

CARBON STORAGE PROGRAM



NETL

NATIONAL ENERGY TECHNOLOGY LABORATORY

OVERVIEW

The National Energy Technology Lab (NETL) is driving innovation that will help enable a carbon-free power sector by 2035 and a net-zero carbon-emissions economy by 2050. As we work toward that goal with a progressively greater reliance on renewable energy resources, fossil fuels currently account for a significant percentage of U.S. energy consumption due to their abundance, high-energy density, and the relatively low cost associated with production, safe transport, and use. To ensure energy security for our nation's future, an environmentally sustainable approach is required to ensure that the CO₂ injected into the subsurface remains safely and permanently in the reservoir. Our primary focus is to further develop a carbon management approach which is capable of lowering industrial emissions in a manner that is both economical and publicly acceptable.

Our Carbon Storage Program is focused on developing and advancing technologies to enable safe, cost-effective, permanent geologic storage of CO₂ in different depositional environments. The program also serves to increase the understanding of the effectiveness of advanced technologies in different geologic reservoirs appropriate for CO₂ storage.

These storage sites include, but are not limited to: saline formations; oil reservoirs; natural gas reservoirs; basalt formations; and organic-rich shale basins. Ultimately, the Carbon Storage Program will enable us to better understand how CO₂ behaves in the earth's subsurface. These objectives are key to increasing confidence in safe, effective, and permanent geologic CO₂ storage.

OBJECTIVE

The overall objective of the Carbon Storage Program is to develop and advance carbon capture and storage (CCS) technologies both onshore and offshore that will significantly improve the effectiveness of the technologies, reduce the cost of implementation, and be ready for widespread commercial deployment. Technical and economic barriers must be addressed and data generated to inform regulators and industry on the safety and performance of CCS. NETL capabilities have been employed to pursue CCS goals in two technology component areas: (1) advanced storage research and development; and (2) storage infrastructure. A third area, risk and integration tools, crosscuts the first two areas.

The Advanced Storage R&D Technology Component

involves both applied laboratory and pilot-scale research focused on developing new technologies and systems for geologic storage. Advanced Storage R&D encompasses three technology areas: Wellbore Integrity and Mitigation; Storage Complex Efficiency and Security; and Monitoring, Verification, Accounting and Assessment (MVA). The Wellbore Integrity and Mitigation is focused on developing new tools to measure well integrity and new materials, tools and techniques to repair well issues. Storage Complex Efficiency and Security is focused on developing advanced models and methods to reduce computational time and uncertainty as well as improve understanding of geomechanical and geochemical impacts. Efforts within MVA are designed to confirm permanent storage of CO₂ in geologic formations, both onshore and offshore, through multilevel monitoring programs that are both reliable and cost-effective. The level of technology R&D conducted in the *Core R&D efforts ranges from laboratory- to pilot-scale activities. Technologies are normally developed in the Core R&D projects to the point where individual companies, utilities, and other business entities are able to design, manufacture, and build the equipment and instrumentation needed to implement or commercialize the processes.

**To learn more about NETL's Core R&D efforts, visit netl.doe.gov and click on "Research and Programs."*

The four regional initiatives to accelerate carbon capture, use and storage (CCUS) include:

- Regional Initiative to Accelerate CCUS Deployment in the Midwest and Northeastern USA
- Carbon Utilization and Storage Partnership of the Western United States
- Southeast Regional Carbon Utilization and Storage Partnership
- Plains Carbon Dioxide Reduction Partnership Initiative to Accelerate CCUS Deployment



To better understand geologic formations, researchers at NETL's High-Pressure Immersion and Reactive Transport Laboratory in Albany are studying subsurface systems.

The Risk and Integration Tools

such as the National Risk Assessment Partnership (NRAP), the Energy Data Exchange (EDX), and the CO₂ Storage Prospective Resource Estimation Excel Analysis (CO₂-SCREEN) tool support both the Advanced Storage and Infrastructure components. NRAP is a U.S. Department of Energy (DOE) multi-national laboratory initiative that harnesses core capabilities developed across the national laboratories to carry out science-based predictions of the critical behavior of engineered-natural systems that can be applied to risk assessment for safe, long-term CO₂ storage. NRAP collaborates with the Storage Infrastructure field projects to obtain field data to develop and validate their protocols and predictive tools. EDX is an online system providing access to information and data relevant to fossil and renewable energy systems. EDX coordinates historical and current data and information from a wide variety of sources to serve as a research and rapid response tool for a wide variety of users. CO₂-SCREEN was developed by NETL to screen saline formations by applying DOE methods and equations to provide a dependable method for calculating prospective CO₂ storage resources. CO₂-SCREEN is a tool within EDX.

