

ACCOMPLISHMENTS





NETL ACCOMPLISHMENTS Quarter 3 – Fiscal Year 2022

NETL Designated as One of Four National Labs in DOE's Net Zero Lab Pilot to Demonstrate and <u>Replicate Decarbonization Innovations</u>

NETL, the Pacific Northwest National Laboratory, the Idaho National Laboratory and the National Renewable Energy Laboratory comprise DOE's Net Zero Lab (NZL) pilot project — a \$13 million initial investment announced in May to advance new technologies and approaches for net-zero emissions and decarbonization that can be replicated in public and private facilities to benefit the entire nation. With each of the four national laboratories exercising its own unique capabilities and specialties, NZL will serve as an example to large domestic and multinational businesses with large emissions footprints by demonstrating how to adopt technologies and procedures that can lead to effective decarbonization. DOE plans for the NZL effort to expand to all 17 national labs in FY23. NETL Director Brian Anderson, Ph.D., joined DOE Secretary Jennifer Granholm and the directors of three other national laboratories to unveil the NZL pilot.

NETL Struck Gold, Silver in Federal Awards Program for Pittsburgh Region

An NETL team and two research leaders whose cutting-edge projects are reducing atmospheric emissions of greenhouse gas and developing transformational processes to produce chemicals and fuels have received prestigious 2022 Excellence in Government Awards from the Pittsburgh Federal Executive Board. In the Supervisor/Manager in a Professional Series category, NETL received two awards: Jose Figueroa, supervisor of the Carbon Capture Team, received the Gold Award; Dushyant Shekhawat, supervisor of the Reaction Engineering Team, received the Silver Award. In addition, NETL's Carbon Capture Team received the Chairperson's Excellence in Government Gold Award and the Outstanding Small Team Gold Award. Carbon Capture Team members are Dustin Brown, Katharina Daniels, José Figueroa, Krista Hill, Andrew Jones, Carl Laird, David Lang, Andrew O'Palko, Mariah Richardson, Zachary Roberts, Elliot Roth and Nicole Shamitko-Klingensmith.



NETL's Carbon Ore Processing Program Supported Economic Revitalization of Mining Communities

With a new \$2.2 million cooperative agreement from a key NETL program that works to create novel technologies and products from carbon ore and related wastes, a research and manufacturing company with facilities in the heart of Appalachia is one step closer to building a prototype structure with carbon materials, offering a chance at revitalization for economically distressed communities. X-MAT*, with a manufacturing pilot line in Bluefield, West Virginia, has been developing carbon ore-derived building materials and, with the support of NETL's Carbon Ore Processing program, has plans to build a prototype structure to test its roof tiles, siding panels, bricks, and blocks by 2023.



NETL's Multi-functional Sorbent Technology Earned Bronze at Edison Awards

Developers of NETL's Multi-functional Sorbent Technology (MUST), a suite of sorbents that offers a practical, affordable and green approach to remove contaminants from water and manufacturing processes, received a bronze award at the Edison Awards Gala held April 21 in Fort Myers, Florida. The Edison Awards is an international annual competition honoring excellence in new product and service development, marketing, human-centered design and innovation. MUST received its awards in the Eco-Innovation category. The team's innovative technology removes selenium and other metals that contaminate water supplies across America and jeopardize the health of millions of people, wildlife and fragile ecosystems. MUST is the only sorbent-based technology known to NETL that effectively reduces selenium to meet federal discharge limits consistently.



NETL, Partners Took 'NExT' Steps to Develop National Experimental Turbine

The project team developing the National Experimental Turbine (NExT), an initiative advanced with NETL support and oversight, has surpassed several key milestones as it builds a first-of-its-kind testing platform for manufacturing a new generation of higher-efficiency gas turbines. Gas turbines play an important role in U.S. energy security and represent a critical technology for energy conversion, with broad uses for combined cycle power plants, aircraft propulsion and backup power generation for renewable energy plants and hospitals. Technological strides in turbine development can have wide-reaching economic and environmental benefits.

NETL Study that Advanced Data Science for Durable Materials Earned Journal Recognition

NETL data analysis research is expanding the work of the Lab's eXtremeMAT program to enable improved materials property prediction that could support the design of cutting-edge clean energy systems. In their 2021 study, "Data Science Techniques, Assumptions, and Challenges in Alloy Clustering and Property Prediction," the researchers explain steps taken to use data from eXtremeMAT to accelerate the development of materials for extreme environments, including the high-temperature, high-pressure conditions in advanced power plants. The study manuscript was named an Editor's Choice Article by the Journal of Materials Engineering and Performance. In a Feb. 22 letter to the research team, Editor-in-Chief Rajiv Asthana noted, "This selection is reflective of the comprehensive nature of your paper and its overall excellence." The journal selects only six papers annually for this recognition.

NETL Invention Captured Lithium and Rare Earth Elements from Brine for Environmentally Safe and Sustainable Supply Chain

A portable and economic process developed by NETL for quickly extracting lithium from natural brines and produced water from oil and gas extraction is attracting commercialization attention from private industry as the world transitions to electric vehicles and develops renewable energy generators that store surplus electricity in batteries for future use. Natural brines consist of water that is found underground, in salt lakes or as seawater. In addition to lithium, natural brines exhibit significant concentrations of valuable minerals like rare earth elements and critical materials. The patented NETL invention (United States Patent: 10,315,926 and United States Patent Application: 0210047196) is currently being evaluated by One World Lithium Inc. for use on naturally occurring brines with the exception of sea water and geothermal brines, through a non-exclusive research and evaluation license.

