Regional Carbon Sequestration Partnerships Review Meeting

November 16-17, 2004
Pittsburgh, Pennsylvania

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Regional Carbon Sequestration Partnerships Review Meeting

Introduction & Overview

Kenneth J. Nemeth
Southern States Energy Board

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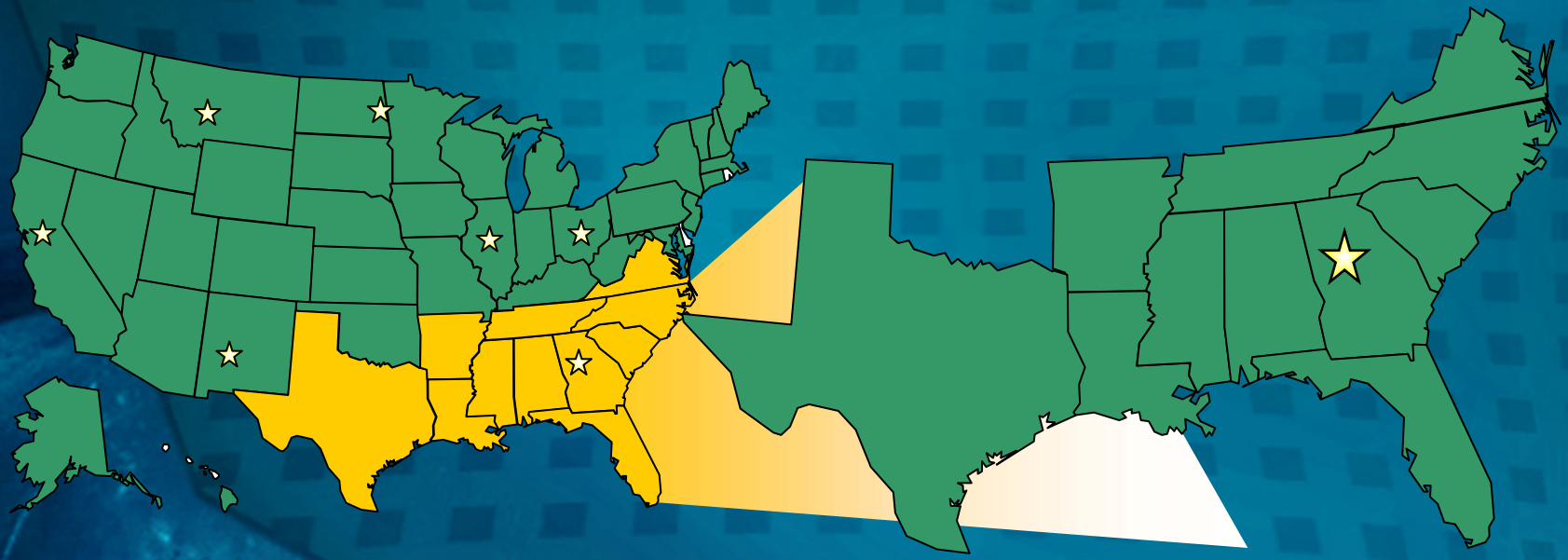
SECARB Presentation Outline

- **Introduction and Overview**
  - Ken Nemeth
- **Progress on Completing Phase I**
  - Pat Esposito
    - Public Outreach, Regulatory & Permitting, MMV, COOP
  - Dick Rhudy and Nick Irvin
    - Sources, Sinks & Infrastructure
    - Test Site Program
- **Completing Phase I and Preparing for Phase II**
  - Bill Higginbotham
    - Chairman's Initiatives for 2005
  - Jerry Hill
    - Identifying "Most Promising Opportunities"

Southeast Regional Carbon Sequestration Partnership



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SECARB Technical Team

Partner Name	City	State	Cong. Dist.
Southern States Energy Board (SSEB) [LEAD]	Norcross	GA	4
Electric Power Research Institute (EPRI)	Palo Alto	CA	14
Mississippi State University, Diagnostic Instrumentation Analysis Laboratory (MSU-DIAL)	Mississippi State	MS	3
Massachusetts Institute of Technology (MIT)	Cambridge	MA	8
Tennessee Valley Authority (TVA) Public Power Institute (PPI)	Chattanooga	TN	3
Winrock International	Morrilton	AR	2
Augusta Systems, Incorporated	Morgantown	WV	1
Texas Bureau of Economic Geology	Austin	TX	10
Virginia Tech Center for Coal and Energy Research	Blacksburg	VA	9
Applied Geo Technologies (AGT)	Choctaw	MS	3
Geological Survey of Alabama (GSA)	Tuscaloosa	AL	7
Susan Rice and Associates, Incorporated (SARA)	Grass Valley	CA	4
Advanced Resources International (ARI)	Arlington	VA	8
The Phillips Group	Elkins	WV	2
RMS Research	Charleston	WV	2
U.S. Department of Energy, National Energy Technology Laboratory (DOE/NETL)	Pittsburgh	PA	

Partnership "Technology Coalition"

- AGL Resources
- American Electric Power
- Arkansas Oil and Gas Commission
- BP America
- Center for Energy and Economic Development
- ChevronTexaco Corporation
- Clean Energy Systems, Inc.
- Dominion
- Duke Power
- Edison Electric Institute Entergy Services
- Florida Power & Light Company
- Georgia Environmental Facilities Authority
- Georgia Forestry Commission
- Interstate Oil and Gas Compact Commission
- Louisiana Department of Environmental Quality
- North American Coal Corporation, The
- North Carolina State Energy Office
- Nuclear Energy Institute
- Oak Ridge National Laboratory
- Old Dominion Electric Cooperative
- Progress Energy
- SCANA Corporation
- South Carolina Public Service Authority/Santee Cooper
- Southern Company
- Tampa Electric Company
- Tennessee Valley Authority (TVA)

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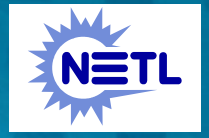


SECARB Industrial Partners – Virginia Tech

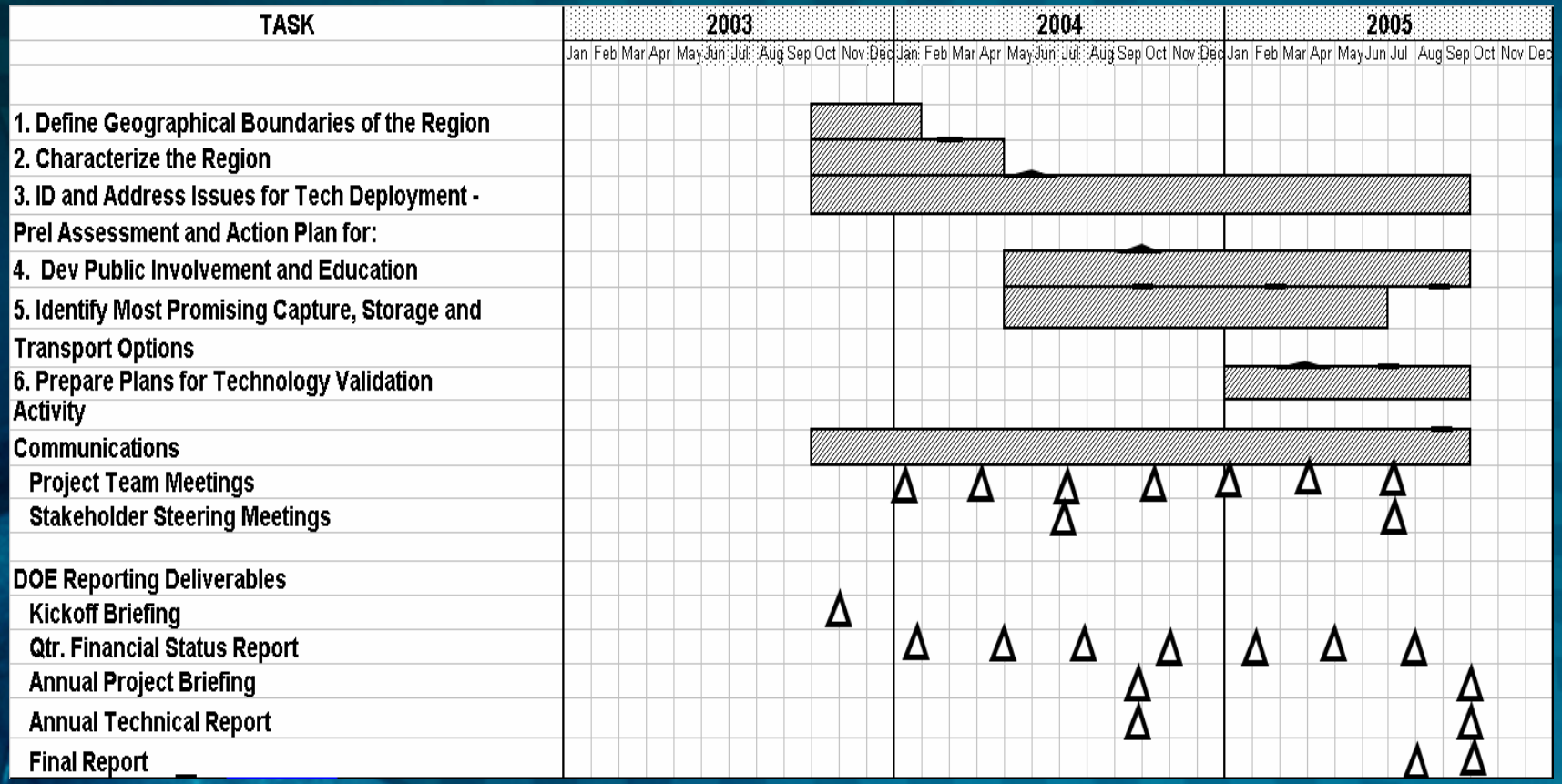
Partner Name	Primary Energy Interest
Natural Resource Partners	Land Holding
Piney Land Company	Land Holding
Berwind Land Company	Land Holding
Bright Industries	Land Holding
Pocahantas Land Company	Land Holding
Tampa Electric (TECO)	Utility & coal Production
Penn Virginia Resources	Land holding & gas production
Arch Mineral	Coal production
Peabody	Coal production
AMVEST	Coal production
Eagle Companies	Coal production
First Energy	Utility
GenPower	Utility

Budget

Start Date	End Date	Government Cost	Cost Share	Total Cost
9/30/03	**9/30/05**	**$ 1,599,908**	**$ 399,977**	**$ 1,999,885**

- DOE Costs to Date: $ 706,950.09
- Cost Share to Date: $ 185,203.85
- Total Costs to Date: $ 892,153.94

Schedule


TASK
2003
2004
2005
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1. Define Geographical Boundaries of the Region
2. Characterize the Region
3. ID and Address Issues for Tech Deployment -
Prel Assessment and Action Plan for:
4. Dev Public Involvement and Education
5. Identify Most Promising Capture, Storage and
Transport Options
6. Prepare Plans for Technology Validation
Activity
Communications
Project Team Meetings
Stakeholder Steering Meetings
DOE Reporting Deliverables
Kickoff Briefing
Qtr. Financial Status Report
Annual Project Briefing
Annual Technical Report
Final Report

Regional Carbon Sequestration Partnerships Review Meeting

Progress on Completing Phase I

Dr. Patrick Esposito, Sr.
Augusta Systems

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Regulatory, Permitting, Safety and Accounting Research Plan

- Analysis of state, federal, and tribal statutes and regulations applicable to regulatory, permitting, and safety issues
  - Specific geologic sequestration focuses include existing laws and administrative practices for CO_2 capture, transport, injection, and storage
  - Specific terrestrial sequestration focuses include existing law and administrative practices for mine land reclamation, no till farming, soil conservation, brownfield restoration, among others
- Investigation of GHG accounting frameworks

Update on Regulatory, Permitting and Safety Research Activities

- Geologic sequestration achievements:
  - Compilation of potentially applicable laws and regulations in SECARB region and other models, including those governing UIC wells and other non-UIC wells
  - Coordinated analysis with IOGCC effort
  - Analysis of laws/regulations for certainties and ambiguities

Update on Regulatory, Permitting and Safety Research Activities

- Terrestrial sequestration achievements:
  - Compilation of potentially applicable laws and regulations in the SECARB region and other models, including those for mine land reclamation, brownfield restoration, land and soil management, etc.
  - Analysis of laws/regulations for certainties and ambiguities

Update on Accounting Framework Research Activities

- Terrestrial sequestration achievements:
  - Accounting framework achievements:
  - Performed analysis of current USDOE 1605(b) requirements and published proposed revisions
  - Completed survey of state accounting methods
  - Assessed domestic public and private accounting framework models
  - Studied international accounting framework measures
- End result: Compilation of SECARB region accounting framework drivers

Next Steps on Regulatory, Permitting, Safety and Accounting Activities

- Develop draft action plans for:
  - Regulatory, permitting, and safety framework action plans with sections covering both geologic and terrestrial sequestration applications
  - Accounting framework action plans
- Submit action plans for review to SECARB Technical Team and Technology Coalition
- With input, finalize action plans

Outreach Plan

- SECARB initial actions:
  - Facilitation of SECARB Technology Coalition Meeting in January 2004
  - Hosting of SSEB Chairman's Forum and meeting of SECARB Technology Coalition in May 2004
  - Development by SSEB of the SECARB website
  - Completion of the USDOE/NETL Sequestration Communications Workshop series
  - Conducting outreach research activities: industry focus group and stakeholder interviews

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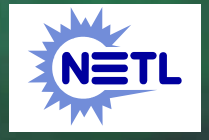

SECARB Focus Group – Sept. 12, 2004

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Outreach Plan (cont.)

- Key leverage points:
  - SECARB Technology Coalition
  - Existing SSEB Committee and Task Force structures
  - Carbon Offset Opportunity Program

Facilitating Sequestration Efforts in the Region

- Carbon Offset Opportunity Program:
  - USDOE/NETL - sponsored platform to match potential investors with contemplated GHG offset and reduction projects, with a focus on carbon sequestration, in a manner that emphasizes voluntary action
  - CO-OP being introduced to potential users nationwide
  - As part of national roll-out, SECARB has embraced CO-OP as a vehicle to catalyze sequestration projects in SECARB and reduce transaction costs for stakeholders

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Next Steps on Outreach Activities

- Initiate general outreach via SECARB deployment of CO-OP
- Conduct final actions on outreach research activities: finalize ongoing efforts, synthesize information
- Develop draft outreach action plans
- Submit draft outreach action plans for review by SECARB Technical Team and Technology Coalition
- With input from SECARB, finalize action plans

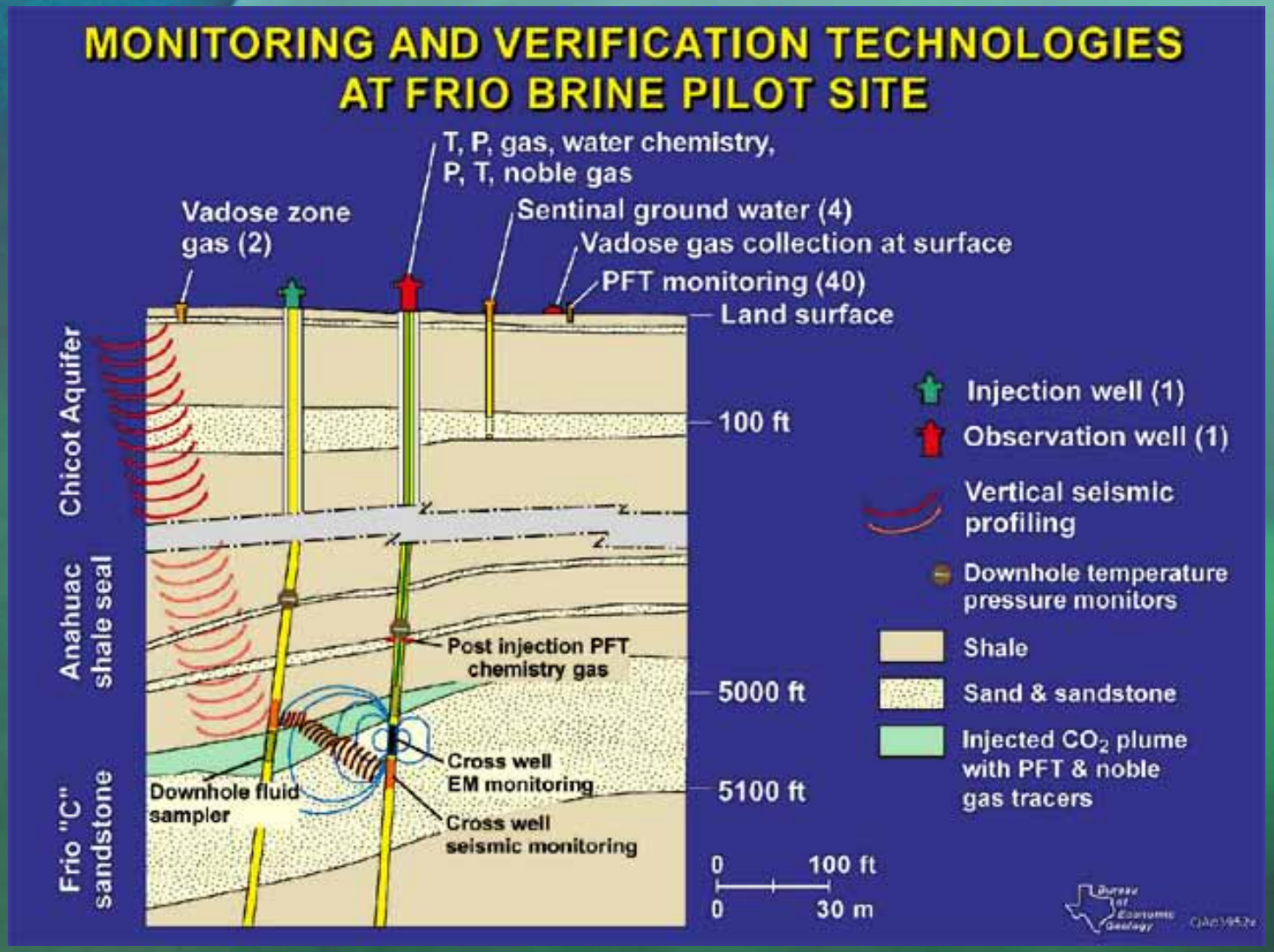
Context for Phase II

- Regulatory, Permitting, Safety, and Accounting Research Activities
  - Significant to effort as initial decisions about regulatory, permitting, safety, and accounting approaches for potential Phase II projects could impact future sequestration frameworks
  - Action plans could have lasting impact in the region beyond Phase II and into wide-scale deployment
- Outreach Activities
  - Central to effort as public awareness of and knowledge regarding sequestration is essential
  - New technology applications bring inherent needs for informed dialogues and communications – it is assumed that sequestration deployment will follow this model

Monitoring, Measurement & Verification

- Determine methods for MMV
- Ensure QA/QC protocols available
- Importance of MMV:
  - The public wants to know that sequestration is safe and effective
  - State, federal and international agencies want to monitor commitments
  - Investors and credit traders want to know that sequestration is working

MONITORING AND VERIFICATION TECHNOLOGIES AT FRIO BRINE PILOT SITE



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Progress on Completing Phase I (cont.)

