

# CARBON CAPTURE NEWS LETTER

U.S. DEPARTMENT OF ENERGY | OFFICE OF FOSSIL ENERGY AND CARBON MANAGEMENT | NATIONAL ENERGY TECHNOLOGY LABORATORY



## HIGHLIGHTS

The newsletter is compiled by the National Energy Technology Laboratory to provide information on recent activities and publications related to carbon capture.

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## NETL Project Review Meeting Includes Updates on Carbon Capture Projects

Participants and researchers at the U.S. Department of Energy (DOE)/National Energy Technology Laboratory's (NETL) 2021 Carbon Management and Oil and Gas Research Project Review Meeting presented results from projects funded through a wide variety of DOE's program areas, including sessions in several areas related to carbon capture, over the month-long conference. The virtual sessions covering "Integrated Carbon Capture Utilization and Storage (CCUS) Projects and Front-End Engineering and Design (FEED) Studies" took place Aug. 2-3, 2021. These sessions featured introductory remarks by Secretary of Energy Jennifer Granholm; plenary presentations from the Principal Deputy Assistant Secretary (PDAS) for the Office of Fossil Energy and Carbon Management (FECM) Jennifer Wilcox and NETL Director Brian Anderson; as well as talks from researchers and experts in CCUS, discussing various projects, CCUS policy, and CCUS concepts. The sessions were capped off with two panel discussions, one on "Financing CCUS Development" and one on "CCUS Infrastructure."

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## NETL Project Review Meeting Includes Updates on Carbon Capture Projects (continued)

The virtual sessions on “Point Source Capture—Lab, Bench, and Pilot-Scale Research” were held on Aug. 12–13 and 16–17, 2021. Opening remarks and an “Overview on Capture for Power and Industrial Sources” was presented by Lynn Brickett, DOE FECM Carbon Capture Program Manager. Experts presented on the capture of carbon dioxide (CO<sub>2</sub>) from power plants, industrial sites, and other large emitters, discussing their cutting-edge work in the design and development of novel materials, devices, and processes to capture CO<sub>2</sub>. Virtual sessions on “Carbon Dioxide Removal Research” were held on Aug 18–19, 2021. Plenary presentations were given by Shuchi Talati, DOE Chief of Staff; Dan Hancu, NETL Carbon Capture Technology Manager; and Douglas Wicks, Program Director, Advanced Research Projects Agency-Energy (ARPA-E). Discussion included CO<sub>2</sub> removal technologies such as direct air capture (DAC) and bio-energy with carbon capture and storage (BECCS). The sessions wrapped up with a panel discussion of DAC commercialization. The conference overall was devoted to the efforts undertaken by NETL and its partners in industry and academia, both in the United States and abroad, to develop carbon capture technologies. The [proceedings](#) for the meeting will be posted on the NETL website.

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## Interagency News and Updates

### DOE Announces Additional Funding for Four DAC Projects

DOE/FECM announced the selection of four additional research and development (R&D) projects to join [six previously announced](#) DAC projects selected to receive DOE funding. The projects selected will focus on R&D to reduce costs that impede DAC deployment, while increasing design and operational efficiency to ensure that the removal process is carbon-negative:

1. Advanced Integrated Reticular Sorbent-Coated System to Capture CO<sub>2</sub> using an Additively Manufactured Contactor (AIR2CO<sub>2</sub> Contactor) — GE Research (Niskayuna, New York);
2. Hybridizing heat-integrated 3D printed modules with mass manufacturable, low pressure drop fiber sorbents — Georgia Institute of Technology (Atlanta, Georgia);
3. Energy-Efficient Direct Air Capture System for High Purity CO<sub>2</sub> Separation — University of Cincinnati (Cincinnati, Ohio);
4. Electrochemically Regenerated Solvent for Direct Air Capture with Cogeneration of Hydrogen at Bench-Scale — University of Kentucky Center for Applied Energy Research (Lexington, Kentucky).

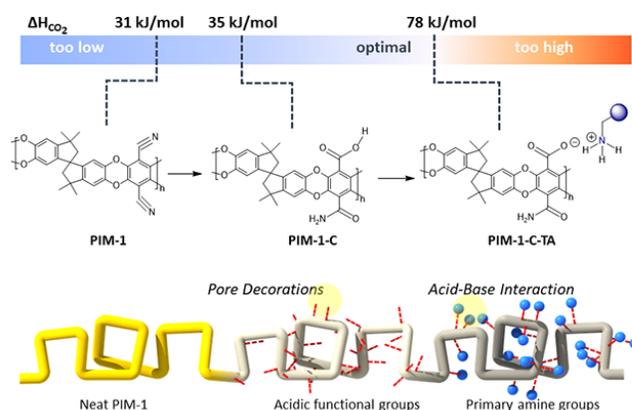
The awards are funded under the funding opportunity announcement (FOA) 2402, *Carbon Capture R&D: Bench Scale Testing of Direct Air Capture Components and Initial Engineering Design for Carbon Capture, Utilization and Storage Systems from Air*.

