Southeast Regional Carbon Sequestration Partnership (SECARB)

NETL

Governor's Energy Summit
Roanoke, West Virginia
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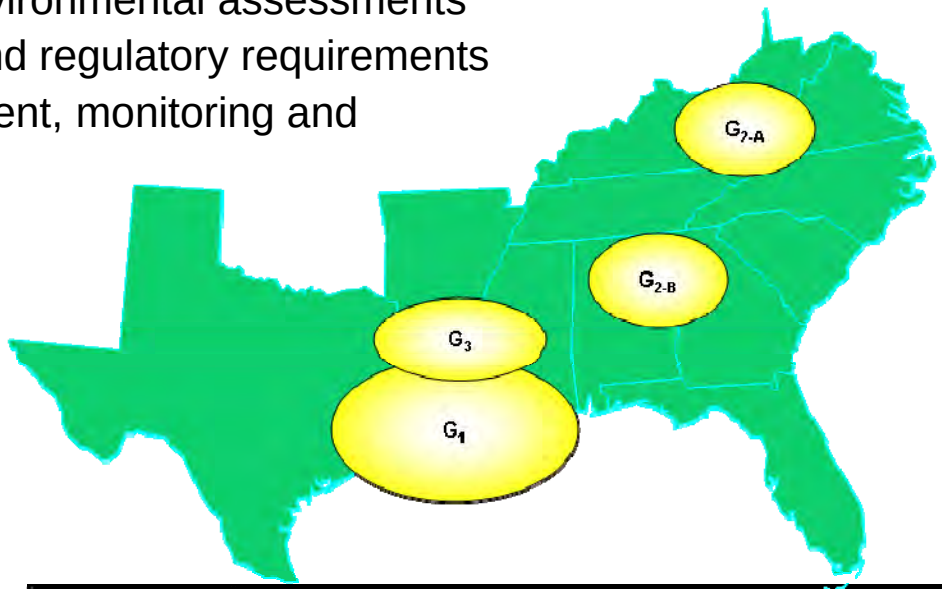
SECARB Technical Coordinator

SECARB Partnership Objectives

- **Phase I: Characterization**
  - Describe CO_2 sources, sinks and transport requirements
  - Develop outreach plan
  - Conduct risk and environmental assessments
  - Review permitting and regulatory requirements
  - Establish measurement, monitoring and verification protocols
  - Establish accounting frameworks (including Section 1605(b) of EPAct)
  - Identify most promising capture and sequestration opportunities
  - Develop Phase II field validation test plans



G_1	Gulf Coast Stacked Storage Sequestration Project
G_{2-A} and G_{2-B}	Coal Seam Sequestration Project
G_3	Saline Reservoir Test Center Sequestration Project

SECARB Regional and National Involvement

Regional Involvement: 100+ Participants

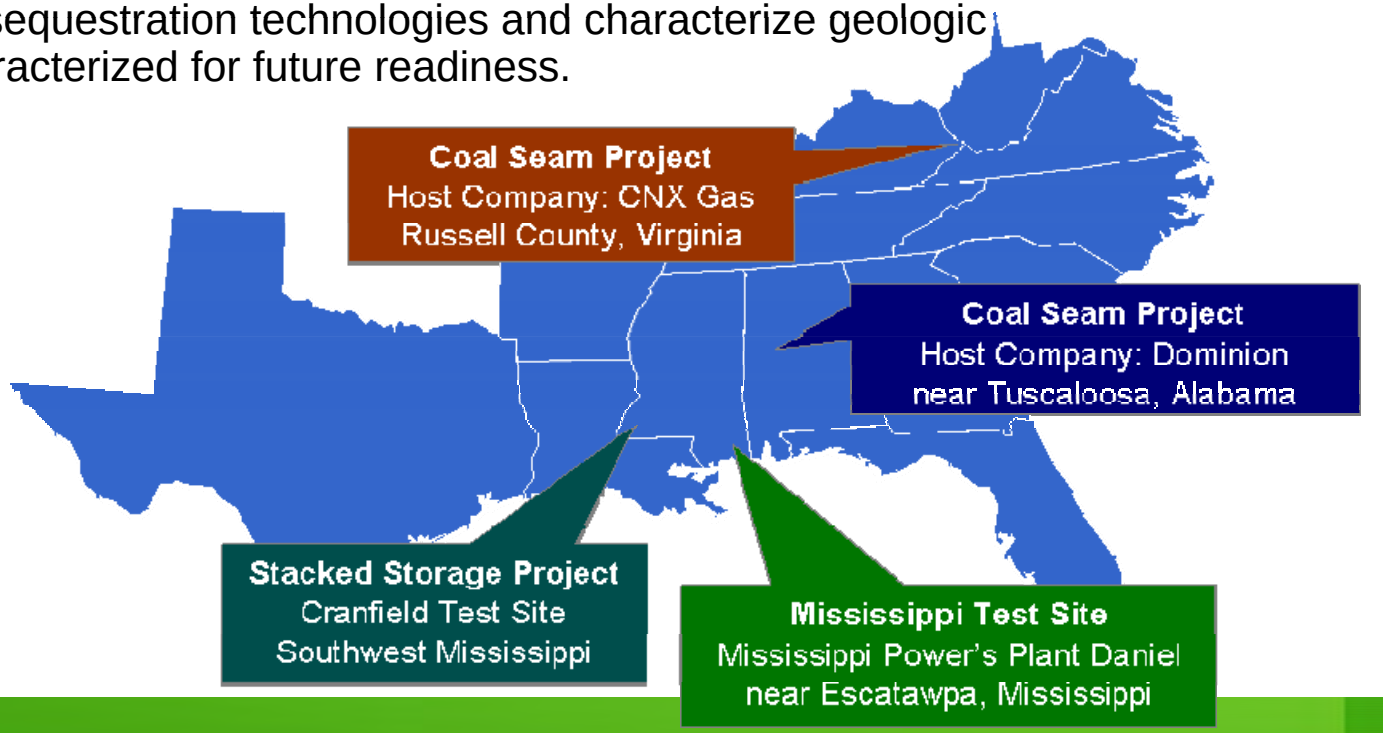
- Member States (Executive, Legislative and Regulatory)
- Industry and Electric Utilities
- Universities and National Laboratories
- NGOs and Trade Associations

