NATIONAL ENERGY TECHNOLOGY LABORATORY

ACCOMPLISHMENTS

Q3 FY23

U.S. DEPARTMENT OF ENERGY

NETL ACCOMPLISHMENTS

Quarter 3 – Fiscal Year 2023

NETL Supported Liftoff of Airborne Technology To Monitor Carbon Storage Sites

A team led by NETL researchers launched airborne technology at a commercial-scale CO_2 geologic storage site in Mississippi to complete a first-of-its-kind electromagnetic survey and collect data needed to monitor greenhouse gas sequestered in the subsurface. Deep underground storage of CO_2 is a major component in the nation's efforts to achieve a 100% carbon emission-free electricity sector by 2035 and a net-zero carbon economy by 2050. However, large-scale carbon sequestration needs to be closely monitored to ensure the greenhouse gas does not escape the protective layer of cap rock and leak to the surface or contaminate underground aquifers that supply drinking water.

NETL Researcher Honored by North American Membrane Society

NETL's Lingxiang Zhu, a researcher who specializes in the development of membranes to capture CO_2 from industrial sources, received the 2023 Young Membrane Scientist Award at the North American Membrane Society annual meeting May 13-17 in Tuscaloosa, Alabama. Zhu was nominated for his substantial contributions to the field of membrane science in the form of three novel and industrially relevant inventions for CO_2 capture, which is vital to the environmental and economic stability of the United States.

NETL Data Portal To Accelerate Completion of Permit Applications for Carbon Storage

NETL launched a new data portal that provides information needed to accelerate the process of completing federal drilling permit applications to sequester CO_2 in the subsurface. An NETL project team developed the Class VI Data Support Tool Geodatabase by leveraging data from the Carbon Storage Open Database, the Energy Data eXchange (EDX), the U.S. Geological Survey and other sources. The free, publicly available geodatabase is hosted on EDX, NETL's virtual data collaboration and curation platform for data-driven technology development.

NETL Discovered Potential Sources of Platinum Group Metals as Part of a Process for Carbon Removal

When NETL researchers, led by Jon Yang (pictured here), began to research the potential to recover critical minerals from rocks that are processed to remove atmospheric CO_2 in a practice called mineral carbonation, they expected to find valuable commodities like chromium, cobalt, and nickel. But their work also discovered valuable quantities of platinum group minerals (PGMs) — extremely precious metal commodities that are critical for the clean energy economy. The finding could have positive implications for both the critical mineral supply chain and an evolving decarbonization technology. The breakthrough could help reduce reliance on foreign sources for PGMs by developing a sustainable domestic supply chain in conjunction with mineral carbonation waste streams.

NETL Developed Pipeline Route Planning Database To Guide CO_2 Transport Decisions

Strategically planning safe and sustainable routes for transportation of CO_2 from where it is captured to where it can be stored underground or converted into other products is a critical priority in achieving a greenhouse gas-neutral economy by 2050. NETL responded to that challenge by creating an expansive and accessible Carbon Capture and Storage Pipeline Route Planning Database to guide routing decisions and increase transportation safety. NETL identified technical gaps, prioritized research needs, and developed tools to facilitate and optimize a robust, national-scale CO_2 transportation infrastructure. The near-term goal for 2030 is to expand the nation's capability to transport 65 million metric tons of CO_2 per year. The long-term goal for 2050 is to ensure the capability to transport 1 gigaton of CO_2 per year.

A New Approach to Power Plant Cooling Can Eliminate the Need for Freshwater Use

Researchers at NETL and the University of Wyoming reported that using brackish water — water that is not suitable for drinking or irrigation because it contains between 1,000 and 35,000 parts per million of dissolved solids — to cool power plants can reduce freshwater consumption by 94% to 100%. The results of the study were reported in a paper published online by Nature Portfolio and available here.

NETL Searches Kentucky's Daniel Boone National Forest for Orphan Wells

Daniel Boone, James Harrod and George Rogers Clark once explored the wilderness of Kentucky with little more than long rifles and curiosity to find places suitable for new settlements. More than 240 years later, a team of NETL researchers roamed much of the same turf with an array of sophisticated data and equipment to uncover long-abandoned oil and gas wells that could leak methane gas into the atmosphere. The team determined the presence of wells, recorded high precision coordinates for well locations, and measured methane emissions from the wells that were found. Results from the Kentucky work will be included in best practices guidance and shared with state, federal and tribal oil and gas regulatory agencies to aid their efforts to find and remediate orphaned oil and gas wells.

Improved Ammonia Production Process Developed in Successful NETL Partnership

When NETL researchers, including Christina Wildfire (right) and former research associate Yuniba Yagues (left), teamed up with colleagues at West Virginia University (WVU) and Malachite Technologies, their mission was to improve on a process that has dominated ammonia production for more than 100 years by producing the valuable chemical at low temperatures and near-ambient pressures. The team found success by combining cutting-edge microwave reaction science research at NETL with specialized catalyst development from WVU and reactor manufacturing experience from Malachite to create the award-winning Microwave Ammonia Synthesis process — an energy efficient, cost-effective technology capable of using intermittent renewable power.

