NATIONAL ENERGY TECHNOLOGY LABORATORY

JULY 2024

# CARBON CAPTURE NEWSLETTER

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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## 2024 FECM/NETL Carbon Management Research Project Review Meeting

Registration is open for the 2024 Office of Fossil Energy and Carbon Management (FECM)/National Energy Technology Laboratory (NETL) Carbon Management Research Project Review Meeting, to be held Aug. 5–9, 2024, in Pittsburgh, Pennsylvania. This meeting will provide attendees a chance to share in the knowledge and insights gained by more than 150 U.S. Department of Energy (DOE)-sponsored research and development (R&D) projects from the following programs: Point Source Carbon Capture (PSCC), Carbon Dioxide Removal (CDR), Carbon Conversion, and Carbon Transport and Storage. A mixture of plenary, multi-topic breakout, and interactive poster sessions will be used to share research results and provide opportunities for discussion and collaboration on research efforts, both domestic and international. In addition to the project teams, participants may include employees of other government agencies, electric utilities, research organizations and industry. The full meeting is open to the public, including foreign national attendees, and will consist solely of publicly available information. The meeting agenda is available here.

# Interagency News and Updates

## DOE Announces Funding to Accelerate America's CDR Industry


Funded by the Bipartisan Infrastructure Law (BIL), the CDR Purchase Pilot Prize allows companies to compete for the opportunity to deliver CDR credits directly to DOE. DOE announced 24 semifinalists of the prize to receive a total of $1.2 million to scale up their CDR technologies. CDR credits can be purchased by any individual or entity that is interested in responsibly managing their past and/or future carbon dioxide ($CO_2$) emissions. This program helps to catalyze the development of CDR markets; demonstrates rigorous monitoring, measurement, reporting and verification practices through third-party scientific validation; and provides a model for workforce and community benefits for high-quality credits. The recording of the DOE/FECM webinar on the CDR Purchase Pilot Prize semifinalists is available here.

## DOE Issues NOI to Fund Test Centers to Advance Carbon Capture, Removal, and Conversion Technologies


This Notice of Intent (NOI) seeks to inform stakeholders regarding a potential funding opportunity for the development and implementation of a facility or facilities for the testing of new carbon capture, removal and conversion technologies that can be applied to reduce $CO_2$ emissions from point sources such as electric generating units and industrial manufacturing facilities, remove $CO_2$ from the atmosphere, or convert captured $CO_2$ into valuable products. If issued, the potential funding opportunity is anticipated to include the following three areas of interest (AOIs): AOI 1 — Carbon Capture, Removal and Conversion Test Center at an Electric Generating Unit; AOI 2 — Enabling Capital Improvements at an Existing Carbon Capture Test Center; AOI 3 — Carbon Capture, Removal and Conversion Test Center at a Cement Manufacturing Facility.

## U.S. Department of the Treasury and DOE Release Additional Guidance on IRA Programs to Incentivize Manufacturing and Clean Energy Investments in Hard-Hit Coal Communities

The U.S. Department of the Treasury (Treasury), DOE and the Internal Revenue Service (IRS) released additional information on key provisions in the Inflation Reduction Act (IRA) to strengthen energy security and drive investment to hard-hit coal communities and underserved communities. The new notice describes how interested parties can apply for an allocation in Round 2 of the IRA-funded Qualifying Advanced Energy Project Tax Credit (§ 48C) program—of which, approximately $2.5 billion in funding will go to projects in § 48C energy communities. To apply to Round 2, taxpayers will have a similar application process. Taxpayers must first submit concept papers describing the proposed project; taxpayers whose concept papers receive a favorable review will be encouraged to submit a full application.

# Interagency News and Updates (continued)

## Researcher Returns to NETL to Develop DAC Center

Dave Luebke spent the first 12 years of his career as a carbon capture researcher at NETL before leaving in 2014 to try his hand at entrepreneurship. He founded two successful companies, but his passionate belief in implementing carbon management brought him back to NETL in 2023 to lead the Direct Air Capture (DAC) Center. Material-scale testing at the DAC Center is already underway. When fully operational, the center will provide technology developers with a facility to test systems at three scales—lab-scale systems designed to examine the long-term stability of DAC materials, bench-scale module testing systems capable of probing flow dynamics, and small pilot-scale skid rooms to test prototype DAC units under a broad range of climate conditions.

