



Midwest Regional Carbon Sequestration Partnership – Phase II Field Tests



MRCSP Phase II Partners



Abstract

The MRCSP Phase II effort focuses on conducting field tests at multiple locations to investigate carbon dioxide sequestration feasibility for the region:

- Geologic field tests have been selected for three main sites. The projects involve a preliminary geologic site assessment, site characterization field work such as seismic surveys and test wells, CO₂ injection tests, and monitoring of the geologic sequestration process.
- Terrestrial field tests validate potential carbon sequestration through agriculture management practices, wetland preservation, and mineland reclamation with the objective to continue to develop best approaches for terrestrial CO₂ sequestration in a variety of land uses.

Results from field tests will be used to promote carbon capture and storage (CCS) opportunities and expand infrastructure necessary to deploy CCS at a meaningful scale in the MRCSP region.

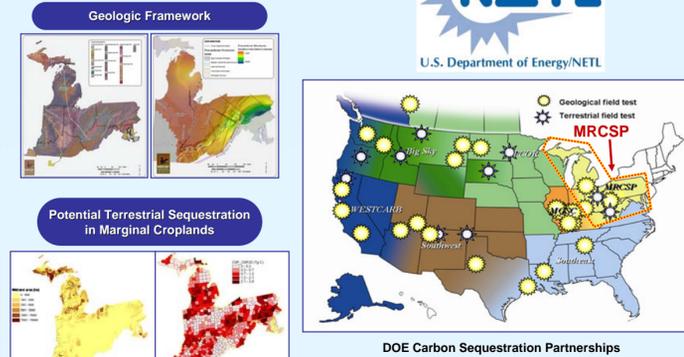
MRCSP Objectives/Overview

- Why:** Part of a national effort sponsored by the U.S. Department of Energy's National Environmental Technology Laboratory (DOE/NETL) to develop robust strategies for mitigating CO₂ emissions that contribute to greenhouse gases
- Who:** 30+ member team, led by Battelle, and drawing from the research community, energy industry, government, and non-government organizations
- What:** Demonstrate the safety and effectiveness of CO₂ sequestration and further add to understanding the best approaches to its implementation in the region
- When:** Phase I Launched, fall 2003; final report available, early 2006; Phase II commenced October 2005
- Where:** Seven-state region of IN, KY, MD, MI, OH, PA, WV

Phase I Results – Characterization of CO₂ Sequestration Opportunities in MRCSP Region

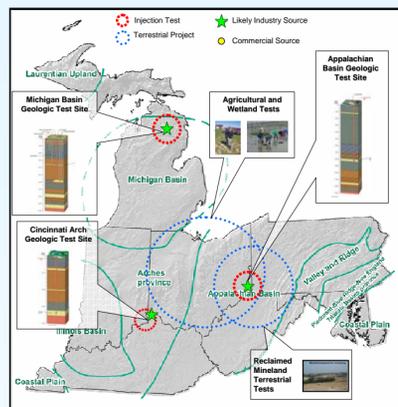
Phase I concluded a preliminary assessment of the region's geologic and terrestrial CO₂ sequestration potential. A comprehensive series of digital maps and tabular databases was constructed to facilitate regional sequestration planning and modeling.

- The Phase 1 assessment indicates that the MRCSP region has the potential to store hundreds of years of CO₂ emissions, but that geologic storage capacity is variably distributed in the region.
- Phase I terrestrial studies indicate significant sequestration potential in marginal cropland areas, reclaimed mineland areas, and wetlands across the MRCSP region.



Field Test Sites

- Three geologic and 10+ terrestrial field test sites were selected based on a variety of reasons, including proximity to CO₂ sources, MRCSP partner support, and overall benefits for advancing carbon sequestration in region
- The region has many opportunities for geologic and terrestrial sequestration. In addition, it has numerous and diverse CO₂ sources. As such, the overall approach for the MRCSP is to test many different sequestration options.
- Terrestrial sequestration tests are planned at traditional farms, reclaimed mineland areas, and wetlands
- Geologic tests are planned for three different deep saline rock formations along distinct, regional geologic features

