

APRIL 2024

CARBON CAPTURE NEWS LETTER



Carbon Negative™



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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DOE to Support Carbon Negative Shot by Funding Pilots and Testbed Facilities for Multiple CDR Pathways

The U.S. Department of Energy's (DOE) Office of Fossil Energy and Carbon Management (FECM) announced up to \$100 million to help develop a commercially viable carbon dioxide removal (CDR) industry in the United States. The funding will support pilot projects and testing facilities to demonstrate and scale CDR technologies that reduce carbon dioxide (CO₂) by removing it directly from the atmosphere and then storing it in geologic, biobased, and ocean reservoirs or converting it into value-added products. This effort will also benefit communities across the nation by improving air quality, creating good-paying job opportunities, and prioritizing community needs. Projects selected under this funding opportunity announcement (FOA) will focus on three areas of interest—small biomass CDR and storage pilots, small mineralization pilots, and multi-pathway CDR testbed facilities.

Interagency News and Updates

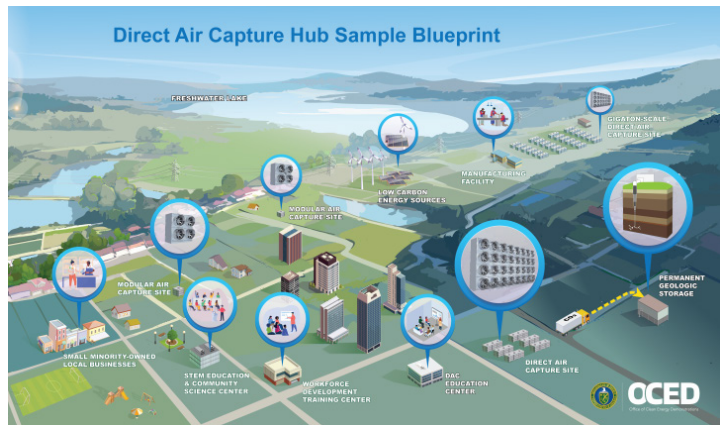
DOE to Invest in Carbon Conversion and Capture Technologies

FECM announced up to \$30 million in additional funding to support two carbon management priorities—the conversion of CO₂ into environmentally responsible and economically valuable products and the development of lower-cost, highly efficient technologies to capture CO₂ from industrial sources and power plants for storage or conversion. Projects selected under this FOA will focus on two areas: (1) technologies that utilize CO₂ from sources such as industrial and power generation facilities, as well as from legacy CO₂ emissions captured directly from the atmosphere, to produce value-added products while simultaneously reducing CO₂ emissions; and (2) lower-cost, highly efficient technologies for carbon capture from industrial facilities and power plants for secure geologic carbon storage or conversion into long-lasting products such as synthetic aggregates, building materials, and concrete.



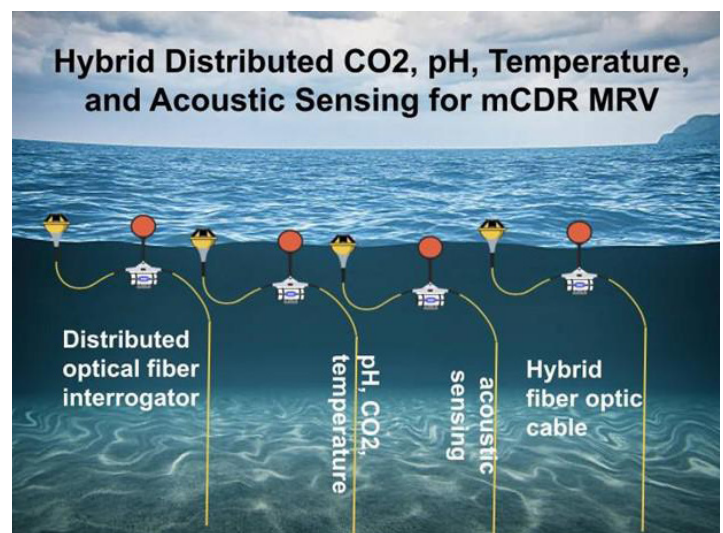
OCED Seeks Public Input on Mid-Scale Commercial DAC Demonstration Facilities

DOE's Office of Clean Energy Demonstrations (OCED) issued a Request for Information (RFI) in support of the Regional Direct Air Capture (DAC) Hubs Program, which aims to kick-start a nationwide network of large-scale CDR sites to address legacy CO₂ and complement rapid emissions reductions. The goal of this RFI is to better understand the role of and funding needs for mid-scale commercial DAC demonstration facilities with capture capacities of about 5,000–25,000 tons per year—specifically seeking public input from industry, investors, developers, academia, research laboratories, government agencies, potentially impacted communities, and other entities.