# Interagency News and Updates (continued)

## Changing Energy Landscape Through Development of DAC Technology

At NETL, researchers are using both experimental and computational methods to screen, design, and synthesize DAC materials such as metal organic frameworks (MOFs), solid oxide materials, amine-impregnated polymer hollow fibers, and carbon-based nano porous sorbents. The objective in studying MOF materials is to develop computational methods coupled with NETL's world-class high-performance computer *Joule* to screen gas sorption and diffusion properties in flexible MOF materials across the large space these materials represent. Solid oxide sorbents are also promising candidates for CO<sub>2</sub> sorbent applications through a reversible chemical transformation due to their high CO<sub>2</sub> adsorption capacities at low CO<sub>2</sub> pressure. High adsorption capacity at low CO<sub>2</sub> pressure coupled with very low cost makes this class of sorbent particularly attractive for DAC applications. However, a single material normally cannot satisfy the technology needs, which has prevented the use of solid sorbents for carbon capture. NETL researchers have previously created basic immobilized amine sorbents (BIAS) with high CO<sub>2</sub> capture capacity and thermal stability over multiple steam regeneration cycles, representing a promising approach for CO<sub>2</sub> removal from a variety of source points, including coal and natural gas combustion power plants. Recently, NETL researchers recognized many advantages could be gained by incorporating features of the BIAS sorbent into a hollow fiber. To that end, NETL researchers are refining BIAS sorbents into a chemisorption hollow fiber sorbent using unique laboratory capabilities to synthesize tailored fibers based on prior membrane development work.

### Polymer based chemi-sorbent for direct air CO<sub>2</sub> capture



## Novel 3D-Printed Device Enhances CO<sub>2</sub> Capture

Oak Ridge National Laboratory (ORNL) scientists have designed and additively manufactured a first-of-its-kind aluminum device that enhances the capture of CO<sub>2</sub> emitted from fossil fuel plants and other industrial processes. ORNL's device focuses on a key challenge in conventional absorption of carbon-using solvents—the process typically produces heat that can limit its overall efficiency. By using additive manufacturing, researchers were able to custom-design a multifunctional device that greatly improves the process efficiency by removing excess heat while keeping costs low. The research team tested the novel circular device, which



integrates a heat exchanger with a mass-exchanging contactor inside an absorption column consisting of seven commercial stainless-steel-packing elements. The prototype demonstrated that it was capable of substantially enhancing CO<sub>2</sub> capture with an amine solution, which was chosen for its high reactivity to CO<sub>2</sub>.

# Interagency News and Updates (continued)

## 2021 ATB Adds Technologies, New Data Features to Support High-Impact Energy Analysis

The 2021 Annual Technology Baseline (ATB) includes data on technology innovation of [coal and natural gas technologies](#), including carbon capture and storage (CCS), from FECM. The ATB offers new and improved electricity-generation technology cost and performance data to inform U.S. electricity-sector analysis. ATB data can contribute to analysis that helps answer new and emerging questions about the evolving power system. The ATB integrates current and projected data from various sources into one user-friendly format for energy analysts, modelers, and system planners. The National Renewable Energy Laboratory (NREL) releases new data each year, including technology-specific information for a wide range of electricity-generation technologies from wind to pumped storage hydropower to coal. Data is based on original projections for the renewable and storage technologies, as well as on scenarios for technological-based innovation for fossil technologies.

## NETL Director Discusses Hydrogen Activities of DOE's Applied National Labs

NETL Director Brian Anderson participated in the [H<sub>2</sub>IQ Hour](#), hosted by DOE's Hydrogen and Fuel Cell Technologies Office, in July 2021 to provide an update on NETL's hydrogen activities, including how those efforts are supporting larger diversity, equity, inclusion, and environmental justice initiatives. Dr. Anderson joined John Wagner, director of Idaho National Laboratory (INL), and Martin Keller, director of NREL, on the program, representing DOE's three applied national laboratories. The H<sub>2</sub>IQ Hour identified opportunities for further collaboration across all three labs to accelerate technological progress, support [DOE's Hydrogen Shot](#), and advance the Biden-Harris Administration's climate goals.