Richard Rhudy
Electric Power Research Institute

Nick Irvin
Southern Company

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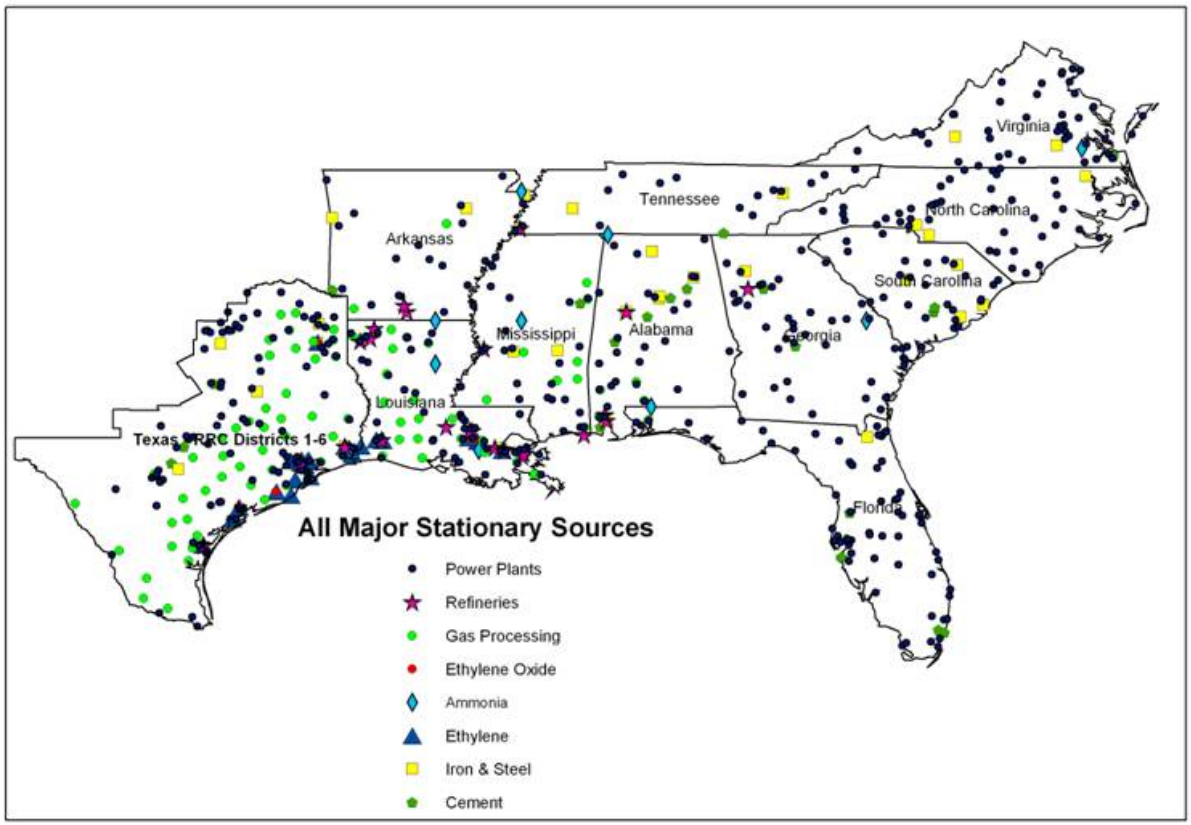
All Sources



Source: Massachusetts Institute of Technology

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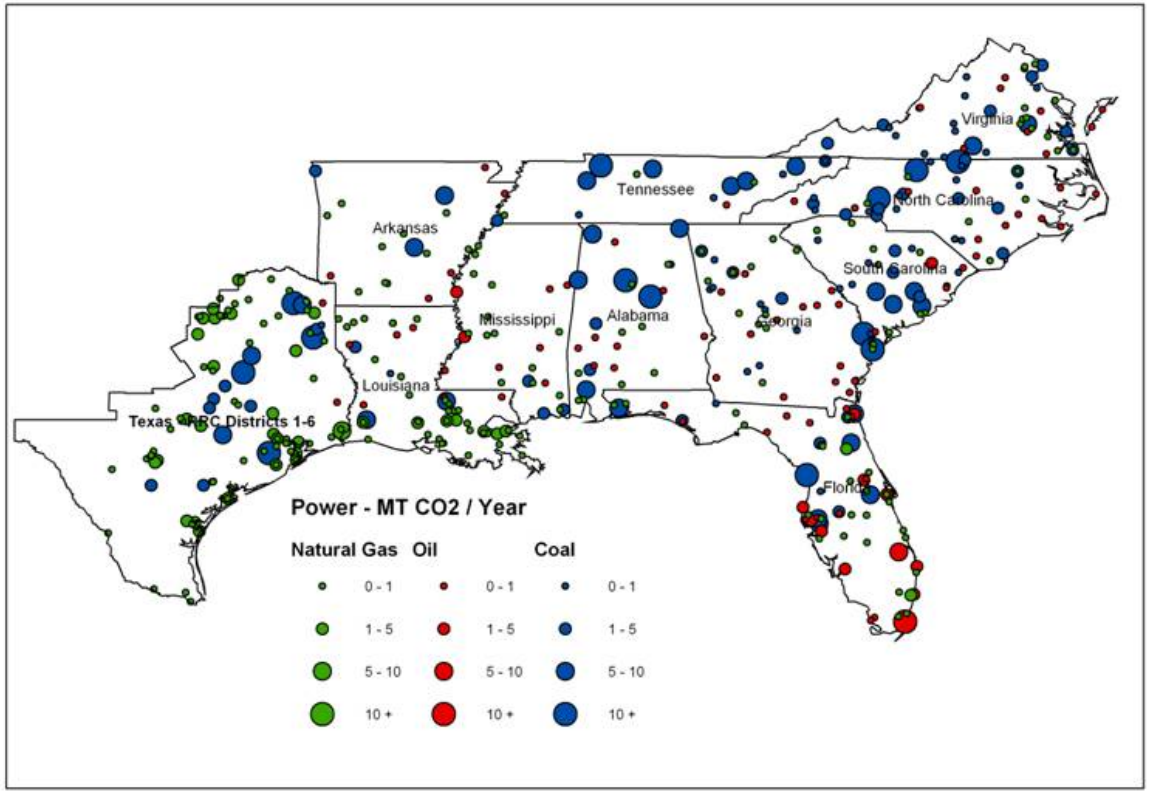
Power Plants



Source: Massachusetts Institute of Technology

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Power Plants

State	Number of Power Plants	CO2 Emissions - by Fuel (MT/Year)			
		Coal	Natural Gas	Oil	Total
Alabama	34	69	1.1	4	74
Arkansas	21	22	2.5	1	26
Florida	98	75	12.4	52	140
Georgia	66	30	1.0	3	34
Louisiana	70	20	25.6	2	48
Mississippi	31	12	1.9	7	21
North Carolina	52	69	0.7	1	71
South Carolina	29	37	0.1	5	43
Tennessee	20	55	0.2	0	56
Texas (RRC Districts 1-6)	148	112	79.6	1	193
Virginia	59	36	1.4	2	40
Total	**628**	**538**	**126**	**79**	**743**

Source: Massachusetts Institute of Technology

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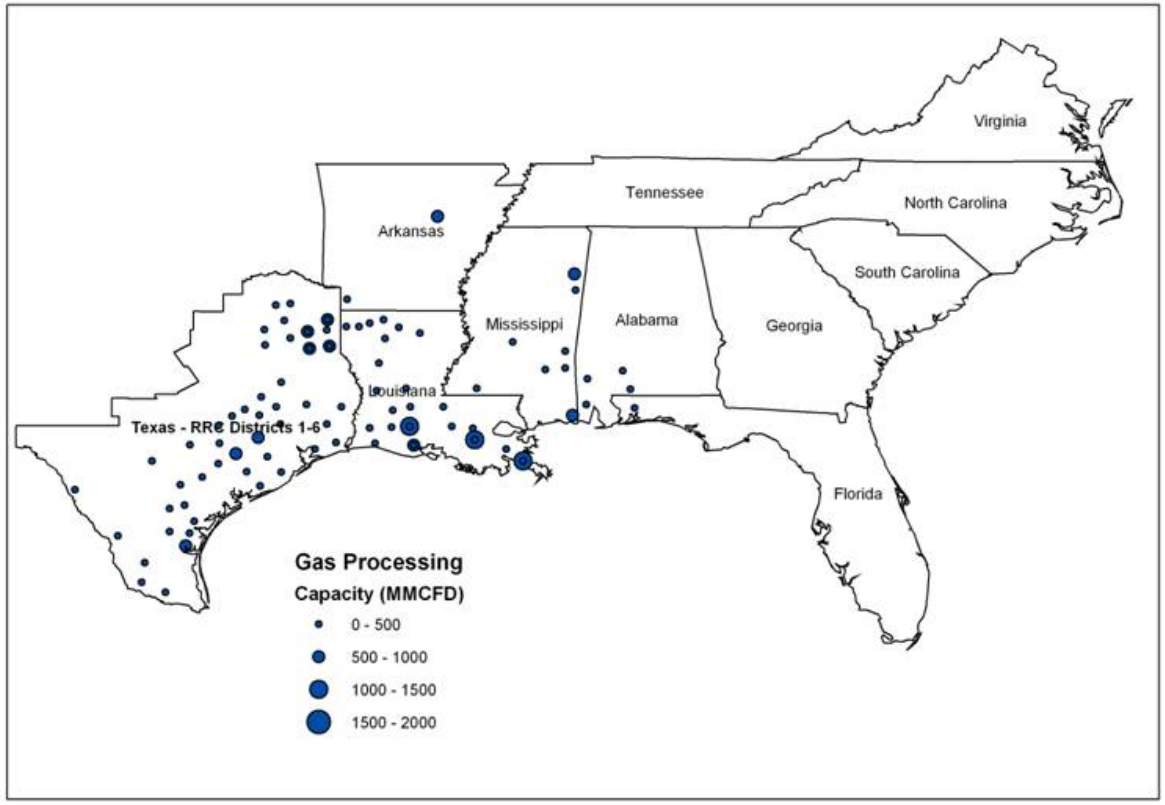
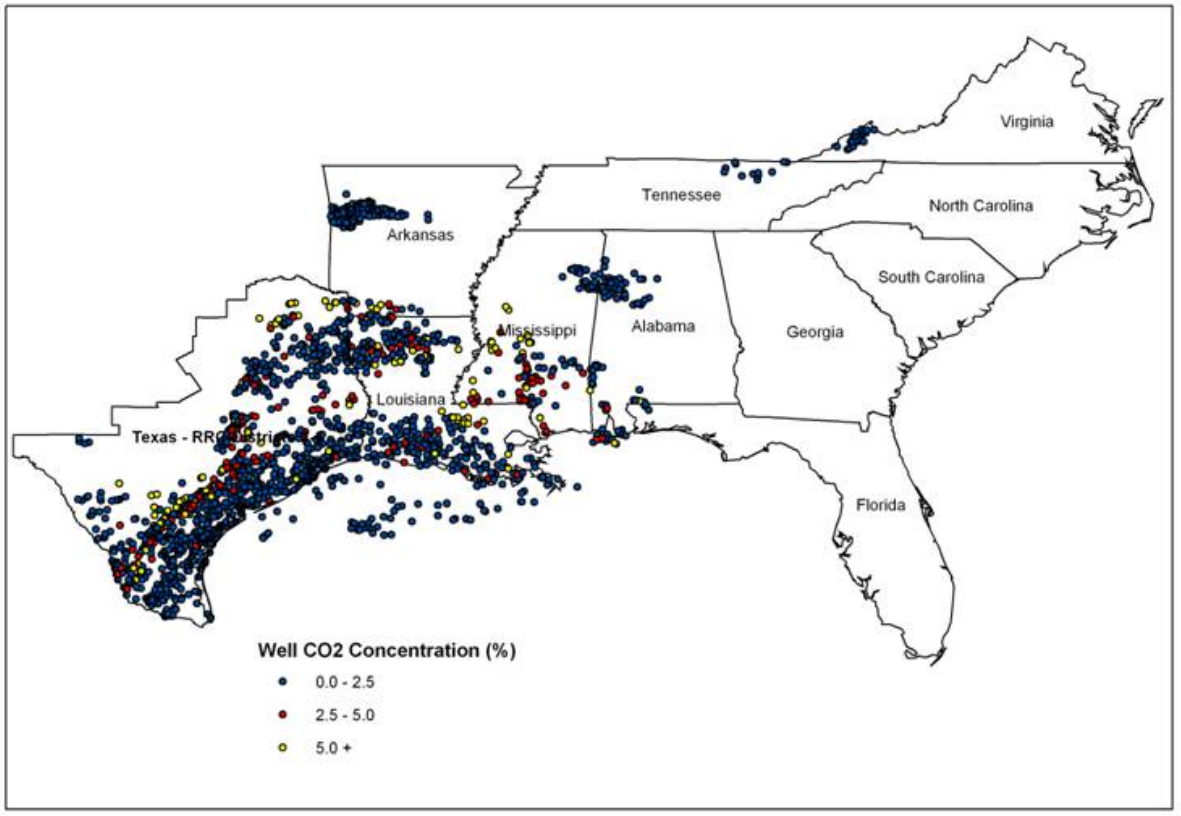
Gas Processing Plants



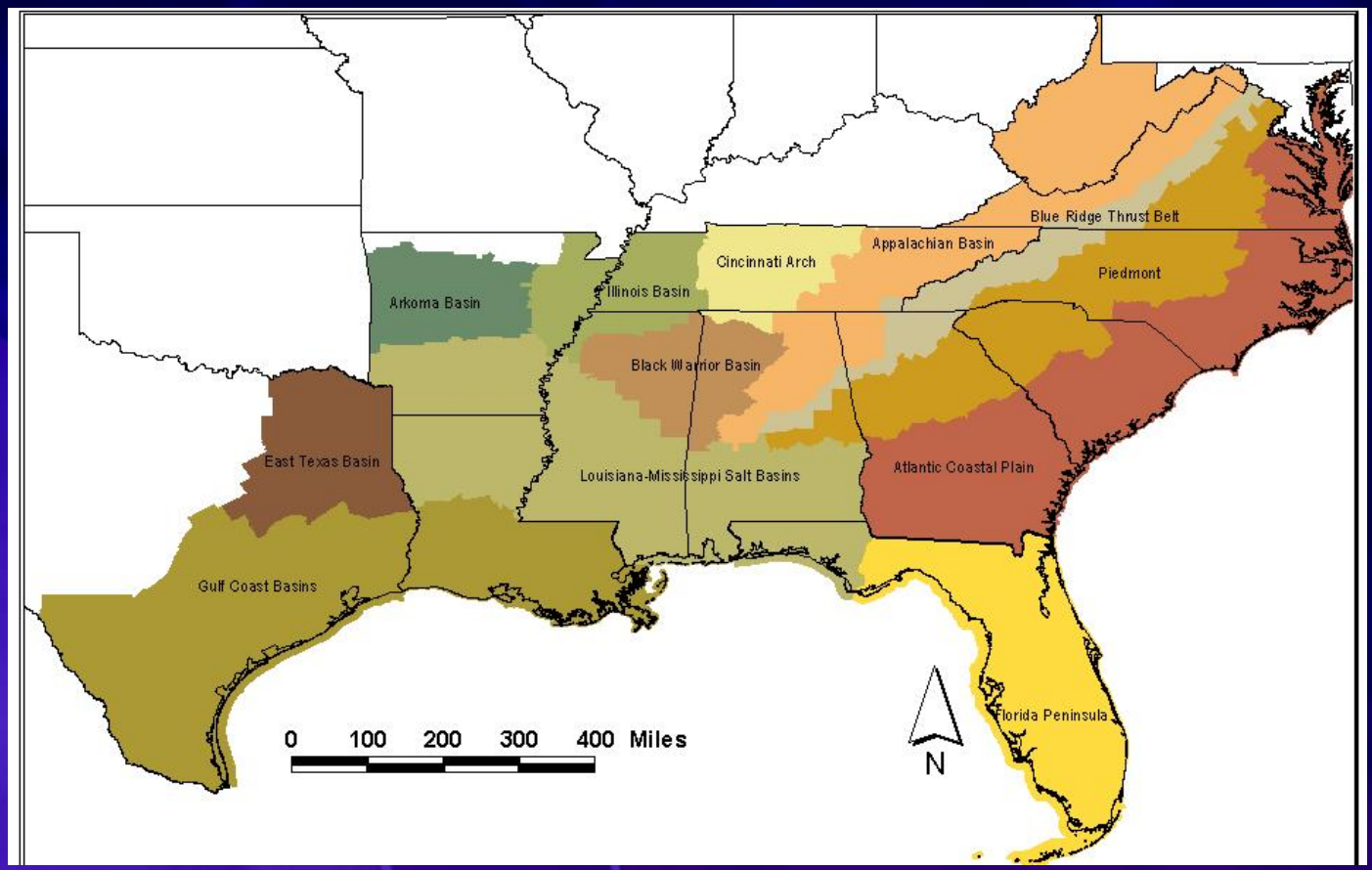
Source: Massachusetts Institute of Technology