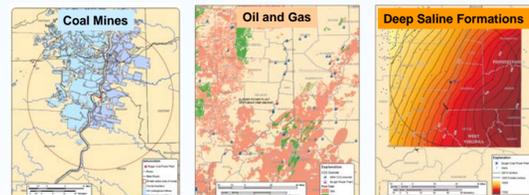


Appalachian Basin Site



R.E. Burger Geologic CO₂ Sequestration Test Site

Several deep saline rock formations were identified for testing at the R.E. Burger Site. A preliminary review of the geology present at site shows that several storage reservoirs exist in the deep subsurface for the site, including the "Clinton-Medina Group" and the Oriskany Sandstone. These formations are present at depths of more than ~5,000-8,000 ft in the study area. However, they are variable in thickness and character such that final test targets will have to be determined with the test well. FirstEnergy plans to pilot test an enhanced version of the PowerSpan technology that would be capable of capturing CO₂ at their R.E. Burger plant during 2007. This would provide an opportunity to test an integrated CO₂ capture, handling, and injection system in this tri-state area of the Appalachian Basin. The R.E. Burger project is well into field work phase. Major tasks have involved preliminary geologic assessment, permitting, a 2-D seismic survey, and test well preparations.



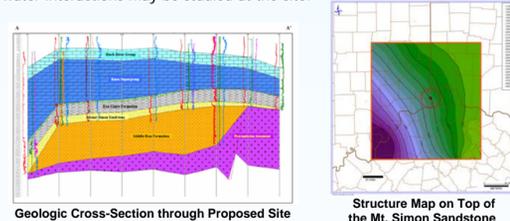
Geologic Field Tests

Cincinnati Arch Site



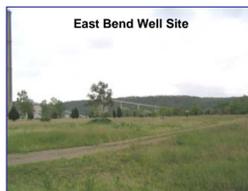
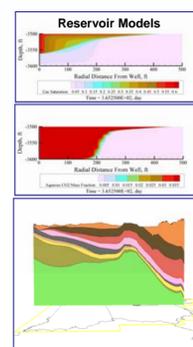
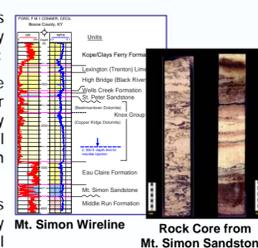
East Bend Geologic CO₂ Sequestration Test Site

The Mt. Simon Sandstone was identified for testing at the East Bend site. This deep saline rock formation is a major CO₂ sequestration target for the MRCSP region. Since the Mt. Simon extends throughout the Midwest United States, much of the information from this test will be useful for other portions of the MRCSP and beyond. In addition to this main objective, the tests are aimed at understanding regional trends (i.e. permeability, porosity, geochemistry, mineralogy) in the Mt. Simon better. In regard to injection tests, the work is aimed at demonstrating CO₂ sequestration processes in older Paleozoic rocks in the Midwest. Since the Mt. Simon is 300 ft thick at the site, tests may be able to reveal any tendency for upward migration of the CO₂. In addition, it is likely that rock-water interactions may be studied at the site.



Most work for the East Bend site has involved site preparation, preliminary geologic assessment, and seismic survey:

- Site preparation activities were completed including survey of the site for suitable test well location, seismic survey lines, and injection system. A test well location was selected and cleared with East Bend plant personnel.
- A preliminary geologic assessment was completed by the Indiana and Kentucky Geological Survey describing the regional geologic setting, target sequestration rock formations, and other issues
- Well construction specifications and a drilling plan were prepared for the site
- A 2-D seismic survey was completed through the injection site July 12-23, 2006, to delineate the arrangement of deep rock layers at the site. The survey lines consisted of two 5.5 mile long perpendicular routes through the test well site.
- Well construction specifications and a drilling plan were prepared for the site
- A plan was developed for a 2-D seismic survey through test site. The survey will be about 10 miles long. A geophysical company was procured for the survey.



Regional Geologic Cross-Section of Deep Rocks Showing Cincinnati Arch

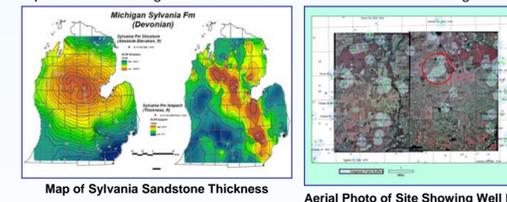
Michigan Basin Site



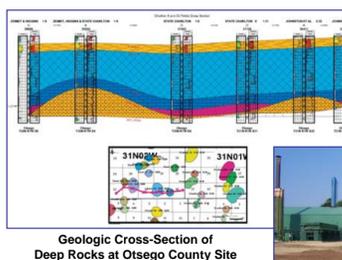
Otsego County, Michigan Geologic Sequestration Test Site

The Bois-Blanc to Sylvania Sandstone, a major CO₂ sequestration target for the Michigan Basin, was identified for testing at the Otsego County site. This portion of the basin is in an area of active enhanced oil recovery (EOR) projects, which provides infrastructure for injection tests. High purity CO₂ is available from a DTE or from other processing plants in the area. A significant amount of infrastructure is available for testing CO₂ sequestration in saline formations.