NETL, Partners to Monitor How Oceans Remove GHG

Researchers at the University of Pittsburgh (Pitt), in collaboration with DOE's National Energy Technology Laboratory (NETL), will develop buoy-based optical fiber sensors to study how the oceans remove carbon from the air and generate findings that could advance the development of marine-based technologies to reduce atmospheric levels of greenhouse gas (GHG). The work is among 11 projects in eight states that were selected to receive a combined \$36 million to accelerate the development of marine CDR technologies.



Interagency News and Updates (continued)

NETL-Sponsored NCCC Hits 150,000 Hours of Technology Testing and Demonstration

The National Carbon Capture Center (NCCC), a cornerstone of U.S. innovation for testing and demonstration of carbon management technologies established by DOE and NETL in 2009, recently achieved the milestone of performing 150,000 hours of technology

testing. Southern Company operates NCCC in Wilsonville, Alabama, through a cooperative agreement with FECM and NETL. NCCC works with innovators from around the world to accelerate the development and deployment of technologies that reduce GHG emissions from power plants and industrial sources, convert captured CO₂ into useful products, or capture CO₂ directly from the atmosphere.



Marianne Walck, Ph.D., Selected as NETL Director

FECM named Marianne Walck, Ph.D., as the new director of NETL. Dr. Walck joins NETL from the Idaho National Laboratory (INL), where she served as deputy laboratory director for science and technology and chief research officer. In this role, she was responsible for executive leadership of research and development (R&D) activities, the annual laboratory plan development and overall strategic planning, the laboratory-directed R&D program, DOE Office of Science programs at INL, university relationships, research integrity, research equipment, and the research culture at the laboratory. Prior to her position at INL, Dr. Walck served in several positions at Sandia National Laboratories, including vice president, California Energy Division and Energy Climate Programs; director for the Geoscience, Climate, and Consequence Effects Center; and director for the Nuclear Energy and Global Security Technology Center.



NETL's Yuhua Duan Named Fellow of the Royal Society of Chemistry

Yuhua Duan, Ph.D., a research physical scientist at NETL, has been named a Fellow of the Royal Society of Chemistry (RSC), a professional society based in the United Kingdom with more than 54,000 members worldwide. RSC awards the designation of Fellow to individuals who have made outstanding contributions to the chemical sciences. Dr. Duan's research interests focus on development of technologies for CO₂ capture, energetic materials that can be applied to batteries and solar cells, exploration of the mechanisms of biological enzyme catalysis and high-temperature gas sensors, and multi-scale modeling of energy systems.



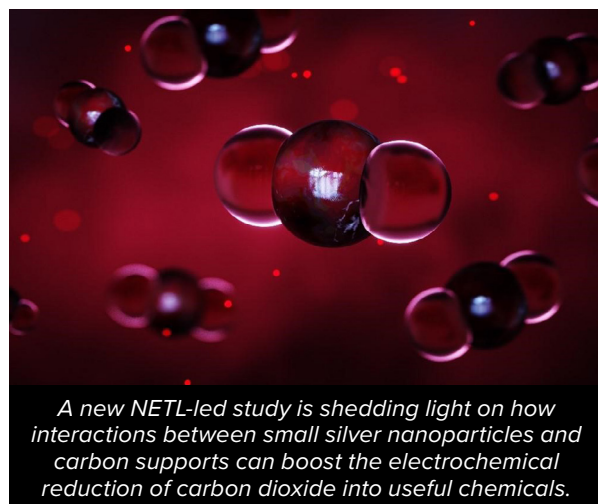
Interagency News and Updates (continued)

DOE Issues NOI to Fund Mixed Algae and Wet Waste Feedstocks R&D for Biofuels and Bioproducts

DOE's Bioenergy Technologies Office and FECM announced their intent to issue funding to support R&D projects for converting algae and other wet waste feedstocks into low-carbon fuels, chemicals, and agricultural products. The intended Mixed Algae Conversion Research Opportunity FOA would address gaps in the use of CO₂, conversion technologies, and product development that limits the use of wet algal feedstocks. The potential funding could include up to \$18.8 million for the following topic areas—Topic Area 1: Conversion of Seaweeds and Waste Algae to Low-Carbon Fuels and Products, and Topic Area 2: Conversion of Algal Biomass for Low-Carbon Agricultural Products.