NETL Earned Best in Class Honors from DOE Technology Transfer Working Group

Two NETL staff members who specialize in executing partnership agreements to enable the real-world application of the Lab's expertise and technology were recognized for excellence at the 2022 Spring Meeting of the U.S. Department of Energy's Technology Transfer Working Group. Leah Bower and Samantha Zhang received Best in Class honors in the Partnering category for expediting the execution of an inter-agency agreement between the federal Pipeline and Hazardous Materials Safety Administration (PHMSA) and NETL, which resulted in an opportunity for the Lab to tackle critical pipeline safety issues.



<u>NETL Upgraded CT Scanning Capabilities to Peer Deep Inside</u> <u>Rock Cores</u>

NETL significantly upgraded its computerized tomography (CT) scanning technology to provide researchers with an enhanced tool to look at dynamic processes inside rock cores. CT scanning is among the unique capabilities NETL researchers use to determine, for example, under what conditions carbon dioxide (CO_2) can safely be injected underground and permanently stored in subsurface rock formations to reduce emissions of greenhouses gases into the atmosphere. NETL is positioned to take its expertise in geologic CT scanning to the next level by producing higher resolution images of microstructures within rock cores in a significantly shorter period of time. The technology to accomplish these goals is the TESCAN DynaTOM CT scanner, the first to be located in the United States, and is now installed in NETL's Center for Advanced Imaging and Characterization.

NETL Compared Cost and Performance of Select Hydrogen Production Plants

NETL released "Comparison of Commercial, State-of-the-Art, Fossil-Based Hydrogen Production Technologies," which reports the levelized cost of hydrogen, in real 2018 dollars, as well as CO₂-equivalent life cycle emissions (cradle-to-gate basis) of select hydrogen production plants, providing critical perspectives for researchers, regulators and policymakers as the nation transitions to a clean energy future. This independent assessment compares the cost, performance and emissions profiles of hydrogen production plants that were selected to reflect the capabilities of current commercial technologies within industrial-scale plant configurations. These technologies and associated plant configurations represent next-commercial offerings facing no fundamental research and development obstacles.

NETL-Supported Project Passed Key Test to Advance Clean Geothermal Technology

The Utah Frontier Observatory for Geothermal Energy (FORGE) research team, with NETL support and oversight, recently surpassed a significant milestone in its ongoing work to develop an enhanced geothermal system (EGS) that will flow hot water naturally from a subsurface depth of more than 10,000 feet and bring it to the surface. Once the clean energy technology is optimized and developed, EGS could power tens of millions of American homes and businesses and help the nation meet its net-zero carbon emission goals in the power sector by 2035 and the broader economy by 2050.



DOE-NETL Incubated R&D for Carbon Conversion: Growing Algae for Better Chicken Feed

Working as part of a three-year cooperative agreement with DOE-NETL, researchers demonstrated that algae grown using CO₂ emitted by a fossil energy power plant can be processed into a nutrient-rich supplement for chicken feed to produce quality eggs and poultry products. Supported with nearly \$1.7 million in federal funding, the project was launched at the Stanton Energy Center, an electric generating station in Orlando, Florida. Project partners included the Orlando Utilities Commission, MicroBio Engineering Inc. and the University of Central Florida. With NETL project oversight and support, they found that growing algae using flue gas was more productive and resulted in greater amounts of algae compared to using a pure CO, stream or ambient air.

Novel Computational Ability Helped NETL Researchers Win the Fight Against Pollution

NETL and West Virginia University researchers successfully used reinforcement learning — which allows a computer program to learn without user input — to develop adaptive control strategies that could reduce environmental emission and treatment costs during flexible operation of the nation's power plants. Reinforcement learning is a type of machine learning technique that involves an intelligent agent, such as a computer algorithm, taking action in an environment and receiving rewards or penalties based on its actions. In this reinforcement learning research, "winning the game" means finding the optimal strategy for controlling nitrogen oxide (NOx) emissions in power plants. This is achieved by tuning the optimal injection rate of ammonia into a power plant's flue gas so that it can be reacted in a selective catalytic reduction unit, which converts NOx into nitrogen and water vapor.

NETL Developed Unique Modeling Capabilities Using Cerebras Wafer-Scale Engine

Through a collaboration with one of the world's leading artificial intelligence (AI) hardware manufacturers, NETL is developing a cuttingedge computer modeling capability using next-generation computer architecture that is much smaller, more energy-efficient, and hundreds of times faster than current supercomputers. Cerebras Systems Inc. designed its revolutionary wafer-scale engine (WSE) to tackle tough AI problems. NETL researchers are working to harness the power of this computational tool to blend AI capabilities with complex energy modeling. Specifically, they have been developing a capability to use the WSE to solve what are known as field equations, which are critical for designing decarbonization technologies. This technology will have a major impact on the pace of development and deployment of carbon-neutral technologies to meet the ambitious decarbonization targets set by the Biden Administration.