National Involvement in RCSP Working Groups

- Storage
- MMV
- Outreach and Education
- Regulatory
- Modeling

SECARB Partnership Objectives

- **Phase II: Implementation**
  - Further characterize the potential carbon sequestration sinks in the Southeast;
  - Conduct three field verification studies in some of the most promising geologic formations in the region;
  - Advance the state of the art in monitoring, measurement and verification techniques and instrumentation; and
  - Develop sequestration technologies and characterize geologic sinks characterized for future readiness.



SECARB Involvement – Coal Seam Projects

Local Involvement:

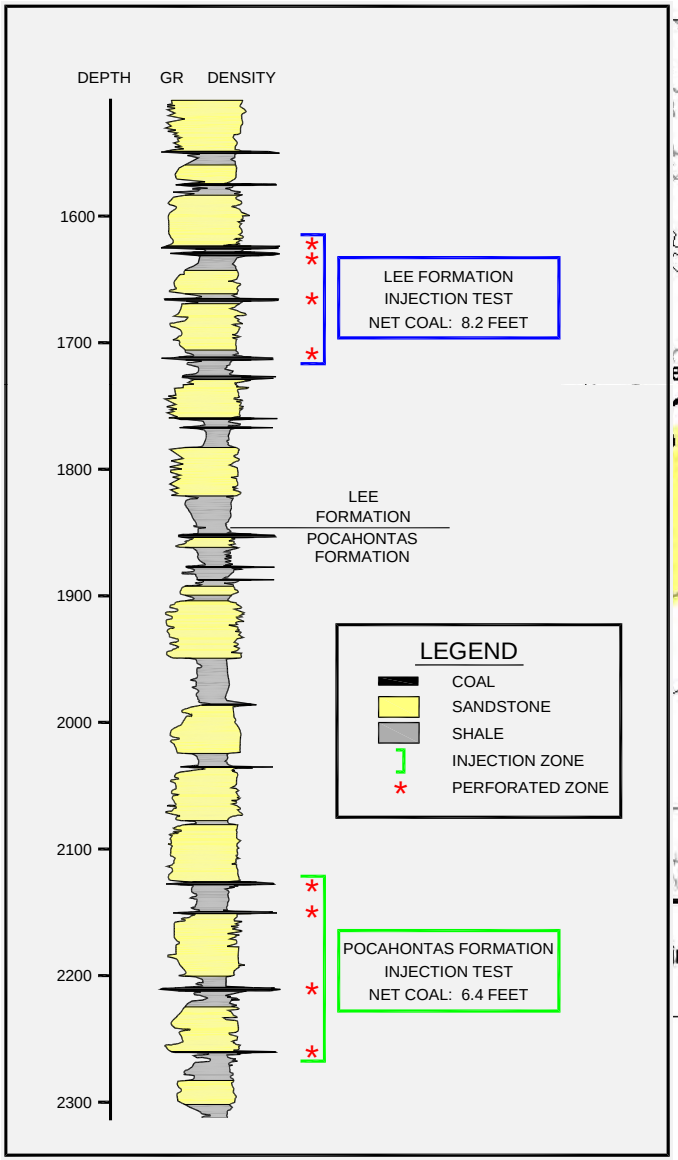
- Alawest
- Alpha Natural Resources
- AMVEST
- Buckhorn Coal
- CCP2 Project
- CDX Gas
- CNX Gas
- CONSOL Energy
- Cumberland Resources Corp.
- Dart Oil & Gas
- Denbury Resources
- Dominion E&P
- Dominion Resources
- Eastman Gasification Services
- EPRI
- Equitable Production
- MSU Inst. Clean Energy Tech.
- GeoMet
- McJunkin Appalachian
- Norfolk Southern
- Natural Resource Partners
- Oak Ridge National Laboratory
- Penn Virginia
- Pine Mountain Oil & Gas
- Piney Land
- Pocahontas Land
- RMB Earth Science Consul.
- Univ. British Columbia