Gas Wells



Source: Massachusetts Institute of Technology

Geological Provinces of the SE Regional Partnership



Source: Applied Resources International

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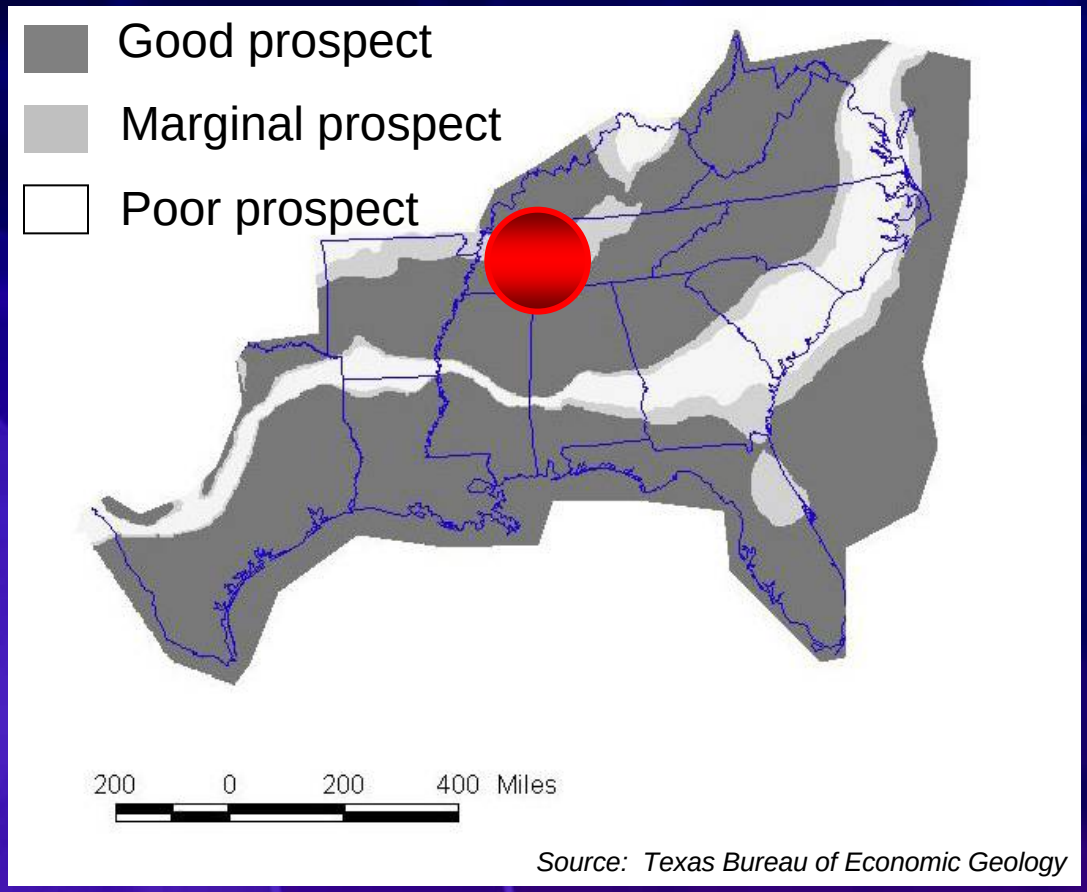
Brine Formation Prospects in the Southeast Region



Source: Texas Bureau of Economic Geology

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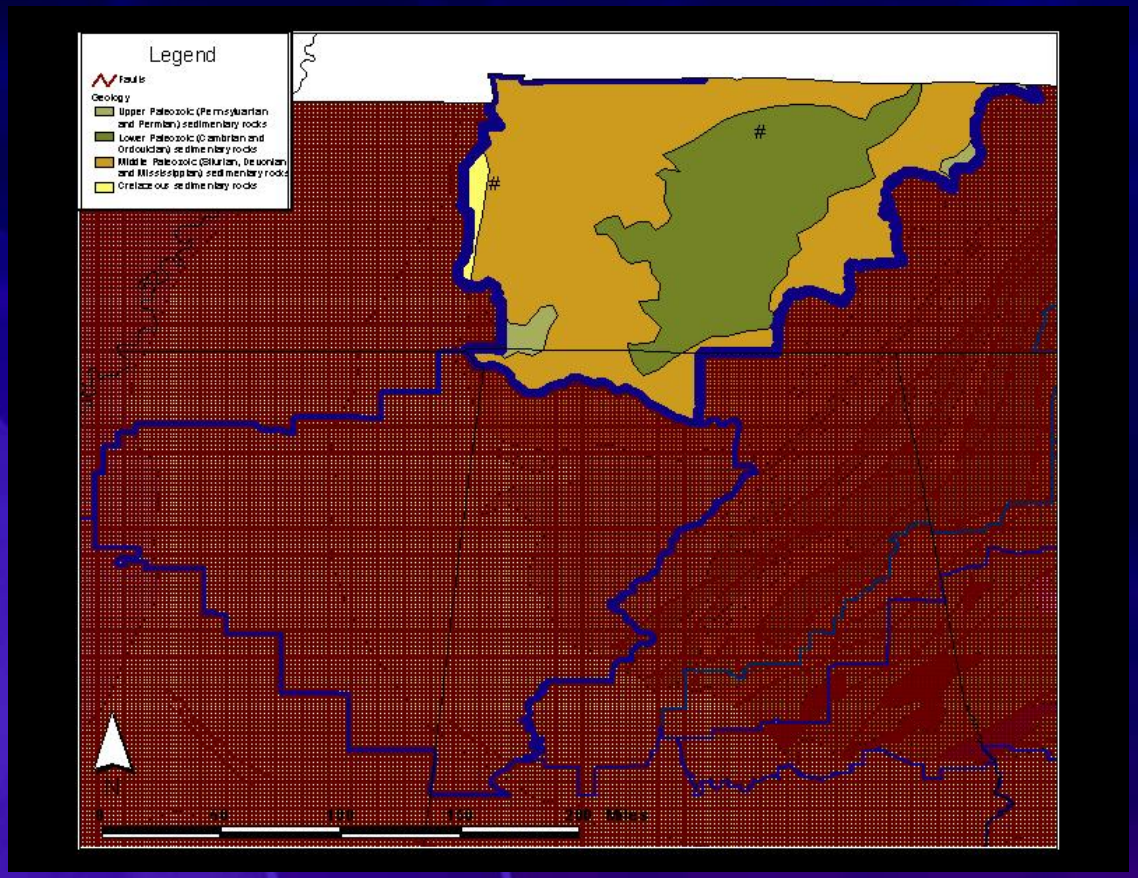
Southern Cincinnati Arch: Surface Geology And Structural Features



Source: Applied Resources International

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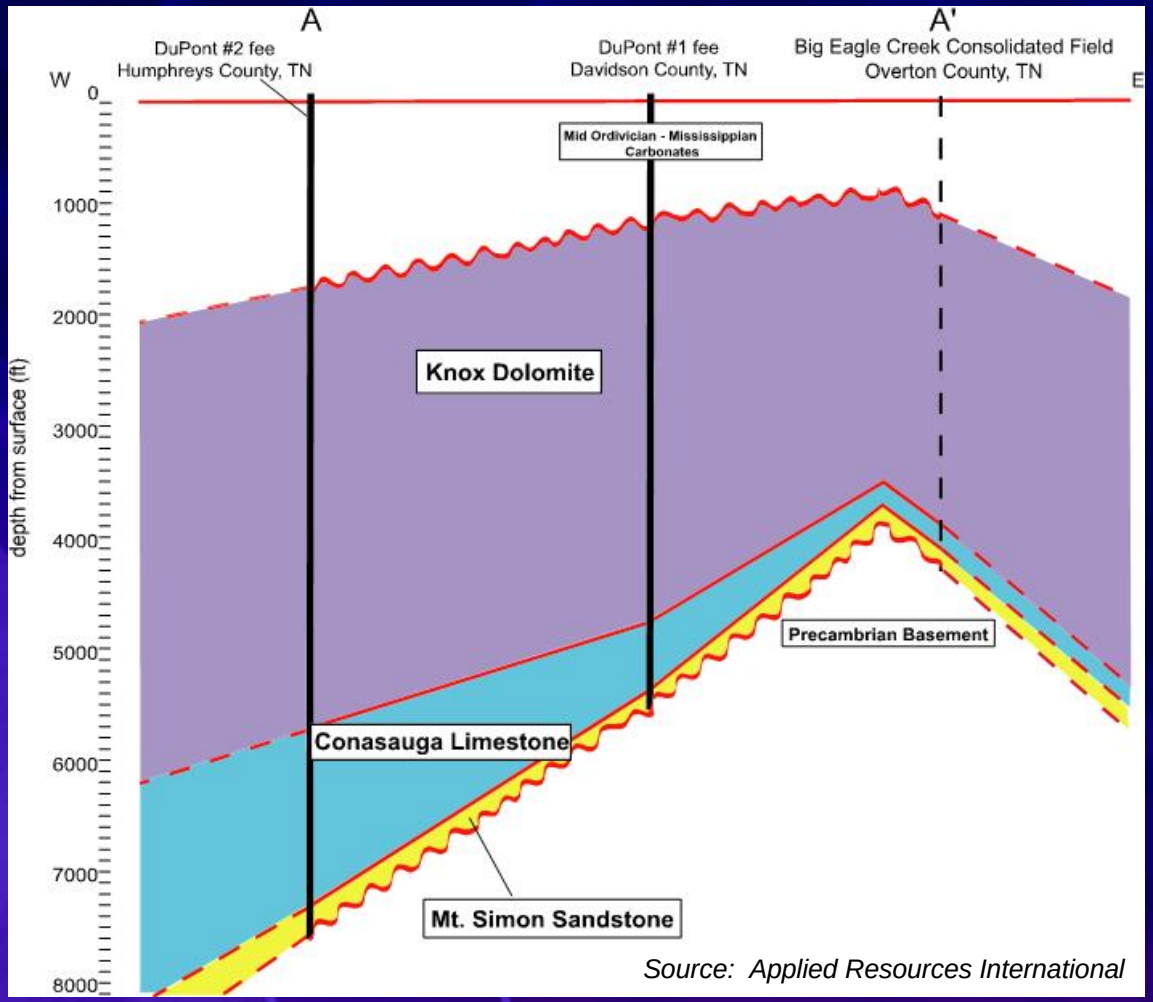
Southern Cincinnati Arch: Cross-Section



Source: Applied Resources International

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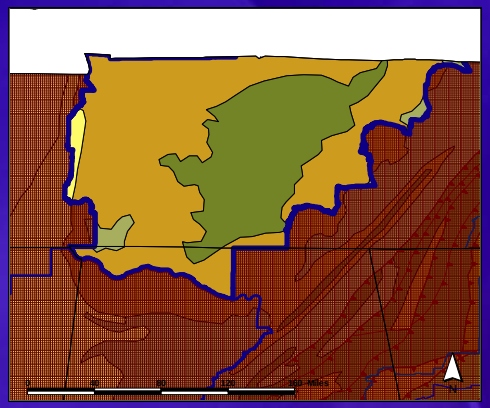
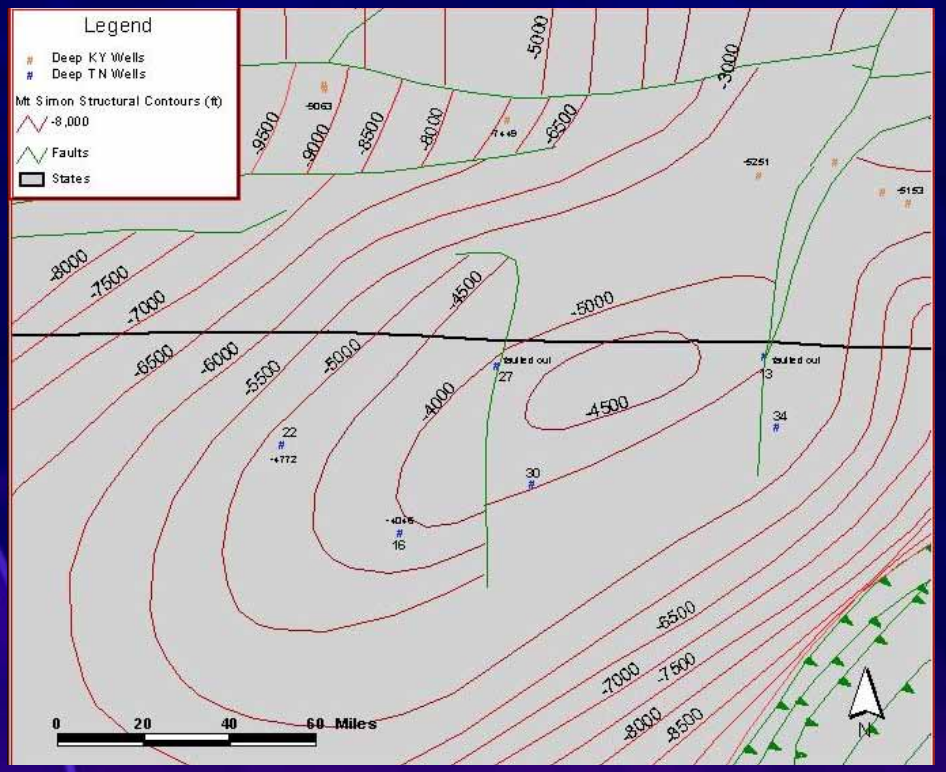
Southern Cincinnati Arch: Reservoir Structure

Structural contours on top of Mt. Simon (Rome/Basal Sand) Formation

Within this area the Mt Simon (Rome/ Basal Sand) Reservoir thickness is 100 feet based on data from wells #22 and #16





Source: Applied Resources International

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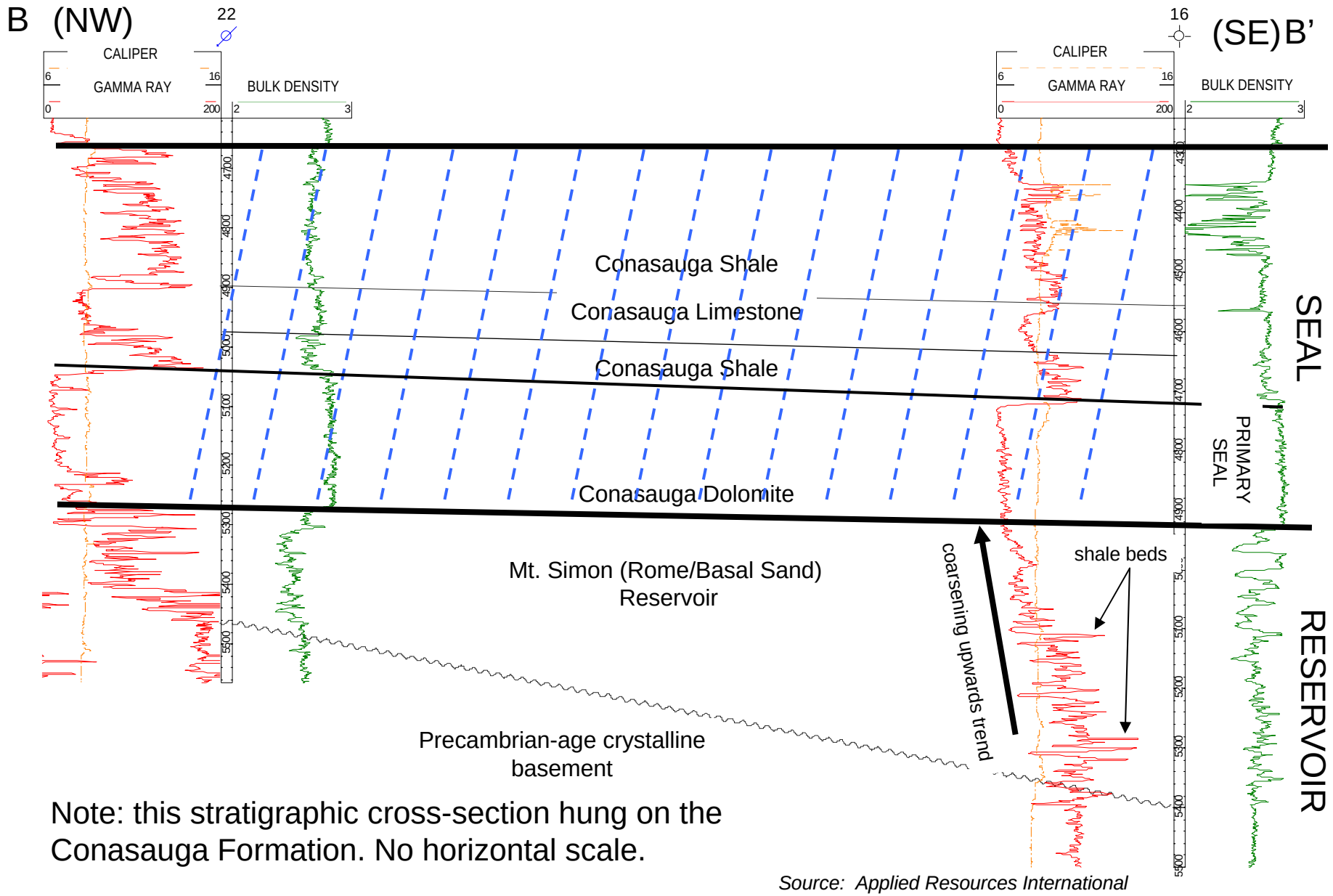
Southern Cincinnati Arch: Reservoir and Seal



Note: this stratigraphic cross-section hung on the Conasauga Formation. No horizontal scale.

