

PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Carbon Sequestration

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MIDWEST REGIONAL CARBON SEQUESTRATION PARTNERSHIP – VALIDATION PHASE

Background

The U.S. Department of Energy (DOE) has selected seven Partnerships, through its Regional Carbon Sequestration Partnership (RCSP) Program, to determine the best approaches for capturing and permanently storing carbon dioxide (CO₂), a greenhouse gas (GHG) which can contribute to global climate change. The Partnerships are made up of state agencies, universities, private companies, and nonprofit organizations that form the core of a nationwide network helping to establish the most suitable technologies, regulation, and infrastructure needs for carbon sequestration. The Partnerships include more than 350 organizations, spanning 41 states, three Indian nations, and four Canadian provinces. The RCSPs are developing the framework needed to validate and deploy carbon sequestration technologies. They will evaluate and determine which of the numerous sequestration approaches are best suited for their specific regions of the country and are studying possible regulatory and infrastructure requirements that will be needed should policy and economics indicate that sequestration be deployed on a wide scale. The Validation Phase (2005–2009) of the Partnership Program is focused on validating promising CO₂ sequestration opportunities through a series of field tests in the seven Partnership regions.

Description

The Midwest Regional Carbon Sequestration Partnership (MRCSP) has been established to assess the technical potential, economic viability, and public acceptability of carbon sequestration within a region consisting of eight contiguous states: Indiana, Kentucky, Maryland, Michigan, Ohio, Pennsylvania, West Virginia, and New York. A group of leading universities, state geological surveys, non-governmental organizations and private companies, led by Battelle Memorial Institute, has been assembled to carry out this research.

The MRCSP's Validation Phase research program will take the large theoretical sequestration potential identified in the MRCSP's Characterization Phase (2003-2005) research program and, through a series of validation tests, show how the region's large, well-distributed and competitively priced sequestration potential can be used to simultaneously advance economic growth and environmental protection. Specifically, the MRCSP will conduct three small-scale CO₂ injection field tests in the region's deep geologic formations to demonstrate the safety and effectiveness of geologic sequestration systems. The MRCSP also will conduct three terrestrial sequestration field validation tests to show how naturally stored carbon can be measured and monitored and how carbon credits could be traded in voluntary greenhouse gas markets. The MRCSP will continue work initiated in the Characterization Phase to map and define the sequestration potential of the region, as well as efforts to understand key regulatory issues and a systematic attempt to engage and inform stakeholders about this technology.

Primary Project Goal

Identify the technical, economic, and social considerations associated with geologic and terrestrial CO₂ sequestration and create viable pathways for its deployment.



PARTNERS

AJW Inc.
American Electric Power
AMP-Ohio
Baard Energy LLC
Babcock & Wilcox
Battelle Memorial Institute
BP Products North America
Center for Energy and Economic Development (CEED)
Chicago Climate Exchange
CONSOL Energy
DTE Energy
Duke Energy
FirstEnergy
Indiana Geological Survey
Indiana Consumer Counsel
Kentucky Geological Survey
Maryland Geological Survey
National Regulatory Research Institute
New York State Energy Research and Development Authority
New York State Museum
Ohio Coal Development Office
Ohio Consumers' Counsel
Ohio Corn Marketing Program
Ohio Division of Geological Survey
Ohio Environmental Council
Ohio Soybean Growers
Ohio State University, School of Natural Resources
Pennsylvania Geological Survey
Praxair
Schlumberger
Stanford University
The Keystone Center
University of Maryland
West Virginia Geological Survey
West Virginia University
Western Michigan University

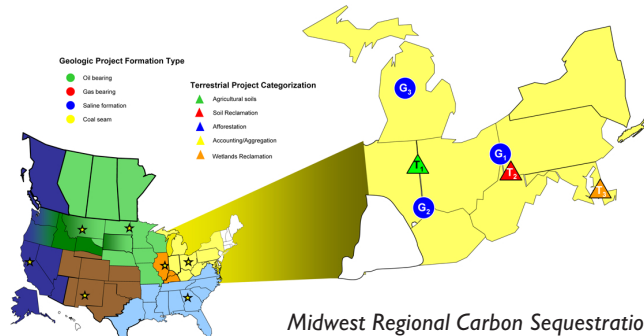
Objectives

- Continue to identify greenhouse gas sources and assess the viability and cost of capturing and sequestering these emissions.
- Continue to engage the public and elected officials at all levels in dialogue on the issues and potential values associated with geologic and terrestrial sequestration.
- Conduct three small-scale CO₂ injection field tests in the region's deep geologic formations to demonstrate the safety and effectiveness of geologic sequestration systems.
- Conduct three small-scale terrestrial carbon sequestration field tests to demonstrate enhanced carbon uptake and validate measurement techniques used to quantify terrestrial carbon storage.
- Link options for capture, transportation, and geological storage within the environmental and regulatory framework.

