the ENERGY lab

PROJECT FACTS

Carbon Storage - Site Characterization

Site Characterization of the Highest-Priority Geologic Formations for CO_2 Storage in Wyoming

Background

Carbon capture and storage (CCS) technologies offer the potential for reducing CO_2 emissions without adversely influencing energy use or hindering economic growth. Deploying these technologies in commercial-scale applications requires adequate geologic formations capable of (1) storing large volumes of CO_2, (2) receiving injected CO_2 at efficient and economic rates, and (3) retaining CO_2 safely over extended periods. Research efforts are currently focused on conventional and unconventional storage formations within depositional environments such as: deltaic, fluvial, alluvial, strand-plain, turbidite, eolian, lacustrine, clastic shelf, carbonate shallow shelf, and reef. Conventional storage types are porous permeable clastic or carbonate rocks that have fluids such as brine, oil, or gas in the natural void spaces of the rocks. Unconventional storage types include unmineable coal, organic shale, and basalt interflow zones[1].

The Department of Energy's (DOE) National Energy Technology Laboratory (NETL) selected 10 projects that received $49 million of DOE funding to characterize promising geologic formations for CO_2 storage. The funding was provided by the American Recovery and Reinvestment Act of 2009 (ARRA), which was enacted to create new jobs, spur economic activity, and promote long-term economic growth. This research further advances DOE's efforts to develop a national assessment of CO_2 storage resources in deep geologic formations. These 10 projects are focusing on the regional site characterization of high-potential geologic storage formations. They will assess and develop comprehensive data sets of storage formation characteristics (porosity, permeability, reservoir architecture, cap rock integrity, etc.) to provide insight into the potential for selected geologic reservoirs across the United States to safely and permanently store CO_2. An additional $50 million of ARRA funding was provided to augment the work that the existing projects are conducting. This additional funding is allowing these projects to further characterize reservoir geology, identifying additional storage opportunities for industrial CO_2 sources. This additional funding is allowing these projects to drill additional and/or deeper wells, collect significantly better log and core data to populate models, collect additional geophysical data, and integrate additional data and conduct more extensive reservoir models.

[1]DOE NETL 2010 - **Geologic Storage Formation Classification:** *Understanding Its Importance and Impacts on CCS Opportunities in the United States,* http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPM_GeologicStorageClassification.pdf

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PROJECT DURATION

Start Date
12/08/2009

End Date
12/07/2012

COST

Total Project Value
$17,979,452

DOE/Non-DOE Share
$9,975,000 / $8,004,452

PROJECT NUMBER

DE-FE0002142

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Project Description

The University of Wyoming and the project partner organizations will characterize the Rock Springs Uplift (RSU) and Moxa Arch deep saline reservoirs in southwestern Wyoming to pave the way for commercial- scale CO_2 storage projects (Figure 1). These reservoirs will be characterized by drilling a test well in the RSU, performing extensive testing in and around the well, and processing data from a well in the Moxa Arch that had been installed previously by ExxonMobil. Analytical measurements taken within the wells and tests performed on samples removed from the wells will determine the suitability of the reservoirs to store CO_2. Additionally, a study will be undertaken to ensure that potential leakage paths from the reservoirs are identified and assessed. The University of Wyoming will accomplish the project objectives over a four-year period. Major project tasks include (1) the installation of a characterization well (which will be completed as a microseismic monitoring well) at the RSU site for the purpose of gathering cores, fluid samples, and geophysical data; (2) 3-dimensional, 3-component seismic surveys and electromagnetic (EM) surveys of the area surrounding the RSU well; (3) development of well catalog and wellbore risk assessments for the RSU and Moxa Arch sites; (4) performing structural and stratigraphic characterization of the RSU and Moxa Arch sites; (5) analysis of host rock mineralization and its effect on CO_2 injectivity and storage and analysis of formation fluids; and (6) design of a commercial-scale sequestration project that includes options for the disposition of displaced waters and a complete performance risk assessment.

Goals/Objectives

The primary objective of the DOE's Carbon Storage Program is to develop technologies to safely and permanently store CO_2 and reduce Greenhouse Gas (GHG) emissions without adversely affecting energy use or hindering economic growth. The Programmatic goals of Carbon Storage research are: (1) estimating CO_2 storage capacity in geologic formations; (2) demonstrating that 99 percent of injected CO_2 remains in the injection zone(s); (3) improving efficiency of storage operations; and (4) developing Best Practices Manuals (BPMs).

The overall project objective is to characterize the RSU and Moxa Arch deep saline reservoirs for potential commercial development in the region. To meet this overall objective, the project will (1) acquire additional seismic and geophysical survey data from the RSU to complement existing Moxa Arch data; (2) acquire wireline logs, core, and cuttings from the RSU through a characterization well; and (3) complete risk assessments and commercial scale storage project designs for both sites. The project team will characterize two distinct geologic storage reservoirs (Weber/Tensleep Sandstone and Madison Limestone) to determine regional storage resources. Preliminary analyses indicate that the targeted formations in the Rock Springs Uplift could store 26 billion metric tons of CO_2; this storage resource is sufficient to accept Wyoming's current annual CO_2 emissions of 55 Mt/yr for more than 472 years.