## Smart Grid Observer CCUS Virtual Forum Details NETL Research and Innovations

NETL demonstrated various technologies under development and emerging best practices to realize the Biden Administration's goal of transforming the U.S. energy sector during the Smart Grid Observer (SGO) Carbon Capture, Storage, and Utilization Virtual Forum, held on July 27, 2021. The event examined the latest technology advances, business models, research findings, and real-world applications for CCUS. The forum also emphasized strategies and options for making the economics of carbon capture acceptable to a broad range of businesses and governments. [NETL provided insights](#) and perspectives during sessions on CCUS, economic analysis and modeling, and NETL's in-house capture and storage programs. NETL Director Brian Anderson kicked off the NETL presentations by detailing NETL's focus on maturing high-impact CCUS technologies that enhance low-carbon energy and approaches to carbon management, in an effort to achieve a net-zero goal by 2050.

## Latest Edition of the SSAE Newsletter Released

The [July 2021 edition](#) of NETL's Strategic Systems Analysis and Engineering (SSAE) Newsletter is filled with updates on the latest research activities undertaken by researchers within NETL's SSAE directorate. The July 2021 edition also features information about the use of SSAE expertise to support successful CCUS systems and technology, and SSAE projects to enable the United States to transition to less carbon-intensive power generation using renewable energy such as wind and solar power. In addition, the newsletter provides a robust list of upcoming conferences, meetings, and events at which SSAE researchers will present their findings and discuss energy concepts.

# U.S. and International Events

## International Pittsburgh Coal Conference

The 2021 International Pittsburgh Coal Conference (PCC), sponsored by the University of Pittsburgh, Swanson School of Engineering, will be held virtually Sept. 20–23, 2021. The annual event is focused on all aspects of coal, energy, and the environment. It aims at fulfilling the ultimate goal of efficient and effective use of coal while protecting the environment. The PCC provides a unique opportunity for in-depth and focused exchange of technical information and policy issues among representatives from industry, government, and academia throughout the world. FECM PDAS Jennifer Wilcox and NETL Director Brian Anderson will speak at [Plenary Session I](#) and NETL's Carbon Capture Technology Manager Dan Hancu will speak at [Plenary Session II](#).

## Global Energy Show Exhibition & Conference

The Global Energy Show Exhibition & Conference, to be held Sept. 21–23, 2021, in Calgary, Canada, brings buyers, sellers, stakeholders, partners, young professionals, and the public together to share knowledge and fuel innovation in the energy landscape. The platform allows for collaboration from all energy sources to showcase innovation and technology that combats the dilemma of matching the increasing energy demand with the need for a transition to a lower-carbon economy.

## IEAGHG 6th Post-Combustion Capture Conference

The International Energy Agency Greenhouse Gas R&D Programme's (IEAGHG) 6th Annual Post-Combustion Capture Conference will be held in the United Kingdom Oct. 19–21, 2021. The event will gather post-combustion capture experts to share their knowledge, findings, and expertise. The agenda is now [available](#).



## Carbon Capture Technology Conference and Expo

The Carbon Capture Technology Conference and Expo is a two-day event to be held Oct. 20–21, 2021, in Stuttgart Messe, Germany. Experts from around the world will discuss the latest advances in new technology for carbon capture, storage, and transport, as well as unique ways of utilizing CO<sub>2</sub> to produce net-zero fuels and for other manufacturing processes.

## Gordon Research Conference: Permanently Removing CO<sub>2</sub> from Our Emissions and Atmosphere

The fourth installation of the CCUS Gordon Research Conference series, to be held Oct. 24–29, 2021, in Waterville Valley, New Hampshire, will examine the following questions: (1) Can the United States decarbonize safely and with a variety of approaches appropriate for the assortment of power and industrial challenges? and (2) Can the United States develop methods to clean up the atmosphere in time to keep within reasonable temperature limits? FECM PDAS Jennifer Wilcox will present “Integrating CCUS into Low Carbon Economies” and DOE FECM Carbon Capture Program Manager Lynn Brickett will present “Direct Air Capture: Where It’s Been, Where It’s Going.”

# U.S. and International Events (continued)

## 26<sup>th</sup> UN Climate Change Conference of the Parties

The United Kingdom will host COP26 in Glasgow, Scotland, Oct. 31–Nov. 12, 2021. COP26 will bring parties together to accelerate action toward the goals of the Paris Agreement and the United Nations (UN) Framework Convention on Climate Change.



## 2021 Appalachian Hydrogen & Carbon Capture Conference

The Appalachian Hydrogen & Carbon Capture Conference (co-sponsored by DOE), to be held Nov. 4, 2021, at Hilton Garden Inn Pittsburgh Southpointe, explores issues surrounding hydrogen use and CCS in the unique context of the Appalachian region.



