NETL ANNUAL ACCOMPLISHMENTS 2023

DRIVING INNOVATION DELIVERING SOLUTIONS

U.S. DEPARTMENT OF ENERGY | Fossil Energy and Carbon Management | NETL NATIONAL ENERGY TECHNOLOGY LABORATORY

11.20.2023

MESSAGE FROM THE ACTING DIRECTOR

For more than a century, NETL has been driving innovation and delivering solutions for an environmentally sustainable and prosperous energy future by ensuring affordable, abundant, and reliable energy that drives a robust economy and strengthens our national security. Today, our talented researchers and project partners from across the Nation are advancing cutting-edge technologies to minimize the climate and environmental impacts of fossil fuels and industrial processes, while working to achieve net-zero emissions across the U.S. economy. To that end, we are also enabling international collaboration and domestic engagement with communities and stakeholders to realize tangible economic, environmental and jobs benefits from the advancement and operation of successful projects.

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 the DOE's mission to ensure America's security and prosperity by addressing its energy and environmental challenges through transformative science and technology solutions. Complementing this hands-on research is a cadre of technology and project management, procurement, legal and National Environmental Policy Act professionals who work with extramural partners to help advance and commercialize those critical technology solutions. Together, our work is driving innovation and delivering solutions that impact the Nation and the world.

I am pleased to present the ***National Energy Technology Laboratory's (NETL) FY 2023 Annual Accomplishments***.

These accomplishments demonstrate the impressive impact of NETL, made possible through research aligned with the Department of Energy's Office of Fossil Energy and Carbon Management's strategic direction, which is comprised of seven research priorities:

- Hydrogen with Carbon Management
- Carbon Capture
- Carbon Conversion
- Carbon Dioxide Removal
- Carbon Storage and Transport
- Domestic Critical Minerals Production
- Methane Mitigation

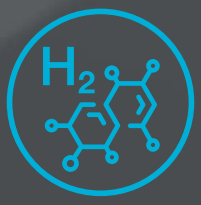
Our innovations support and inform energy strategies that can turn the challenges of climate change into opportunities to strengthen the U.S. energy and manufacturing sectors while also creating good-paying jobs, spurring economic revitalization, remediating environmental degradation, and supporting energy workers in communities across the country.

I am proud of the innovations and discoveries from our laboratory that are building a foundation for new industries with new jobs and informing energy policies that stimulate our economy, ensure our security, and protect our health. This critical work is forging a bright future for future generations by enhancing the Nation's energy security while decarbonizing our economy. Thank you for supporting our work!

Sincerely,

Sean I. Plasynski, Ph.D.,
Acting Director
National Energy Technology Laboratory (NETL)

RESEARCH PRIORITIES



HYDROGEN WITH CARBON MANAGEMENT

FECM will invest in research, development, demonstration and deployment (RDD&D) for hydrogen production coupled with carbon capture and storage using sustainably sourced carbon-based feedstocks (e.g., biomass, fossil fuels and plastics, including wastes). FECM will invest in the advancement and utility-scale demonstration of hydrogen supply and utilization technologies like hydrogen storage, reversible solid oxide fuel cells and 100% hydrogen-fired turbines, supporting DOE's Hydrogen Shot target.

CARBON CAPTURE

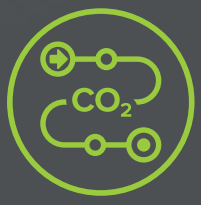
FECM will invest in RDD&D to reduce the cost, increase the efficacy and advance the deployment of commercial-scale carbon capture technologies coupled to permanent storage in the power and industrial sectors.

CARBON CONVERSION

FECM will accelerate capabilities for large-scale conversion of CO_2 into products that advance net-zero and justice goals, facilitated by markets for CO_2 as a feedstock. FECM will help accelerate the path to a net-zero refinery, advance mineral carbonation approaches and expand the availability of synthetic fuels.

CARBON DIOXIDE REMOVAL (CDR)

FECM will invest in a diverse set of CDR approaches to support DOE's Carbon Negative Shot of just, sustainable and scalable CDR at costs below $100/net metric ton of CO_2-equivalent (CO_2e). This full suite of CDR approaches will help address emissions from extremely hard-to-decarbonize sectors and eventually address legacy emissions. Near-term focus areas include advancing direct air capture coupled to durable storage and creating a framework for developing the full portfolio of CDR methods.



CARBON STORAGE AND TRANSPORT

FECM will establish the foundation for a successful carbon transport and storage industry, supporting the transition from carbon production to storage, by making advancements in storage technologies and transport mechanisms, providing technical assistance in Class VI well permitting and supporting large-scale transport and storage facilities and regional hubs.

DOMESTIC CRITICAL MINERALS (CM) PRODUCTION

FECM will help grow an environmentally and economically sustainable, secure, diverse and resilient domestic CM and carbon ore resource recovery industry, especially coupled to remediation of legacy wastes. FECM will support demonstrations from extraction and remediation to processing and refining for building a strong CM supply chain while creating good-paying jobs.

METHANE MITIGATION

FECM will invest in minimizing the environmental impacts associated with the extraction of fossil energy sources produced in the United States, including coal, oil and natural gas, with a specific focus on methane mitigation. FECM plans to advance cost-effective technology to efficiently identify, quantify and predict methane leaks across sectors more efficiently and improve accessibility and reliability of methane emissions data.

ACCOMPLISHMENTS POSTERS

Green represents accomplishments performed under NETL's Research and Innovation Center (RIC).
Blue represents accomplishments performed under extramural projects.

RESEARCH PRIORITIES:

HYDROGEN WITH CARBON MANAGEMENT | CARBON CAPTURE | CARBON CONVERSION | CARBON DIOXIDE REMOVAL | CARBON STORAGE AND TRANSPORT | DOMESTIC CRITICAL MINERALS PRODUCTION | METHANE MITIGATION

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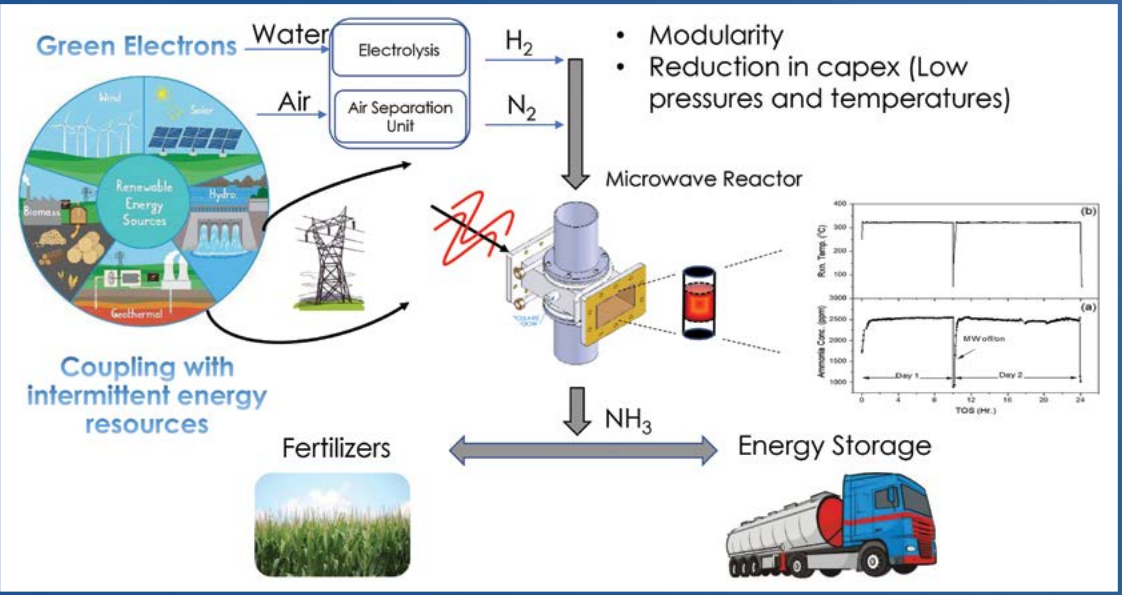
HYDROGEN WITH CARBON MANAGEMENT · CARBON CAPTURE · CARBON CONVERSION · CARBON DIOXIDE REMOVAL · CARBON STORAGE AND TRANSPORT · DOMESTIC CRITICAL MINERALS PRODUCTION · METHANE MITIGATION

IMPROVED AMMONIA PRODUCTION PROCESS DEVELOPED IN SUCCESSFUL NETL PARTNERSHIP

NETL partnership produces ammonia at low temperatures and near-ambient pressures.



NETL ammonia (NH_3) microwave process enabling point-of-use manufacturing.

Combining cutting-edge microwave reaction science research at NETL with specialized catalyst development from West Virginia University and reactor manufacturing experience from Malachite Technologies created the award-winning Microwave Ammonia Synthesis (MAS) process.

- Conventional reaction processes often rely on conduction, convection and radiation to heat catalyst vessels at high pressures to synthesize ammonia.
- The MAS process, however, uniquely uses microwaves to selectively heat the catalyst directly.
- The new technology is energy efficient, cost effective and capable of using intermittent renewable power.
- The MAS process is also modular, with smaller-scale ammonia plants that allow for greater flexibility.
- Ammonia can be used as a hydrogen carrier, which will increase in importance as the nation transitions to a clean hydrogen economy.

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HYDROGEN WITH CARBON MANAGEMENT

PERFORMERS

NATIONAL ENERGY TECHNOLOGY LABORATORY

WestVirginiaUniversity.

Malachite Technologies

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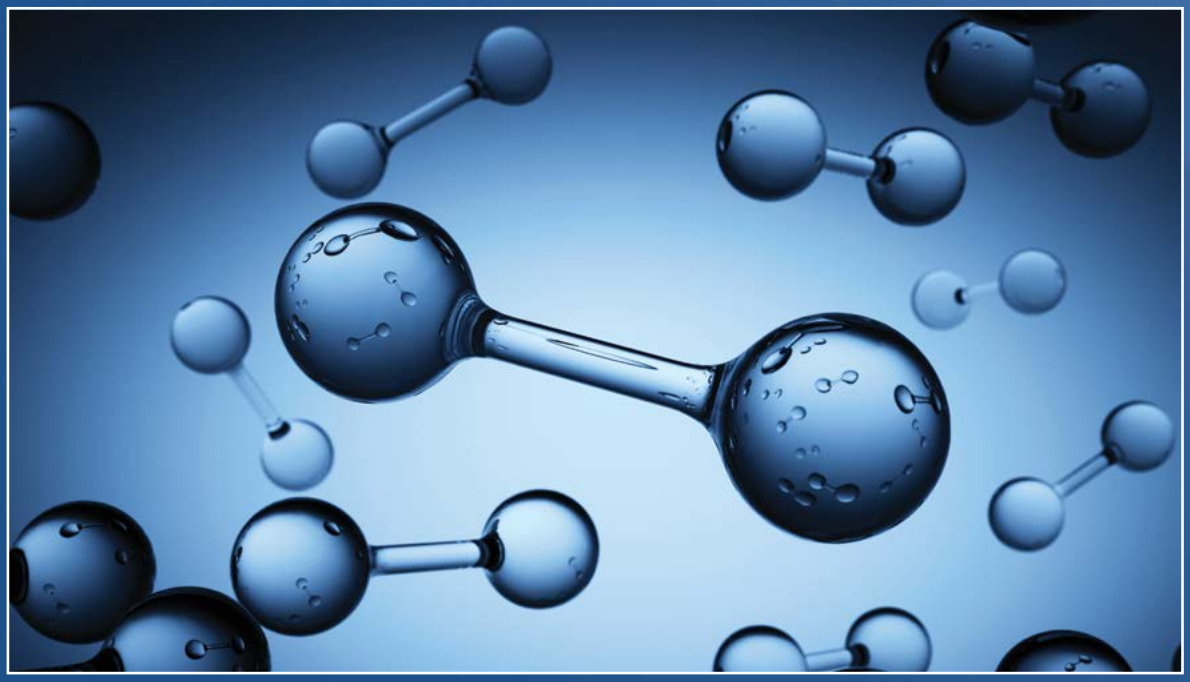
NETL HYDROGEN SAFETY REVIEW REPORT RELEASED

New report reviews and summarizes the unique safety challenges involved with producing and utilizing hydrogen for power generation at a large scale.



Hydrogen power can be a key contributor to a net-zero carbon emissions energy sector, but there are many technological and cost challenges associated with handling hydrogen safely. This new NETL report is intended as a valuable resource in planning for future hydrogen projects to assist in building safe, sustainable bulk hydrogen production and power generation infrastructure.

- The report reviews the unique safety issues of solid oxide fuel cells and gas turbines fueled from hydrogen and of hydrogen production from fuel reforming, gasification, chemical looping and solid oxide electrolysis cells.
- The report includes the approaches presently used to address hydrogen safety and identifies some potential technology advancements to improve the performance and reduce the cost for safety monitoring.

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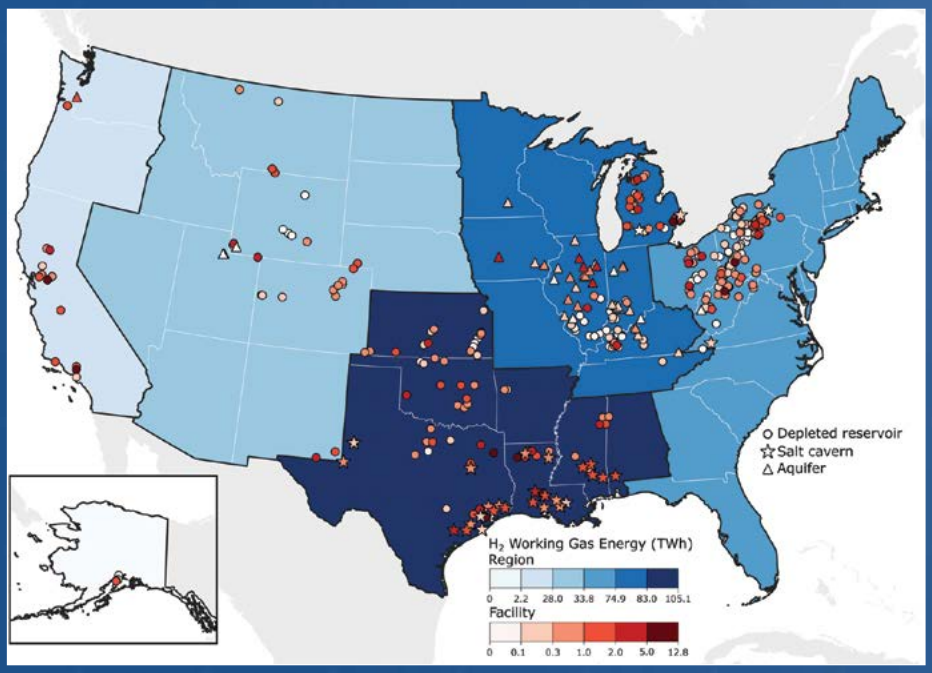
NETL RELEASES STUDY ON HYDROGEN STORAGE POTENTIAL IN EXISTING UNDERGROUND GAS FACILITIES

Study shows existing U.S. underground gas storage (UGS) facilities can viably store hydrogen-methane blends.



