

## **Carbon Capture and Storage & CO<sub>2</sub>-Enhanced Oil Recovery in the Midwest: Creating Jobs and Increasing Energy Security**

Deployment of carbon capture and storage (CCS) infrastructure and technologies paired with carbon dioxide enhanced oil recovery (CO<sub>2</sub>-EOR) will contribute to Midwestern leadership in producing more domestic energy. These technologies can take advantage of the region's vast coal reserves, abundant biomass resources and significant oil potential. Through CO<sub>2</sub>-EOR, the Midwest can translate its CO<sub>2</sub> emissions from a range of industrial sources into a domestic energy security solution that also yields environmental benefits. The combination of EOR with CCS provides a pathway for the Midwest to produce more domestic oil, create high-paying jobs and develop expertise in key energy technologies.

Accelerated commercial deployment of CO<sub>2</sub>-EOR is a key component for Midwestern leadership in a future CCS industry. Oil companies can purchase Midwestern CO<sub>2</sub> needed in EOR operations, thus providing an economic incentive for emissions-intensive industries of all kinds to capture and sell their CO<sub>2</sub>. This revenue stream can help finance the necessary build-out of CO<sub>2</sub> pipeline infrastructure and accelerate the development of a CCS industry to serve Midwestern coal, natural gas, utility, biofuels, fertilizer and other industries for decades to come. Once in place for CO<sub>2</sub>-EOR, a commercial CCS infrastructure of CO<sub>2</sub> capture, compression and pipeline transport can enable long-term storage of industrial CO<sub>2</sub> in geologic formations other than oil and gas reservoirs, including deep saline formations.

At a time when Midwestern states seek to retool and revitalize the region's traditional industrial base, CCS & CO<sub>2</sub>-EOR offer a range of other important benefits:

- increase domestic petroleum production within the existing environmental footprint of mature Midwestern oil fields, without incurring risks associated with new drilling in ever more challenging circumstances;
- enhance national security by reducing dependence on overseas oil;
- reduce our trade and current account deficits by keeping oil expenditures at home and at work revitalizing America's Heartland;
- attract private sector investment and new jobs to the Midwest; and
- enable and accelerate commercial deployment of a regional CCS industry to the benefit of many established Midwestern industry sectors.

The Midwest has North America's largest cluster of proposed large-scale carbon capture projects nearing commercial operation, as well as a major proposed CO<sub>2</sub> pipeline that would transport CO<sub>2</sub> from Midwestern industrial sources to Gulf Coast EOR operations. The commercial-scale projects currently under consideration and on-going research efforts have the potential to position the Midwest as a major long-term contributor to America's domestic energy security and as a world leader in a future carbon capture and storage (CCS) industry.

## CCS & CO<sub>2</sub>-EOR in the Midwest:

### Snapshots of key research & commercial-scale projects in the MGA region

**Core Energy, LLC** (Michigan). Core Energy has commercial CO<sub>2</sub>-EOR operations in Michigan that use CO<sub>2</sub> captured from a natural gas processing plant for EOR. Core Energy produced its one millionth barrel of oil in 2008 and estimates that up to 500 million barrels of oil could be produced in Michigan using CO<sub>2</sub>.

**Denbury: Midwest to Gulf Coast pipeline**. The Denbury pipeline would take CO<sub>2</sub> from a set of carbon capture projects in the Midwestern region and transport the CO<sub>2</sub> by pipeline to EOR fields in the Gulf Coast region. Two routes are under consideration: the Eastern route connects Indiana and Illinois to Mississippi; the Western route connects Indiana and Illinois to Louisiana.

**DTE Energy and Core Energy LLC** (Michigan). This project studied and demonstrated CO<sub>2</sub> storage between oil and gas producing zones within the Michigan basin. The project was hosted by Core Energy using CO<sub>2</sub> from a natural gas processing plant owned at the time by DTE Energy as part of the United States Department of Energy National Energy Technology Laboratory's (US DOE NETL) Midwest Regional Carbon Sequestration Partnership (MRCSP).

**Duke Energy: Edwardsport IGCC Station** (Edwardsport, IN). First 618 MW class integrated gasification-combined cycle (IGCC) project for electric generation with partial capture and storage. The plant will begin commercial operation in 2012, with the proposed capture and storage of CO<sub>2</sub> as a retrofit dependent on the regulatory and economic environment.

**East Canton Oil Field** (Ohio). This project will determine the viability of the large "Clinton" sandstone oil and gas reservoir for full-scale CO<sub>2</sub>-assisted EOR and permanent CO<sub>2</sub> storage. The initial demonstration project will involve 20,000-50,000 tons of CO<sub>2</sub> injection, reservoir characterization and modeling. Success of this pilot could lead to injection of up to 2 million tons of CO<sub>2</sub> annually and to production of an additional 100 million barrels of oil.