Source: Applied Resources International

Southern Cincinnati Arch: Reservoir Storage Capacity and Injectivity

Reservoir and Fluid Properties*

Porosity = 10%**
Permeability = 15.9 md
Temperature = 113ºF
Pressure = 2,330 psi
Thickness = 100 feet
Salinity = 25,000 ppm
CO_2 Solubility = 125 scf/bbl
Residual CO_2 = 23%
CO_2 FVF = 2,278 scf/bbl

**The Mt. Simon (Rome/Basal Sand) Formation characteristics are based on a core report for well #22 in Davidson County.*

***Average of core and geophysical log porosity calculations and measurements*

Storage Capacity (CO_2)

Area = 5,000 mi^2*
Capacity = 0.71 MMt/mi^2
TOTAL = 3,558 MMt

- In solution = 595 MMt
- Trapped = 1,996 MMt
- Free = 967 MMt

Injectivity (CO_2)**

$$q_{sc} = \frac{(\Psi_2 - \Psi_1)kh}{\gamma T P_t}$$

q_{sc} = (CO_2 injection rate)
= 18 MMscfd/well
= 1,047 t/d per well

** For Nashville Dome*
** *Calculated using pseudo pressure equation for CO_2*

Source: Applied Resources International

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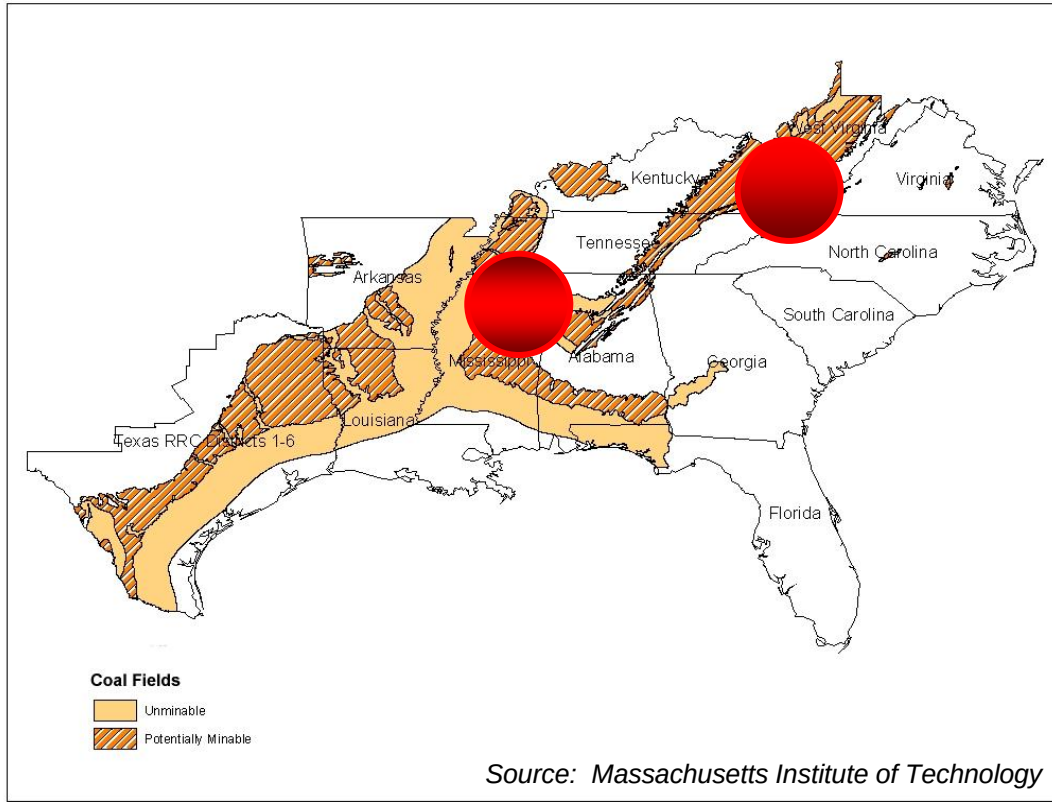
Coal Formation Prospects in Southeast Region



Source: Massachusetts Institute of Technology

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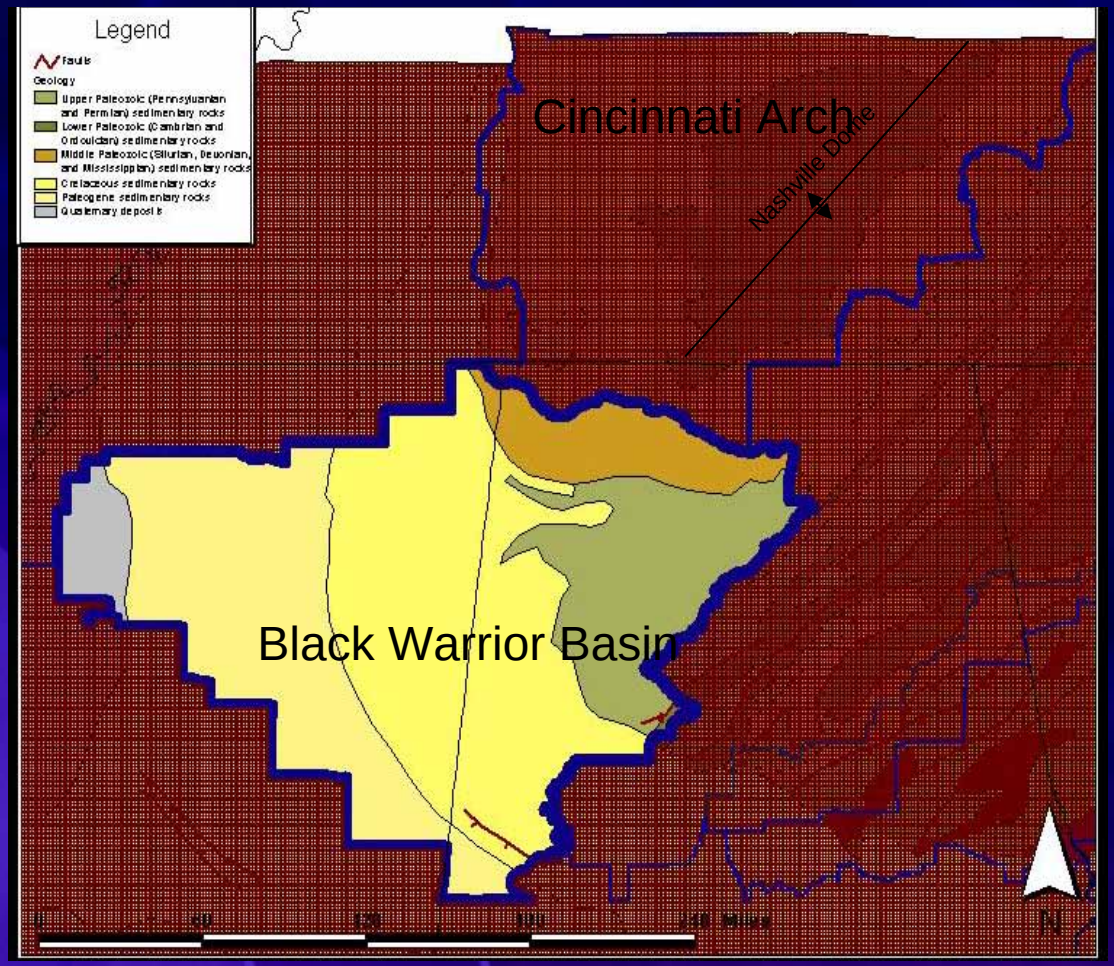
Black Warrior Basin: Geology



Source: Applied Resources International

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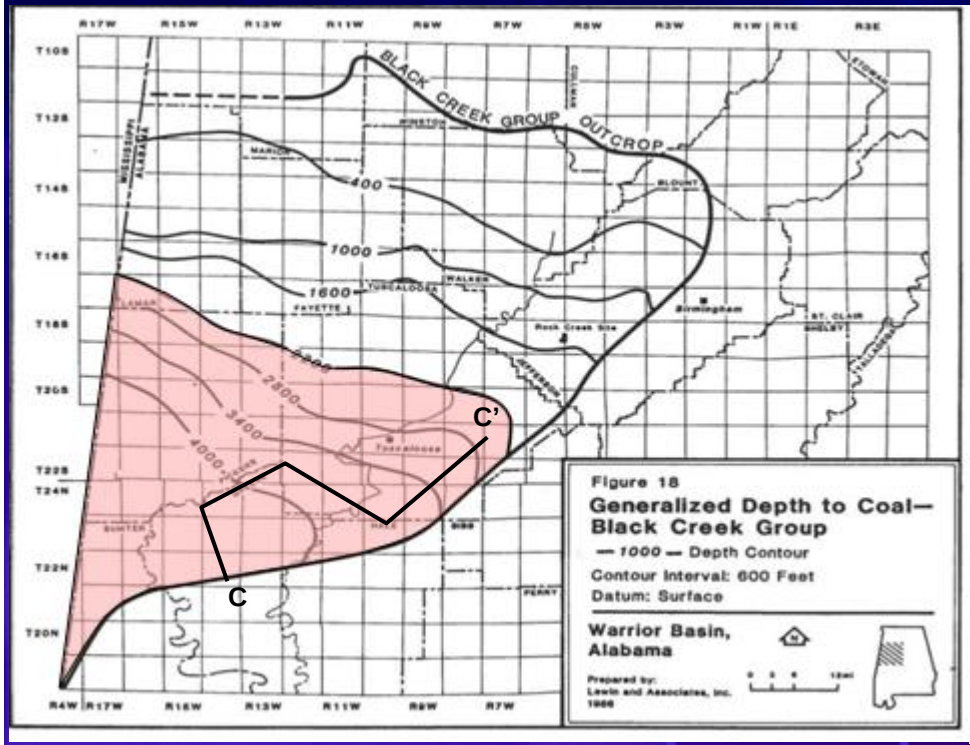
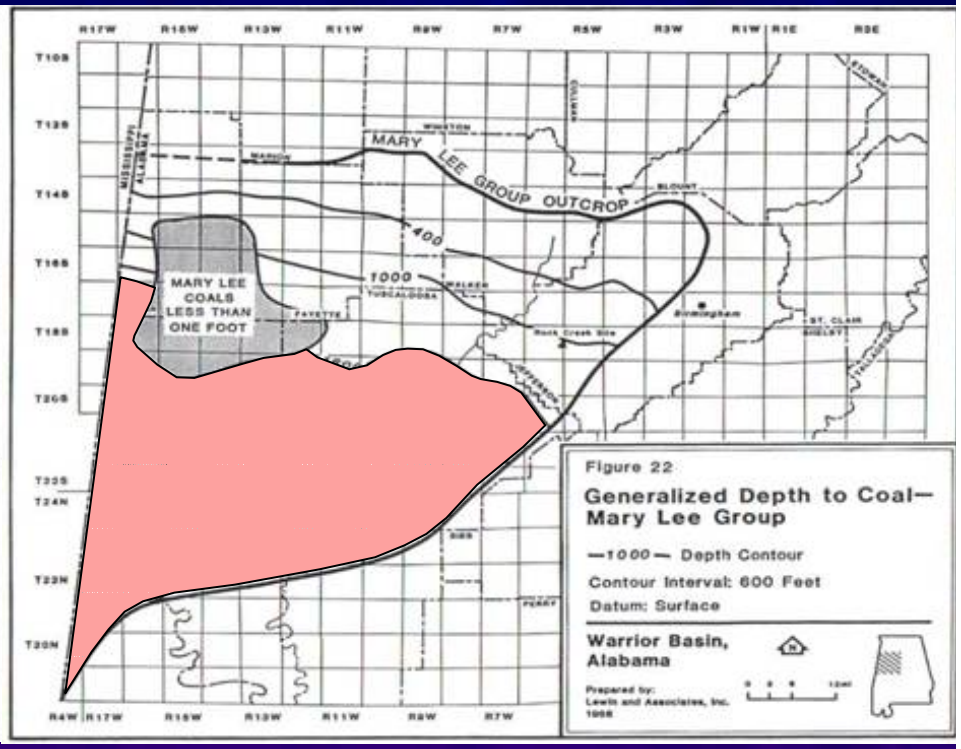
Black Warrior Basin: Depth to Black Creek and Mary Lee Coal Groups

Unminable Portion of the Black Creek Coal Group



Unminable Portion of the Mary Lee Coal Group



Source: Applied Resources International

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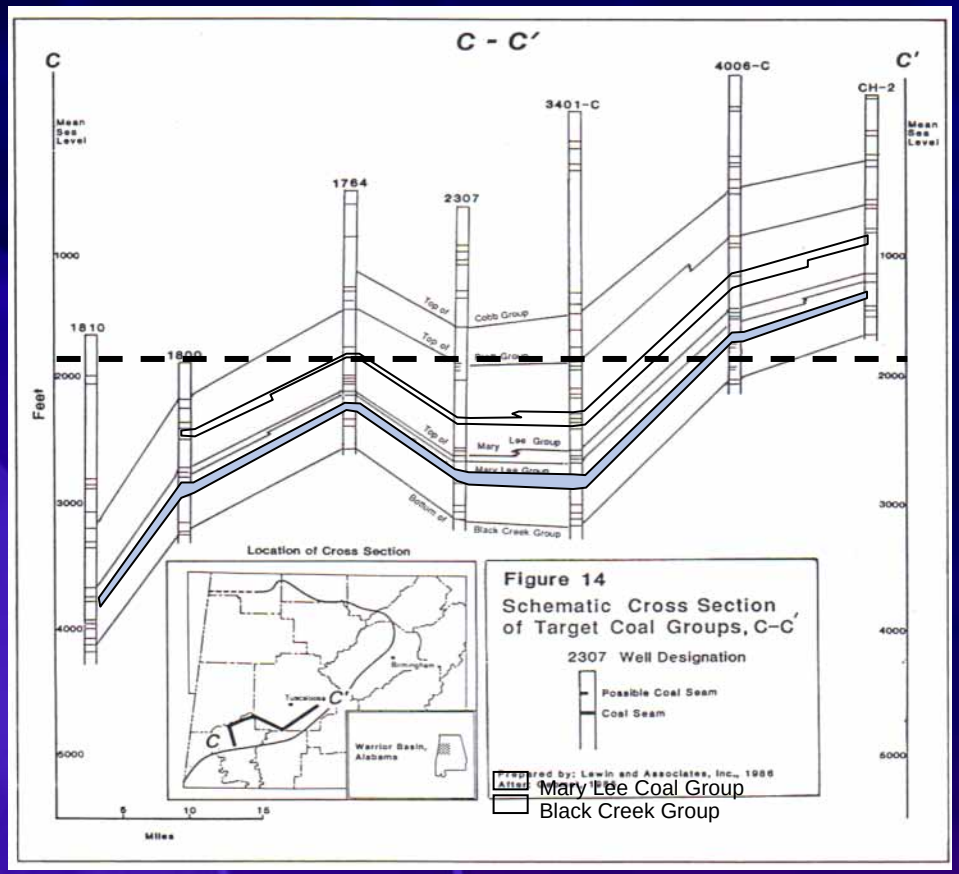
Black Warrior Basin: Depth to Black Creek and Mary Lee Coal Seams



Source: Applied Resources International

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Black Warrior Basin: Reservoir Storage Capacity

Reservoir Properties

1. Black Creek Group

Thickness = 4 feet
Min Depth = 2,200 ft
Average Depth = 3,600 ft
Primarily High Vol A
and Med Vol

