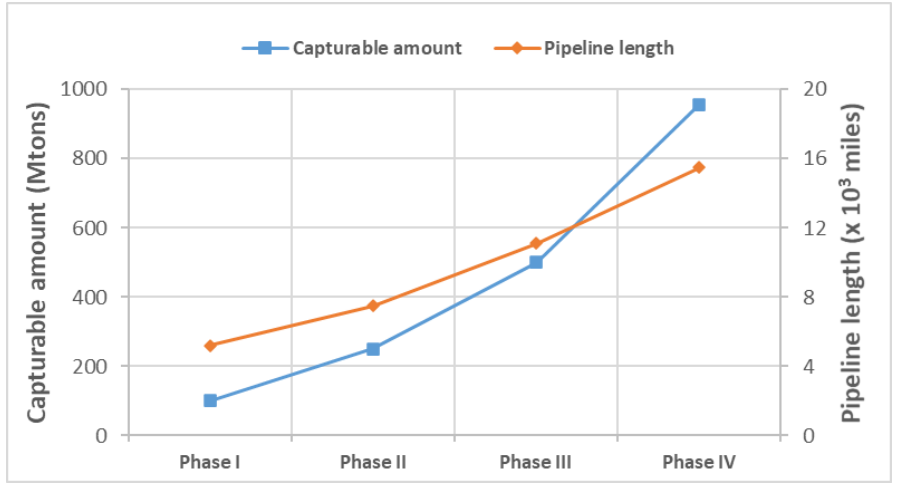


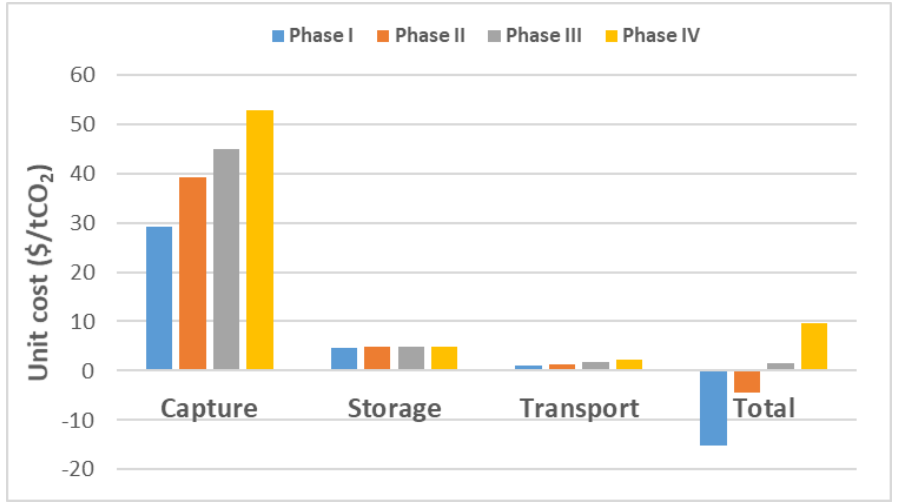
Pipeline optimization avoiding tribal lands (blue polygons) and environmental justice communities (beige polygons). Figure courtesy of Los Alamos National Laboratory.