**Erora Group: Cash Creek** (Henderson County, KY). A 715 MW (gross) commercial-scale hybrid IGCC project. The project will supply CO<sub>2</sub> to EOR operations.

**Evaluation of the Carbon Sequestration Potential of the Cambro-Ordovician Strata of the Illinois and Michigan Basins**. Evaluation of the carbon storage potential of the Cambro-Ordovician Strata of the Illinois and Michigan Basins that include most of Illinois, Indiana, Kentucky and Michigan. This project is conducted by a consortium led by the Illinois State Geological Survey (ISGS), the Kentucky Geological Survey, Brigham Young University, Schlumberger Carbon Services, Western Michigan University and the Indiana Geological Survey (IGS) and in partnership with the US DOE NETL.

**FutureGen 2.0** (Meredosia, IL and downstream sequestration locations). The project will repower a 200 MW pulverized coal plant with an advanced oxy-combustion technology expected to achieve a 90 percent capture rate and eliminate most SO<sub>x</sub>, NO<sub>x</sub>, mercury and particulate emissions. Morgan County, Illinois has been selected as the preferred location for the storage site, visitor center, and research and training facilities. This project is a public-private partnership supported in part by the US DOE and the FutureGen Industrial Alliance.

**Illinois Basin-Decatur Project (IBDP)**. A large-volume, saline formation sequestration test that will involve the injection of 367,000 tons of CO<sub>2</sub> per year for three years into the Mt. Simon Sandstone Formation in the Illinois Basin. The CO<sub>2</sub> is captured from a fermentation plant at Archer Daniels Midland (ADM) Company's ethanol production facility. The project is led by the ISGS as part of the US DOE NETL's Midwest Geological Sequestration Consortium (MGSC) and in partnership with ADM.

**Illinois Industrial Carbon Capture and Sequestration Project**. This project builds on the success of the IBDP project and is a commercial-scale CCS project. ADM will capture one million tons per year at their ethanol production plant using dehydration and compression for injection and storage in the Mt. Simon Sandstone Formation. The project is led by ADM in partnership with the ISGS, Schlumberger Carbon Services, and Richland Community College and the US DOE NETL.

**Indiana Gasification/Leucadia** (Rockport, IN). Coal to substitute natural gas (SNG) plant using GE technology to produce 40 bcf of SNG. The plant will supply CO<sub>2</sub> to EOR operations.

**Modeling CO<sub>2</sub> Sequestration in a Saline Formation and Depleted Oil Reservoir to Evaluate Regional CO<sub>2</sub> Sequestration Potential of Ozark Plateau Aquifer System, South-Central Kansas**. This project is a partnership between the University of Kansas, BEREXO Inc., Bittersweet Energy Inc., Kansas Geological Survey, and the Kansas State University.

**Near Miscible CO<sub>2</sub> Application to Improve Oil Recovery** (Kansas). The University of Kansas Center for Research investigated the feasibility of using near-miscible CO<sub>2</sub> flooding to extend the life of mature oil fields in Kansas' Arbuckle Formation while storing CO<sub>2</sub>. The study shows significant potential in Kansas for CO<sub>2</sub>-EOR to access additional oil reserves. The study was administered through the Research Partnership to Secure Energy for America and managed by the US DOE NETL.

**Research to Better Define Sequestration Options in Eastern Ohio and the Appalachian Basin** (Ohio). This project will gather data and study geologic storage options in Eastern Ohio and the Upper Ohio River Valley area. This project will also develop plans for geologic characterization needed to define fully the storage potential along the Ohio Valley Energy Corridor. The research will be conducted by the Ohio Department of Natural Resources, Division of Geological Survey in Partnership with Battelle Memorial Institute (Battelle) and is funded with support from the Ohio Coal Development Office (OCDO).

**Simulation Framework for Regional Geologic CO<sub>2</sub> Storage Infrastructure Along Arches Province of Midwest United States** (Ohio). This site characterization and geologic mapping project will use available data from existing waste injection wells, oil and gas exploration wells and geologic core analyses, focusing on the "Arches Province" geologic formation that underlies parts of Ohio, Indiana, Kentucky and Michigan, to develop a simulation framework for large-scale CO<sub>2</sub> storage. The project is conducted by Battelle in partnership with the OCDO of the Ohio Air Quality Development Authority; Ohio, Indiana, and Kentucky Geological Surveys; Western Michigan University; and Battelle's Pacific Northwest Division.

For more information on MGA Energy Initiatives related to CCS & EOR, please see:

<http://www.midwesterngovernors.org/CCS.htm>