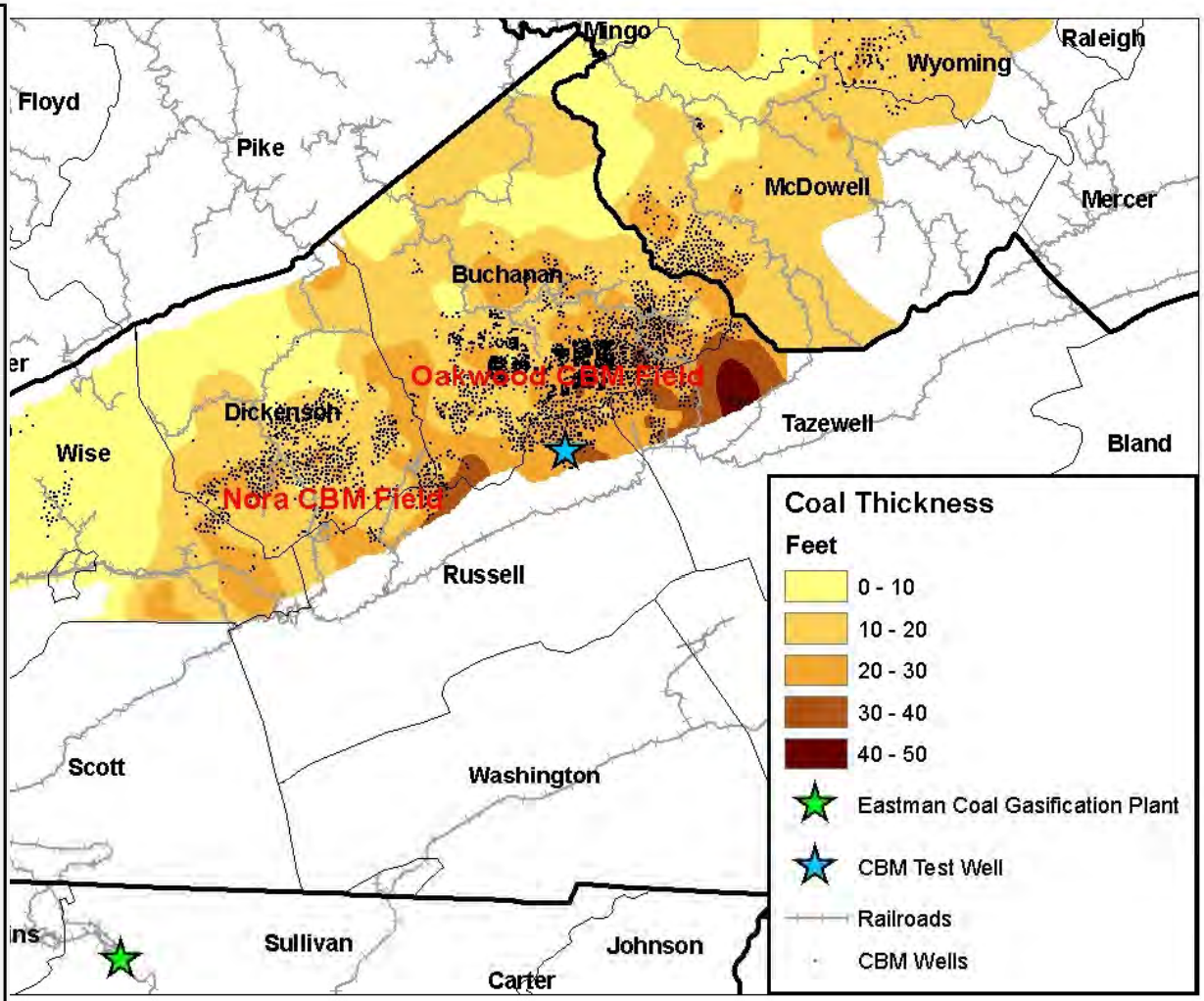
Phase II Carbon Sequestration in Coal Seams

Phase II Coal Seam Activities

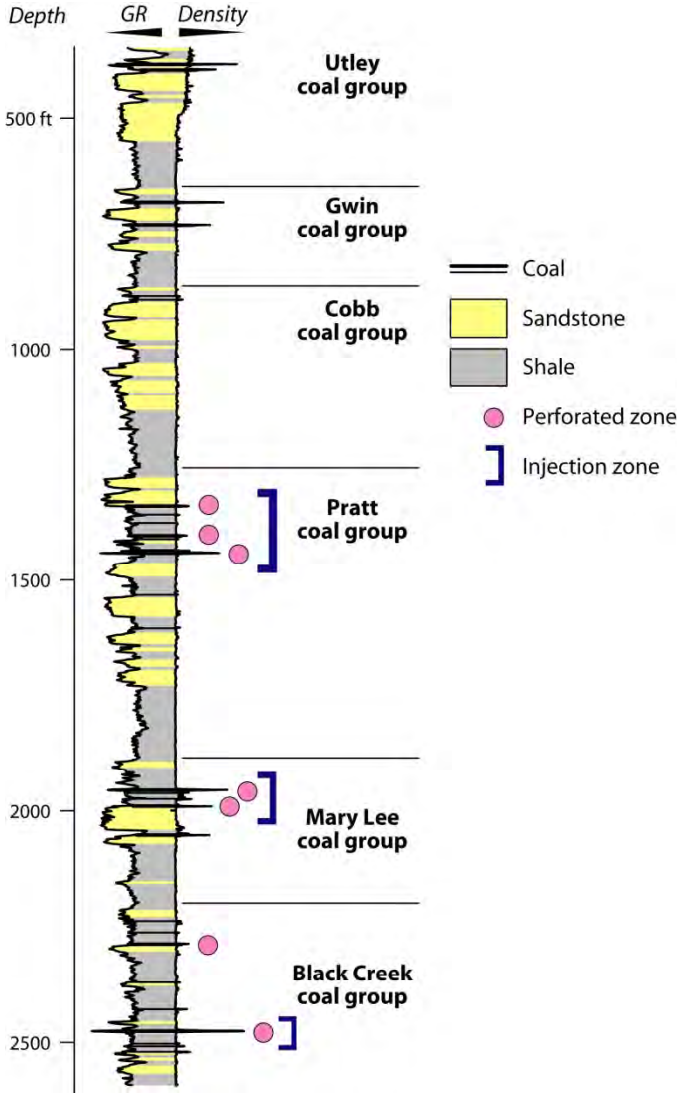
- Central Appalachian Basin Test Planned for Russell County, Virginia
- Evaluate Carbon Sequestration Potential in Coal Seams
- Evaluate Enhanced Coal Bed Methane Recovery with CO_2 Injection
- Develop Plan for Large Scale Injection

