Southeast Regional Carbon Sequestration Partnership

Phase II Activities

Presented to:
Workshop on
Gasification Technologies
Tampa, Florida
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Presented by:
Gerald R. Hill, Ph.D.
Senior Technical Advisor
Southern States Energy Board

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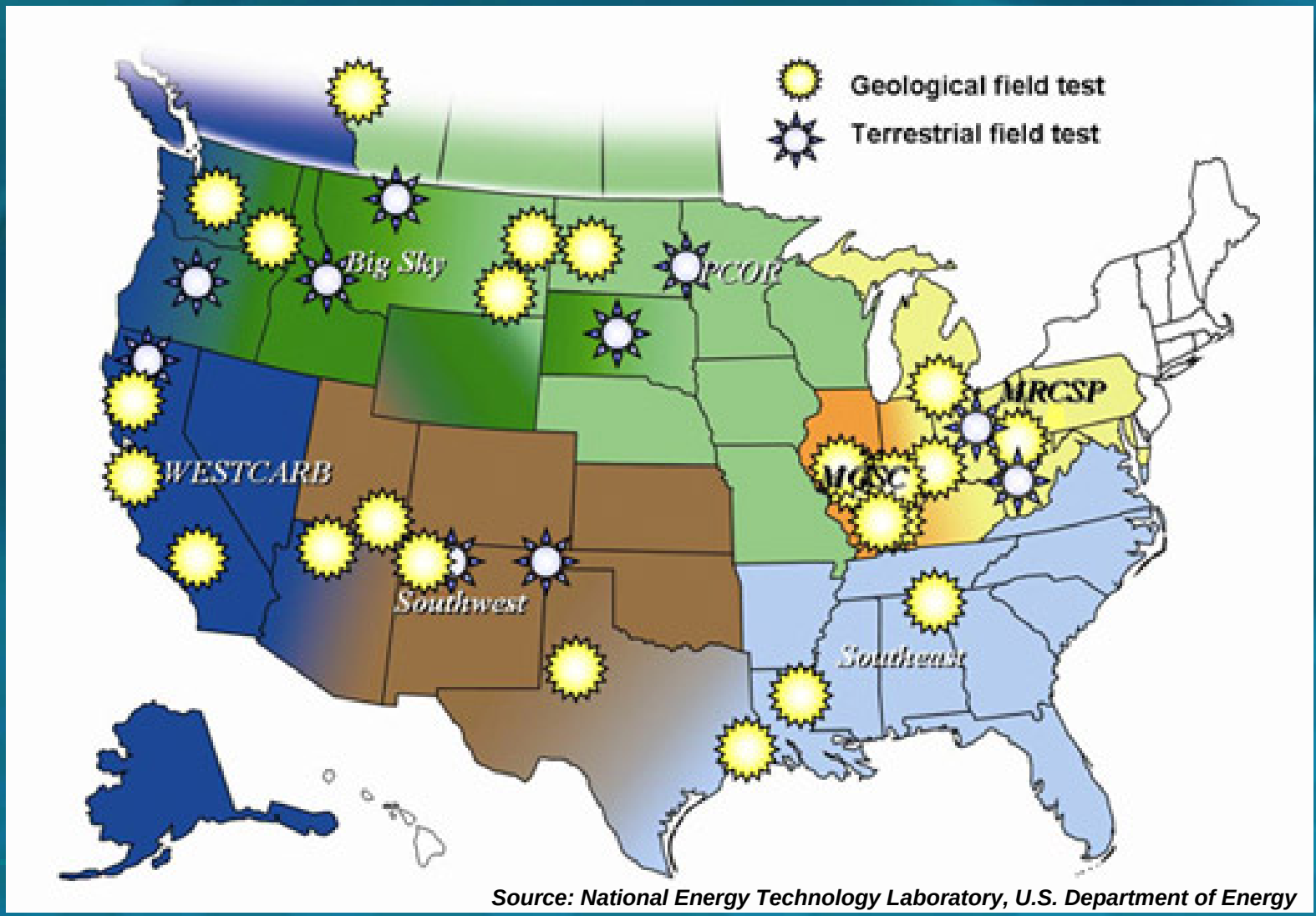
Phase I SECARB Objectives

- 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

Phase II Regional Carbon Sequestration Partnerships



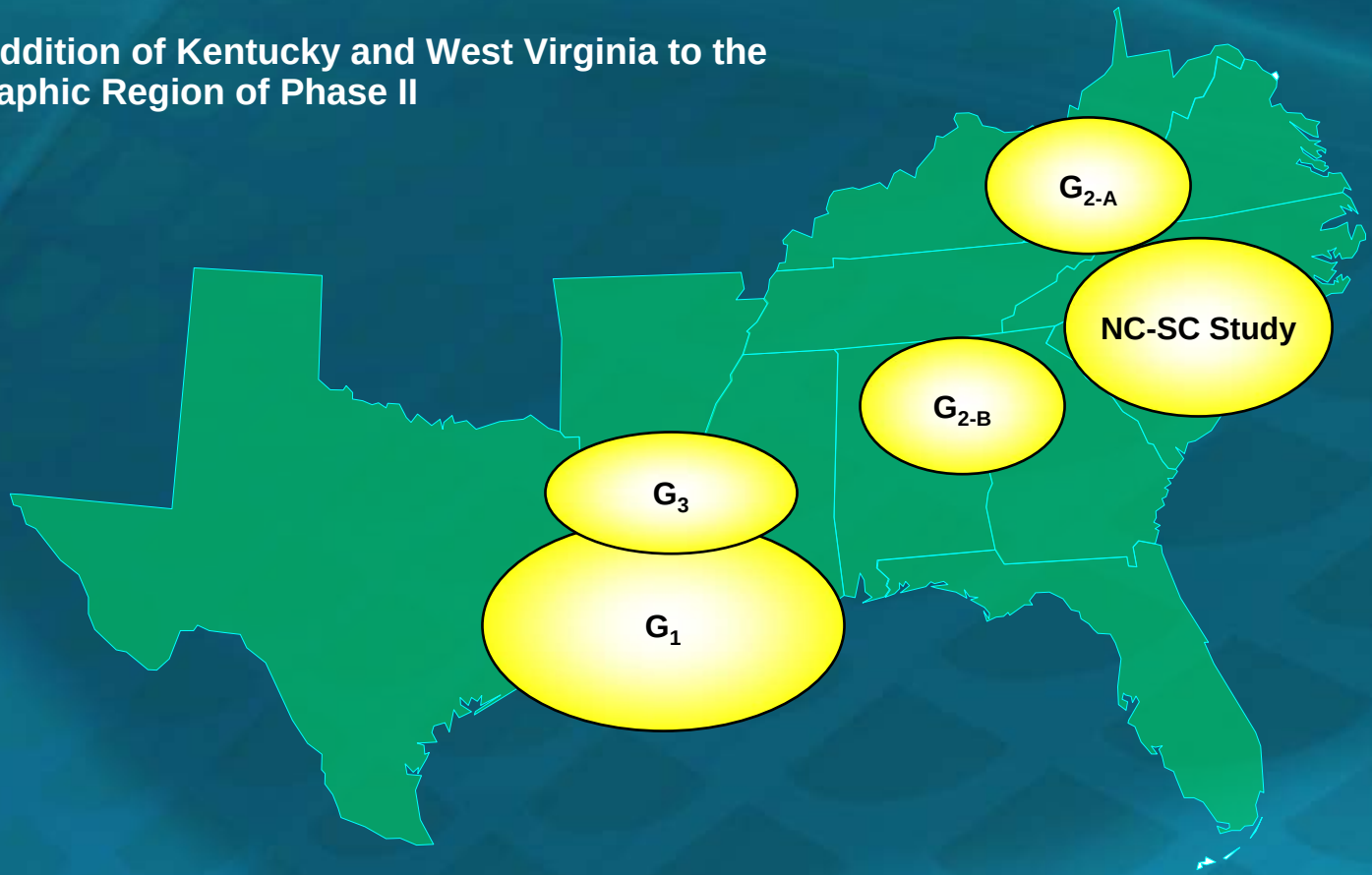
Source: National Energy Technology Laboratory, U.S. Department of Energy

Phase II SECARB Goals

- 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
- Have sequestration technologies developed and geologic sinks characterized for future readiness.

