Southeast Regional Carbon Sequestration Partnership
Phase II Activities

Presented to:
Workshop on
Gasification Technologies
Tampa, Florida
March 2, 2006

Presented by:
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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
<table>
<thead>
<tr>
<th>Advanced Resources International</th>
<th>Entergy Services</th>
<th>Progress Energy</th>
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<tr>
<td>AGL Resources</td>
<td>Equitable Production</td>
<td>RMB Earth Science Consultants, Ltd.</td>
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<td>American Electric Power</td>
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<td>RMS Strategies</td>
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<td>Schlumberger</td>
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<td>Georgia Environmental</td>
<td>Smith Energy</td>
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<td>South Carolina Dept. of Agriculture</td>
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<td>Georgia Forestry Commission</td>
<td>South Carolina Electric &amp; Gas Company</td>
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<td>Georgia Power Company</td>
<td>South Carolina Public Service Authority/Santee Cooper</td>
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<td>CO₂ Capture Project</td>
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<td>Lawrence Berkeley National Laboratory</td>
<td>Southern Company Services</td>
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<td>Lawrence Livermore National Laboratory</td>
<td>Southern States Energy Board</td>
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<td>Louisiana Department of Environmental Quality Louisiana</td>
<td>Susan Rice and Associates, Inc.</td>
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<td>Marshall Miller &amp; Associates</td>
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<td>CONSOL, Inc.</td>
<td>Massachusetts Institute of Technology</td>
<td>Texas Bureau of Economic Geology -Gulf Coast Carbon Center</td>
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<td>McJunkin Appalachian Oilfield Company</td>
<td>United Company, The</td>
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<td>Dart Oil &amp; Gas Corporation</td>
<td>Mississippi State University (MSU)</td>
<td>United States Department of Energy/National Energy Technology Laboratory</td>
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<td>North American Coal Corporation</td>
<td>Virginia Polytechnic Institute and State University</td>
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<td>Dominion Resources</td>
<td>North Carolina State Energy Office</td>
<td>Winrock International</td>
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<td>Duke Power</td>
<td>Nuclear Energy Institute</td>
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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

NC-SC Study

www.secarbon.org
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/uncertainty.
<table>
<thead>
<tr>
<th>Region</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Valley and Ridge</td>
<td>complex, likely local capacity</td>
</tr>
<tr>
<td>Blue Ridge</td>
<td>no capacity</td>
</tr>
<tr>
<td>Piedmont</td>
<td>no capacity</td>
</tr>
<tr>
<td>Mesozoic rift basins</td>
<td>Dan River, Deep River – local potential in sediments associated with basalt</td>
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<tr>
<td>Atlantic coastal plain</td>
<td>capacity only near coast</td>
</tr>
<tr>
<td>Nashville dome</td>
<td>poor to no capacity</td>
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Focus of Carolinas Capacity Assessment

Proposed focus areas:

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

Focus of Carolinas Capacity Assessment:

- Mid-south Interior
- Savannah Area Tertiary and Rift
- Mesozoic Rift Fills
- Atlantic Coastal Wedge
Stacked Storage Project
Greens = known capacity
Oranges and reds = capacity poor to none
Blue outlines = likely capacity under study

Appalachians and Gulf Coastal Plain
Mid-south Interior
Gulf Coast Region
Florida – South Georgia

Miles 0 100 200
The Gulf Coast region accounts for approximately 16% of the U.S. annual CO₂ emissions from fossil fuels.

Annual emissions of CO₂ in Texas, Louisiana and Mississippi are ~ 1 billion metric tons (1 GT), and Texas alone emits 667 million metric tons of CO₂.

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 CO₂ EOR

Environmental vulnerability
Most Promising Saline Formations

- Offshore GOM
- Upper Tertiary ss
- Middle Tertiary ss
- Lower Tertiary ss
- Cretaceous ss
- Lower Potomac Fm.
- Cape Fear Fm.
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

Research Elements
Gulf Coast Stacked Storage Pilot

Ecosystem monitoring:
Chemical and biologic change

Ground water monitoring for geochemical change

Injection horizon: pressure, temperature, oil and CO₂ saturation during and post-injection, instrumented slant hole

Characterization of deeper horizon in preparation for eventual disposal
Coal Seam Project

G2-A

G2-B
Coal Formation Prospects in Southeast Region

Source: Massachusetts Institute of Technology
Virginia CBM Development

Source: Virginia Center for Coal and Energy Research, Virginia Tech

COAL RANK

- Medium volatile bituminous
- Low volatile bituminous
- High volatile bituminous
- Coalbed methane well
Black Warrior Basin - Alabama

Legend

Source: Applied Resources International
Saline Aquifer Test Center Project
Site Selection Through EPRI CO₂ Test Centers Project

- **Build and operate 2-3 Test Centers**
  - Capture and store CO₂ at 10 MW scale
  - Real operating environments
  - Monitor 1 million tons CO₂ 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

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Work Plan

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

Task 2. **Project Design.** Procure CO₂ 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 CO₂ injection well.

Task 4. **Project Operations.** Inject CO₂ (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 CO₂ 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)
Sources & Sinks Matching

CO2 Sources and Sinks Matching via Least-cost Path (TX)

Legend
- CO2 Sources Transported to Aquifers / Gas Fields
- Path to Aquifers / Gas Fields
- Path to EOR Sinks
- EOR Sinks
- CO2 Sources Transported to EOR sinks

Final Results

Source: Advanced Resources International
Southeast Regional Carbon Sequestration Partnership
Phase II Activities

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