# Business and Industry News

## NCCC Completes First Test of Carbon Utilization Technology

In a broadening of its research scope, the National Carbon Capture Center (NCCC) successfully completed its first demonstration of carbon utilization technology with a multi-week test of CarbonBuilt's Reversa™ process, which could reduce the CO<sub>2</sub>



emissions of concrete by more than 50%. The project team used CO<sub>2</sub> directly from fossil-based flue gas streams to cure more than 5,000 concrete blocks, proving the efficacy of CarbonBuilt's technology as a functional replacement for traditional concrete products. During the test campaign, teams worked to test CarbonBuilt's technology under a range of actual power plant operating conditions. Post-production analysis of the blocks verified both the CO<sub>2</sub> uptake (i.e., utilization) from the flue gas streams and performance (e.g., strength testing) relative to industry standards. The testing was successful across all metrics. As a neutral test bed for NETL, the NCCC has provided more than 115,000 hours of real-world testing—reducing the projected cost of carbon capture for fossil-based power plants by approximately 40%. Under a collaborative agreement with NETL, renewed in October 2020, the center's research scope was formally expanded to new areas of technology development, including carbon capture for natural gas power generation, carbon utilization, and negative-emission solutions such as DAC.

# Business and Industry News (continued)

## Cormetech Selected for DOE Award to Increase Amount of CO<sub>2</sub> Captured in DAC Operations

Cormetech has been selected for an award from FECM and NETL to demonstrate technology that increases the amount of CO<sub>2</sub> captured in DAC operations. Cormetech plans to further develop its DAC contactor, which is the key component of this system. Air is moved through the contactor and CO<sub>2</sub> is selectively adsorbed onto it. The improved contactor will maximize the amount of CO<sub>2</sub> captured from the atmosphere, while reducing the amount of energy needed to operate.

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## Publications

### 3D printed MOF-based mixed matrix thin-film composite membranes

*SAMEH K. ELSAIDI, MAYUR OSTWAL, LINGXIANG ZHU, ALI SEKIZKARDES, MONA H. MOHAMED, MICHAEL GIPPLE, JEFFREY R. MCCUTCHEON, DAVID HOPKINSON, RSC ADVANCES, VOLUME 11, ISSUE 41, 2021.*

### Worldwide Carbon Capture and Storage Database

*NETL'S CARBON CAPTURE AND STORAGE DATABASE—AN INTERACTIVE TABLEAU DASHBOARD—INCLUDES INFORMATION ON ACTIVE, PROPOSED, AND TERMINATED CCS PROJECTS WORLDWIDE.*



### Technoeconomic and Life Cycle Analysis of Bio-Energy with Carbon Capture and Storage (BECCS) Baseline

*KYLE L. BUCHHEIT, ERIC LEWIS, KISHORE MAHBUBANI, DERRICK R. CARLSON, JULY 16, 2021.*

### Comparative Analysis of Carbon Capture and Storage Finance Gaps and the Social Cost of Carbon

*AMANDA HARKER STEELE, TRAVIS WARNER, DEREK VIKARA, ALLISON GUINAN, PETER BALASH, ENERGIES, VOLUME 14, ISSUE 11, MAY 21, 2021.*



*energies*

### Council on Environmental Quality Report to Congress on Carbon Capture, Utilization, and Sequestration

*COUNCIL ON ENVIRONMENTAL QUALITY, JUNE 2021.*

### Process intensification of CO<sub>2</sub> capture by low-aqueous solvent

*GYOUNG GUG JANG, JOSH THOMPSON, XIN SUN, COSTAS TSOURIS, CHEMICAL ENGINEERING JOURNAL, VOLUME 426, DEC. 15, 2021. (SUBSCRIPTION MAY BE REQUIRED.)*



# About DOE's Carbon Capture Program

NETL's Carbon Capture Program is developing the next generation of advanced carbon dioxide (CO<sub>2</sub>) capture technologies. The U.S. Department of Energy's (DOE) Office of Fossil Energy and Carbon Management has adopted a comprehensive multi-pronged approach for the research and development of advanced CO<sub>2</sub> capture technologies that have the potential to provide step-change reductions in both cost and energy requirements as compared to currently available technologies.

The Compendium of Carbon Capture Technology provides a technical summary of the DOE/NETL's Carbon Capture Program, assembling carbon dioxide capture technology research and development (R&D) descriptions in a single document.



# Carbon Capture Reference Materials

- Carbon Capture Program Factsheet
- Carbon Capture Infographics
- Compendium of Carbon Capture Technology
- Carbon Dioxide Capture Handbook
- CCSI<sup>2</sup>
- Systems Analysis
- Conference Proceedings
- Accomplishments Posters
- Fossil Energy Techlines

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[www.netl.doe.gov](http://www.netl.doe.gov)

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