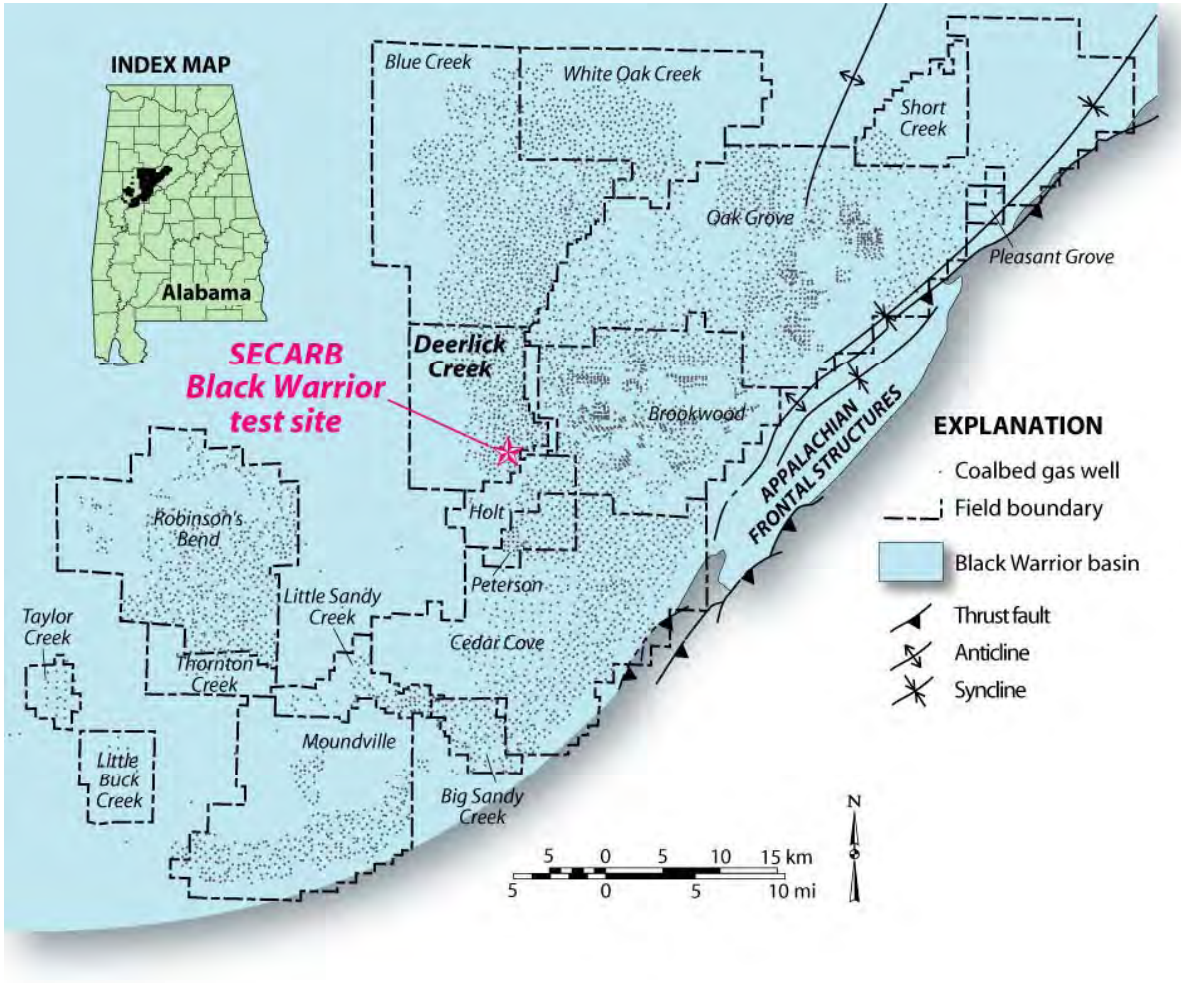
Central Appalachian Coal Seam Project Location
CNX Gas CBM Well in Russell County, Virginia