The Carbon Storage Program

supports several integrated domestic and international activities to ensure CCS technologies are cost-effective and commercially available. The program relies on its own capabilities as well as the national laboratory network to complement the program approach to reducing CO₂ emissions. NETL provides the DOE Fossil Energy R&D Program an onsite location where fundamental and applied fossil energy R&D is performed by government engineers and scientists. The Carbon Storage Program also relies on international collaborations. DOE is partnering with several international organizations, such as the International Energy Agency's Greenhouse Gas R&D Programme and the Carbon Sequestration Leadership Forum. DOE is also directly engaged in several large-scale CCS demonstration projects around the world, spanning five continents.

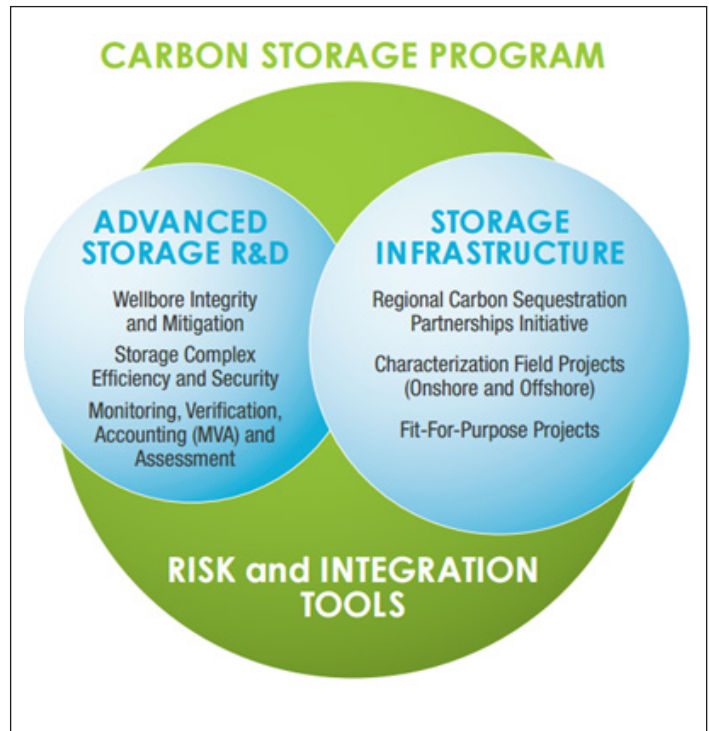
Carbon Storage Atlas V: The primary purpose of the fifth edition of DOE’s Carbon Storage Atlas is to update the CO₂ storage potential for the United States and to provide updated information on the RCSPs’ large-scale field activities, small-scale field projects, and site characterization projects.