SECARB-USA: Ongoing Activities

- **Scenario:**
  - Four separate 5-year phases



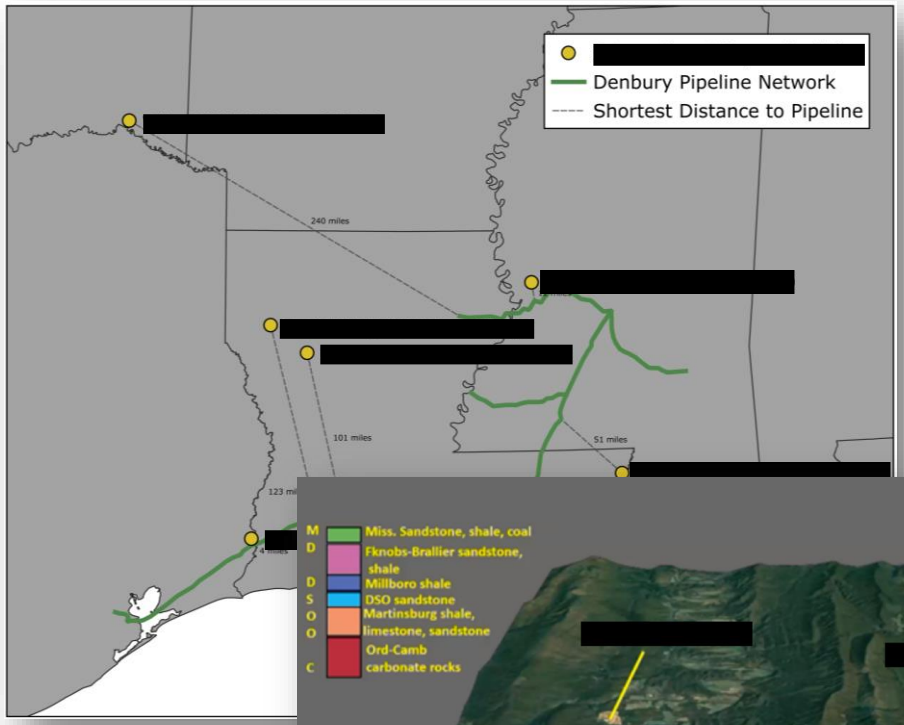




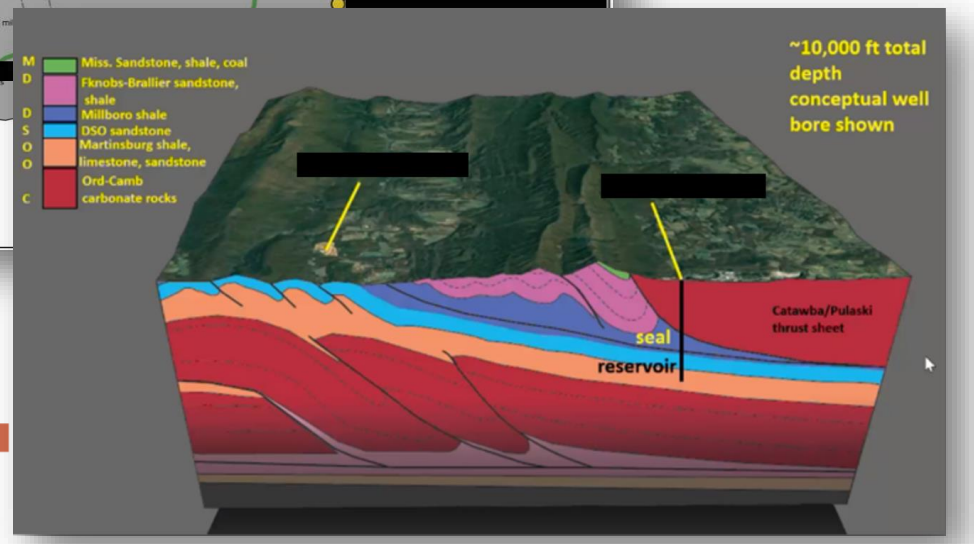
Scenario and graphics produced by LANL.

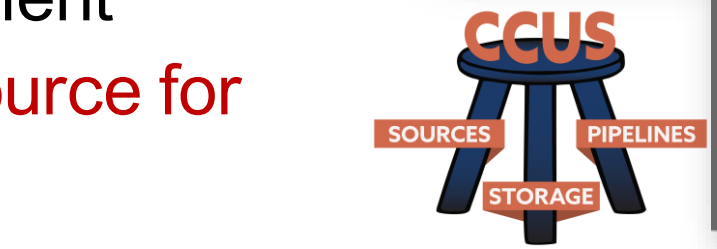
SECARB-USA: Industry Outreach Activities

- Over 180 reported instances of outreach over the last year
- 65 instances of knowledge sharing with industry partners interested in CCS
- Outreach may include general overview of regional initiatives and CCS
- Initial feasibility studies developed for pulp/paper and cement
- Regional knowledge source for industry partners



Least distance path from existing pulp and paper facilities to existing CO_2 pipelines owned and operated by Denbury in Louisiana, Mississippi, and Texas. Figure authored by SSEB.





Conceptual schematic of the study area and geology underlying a cement plant near southwest Virginia. Figure courtesy of Dr. Philip Prince, Virginia Tech.