At this site, we intend to inject a fairly significant volume of CO₂ (10,000s tons) because a clear source is available from nearby gas processing plant. This should allow for more substantial monitoring of the injected CO₂ such as 4-D seismic and/or cross-well seismic. In addition, we plan on retrofitting an abandoned well at the site for monitoring.



- Site preparation activities were completed including walkover of the site for suitable test well location and monitoring options for abandoned wells present at the site. A test well location was selected and cleared with the field operator.
- A preliminary geologic assessment was completed by Western Michigan/Michigan Core Research Laboratory describing the regional geologic setting, target sequestration rock formations, and other geology issues
- Well construction specifications and a drilling plan was prepared for the site
- A plan was developed for installation of a test well and retrofitting an abandoned well



Terrestrial Field Tests

Agricultural Cropland Sequestration



- Quantify the actual carbon sequestration in croplands by comparing crop management methods
- Sample 13 major land resource areas (MLRAs) (7 in Ohio, 4 in Indiana, and 2 in Pennsylvania)
- Collect soil samples from farms using conventional till and no-till methods, as well as from woodlots that will be used to understand the baseline measurements for that area
- Analyze samples to ascertain how much carbon can be stored in farmland by simply switching farming practices
- Extrapolate MLRA data to estimate sequestration potential in region

Reclaimed Minelands



Mineland Potential Map

- Compare carbon measurements from mine sites of different ages from similar locations allows researchers to assess basic soil carbon at the beginning of a reclamation process, and over time
- Determine the initial levels of carbon in the soil at project start
- Collect and analyze soil samples from identified reclaimed mine sites
- Calculate the annual rate of change of soil carbon accumulation in mined soils by sampling mine sites of different ages

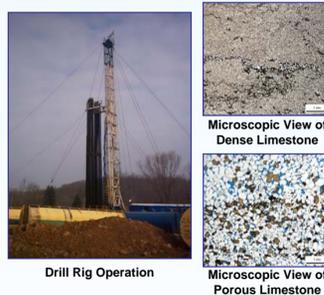
Wetlands



- Analyze accretion and long-term continual sequestration potential in wetlands
- Examine three tidal marsh cells – one newly created 5-acre cell created with dredge material in 2003; one older cell, created in 1983; and a third that is a natural marsh cell
- Establish approximately 50 field plots per cell conduct annual soil analyses, including organic carbon, bulk density, active carbon, nutrients, pH, and other selected samples
- Use data to determine carbon sequestration rates and total amount of carbon that can be sequestered in restored vs. natural marshes

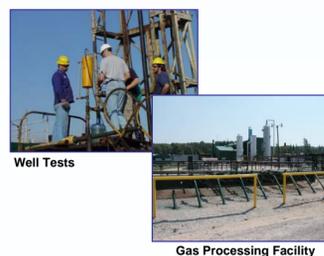
Site Characterization/Field Work

- Site characterization work is focused on providing information to design geologic/terrestrial tests in real-world settings
- Seismic surveys, test-well drilling, reservoir tests, brine sampling, and other field work are in progress for the geologic field test sites
- Soil sampling, chemical analysis, and sequestration rate monitoring are in progress at terrestrial sites
- Data will also be used to expand understanding of sequestration options for the MRCSP region
- Regional "piggy-back" drilling and testing is also planned



CO₂ Injection Tests and Monitoring

- CO₂ injection and storage tests are planned for each of the geologic test sites
- These are small tests with small injection volumes. The objective is to show that the CO₂ can be safely and permanently stored in deep rock formations otherwise saturated with dense brine.
- A monitoring plan will be implemented to evaluate the performance of the geologic sequestration tests, including leakage, CO₂ migration, and health & safety



Stakeholder Outreach

- Share information with the public
- Solicit public input at all stages
- Develop general information materials
- Develop a public contact database
- Open lines of communication
- Inform local community of field work and injection tests



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