2. Mary Lee Group

Thickness = 6 feet
Min Depth = 2,200 ft
Average Depth = 3,400 ft
High Vol A

Injectivity (CO_2)

To be determined

Storage Capacity (CO_2)

1. Black Creek Group

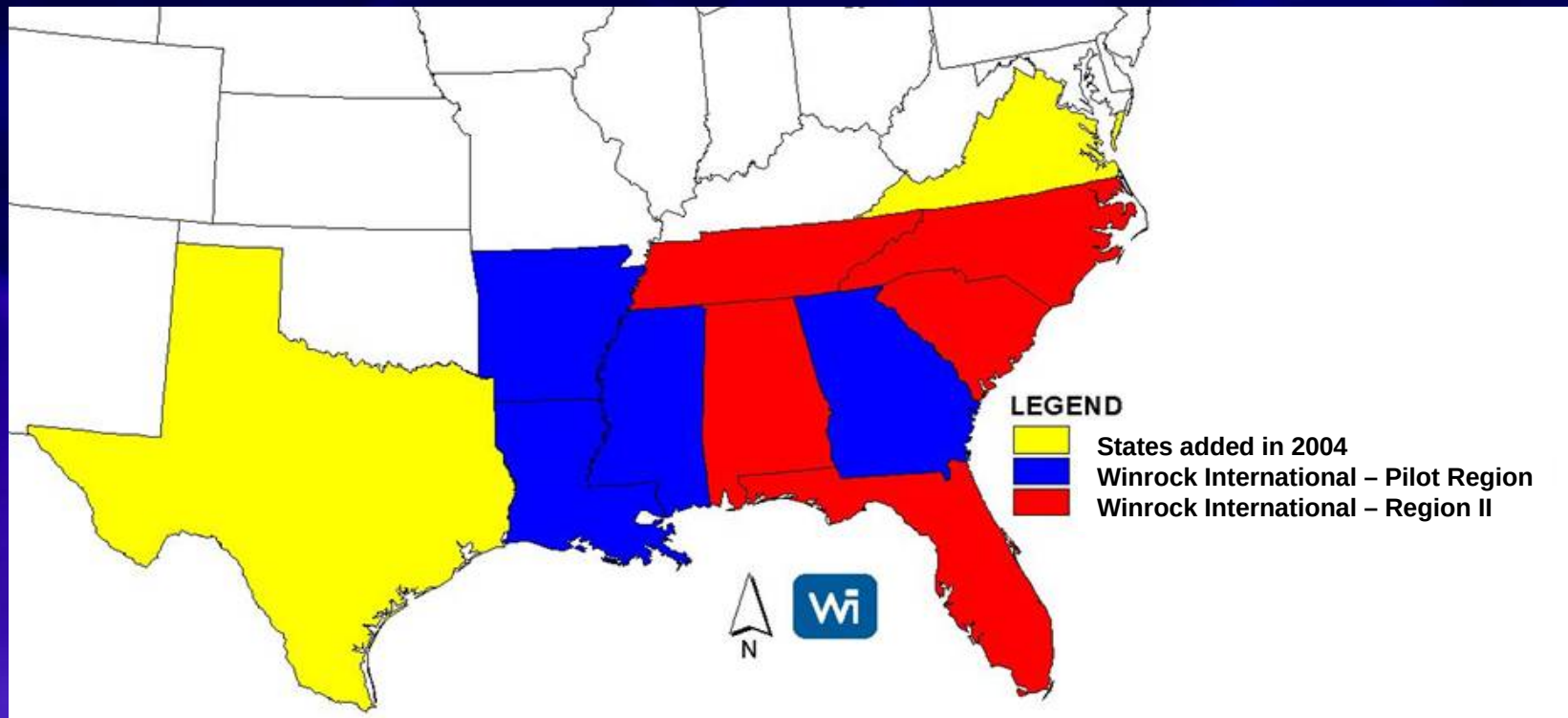
Area = 2,200 mi^2
Volume = 5,632,000 acre-feet
Mass = 10.1 x 10^9 tons
CO_2 per ton = 1,100 cf/ton
TOTAL CO_2 = 648 MMTons

2. Mary Lee Group

Area = 1,800 mi^2
Volume = 6,912,000 acre-feet
Mass = 12.4 x 10^9 tons
CO2 per ton = 1,000 cf/ton
TOTAL CO_2 = 723 MMTons

Source: Applied Resources International

Terrestrial Evaluation



Source: Winrock International

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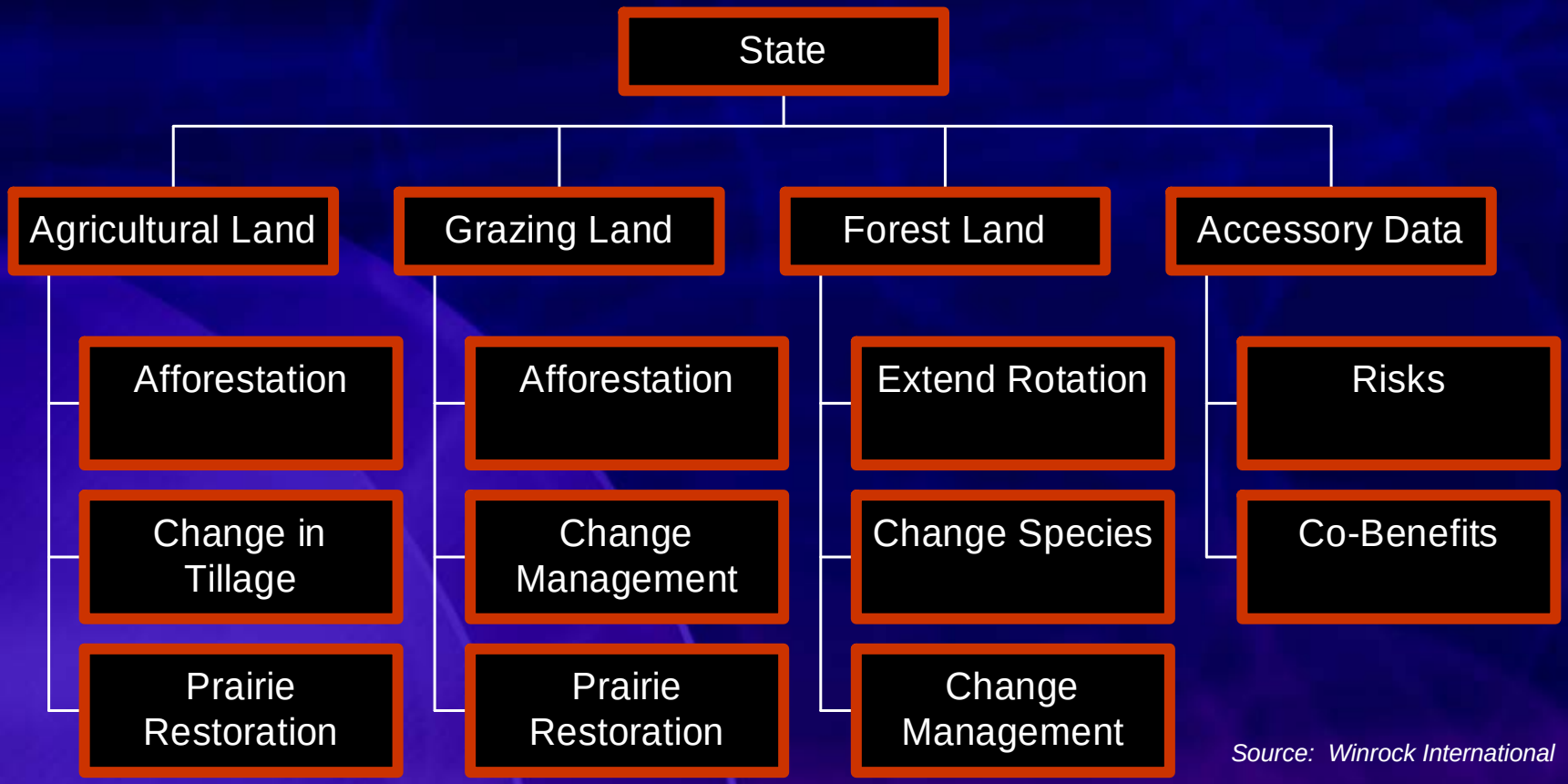
Overall Data Structure



Source: Winrock International

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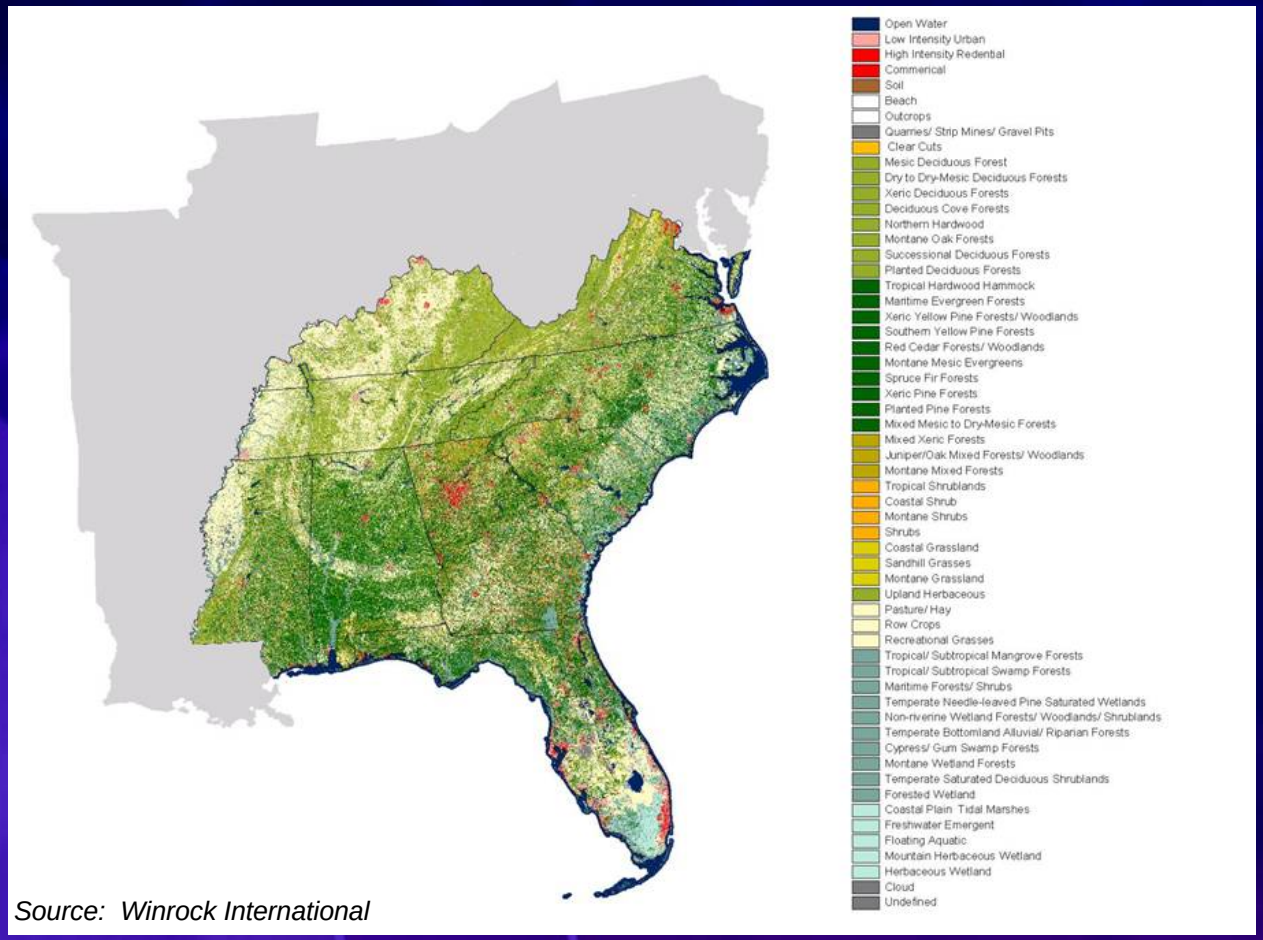
Gap Analysis



Source: Winrock International

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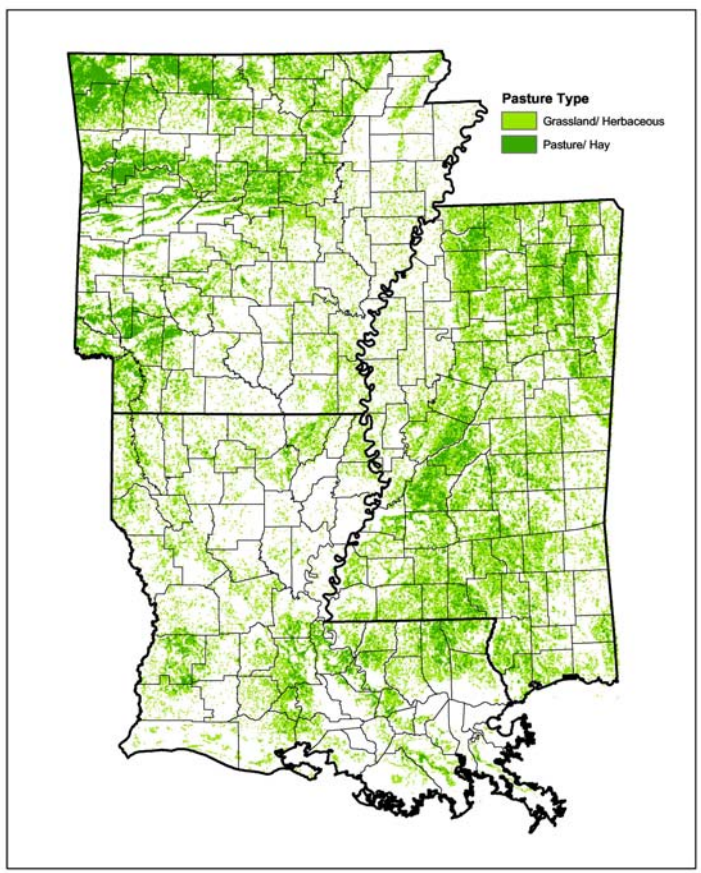
Grazing Lands



Source: Winrock International

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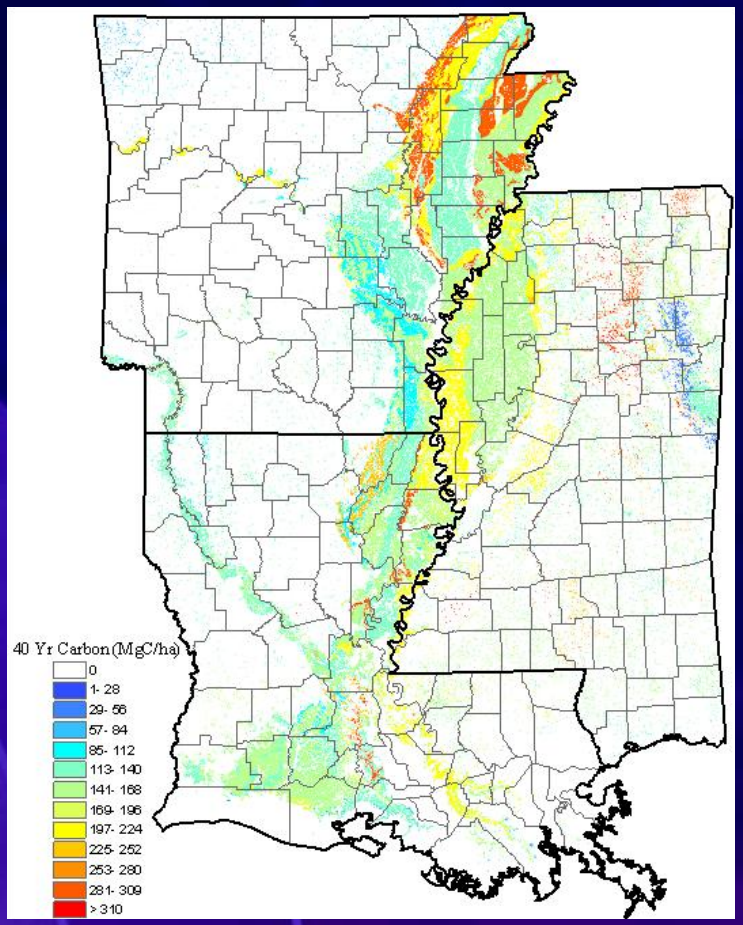
Afforestation on Agricultural Lands