*Dave Luebke (Technical Director, NETL Direct Air Capture Center) leads a discussion during a tour of the NETL Direct Air Capture Center.*

## NETL Pursues Groundbreaking CDR Research

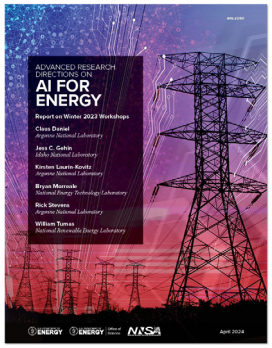

NETL's CDR Program includes a diverse portfolio of approaches, including DAC, biomass carbon removal and storage, marine CDR, and enhanced mineralization. Permanent storage or conversion of captured $CO_2$ into durable products such as low-carbon concrete is a part of each approach. To quantify benefits of the approaches, NETL is building a suite of robust life cycle and techno-economic analysis tools. NETL's efforts are focused on advancing CDR goals by accelerating scale-up and commercialization of DAC technology. One portion of this effort includes developing the tools and facilities to support public and private sector partners interested in advancing DAC technology to commercial scale. Another piece involves research to address broad challenges that impact CDR technology.

## PNNL Researchers Studying Marine-Based Global Warming Solutions

Researchers at PNNL are applying their expertise in ecosystems science, biogeochemistry and engineering to develop and study techniques for the ocean's role as a natural carbon sink. The approach, known as marine CDR (mCDR), involves diverse natural and technological pathways. As researchers create new mCDR technologies, they also work toward economical and environmentally responsible deployment. Their efforts include quantifying how much carbon is removed, improving process efficiencies, understanding the effects on ecosystems and engaging stakeholders.

## How AI Can Transform U.S. Energy Infrastructure

One hundred experts from the fields of clean energy and artificial intelligence (AI) met at Argonne National Laboratory for two days to discuss how to secure America's energy future and leadership. The "AI for Energy" report outlines their vision, identifying grand challenges across five areas of the U.S. energy infrastructure: nuclear power, the power grid, carbon management, energy storage and energy materials. Across these challenges, three common needs emerged: quick and highly reliable computer-aided design and testing of materials and systems, improvement of scientists' ability to pinpoint uncertainties in their predictions and how systems will perform, and AI to integrate data from multiple sources and formats.



# Interagency News and Updates (continued)

## Funding Notice: BIL — Carbon Utilization Procurement Grants

DOE is making $100 million available to support states, local governments and public utilities in purchasing products derived from converted carbon emissions. The goal is to speed up adoption of advanced carbon management technologies, creating a market for environmentally sustainable alternatives in fuels, chemicals and building products sourced from captured emissions from industrial and power generation facilities. The Carbon Utilization Procurement Grants Program will help offset 50% of the costs to states, local governments, and public utilities or agencies to procure and use products developed through the conversion of captured $CO_2$ and carbon monoxide emissions. The commercial or industrial products to be procured and used under these grants must demonstrate a significant net reduction in GHG emissions compared to incumbent products via a life cycle analysis, which will be checked for conformance and approved by NETL.

## Roadmap to Close the Carbon Cycle: A Holistic Approach to Reach Net-Zero Carbon Emissions Across the Economy


nature reviews chemistry

Roadmap

A US perspective on closing the carbon cycle to defossilize difficult-to-electrify segments of our economy

Led by chemist Wendy Shaw of Pacific Northwest National Laboratory (PNNL), a multi-institutional effort produced a new roadmap to reducing emissions in hard-to-electrify segments of the economy. The multifaceted approach includes developing non-carbon fuels, finding non-fossil sources of carbon, and keeping carbon in play once it enters the cycle, ideally resulting in multiple uses of each carbon atom. The ideas emerged from a workshop on "Closing the Carbon Cycle," jointly hosted by PNNL, Ames National Laboratory, Argonne National Laboratory, Brookhaven National Laboratory, Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory and the SLAC National Accelerator Laboratory. The full article is available in Nature Reviews Chemistry.

## AEO2025 Fact Sheet: Carbon Capture, Allocation, Transportation, and Sequestration Module


eia U.S. Energy Information Administration

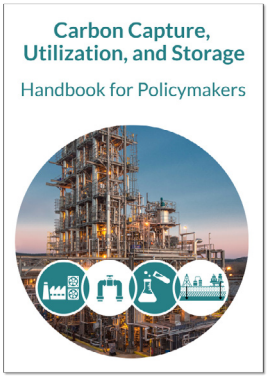
February 2024

Annual Energy Outlook 2025 Fact Sheet: Carbon Capture, Allocation, Transportation, and Sequestration Module

The U.S. Energy Information Administration introduces its Carbon Capture, Allocation, Transportation, and Sequestration (CCATS) Module in the National Energy Modeling System for the Annual Energy Outlook 2025 (AEO2025) to better reflect the emerging market for captured $CO_2$. CCATS was designed to be flexible to incorporate future policies and to more accurately project long-term trends in U.S. energy markets. CCATS is an optimization module that minimizes various operation and investment costs for capturing, transporting and storing or utilizing $CO_2$. After applying policy incentives, the module determines the most cost-effective network flow of $CO_2$ from supply sources to demand locations and projects the development of $CO_2$ infrastructure for both transportation and saline storage until 2050. Find more AEO2025 resources here.