SECARB Phase II Geographic Region & Field Test Site Locations

Note addition of Kentucky and West Virginia to the Geographic Region of Phase II



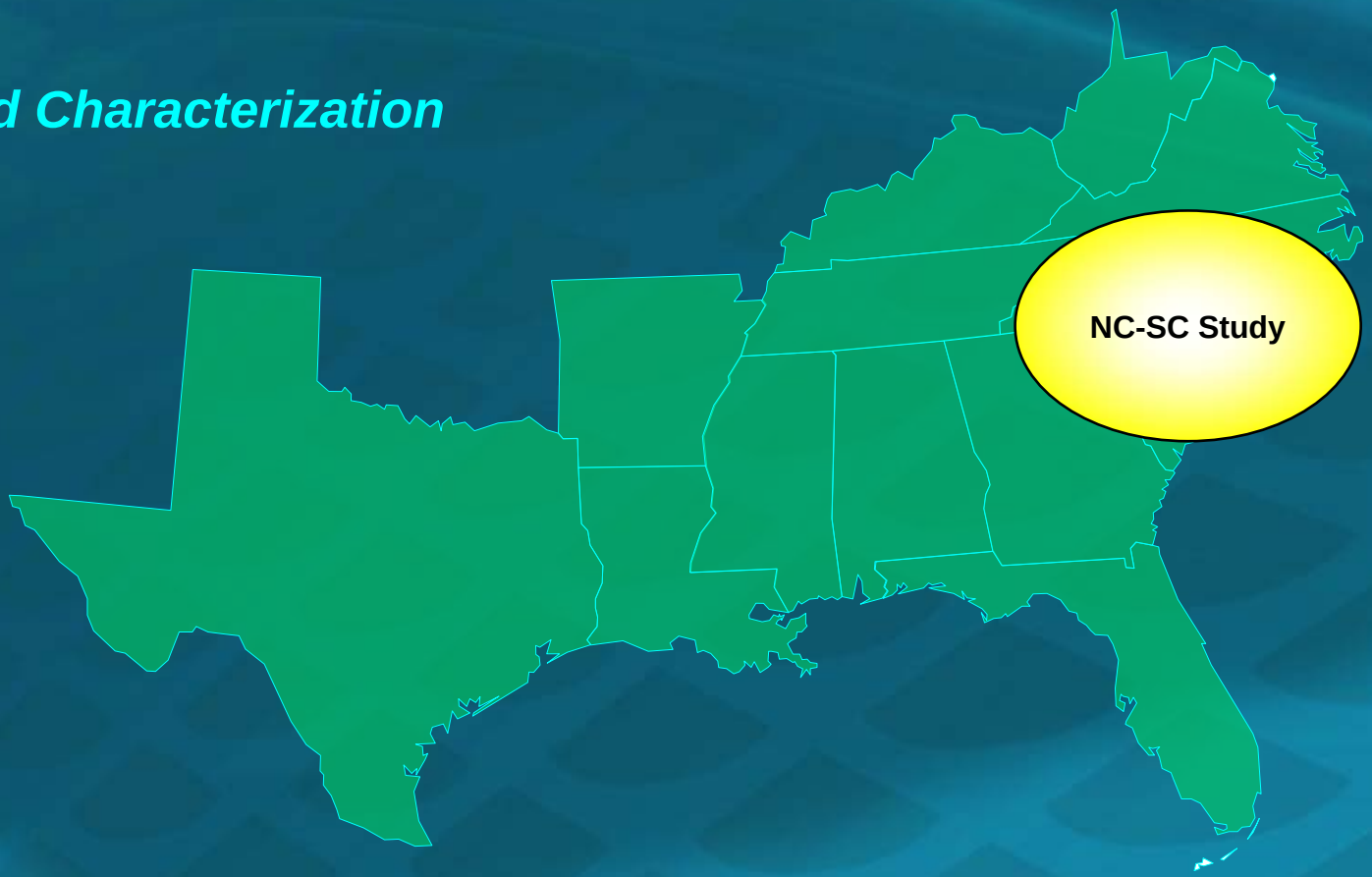
SECARB Phase II Partners *(in alphabetical order)*

Advanced Resources International
AGL Resources
American Electric Power
Amvest Gas Resources, Inc.
Applied Geo Technologies
Arkansas Oil and Gas Commission
Augusta Systems, Inc.
BP America, Inc.
Buchanan Energy Company of Virginia, LLC
CO_2 Capture Project
CDX Gas, LLC
Center for Energy and Economic Development
ChevronTexaco Corporation
Clean Energy Systems, Inc.
Composite Technology Corporation
CONSOL, Inc.
Core Laboratories
Dart Oil & Gas Corporation
Dominion Energy
Dominion Resources
Duke Power
Eastern Coal Council
Edison Electric Institute
Electric Power Research Institute (EPRI)
Entergy Services
Equitable Production
Florida Power & Light Company
Geological Survey of Alabama
Geological Survey of Kentucky
Georgia Environmental Facilities Authority
Georgia Forestry Commission
Georgia Power Company
Interstate Oil and Gas Compact Commission
Lawrence Berkeley National Laboratory
Lawrence Livermore National Laboratory
Louisiana Department of Environmental Quality Louisiana Geological Survey
Marshall Miller & Associates
Massachusetts Institute of Technology
McJunkin Appalachian Oilfield Company
Mississippi State University (MSU)
North American Coal Corporation
North Carolina State Energy Office
Nuclear Energy Institute
Oak Ridge National Laboratory
Old Dominion Electric Cooperative
Phillips Group, The
Pine Mountain Oil & Gas, Inc.
Praxair
Progress Energy
RMB Earth Science Consultants, Ltd.
RMS Strategies
SCANA Energy
Schlumberger
Smith Energy
South Carolina Dept. of Agriculture
South Carolina Electric & Gas Company
South Carolina Public Service Authority/Santee Cooper
Southern Company
Southern Company Services
Southern States Energy Board
Susan Rice and Associates, Inc.
Tampa Electric Company
Tennessee Valley Authority
Texas Bureau of Economic Geology -Gulf Coast Carbon Center
United Company, The
United States Department of Energy/National Energy Technology Laboratory
Virginia Polytechnic Institute and State University
Winrock International

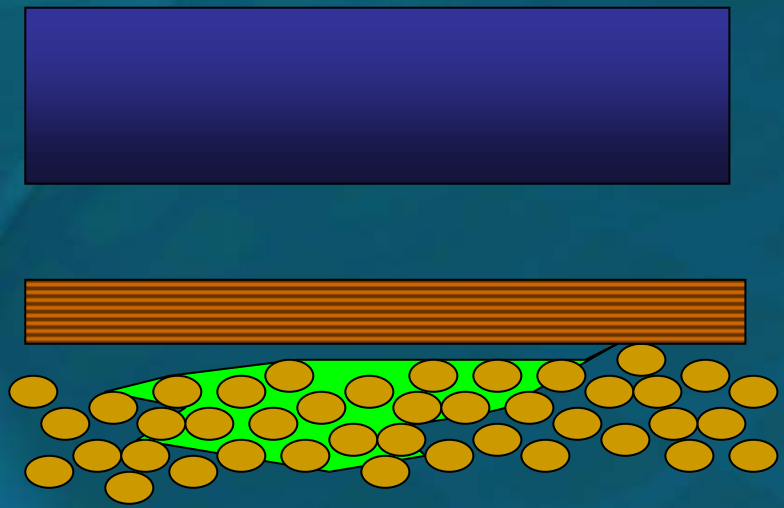
Benefits to the Region

- Increased awareness of the opportunities and challenges associated with carbon sequestration technologies and applications.
- Expanded research efforts in the local, state, federal and private sector communities.
- Increased utilization of clean coal technologies using lower rank coals.

Continued Characterization



Assessing CO_2 Storage Capacity in Brine-bearing Formations



Identify a porous and permeable rock volume in the subsurface

…That is below underground sources of drinking water

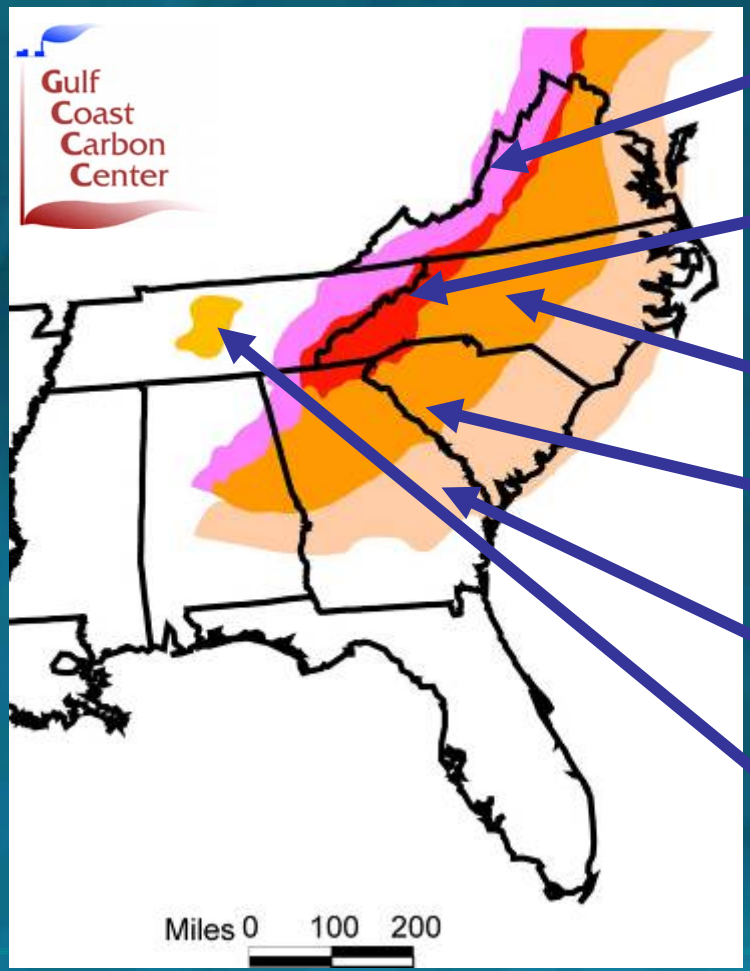
…and isolated from them and from escape to the atmosphere by one or more seals

… and collect data on areal extent, thickness, CO_2 density porosity, and permeability that permit simple estimates of storage capacity for CO_2

If preceding steps are favorable, proceed to additional steps, including
matching to sources, estimating cost, permanence, and risk/uncertainly