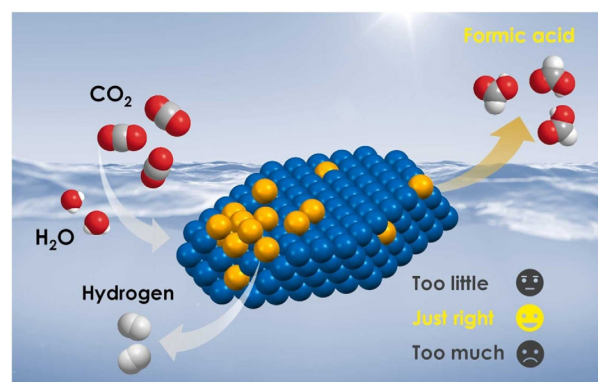
NETL Research Provides New Insight into Catalysts for Carbon Conversion

NETL researchers focused on developing CO₂ conversion technologies recently demonstrated that the material on which a catalyst is affixed, called a support, can have a dramatic impact on its performance. The discovery could lead to improved energy efficiency, boosted catalyst performance, and reduced metallic catalyst materials needed for these systems. The team leveraged computational modeling capabilities to carefully grow, analyze, and quantify interactions between small silver particles and carbon catalyst supports. The results of the research have been published in ACS Catalysis.



NETL-Led Team Develops High-Performing Catalyst for Carbon Conversion

A team of NETL and Pitt researchers has developed a record-setting catalyst that electrochemically converts CO₂ and water into formic acid, which can be used as a hydrogen carrier. Deliberately adding sulfur into tin-based catalysts, known as doping, has been shown to improve electrochemical CO₂ reduction activity and selectivity; however, the precise relationship between sulfur-dopant levels and catalyst performance remains largely unexplored from an experimental standpoint. In this work, the NETL-led team sought to close that knowledge gap and experimentally quantified the composition-dependent role of sulfur dopants, demonstrating that its beneficial influence on CO₂ conversion only occurs over a very narrow composition range. The research was published in Applied Catalysis B: Environmental.



Graphical abstract from: "Precisely doping the surface of tin-based electrocatalysts for improved CO₂ conversion to liquid chemicals," Thuy-Duong Nguyen-Phan, James E. Ellis, Anantha Venkataraman Nagarajan, Bret H. Howard, Giannis Mpourmpakis, Douglas R. Kauffman, *Applied Catalysis B: Environmental*, Volume 340, 2024.

Interagency News and Updates (continued)

OCED Selects Four Projects to Advance Technologies to Reduce CO₂ Emissions

OCED announced up to \$304 million in funding for four projects to pilot transformational technologies designed to capture CO₂ emissions. Funded by the Bipartisan Infrastructure Law (BIL), these large-scale pilot projects—located at power and industrial sites in Kentucky, Mississippi, Texas, and Wyoming—have the potential to capture more than 500,000 metric tons of CO₂ per year. The projects will be required to implement a comprehensive Community Benefits Plan—which will be informed by early and meaningful community and labor engagement. Watch a video [recording](#) of the Feb. 6, 2024, “Carbon Capture Large-Scale Pilot Projects Program Selections” webinar, featuring senior DOE officials.

Carbon Management Liftoff Webinar

The “Pathways to Commercial Liftoff” webinar features senior DOE leaders as they discuss the Carbon Management Liftoff Report and the industry’s barriers to carbon management technology deployment at scale. “Pathways to Commercial Liftoff” is a DOE-wide initiative to strengthen engagement between the public and private sectors to accelerate the commercialization and deployment of key clean energy technologies. The Liftoff Reports (*Pathways to Commercial Liftoff: Carbon Management*, *Pathways to Commercial Liftoff: Decarbonizing Chemicals & Refining*, and *Pathways to Commercial Liftoff: Low-Carbon Cement*) provide the private sector and other industry partners a valuable, engagement-driven resource on how and when certain technologies can reach full-scale deployment.



Catalytic Combo Converts CO₂ to Solid Carbon Nanofibers

Scientists at DOE’s Brookhaven National Laboratory and Columbia University have developed a way to convert CO₂ into carbon nanofibers. Their strategy uses tandem electrochemical and thermochemical reactions run at relatively low temperatures and ambient pressure. As the scientists [describe](#) in *Nature Catalysis*, this approach could successfully lock carbon away in a useful solid form to offset or even achieve negative carbon emissions.



