Purpose of the Demonstration

DTE Energy and Core Energy LLC, members of the U.S. Department of Energy’s (USDOE’s) Midwest Regional Carbon Sequestration Partnership (MRCSP)¹ are participating in a field test of a promising technique for storing carbon dioxide in deep underground rock formations located near Gaylord, Michigan. These rock formations are part of the Michigan Basin. The test is one of three geologic tests being conducted in the Midwest by the Partnership.

Carbon dioxide is the most common of the man-made greenhouse gases that are believed to contribute to global warming. Concern about global warming has led to efforts to find ways to reduce carbon dioxide emissions to the atmosphere. Storing carbon dioxide deep underground in carefully selected geologic formations is one of several options being studied. This concept is often referred to as geologic sequestration.

Using carbon dioxide for enhanced oil recovery, or EOR as it is commonly called, is a very familiar and frequently used technique in Michigan and in other depleted oil fields around the country. The state’s oil and gas industry has long experience with well drilling and injecting carbon dioxide into oil-bearing formations to enhance production. While using similar techniques as in oil production, this field test differs, however, in that its purpose is to store rather than recycle the carbon dioxide.

¹ The Midwest Regional Carbon Sequestration Partnership is one of seven regional partnerships established by the USDOE. It includes Michigan, as well as Indiana, Kentucky, Maryland, New Jersey, New York, Ohio, Pennsylvania and West Virginia. The MRCSP is made up of over 30 members including universities, state geologists, many of the major energy regional companies, and state and federal officials. It is led by Battelle, a non-profit research institute headquartered in Ohio, which is a global leader in technology deployment and commercialization.
Suitable formations for geologic sequestration include saline or brine (saltwater) reservoirs, depleted oil and gas fields, or coal beds that are too thin or deep to be cost-effectively mined. In the field test, as shown in Figure 1, members of the MRCSP research team will inject carbon dioxide into a deep saline formation that is located thousands of feet below freshwater zones and at an intermediate depth between the gas-producing layers and the oil-producing layers. The test is being designed to increase our understanding of storage technologies in a real-world setting.

Although the test is small in scale, it holds great promise as an important step in building our knowledge and helping future generations to address global warming. Michigan appears to be especially well-suited for development of this technology. Geoscientists at the Michigan Geological Repository for Research and Education at Western Michigan University, who have studied Michigan’s underground rock formations extensively, have concluded that the formations may contain enough capacity to store hundreds of years’ worth of current emissions from large point sources of carbon dioxide in the state.

**What Activities Are Taking Place?**

The test is taking place in an existing oil and gas field near Gaylord, Michigan. Ongoing EOR operations by Core Energy, LLC, in the area make this an ideal location because much of the infrastructure for the demonstration is already present at the site. This includes carbon dioxide compressors, pipeline, injection systems, and existing wells for monitoring research. One of these existing wells has been converted to a monitoring well. Core Energy, LLC, the well owner, is working with the MRCSP to use the injection system for the deep saline formation test. Figure 2 shows the components of the geologic sequestration system.
The carbon dioxide comes from DTE Energy’s Turtle Lake natural gas processing plant, near Gaylord, Michigan. After compression in the nearby compression facility, it is transported about eight miles via the existing carbon dioxide pipeline to the well. Injection occurs at a depth of 3,000 to 4,000 feet into the saline rock formations, where it will remain trapped—much like oil and gas deposits are trapped for millions of years. This is far below drinking water sources, which are at a depth of less than 1,000 feet in this region. Figure 3 shows the protective mechanisms incorporated into the design of the injection well.

Field demonstration activities are spread over a period of about three years. In an initial test, which took place over a three-week period in February and March, 2008, approximately 10,000 tonnes of carbon dioxide were successfully injected. Field activities that have been completed include the following:

1. During the summer of 2006, members of the MRCSP study team evaluated the design of a well that had been closed and determined that it could be used as a monitoring well. The team also identified a nearby area to drill a new injection well.

2. The team successfully applied for a drilling permit from the Michigan Department of Environmental Quality and completed drilling the injection well and converting the existing well into a monitoring well in the fall of 2006. Core samples taken from the well were studied to confirm the suitability of the location for safely storing carbon dioxide. Suitable locations for
storage must be deep enough to keep the injected carbon dioxide pressurized, isolated from groundwater supplies, protected by cap rocks that act as a seal to keep the carbon dioxide in place, and free of major faults or abandoned wells.

3. After confirming that the site was suitable, the MRCSP study team prepared an application for an injection permit to the U.S. Environmental Protection Agency (EPA) Region 5. The permit, which was granted in December 2007, specified the pressure at which the carbon dioxide should be injected and required preparation of a plan for monitoring the safety of the operations and subsequent well closure or use.

4. As the recorded well owner, Core Energy submitted the applications for the drilling and the injection permits on behalf of the MRCSP.

5. The initial test involved injecting about 10,000 tonnes into the target storage zone over a period of about three weeks in February and March, 2008. As required by the permit, activities at all stages were monitored to track the condition of the well and the injected carbon dioxide. Project researchers observed that the behavior of the carbon dioxide in the formation closely matched the behavior predicted by the computer model prior to the field test. The field test data were used to further calibrate the model.

6. After completing the initial test, the research team concluded that the site offered a valuable opportunity to build on the knowledge already gained about the storage of carbon dioxide. Plans were therefore begun to conduct a second test that would provide a better understanding about the long-term behavior of carbon dioxide, as well as the performance of the monitoring and computer modeling tools used to track the carbon dioxide.

7. The second test, which involved the injection of up to 50,000 tonnes of carbon dioxide, took place in mid-February through July 2009. As with the initial test, it was done in compliance with all state and federal permitting requirements and activities were monitored throughout to track the condition of the well and the injected carbon dioxide.

After completion of this second, expanded test, the research team will conduct post-injection monitoring and will evaluate and communicate the results to the public.

**How can I Get More Information or Provide Input?**

If you have questions about the project, please contact T.R. Massey, at MasseyTR@Battelle.org.

The MRCSP web site (www.mrcsp.org) includes a series of snapshots that illustrate project activities (click on the menu button Geologic Demonstrations and move to the Michigan Basin site). Additional fact sheets that provide more detailed information about geologic tests are available from the web site, including information about global climate change, carbon sequestration and the overall activities of the MRCSP.