the ENERGY lab

PROJECT FACTS

Carbon Storage

Near-Surface Leakage Monitoring for the Verification and Accounting of Geologic Carbon Sequestration Using a Field-Ready ^{14}C Isotopic Analyzer

Background

Through its core research and development program administered by the National Energy Technology Laboratory (NETL), the U.S. Department of Energy (DOE) emphasizes monitoring, verification, and accounting (MVA), as well as computer simulation and risk assessment, of possible carbon dioxide (CO_2) leakage at CO_2 geologic storage sites. MVA efforts focus on the development and deployment of technologies that can provide an accurate accounting of stored CO_2, with a high level of confidence that the CO_2 will remain stored underground permanently. Effective application of these MVA technologies will ensure the safety of geologic storage projects with respect to both human health and the environment, and can provide the basis for establishing carbon credit trading markets for geologically storing CO_2. Computer simulation can be used to estimate CO_2 plume and pressure movement within the storage formation as well as aid in determining safe operational parameters; results from computer simulations can be used to refine and update a given site's MVA plan. Risk assessment research focuses on identifying and quantifying potential risks to humans and the environment associated with geologic storage of CO_2, and helping to ensure that these risks remain low.

Project Description

This four-year project—performed by Planetary Emissions Management, Inc. (PEM)—is developing a carbon-14 (^{14}C) field-ready analyzer having a sensitivity of approximately 1 ppm of fossil fuel CO_2 in ambient air. The primary focus of the application is within the near surface environment covering the project area, however, a gas stream from any component of a geologic carbon storage project or location may be analyzed. The analyzer is based on PEM's already completed multi-isotopic Global Monitor Platform (GMP) and is being deployed for testing and validation at two reference sites: one where CO_2 leaks from natural geologic reservoirs and the other a pilot CO_2 injection site.

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).

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PROJECT DURATION

Start Date	End Date
01/15/2010	01/14/2014

COST

Total Project Value
$3,078,686

DOE/Non-DOE Share
$1,995,575/$1,083,111

PROJECT NUMBER

DE-FE0001116

U.S. DEPARTMENT OF ENERGY

The overall project goal is to field a high-resolution, low-cost, spatial and temporal data analyzer for direct tracking of fossil fuel CO_2—namely, the ^{14}C content of CO_2—as a means to detect leakage of geologically stored CO_2 (GSC) (Figure 1). This effort will help to meet the goal of assuring CO_2 storage permanence in the subsurface. The primary focus of the application is within the near-surface environment covering the project area; however, a gas stream from any component of a GSC project or location may be analyzed. Further objectives are to:

- Deploy the ^{14}C analyzer as a spatial array of devices across the project location to monitor and verify leakage of GSC at project-relevant scales.
- Co-deploy an already developed ^{13}C radiocarbon analyzer in a common instrument platform offering simultaneous ^{13}C and ^{14}C isotope ratios.
- Continue development with the ultimate goal of commercializing the analyzer.

Accomplishments

- Selection of Horseshoe Lake Tree Kill, Mammoth Mountain, California as the first natural CO_2 leakage field site was made and an integrated ^{12}C, ^{13}C and ^{14}C multi-isotopic platform (the initial GMP) was installed and tested. Results from the initial field test were used to upgrade the GMP for deployment at the second natural CO_2 leakage site.
- Selection of Soda Springs, Idaho as the second natural CO_2 leakage field site was made, the upgraded GMPs were deployed, and data collection has commenced.
- Research and selection of the geologic carbon storage field site is underway so that the platform can be validated at an active injection site.

Benefits

As carbon capture, utilization, and storage (CCUS) capacity increases and projects become commercial beyond 2020, the importance of accurate geologic models and robust risk assessment protocols will become increasingly important to project developers, regulators, and other stakeholders. NETL's Carbon Storage Program aims to continue improvements to the models and risk assessment protocols. Specific goals within the Simulation and Risk Assessment Focus Area that will enable the Carbon Storage Program to meet current programmatic goals are to (1) validate and improve existing simulation codes which will enhance the prediction and accuracy of CO_2 movement in deep geologic formations to within ± 30 percent accuracy, (2) validate risk assessment process models using results from large-scale storage projects to develop risk assessment profiles for specific projects, and (3) develop basin-scale models to support the management of pressure, CO_2 plume, and saline plume impacts from multiple injections for long-term stewardship in major basins of the United States.

This technology represents a breakthrough in the capability to directly track fossil fuel CO_2 with high precision and lower costs than existing Accelerator Mass Spectrometry (AMS) approaches. The realization of increased data rates for ^{14}C analysis at lowered cost is expected to benefit end users in MVA programs as well as policymakers and the public. Furthermore, an increased data rate for a number of locations offers the opportunity to create spatial baselines for ^{14}C of atmospheric CO_2, as well as from a variety of environments in the near-surface zones of the geologic reservoir holding sequestered CO_2. The research will provide a monitoring tool that improved the ability to detect any CO_2 releases from the storage formation to monitor for storage permanence.

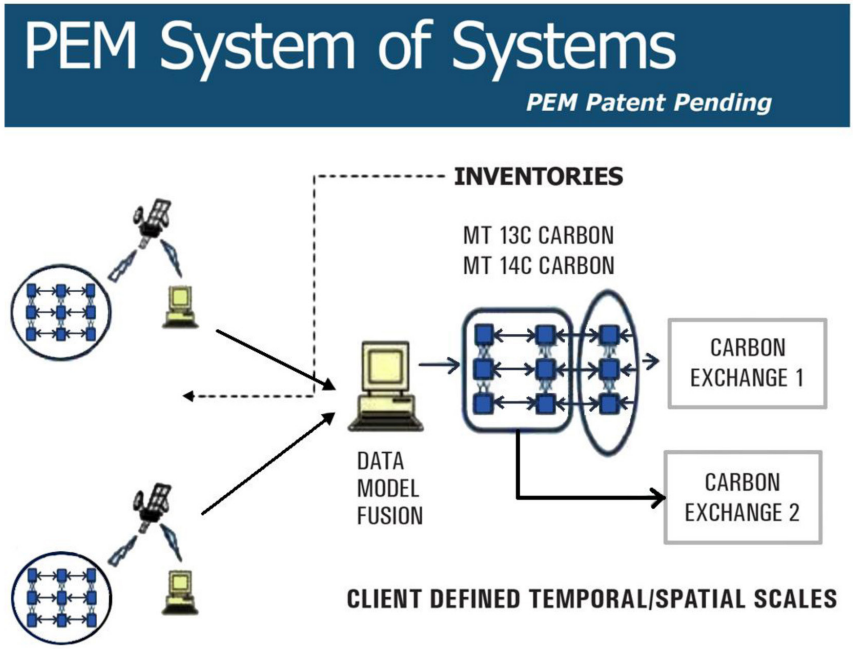

Figure 1 - A system of systems utilizing data acquisition across landscapes at differing locations resulting in comparable carbon trading units for fossil carbon and biogenic carbon flux suitable for carbon trading platforms. PEM has applied for a patent covering proprietary hardware and software.