Estimated working-gas energy (TWh) of pure (i.e., 100%) H_2 in U.S. UGS facilities (light to dark red). UGS facility storage-formation types are designated by symbol shape. Shaded regions (light to dark blue) represent total working-gas energy (TWh) of 100% H_2 storage by the natural gas storage reporting regions used by the U.S. Energy Information Agency (South Central, Midwest, East, Mountain, Pacific, and Alaska).

During times of low demand, power providers store excess gas. Then, during periods of high demand, the stored gas is used to meet the increased energy needs.

- The research team characterized the hydrogen storage potential of UGS facilities in the U.S. and calculated the viability of blending hydrogen with the methane currently contained in the geologic formations.
- The study found that over 70% of UGS facilities can store hydrogen blends of up to 20% and still meet their current energy demand.
- This finding confirms that creating hydrogen during periods of energy surplus and storing it underground could be a long-duration, low-emission, energy storage option.

RESEARCH PRIORITY

H_2 HYDROGEN WITH CARBON MANAGEMENT

PERFORMERS

NETL NATIONAL ENERGY TECHNOLOGY LABORATORY

Pacific Northwest NATIONAL LABORATORY

Lawrence Livermore National Laboratory

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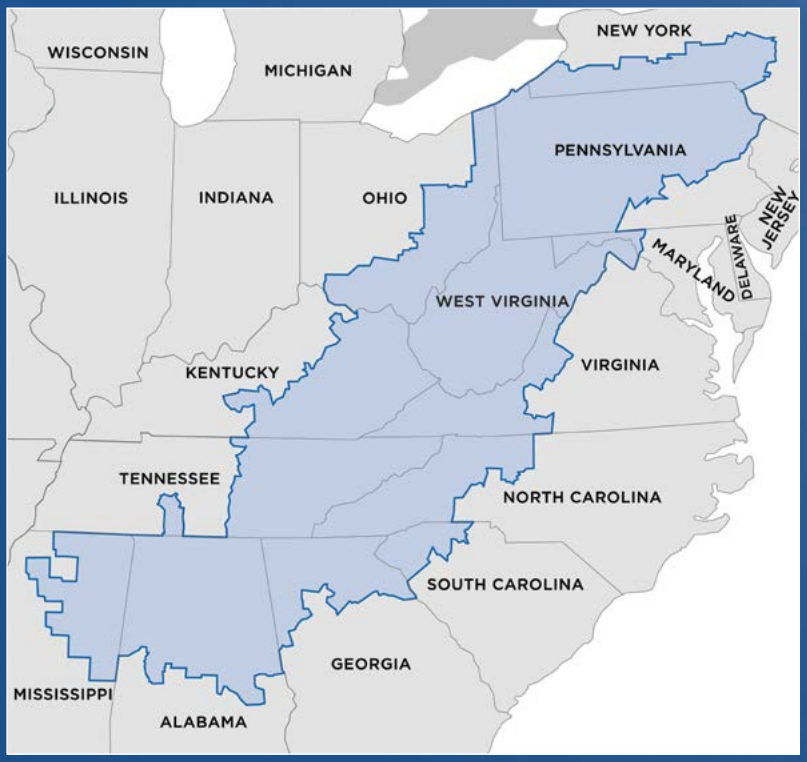
NETL STUDY ASSESSES APPALACHIAN REGION'S POTENTIAL TO DEVELOP A HYDROGEN ECONOMY

Appalachia is well suited to be a clean energy hydrogen hub due to natural gas resources, infrastructure, storage capacity, workforce and industrial demand.



Appalachian region.

NETL evaluated how the region's current natural gas transportation and storage infrastructure might be adapted for use with hydrogen.

- The study shows that Appalachia can lead a clean energy revolution by using natural gas with carbon capture and storage to produce, transport, store, and utilize hydrogen.
- Developing an Appalachian hydrogen ecosystem will create new clean energy jobs, revitalize distressed communities, advance environmental justice and help achieve the administration's goal of a net-zero carbon emissions in the electricity sector by 2035.
- The report is titled "Appalachian Hydrogen Infrastructure Analysis."

RESEARCH PRIORITY

H_2 HYDROGEN WITH CARBON MANAGEMENT

PERFORMER

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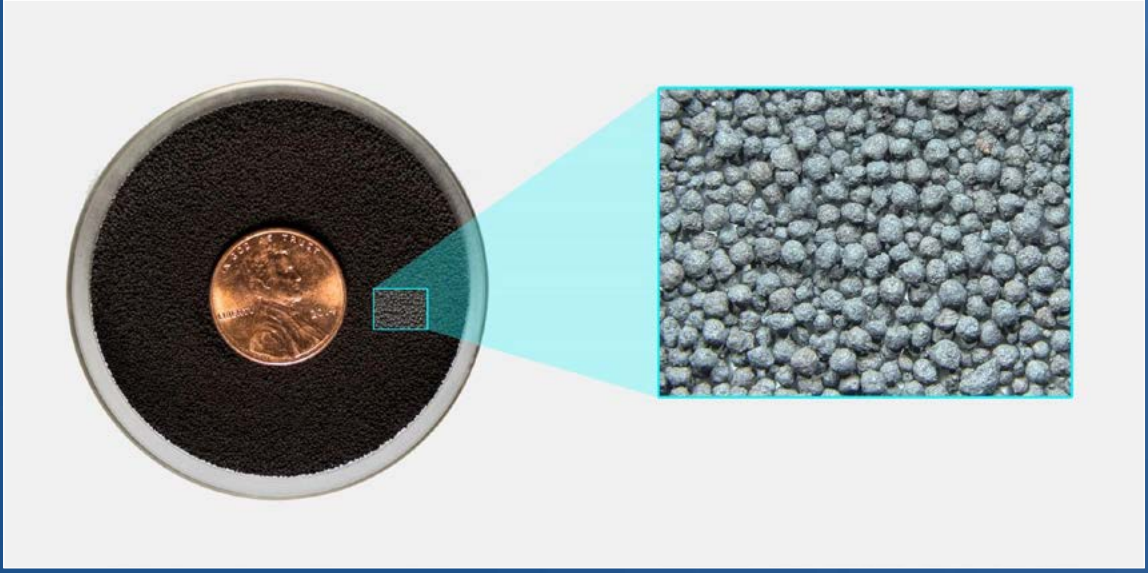
NETL-Developed Oxygen Carrier Selected for Canadian Government-Industry Chemical Looping Combustion Project

Advanced material with unparalleled durability was selected by Natural Resources Canada (NRCan) and industry collaborator Hatch for use in a novel chemical looping combustion (CLC) reactor.



The microscopic structure of NETL's more durable oxygen carriers can be seen here in the expanded view.

CLC is an advanced energy technology that delivers affordable and dependable power, process heat, steam and synthesis gas while reducing environmental impacts due to in-situ carbon dioxide (CO_2) separation and capture capability.

- Oxygen carrier durability is a major technical barrier to CLC success, but NETL has made significant strides toward mitigating this issue through its oxygen carrier research.
- The selection of NETL oxygen carriers for this project underscores the Lab's expertise in materials development.
- This project has the potential to push CLC technology closer toward commercialization, enabling higher power plant efficiencies while simultaneously mitigating CO_2 emissions.

RESEARCH PRIORITY

HYDROGEN WITH CARBON MANAGEMENT

PERFORMERS

NATIONAL ENERGY TECHNOLOGY LABORATORY

HATCH

Natural Resources Canada

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NETL-SUPPORTED SOLID OXIDE ELECTROLYSIS CELL PRODUCES HYDROGEN AT HIGH PRESSURES

Technology builds upon earlier extraplanetary success to create a stable, robust and low-cost system that produces hydrogen at high pressures — an important step toward the commercialization of clean energy devices.

OxEon's solid oxide electrolysis cell.

Solid oxide electrolysis cells (SOECs) produce hydrogen by splitting it from water using an electric current. The newly developed SOEC is based on an electrolysis stack used during NASA's Mars 2020 Perseverance Rover mission developed by OxEon Energy.

- The NETL-supported project operated an SOEC that produced hydrogen at elevated pressures of 2 to 3 bar.
- SOEC hydrogen production at elevated pressures lowers costs — a key to commercializing new clean energy devices.
- The project also addressed common challenges faced by the SOEC industry by implementing process and cell component modifications to demonstrate improved cell performance and stability, oxidation recovery of the fuel electrode, performance stability through thermal cycles, and evaluation of the effect of contaminants.

RESEARCH PRIORITY

H_2 HYDROGEN WITH CARBON MANAGEMENT

PERFORMERS

Pacific Northwest NATIONAL LABORATORY

OxEon energy

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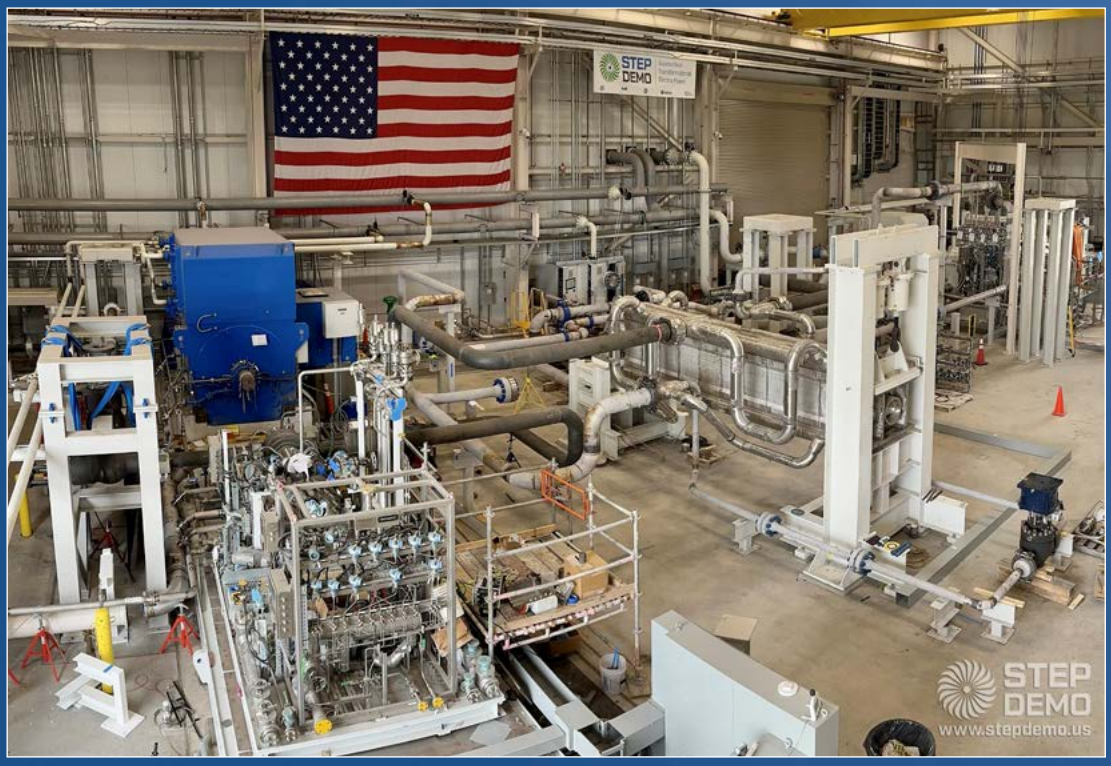
PILOT PLANT ACCELERATES SUPERCRITICAL CARBON DIOXIDE TECHNOLOGY

The Supercritical Transformational Electric Power (STEP) pilot plant has achieved supercritical carbon dioxide (sCO_2) conditions in the main compressor — a significant milestone for the NETL-sponsored project.



Supercritical Transformation Electric Power 10 MWe pilot plant.

Traditional power plants typically use steam in turbines to produce electricity, but sCO_2 can also be used. sCO_2 acts like a gas while having the density of a liquid, resulting in increased efficiency, lower cost of electricity, and reduced water consumption.

- A single desk-sized sCO_2 turbine can power 10,000 homes, creating a new generation of power plants that will use less fuel, produce fewer greenhouse gas emissions, and require less space.
- A sCO_2 power cycle is also very flexible, making it well suited for integrating with renewable energy sources.
- This pilot plant is the world's largest indirect-fired sCO_2 power cycle test facility.

RESEARCH PRIORITY

HYDROGEN WITH CARBON MANAGEMENT

PERFORMERS

SwRI

GE

GTI ENERGY

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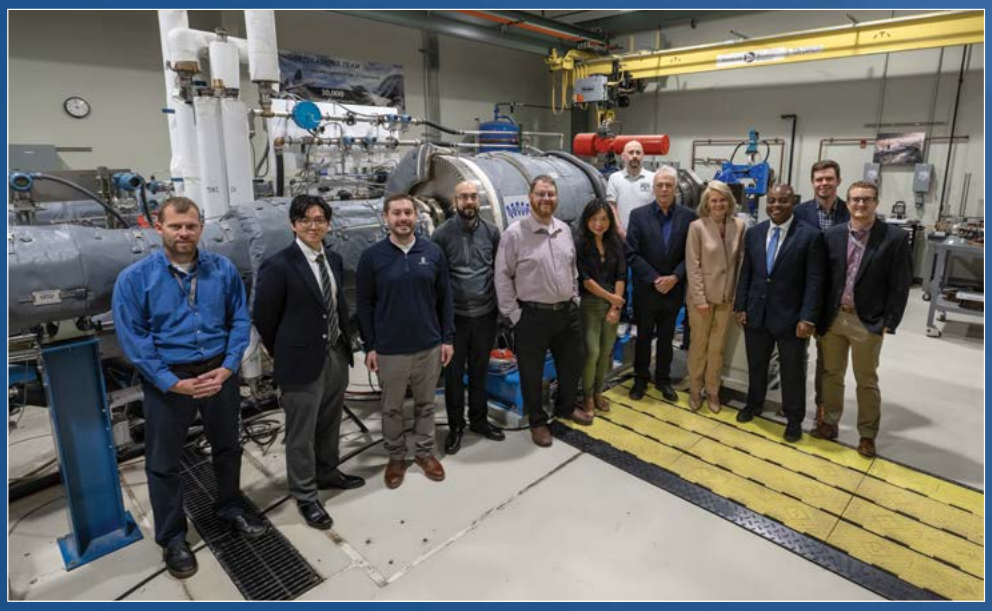
TURBINE COMPONENT DESIGN ADVANCED AT PENN STATE FACILITY THROUGH NETL COLLABORATION

The National Experimental Turbine initiative (NExT), with NETL support and oversight, has made major advancements in turbine design.