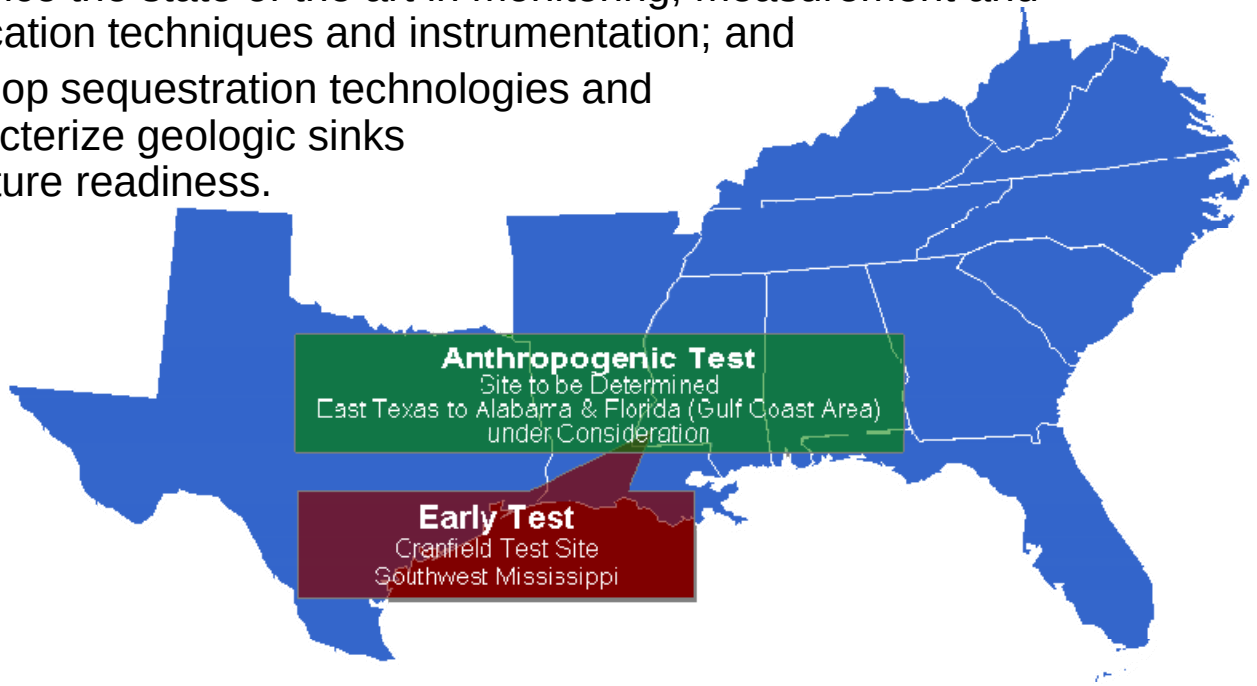
Black Warrior Basin Coal Seam Project Location Near Tuscaloosa, Alabama





SECARB Phase III Objectives

- **Phase III Demonstration**
  - Characterize the potential carbon sequestration sinks in the Southeast;
  - Conduct field verification studies in the most promising geologic formations in the region;
  - Advance the state of the art in monitoring, measurement and verification techniques and instrumentation; and
  - Develop sequestration technologies and characterize geologic sinks for future readiness.



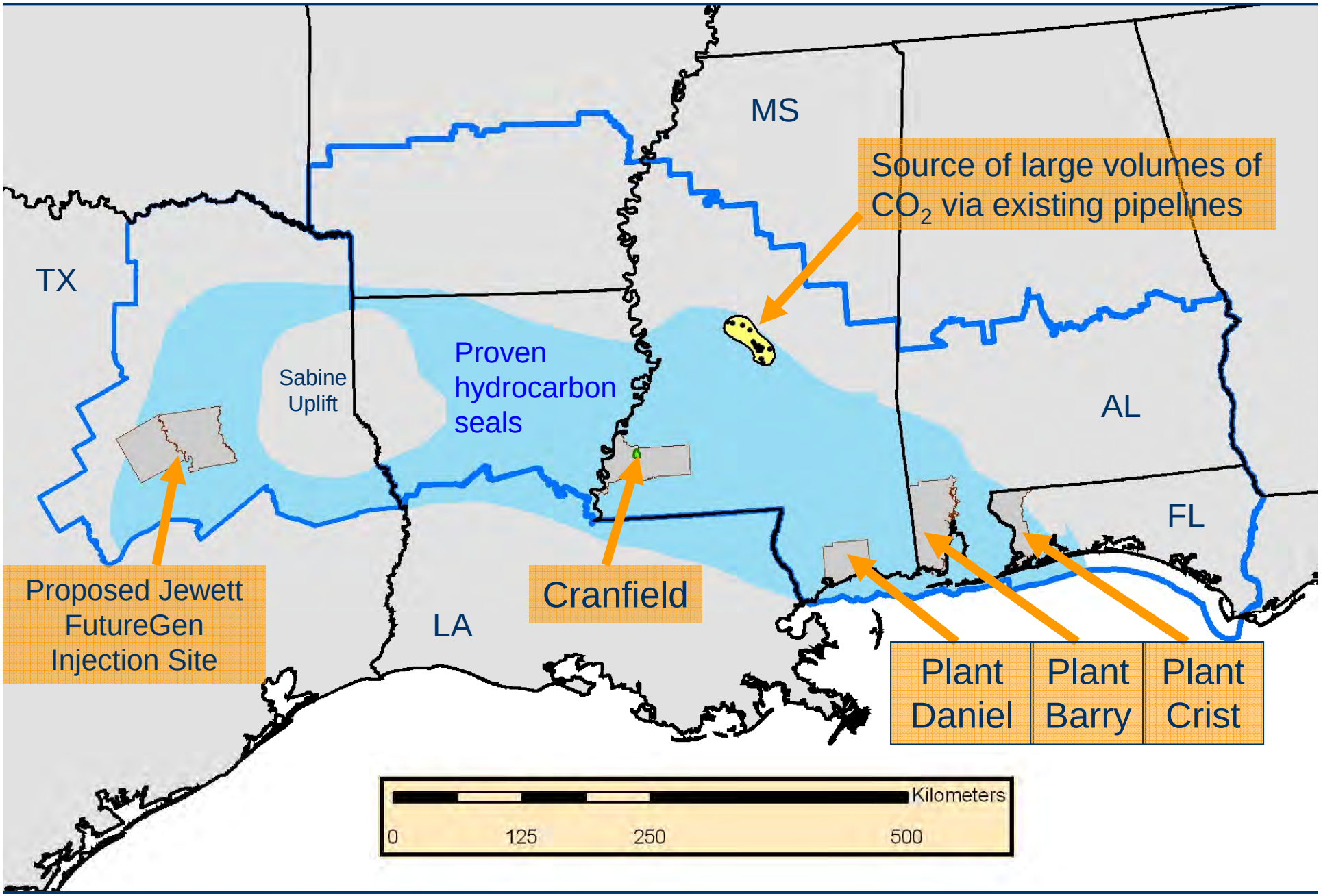
Net Electricity Generation Capacity & CO_2 Emissions by State