Accomplishments

- The RSU characterization well, which is located near PacifiCorp's 2,200 MW Jim Bridger coal-fired power plant, was completed to a total depth of 12,810 feet in August 2011
- A full log suite was recovered from the RSU well, including mud, gamma ray, sonic, VSP, density, resistivity, check short, neutron, porosity, and image logs.
- Over 900 ft. of high-quality core was retrieved from the RSU characterization well, with a focus on the key storage injection and confining zones.
- Microfrac tests of the primary seal (Dinwoody Shale) and two target storage reservoirs were conducted.
- A 3-D seismic survey and an electromagnetic (EM) survey have been completed over a 25-square mile area surrounding the characterization well site.
- A well catalog that includes all existing log and core data has been constructed for the Rock Springs Uplift, with special attention paid to the 5 mile × 5 mile 3-D seismic survey area.
- Researchers have performed numerical simulations of a wide variety of CO_2 injection/storage scenarios, from 40,000 metric tons/year to 15 million metric tons/year for 50 years (750 Mt total) in order to predict reservoir pressures and the displacement of formation saline fluids.

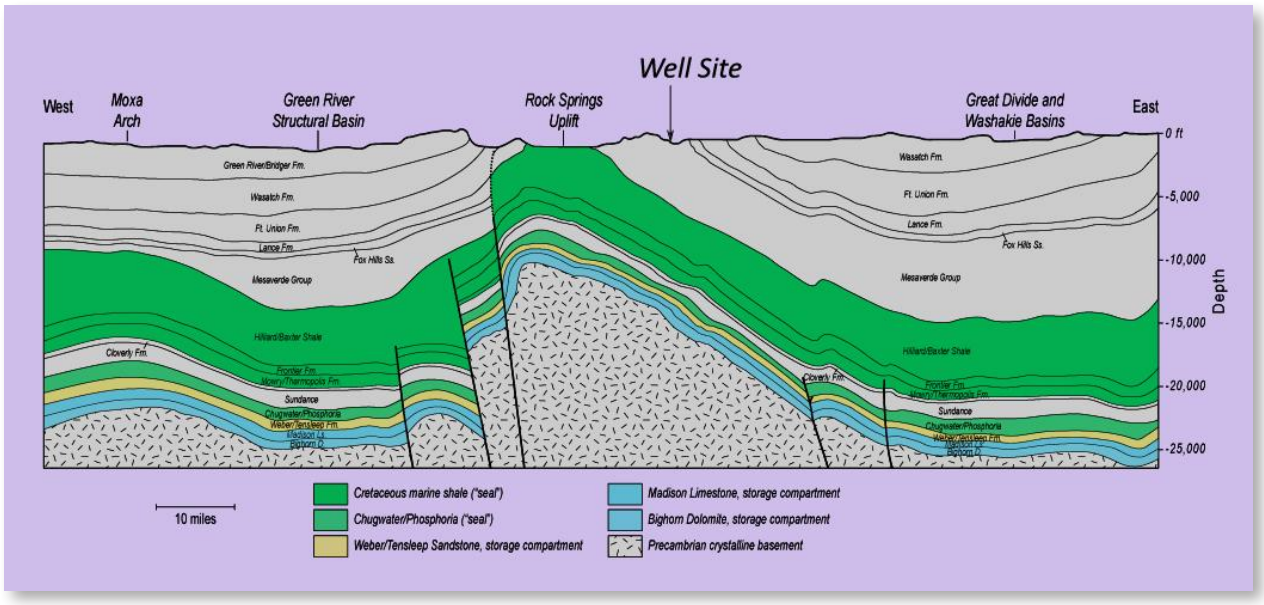

Figure 1. Cross-section of Moxa Arch-Rock Springs Uplift in Southwestern Wyoming

Benefits

The overall effort will provide greater insight into the potential for geologic formations across the United States to safely and permanently store CO_2. The information gained from this endeavor will further DOE efforts to refine a national assessment of CO_2 storage resource in deep geologic formations. Specifically, this project will result in preparing the RSU and Moxa Arch deep saline reservoirs in south-western Wyoming for the development of commercial scale CO_2 storage projects. The RSU has the potential to be an outstanding for geological CO_2 storage because it is overlain by thick sealing lithologies and is huge in area (1,750 mi^2). The preparation of the sites will involve a detailed geologic site characterization; a monitoring, verification, and accounting (MVA) plan; and a commercial-scale storage design that includes displaced geologic fluid management and a possible CO_2 injection well. These geologic sites are located in the vicinity of several of the state's largest sources of anthropogenic CO_2 and are high-priority opportunities for the development of geological storage of CO_2. The data gathered as part of this research effort will be shared with the Regional Carbon Sequestration Partnership (RCSP)Big Sky Carbon Sequestration Partnership's (Big Sky), integrated into the National Carbon Sequestration Database and Geographic Information System (NATCARB), and utilized for the 4th Edition of the Carbon Sequestration Atlas of the United States and Canada.