NETL federal project managers, Patcharin Burke and Richard Dalton, visited the START Lab facility along with Rich Dennis, the Lab's Advanced Turbines technology manager, in 2022. Photo Credit: Kelby Hochreither

The NExT initiative is located at the Pennsylvania State University Steady Thermal Aero Research Turbine (START) Lab. In this milestone achievement, the NExT team performed the successful integration and operation of additively manufactured, cooled turbine blades at engine-representative conditions.

- Additive manufacturing provides a faster way, at a relatively lower cost, to develop components that must operate in extreme environments and withstand high temperatures.
- The demonstration was the first of its kind at any U.S. university turbine facility.
- DOE's investment in the START facility and the NExT design enables the U.S. to have an unmatched testing capability for improving cooling designs that will lead to improved turbine performance across the turbine fleet.

RESEARCH PRIORITY

HYDROGEN WITH CARBON MANAGEMENT

PERFORMERS

AGILIS Revolutionary Insight

Pratt & Whitney A United Technologies Company

SIEMENS energy

Solar Turbines A Caterpillar Company

Honeywell

PennState

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THE UNIVERSITY COALITION FOR BASIC AND APPLIED FOSSIL ENERGY RESEARCH AND DEVELOPMENT WRAPS UP SUCCESSFUL SEVEN-YEAR COLLABORATION WITH NETL

Over $16 million of federal funding was awarded to 43 advanced energy research projects.

Terence Musho, an associate professor with West Virginia University, presenting during a UCFER project meeting.

The University Coalition for Basic and Applied Fossil Energy Research and Development (UCFER) was established in 2015 to promote collaboration among NETL and 15 universities, ultimately developing a broad portfolio in research areas such as carbon capture, carbon conversion, fuel cell technologies, and direct air capture.

NETL played a major role in each UCFER project, including:

- Consultation, technical guidance, sample analysis and sample preparation.
- Financial support for internships at various universities.
- Access to NETL's state-of-the-art facilities for coalition participants.

RESEARCH PRIORITIES

- HYDROGEN WITH CARBON MANAGEMENT
- CARBON CAPTURE
- CARBON CONVERSION
- CARBON DIOXIDE REMOVAL
- CARBON STORAGE AND TRANSPORT
- DOMESTIC CRITICAL MINERALS PRODUCTION
- METHANE MITIGATION

PERFORMERS

PennState

Other university performers can be found using the link below.

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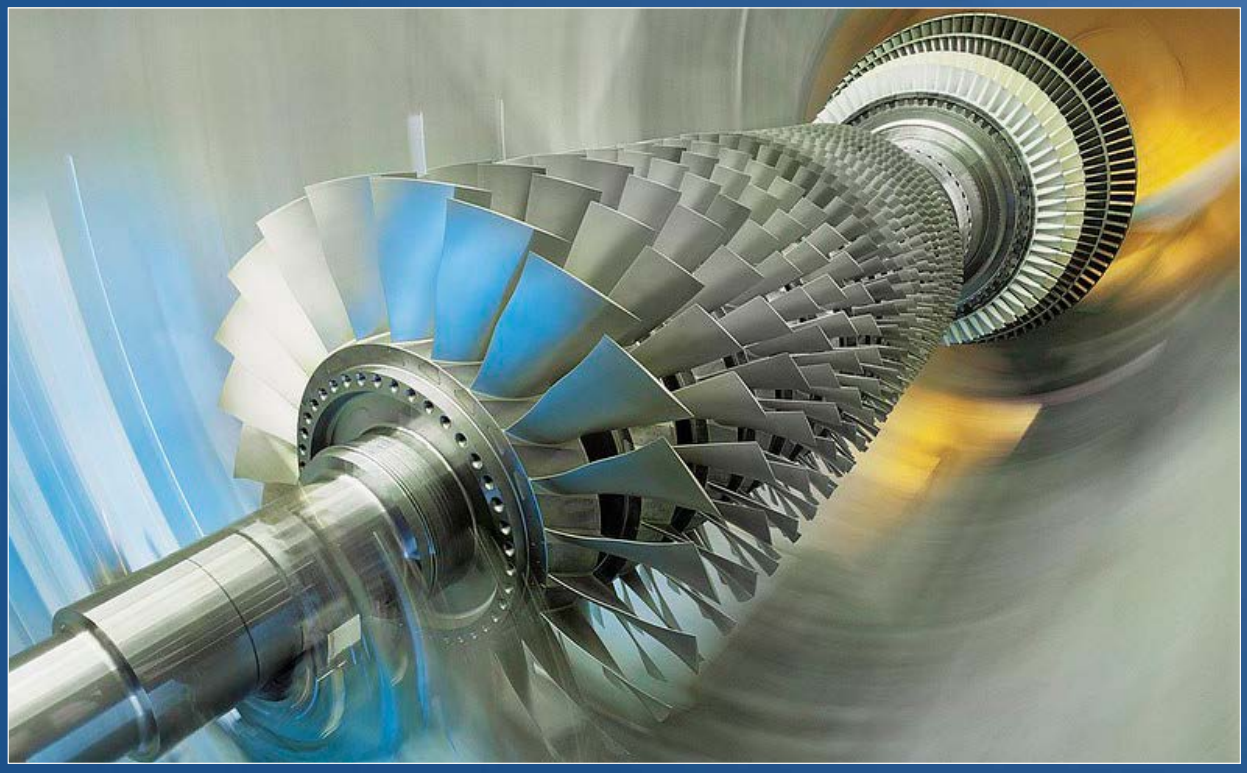
NETL PUBLISHES STUDY ON FLEXIBILITY OF COMMERCIAL NATURAL GAS POWER GENERATION

Report characterizes flexibility attributes — both performance and cost — of nine common commercial natural gas-fueled electricity generating units.



In the near term, dispatchable gas-fired generators must provide reliable, on-demand power to accommodate increasing renewable generation.

- However, these fossil-fueled technologies are a significant source of carbon dioxide emissions.
- As a result, accurate cost and performance data on gas-fired units is required to identify least-cost approaches as the nation pursues a decarbonized energy sector by 2035.
- The report is titled "Cost and Performance Baseline for Fossil Energy Plants, Volume 5: Natural Gas Electricity Generating Units for Flexible Operation," published May 5, 2023.

RESEARCH PRIORITY

CARBON CAPTURE

PERFORMER

NATIONAL ENERGY TECHNOLOGY LABORATORY

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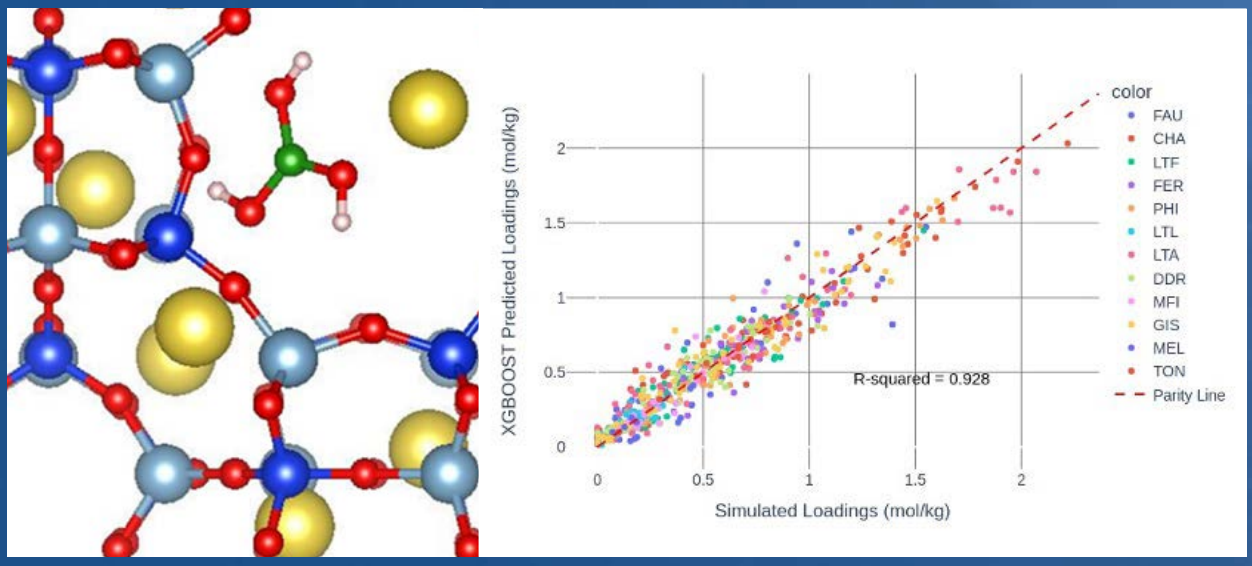
NETL USES MACHINE LEARNING METHODS TO DESIGN WATER TREATMENT SORBENTS

Using machine learning techniques, NETL designs sorbents synthesized from fly ash to treat water leaching from coal combustion waste.



Machine learning methods were used to design zeolite sorbents optimized for boric acid uptake.

Sorbents such as zeolites can adsorb harmful substances in coal waste leachate. However, new sorbents can be expensive and time-consuming to design and create.

- In this project, physics-based simulations were used to predict adsorption of a pollutant in zeolites.
- A machine learning regression model was fit to the adsorption database.
- The machine-learned model was used with a genetic algorithm to design the optimal zeolite sorbent for boron adsorption for an individual impoundment site.
- The methods developed by NETL can be applied to many applications in materials design.

RESEARCH PRIORITY

CARBON CAPTURE

PERFORMER

NATIONAL ENERGY TECHNOLOGY LABORATORY

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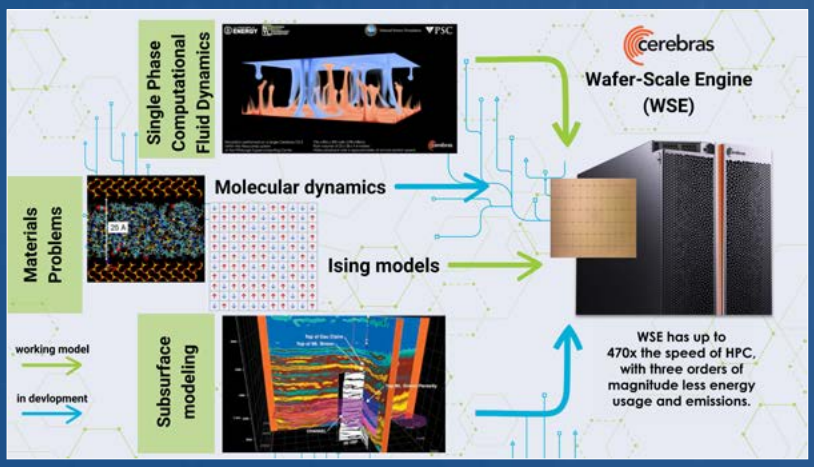
NETL, CEREBRAS AND PITTSBURGH SUPERCOMPUTING CENTER WORK TOGETHER TO DEVELOP A NEW FUTURE FOR HIGH PERFORMANCE COMPUTING ON WAFER-SCALE ENGINES

The impact will be transformative, improving modeling and simulation solution times by several hundred times over current methods.



A programming interface such as the wafer-scale engine (WSE) field equation application (WFA) programming interface allows different computer programs to communicate — in this case with the revolutionary WSE designed by Cerebras Systems Inc.to tackle tough artificial intelligence (AI) problems.

- Applications for the WFA to accelerate and support include materials modeling, molecular dynamics and AI-accelerated scientific modeling, among others.
- The WSE allows for dramatic acceleration of existing scientific models on unique and emerging hardware, marching down the path to a new exascale computing method.
- With continued investment in software and hardware development, it will be possible to run the majority of NETL's computational methods on the WSE, dramatically increasing productivity as well as optimizing the operation of facilities and systems.
- NETL and Cerebras are now pursuing the first commercial application to run on the WSE through the NETL WFA interface.

RESEARCH PRIORITIES

- CARBON CAPTURE
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- CARBON STORAGE AND TRANSPORT
- HYDROGEN WITH CARBON MANAGEMENT
- DOMESTIC CRITICAL MINERALS PRODUCTION
- METHANE MITIGATION

PERFORMERS

NATIONAL ENERGY TECHNOLOGY LABORATORY

PITTSBURGH SUPERCOMPUTING CENTER

cerebras

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NETL INNOVATION EFFICIENTLY CONVERTS CARBON DIOXIDE INTO ACETATE

NETL researchers have developed a biocatalyst with 99% efficiency to convert carbon dioxide (CO_2) into acetate for use in a variety of popular products.

NETL researchers, left to right, Sam Flett, Djuna Gulliver and Dan Ross at work in their lab.

Biological conversion of CO_2 is an attractive option to reduce carbon emissions. Biocatalysts are natural substances that use enzymes from biological sources to improve the rate of chemical reactions.

- When NETL's innovative biocatalyst is applied to CO_2, all the CO_2 is converted into acetate, a widely used chemical.
- The NETL biocatalyst technology requires little energy.
- The biocatalyst also has a unique adaptability to feedstocks and resistance to contamination challenges, making it a promising target for large-scale deployment.
- Adaptability to different feedstocks is key to converting CO_2 found in waste gas streams from ethanol plants, syngas production and blue hydrogen production.