Gulf Coast Carbon Center

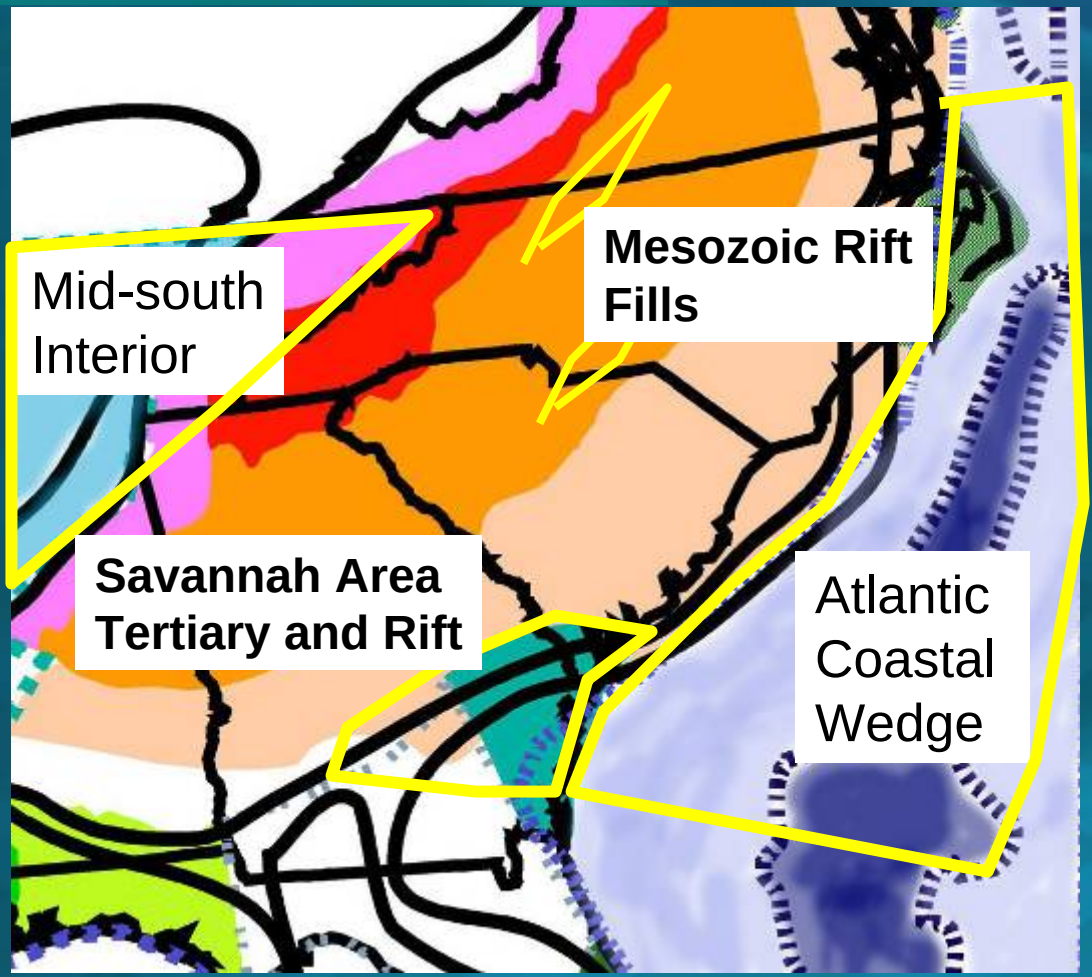
Appalachians and Atlantic Coastal Plain



- Valley and Ridge – complex, likely local capacity
- Blue Ridge – no capacity
- Piedmont – no capacity
- Mesozoic rift basins – Dan River, Deep River – local potential in sediments associated with basalt
- Atlantic coastal plain – capacity only near coast
- Nashville dome – poor to no capacity

Focus of Carolinas Capacity Assessment

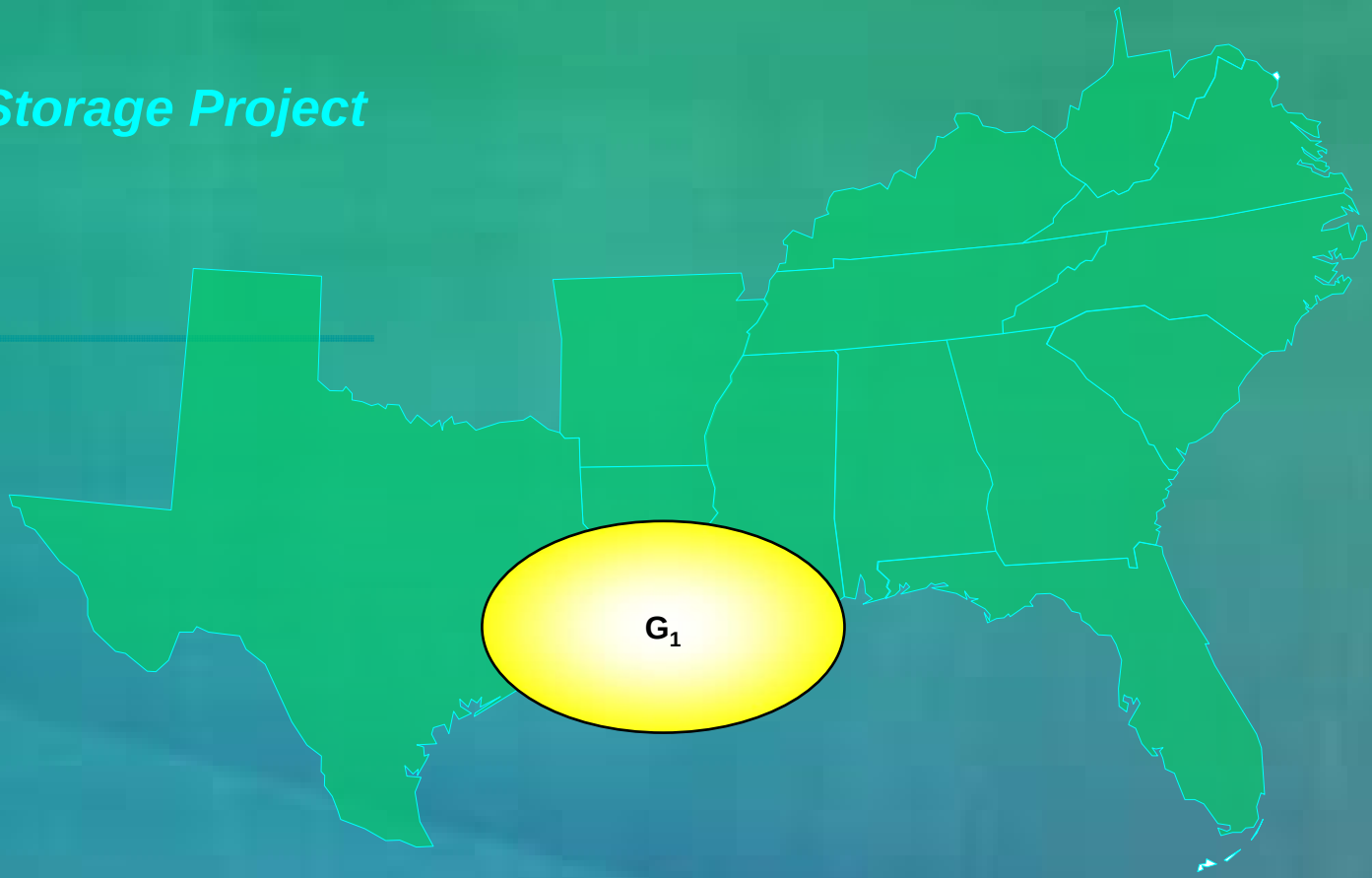
Proposed focus areas

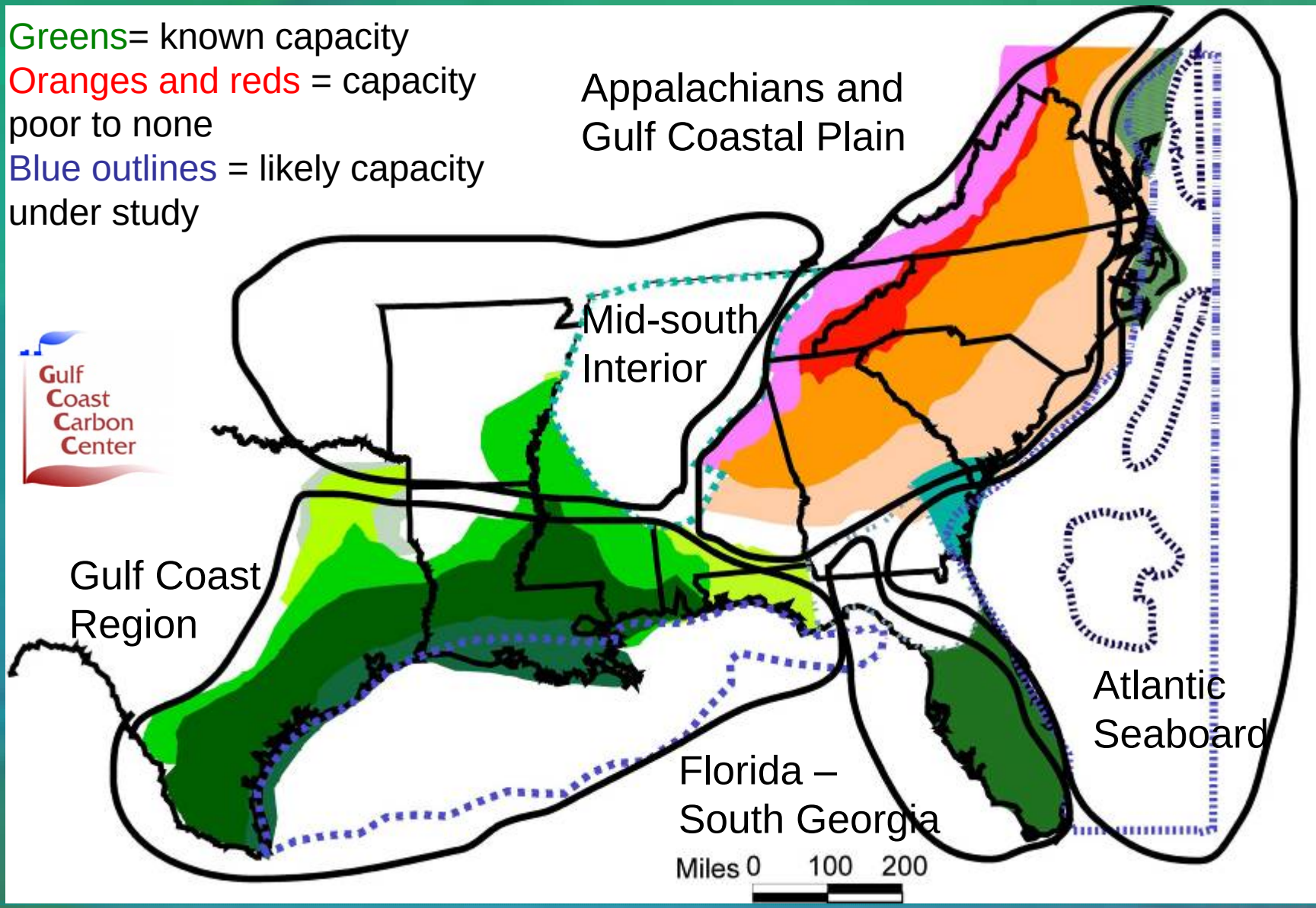


Greens= known capacity
Oranges and reds = capacity poor to none
Blue outlines = likely capacity under study