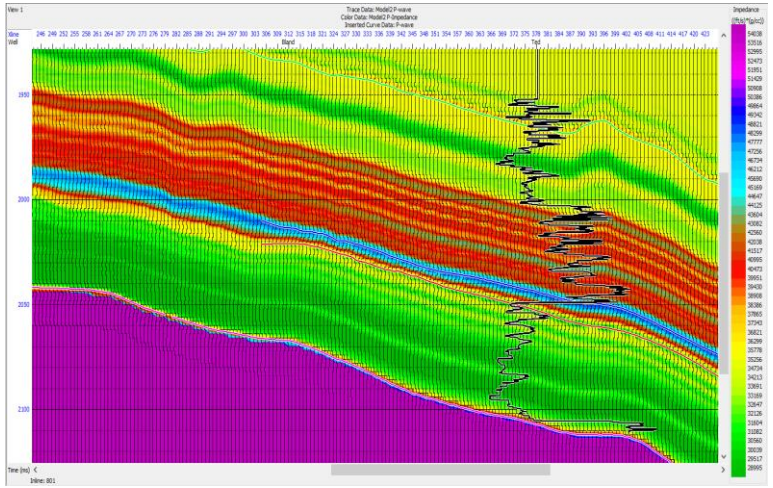
Other Outreach Activities

- Providing SME to regulators and identifying areas of multi-state and multi-agency collaboration
  - Coordinating meetings to discuss technical aspects of Class VI permitting (e.g., well design)
- Hosted May 16 Regulator Workshop in collaboration with SECARB: Offshore and GoMCarb
  - AL, AR, and MS interested in primacy (consolidating authority)
  - Lots of industry interest in LA and TX
  - BOEM and BSEE developing regulations as required by the bipartisan infrastructure law

Participation in the 2022 Gulf Region Regulator Workshop

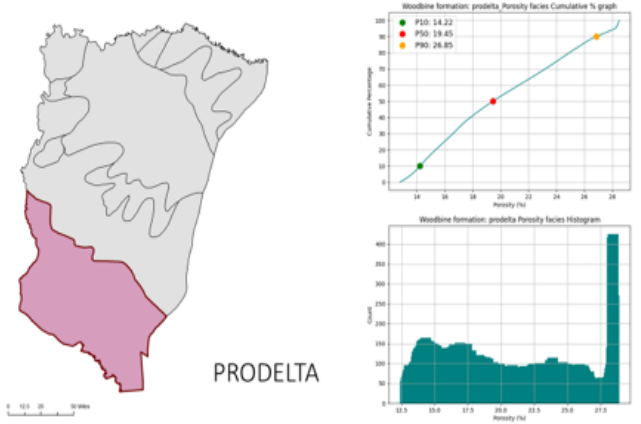
SECARB-USA: Other Activities

Regional Characterization



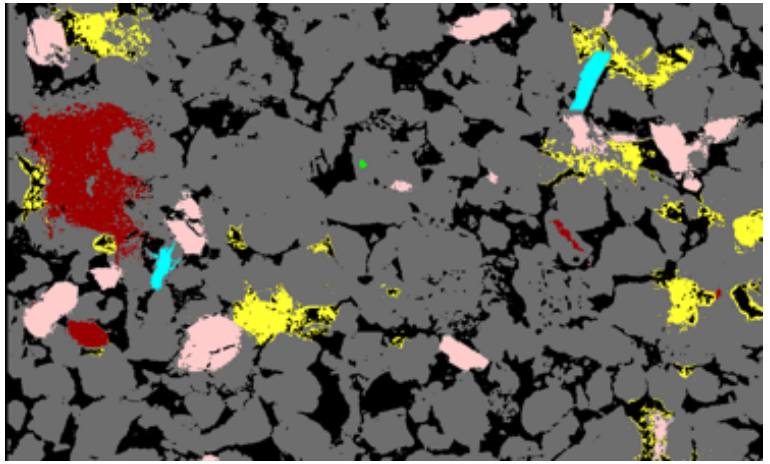
Continued characterization of storage targets utilizing existing data. Recent efforts are focused on GA, LA, OK, TX, and VA.

Basin Variability



Developing a methodology to account for basin subsurface heterogeneity to inform infrastructure modeling and injection scenarios.

Pore-Scale Impacts



Evaluating pore-scale impact of CO_2 on storage reservoir and cap rock integrity. Utilizing known regional targets and cap rocks.

SECARB-USA: Moving Forward

- Augment existing regional subsurface data by acquiring 2D seismic and drilling additional stratigraphic test wells – **scheduled for September 2022**
- Collaborate with industry partners to evaluate CO_2 storage feasibility near existing assets and to assist in the development of business plans, many of which involve multiple companies (hub concept) - **ongoing**
- Build out a more robust stakeholder engagement and outreach plan, focusing on disadvantaged communities and tribal lands - **ongoing**
- Build on existing infrastructure assessments and development cost models – **ongoing working with FEED studies to update capture data**
- Develop an interactive dashboard for educational purposes that includes infrastructure scenarios, costs, risks, societal considerations and impacts (energy and environmental justice; and diversity, equity, inclusion and accessibility), and workforce readiness and development - **ongoing**

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