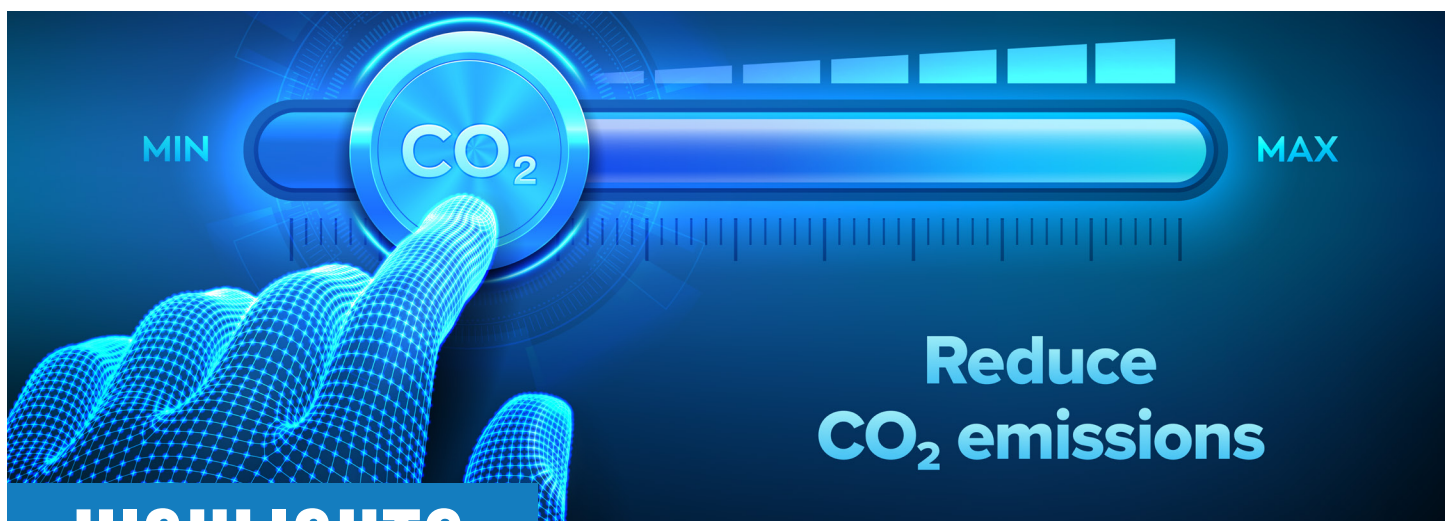


JUNE 2022

# CARBON CAPTURE NEWSLETTER



## 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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## Biden-Harris Administration Announces Investment to Reduce CO<sub>2</sub> Emissions

The U.S. Department of Energy (DOE) announced more than \$2.3 billion for efforts to advance diverse carbon management approaches that reduce carbon dioxide (CO<sub>2</sub>) emissions, address the impacts of potential climate change, and create good-paying jobs while prioritizing community engagement and environmental justice. The first effort is a Notice of Intent for \$2.25 billion, funded by the Bipartisan Infrastructure Law (BIL), to accelerate geologic carbon storage projects capable of storing at least 50 million metric tons of captured CO<sub>2</sub> each. In addition, DOE issued two funding opportunities: the \$45 million “CarbonSAFE: Phase II - Storage Complex Feasibility” Funding Opportunity ([DE-FOA-0002610](#)) aiming to improve procedures to safely, efficiently, and affordably define and assess onshore and offshore CO<sub>2</sub> storage sites at a commercial scale; and the \$46 million “Carbon Management” Funding Opportunity ([DE-FOA-0002614](#)) aiming to develop technologies to remove, capture, and convert or store CO<sub>2</sub> from utility and industrial sources or the atmosphere.

