the ENERGY lab

R&D FACTS

Carbon Storage

Development of Comprehensive Monitoring Techniques to Verify the Integrity of Geological Storage Reservoirs Containing Carbon Dioxide

Background

Research aimed at monitoring the long-term storage stability and integrity of carbon dioxide (CO_2) stored in geologic formations is one of the most pressing areas of need if geological storage is to become a significant factor in meeting the United States' stated objectives to reduce greenhouse gas emissions. The most promising geologic formations under consideration for CO_2 storage are active and depleted oil and gas formations, brine formations, and deep, unmineable coal seams. Unfortunately, the long-term CO_2 storage capabilities of these formations are not yet well understood.

Primary Project Goal

The goal of this effort is to develop and demonstrate advanced monitoring techniques to assess the capacity, stability, and leakage risk profile of CO_2 storage in geologic formations.

Soil-gas monitoring conducted by NETL personnel at an enhanced coalbed methane recovery site (Southwest Regional Sequestration Partnership) located at the San Juan Basin in northern New Mexico.

Objectives

The primary objective of this project is to apply a complementary suite of surface and near-surface monitoring techniques to detect short-term, rapid loss, or long-term intermittent leakage of CO_2 from geologic storage formations. These techniques include monitoring perfluorocarbon (PFC) tracers added to the injected CO_2 that can be detected in soil-gas or atmosphere at parts-per-quadrillion levels, shallow water aquifer chemistry changes, monitoring fluxes of CO_2 at the surface, and monitoring natural tracers (e.g., radon and light hydrocarbons) in soil-gas.

CONTACTS

George Guthrie
Focus Area Leader
Geological and Environmental Sciences
412-386-6571
george.guthrie@netl.doe.gov

Arthur Wells
Project Manager
Geological and Environmental Sciences
412-386-5975
arthur.wells@netl.doe.gov

PARTNERS

Apogee Scientific
Carnegie Mellon University
Chaparral Energy
CONSOL Energy
Energy Corporation of America
New Mexico Institute of Mining and Technology
Southwest Regional Partnership on Carbon Sequestration
West Virginia University

NATIONAL ENERGY TECHNOLOGY LABORATORY

Albany, OR • Anchorage, AK • Morgantown, WV • Pittsburgh, PA • Sugar Land, TX

Website: www.netl.doe.gov

Customer Service: 1-800-553-7681

U.S. DEPARTMENT OF ENERGY

Additional objectives are to:

- Perform geophysical site analysis using ground-based measurements and remote sensing that combines satellite-visible and infrared views with optical aerial photography.
- Monitor for long- and short-term leakage during the Regional Carbon Sequestration Partnerships' (RCSPs) Phase II and Phase III projects and through Zero Emissions Research Technology (ZERT) projects.
- Locate abandoned wells using airborne and ground-based magnetometry, while simultaneously evaluating the leakage potential using radiometry and methanometry.

Benefits

The development of techniques to monitor the integrity of geologically stored CO_2 is needed to assure public health and safety and gain public acceptance of geological storage technology. Active and depleted oil and gas formations, brine formations, and deep coal seams that were previously unused now have the potential to serve as sinks for CO_2 storage. Additionally, harmful emissions, which may contribute to global warming, are prevented from entering the atmosphere.

Accomplishments

The United States Department of Energy's (DOE) National Energy Technology Laboratory (NETL) is currently involved in collaborations with the seven RCSPs to monitor Phase II and Phase III pilot- to intermediate-scale field tests, with ZERT collaborations and with commercial energy production companies. These tests involve injection of CO_2 to enhance production in oil reservoirs and methane in deep coal-beds and for monitoring methane migration in shale-gas formations. These injections range from hundreds of tons to a million tons of CO_2. For this effort, NETL is employing a large suite of complementary surface and near surface monitoring techniques as mentioned in the objectives statement above, developing risk-assessment software that will be applied to field sites, and performing geo-mechanical stress tests on RCSPs' reservoir and cap rock samples. NETL participated in the ZERT field near-surface verification experiments which injected small amounts of tracer-spiked CO_2 just below the soil from vertical and horizontal wells. Surface flux, PFC tracers mappings and ground-water and vadose zone chemistry provided complementary information for modeling CO_2 movement near the surface. Resistivity surveys were used to image subsurface features including the development of the CO_2 plume. NETL successfully developed methods for finding and evaluating abandoned wells using ground-based and aerial magnetometry and methanometry surveys. The precise location of abandoned wells and the evaluation of their leakage potential is an essential component of NETL's storage monitoring program. Within the past five years, R&D magazine has selected both near-surface monitoring with PFC tracers and the helicopter well-finding technology as one of the years' most technologically significant products.

Within the last year, NETL has 1) successfully conducted the first demonstration of the use of PFC tracers to monitor the movement of shale-gas, activated through hydraulic fracturing, between production wells, and it's confinement within the production reservoir, and 2) published the results of a multi-year monitoring effort at a coal-bed methane production/ Carbon Capture Utilization and Storage (CCUS) site that employed a complete suite of near-surface and reservoir monitoring technologies. The study was successful in revealing temporary subsurface and atmospheric releases and in providing the reservoir modeling effort with production well breakthrough information not otherwise attainable without tracers. The complimentary value of the suite of near-surface monitoring technologies was demonstrated.