Scientists have devised a strategy for converting carbon dioxide (CO₂) from the atmosphere into valuable carbon nanofibers. The process uses tandem electrocatalytic (blue ring) and thermocatalytic (orange ring) reactions to convert the CO₂ (teal and silver molecules) plus water (purple and teal) into “fixed” carbon nanofibers (silver), producing hydrogen gas (H₂, purple) as a beneficial byproduct. The carbon nanofibers could be used to strengthen building materials such as cement and lock away carbon for decades. (Zhenhua Xie/Brookhaven National Laboratory and Columbia University; Erwei Huang/Brookhaven National Laboratory)

Interagency News and Updates (continued)

Big Potential with Small-Scale Carbon Capture

When Continuum, a winery in California's Napa Valley, contacted the Lawrence Livermore National Laboratory (LLNL) in 2020 to discuss sustainable winemaking efforts, LLNL scientists recognized an opportunity of particular interest. The CO₂ emitted was biogenic—a byproduct of microbial fermentation of the carbohydrates in wine grapes—and, thus, neutral emissions from a carbon cycle perspective. Therefore, capture and storage of this CO₂ would be considered CDR. In response, the laboratory applied advanced manufacturing and industrial chemistry expertise to devise a technology that captures CO₂ from fermentation at the source and then safely and reliably stores the carbon. This effort has opened a pathway for winemakers and other industries on a similar scale to achieve notable carbon emissions reductions.

DOE STEM Portal

DOE is building pathways for a diverse workforce to pursue science, technology, engineering, and mathematics (STEM) careers. DOE seeks to engage learners at all levels to promote STEM and energy literacy and to attract, inspire, and develop a STEM identity and a sense of belonging in STEM. DOE is committed to promoting and supporting people from all backgrounds and perspectives, including individuals and communities that have been historically underrepresented in STEM fields and activities at DOE.

Explore Career Opportunities with FECM

FECM is looking for enthusiastic, driven professionals to join the team and help define the future of energy. Sign up for FECM career alerts now to receive the newest vacancies. Text FECM CAREERS to 468311 to receive text message alerts or subscribe [here](#).

Explore Career Opportunities at NETL

At the core of NETL's success is its commitment to hiring the right people for the right positions. DOE's only government-owned and government-operated national laboratory offers exciting federal careers in research and engineering, technical project management, procurement, finance and budget, legal, and administrative support. Learn more at [NETL Careers](#).

Bipartisan Infrastructure Law Hub

The BIL represents the most dramatic changes to DOE since its founding in 1977. The BIL is standing up 60 new DOE programs, including 16 demonstration and 32 deployment programs, and expand funding for 12 existing research, development, demonstration, and deployment programs. NETL's [BIL 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.

U.S. and International Events

Conference: 2024 Europe Forum on Carbon Capture & Storage

The Global CCS Institute's 2024 Europe Forum on Carbon Capture and Storage, to be held April 17, 2024, in Rotterdam, Netherlands, is an opportunity for policy leaders, nongovernmental organizations, industry experts, academics, those in the financial sector, and the general public to meet and discuss the state of carbon capture, utilization, and storage (CCUS) technology in Europe.



Conference: CO₂ Capture, Storage & Reuse 2024

CO₂ Capture, Storage & Reuse 2024, to be held May 15–16, 2024, in Copenhagen, Denmark, will focus on presentations, industry panel discussion, technical insights, and networking. The day before the main event (on May 14, 2024), a limited number of conference participants will have a unique opportunity to visit the state-of-the-art Amager Bakke facility managed by ARC.

Conference: Carbon Capture & Storage Summit

The Carbon Capture & Storage Summit, to be held June 10–12, 2024, in Minneapolis, Minnesota, will offer attendees a comprehensive look at the economics of carbon capture and storage, the infrastructure required to make it possible, and the financial and marketplace impacts to participating producers.



Conference: Carbon Capture Technology Expo

The Carbon Capture Technology Expo, to be held June 26–27, 2024, in Houston, Texas, will unveil the latest current and emerging technologies from some of the sector's leading experts and energy leaders while providing a showcase for innovative models that can capture carbon's potential by turning CO₂ byproducts into profitable applications for concrete, carbon fiber, polymers, food, fertilizers, liquid fuels, chemicals, graphene, and more.



Conference: Carbon Capture World Expo & Conference

The Carbon Capture World Expo & Conference, to be held June 26–27, 2024, in Essen, Germany, brings together carbon capture experts from the global marketplace to provide an opportunity to meet with all parties—technology providers, equipment builders, engineering companies, and end users—determined to resolve anthropogenic CO₂ emissions.