State	Natural Gas	Petroleum	Nuclear	Coal	Other*	Electric Power Industry Emissions
	(thousand MWh)	*(thousand MWh)*	*(thousand MWh)*	*(thousand MWh)*	*(thousand MWh)*	*CO_2 (metric tons)*
AL	4,148	12	3,255	7,160	729	85,116,254
AR	1,800	19	1,363	2,646	465	28,494,445
FL	11,259	2,558	2,608	6,504	396	126,528,977
GA	3,821	30	2,905	8,489	539	89,897,927
KY	577	7	0	8,907	148	93,160,139
LA	5,342	79	1,582	2,307	302	54,098,016
MS	3,644	3	770	1,588	132	25,802,259
NC	1,341	54	3,709	7,814	443	73,138,096
SC	1,603	53	4,856	4,013	301	40,847,197
TN	342	11	2,499	5,484	675	61,379,959
TX	23,739	5	3,664	13,573	1002	257,552,164
VA	2,130	321	2,550	3,464	356	42,067,787
WV	82	17	0	8,592	63	85,075,495
Total	*59,828*	*3,169*	*29,761*	*80,541*	*5,551*	*1,063,158,715*

**Other: Hydroelectric and Other Renewables*

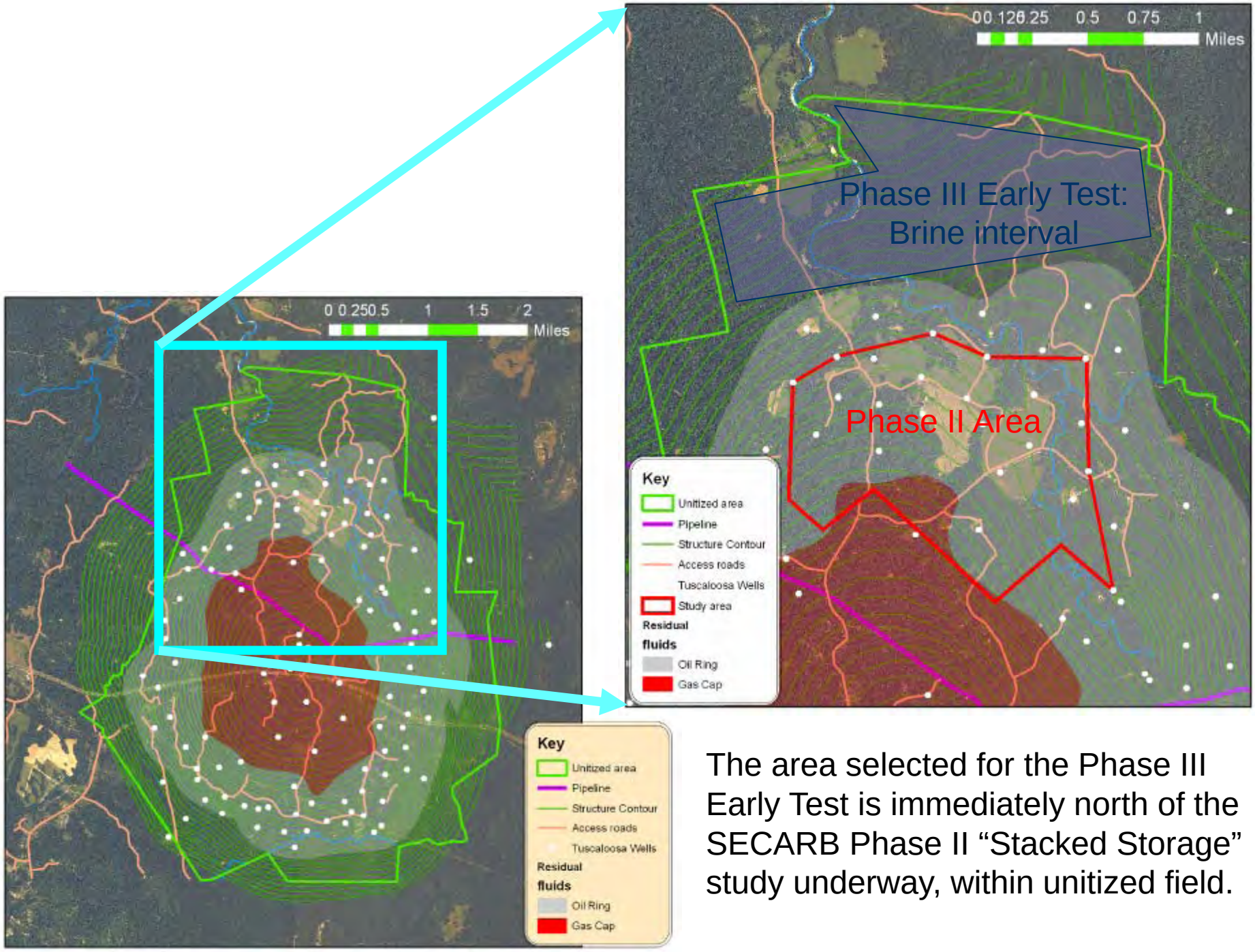
Source: Energy Information Administration Website, State Energy Profiles, http://tonto.eia.doe.gov/state/
Last Update: November 22, 2007 (EIA)