# Interagency News and Updates

## DOE Invests in DAC and Storage Technology, Coupled to Low-Carbon Energy Resources

DOE announced \$14 million in funding for five front-end engineering design studies that will leverage existing zero- or low-carbon energy to supply direct air capture (DAC) projects combined with dedicated and reliable carbon storage. The [selected studies](#) will advance the evaluation of DAC technologies coupled to durable storage that are capable of removing a minimum of 5,000 metric tons of net CO<sub>2</sub> per year from the air and are co-located with domestic zero- or low-carbon thermal energy sourced from geothermal or nuclear power plants and low-grade heat from industrial facilities. This funding opportunity was a collaborative effort among DOE's Office of Fossil Energy and Carbon Management (FECM), Office of Nuclear Energy, and Office of Energy Efficiency and Renewable Energy's Geothermal Technologies Office. The selected projects will be managed by FECM's National Energy Technology Laboratory (NETL) and will support FECM's Carbon Dioxide Removal and Conversion programs.



## NETL Receives Excellence in Government Awards for Pittsburgh Region

An NETL team and two research leaders received prestigious 2022 Excellence in Government Awards from the Pittsburgh Federal Executive Board. NETL's Carbon Capture Team, led by José Figueroa, received the Chairperson's Excellence in Government Gold Award and the Outstanding Small Team Gold Award. Team members are (left to right, top to bottom) José Figueroa, Elliot Roth, Dustin Brown, Nicole Shamitko-Klingensmith, Andrew O'Palko, Katharina Daniels, David Lang, Andrew Jones, Carl Laird, Krista Hill, Mariah Richardson, and Zachary Roberts. Projects included pre- and post-combustion technologies to capture CO<sub>2</sub> from industrial sources, as well as projects to develop DAC and second-generation solvents, sorbents, membranes, and hybrid technologies. Figueroa, who serves as supervisor of the Carbon Capture Team, also received the Gold Award in the Supervisor/Manager in a Professional Series category. Dushyant Shekhawat, NETL's Reaction Engineering Team Supervisor, received the Silver Award in the Supervisor/Manager in a Professional Series category. Projects included using microwave technology to improve chemical conversions and discovering new processes to manufacture high-value chemicals, fuels, fuel additives, and other products from fossil energy resources.



NETL's Carbon Capture Team



On left, NETL's José Figueroa, Supervisor of the Carbon Capture Team and on right, NETL's Dushyant Shekhawat, supervisor, Reaction Engineering Team.

## Capturing Carbon with Inspiration from Battery Chemistry

DOE's Lawrence Berkeley National Laboratory (LBNL) is recognizing the urgency of carbon dioxide removal (CDR) with its Carbon Negative Initiative. Using seed money through the Laboratory-Directed Research and Development Program, LBNL is funding an array of emerging technologies to remove and store CO<sub>2</sub> from the atmosphere. Funded projects include a chemistry approach to DAC and conducting techno-economic analysis to make these projects more impactful and practicable.

# Interagency News and Updates (continued)

## NETL Carbon Capture Expertise Made Available to Pennsylvania Symposium

NETL lent its wealth of knowledge on carbon capture, utilization, and storage (CCUS) to stakeholders in western Pennsylvania for a special Carbon Capture Symposium to provide crucial information and best practices on sustainable energy. The invite-only gathering, organized by the Pennsylvania Environmental Council and in partnership with the Great Plains Institute and Clean Air Task Force, shared perspectives on the opportunities and challenges presented by CCUS. Speakers included Emily Grubert, deputy assistant secretary for the Office of Carbon Management in FECM, and Sarah Forbes, director of Carbon Capture Utilization and Storage, White House Council on Environmental Quality, who served as the symposium's keynote speaker.

## Bipartisan Infrastructure Law Hub

The BIL represents the most dramatic changes to DOE since its founding in 1977. For the next five years, the BIL will stand up 60 new DOE programs, including 16 demonstration and 32 deployment programs, and expand funding for 12 existing research, development, demonstration, and deployment (RDD&D) programs. NETL's [Bipartisan Infrastructure Law Hub](#) provides information on the BIL, including links to the Guidebook, DOE's Clean Energy Corps, DOE's Applicant Portal, and DOE's Grid Resilience Program, as well as information on solicitations and funding opportunities.