– tons carbon per hectare after 40 years



Source: Applied Resources International

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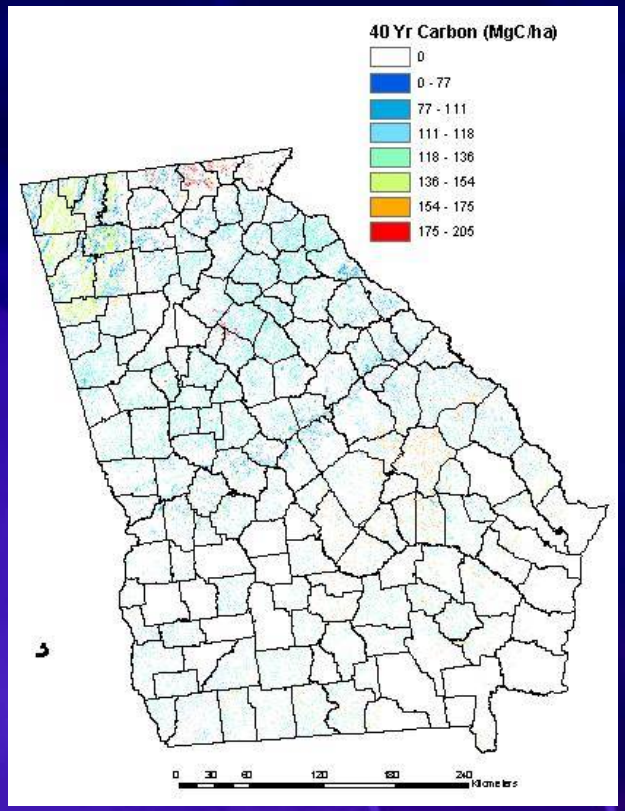
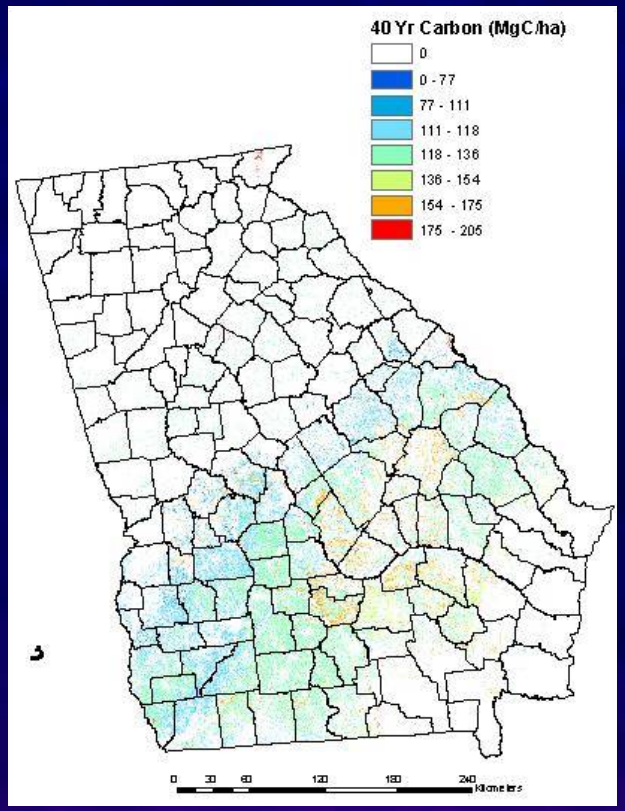
Afforestation

Grazing Lands



Ag Lands



Source: Applied Resources International

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Test Center Initiative

- A set of two or three pilot-scale test centers to develop and evaluate CO_2 combined capture and containment
- At existing power plants, in real operating environments
- A single well disposal/storage design for initial pilot testing
  - Nominally 10 MW
- The goals include:
  - Accelerate development of cost-effective options
  - Evaluate technical and environmental issues at a reasonable size
  - Collect long-term data (10 years worth)

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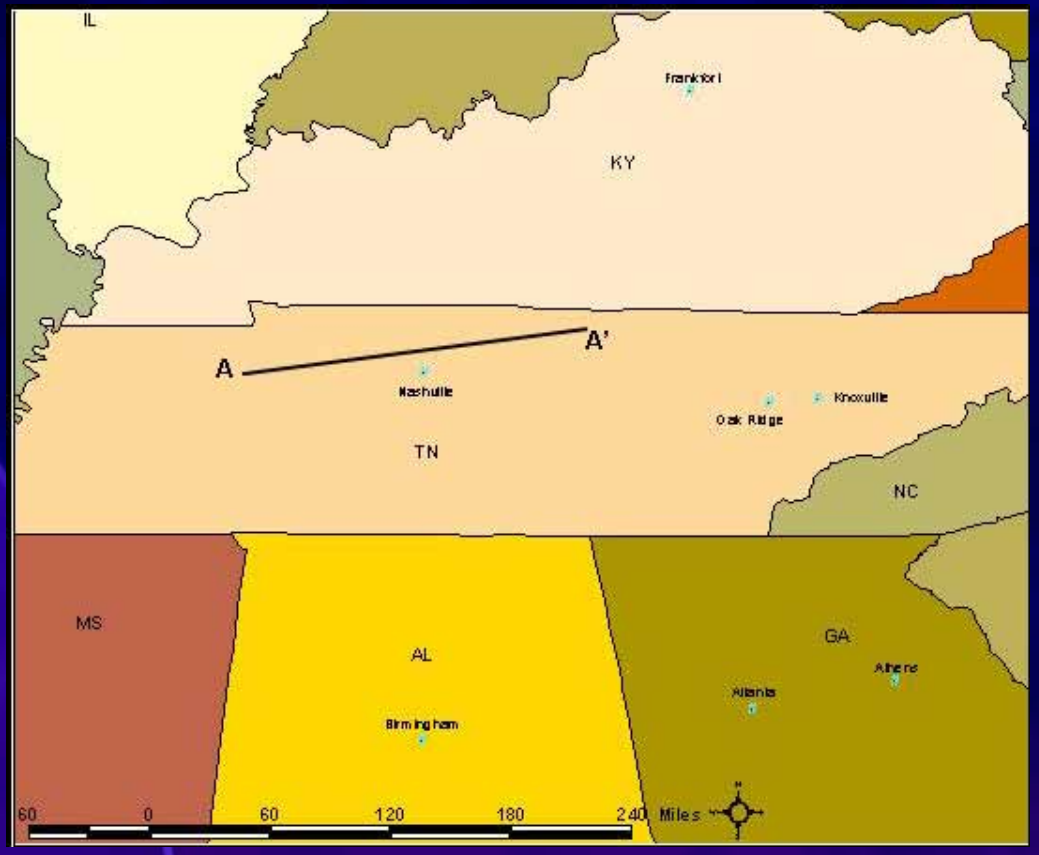
Phase I: Scoping Study

- Status
  - Six EPRI members
  - One test center engineering and cost
  - Best sites selected from member plants from capture viewpoint
  - Site-specific storage evaluation
    - Four finalists selected
    - Selection committee to select final plant
  - Fold information into regional partnership Phase 2
- Example of a site evaluation
  - First time this has been done in this level of detail

General Plant Location

- Oil/Gas Reservoirs
  - Too shallow and low capacity
- Coal
  - Minable
- Aquifer
  - Nearby and of significant volume



Source: Applied Resources International

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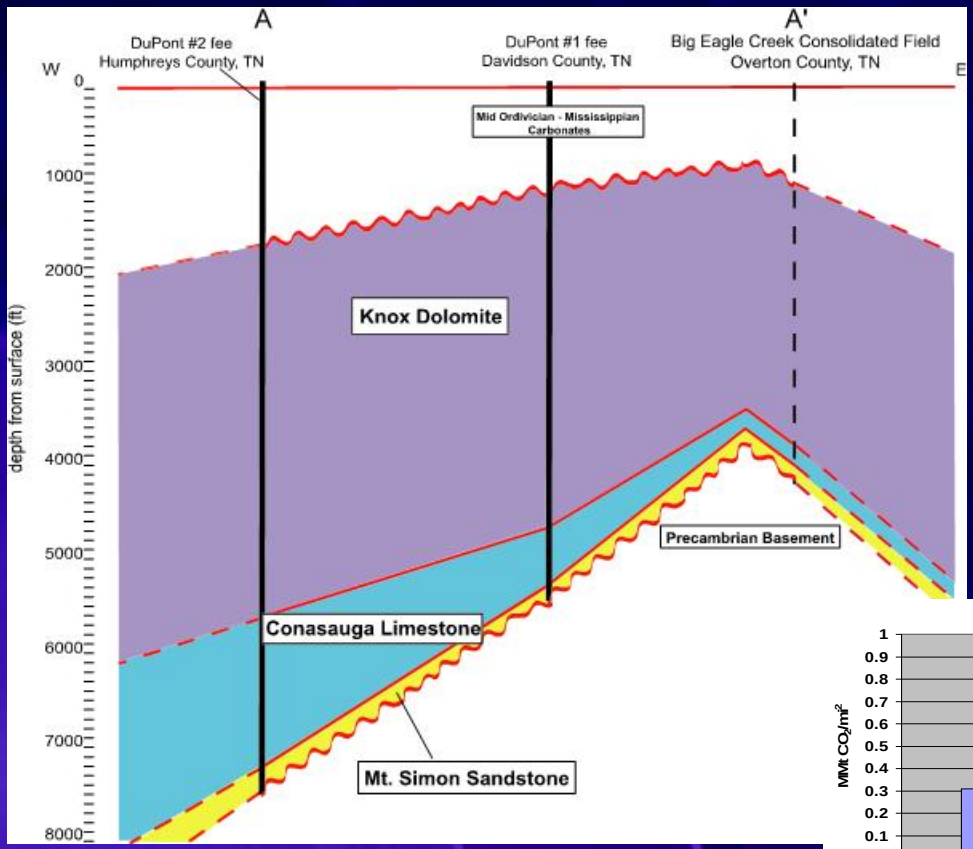
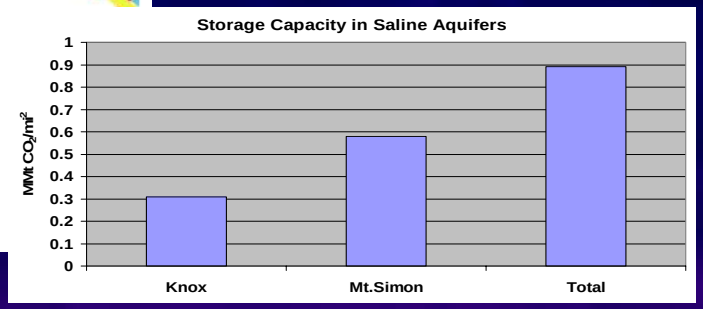
Geologic Storage Capacity



Plant Emissions = 0.80 MM t CO_2 / y

MM t CO_2 / mi ^{2} = 0.89

Need approx. 27 mi ^{2} for 30 y



Source: Applied Resources International

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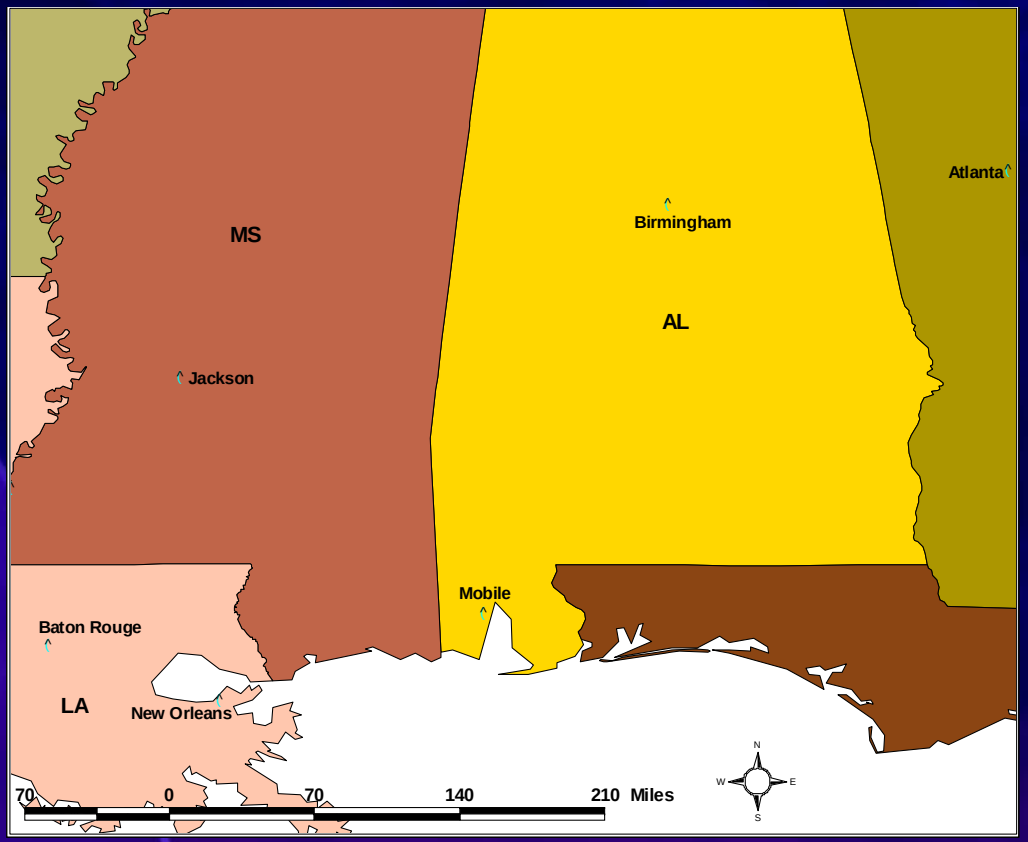
General Plant Location

- Oil/Gas Reservoirs
  - 40 to 50 miles away
- Coal
  - Lignites 30 miles away (more data needed)
- Aquifer
  - Nearby and of significant volume
- Salt Dome
  - 80 miles away



Source: Applied Resources International

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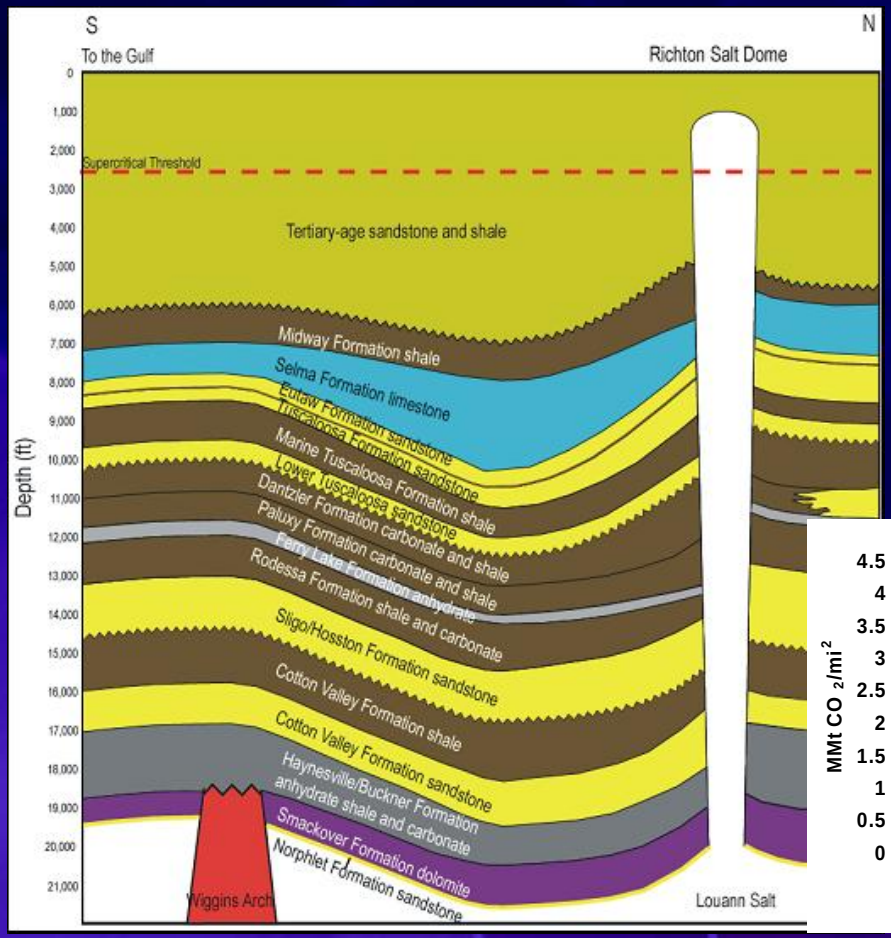
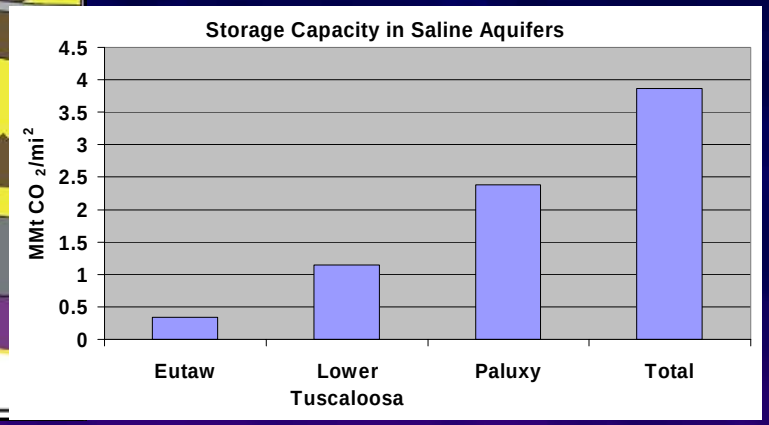
Geologic Storage Capacity



Plant Emissions = 0.80 MM t CO_2 / y

MM t CO_2 / mi ^{2} = 3.87

Need approx. 6.2 mi ^{2} for 30 y



Source: Applied Resources International

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Future Efforts

- At the end of the scoping study, plan to have one facility preliminary design and cost
- Planning that one of the options to be considered for the SECARB region will be a facility based on the results of this project
- Several utility members of the project have indicated support for such a facility and an interest in a combined capture and storage pilot based on gas from a coal-fired boiler