Conference: GHGT-17

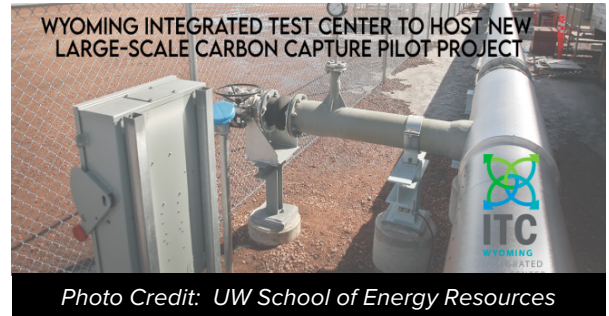
The 17th Greenhouse Gas Control Technologies (GHGT) Conference, to be held Oct. 20–24, 2024, in Calgary, Alberta, Canada, is the principal international conference on GHG mitigation technologies. The GHGT conferences are held every two years in member countries, rotating between North America, Europe, and Asia. Each conference is a forum for technical discussions related to the field of GHGT.



Business and Industry News

Wyoming Integrated Test Center to Host New Large-Scale Carbon Capture Pilot Project

OCED announced the selection of TDA Research Inc. (TDA) to negotiate an award of up to \$49 million to test a carbon capture system at the Wyoming Integrated Test Center (ITC). The ITC hosts developers to test CCUS technologies using flue gas directly from the power plant. Led by TDA and in collaboration with SLB as the technology development and deployment partner, the project is a large-scale pilot with the aim of testing a sorbent-based, post-combustion carbon capture system capable of capturing 158,000 metric tons of CO₂ each year.



RTI International Selected by DOE to Lead Large-Scale Carbon Capture Pilot Project

OCED announced the selection of RTI International for award negotiations to lead a carbon capture pilot in Mississippi in collaboration with International Paper (IP), SLB, and Amazon. The pilot will be at IP's Vicksburg Containerboard Mill. The project aims to capture 120,000 metric tons of CO₂ per year and direct it to a site for geologic storage. Phase 1 of this pilot project will conduct a front-end engineering design study for a carbon capture system at IP's containerboard mill. If successful, subsequent phases would lead to permitting, construction, and operation of a carbon capture plant.

Delek US Holdings' Big Spring Refinery Selected by DOE for Carbon Capture Project

OCED announced the selection of Delek US Holdings Inc. to negotiate a cost-sharing agreement in support of a carbon capture pilot project in the Big Spring refinery. The project will deploy Svante Technologies Inc.'s second-generation carbon capture technology at the Delek Big Spring refinery's fluidized catalytic cracking unit, while maintaining existing production capabilities and turnaround schedule. Expectations for the project are to capture 145,000 metric tons of CO₂ per year, as well as reduce health-harming pollutants, such as sulfur oxides and particulate matter.

PPL, Affiliate Partners Selected by OCED for Research Grant

OCED selected PPL Corporation and its research partners for an award negotiation to help fund a ground-breaking CO₂ capture R&D project expected to cost in excess of \$100 million. The research project will be hosted at PPL subsidiaries Louisville Gas and Electric Company's and Kentucky Utilities Company's Cane Run 7 natural gas combined cycle generating station in Louisville, Kentucky. The new 20-megawatt research system planned for Cane Run is designed to capture a portion of the CO₂ from the natural gas plant's flue gas using an advanced heat-integrated CO₂ capture technology.

Business and Industry News

Climeworks and Svante to Collaborate on DAC Hubs Advancement

Climeworks will purchase contactor blocks from Svante for its planned U.S. DAC hubs. The companies will also collaborate on three major CDR projects. The partnership represents a step toward developing DAC hubs in the United States capable of capturing megatons of CO₂. The purchase of contactor blocks for the three major Climeworks projects is also intended to lead to a commercial-scale supply agreement.

Celanese Low-Carbon ECO-CC Products Available Through DOE Procurement Grant Program

Celanese Corporation has been approved by FECM as a Utilization Procurement Grants (UPGrants) vendor. Celanese is now the only producer offering low-carbon acetic acid under the ECO-CC product name. ECO-CC has demonstrated significant net reductions in life cycle GHG emissions and passed a critical DOE review of the product's life cycle analysis. As a UPGrants vendor, Celanese has already begun working with value-chain partners to extend product usage opportunities to eligible U.S. government entities nationwide.