Gulf Coast Carbon Center

Stacked Storage Project

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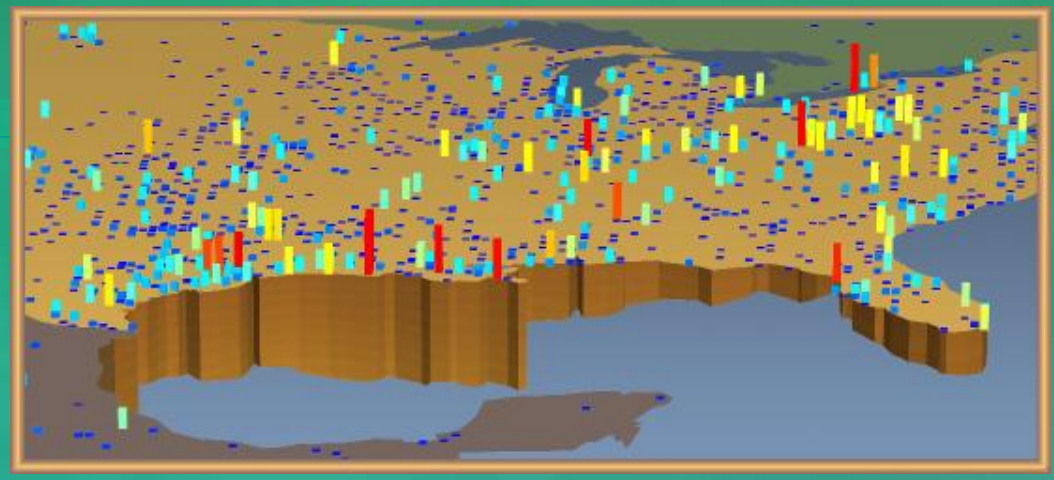
Oranges and reds = capacity poor to none
Blue outlines = likely capacity under study
Appalachians and Gulf Coastal Plain
Mid-south Interior
Gulf Coast Carbon Center
Gulf Coast Region
Atlantic Seaboard
Florida – South Georgia
Miles 0 100 200

Why apply CCS to the Gulf Coast?

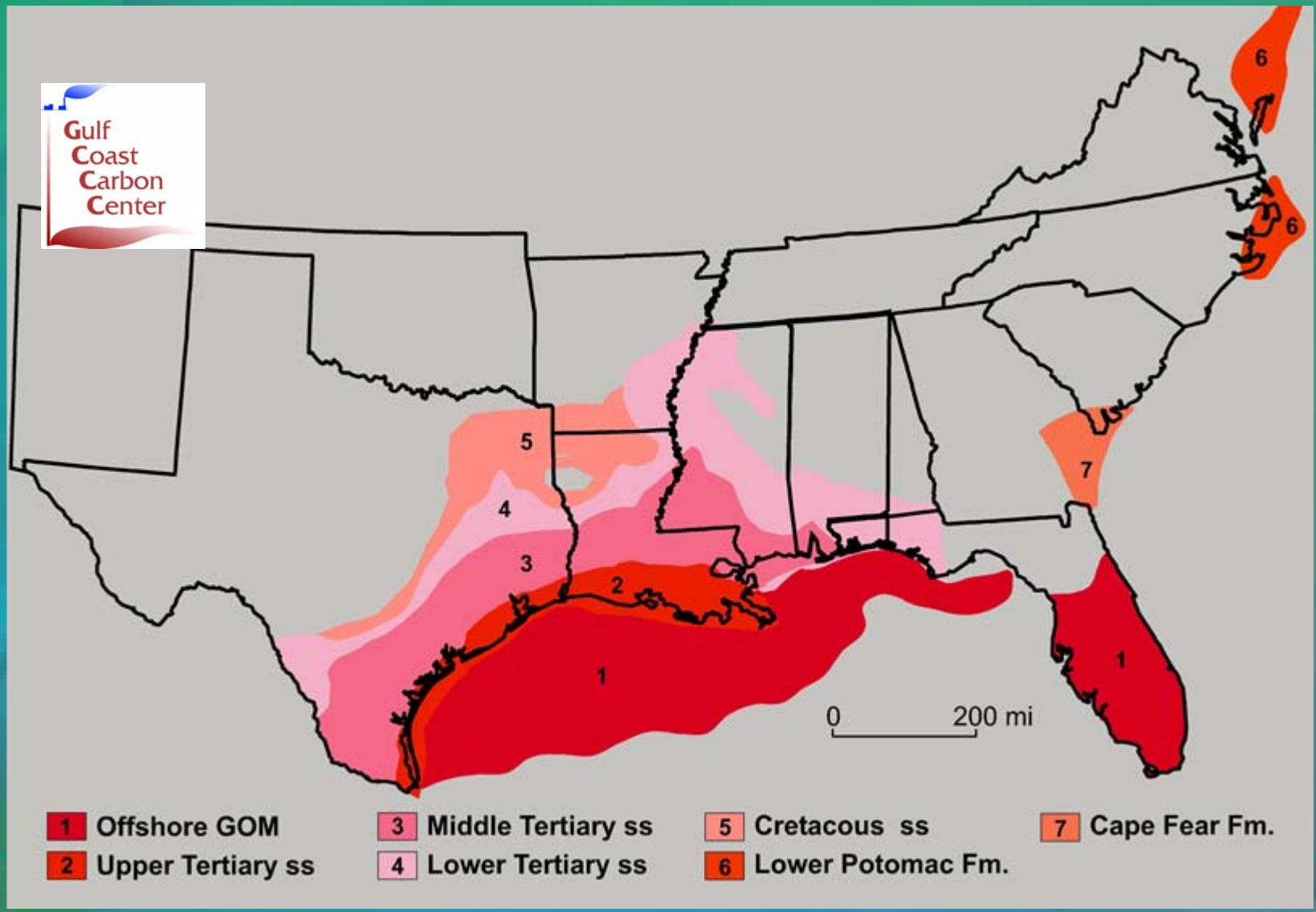


Column height and color show emissions

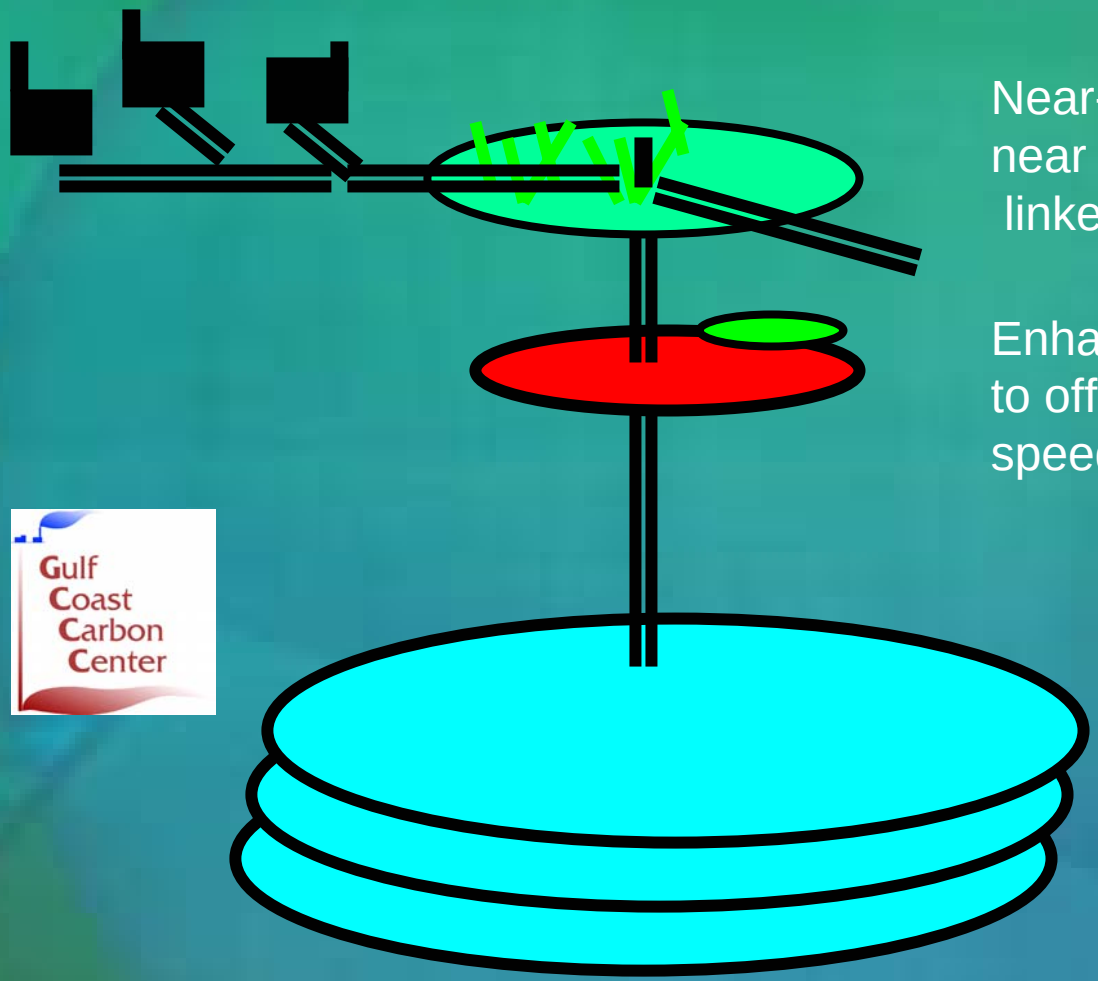
Brown wedge shows capacity

- **The Gulf Coast region accounts for approximately 16% of the U.S. annual CO_2 emissions from fossil fuels.**
- **Annual emissions of CO_2 in Texas, Louisiana and Mississippi are ~ 1 billion metric tons (1 GT), and Texas alone emits 667 million metric tons of CO_2.**
- **Source-sink proximity**
- **“Stacked Sinks”; oil and gas fields overlying large volume brine aquifers**
- **Regional and local geology is well understood**
- **Extensive pipeline infrastructure is already in place**
- **Economic feedback from CO_2 EOR**
- **Environmental vulnerability**

