the ENERGY lab

PROJECT FACTS

Carbon Sequestration

Development of a Software Framework for System-Level Carbon Sequestration Risk Assessment

Description

The National Energy Technology Laboratory (NETL), the only national lab owned and operated by the U.S. Department of Energy (DOE), emphasizes computer simulation and risk assessment of potential CO_2 Geologic Storage (GS) sites as a significant component of its monitoring, verification, and accounting (MVA) program. MVA utilizes both simulation and risk assessment to provide an accurate account of stored CO_2 and to develop a scientific basis to support decisions related to the permanence of CO_2 GS. Proper use of the MVA information will ensure that GS of CO_2 does not adversely impact human health and/or the environment. Research will focus on identifying and quantifying potential risks to humans and the environment from GS and potentially provide a basis for establishing carbon credit trading markets.

This three-year project—performed by GoldSim Technology Group LLC in partnership with Los Alamos National Laboratory (LANL)—will develop an integrated system-level risk analysis approach for CO_2 capture and GS, based on dynamic, probabilistic simulation. Project success will be achieved by adapting and significantly extending an existing highly-regarded and widely-used probabilistic simulation framework (GoldSim) that was originally developed for long-term safety analyses of nuclear waste disposal. Software modifications will provide better support for intensive numerical computations and manipulation of large multidimensional arrays. These adaptations will result in a robust and flexible tool that can be readily integrated with advanced subsurface flow codes and MVA technologies.

GoldSim has been adapted to a wide range of engineering applications, from water resource management to project management to mission risk analysis. In its present form, the software framework has been successfully used by LANL and the Lawrence Berkeley National Laboratory to develop system-level performance assessment models for CO_2 risk assessments. Although they take a system-level approach, both of these efforts have focused primarily on the technical risks associated with GS, namely, the injection of CO_2 into the subsurface, its potential migration within and escape from the storage reservoir (e.g., via well bores or faults), and, ultimately, its release into the atmosphere, fresh water aquifers, and other accessible environments.

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PARTNERS

Los Alamos National Laboratory

COST

Total Project Value
$1,391,689

DOE/Non-DOE Share
$1,113,228 / $278,461

Primary Project Goal

The overall project goal is to provide a powerful and flexible framework that allows system designers and/or regulators to build comprehensive, system-level risk assessments that incorporate and couple all important aspects of CO_2 capture and GS projects (technical, financial, and programmatic).

Accomplishments

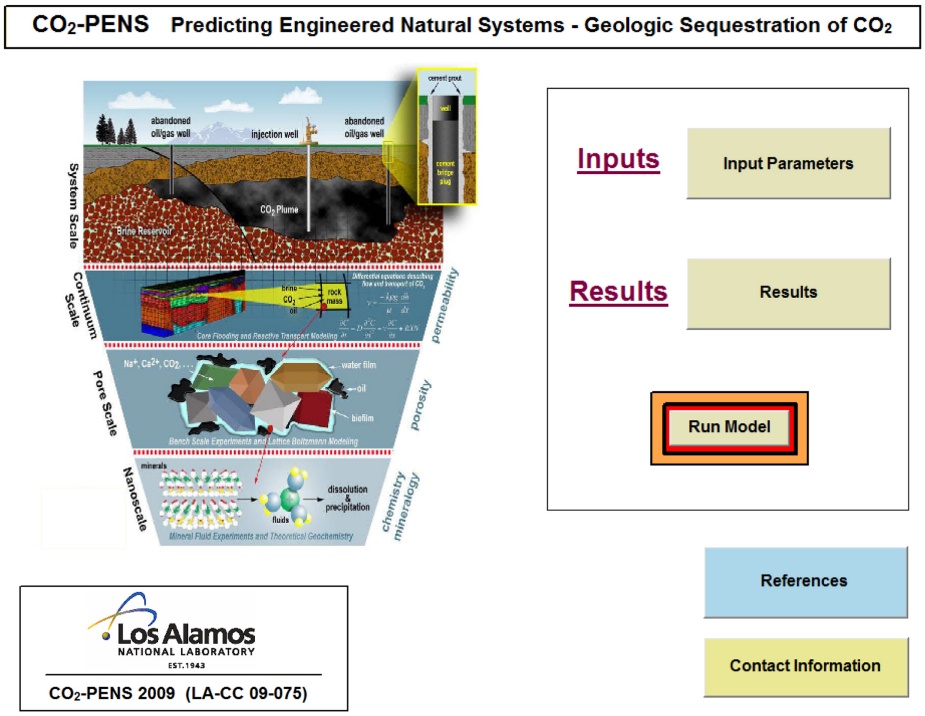
This project was awarded on October 1, 2009. The project team will accomplish the above goal through a series of four overlapping development and demonstration activities that significantly extend the GoldSim probabilistic simulation framework by adding new capabilities and allowing GoldSim to better simulate risk in CO_2 capture and storage projects. These activities and their objectives are as follows.

- Develop modifications that provide better support for intensive numerical computations and manipulation of large multidimensional arrays, thereby improving the ability of the framework to model subsurface technical risks associated with the injection and potential release and transport of CO_2.
- Develop scenario analysis and model reuse capabilities that improve the ability to rapidly create new models and compare alternative scenarios and approaches.
- Better represent and model programmatic risk to support detailed project simulation capabilities that will facilitate decision-analysis for evaluation and comparison of alternative plans of activities, assessment of the impacts of alternative budget/funding scenarios, and representation of the consequences of identified risks that might affect project success and cost.
- Conduct an analysis to identify requirements for providing basic, system-level material balance and network simulation capabilities that will enable users to model in detail the complex processes and risks associated with capturing, compressing, processing, and transporting CO_2.

Following completion of each software development component, the participant will test and confirm the value of the new software capabilities by applying them to a sequestration project. Where appropriate, existing GoldSim models developed by LANL as part of its original CO_2-PENS project will be modified to test the new software capabilities.

Benefits

This technology is likely to benefit a wide range of end users, including project developers, regulators, scientists, insurers, and policy makers. They will use the technology to build comprehensive, system-level risk assessments that realistically incorporate and couple all important aspects of a CO_2 sequestration system (technical, financial, and programmatic) and could ultimately be used to understand the effectiveness of such systems. Having a single tool that all stakeholders can access, that is of high enough quality that they can actually use it, will improve confidence in risk assessment methodologies and lend greater transparency to CO_2 sequestration projects.



LANL's CO_2-PENS Model is built on the GoldSim platform.