PROJECT facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Carbon Sequestration

4/2008

Storage of CO_2 in Geologic Formations in the Ohio River Valley Region

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Background

The storage of carbon dioxide (CO_2) in a dense, supercritical phase in deep saline sandstone formations is deemed to be a promising long-term option for safe sequestration. Deep saline formations are among the largest and most widely available potential reservoirs for long-term storage. Battelle researchers, supported by the U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL), proposed to explore the potential of using deep geologic formations as a means of sequestering CO_2. This phased project, with competitive down-selection during each phase, was funded as part of the "Global Climate Change—Novel Concepts for Management of Greenhouse Gases (GHG)" Program.

AEP's Mountaineer Power Plant in New Haven, West Virginia

The selection of this project for continuation to Phase III in 2002 underscored the progression of DOE's geologic sequestration program from computer and laboratory assessments toward pilot-scale testing and verification. Phase III is focused on a site characterization (surface and subsurface) for possible injection of CO_2 into a suitable formation. In this project, the research team has conducted a field study to determine whether the deep rock layers in the Ohio River Valley are suitable for storing CO_2.

PARTNERS

American Electric Power (AEP)

British Petroleum (BP)

Ohio Coal Development Office (OCDO)

Ohio Geological Survey

Pacific Northwest National Laboratory (PNNL)

Schlumberger

West Virginia Geologic & Economic Survey

West Virginia University

PERFORMANCE PERIOD

4/28/2005 to 5/31/2008

COST

Total Project Value
$4,172,441

DOE/Non-DOE Share
$3,151,441 / $1,021,000

Description

The objectives of the project are to conduct seismic, drilling, logging, and coring analyses so that the following can be determined: 1) the potential for long-term sequestration of CO_2 in a deep, regional sandstone saline formation and 2) the integrity of overlying caprock, with regard to its effectiveness to prevent CO_2 from escaping. The tested media was obtained from multiple sandstone formations and the overlying impermeable caprock. The Mt. Simon Sandstone and the overlying confining formations were the original target formation, but after coring and logging through this zone it was determined that the Mt. Simon site is unsuitable for storing CO_2, because it is thin at the spot for potential injection. However, several other potential sandstone formations noted in the geophysical well logs were found to be overlain by extensive low-permeability confining layers that prevent the upward movement of injected fluids.

To date, project efforts show that the deep rock layers in the Ohio River Valley are suitable for storing CO_2. The effort focused on addressing future CO_2 emissions from the many coal-based electricity power plants in West Virginia and Ohio. Results indicate that storing CO_2 deep underground in the Ohio River Valley may be a safe, practical, and effective way to reduce large sources of GHGs in the United States.

Primary Project Goal

The project involved site assessment to develop the baseline information necessary to make decisions about a potential CO_2 geologic storage test and verification experiment at the site. This project is focused in the Ohio River Valley, which is home to the largest concentration of fossil-fuel-fired electricity generation in the nation. Additionally, the potential for long-term sequestration of CO_2 in deep, regional sandstone formations and the integrity of overlying caprock is being evaluated for future sequestration projects. No CO_2 injection is planned during this phase; however, the findings of this work have been used by the host site to develop plans for future deployment. The project goals have been met through the regional geologic study: seismic survey of the area; drilling, coring, logging, and testing a deep well through the entire sedimentary column at the power plant property; reservoir modeling and risk assessment; stakeholder outreach; and CO_2 capture.

Objectives

- Thoroughly assess the surface and subsurface environment in the Ohio River Valley to ascertain a viable field test site.
- Obtain all permits from agencies (Federal and state) to drill and core an exploratory deep well at the project site.
- Conduct a two-dimensional (2-D) seismic survey to delineate subsurface geologic structures.
- Drill an exploratory deep (~9,200 foot) well to collect scientific data to assess the potential for conducting a CO_2 storage test at the site.

- Design, coordinate, and conduct field tests to comprehensively characterize the underlying reservoirs, caprocks, and overlying layers, thereby developing a thorough understanding of the geology, hydrogeology, and geochemistry at the site.
- Prepare the necessary permits and regulatory documents to allow use of the deep well to inject CO_2 captured from a nearby coal-fired power plant.
- Develop and apply a comprehensive risk analysis and stakeholder involvement process for the capture, transport, injection, and long-term storage of CO_2 at the field demonstration site.
- Develop a comprehensive monitoring, mitigation, and verification (MMV) plan to ensure the safe, long-term storage of CO_2 in deep geologic formations.

Accomplishments

- Regional geologic data, reservoir and geochemical simulations, geochemical experiments, and seismic aspects reports with specific focus on Ohio River Valley Region were all assessed.
- A detailed report on engineering and economic aspects for CO_2 capture and storage was written.
- Laboratory geochemical experiments on interactions between CO_2, rocks, and brine were evaluated.
- Regional-scale assessments in the Midwest that showed a large potential storage capacity in sedimentary basins with proximity to CO_2 sources were accomplished. However, site-specific tests and characterization are needed to determine injection potential at individual locations.
- A geologic framework of the region was constructed from existing wells in a 20-mile radius of the power plant.
- A 9,200-foot exploratory well was drilled through the underlying formations to ascertain the potential for storage potential for CO_2.
- A seismic survey of the surrounding area on both sides of the Ohio River was conducted to evaluate the integrity of underlying formations and any existing fracture/fault systems.
- A pipeline system (slip stream) was installed from the main stack at the power plant to the well head location for future testing of CO_2 injection into targeted deep formations.
- A project Site Characterization Report was completed.
- A topical report on risk assessment and modeling, titled, “The Ohio River Valley CO_2 Storage Project—Numerical Simulation and Risk Assessment Report” was completed.
- A topical report discussing potential capture technologies, titled, “The Ohio River Valley CO_2 Storage Project—Capture and Feasibility Report” was completed.

Benefits

The project has met all of its technical objectives and based on the findings, the host company is moving forward with the next steps at the Mountaineer Power Plant site. On March 15, 2007, AEP announced an aggressive, multi-dimensional initiative to develop and deploy carbon capture and storage (CCS) technologies at selected AEP plants in collaboration with several companies, including Battelle. The first step in this initiative involves integrating CO_2 capture using Alstom's Chilled Ammonia Process and geologic storage assessment effort at the Mountaineer Power Plant. The next step will include implementation of an injection and monitoring program with more than 100,000 tonnes of CO_2 to be supplied annually for several years. The test at the Mountaineer Plant will be followed by a larger-scale retrofit at a plant in Oklahoma. This progression exemplifies the success of the Mountaineer project and related research. Evaluating the feasibility of CO_2 storage will allow the energy industry to prove the viability of an evolving U.S. technology that will allow fossil-fuel fired power plants to continue operating well into the future. It will be especially beneficial to states that heavily depend on coal for electricity generation, such as West Virginia, Ohio, and many of the large, industrial Midwest states.

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