Most Promising Saline Formations



Geologic Storage Evolution in the Gulf Coast

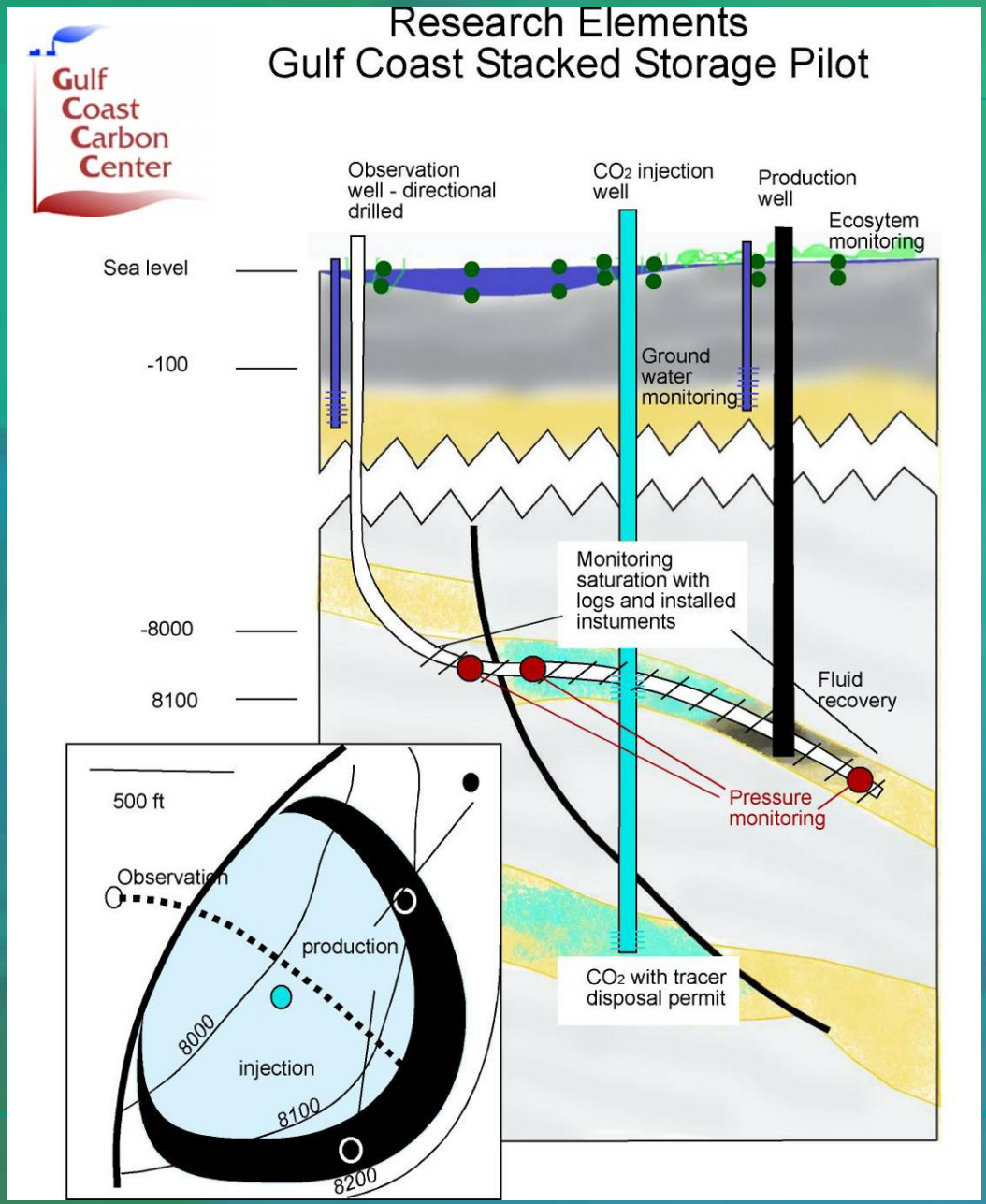


Near-term and long-term sources and near and long-term sinks linked regionally in a pipeline network

Enhanced oil and gas production to offset development cost and speed implementation

Very large volume storage in stacked brine formations beneath reservoir footprints

Stacked Storage Monitoring Elements



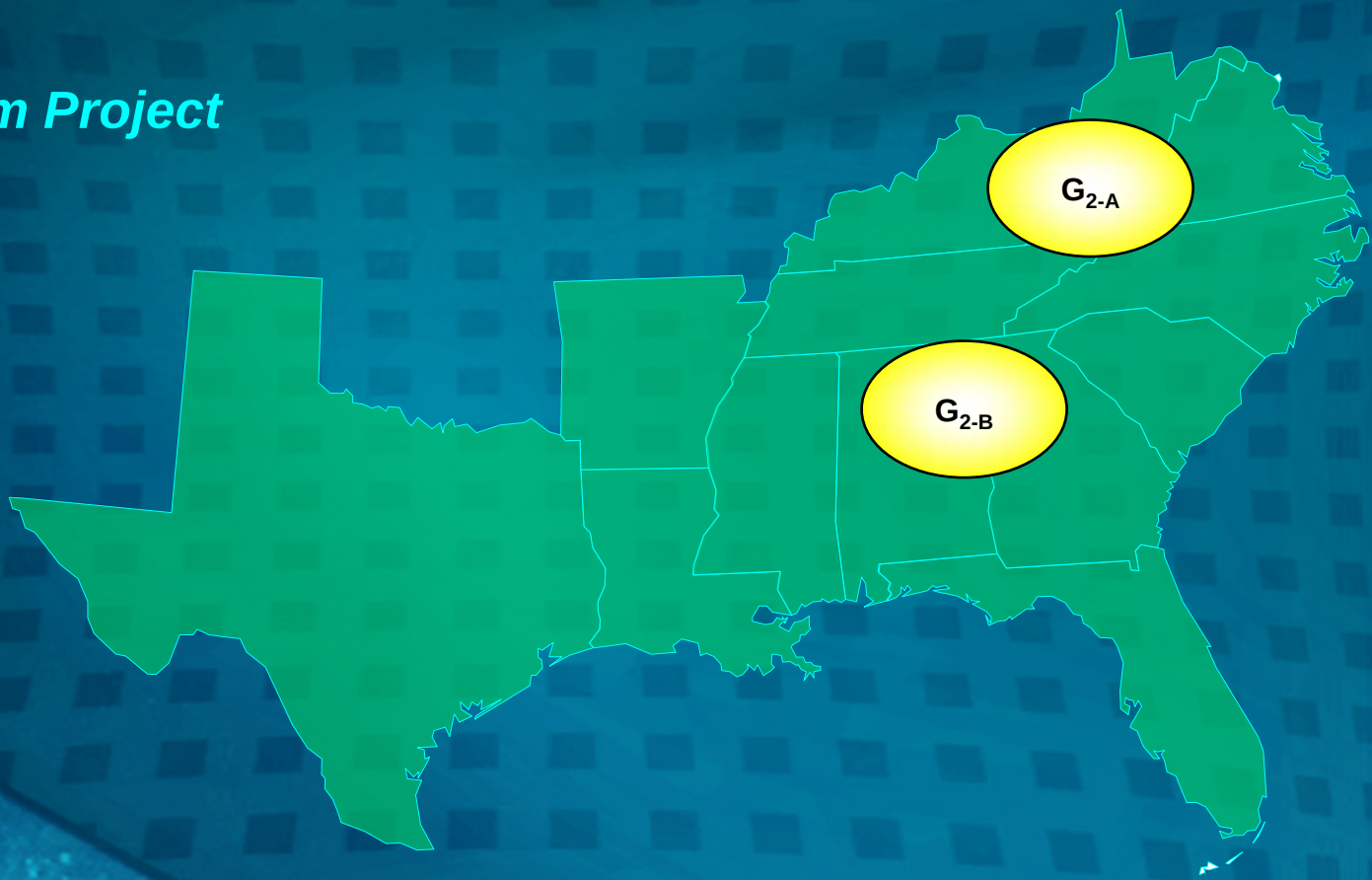
Ecosystem monitoring: Chemical and biologic change

Ground water monitoring for geochemical change

Injection horizon: pressure, temperature, oil and CO_2 saturation during and post-injection, instrumented slant hole