Geographic Focus of SECARB Phase III Program



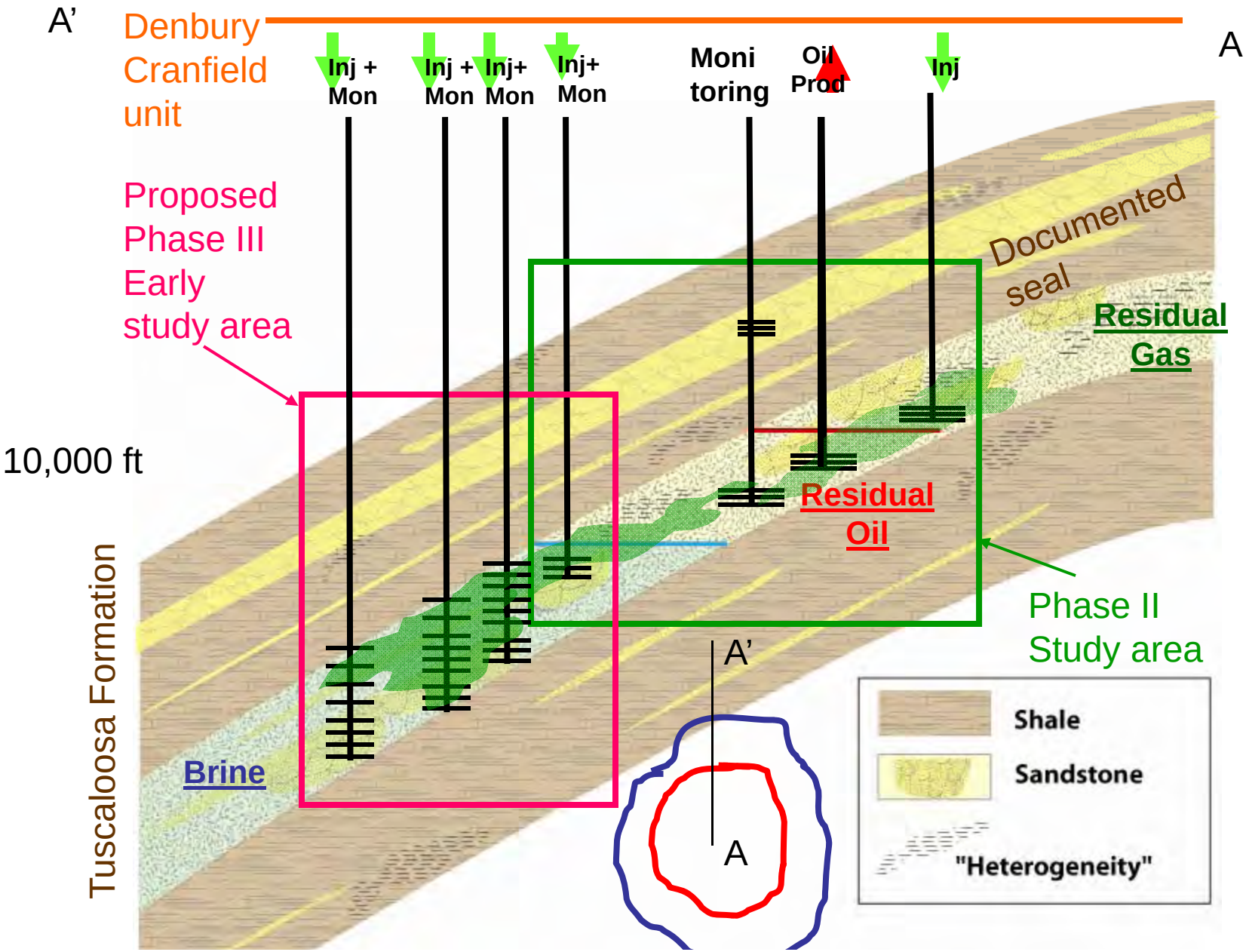
Site Selection for SECARB Phase III Early Test

- Large volumes of low-cost CO_2 available 2008
  - Denbury Sonat pipeline
- Well-known geologic environment in saline aquifer
  - injectivity and seal are demonstrated
  - 3-D seismic available
- Mineral and surface rights available in short time
  - Minerals rights owned by Denbury
  - Surface ownership well known and owners likely to welcome monitoring for standard use fee
- Permitting streamlined
  - EQ similar to Phase II EQ



The area selected for the Phase III Early Test is immediately north of the SECARB Phase II “Stacked Storage” study underway, within unitized field.