RESOURCES

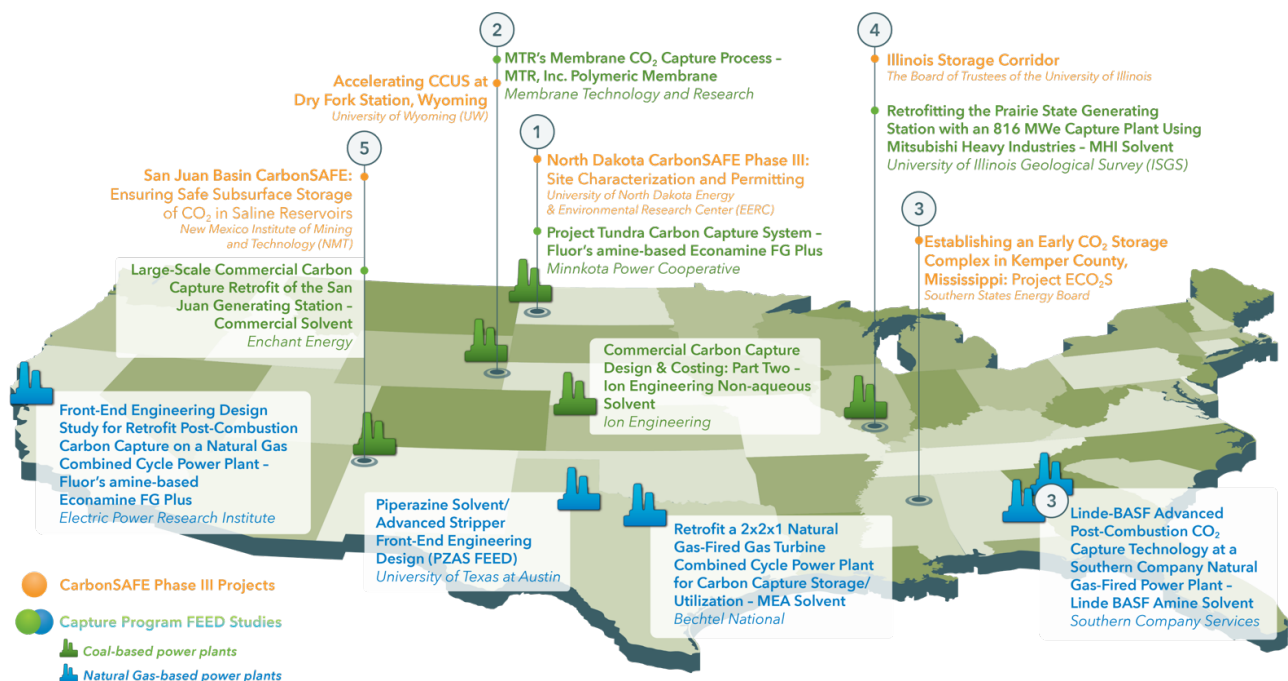
NETL’s Carbon Storage Program has a distinguished record of working with universities and initiatives that include other national laboratories, international organizations, regional partnerships, and government engineers and scientists. Additional information about that history of cooperation and new opportunities for collaboration can be found on NETL’s Carbon Storage Program website: <https://go.usa.gov/xsBEw>.

The Energy Data eXchange (EDX) is an online coordination and collaboration platform developed by NETL to support subsurface energy research. Efficient and timely research has always been driven by access to existing information, the ability to quickly share and coordinate data with collaborators, and the ability to disseminate the results of work products as they develop. EDX supports these needs, offering timely access and coordination to data for researchers that require information associated with subsurface energy sources. EDX is utilized as a platform for rapidly disseminating NETL’s research products, to include our monthly Carbon Storage Newsletter. More information is available on the EDX website: <https://edx.netl.doe.gov/>.

NETL’s **CCS Database** includes active, proposed, and terminated CCS projects worldwide. The information is taken from publicly available sources to provide convenient access to information regarding efforts by various industries, public groups, and governments toward development and eventual deployment of CCS technology. Information about NETL’s CCS Database is available at <https://go.usa.gov/xsBEw>.



CONVERGENCE OF CAPTURE AND STORAGE INFRASTRUCTURE CARBONSAFE PHASE III & CAPTURE FUNDED FEED STUDIES LOCATIONS





NETL is a [U.S. Department of Energy](#) national laboratory that drives innovation and delivers technological solutions for an environmentally sustainable and prosperous energy future. Through its world-class scientists, engineers and research facilities, NETL is ensuring affordable, abundant and reliable energy that drives a robust economy and national security, while developing technologies to manage carbon across the full life cycle, enabling environmental sustainability for all Americans, advancing environmental justice and revitalizing the economies of disadvantaged communities.

Leveraging the power of workforce inclusivity and diversity, highly skilled innovators at NETL's research laboratories in Albany, Oregon; Morgantown, West Virginia; and Pittsburgh, Pennsylvania conduct a broad range of research activities that support DOE's mission to ensure America's security and prosperity by addressing its energy and environmental challenges through transformative science and technology solutions.

NETL lends its expertise toward achieving a carbon-free power sector by 2035 and a net-zero economy by 2050 while catalyzing economic revitalization, creating good-paying jobs and supporting workers in energy communities, especially hard-hit coal, oil and gas, and power plant communities across the country. One of the most rewarding aspects of NETL's research is that our innovations and technologies have the potential to improve people's lives in meaningful ways.

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