RESEARCH PRIORITY

CARBON CONVERSION

PERFORMER

NATIONAL ENERGY TECHNOLOGY LABORATORY

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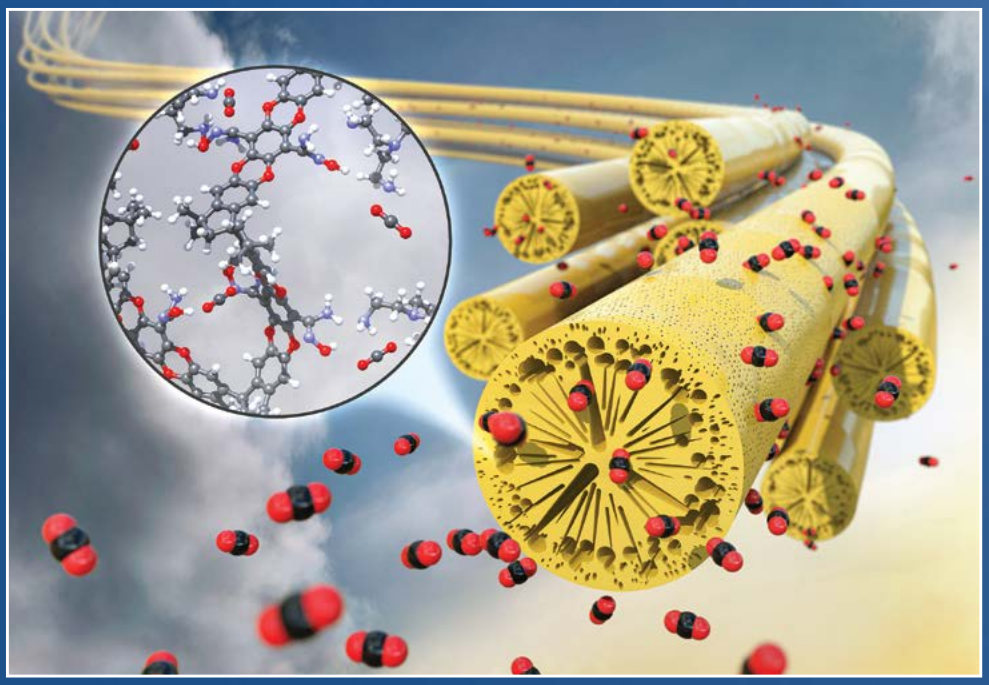
NETL ENGAGES IN FOUR-YEAR PLAN TO ADVANCE DIRECT AIR CAPTURE TECHNOLOGY

Project integrates expertise from NETL's extensive materials design, computational materials design, computation fluid dynamics, and process system design research portfolios to advance a cutting-edge technology to remove carbon dioxide (CO_2) from the atmosphere.



DAC, which removes CO_2 directly from the atmosphere, will be critical for counterbalancing hard-to-decarbonize sectors.

Direct air capture (DAC) technologies usesorbents to pull CO_2 directly out of the air in contrast to point source capture processes that capture the greenhouse gas at power plants or industrial facilities.

- The NETL team is collaborating to use an innovative sorbent developed by NETL in an efficient and low pressure-drop adsorption process.
- In a DAC process, CO_2 is collected from the sorbent during the regeneration step, which often relies on heating the sorbent to release the CO_2.
- With NETL's sorbent formulation, regeneration can occur at comparatively low temperatures that are less likely to cause sorbent degradation.
- The goal of the project is to license the materials and system to entities capable of scaling up the technology and performing commercial DAC operations.

RESEARCH PRIORITY

CARBON DIOXIDE REMOVAL

PERFORMER

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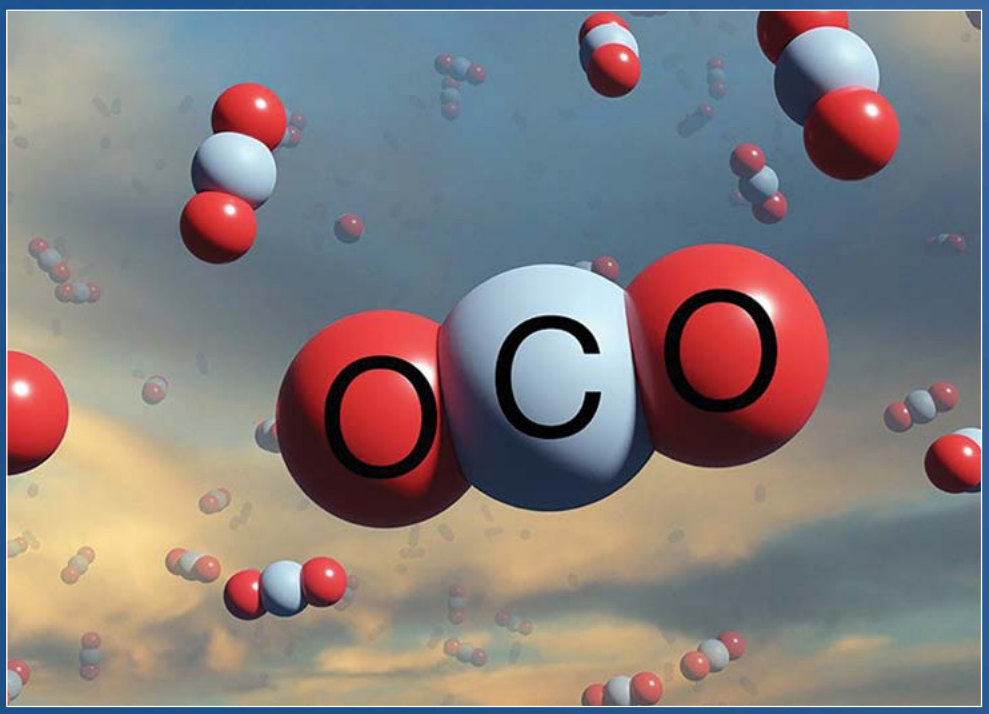
NETL TEAM USES MICROWAVES TO REDUCE ENERGY FOR DIRECT AIR CAPTURE OF CARBON DIOXIDE

Innovative process could substantially reduce expensive water and energy requirements of some promising direct air capture technologies.



Sorbents are materials used to absorb or adsorb liquids or gases such as carbon dioxide (CO_2). Sorbents must be regenerated after use to remain effective and so that additional CO_2 can be collected for storage or utilization.

- Traditional thermal desorption regeneration processes require costly amounts of water and energy.
- However, the NETL technology regenerates sorbents in a microwave-accelerated process.
- Microwave-assisted CO_2 desorption from solid sorbents can replace thermal desorption approaches, translating to lower energy consumption.
- The NETL process also does not require steam regeneration and a heat exchanger — reducing water requirements.

RESEARCH PRIORITY

CARBON DIOXIDE REMOVAL

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NATIONAL ENERGY TECHNOLOGY LABORATORY

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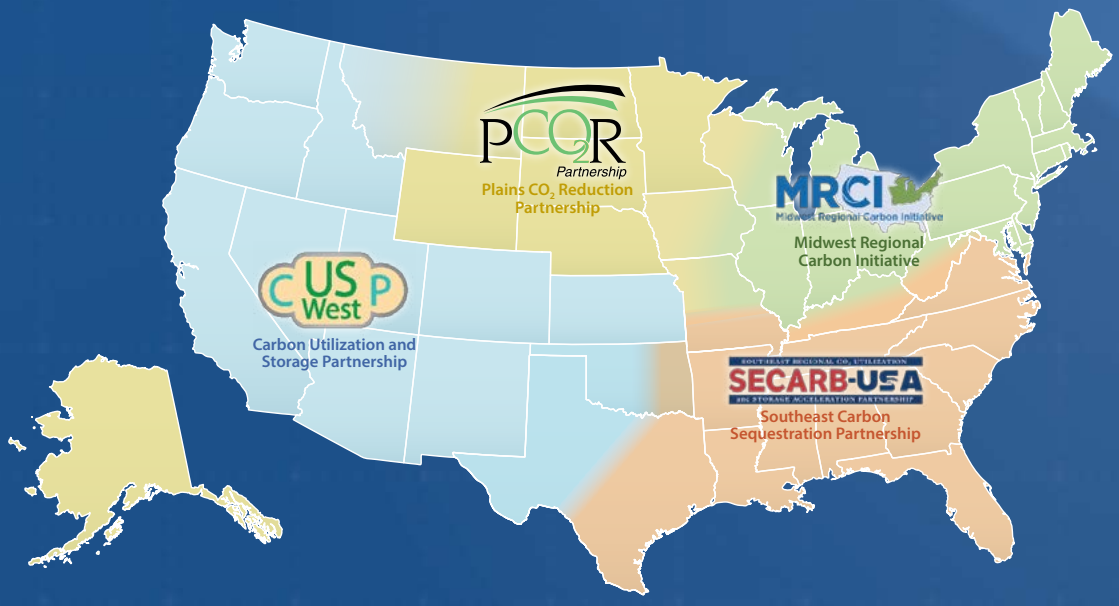
CARBON MANAGEMENT REGIONAL INITIATIVES PAVING WAY FOR SUSTAINABLE FUTURE

Four Regional Initiatives funded by NETL are identifying and addressing nationwide challenges facing commercial deployment of carbon capture, utilization and storage (CCUS).



NETL's Regional Initiatives program.

DOE's regional CCUS effort began with the Regional Carbon Sequestration Partnerships (RCSP) Initiative, which lasted from 2003 through 2019. To build on these successes, DOE competitively selected four new research and development (R&D) projects collectively known as the "Regional Initiatives" (RIs). Each of these regional projects engages stakeholders in academia, industry and government agencies.

- The four RIs are providing a broad range of technical, procedural, and outreach assistance to CCUS efforts across the U.S.
- The projects have generated and shared a tremendous amount of critical technical information, enabling the development and eventual large-scale deployment of carbon management technologies.
- Participants in the RIs have published more than 300 abstracts, papers and posters related to CCUS deployment, participated in more than 400 presentations and panel sessions around the country, and conducted more than 100 CCUS workshops.

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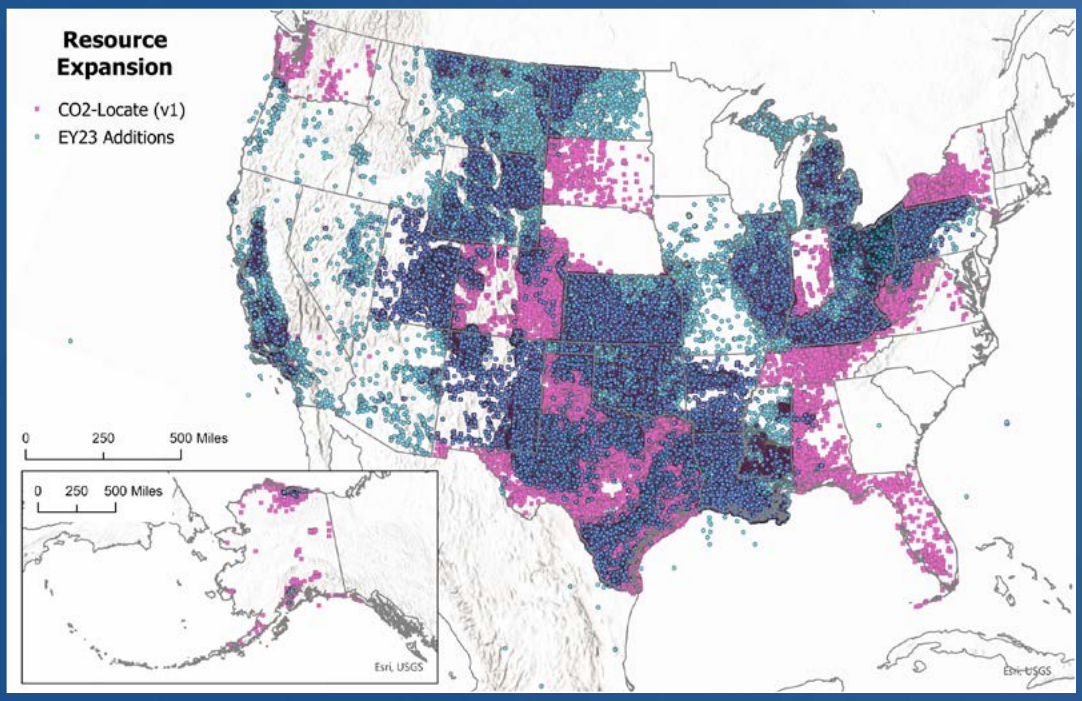
NETL CO_2-LOCATE DATABASE TO ENHANCE CARBON CAPTURE AND STORAGE PROJECTS

CO_2-Locate is an up-to-date, national, and integrated resource built to support safe and optimal Carbon Capture and Storage (CCS) site selection and inform risk mitigation.



The CO_2-Locate Database empowers researchers, industry, regulators, and other key stakeholders to easily access and visualize wellbore data across the nation.

Safe and effective CCS requires data to inform safe and environmentally prudent decision-making. A key element of understanding safe site selection for geologic carbon storage and permitting is existing wellbore infrastructure. CO_2-Locate provides this resource in a digital, usable format.

- CO_2-Locate is a national well database, with integrated well resources from state and federal entities.
- The first year of the effort resulted in over 3 million wells from 11 public resources, which has since been expanded to more than 40 resources and 7 million public well records.
- CO_2-Locate also features spatial summaries of key wellbore characteristics such as age, depth, and status derived from proprietary resources.

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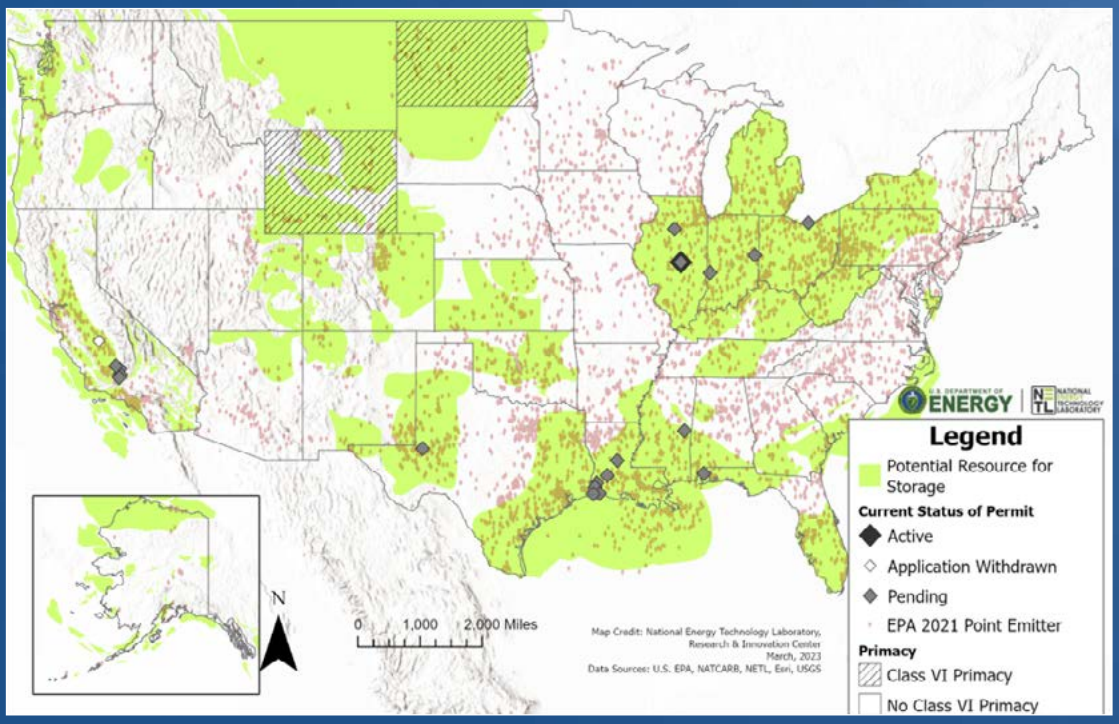
NETL DATA PORTAL WILL ACCELERATE COMPLETION OF PERMIT APPLICATIONS FOR SUBSURFACE CARBON STORAGE WELLS

Providing datasets in one location creates a valuable tool for permit applicants, operators and researchers.



