the ENERGY lab

R & D FACTS

Carbon Storage

Carbon Storage Research

Carbon capture and storage (CCS) is a key component of the U.S. carbon management portfolio. Numerous studies have shown that CCS can account for up to 55 percent of the emissions reductions needed to stabilize and ultimately reduce atmospheric concentrations of CO_2.

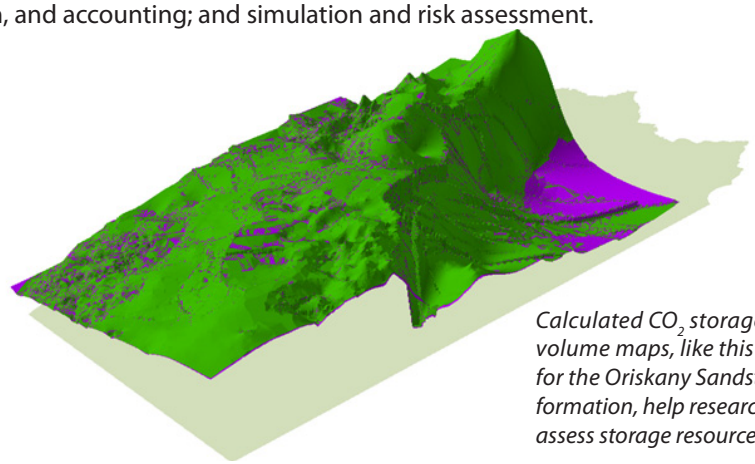
NETL's Carbon Storage Program is readying CCS technologies for widespread commercial deployment by 2020. The program's goals are:

- By 2015, develop technologies that can separate, capture, transport, and store CO_2 with a less than 10 percent increase in energy costs.
- By 2015, develop technologies to help industry predict CO_2 storage capacity in geologic formations with a ± 30 percent margin of error.
- By 2015, develop technologies to verify that 99 percent of injected CO_2 remains in injection zones.
- By 2020, complete a series of best practices manuals for site selection, characterization, and operations and closure practices.

Core R&D Under NETL's Carbon Storage Program

NETL's is conducting a range of projects under the Carbon Storage Program's Core R&D element, one of three program elements that also include Infrastructure and Global Collaborations. Members of the NETL-Regional University Alliance (NETL-RUA) collaborate with NETL's Office of Research and Development (ORD) on these projects.

ORD's activities involve applied laboratory and pilot-scale experiments as well as numerical modeling. Projects encompass three of five Core R&D technical focus areas for CCS technology and protocol development: geologic storage; monitoring, verification, and accounting; and simulation and risk assessment.



Calculated CO_2 storage volume maps, like this one for the Oriskany Sandstone formation, help researchers assess storage resources.

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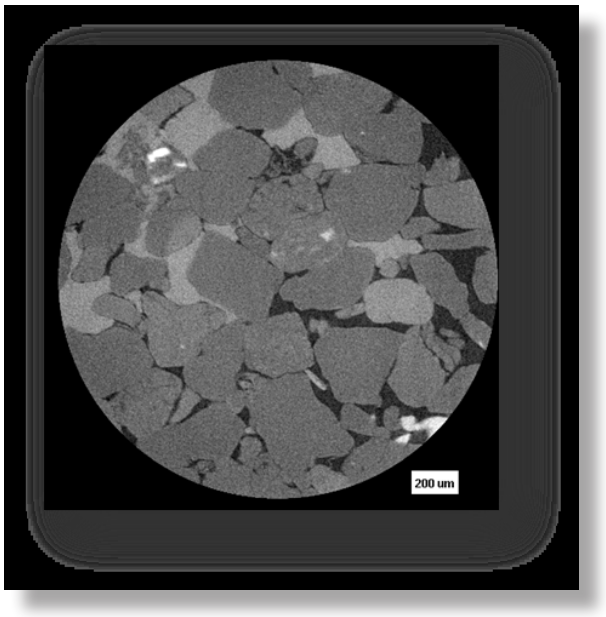
U.S. DEPARTMENT OF ENERGY

Proposed Research

Research tasks are organized into five theme areas to address key research needs as outlined in NETL's *Carbon Sequestration Program: Technology Program Plan*.

- **Flow properties of reservoirs and seals**—Assessing the impact of chemical reactions and geomechanics on injectivity and storage permanence.
- **Fundamental processes and properties**—Improving our ability to predict capacity, injectivity, and storage permanence by better understanding reaction kinetics and fluid properties.
- **Estimates of storage potential**—Evaluating, improving, and expanding current methodologies for predicting storage capacity to improve accuracy and allow for use in alternative reservoirs.
- **Verifying storage performance**—Improving subsurface and near-surface monitoring technologies through verify storage permanence and track plume movement.
- **Geospatial data resources**—Developing resources to improve access to geospatial data for public use (NATCARB), as well as for researchers.



A micro-CT image of a sample reservoir rock structure.

ORD Objectives and Expected Benefits Under Core R&D

Research being conducted by ORD in collaboration with NETL-RUA will enable the development of technologies that will significantly improve the safety and permanence of geologic CO_2 storage.

Objectives include:

- **Geologic storage**—Refine methodology for capacity estimation and determine the geochemical and geo-mechanical impacts on capacity, injectivity, and storage permanence.
- **Monitoring, verification, and accounting**—Develop technologies and techniques to track CO_2, brine, and pressure plume migration in the deep subsurface, into groundwater aquifers, and into the atmosphere.
- **Simulation and risk assessment**—Improve predictions for chemical and biological processes that can impact porosity and permeability of reservoirs and natural seals.

Expected benefits include:

- **Multiphase flow in reservoirs and seals**—Improved models for predicting reservoir performance (injectivity, capacity, and permanence) based on mineralogy, mechanical stresses, water chemistry, and microbial community. Site-specific assessments of reservoir and seal flow properties.
- **Fundamental processes and properties**—Improved representation of fluid properties and reaction kinetics relevant to storage performance.
- **Estimates of storage potential**—A capacity-estimates model adapted to unconventional storage systems (shales, coal seams, etc.) and CO_2 enhanced oil recovery.
- **Verifying storage permanence**—Methods to ensure storage permanence, including detecting leakage to the surface or groundwater aquifer; tracking CO_2 and pressure plume mitigation in the deep subsurface; and evaluating caprock integrity.
- **Geospatial data resources**—Continuous improvement of the National Carbon Sequestration Database and Geographic Information System (NATCARB), NATCARB website, and future editions of the *Carbon Storage Atlas of the United States and Canada*, as well as the development of a geospatial database for research use.