



the **ENERGY** lab

PROJECT FACTS

Carbon Sequestration

Midwest Geological Sequestration Consortium—Validation Phase

Background

The U.S. Department of Energy (DOE) has selected seven partnerships, through its Regional Carbon Sequestration Partnership (RCSP) initiative, 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 RCSPs are made up of state and local agencies, coal companies, oil and gas companies, electric utilities, 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 43 states and four Canadian provinces. The RCSPs are developing the framework needed to validate and deploy carbon sequestration technologies. The RCSPs will determine which of the numerous sequestration approaches are best suited for their specific regions of the country and identify regulatory and infrastructure requirements that will be needed should policy and economics indicate that sequestration be deployed on a wide scale. The RCSP initiative is being implemented in three phases. The Characterization Phase began in September 2003 with the seven partnerships working to develop the necessary framework to validate and potentially deploy carbon sequestration technologies. The Validation Phase of the RCSP effort (2005–2009) is focused on evaluating promising CO₂ sequestration opportunities through a series of field tests in the seven partnership regions. Presently, activities in the Development Phase (2008–2017) are proceeding and will continue the validation process to determine that CO₂ capture, transportation, injection, and storage can be achieved safely, permanently, and economically at a large scale. These tests will promote understanding of injectivity, capacity, and storability of CO₂ in the various geologic formations identified by the partnerships. Results and assessments from these efforts will assist commercialization efforts for future sequestration projects in North America.

Description

The Midwest Geological Sequestration Consortium (MGSC) is led by the Illinois State Geological Survey, in collaboration with the Indiana and Kentucky Geological Surveys, and focuses on geologic sequestration potential in Illinois, southwest Indiana, and western Kentucky. This partnership was established to assess the safety and capacity of geologic carbon sequestration options in the Illinois Basin, including unmineable coal seams, mature oil fields, and deep saline reservoir formations. The MGSC is testing the ability of these types of reservoirs to serve as sinks for some of the more than 334 million tons (304 million metric tons) of annual CO₂ emissions from fixed sources in the Illinois Basin. A series of six small-scale pilot

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Geologic Sequestration Opportunities

Data gathered during the Characterization Phase (2003–2005) indicate that the geology of the Illinois Basin is favorable for CO₂ sequestration. MGSC's research estimated 484 million tons (440 million metric tons) of potential storage capacity in existing depleted oil and gas reservoirs, 2.64 billion tons (2.4 billion metric tons) of potential unmineable coal bed storage, and 128 billion tons (117 billion metric tons) of storage potential in saline formations. In some locations, two or more potential CO₂ sinks are stacked vertically. A particular focus is on formation properties that control CO₂ injectability, total storage capacity near major CO₂ sources, the safety of injection and storage processes, and the integrity of the overlying strata that acts as a seal. The integrity of these seals is critical for safe and effective isolation of CO₂. MGSC is engaged in six geologic field tests during the Validation Phase to assess geologic sequestration opportunities in the Illinois Basin. Each test will have an extensive monitoring program for air, shallow ground water, oil and water produced from oil reservoirs, and for saline water produced from deep reservoirs to provide data to enhance understanding of the fate of injected CO₂ at the test sites. The entire process will be scrutinized to determine what contribution Illinois Basin geological sinks can make to national and international carbon sequestration goals in achieving carbon emissions reductions and how technology developed by the MGSC can be exported to other regions. MGSC's geologic tests are summarized below.

Saline Formation Tests (G1)

The saline formation test originally planned for the Validation Phase is currently under development as the MGSC Development Phase project in collaboration with Archer Daniels Midland Company (ADM) and Schlumberger Carbon Services. The Mt. Simon Sandstone saline formation has been selected for this project, which involves the injection of approximately one million metric tons of CO₂ into the formation during a three year period at a depth of 7,500 feet. Mt. Simon is one of the most significant potential carbon storage resources in the United States. This project will employ groundwater and geochemical modeling along with monitoring, verification, and accounting (MVA) protocols. The location for this project has been selected and is proceeding in Decatur, Illinois on the ADM property. Carbon dioxide will be provided from the ADM methanol production facility. An underground injection control Class I – Non-Hazardous permit has been issued by the Illinois Environmental Protection Agency, and the drilling of the injection well began in February 2009. Two-dimensional seismic has been conducted at the site and the MVA program has been collecting data since spring 2008. In the fall of 2009, 3D seismic will be collected, and injection is expected to begin in early 2010.

Enhanced Oil Recovery Test (G2)

This mature oil field enhanced oil recovery (EOR) test, also known as a "Huff 'n Puff," evaluated the potential for geological sequestration of CO₂ in mature Illinois Basin oil reservoirs as part of an EOR program. During the process, CO₂ is injected (normally as a gas) into a producing well (the "Huff" phase), the well is shut, and CO₂ is allowed to penetrate the formation, and

then the well is placed back on production (the "Puff" phase). The test was conducted at the Loudon Field in Fayette County, Illinois. A total of 43 tons (39 metric tons) of CO₂ was injected over a five-day period into the Mississippian Weiler Sandstone formation at a depth of approximately 1,550 feet.

Accomplishment Highlights:

- Oil production during the first two months following the soak period was 93 barrels.
- Results indicate that the Illinois Basin oil field may have an added-value benefit as a precursor to build and invest in the infrastructure to establish a sequestration industry within the Basin.

Enhanced Oil Recovery Test (G3)

The well conversion EOR field test does not require the drilling of any new wells because available well(s) will be converted to handle CO₂ injection and because the pattern and spacing of existing wells is adequate to test EOR processes in the reservoir. The MGSC has selected the pilot site at the Sugar Creek oil field near Madisonville, Kentucky. It is designed to be an immiscible CO₂ flood, as the CO₂ is expected to be in the gas phase in the reservoir. CO₂ injection is planned for about 6-10 months followed by water injection. Provided that CO₂ injection rates are relatively high, CO₂ is planned for injection into one existing water injection well. There are eight oil producing wells and three monitoring wells surrounding the centrally located injection well. Eight thousand metric tonnes (8,820 tons) of CO₂ have been budgeted for this pilot. The Kentucky Geological Survey will be providing additional funding and field and lab support to the MVA shallow groundwater program of this pilot.

Accomplishment Highlights:

- Completion of site-screening-process in order to determine a site with the highest probability of CO₂ response during operations.
- A project site has been selected and the MVA program is currently under development.
- Site development has begun and injection is anticipated to begin in May 2009.

Enhanced Oil Recovery Test (G4)

Depending on reservoir properties, management scheme of the existing waterflood, reservoir geology, and assessment of where in the reservoir unrecovered oil resides, a new well may not be required to create an optimum field test. A site will be sought to optimize the test pattern and provide an opportunity to collect additional data, such as advanced well logs, which are needed to assess the reservoir and understand sequestration potential. Additional data will be particularly useful to characterize and understand flow in carbonate reservoirs that are often more diagenetically complex compared to sandstones. A comprehensive MVA plan will be implemented in all phases of the pilot.