Class VI wells are used to inject carbon dioxide (CO_2) into deep geologic formations for permanent storage. Permit applications require extensive data to ensure these wells are appropriately sited, constructed, tested, monitored, funded and closed.

- The NETL Class VI Data Support Tool Geodatabase leverages data from the Carbon Storage Open Database, the Energy Data eXchange (EDX), the U.S. Geological Survey and other sources.
- The data can help produce narratives and maps required for site characterization in a Class VI permit.
- The geodatabase is free and publicly available on EDX, NETL's virtual data collaboration and curation platform for data-driven technology development.

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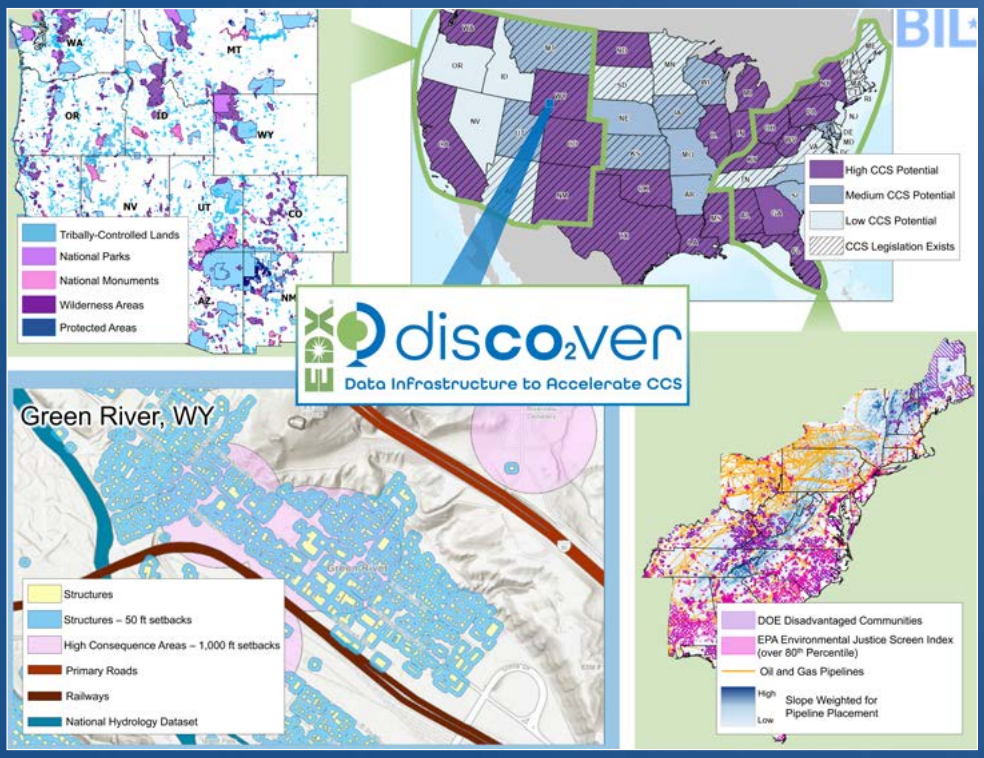
NETL DEVELOPS PIPELINE ROUTE PLANNING DATABASE TO GUIDE CARBON DIOXIDE TRANSPORT DECISIONS

The Pipeline Route Planning Database guides decisions on safely transporting carbon dioxide (CO_2) from capture sources to underground storage sites and conversion facilities.



Strategically planning safe and sustainable routes for transporting CO_2 is a critical priority in achieving a greenhouse gas-neutral economy by 2050.

- Planning infrastructure for CO_2 transport depends on evaluating a variety of regulatory, topographic, and potential risk variables.
- NETL has developed tools to facilitate and optimize a robust, national-scale CO_2 transportation infrastructure.
- The new database provides a curated compilation of critical decision factors, such as slope, public and energy infrastructure that provide planners with information about areas that are favorable for transportation routes.

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NETL OVERSEES LANDMARK RESEARCH TO PROTECT CAPROCK INTEGRITY AT CARBON STORAGE SITES

Research studied important subsurface behaviors to ensure that carbon dioxide (CO_2) stored underground remains safely and securely sequestered in the subsurface.

Research was conducted at a depth of approximately 1,200 feet below the surface at the Mont Terri Underground Research Laboratory in Switzerland.

Carbon storage reservoirs are layers of porous rock underneath a layer of impermeable rock that acts as a seal. The caprock prevents injected CO_2 from returning to the surface or migrating to aquifers that provide drinking water.

- The work completed by NETL partners at the Lawrence Berkeley National Laboratory and Rice University marked the first time a mixture of CO_2 and water was injected into a fault.
- The injection caused a controlled CO_2 -induced fault slip to determine its impact on the caprock that prevents CO_2 leakage.
- The experiment provided significant observations about fault slip and strain related to CO_2 injection and the effect that CO_2 -induced fault activation has on storage reservoir caprocks zones.

RESEARCH PRIORITY

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NETL RELEASES UPDATED VERSION OF CARBON DIOXIDE TRANSPORT COST MODEL

Updated model helps decision makers, planners, and researchers calculate costs for installation and operation of new underground carbon dioxide (CO_2) pipelines.

NETL has released an updated version of its popular open-source tool.

Supported by the U.S. Department of Energy's Office of Fossil Energy and Carbon Management (FECM) and NETL, the open-source CO_2 Transport Cost Model is an Excel-based tool that estimates revenues and capital, operating and financing costs for transporting liquid-phase CO_2 by pipeline.

- The newest version includes an updated algorithm for calculating the pipeline capital costs and improvements in the financial component.
- Users can specify the number of years the pipeline operates and several financial variables to calculate the capital, operating and financing costs for the pipeline.
- Development of the tool is part of NETL's work to facilitate and optimize a robust, national-scale CO_2 transport infrastructure.

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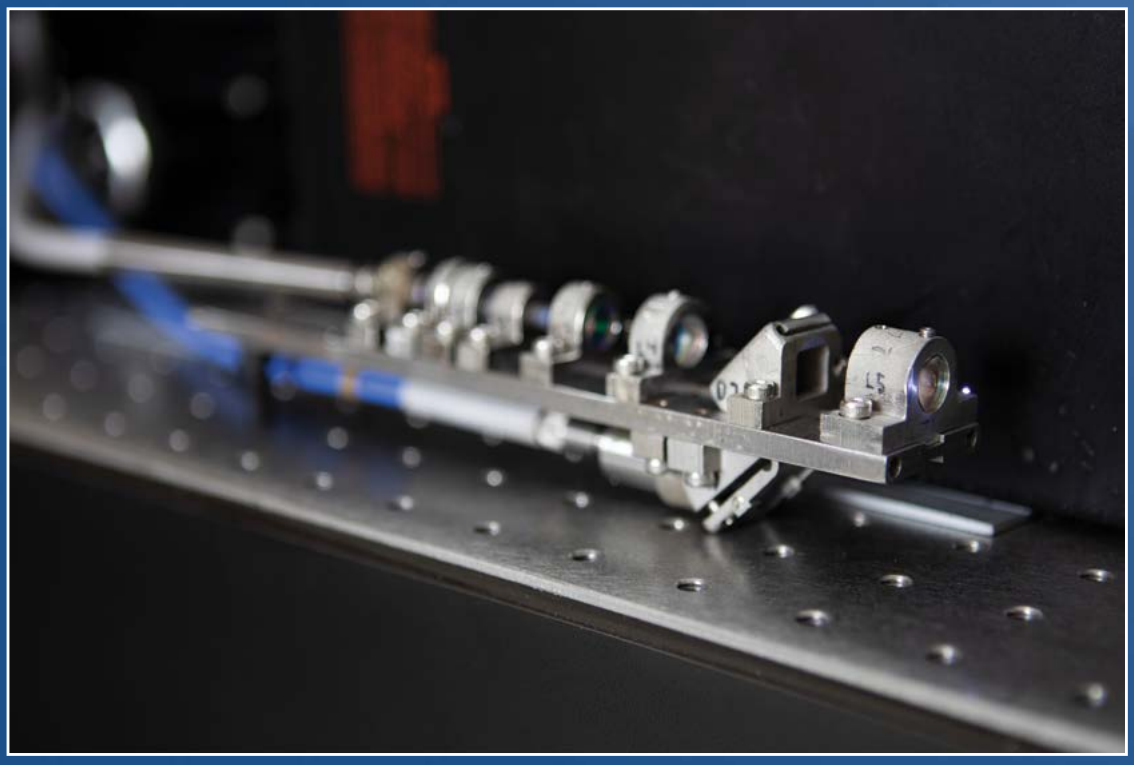
NETL SHOWCASES LASER-BASED FLUID MEASUREMENT SENSOR AND SYSTEM AT NATIONAL LAB ACCELERATOR PITCH EVENT

NETL researchers presented the Lab's work on new laser-based optical sensors with potential uses in subsurface fluid management.



The annual National Lab Accelerator (NLA) Pitch Event pitches national lab technology and business models to the investor and business community. All national labs are invited to participate.

- This year, NETL showcased "Harsh Environment Laser-Based Optical Sensor for Remote Applications."
- The sensor system induces laser sparks within subsurface fluids or on submerged solids in the subsurface.
- The new system takes the lab to the field and into the subsurface, allowing geochemists to complete rapid and targeted elemental analysis of subsurface fluids.

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NETL SUPPORTS AIRBORNE TECHNOLOGY TO MONITOR CARBON STORAGE SITES

A team led by NETL researchers completed a first-of-its-kind electromagnetic survey to monitor carbon dioxide (CO_2) at a subsurface geologic storage site.

Airborne surveying of subsurface geologic storage site.

Large-scale CO_2 sequestration must be closely monitored to ensure the greenhouse gas does not leak to the surface or contaminate underground aquifers that supply drinking water.

- Currently, special trucks are used to generate seismic waves and collect the reflected subsurface seismic data. This technique is expensive. A cheaper solution to image subsurface CO_2 plumes was needed.
- Airborne electromagnetic surveys require far less time and can be completed at lower cost.
- Airborne surveys also eliminate the need to negotiate agreements with landowners to bring equipment to a site when a survey needs to be completed.

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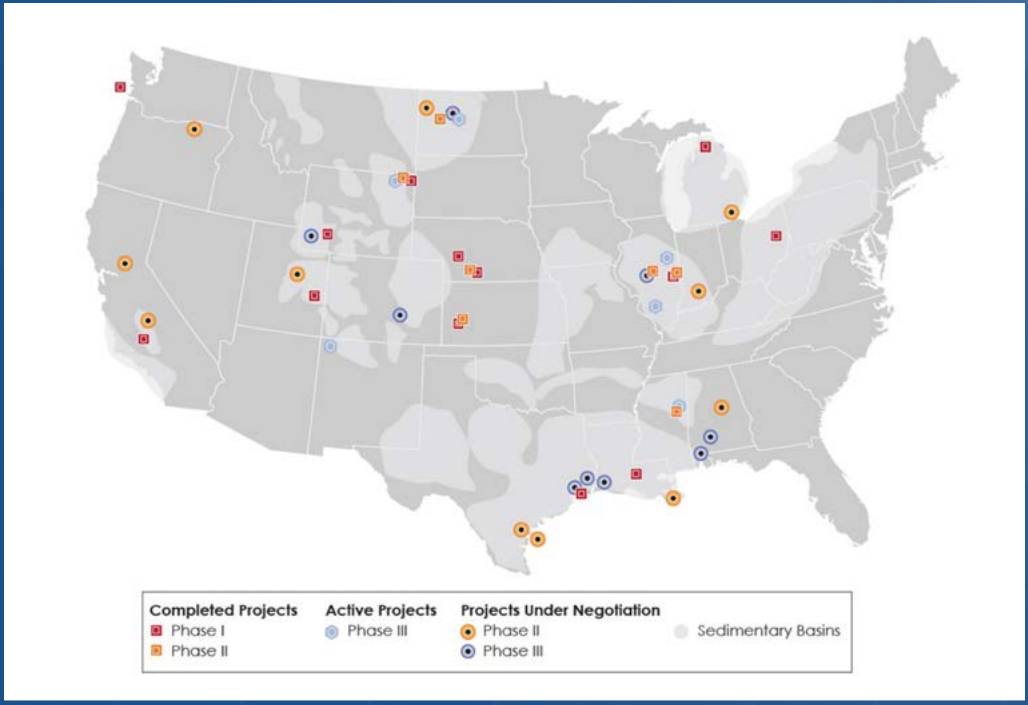
NETL-LED CARBON STORAGE ASSURANCE FACILITY ENTERPRISE INITIATIVE MAKING PROGRESS TOWARD COMMERCIALIZATION

Technologies developed by Carbon Storage Assurance Facility Enterprise (CarbonSAFE) will create new job opportunities while addressing the effects of climate change.



CarbonSAFE Initiative Projects are being funded and launched all over the country.

CarbonSAFE was initiated in 2016 and has funded 24 and is currently negotiating 20 additional projects, with many more to follow. The projects address key gaps on the critical path toward commercial carbon capture and storage (CCS) deployment.

- CarbonSAFE projects aim to permanently store hundreds of millions of tons of CO_2 emissions every year.
- Developing large-scale, commercial carbon storage projects with capacities to securely store more than 50 million metric tons of CO_2 is a key facet of CarbonSAFE.
- The Initiative will reduce technical risk, uncertainty and the cost of commercial-scale saline storage projects.