Characterization of deeper horizon in preparation for eventual disposal

Coal Seam Project



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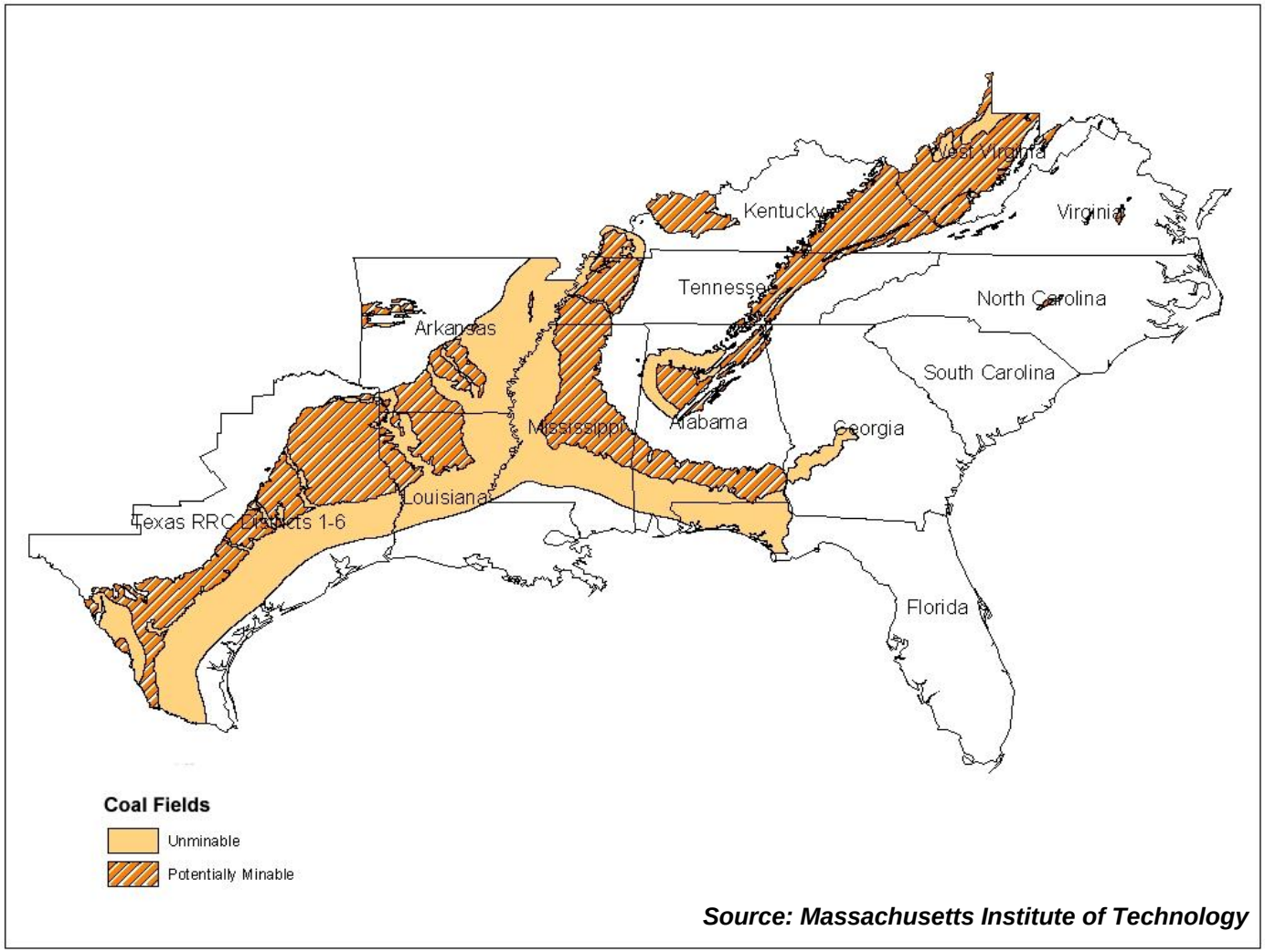
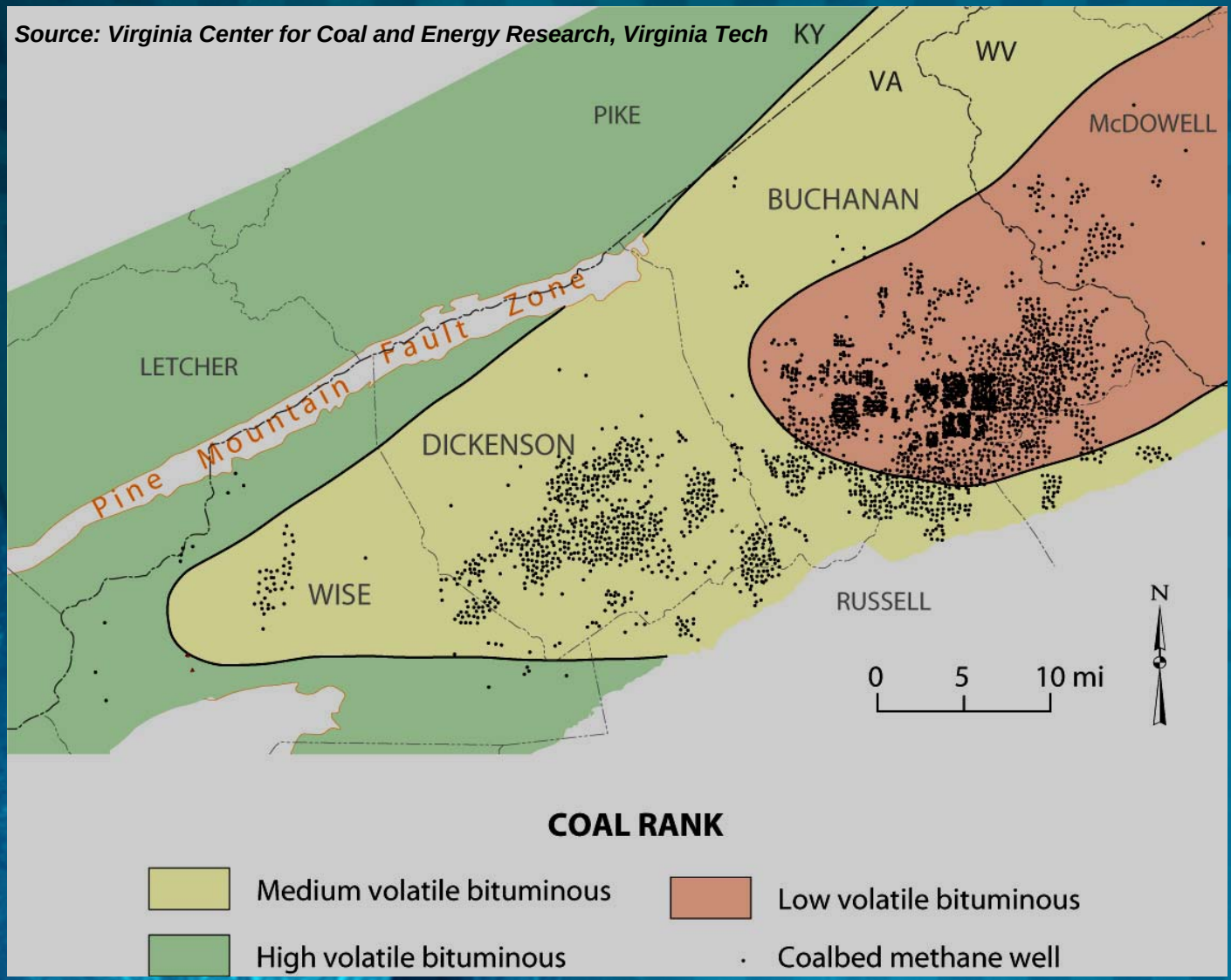
Coal Formation Prospects in Southeast Region