NETL Environmental Engineer Won Prestigious Flemming Award

NETL's Natalie Pekney, Ph.D., an environmental engineer leading research to mitigate methane emissions from abandoned oil and gas wells, was named the recipient of a 2022 Arthur S. Flemming Award, one of the nation's top honors presented to federal employees. Established in 1948, the Flemming Awards recognize outstanding early to mid-career federal employees who go beyond what is expected and whose federal government achievements have a broad, positive impact on society. Previous winners have included Neil Armstrong, Elizabeth Dole and Anthony Fauci. NETL's David Miller, chief research officer, and Paul Jablonski, a metallurgist who was instrumental in the Lab's development of a revolutionary coronary stent, received Flemming Awards in 2014 and 2012, respectively.

NETL Study Assessed Appalachian Region's Potential To Develop a Hydrogen Economy

The Appalachian region is well suited to be one of the nation's clean energy hydrogen hubs because of its natural gas resources, infrastructure, storage capacity, workforce and industrial demand, according to a report conducted by NETL. According to the Appalachian Regional Commission, Appalachia is made up of 423 counties across 13 states and spans 206,000 square miles, from southern New York to northern Mississippi. The report's authors, said development of Appalachian hydrogen infrastructure will help 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.

NETL Contractor Received Best in Region Award from Federal Laboratory Consortium

An NETL specialist whose work significantly reduced the complexity of transferring the Lab's technologies to the private sector and increased the number of agreements executed by 27% was recognized as the "Best in Region" for the Mid-Atlantic region by the Federal Laboratory Consortium (FLC). Chris Bond, a technology transfer agreement specialist with Leidos, a support contractor to NETL, received the FLC's Rookie of the Year award in January.

NETL Developed New Biocatalysts for Carbon Conversion

NETL researchers, led by Djuna Gulliver (pictured here), are growing versatile biocatalysts using microbes from a coalbed methane (CBM) well to convert industrial CO_2 wastes and other single-carbon compounds into useful chemicals to manufacture biofuel, food additives and other high-value products while reducing emissions of greenhouse gas. In testing completed at NETL, researchers found the microbes from the CBM well, which was drilled in an Appalachian coal seam as part of a mining operation, generated a biocatalyst that outperformed other biocatalysts from microbes collected at oil and natural gas well sites and other locations.

NETL-Supported Project Developed First-of-Its-Kind Gas Sensor for Early Warning Detection

SensorComm and the University of New Mexico Technologies Inc., with support from NETL, developed a first-of-its-kind field-deployable technology that can accurately sense, identify and quantify the presence of natural gas as an early warning system for leaks, which contribute to greenhouse gas emissions. Natural gas is one of the largest energy resources in the United States. Because of a myriad of variables, leaks can develop in the infrastructure needed to produce, gather, store, transport and distribute natural gas, emitting methane into the atmosphere. Detecting these infrastructure-related leaks can be difficult because of the typical presence of natural sources of methane in the atmosphere such as livestock, wetlands and other sources.

NETL-Developed Oxygen Carrier Selected for Use in Canadian Government-Industry Project

An advanced material that demonstrated unparalleled durability in a groundbreaking NETL test was recently selected by Natural Resources Canada (NRCan) and their industry collaborator Hatch for use in a novel chemical looping combustion (CLC) reactor. CLC is an advanced energy technology capable of delivering affordable and dependable power, process heat, steam and synthesis gas while reducing environmental impacts due to the process's in-situ 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. NETL's oxygen carrier showed promising results for CLC energy production using Hatch's novel Plug Flow Internal Recirculation reactor and could be the best available materials to meet technology needs based on initial tests.

NETL Published New Baseline Study Report on the Flexibility Attributes of Commercial Natural Gas Power Generation Technologies

To address the data needs of energy system designers and to serve as a baseline for research and development, NETL carried out a study to characterize the flexibility attributes — both performance and cost — of nine common commercial natural gas-fueled electricity generating units. The intermittent output of low-carbon, renewable power generation sources such as wind and solar create challenges to grid stability and reliability. Fossil-fueled power generation technologies are currently used to provide reliable, on-demand power during periods of reduced renewable output. Dispatchable generators must be able to accommodate increasing renewable generation as the nation pursues the administration's target of a decarbonized energy sector by 2035. As energy system experts seek to identify least-cost approaches to decarbonization, accurate cost and performance data characterizing dispatchable fossil generators that operate flexibly, at capacity factors that have been declining over time, and are needed to inform models for capacity expansion.

Supercritical CO_2 Technology Accelerated at STEP Pilot Plant

A 10-megawatt supercritical carbon dioxide (sCO_2) test facility recently achieved supercritical CO_2 conditions in its turbine compressor section — a milestone representing a significant step forward in the NETL-sponsored project, which offers a path to lower-cost power generation. The objectives of this award, which commenced in October 2016, include demonstrating the operability of the sCO_2 power cycle, verifying the performance of components (turbomachinery, recuperators, and compressors, etc.), showing the potential for producing a lower cost of electricity in relevant applications, and demonstrating the potential and pathway for a thermodynamic cycle efficiency greater than 50%.