Regional Carbon Sequestration Partnerships Review Meeting

Completing Phase I and Preparing for Phase II

Dr. William Higginbotham
Kentucky Coal Council

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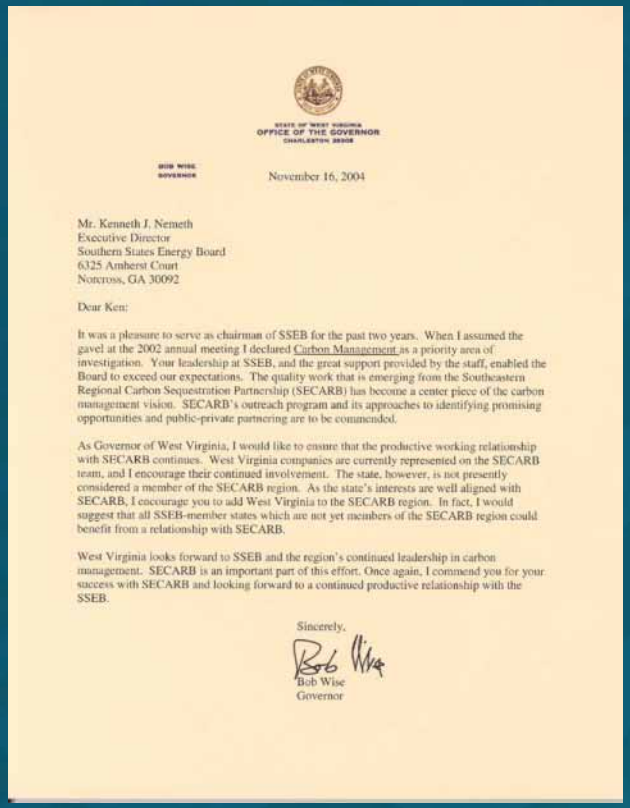
Carbon Management & Clean Coal Initiatives



STATE OF WEST VIRGINIA
OFFICE OF THE GOVERNOR
CHARLESTON 25305

BOB WISE
GOVERNOR

November 16, 2004

Mr. Kenneth J. Nemeth
Executive Director
Southern States Energy Board
6325 Amherst Court
Norcross, GA 30092

Dear Ken:

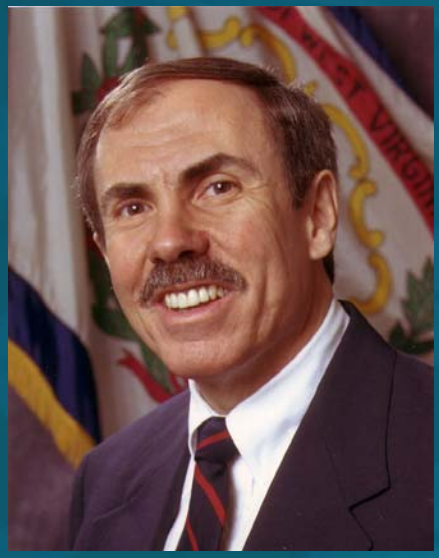
It was a pleasure to serve as chairman of SSEB for the past two years. When I assumed the gavel at the 2002 annual meeting I declared Carbon Management as a priority area of investigation. Your leadership at SSEB, and the great support provided by the staff, enabled the Board to exceed our expectations. The quality work that is emerging from the Southeastern Regional Carbon Sequestration Partnership (SECARB) has become a center piece of the carbon management vision. SECARB's outreach program and its approaches to identifying promising opportunities and public-private partnering are to be commended.

As Governor of West Virginia, I would like to ensure that the productive working relationship with SECARB continues. West Virginia companies are currently represented on the SECARB team, and I encourage their continued involvement. The state, however, is not presently considered a member of the SECARB region. As the state's interests are well aligned with SECARB, I encourage you to add West Virginia to the SECARB region. In fact, I would suggest that all SSEB-member states which are not yet members of the SECARB region could benefit from a relationship with SECARB.

West Virginia looks forward to SSEB and the region's continued leadership in carbon management. SECARB is an important part of this effort. Once again, I commend you for your success with SECARB and looking forward to a continued productive relationship with the SSEB.

Sincerely,

Bob Wise
Governor



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Regional Carbon Sequestration Partnerships Review Meeting

Completing Phase I and Preparing for Phase II

Dr. Gerald R. Hill
Southern States Energy Board

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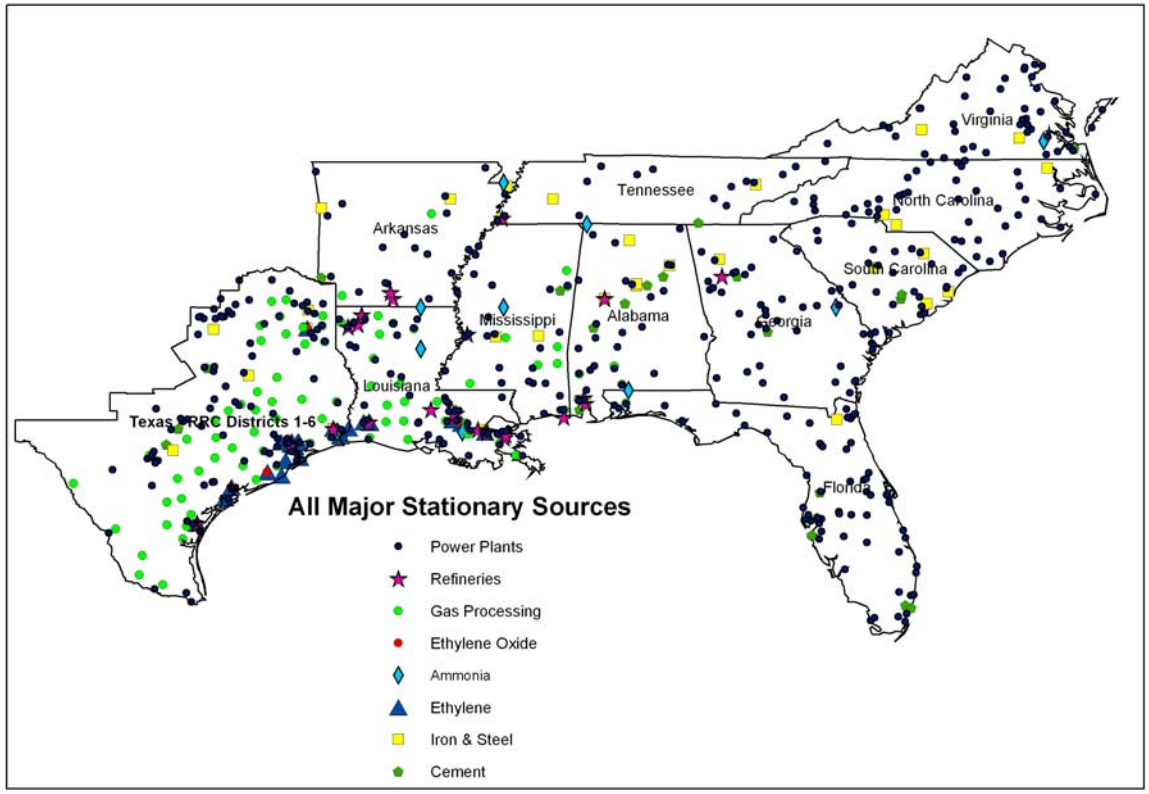
Next Steps on Regulatory, Permitting, Safety, and Accounting Activities

- Transition from general assessment towards opportunity-specific focus
- Address terrestrial and geological opportunities that emerge as promising
- Develop action plans with input from SECARB technical team, Technology Coalition and stakeholders associated with promising options

Outreach Activities

- Transition from general outreach activities towards opportunity-specific focus
- Develop action plans with input from SECARB technical team, Technology Coalition and stakeholders associated with promising options
- Engage local stakeholders BEFORE announcing site-specific opportunities

Capture/Separation Sources



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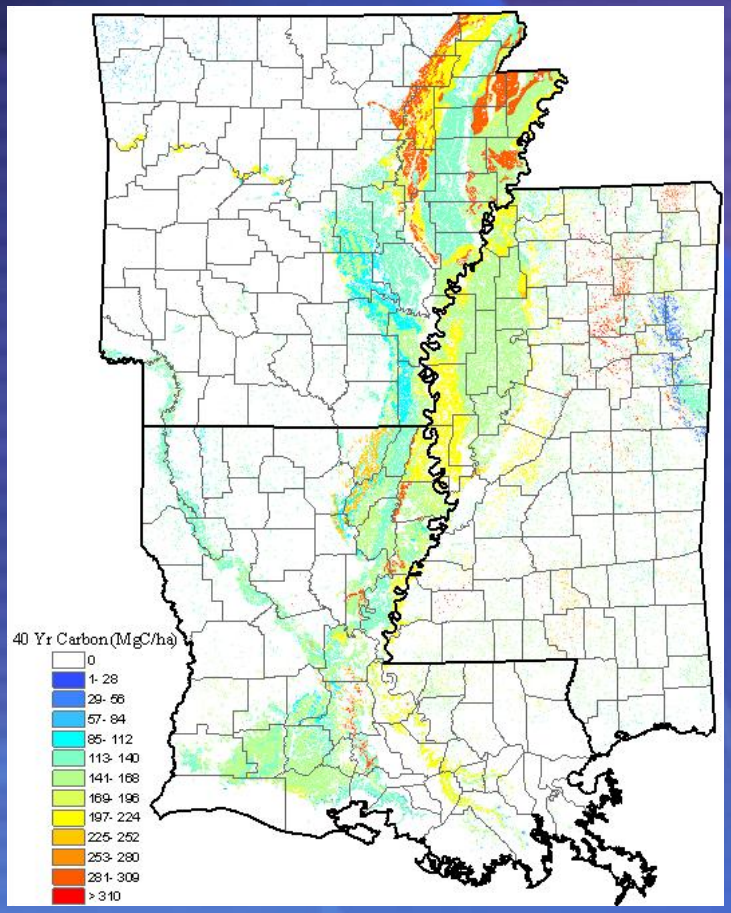
Terrestrial Sinks

Afforestation on Agricultural Lands – tons carbon per hectare after 40 years



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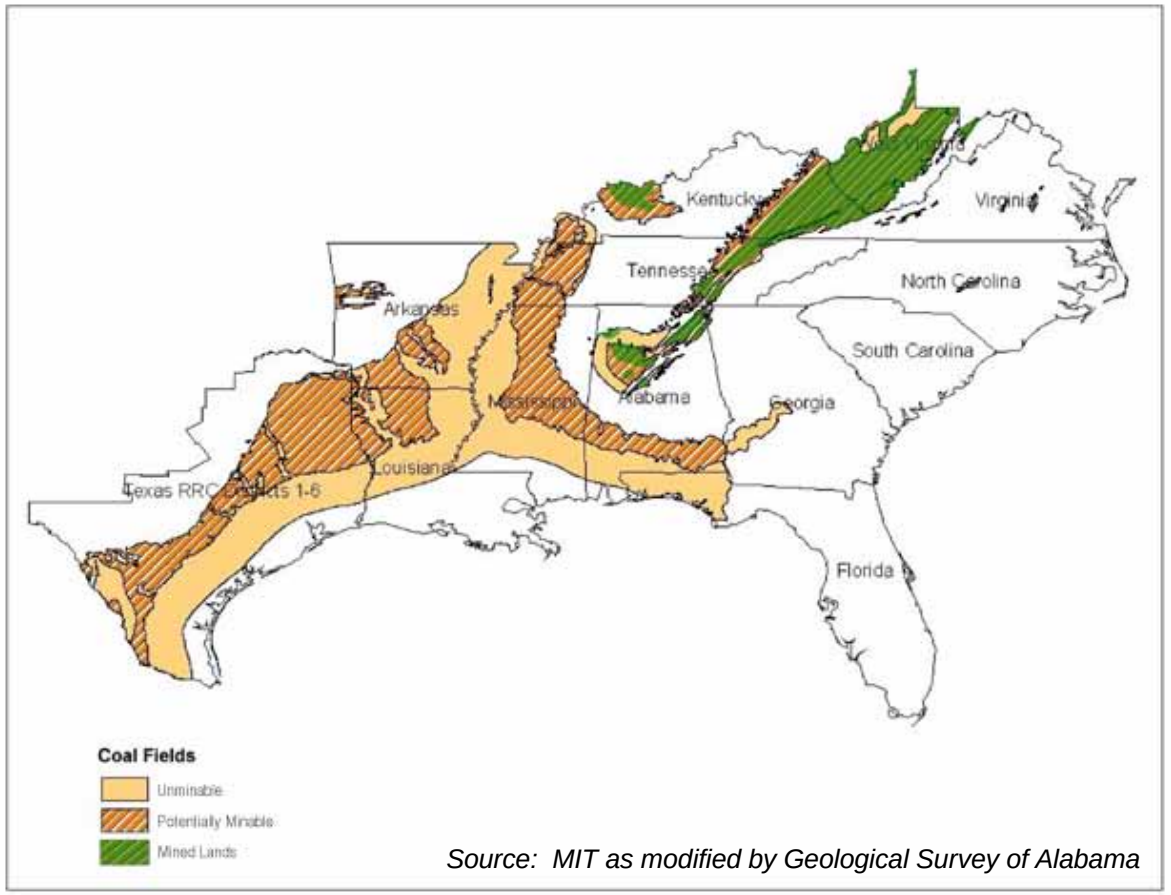
Coal Sinks and Inventory of Mine Lands



Source: MIT as modified by Geological Survey of Alabama

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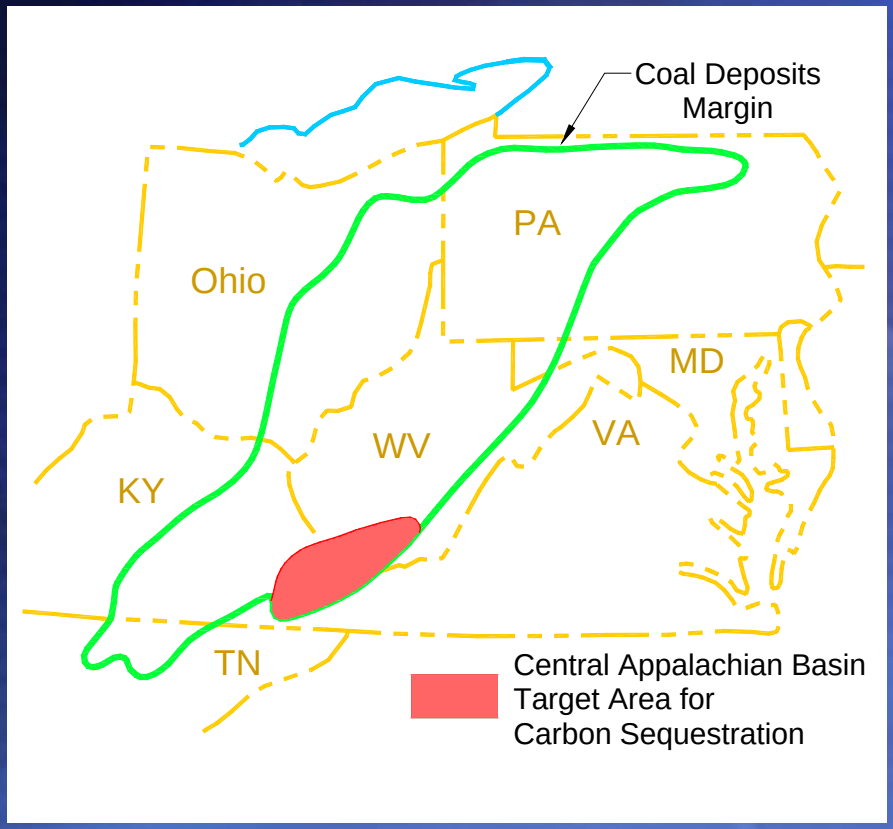
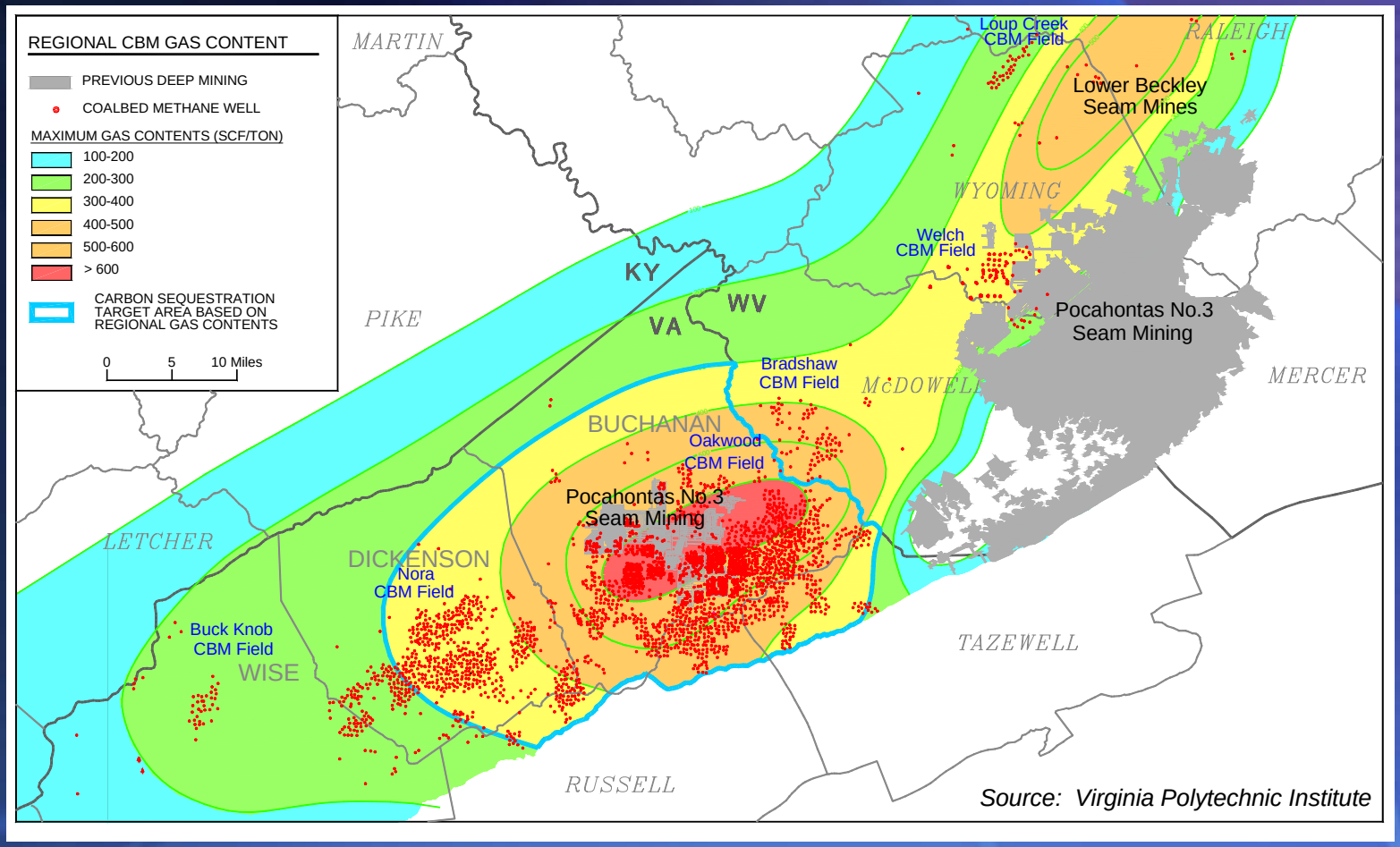
Coal Sinks and CBM