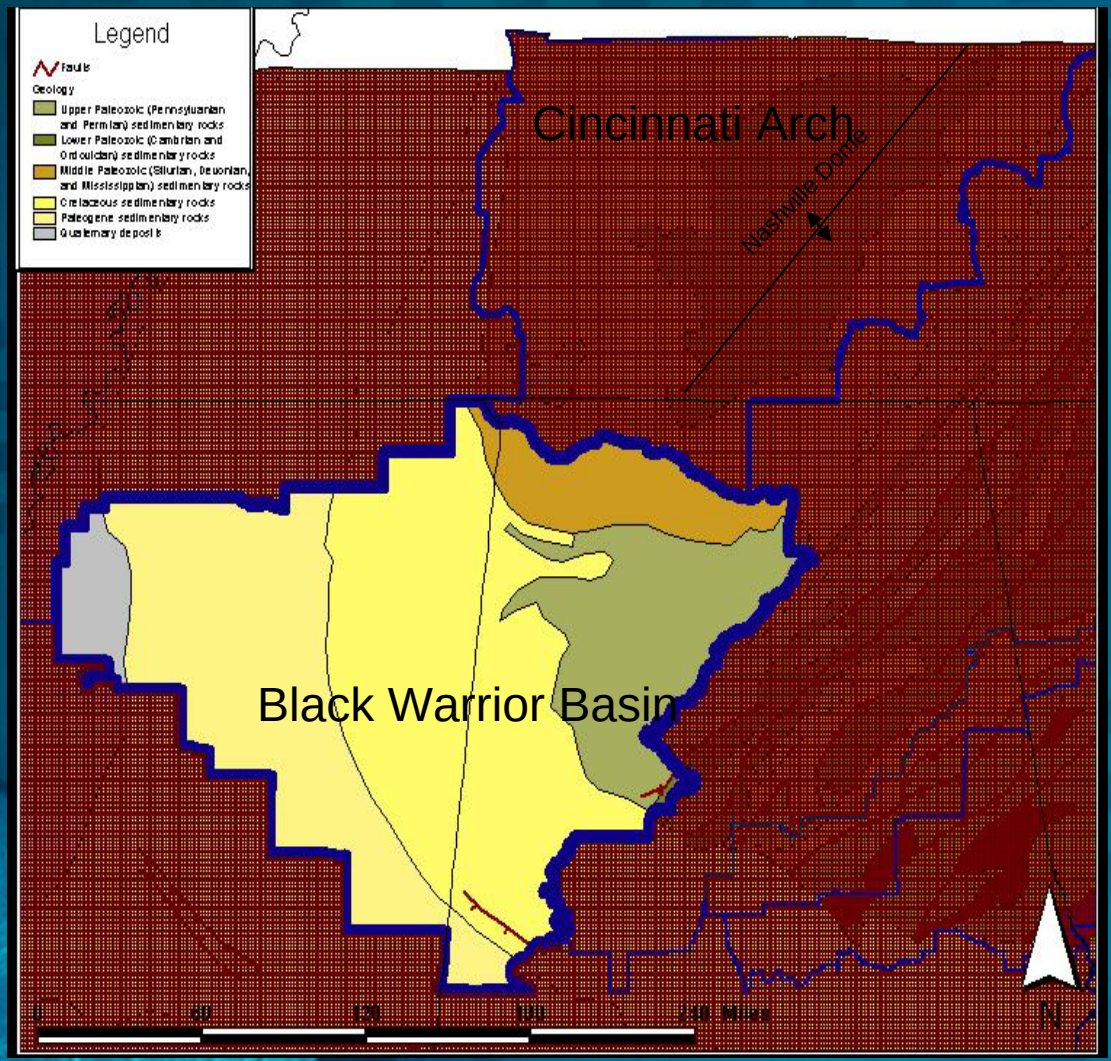


Source: Massachusetts Institute of Technology

Virginia CBM Development



Black Warrior Basin - Alabama



Source: Applied Resources International


Blue
Creek
Field
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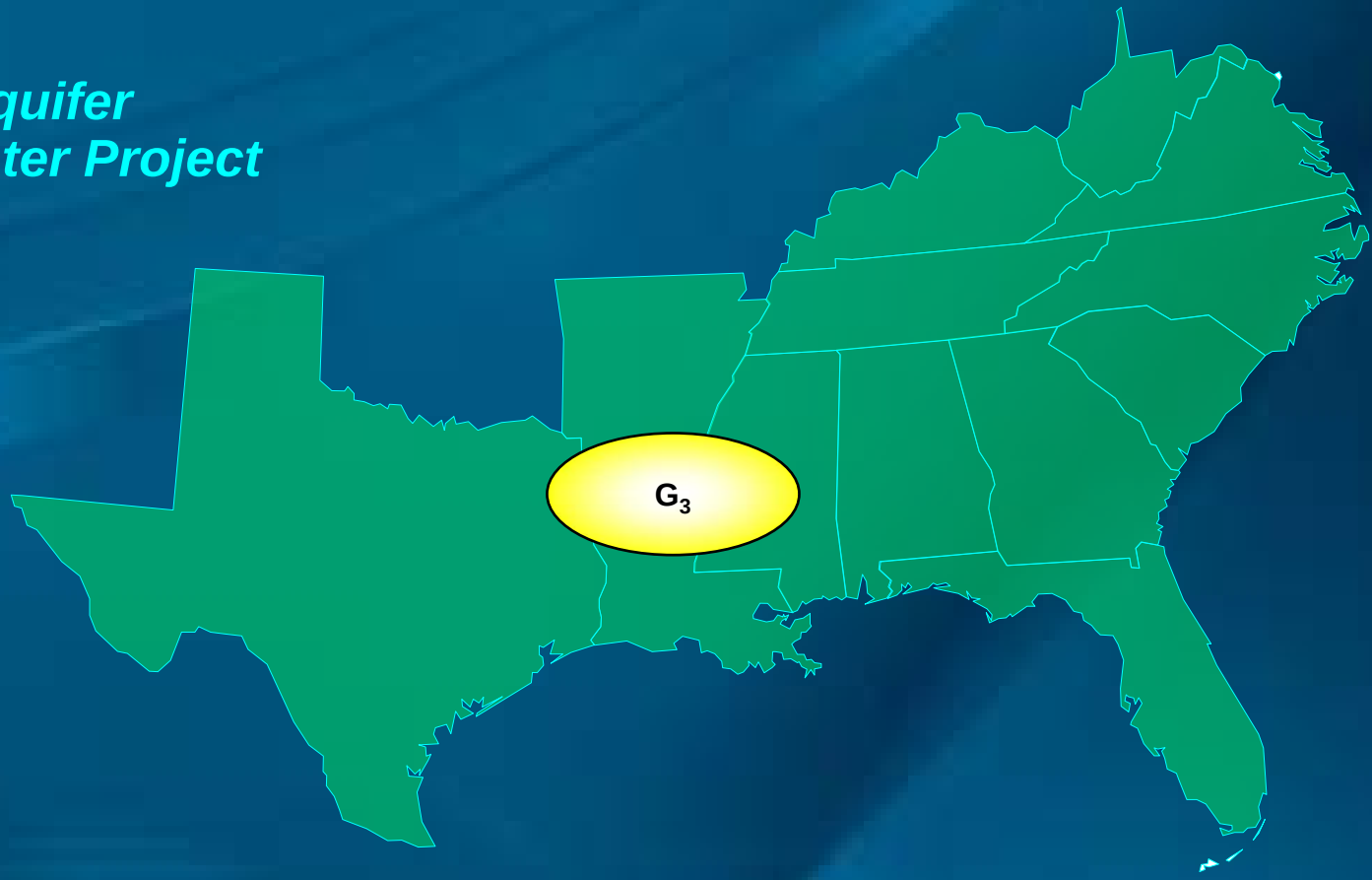
Saline Aquifer Test Center Project



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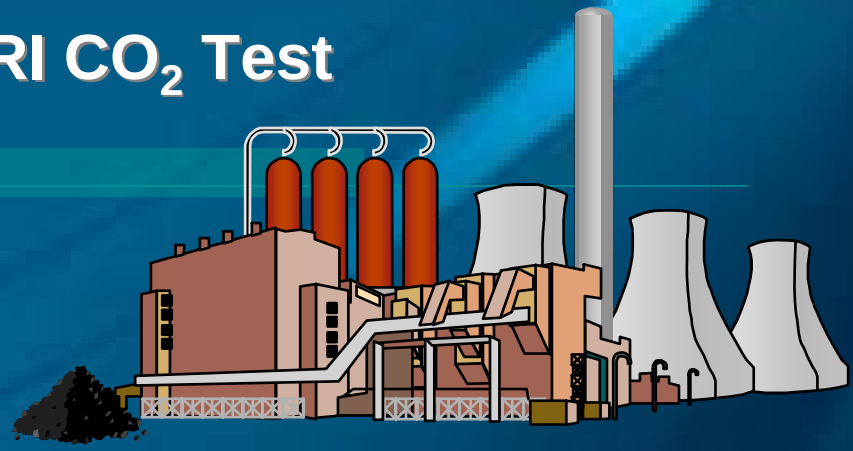
Site Selection Through EPRI CO_2 Test Centers Project



- **Build and operate 2-3 Test Centers**
  - Capture and store CO_2 at 10 MW scale
  - Real operating environments
  - Monitor 1 million tons CO_2 over a 10-year period
- **First site likely an existing PC-fired unit**
  - Results applicable to new PC plants
- **Single well disposal/storage design for initial pilot**
- **Goals include:**
  - Accelerate development of cost-effective options
  - Evaluate technical and environmental issues at a reasonable size
  - Collect long-term data

Work Plan

Task 1. ***Project Definition.*** Build initial geologic and reservoir model and conduct public outreach.

Task 2. ***Project Design.*** Procure CO_2 supply (3,000 tons), define MMV protocols and complete regulatory compliance.

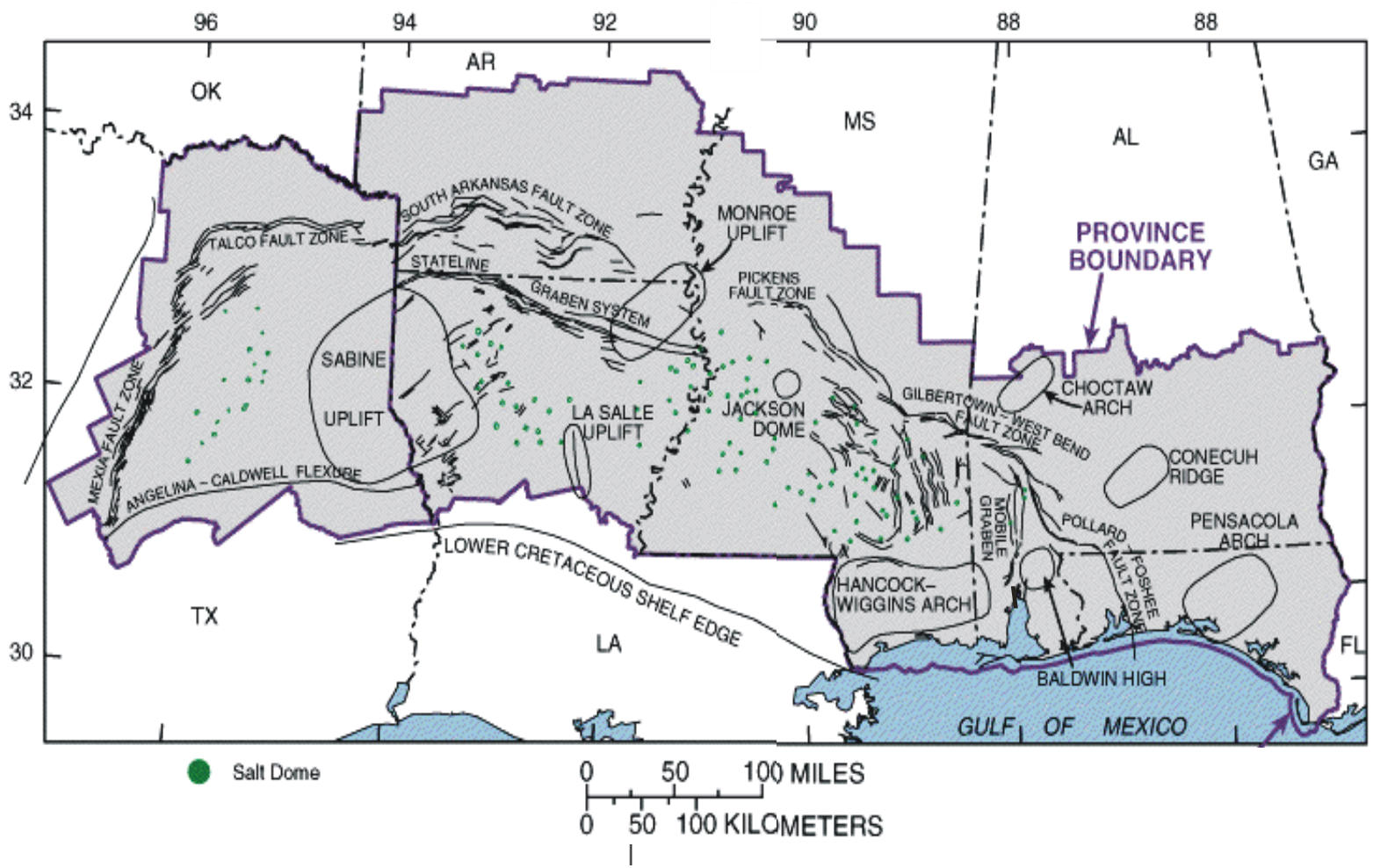
Task 3. ***Project Implementation.*** Drill, log and test slim-hole reservoir characterization well, gather baseline data and prepare field test site. Drill, complete and test CO_2 injection well.