RESEARCH PRIORITY

CARBON STORAGE AND TRANSPORT

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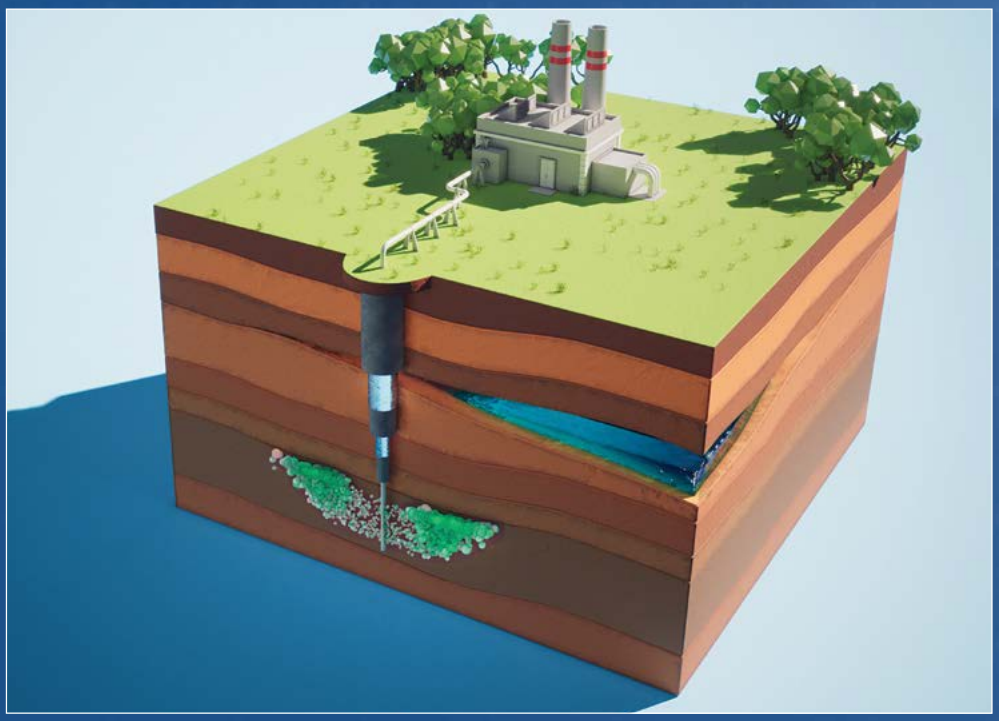
NETL-SUPPORTED PROJECT DEVELOPS DEEP LEARNING TOOL TO HELP ENSURE SAFE CARBON STORAGE

Achieves faster and more accurate real-time monitoring, identifies more seismic events and improves subsurface imaging.



Ensuring safe carbon storage operations is key to achieving a carbon emissions-free economy by 2050.

There is a critical need to determine seismic activity — vibrations in the earth — occurring before, during or after carbon dioxide (CO_2) injection into geologic storage sites.

- Fiber-optic sensing technology called distributed acoustic sensing (DAS) shows great promise as a seismic monitoring tool, but current data processing methods do not fully realize the technology's potential.
- With NETL support, Zanskar Geothermal and Minerals Inc. developed novel deep-learning techniques using artificial neural networks to improve the detectability of DAS signals including local, regional and distant earthquakes.
- The innovative technology could help ensure safe storage of CO_2 at geologic sites.

RESEARCH PRIORITY

CARBON STORAGE AND TRANSPORT

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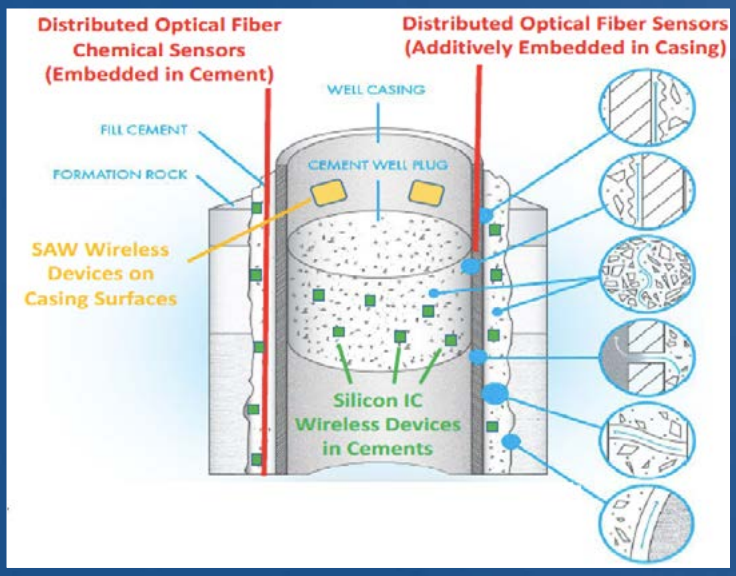
NETL AND PARTNERS DEVELOP EMBEDDED SENSOR TECHNOLOGIES FOR SUBSURFACE WELLBORE INTEGRITY MONITORING

The technologies are critical for wellbore integrity in geologic carbon storage, subsurface natural gas and hydrogen storage and enhanced geothermal systems.



Schematic figure of a suite of complementary, multi-functional embedded sensor technologies for real-time subsurface monitoring of wellbore integrity.

Cement and casing steel are wellbore structural components. Real-time and predictive monitoring of these components can reduce wellbore integrity risks and support broad applications in subsurface activities.

- NETL and partners created a suite of complementary, multi-functional embedded sensor technologies for real-time subsurface monitoring of wellbore integrity, with emphasis on pH and corrosion monitoring of cement and casing steels.
- Thin film sensing layers and integration with sensor devices were pursued in parallel with device development and design efforts to enable the successful chemical sensing of three classes of devices, including optical fiber-based sensors, wireless surface acoustic wave sensors and wireless silicon integrated circuit sensors.
- The project has generated seven filed and issued patents, 22 published journal papers, 13 presentations and 27 conference papers.

PATENTED TECHNOLOGY

RESEARCH PRIORITIES

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- CARBON STORAGE AND TRANSPORT
- METHANE MITIGATION

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ILLINOIS
Illinois State Geological Survey
PRAIRIE RESEARCH INSTITUTE

IOS INTELLIGENT OPTICAL SYSTEMS, INC.

UCLA

University of Pittsburgh

Carnegie Mellon University

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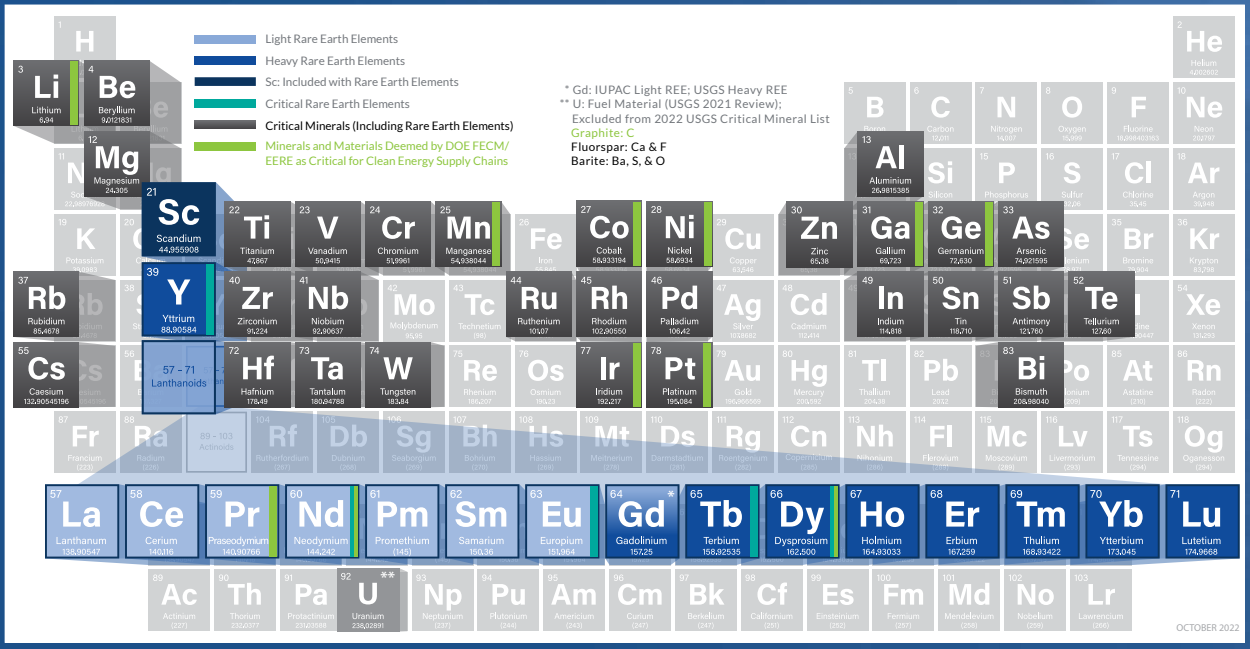
CRITICAL MINERALS AND MATERIALS PROJECTS REACHING IMPORTANT MILESTONES WITH NETL SUPPORT

Six recently selected projects are helping the U.S. move toward a sustainable supply chain of critical minerals and materials (CMMs), including rare earth elements (REEs).



Six projects recently selected by NETL have made great strides toward strengthening the nation's supply chains of valuable CMMs, including REEs.

- Milestones achieved to date include characterizing midstream REE concentrates and conducting value analyses to determine the recoverable value of REEs from acid mine drainage.
- If successful, these projects will revitalize distressed, coal-producing communities with new industries and employment opportunities.
- These projects could also help insulate domestic manufacturers from supply disruptions by creating a sustainable domestic REE and CMM supply chain.

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THE UNIVERSITY OF UTAH®

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UND UNIVERSITY OF NORTH DAKOTA

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NETL DISCOVERS SOURCES OF PLATINUM GROUP METALS AS PART OF A PROCESS FOR ATMOSPHERIC CARBON REMOVAL

This breakthrough has positive implications as an evolving decarbonization technology by developing a sustainable domestic supply chain in conjunction with mineral carbonation waste streams that relies on enhanced mineralization or natural weathering to remove carbon dioxide (CO_2).

Platinum group minerals discovered in samples from the Twin Sisters olivine mine in Whatcom County, Washington.

Ultramafic rocks contain minerals that are naturally highly reactive to CO_2. These rocks are mined and processed to remove atmospheric CO_2 in a practice called mineral carbonation. NETL research focused on pulling critical minerals such as chromium, cobalt, and nickel from these rocks prior to mineral carbonation also discovered valuable quantities of platinum group metals (PGMs).

- Coupling the recovery of PGMs from rocks that are already being mined for CO_2 removal improves the economics of both processes.
- PGMs are crucial catalysts in green hydrogen technologies.
- PGMs are also critical catalytic materials in the manufacturing and automotive sectors.

RESEARCH PRIORITY

DOMESTIC CRITICAL MINERALS PRODUCTION

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NATIONAL ENERGY TECHNOLOGY LABORATORY

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NETL DRIVES RESEARCH TO PRODUCE GRAPHITE FROM CARBON WASTE MATERIALS

Carbon waste materials are exceptional feedstocks for making high-quality graphite suitable for battery and other high-performance applications.

Demand for graphite is expected to soar as U.S. production of electric vehicles increases.

Research projects by NETL and ORNL are developing technologies to quickly and inexpensively produce graphite — an essential component for battery electric vehicles and other green technologies.

- A novel process developed by NETL lowers process temperatures from 3,000 °C down to 1,500 °C and reduces process times from several days to just a few hours.
- Graphite produced with the NETL process has been shown to outperform anodes made with commercially sourced graphite materials.
- Accompanying research at ORNL, supported by NETL, also significantly reduces process temperatures and time, which improves the overall carbon footprint of the graphite manufacturing process.
- The ORNL process allows low-value carbon feedstocks typically considered "non-graphitizable" to be converted directly into high-value graphite.

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DOMESTIC CRITICAL MINERALS PRODUCTION

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OAK RIDGE National Laboratory

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NETL RECEIVES PATENT FOR PROCESS TO PRODUCE GAME-CHANGING CARBON NANOSHEETS

Low-cost NETL process uses coal wastes to produce carbon nanosheets that can lead to safer, fuel-efficient vehicles, durable roads and bridges, and improved computer memory devices.

Carbon nanosheets consist of several atomic layers of carbon that can improve the strength of composite materials and the performance of computer memory devices. However, carbon nanosheets are not widely used in consumer products due to the cost of the material.

- NETL's process reduces production costs by eliminating the need for expensive graphite feedstocks.
- The NETL process instead relies on inexpensive components — coal waste and potassium chloride or sodium chloride (salts).
- These materials are heated in a simple manufacturing process to produce a superior quality graphene-like material that is significantly less expensive.