Source: Virginia Polytechnic Institute

Coal Sinks and CBM



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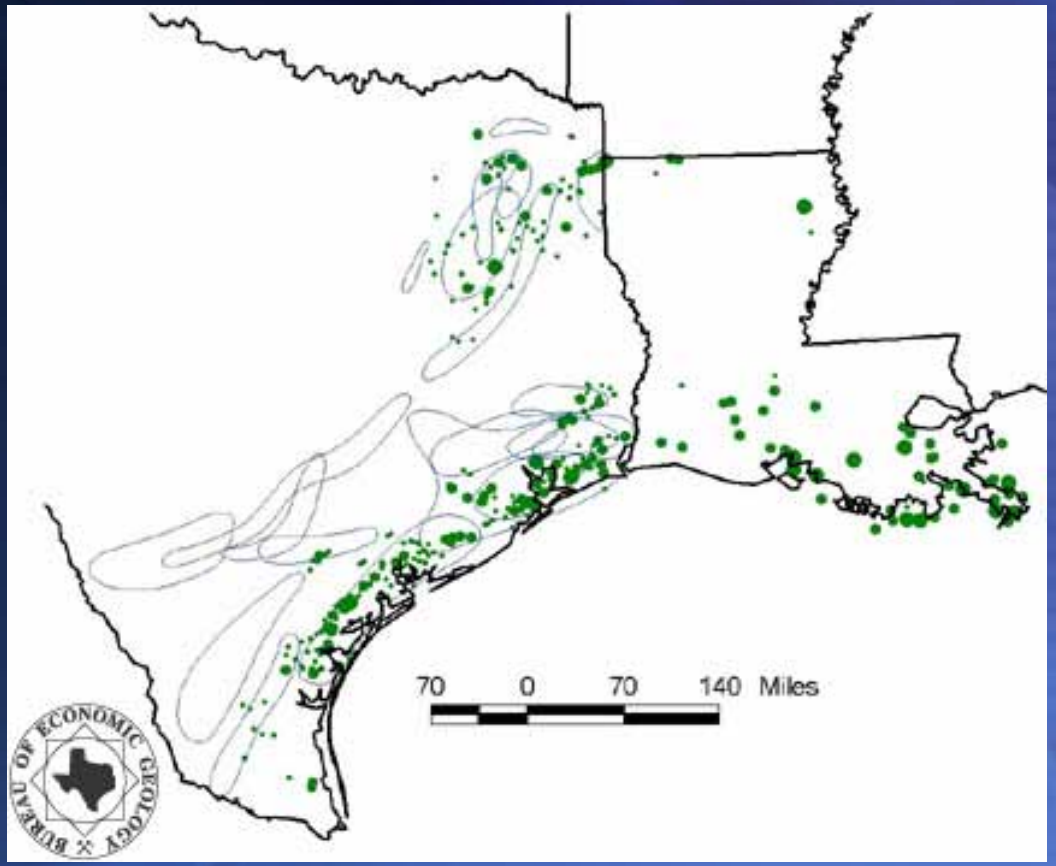
EOR Sinks



Cumulative production (million bbls)

- >100
- 10 -100
- <10

Capacity assessment in fields that could have economic offset for storage with EOR prior to depletion

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Screening Gulf Reservoirs for EOR Potential

Texas:

- Oil reservoir database developed for Texas: total of 3,266 reservoirs.
- Applied screening criteria for 21 Texas Gulf Coast counties and work with Mississippi as part of DOE SE Regional Partnership.
- 33 North-Central and East Texas counties.
- 360 candidates screened in Texas Gulf Coast & 274 candidates screened in North-Central and East Texas counties.

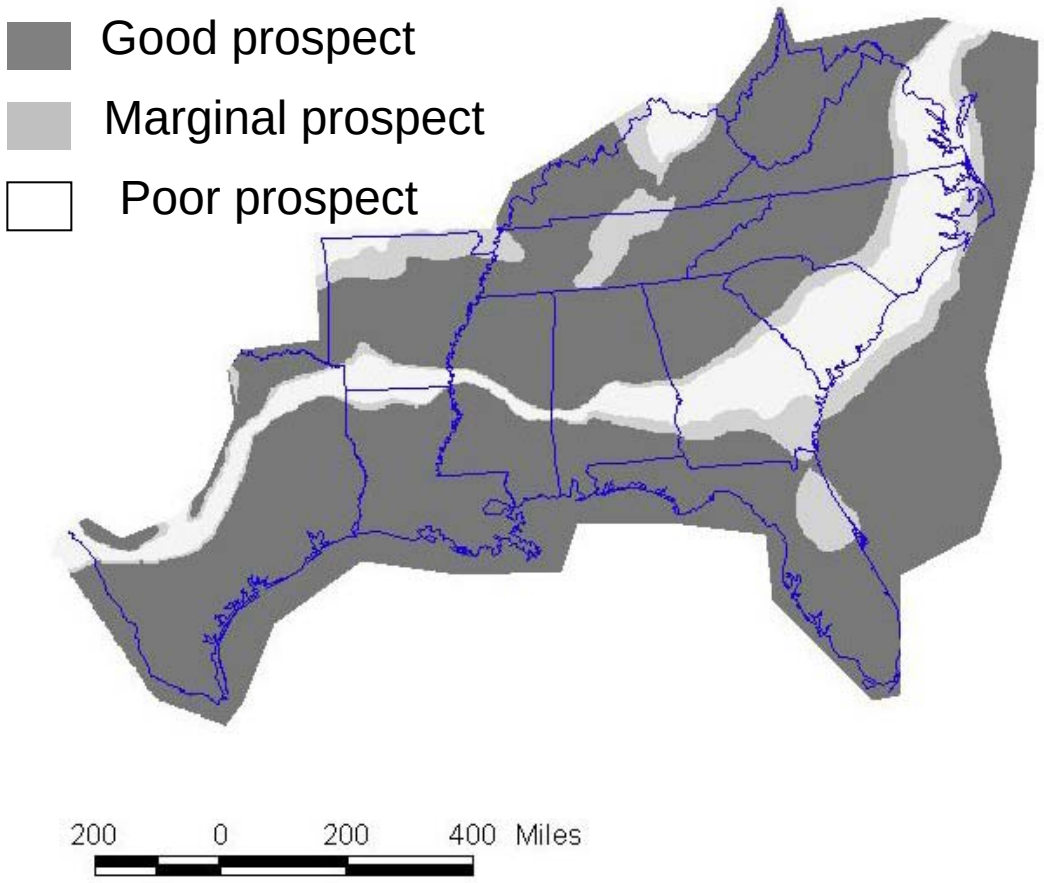
Louisiana:

- DOE TORIS database utilized to screen 122 candidates.
- Continued work with LA Geological Survey as part of DOE SE Regional Partnership.

Mississippi:

- DOE TORIS database utilized to screen 11 candidates.
- Only current floods (Little Creek & Mallalieu, West) located.
- Continued

Saline Sinks

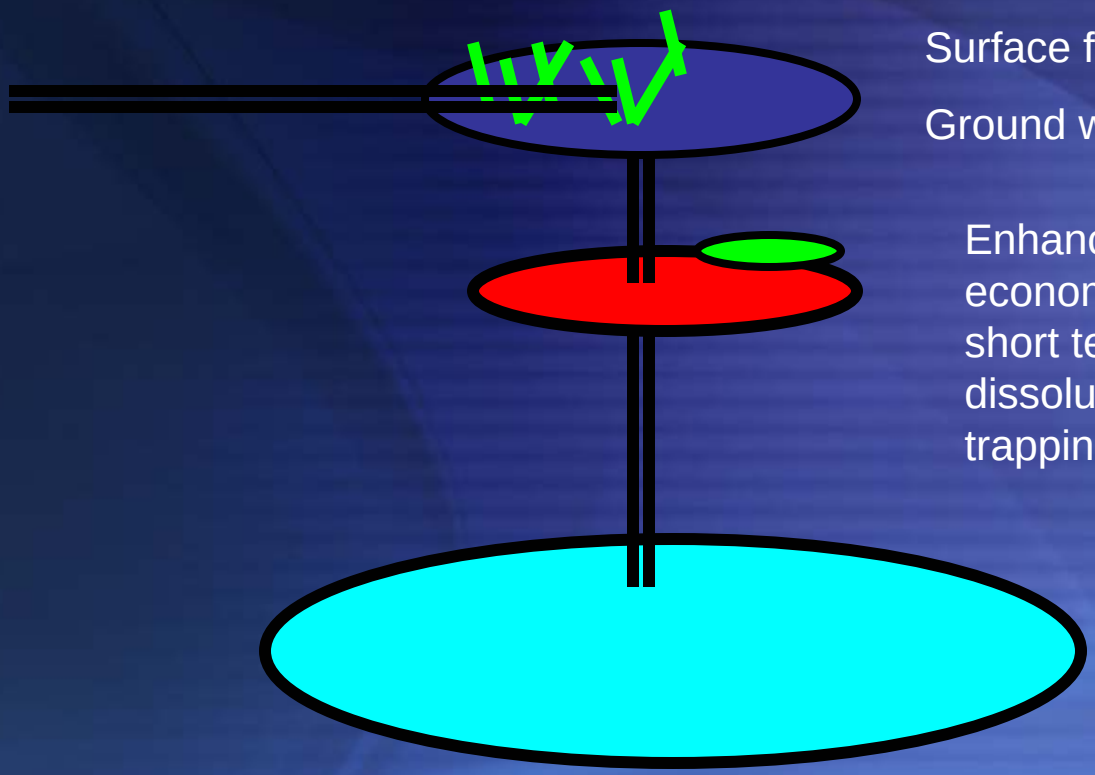


Source: Texas Bureau of Economic Geology

Importance and Monitoring, Measurement and Verification

- The public wants to know that sequestration is safe and effective
- State, federal and international agencies want to monitor commitments
- Investors and credit traders want to know that sequestration is working

Environment/Storage/Economic Project – MMV Design



Surface features & elevation

Ground water & risk assessment issues

Enhanced oil (gas/CBM) production economics, well leakage risk, long and short term trapping in reservoir by dissolution in water and oil and phase trapping

Very large volume storage in brine – foot print, permanence, fluid displacement interaction with faults, Ultimate fate of injectate.

Source: SECARB & Gulf Coast Carbon Center

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Regional Attributes – A Temporal Approach

Near-Term ➡ Terrestrial Sinks

- Address YR2012 Voluntary Targets

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Regional Attributes – A Temporal Approach

Near-Term ➡ Terrestrial Sinks

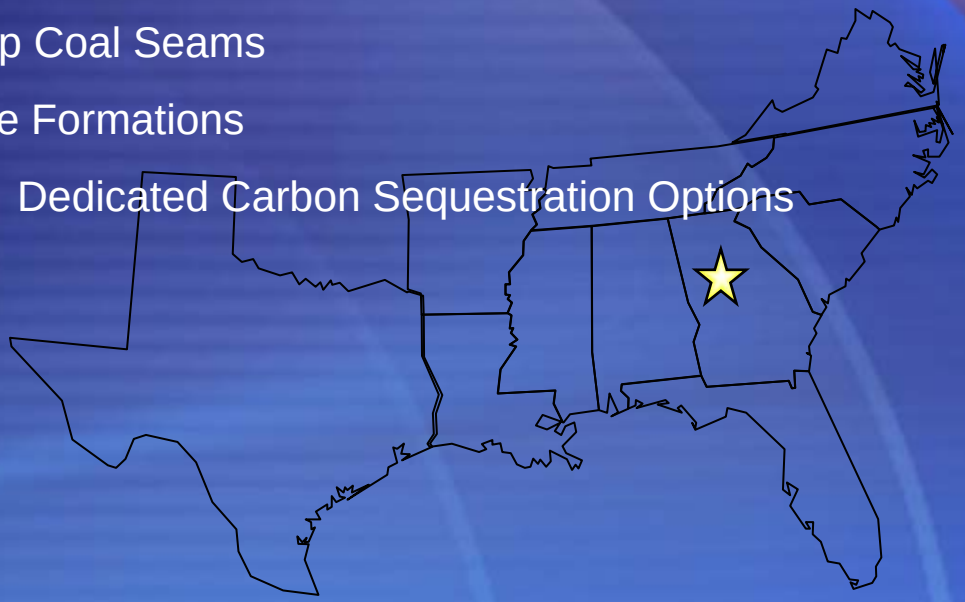
- Address YR2012 Voluntary Targets

Long-Term ➡ Depleted Reservoirs

Deep Coal Seams

Brine Formations

- Dedicated Carbon Sequestration Options



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Regional Attributes – A Temporal Approach

Near-Term → Terrestrial Sinks

- Address YR2012 Voluntary Targets

Mid-Term → EOR & CBM

Economic Drivers

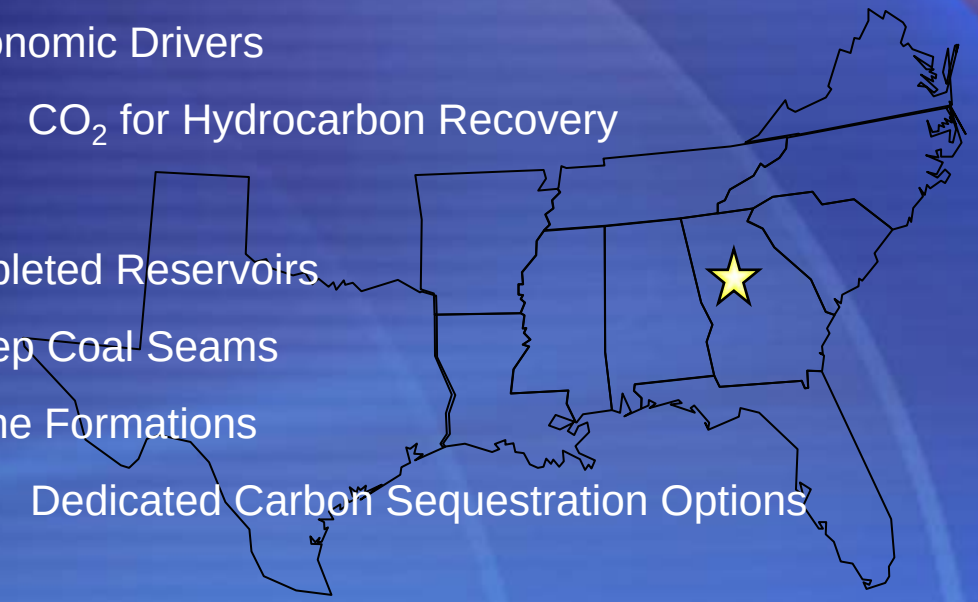
- CO_2 for Hydrocarbon Recovery

Long-Term → Depleted Reservoirs

Deep Coal Seams

Brine Formations

- Dedicated Carbon Sequestration Options



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Regional Carbon Sequestration Partnerships Review Meeting

November 16-17, 2004
Pittsburgh, Pennsylvania

SECARB