Benefits

Under U.S. DOE's auspices, a team of over 30 industry and research organizations, led by Battelle, is conducting the MRCSP's Validation Phase efforts. In the Validation Phase the MRCSP is evaluating the feasibility of sequestering carbon in both geological formations and terrestrial ecosystems in the MRCSP eight-state area. The Validation Phase project will take the first steps towards demonstrating whether there are a cost-effective ways to reduce CO₂ emissions in the high-emissions Midwest region. The result will yield an important knowledge base for stakeholders to develop robust carbon mitigation strategies. Results obtained from the tests will be crucial to the development of DOE's FutureGen Initiative, which will produce both hydrogen and electricity from a highly efficient and technologically sophisticated coal-fired power plant with virtually no emissions.

Field Projects



Midwest Regional Carbon Sequestration Partnership
Validation Phase Field Tests

Accomplishments

Geologic Sequestration: MRCSP's research estimated more than 192.4 billion metric tonnes (212 billion tons) of potential CO₂ storage capacity in the region's deep geologic formations, which could accommodate hundreds of years worth of current CO₂ emissions from the region's large point sources, such as power plants, cement plants, and refineries. MRCSP's research also estimated at least 2.5 billion metric tonnes (2.75 billion tons) of potential storage capacity in existing depleted oil and natural gas fields (which could lead to hundreds of millions of barrels of additional oil production), 0.9 billion metric tonnes (0.99 billion tons) of potential unmineable coal bed storage, and 189 billion metric tonnes (208.3 billion tons) of storage potential in saline formations. During the Validation Phase, the MRCSP is evaluating three geologic sequestration CO₂ injection projects, which are summarized below:

Appalachian Basin Geologic Test (G1)

This saline formation pilot project provides an opportunity to test an injection system in the Appalachian Basin, at FirstEnergy's R.E. Burger plant near Shadyside, Ohio. This project will evaluate the feasibility of injecting approximately 1,000-3,000 tonnes of CO₂ into sandstone formations at depths between 5,000 and 8,000 feet.

Accomplishment Highlights:

- Site preparation activities (defining test area and well location) completed.
- Preliminary geologic assessment completed by the Ohio Geological Survey describing the regional geologic setting, target sequestration rock formations, and other issues.
- A test well just over 8,300 feet depth was completed in February 2007.
- Underground Injection Control (UIC) permitting process initiated.
- Two-dimensional (2-D) seismic survey conducted at the injection site.
- A stakeholder outreach program was completed for the FirstEnergy Plant employees, local residents and the media.
- Draft UIC injection permit submitted to Ohio EPA.

Cincinnati Arch Geologic Test (G2)

This saline formation pilot project aims to demonstrate carbon sequestration in the Mt. Simon sandstone formation, a major CO₂ sequestration target in the MRCSP, and typical of the region's geologic structure. Results of the injection testing and monitoring at the Duke Energy East Bend Plant (located near Rabbit Hash, Kentucky) could be applied to similar power plants in this region, as the site is representative of the geology of a large part of the MRCSP region. This project will inject between 1,000 and 3,000 tonnes of CO₂ at depths between 3,200 and 3,500 feet, which will be collected from an outside source and transported to the active plant site. The project may potentially demonstrate oxy-combustion CO₂ capture technology from a Babcock and Wilcox system in southeast Ohio.

Accomplishment highlights:

- Site preparation activities completed: site survey, identification of test well location, seismic survey lines, and injection system.
- Preliminary geologic assessment completed by the Indiana and Kentucky Geological Survey.
- Underground Injection Control (UIC) permitting process initiated.
- Preliminary well construction specifications and a drilling plan were prepared for the site.
- 2-D Seismic survey completed for the site.

Michigan Basin Geologic Test (G3)

This project involves injection of approximately 10,000 tons of CO₂ into a saline formation between depths of 2,800 to 3,200 feet. The test location is the Charlton 30/31 field in Otsego County, Michigan, site of an enhanced oil recovery (EOR) project. The site, located in the northern part of the Michigan Basin, is in the vicinity of a natural gas processing plant which currently provides CO₂ for the EOR operations. The captured CO₂ from the nearby gas processing plant, combined with the EOR operation, provides available infrastructure for testing CO₂ sequestration in adjacent saline formations. The target saline formation is the Bois-Blanc Sylvania Sandstone, an important sequestration target in the Michigan Basin. Site geology is well-characterized due to oil and natural gas exploration in the area with many available well logs.