## NETL's Multi-Functional Sorbent Technology Earns 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. 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 the United States 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 consistently meet federal discharge limits.



NETL's Fan Shi accepts an Edison Award for MUST.

## Secretary Granholm on the U.S. Senate Confirmation of Brad Crabtree

U.S. Secretary of Energy Jennifer M. Granholm issued the following statement after the U.S. Senate confirmation of Brad Crabtree to serve as Assistant Secretary for FECM: "I am so grateful to the Senate for confirming Brad Crabtree to serve as DOE's Assistant Secretary for Fossil Energy and Carbon Management. Brad is considered one of the nation's top practitioners on carbon capture, storage, and utilization, and he could not be joining the Department at a more critical time as we work to slash carbon emissions in every part of our economy and implement the BIL. Brad's expertise will help us confront the climate crisis while creating good-paying jobs and supporting energy communities in transition. I am thrilled that he's willing to serve the American people and excited to welcome him into the DOE family."



Brad Crabtree to serve as Asst. Secretary for FECM.

# Interagency News and Updates (continued)

## Using Old Chemistry to Capture Carbon Directly from Air

Scientists at LBNL are working on new approaches to achieve DAC. In a recent Q&A, Andrew Haddad, a researcher in LBNL's Energy Technologies Area with a Ph.D. in inorganic chemistry, talked about how a Nobel Prize-winning chemistry concept from more than a century ago inspired his idea for efficiently capturing CO<sub>2</sub>.

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## U.S. and International Events

### ASME's Turbomachinery Technical Conference and Exposition

The American Society of Mechanical Engineers (ASME) Turbomachinery Technical Conference and Exposition, to be held June 13–17, 2022, in Rotterdam, Netherlands, attracts the industry's leading professionals and key decision-makers whose innovation and expertise help to shape the future of the turbomachinery industry. The five-day conference and three-day expo will include hundreds of live presenting authors and a panel on utilization, transportation, storage, production, and carbon capture and storage (CCS).

### XIX International Conference on Carbon Dioxide Utilization

The Summer 2022 XIX International Conference on Carbon Dioxide Utilization (ICCDU-22), to be held June 26–30, 2022, at Princeton University, New Jersey, is a global meeting place for chemists, engineers, and environmental policy planners to discuss the latest developments in the field of CO<sub>2</sub> capture and utilization.



### Carbon 2022

The World Conference on Carbon (Carbon 2022), to be held July 3–8, 2022, at Imperial College London, brings together scientists from around the globe to discuss advancements in the field of carbon science and technology for a greener future.

### DOE Carbon Negative Shot Summit

DOE's Carbon Negative Shot Summit, to be held virtually July 20–21, 2022, will convene a diverse set of perspectives to discuss the development and deployment of CDR in the United States, as well as explore justice and equity principles and workforce development opportunities.



### Clearwater Clean Energy Conference

The 46th Clearwater Clean Energy Conference, to be held Aug. 1–4, 2022, in Clearwater, Florida, presents an extensive overview of emerging, evolving, and innovative technologies, fuels, and/or equipment in the power generation industry.



# U.S. and International Events (continued)

## NETL Multiphase Flow Science Workshop

NETL's 2022 Virtual Workshop on Multiphase Flow Science, to be held Aug. 2–4, 2022, will bring together international leaders from industry, academia, and government laboratories working in multiphase flow sciences to discuss current research projects and future research and development (R&D) needs.



## NETL Carbon Management Project Review Meeting

NETL's 2022 Carbon Management Project Review Meeting will be held on Aug. 15-19, 2022, at the Westin Pittsburgh Hotel, in Pittsburgh, Pennsylvania. Registration is available online and the agenda is soon to be released.