Oregon State University Research Advances DAC

Scientists at Oregon State University are exploring how some transition metal complexes can react with air to remove CO₂ and convert it to a metal carbonate, similar to what is found in many naturally occurring minerals. The team has demonstrated the ability of vanadium peroxide molecules to react with and bind CO₂—an important step toward improved technologies for removing CO₂ from the atmosphere. The [study was published](#) in Chemical Science.



Vanadium, one of the CO₂ capture materials, displaying a brilliant deep purple color (image provided by May Nyman, chemistry professor, OSU College of Science).

Publications

The Impact of Cement Plant Air Ingress on Membrane-Based CO₂ Capture Retrofit Cost

SYDNEY HUGHES, PATRICIA CVETIC, RICHARD NEWBY, SALLY HOMSY, ALEXANDER ZOELLE, MARK WOODS, ERIC GROL, TIMOTHY FOUT, CARBON CAPTURE SCIENCE & TECHNOLOGY, VOLUME 11, JUNE 2024.

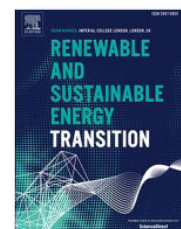


Flexible carbon capture using MOF fixed bed adsorbers at an NGCC plant

MAHPARA HABIB, AARON M. ESQUINO, RYAN HUGHES, FRITS BYRON SOEPYAN, LEO R. NEMETZ, ZHIEN ZHANG, MD EMDADUL HAQUE, DAVID R. LUEBKE, G. GLENN LIPSCOMB, MICHAEL S. MATUSZEWSKI, DEBANGSU BHATTACHARYYA, KATHERINE M. HORNBOSTEL, CARBON CAPTURE SCIENCE & TECHNOLOGY, VOLUME 10, MARCH 2024.

Economic assessment of clean hydrogen production from fossil fuels in the intermountain-west region, USA

FANGXUAN CHEN, BAILIAN CHEN, ZHIWEI MA, MOHAMED MEHANA, RENEWABLE AND SUSTAINABLE ENERGY TRANSITION, VOLUME 5, AUGUST 2024.



Direct ocean capture: the emergence of electrochemical processes for oceanic carbon removal

PRINCE ALETA, ABDELRAHMAN REFAIE, MOHSEN AFSHARI, AHMAD HASSAN, MOHAMMAD RAHIMI, ENERGY & ENVIRONMENTAL SCIENCE, ISSUE 11, 2023. (SUBSCRIPTION MAY BE REQUIRED.)

A mixed integer linear programming approach for the design of chemical process families

GEORGIA STINCHFIELD, JOSHUA C. MORGAN, SAKSHI NAIK, LORENZ T. BIEGLER, JOHN C. ESLICK, CLAS JACOBSON, DAVID C. MILLER, JOHN D. SIIROLA, MIGUEL ZAMARRIPA, CHEN ZHANG, QI ZHANG, CARL D. LAIRD, COMPUTERS & CHEMICAL ENGINEERING, VOLUME 183, APRIL 2024. (SUBSCRIPTION MAY BE REQUIRED.)



Development of a chemistry-based isotherm model and techno-economic optimization of a moving bed process for CO₂ capture using a functionalized metal-organic framework

RYAN HUGHES, GOUTHAM KOTAMREDDY, DEBANGSU BHATTACHARYYA, SURYA T. PARKER, MATTHEW N. DODS, JEFFREY R. LONG, BENJAMIN OMELL, MICHAEL MATUSZEWSKI, CHEMICAL ENGINEERING SCIENCE, VOLUME 287, 5 APRIL 2024. (SUBSCRIPTION MAY BE REQUIRED.)



About DOE Carbon Capture:

DOE/NETL is developing the next generation of advanced CO₂ capture technologies through NETL's Point Source Carbon Capture Program (PSCC) and advancing a diverse set of CDR approaches to directly remove CO₂ emissions from the atmosphere through NETL's Carbon Dioxide Removal Program.



The Digital 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 searchable database.



Carbon Capture Reference Materials

- Point Source Carbon Capture Program Fact Sheet
- Carbon Dioxide Removal Program Fact Sheet
- Carbon Capture Infographics
- Interactive Project Maps: PSCC and CDR
- Compendium of Carbon Capture Technology
- Carbon Dioxide Capture Handbook
- CCSI²
- Systems Analysis
- Conference Proceedings
- Accomplishments Posters: PSCC and CDR

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