Cranfield Program Overview



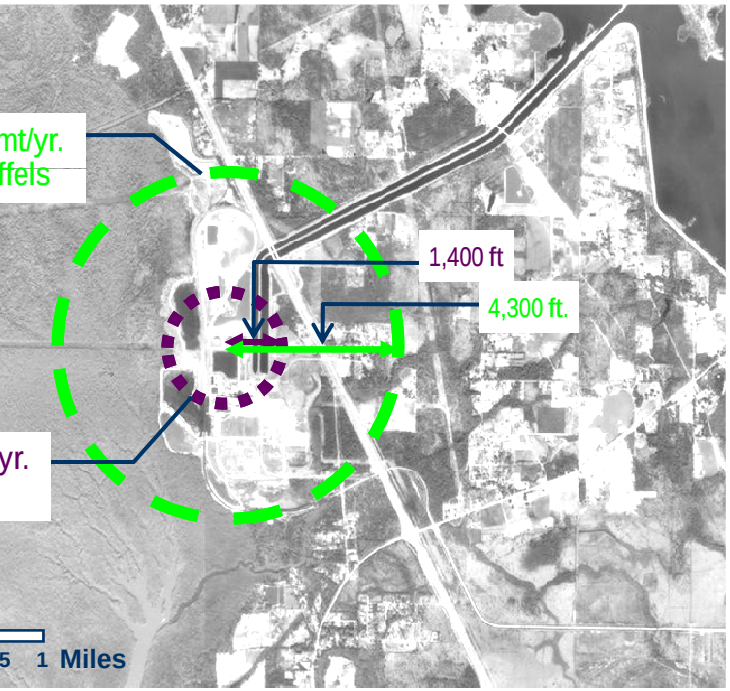
SECARB Phase III Anthropogenic Test

- **Unique opportunity to demonstrate storage and MMV at a coal coal-fired power plant**
  - Seek to transfer lessons learned from Cranfield test and apply lessons learned at a power plant site
  - Will help determine appropriate MMV techniques and protocols as they apply to a power plant site (what works/what doesn't)
  - Defines business and legal issues that make a power plant site unique, i.e., demonstration in light of electrical reliability and cost of commercialization
- **Appropriately planned and implemented MMV is the pathway to public acceptance. This is a high priority for SECARB at a coal-fired power plant as it will:**
  - Assure operator & public safety (often the same)
  - Support regulatory and institutional framework and public outreach
  - Support long-term management, liability, and compliance considerations
  - Help address siting criteria for future CCS coal-fired power plants
  - Support utility owner's engineer understanding

Optimizing and Concentrating CO_2 Storage

Extent of the CO_2 Plume

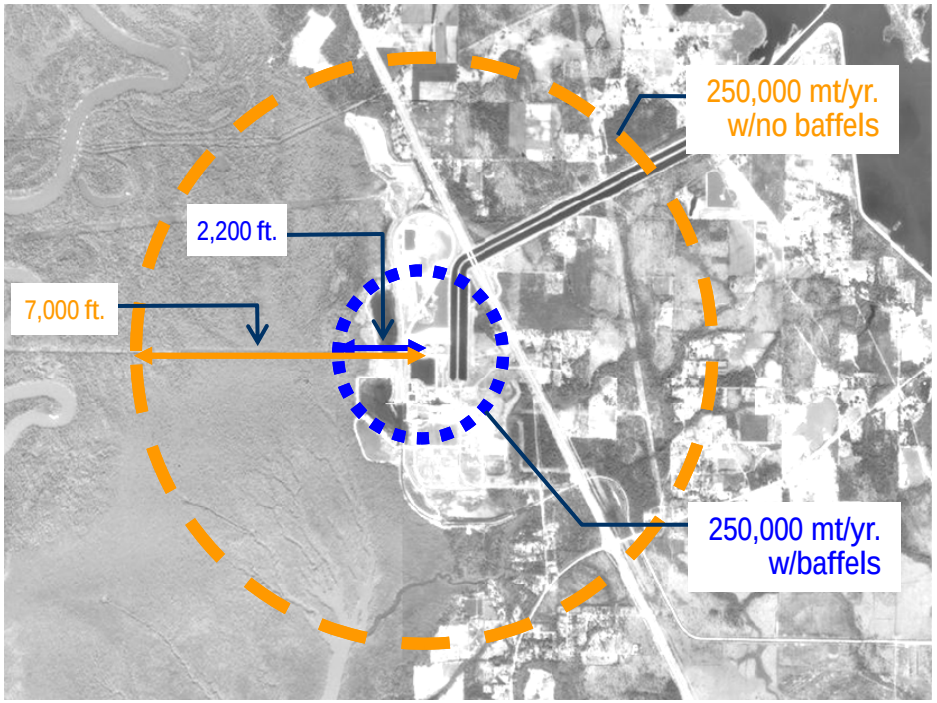
(CO_2 injection @ 100,000 mt/yr; 10 years of time)



ve use of reservoir architecture
s CO_2 storage by nearly 10 fold.

Extent of the CO_2 Plume

(4 years of CO_2 injection @ 250,000 mt/yr; 10 years of time)



Extensive use of reservoir architecture reduces the areal extent of the CO_2 plume by 90%.

SECARB Phase III MMV Goals

ian Strazisar – NETL (Isotopes)

- Demonstrate that geologic storage of CO_2 is environmentally safe with public acceptance of science-based monitoring protocols
- Demonstrate protocols capable of surveying large areas and identifying seepage over project life cycle
- Understand the relationship between site characterization, storage mechanisms, and leakage
- Validate and calibrate model predictions and monitoring tools for fate and transport
- Transfer knowledge and technologies:
  - lessons learned from Phase II to Phase III
  - unique opportunity to deploy MMV at a coal-fired power plant