## Pittsburgh Coal Conference

The 2022 International Pittsburgh Coal Conference, to be held virtually Sept. 19–22, 2022, is an outgrowth of a series of conferences spanning more than three decades, dealing with coal utilization, both in the United States and internationally. The conference is dedicated to providing 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.

## CEM13/MI7

The 13th Clean Energy Ministerial (CEM) and the ministerial for Mission Innovation (MI)—a collective effort by the public and private sector to rapidly create the net-zero economy that leaves no community behind—will be held Sept. 22–23, 2022, in Pittsburgh, Pennsylvania. CEM is a platform for members to help shape the global clean energy agenda and advance the deployment of specific clean energy technologies and solutions.



## Carbon Capture Technology Conference and Expo

The Carbon Capture Technology Conference and Expo, to be held Oct. 19–20, 2022, in Messe Bremen, Germany, will bring together leading engineering firms, technology manufacturers and suppliers, energy firms, the oil and gas sector, heavy industry, chemical companies, various manufacturing organizations, research groups and non-governmental organizations, consultants, and government bodies to explore how to rapidly accelerate the deployment and commercialization of carbon-removal technologies as a key solution on the pathway to net-zero carbon emissions.

## 16th Greenhouse Gas Control Technologies Conference

The 16th Greenhouse Gas Control Technologies (GHGT) Conference, to be held Oct. 23–27, 2022, in Lyon, France, has established itself as the principal international conference on GHG mitigation technologies, especially CCS. The GHGT conferences are held every two years in member countries, rotating between North America, Europe, and Asia. Each conference is a forum for technical discussions related to the field of GHGT.

# Business and Industry News

## DOE Awards Funding for Study at Constellation Nuclear Plant in Illinois

DOE awarded a \$2.5 million grant to Constellation, who will partner with 1PointFive Inc., Worley Group Inc., Carbon Engineering Ltd., Pacific Northwest National Laboratory, and the University of Illinois Urbana-Champaign to research the viability of DAC technology at Constellation's zero-emission Byron plant. The DAC project could capture 250,000 tons of CO<sub>2</sub> per year. The study will also focus on the potential for a nuclear plant to become the center of a DAC hub, partnering the DAC technology with storage of CO<sub>2</sub>.

## UK, Nucor Steel Gallatin Partnering on Unique CO<sub>2</sub> Capture Project

NETL awarded \$4.9 million in funding to the University of Kentucky (UK) to capture CO<sub>2</sub> at a low concentration from the Nucor Steel Gallatin process flue gas stream. The project, "Application of Transformational UKY 3 Tonne/day CO<sub>2</sub> Capture System at A Steel Process Plant," will leverage technology previously developed between the UK Center for Applied Energy Research (CAER) and Louisville Gas and Electric Company and Kentucky Utilities Company.



*CAER Research Program Manager Heather Nikolic with UK Associate Professor Kunlei Liu, who is leading the new project.*

## Holcim US Becomes a Member of Carbon Capture Coalition

The Carbon Capture Coalition Governance Board unanimously approved the membership of Holcim US, a cement and concrete building materials provider. Holcim has made significant investments in the development of low-carbon solutions and has been actively developing carbon capture feasibility studies. With significant support and grants from DOE/NETL, Holcim is assessing the viability and design of a commercial-scale carbon capture facility. The studies are in collaboration with research institutions and corporate partners and are being conducted at the Portland cement plant in Colorado, and the Ste. Genevieve cement plant in Missouri.

## Nutrien Fertilizer Plant to Feature Carbon Capture and Conversion Tech

AirCapture and OCOchem unveiled plans to design an integrated carbon capture and conversion plant that uses waste steam from Nutrien's fertilizer facility to extract CO<sub>2</sub> from the air and convert it, with water and electricity, to make formic acid. Once formed, the acid can then be stored, transported, and used directly in many industrial, consumer, transportation, and agricultural industries, as well as to transport green hydrogen safely in an energy-dense liquid carrier. DOE awarded \$2.93 million to support the design and engineering of the plant.