Task 4. ***Project Operations.*** Inject CO_2 (for 30 days), complete MMV protocols and modify reservoir model.

Task 5. ***Project Completion, Post Appraisal and Report***. Extrapolate field test for injectivity, storage capacity and costs of geologic CO_2 storage in SECARB region. Prepare MMV protocols chapter and final reports.

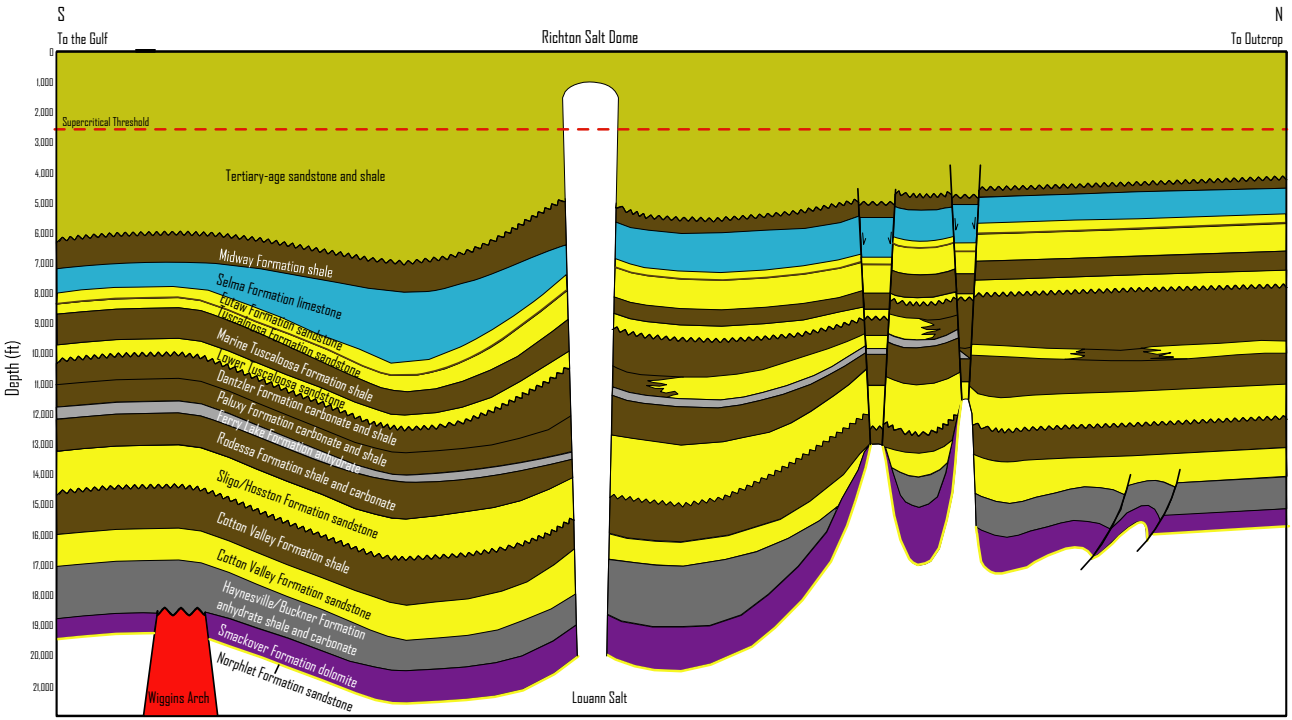
Geologic Setting for Field Test G-3

The Mississippi Interior Salt Dome Province
(Source: USGS, 1995)



Geologic Cross Section of the Field Test G-3 Area

Source: Advanced Resources International, 2004 based on Williams, 1969



STRATIGRAPHY OF THE MISSISSIPPI SALT BASIN PROVINCE
(Source: USGS, 1995)

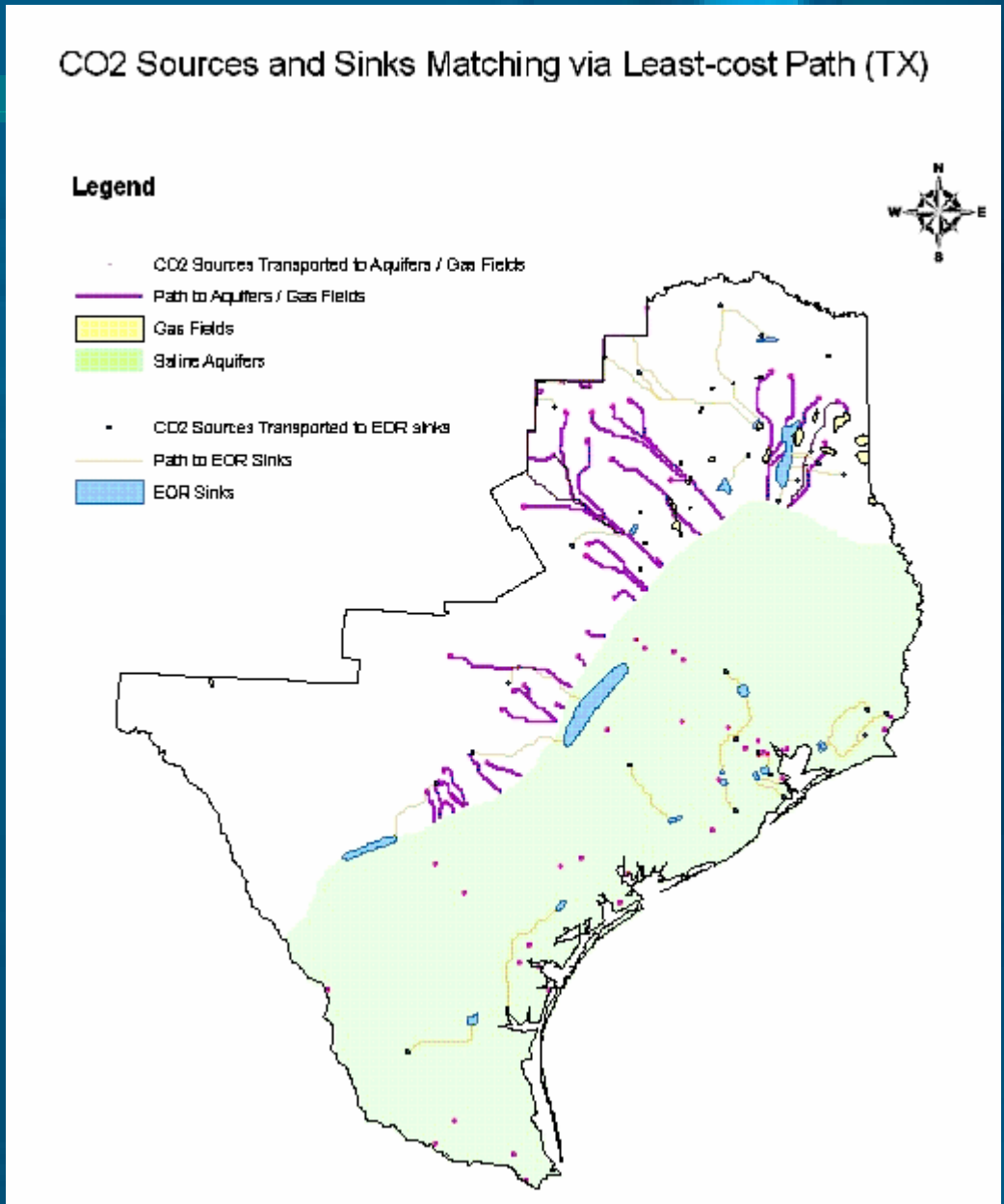
SYSTEM	SERIES	STRATIGRAPHIC UNIT: S. MISSISSIPPI	STRATIGRAPHIC UNIT: SW ALABAMA, FLORIDA
TERTIARY	Miocene		
	Oligo.	Frio / Vicksburg	Tampa
	Eocene	Jackson	Jackson
		Claiborne Group	Claiborne Group
	Paleo-cene	Wilcox Group	Wilcox Group
CRETACEOUS	Upper	Midway / Selma Gas Rock / Selma	Midway / Selma
		Eutaw	Eutaw
		Eagleford / Tuscaloosa Group	Tuscaloosa Group
	Lower	Dantzler	Dantzler
		Paluxy	Paluxy
		Glen Rose subgroup / James Ls.	Glen Rose subgroup
		Sligo	Sligo
		Hosston	Hosston
JURASSIC	Upper	Cotton Valley Gp.	Cotton Valley Gp.
		Haynesville	Haynesville
		Buckner	Buckner
		Smackover	Smackover
		Norphlet	Norphlet
	Middle	Louann Salt	Louann Salt
		Werner	Werner
TRIAS-SIC		Eagle Mills	Eagle Mills

Target #1

Target #2

seal aquifer/reservoir

Sources & Sinks Matching



Source: Advanced Resources International

Final Results

Southeast Regional Carbon Sequestration Partnership

Phase II Activities

Gerald R. Hill, Ph.D.
Senior Technical Advisor
Southern States Energy Board
6325 Amherst Court
Norcross, Georgia 30092
Phone: (770) 242-7712
Fax: (770) 242-9956
hill@sseb.org

www.SECARBON.org