Accomplishment Highlights:

- Drilled a new test/injection well (~5,000 feet deep) and an existing EOR well was redeveloped as a monitoring well.
- Rock core samples taken from the Bois Blanc-Bass Islands interval (180 feet deep).
- A Class V UIC permit was completed through EPA Region 5.
- Injection of approximately 10,000 tons of CO₂ into the Sylvania Sandstone formation completed in March 2008.

Terrestrial Opportunities: There are approximately 10.7 million hectares (Mha) of productive cropland, 1.6 Mha of eroded cropland, and 0.6 Mha of minelands distributed across each of the eight MRCSP states within the MRCSP region. Terrestrial sequestration research is focused on five land use categories 1) non-eroded prime croplands; 2) eroded prime croplands; 3) marginal lands such as forest, pasture, and severely eroded croplands; 4) minelands; and 5) wetlands. The region's total terrestrial sequestration potential for these five land use classes is estimated to be 144 million tons of CO₂ per year, the majority of which would come from conversion of marginal croplands (98.6 million tons CO₂/year), followed by wetlands (14.3 million tons CO₂/year), non-eroded croplands (13.6 million tons CO₂/year), eroded croplands (11.4 million tons CO₂/year), and mineland restoration (5.5 million tons CO₂/year). Ancillary, non-climate benefits associated with terrestrial sequestration within the MRCSP region include improved soil quality, reduced erosion and sedimentation, bio-filtration of pollutants, and decreased rates of CO₂ emissions. Adoption of recommended management practices may enhance crop yield in some soils by 1 - 2 percent annually, decrease the magnitude of soil erosion and non-point source pollution by 70 - 80 percent, and reduce the transport of pesticides and heavy metal runoff and percolation water by 70 - 80 percent.

COST

Total Project Value

\$23,745,399

DOE/Non-DOE Share

\$17,458,272 / \$6,287,127

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Terrestrial Sequestration Field Test: Croplands (T1)

This project will employ monitoring, mitigation, and verification (MMV) protocols, and technologies of thirteen cropland plots over the MRCSP region, primarily in the states of Ohio, Indiana, and Michigan. Soil sample analyses will be used to determine the actual rate of sequestration and potential for the region's farm lands to adopt "no-till" or reduced tillage practices to increase the amount of carbon stored in agricultural soils. The potential benefit over a 20 year period could result in an estimated 250 million tons of additional CO₂ sequestered. The stored carbon may be sold as CO₂ offset credits, which would provide additional profit to the landowners in the region.

Accomplishment Highlights:

- A total of 1,442 geo-referenced carbon data points from the MRCSP region are being analyzed
- Began generating a 30 million pixel Digital Elevation Model (DEM) of the study area
- Held a meeting with farmers involving MRCSP's project and discussed issues related to global climate change, carbon sequestration in croplands, geologic carbon sequestration and work being conducted by the DOE

Terrestrial Sequestration Field Test: Minelands (T2)

Four mine sites in Monongalia County, West Virginia have been selected for this project, whereby the amount of soil carbon that may be stored in mine sites reclaimed to grass and/or legumes will be estimated. Soil samples will be taken from various mine sites at the onset of reclamation activities, and monitoring of the samples will be continued over time. Sites throughout the region will employ MMV protocols and technologies on the mined lands. Additionally, the project will provide an estimate of the economic benefits of carbon sequestration for other reclaimed mine sites in the MRCSP region. Value added products include carbon credits, improved water quality, and wood products.

Accomplishment Highlights:

- Completed assessment of statistical variability in measured soil carbon from four mine sites in WV
- A total of 670 sampling points have been identified and soil samples have been collected from 524 of these locations (for total carbon and nitrogen content)
- Estimated Total Organic Matter (TOM) from 524 soil samples
- Developed carbon sequestration rate estimates that result from forestry activities

Terrestrial Field Test: Wetland- Blackwater Refuge (T3)

This project will monitor the carbon sequestration rates in tidal marshes at the Blackwater National Wildlife Refuge near Cambridge, Maryland, where lost tidal marsh is being restored using clean dredged material. The results of this study will be used to estimate carbon sequestration rates in restored marshes over time, evaluate the extent to which various management practices influence this process, and develop a sampling protocol for CO₂ validation in restored marshes.

Accomplishment Highlights:

- Established project transects, laid down marker horizons, and conducted first and second year sampling data collection

Benefits

The Validation Phase project will take the first steps towards demonstrating whether there are cost-effective ways to reduce CO₂ emissions in the high-emissions Midwest region, and will yield an important knowledge base for stakeholders to develop robust carbon mitigation strategies.