# Publications

## Biomass Cofiring With Precombustion Carbon Capture Baseline Testing at UND EERC

BOBBIE RAKOCZY, JOSH STANISLOWSKI, SCOTT G. TOLBERT, CHRISTOPHER J. BEDDOE, MARK A. MUSICH, ANN K. HENDERSON, NATHANIEL D. CARRIERE, NETL, APR. 6, 2022.

## Supramolecular assemblies of polybenzimidazole and aromatic polycarboxylic acids with superior mechanical and H<sub>2</sub>/CO<sub>2</sub> separation properties

LEIQING HU, VINH T. BUI, SHOUHONG FAN, WENJI GUO, SANKHAJIT PAL, YIFU DING, HAIQING LIN, JOURNAL OF MATERIALS CHEMISTRY A, APR. 6, 2022. (SUBSCRIPTION MAY BE REQUIRED.)



## AssessCCUS: An Integrated Approach for Aggregating Resources to Enable Techno-Economic and Life Cycle Assessment of Carbon Management Technologies

GRANT FABER, CHRISTOPHE MANGIN, BARBARA OLFE-KRAUTLEIN, JOSHUA A. SCHAIDLE, FRONTIERS IN CLIMATE, VOLUME 4, FEB. 17, 2022.

## Promoting CO<sub>2</sub> Release from CO<sub>3</sub><sup>2-</sup>-Containing Solvents during Water Electrolysis for Direct Air Capture

XINGAO, AYOKUNLE OMOSEBI, ROGER PERRONE, KUNLE LIU, JOURNAL OF THE ELECTROCHEMICAL SOCIETY, VOLUME 169, ISSUE 4, APR. 27, 2022. (SUBSCRIPTION MAY BE REQUIRED.)



## Adapting the Technology Performance Level Integrated Assessment Framework to Low-TRL Technologies Within the Carbon Capture, Utilization, and Storage Industry, Part I

NICOLE MENDOZA, THOMAS MATHAI, BLAKE BOREN, JESSE ROBERTS, JAMES NIFFENEGGER, VOLKER SICK, ARNO W. ZIMMERMANN, JOCHEM WEBER, JOSHUA SCHAIDLE, FRONTIERS IN CLIMATE, VOLUME 4, MAR. 18, 2022.

## Life-Cycle and Techno-Economic Assessment of Early-Stage Carbon Capture and Utilization Technologies - A Discussion of Current Challenges and Best Practices

ARNO W. ZIMMERMANN, TIM LANGHORST, SHEIKH MONI, JOSHUA A. SCHAIDLE, FARID BENSEBAA, ANDRE BARDOW, FRONTIERS IN CLIMATE, MAR. 28, 2022.

## Advanced Theory and Simulation to Guide the Development of CO<sub>2</sub> Capture Solvents

LOUKAS KOLLIAS, DIFAN ZHANG, SARAH I. ALLEC, MANH-THUONG NGUYEN, MAL-SOON LEE, DAVID C. CANTU, ROGER ROUSSEAU, GLEZAKOU VASSILIKI-ALEXANDRA, ACS OMEGA JOURNAL, VOLUME 7, ISSUE 15, APR. 4, 2022.



# 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

## Contact Us

### DOE Carbon Capture contacts:

Andrew Jones, Carbon Dioxide Removal Technology Manager, 412.386.5531

Dan Hancu, DOE Senior Program Manager, Point Source Carbon Capture, 240.220.1186

Lynn Brickett, Director, Point Source Carbon Capture Division, 412.386.6574

1450 Queen Avenue SW  
**Albany, OR** 97321-2198  
541-967-5892

3610 Collins Ferry Road  
P.O. Box 880  
**Morgantown, WV** 26507-0880  
304-285-4764

626 Cochran's Mill Road  
P.O. Box 10940  
**Pittsburgh, PA** 15236-0940  
412-386-4687

Program staff are also located in **Houston, Texas** and **Anchorage, Alaska**

**CUSTOMER SERVICE:** 1-800-553-7681

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