RESEARCH PRIORITY

DOMESTIC CRITICAL MINERALS PRODUCTION

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RAMACO CARBON

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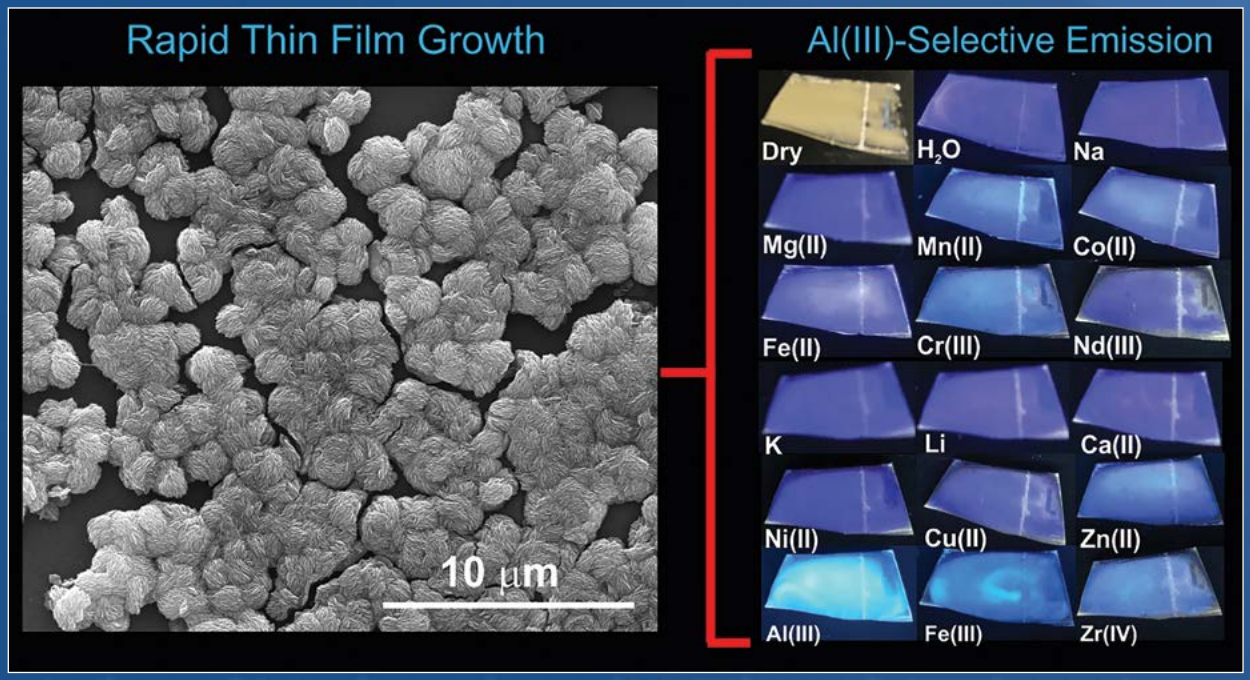
NETL RESEARCHERS CREATE TECHNOLOGY TO DETECT ALUMINUM IMPURITIES IN RARE EARTH ELEMENT SOURCES

Monitoring the effectiveness of aluminum removal processes during rare earth element (REE) production from liquid streams reduces cost, saves time, and helps ensure a high-purity REE product.



Aluminum can interfere with quick and effective extraction of valuable REEs from coal waste byproducts.

- The new NETL-developed sensing film emits blue light in the presence of water that becomes more intense in the presence of aluminum ions.
- It is a simple, scalable method for fabricating high-performance sensors to detect aluminum impurities in REE feedstocks.
- Removing and refining aluminum from liquid sources can also provide an additional domestic source of aluminum.

RESEARCH PRIORITY

DOMESTIC CRITICAL MINERALS PRODUCTION

PERFORMER

NATIONAL ENERGY TECHNOLOGY LABORATORY

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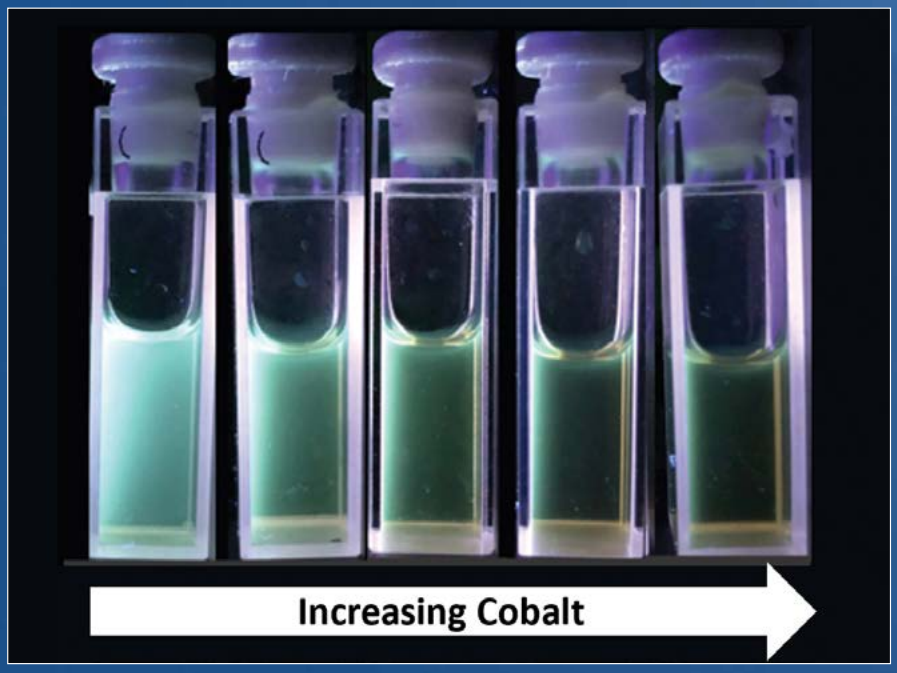
NETL RESEARCHERS DEVELOP TECHNOLOGY TO DETECT A SCARCE CRITICAL MINERAL IN COAL BYPRODUCTS

NETL researchers have created a compact, portable device to detect cobalt at low concentrations in U.S. coal byproducts.



Coal byproducts include materials such as power plant coal ash and acid mine drainage. Cobalt is used for a wide range of applications, from aircraft engine alloys to lithium batteries for electric vehicles and consumer products.

- The NETL technology responds nearly instantly to cobalt in coal byproducts with detection performance comparable to commercial devices but at significantly lower costs.
- The NETL system uses luminescent carbon dots that are co-doped with phosphorus and nitrogen-containing molecules as the sensing materials and is used in liquid streams such as coal ash extractants.
- Using U.S. coal byproducts as a source for cobalt could provide a new domestic resource for a critical mineral that is currently sourced principally from other countries.

RESEARCH PRIORITY

DOMESTIC CRITICAL MINERALS PRODUCTION

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NETL SUPPORTS R&D OF AWARD-WINNING TECHNOLOGY TO DECREASE LITHIUM-ION BATTERY COSTS

This technology represents a domestic, abundant and inexpensive alternative to graphite.

Semplastics received Voltage Award from the Battery Innovation Center.

NETL supported Semplastics R&D of polymer-derived ceramic composite lithium-ion battery anodes that utilize coal as an alternative to graphite.

- The technology received the Voltage Award from the Battery Innovation Center that recognizes an emerging company and/or technology with the highest potential to make a difference in batteries and electrification.
- The technology addresses a growing demand for lithium-ion anode materials used in battery electric vehicles (BEVs), energy storage, and other products.
- If all BEVs utilized this technology, the total global annual BEV production could be addressed with less carbon than two months' operation of a single coal-fired power plant.
- The innovative technology also promotes remediation of existing coal waste sites throughout the U.S.

RESEARCH PRIORITY

DOMESTIC CRITICAL MINERALS PRODUCTION

PERFORMER

Semplastics

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NETL-DEVELOPED ONLINE DATABASE BRINGS ENERGY-RELATED WASTEWATER STREAM DATA TO PUBLIC'S FINGERTIPS

Database also identifies energy-related wastewater streams that are rich in critical minerals (CMs), including rare earth elements (REEs).

NETL's Madison Wenzlick (far left), Alexis Hammond, a Mickey Leland Energy Fellowship summer fellow, and Nicholas Siefert (far right) discussing the recently developed NEWTS database.

The National Energy Water Treatment and Speciation (NEWTS) Database and Dashboard provides information at no cost about toxins, metals and other hazardous materials found in energy-related wastewater streams, which include power plant leachate, acid mine drainage, brackish water and oil and gas produced water.

- The data can be used to mitigate environmental risks and identify possible sources of valuable CMs and REEs.
- Researchers and members of the public can input the data into computer software to develop appropriate remediation steps.
- Future releases will include additional large datasets of energy-related water samples with accompanying compositions.

RESEARCH PRIORITY

DOMESTIC CRITICAL MINERALS PRODUCTION

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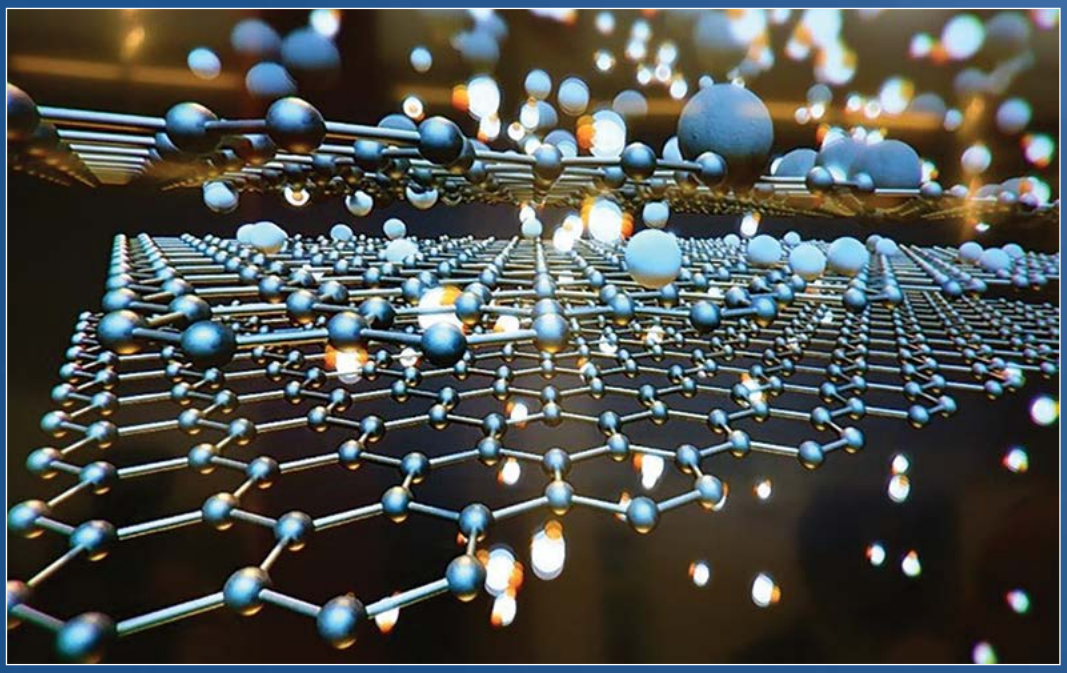
NETL-SUPPORTED TECHNOLOGY TRANSFORMS COAL AND COAL-WASTES INTO NANOMATERIAL 200 TIMES STRONGER THAN STEEL

Production of high-quality graphene on a large scale at a low cost could enable new and disruptive applications for the nanomaterial.



Graphene consists of tightly bonded carbon atoms arranged in a hexagonal lattice.

NETL supported Universal Matter in demonstrating a breakthrough graphene production technology called Flash Joule Heating (FJH), which can transform diverse carbonaceous material feedstocks — including coal and coal-wastes — to low-cost, high-quality graphene.

- Graphene is a versatile carbon-based nanomaterial that is 200 times stronger than steel and can stretch up to 25% of its original length.
- Graphene is more electrically conductive than copper, possesses extremely high thermal conductivity, and is stronger (tensile strength) than any known material.
- The high quality and low costs of the graphene produced by FJH could enable the electronics, steel, aluminum, concrete, and plastics industries — among many others — to develop new and disruptive uses for graphene.

RESEARCH PRIORITY

DOMESTIC CRITICAL MINERALS PRODUCTION

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UNIVERSAL MATTER

University of Missouri

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NETL PRODUCES A MORE ROBUST PIPELINE STEEL BY ALLOYING WITH SMALL AMOUNTS OF THE RARE EARTH ELEMENT, CERIUM

The addition of cerium results in a tougher steel alloy to make pipelines for transporting hydrogen supplies and captured carbon dioxide. It also increases demand for cerium, which will stimulate additional production of critical minerals.

The abundance of cerium presents an excellent opportunity for the renewed consideration of these rare earths as promising and inexpensive alloy additions in steelmaking.

Cerium added to pipeline material reacts with oxygen and sulfur impurities and produces a steel less susceptible to cracking. Moreover, cerium is currently a major unused byproduct of the extraction of more valuable rare earths. Incorporating even small amounts of cerium into the high production volume steel components would significantly increase its demand. Additionally, adding a small amount of cerium improves the mechanical response of the steel, making it tougher and more resistant to failure, and enhancing the reliability of components manufactured from the steel.

- Improvement in steel toughness is important for new pipelines for carbon dioxide and hydrogen transport where running ductile fracture is a major concern.
- Developing high-volume applications for cerium can improve the economics of domestic production of rare earths by making the cerium byproduct more valuable.

RESEARCH PRIORITIES

DOMESTIC CRITICAL MINERALS PRODUCTION

HYDROGEN WITH CARBON MANAGEMENT

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NETL JOINS INTERAGENCY PARTNERSHIP TO ADDRESS MAJOR DRIVER OF CLIMATE CHANGE

NETL will lead a $1.3 billion partnership to reduce methane emissions – the second-largest contributor to climate change – across the U.S. oil and natural gas industry.

The Environmental Protection Agency (EPA) ranks oil and natural gas operations as the nation's largest industrial source of methane emissions, which also contain harmful air pollutants.

The U.S. Department of Energy's (DOE) Office of Fossil Energy and Carbon Management, through NETL, has agreed to partner with the EPA by executing and participating in their Methane Emissions Reduction Program. NETL efforts will include:

- Leveraging its core competencies, capabilities, resources and expertise to quantify and reduce methane emissions from inefficient and leaking oil and gas operations.
- Equipping the oil and gas industry with the computational tools, standardization of approach for measuring emissions, and technical assistance.
- Managing a grant program that will provide up to $350 million in financial and technical assistance to eligible states for mitigating methane emissions from low-producing, conventional wells.
- Managing future applied research and development grants on marginal conventional wells and other oil and gas activities.

