SECARB Phase II: Carbon Sequestration Field Verification Tests in Coal Seams

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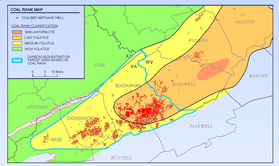
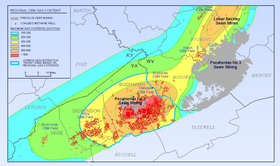
Abstract

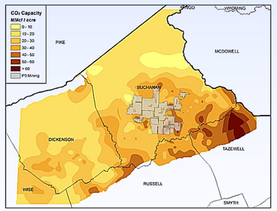
Research and characterization studies conducted during Phase I of the Southeast Regional Carbon Sequestration Partnership (SECARB) have identified two exceptionally prospective sites for sequestration of carbon dioxide in coal of the southeastern US. These sites contain mature coal bed methane reservoirs in the Black Warrior and Appalachian basins, where abundant subsurface and well data minimize uncertainty and risk. Field tests in these areas will focus on injection in a vertical well and in a pinnate horizontal well. The horizontal-pinnate well test will be performed in Central Appalachia and may provide a technological breakthrough in terms of carbon sequestration injection efficiency in the region. Injection operations at each of the coal seam test sites will comprise a series of injection-falloff and production tests. In the Black Warrior basin, a series of production and injection-falloff tests will be performed in three separate coal zones to analyze pressure response and the distribution of permeability. Monitoring and verification will focus on two approaches: deep monitoring in multiple observation wells and shallow surface and subsurface monitoring of soil gas and fluids in shallow fracture systems.

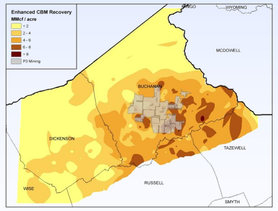
Central Appalachia

The Central Appalachian coal seam research team, led by the Virginia Center for Coal and Energy Research (Virginia Tech) and Marshall Miller & Associates, conducted regional characterization of the coalbeds, located favorable areas to sequester carbon dioxide (CO2), and quantified the CO2 storage capacity and associated enhanced coalbed methane (ECBM) recovery potential within southwestern Virginia. CO2 sequestration capacity values for coal seams have been calculated by processing and assimilating net coal thickness, coal rank, coal isotherm, and other related coal reservoir data. Factors such as historical deep mining and currently permitted mine areas for the Pocahontas No. 3 seam have been taken into account in the calculations, as carbon dioxide cannot be effectively sequestered in mined locations. Ideal areas for sequestration have been identified in mature coalbed methane (CBM) production areas within Buchanan and Dickenson Counties, Virginia with more than 4.9 trillion cubic feet of carbon dioxide capacity.



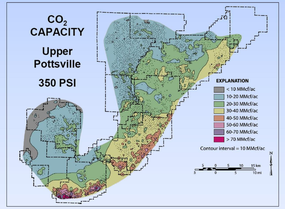


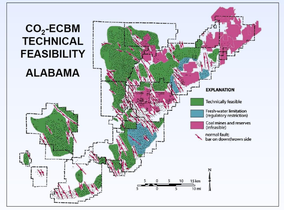


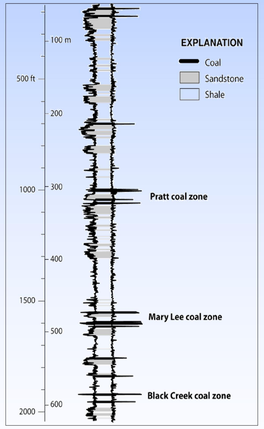


Alabama

Coalbed methane is produced from Pennsylvanian-age strata of the Pottsville Formation in the Black Warrior basin of Alabama, and injection of carbon dioxide can be used to enhance coalbed methane recovery. Pottsville coal beds are of bituminous rank, are typically between 0.3 and 3.0 meters thick, and are distributed through 700 to 1,500 meters of section. A recent assessment by the Geological Survey of Alabama indicates that more than 5.9 trillion cubic feet of carbon dioxide can be sequestered in the established coalbed methane fields and that enhanced recovery operations has potential to increase coalbed methane reserves by more than 20 percent. Additional sequestration potential exists in low-rank coal in Tertiary-age strata (Midway and Wilcox Groups) of the Gulf of Mexico basin, but little information exists on the distribution, thickness, and reservoir quality of coal in this area.





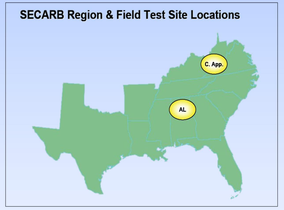


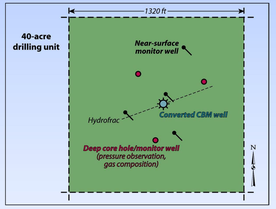
Field Tests

A sequence of parallel tests will be preformed in the Black Warrior and Central Appalachian basins through injection-falloff and production testing, as well as the implementation of deep and shallow subsurface monitoring programs. This project includes sequestration testing using a horizontal CBM well within the Central Appalachian Basin.

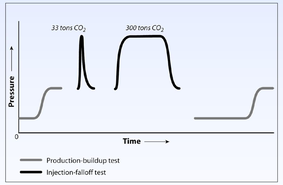
The Black Warrior field test will be conducted in the northwestern coalbed methane fields, where coalbed methane wells are reaching maturity and potential for commercialization of carbon sequestration and enhanced coalbed methane recovery technology is high.

Reservoir testing will consist of a series of production and injection-falloff tests in three coal zones at depths between 300 and 700 meters, and deep monitoring of pressure and gas composition will be conducted through packer tests in observation wells.

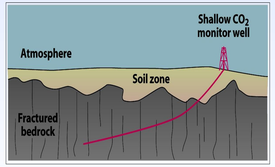




Schematic plan view of the SECARB Black Warrior test site.



Schematic graph showing the plan for production-buildup and injection-falloff testing to be conducted in each coal zone.



Schematic of Shallow Monitoring Program

Partners

Alawest, Inc
Alpha Natural Resources, Inc.
Amvest Gas Resources, Inc.
CDX Gas, LLC
CONSOL Energy, Inc.
Dart Oil & Gas Corporation
Denbury Resources, Inc.
Dominion Resources, Inc.
F.D. Robertson Enterprises
International Coal Group, Inc.
McJunkin Appalachian Oil Field Supply Company
Natural Resource Partners L.P.
Norfolk Southern Corp.
Penn Virginia Corp.
RMB Earth Science Consultants Ltd.
Southern Company

Outreach

This project includes a vigorous technology transfer program designed to support the demonstration and commercialization of carbon sequestration technology. Results have been and are being presented at technical meetings and workshops and have been incorporated into the national carbon sequestration database. Websites have been developed for both field tests and are

www.energy.vt.edu/SECARB

portal.gsa.state.al.us/CO2/CO2.htm