RESEARCH PRIORITY

METHANE MITIGATION

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EPA

U.S. DEPARTMENT OF ENERGY | Fossil Energy and Carbon Management

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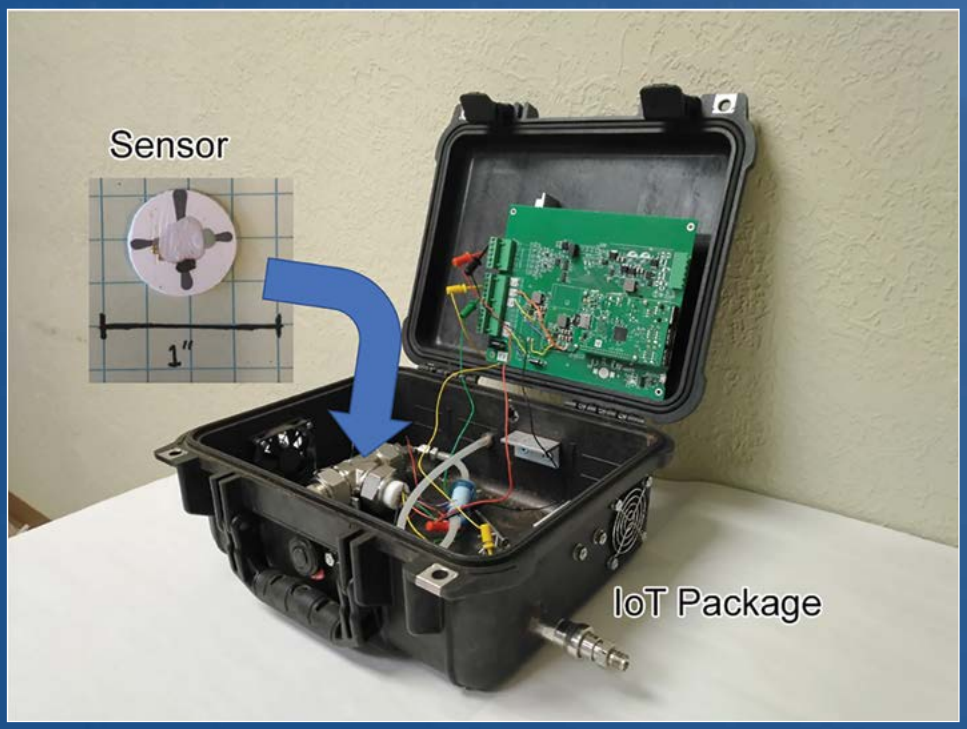
NETL-SUPPORTED PROJECT DEVELOPS FIRST-OF-ITS-KIND GAS SENSOR FOR EARLY WARNING DETECTION

Field-deployable technology can accurately sense, identify and quantify natural gas as an early warning system for leakage.



Fully integrated IoT-sensor prototype

Leaks can develop in the infrastructure needed to produce, gather, store, transport and distribute natural gas, emitting methane — a greenhouse gas that is a primary component of natural gas.

- University of New Mexico and SensorComm Technologies Inc., with support from NETL, developed an advanced sensor with an Internet of Things (IoT) network for natural gas emissions detection.
- Field testing shows methane concentration can be predicted over a range of 10-3,000 parts per million.
- In addition to environmental concerns caused by leaking methane, product loss costs billions of dollars per year.
- Sensors such as these not only help to mitigate climate impacts but also can contribute to lower fuel costs for consumers because less product is lost.

RESEARCH PRIORITY

METHANE MITIGATION

PERFORMERS

SENSORCOMM TECHNOLOGIES

THE UNIVERSITY OF NEW MEXICO

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NETL DEVELOPS COATING TECHNOLOGY TO PROTECT PIPELINES FROM CORROSION AND IMPROVE SAFETY AND RELIABILITY

The invention protects against corrosion in natural gas, hydrogen, and carbon dioxide (CO_2) pipelines that can cause catastrophic failure events.

The new material can be applied to steel structures in a cold spray process to protect them from the effects of corrosion.

Internal corrosion in pipelines is due primarily to the presence of water, CO_2, and hydrogen sulfide contained in natural gas and it can result in leakage, cracks, and rupture of the pipeline leading to explosion hazards and methane emissions.

- The NETL innovation is a cold spray coating consisting of a new zinc-rich material that creates an effective protective layer for internal pipeline corrosion protection.
- In addition to uses for new pipelines, the new coating can be used as structural material to repair used/damaged pipeline.
- It remains stable regardless of temperature/pressure changes of the service environment.
- The coating can also self-heal when damaged by forming protective corrosion products.

RESEARCH PRIORITIES

- METHANE MITIGATION
- CARBON STORAGE AND TRANSPORT
- HYDROGEN WITH CARBON MANAGEMENT

PERFORMERS

NATIONAL ENERGY TECHNOLOGY LABORATORY

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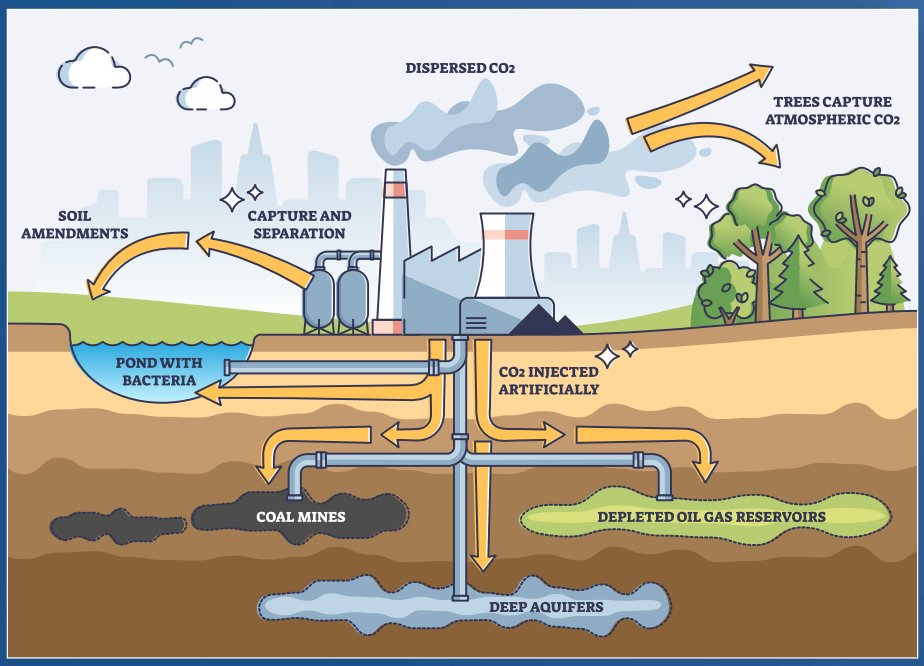
NETL TEAM DEMONSTRATES THAT NANOMATERIALS AND COMPOSITE COATING CAN ENHANCE FIBER OPTIC SENSORS USED FOR DETECTING CARBON DIOXIDE AND METHANE

The new technology can provide safer, quicker and more secure underground storage and pipeline monitoring.



Researchers developed the highly sensitive material that can be used to detect carbon dioxide and methane in ambient environments.

NETL researchers demonstrated how plasmonic nanomaterials and porous polymer composite coating can enhance the ability of optical fiber sensors to detect energy-relevant gases such as carbon dioxide and methane.

- Real-time monitoring of carbon dioxide and methane is needed to assure storage and pipeline infrastructure integrity and to detect early signs of gas leakage.
- Optical fiber sensors offer advantages over other types of sensors because they are small, lightweight, can endure high temperatures and pressures and are immune to electromagnetic interference.
- Early leak detection of greenhouse gases will help to mitigate gas emissions and combat global warming.

RESEARCH PRIORITIES

METHANE MITIGATION

CARBON STORAGE AND TRANSPORT

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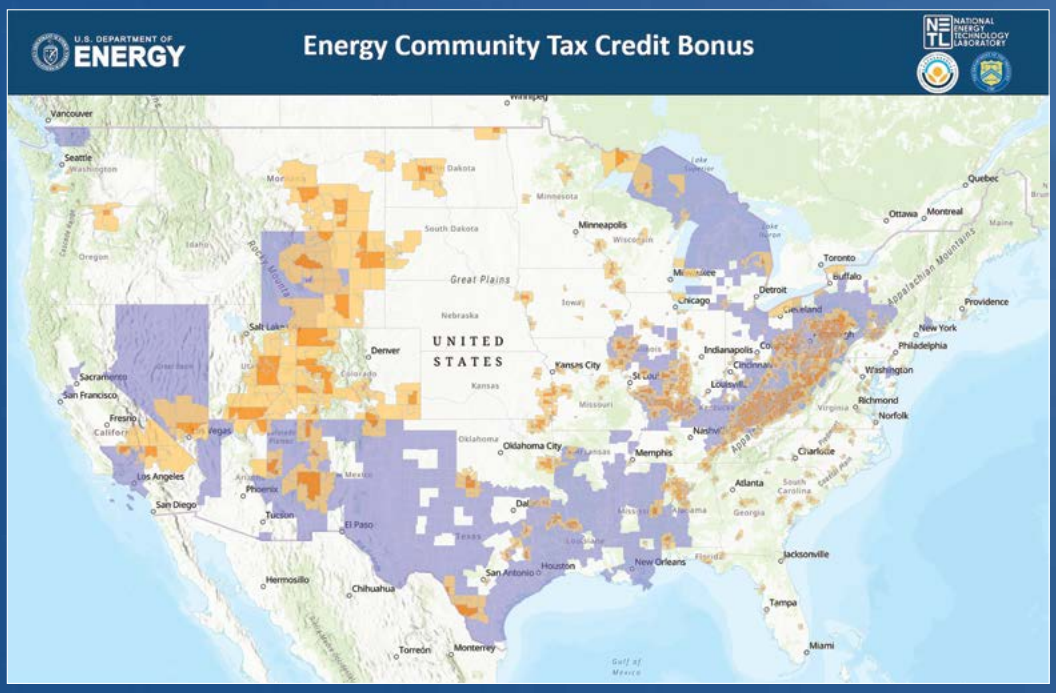
NETL GEO-DATA HELPS PRIORITIZE ENERGY COMMUNITIES IN AMERICA

Data and maps provide critical information for U.S. communities, allowing them to evaluate funding opportunities and tax credits, as well as opportunities for clean energy transitions.



Since November 2021, demand for NETL's geo-data science expertise has grown to help map and visualize energy data and affiliated environmental, community and justice data.

Examples of NETL's analyses and mapping efforts include:

- The Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization — to help inform the distribution of investments to the hardest-hit energy communities across the country.
- DOE's Communities Local Energy Action Program — to inform eligibility criteria to facilitate community-based pathways for a sustainable, resilient, equitable clean energy future and community-wide economic and environmental benefits.
- FECM's Carbon Capture & Storage Environmental Justice and Social Justice Database — to provide information on environmental, social, economic, and energy justice metrics for carbon capture and storage projects.

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NETL-COORDINATED WORKING GROUP PROVIDES INFORMATION, RESOURCES TO CONNECT ENERGY COMMUNITIES WITH FEDERAL ASSISTANCE

The one-stop-shop website provides centralized, easy-to-navigate tools and resources to ensure no community is left behind in the energy transition.

Over the past two years, the Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization has worked on providing a one-stop-shop to make it easier for energy communities to access and apply for federal assistance through its website, energycommunities.gov.

Some resources at the website include:

- Technical assistance —A database of federal technical assistance programs that help communities that do not have the capacity to plan, apply for, manage and implement grants.
- Eligibility maps — The Inflation Reduction Act includes several tax credits for which organizations in eligible energy communities can apply.
- Funding clearinghouse — a curated set of aligned funding opportunities are listed in a searchable database covering 11 agencies sponsored by the American Rescue Plan, Bipartisan Infrastructure Law, Inflation Reduction Act and annual appropriations.

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Interagency Working Group on Coal & Power Plant Communities & Economic Revitalization

Office of Management and Budget/Domestic Policy Council

U.S. Department of Energy

U.S. Department of the Treasury

U.S. Department of the Interior

U.S. Department of Agriculture

U.S. Department of Commerce

U.S. Department of Labor

U.S. Department of Health and Human Services

U.S. Department of Transportation

U.S. Department of Education

U.S. Environmental Protection Agency

Appalachian Regional Commission

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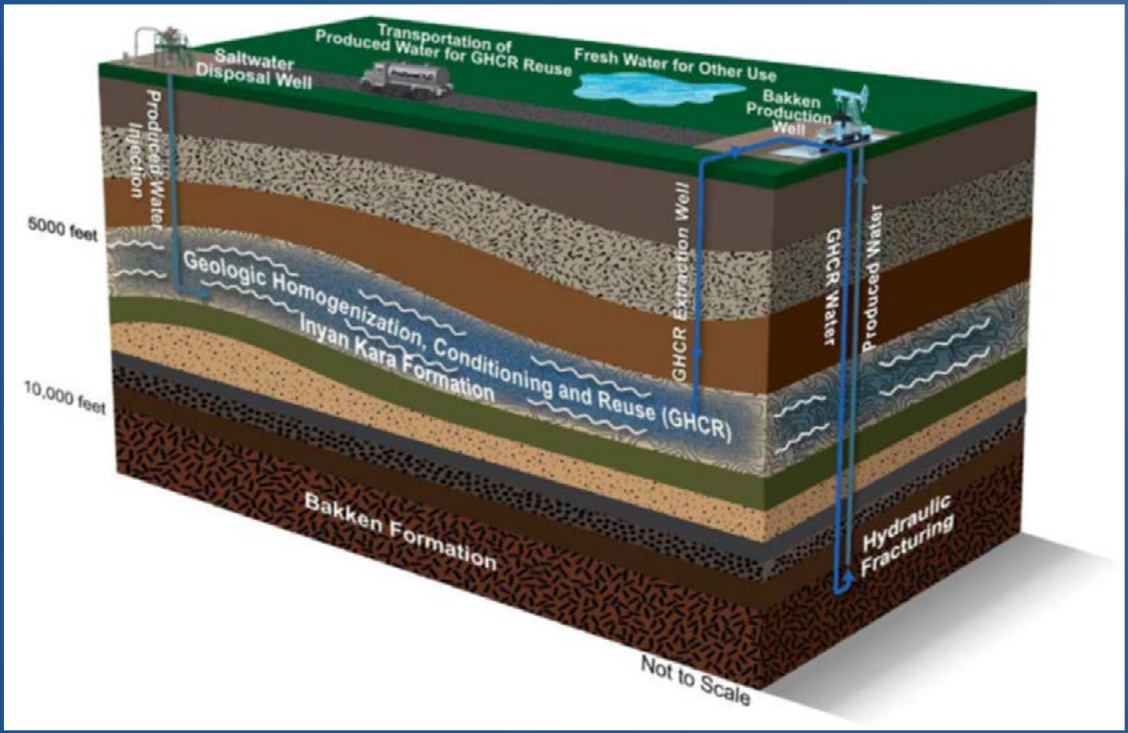
PRODUCED WATER RECYCLING APPROACH ATTRACTS INTERNATIONAL ATTENTION

NETL-funded research on recycling hydraulic fracturing water received a "highly commended" recognition in a global competition.



Geologic homogenization, conditioning and reuse (GHCR).

When hydrocarbons are recovered from oil and gas formations through hydraulic fracturing, significant quantities of high-salinity water are often co-produced. This water is generally referred to as "produced water."

- Produced water management is a key focal point in environmental, social and governance initiatives.
- In the studied approach, produced water is reinjected into the subsurface.
- Natural filtration and biogenic activity of geological strata removes contaminants.
- The produced water can then be reused in hydraulic fracturing, reducing demand for freshwater.

PERFORMERS

EERC

Nuverra Environmental Solutions

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