# Interagency News and Updates (continued)

## CCUS Handbook for Policymakers Now Available



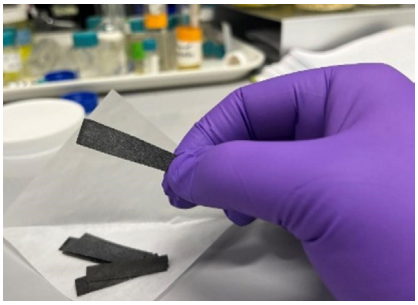

In support of the Clean Enhancing Development and Growth Through Energy (EDGE) Asia initiative—and sponsored by the U.S. Department of State, Bureau of Energy Resources—the Commercial Law Development Program (CLDP) developed an open-access plain language handbook for policymakers on carbon capture, utilization and storage (CCUS). CLDP has the following CCUS-related capabilities: Regulatory Review, Risk Reduction, Standards and Technology Overview, Market Assessment, and CCUS Project Finance. The CCUS Handbook for Policymakers is a starting point for understanding the policies, rules, and best practices that countries can adopt and implement for CCUS.

## FECM Fact Sheet: Voluntary CDR Purchasing Challenge


In March 2024, FECM announced plans to launch the Voluntary CDR Purchasing Challenge, which calls on organizations to purchase high-quality, durable CDR credits. This follows DOE's announcement last year stating that it would become one of the first governments worldwide to procure CDR credits with the Purchase Pilot Prize. To meet midcentury climate goals, CDR must complement, not replace, direct supply chain emissions reductions. FECM's fact sheet provides details on the Voluntary CDR Purchasing Challenge and describes the role of CDR in achieving net-zero greenhouse gas (GHG) emissions.

## NETL Research Targets Degradation of Sorbents Used in DAC

With a long successful history in advancing technologies to capture $CO_2$ from the flue gas streams produced by power plants and other industries, NETL expertise was tapped to intensify research on development of DAC technologies. DAC technologies use sorbents to pull $CO_2$ directly out of the air. Unfortunately, the sorbent materials are vulnerable to oxidation and thermal degradation in the adsorption and regeneration processes, which, over time, can result in reduced effectiveness in $CO_2$ capture and the possible emission of unwanted pollutants. Key parts of the research are designing, testing and validating accelerated aging tests that will help predict long-term aging. By improving the understanding of sorbent degradation, NETL researchers will be able to ensure better, safer DAC implementation.



*NETL researchers are studying how to increase the lifetimes and effectiveness of sorbents used in Direct Air Capture technologies.*

## Regional Decarbonization Workshop Held in Anchorage, Alaska

The United States Energy Association, in cooperation with FECM, DOE's Arctic Energy Office, DOE's Grid Development Office and the National Rural Electric Cooperatives Association, will be hosting a workshop on Regional Decarbonization in Anchorage, Alaska, May 7–8, 2024. This is the first of several regional workshops, with future workshops to be held in the South Central United States (including the Gulf Coast), American Heartlands and Appalachia. These regional workshops are focused on areas of the United States with a strong history and reliance on fossil energy and where FECM and broader DOE program areas are likely to be critical in building a clean energy and industrial economy.

**Regional Decarbonization Series Alaska Workshop**

U.S. DEPARTMENT OF ENERGY
Fossil Energy and Carbon Management

U.S. DEPARTMENT OF ENERGY
ARCTIC ENERGY OFFICE

USEA United States Energy Association

NRECA America's Electric Cooperatives

# Interagency News and Updates (continued)

## FECM Releases New Carbon Management Resource Portal

FECM released a new Carbon Management Resource Portal—a user-friendly platform created to address the following objectives: provide information on the different technology areas that fall under the umbrella term "carbon management" for different knowledge levels; provide information in different formats (including videos, infographics, fact sheets, frequently asked questions [FAQs] and research articles); and provide a mechanism for the public to ask DOE experts questions about the information in this portal.


## DOE STEM Portal

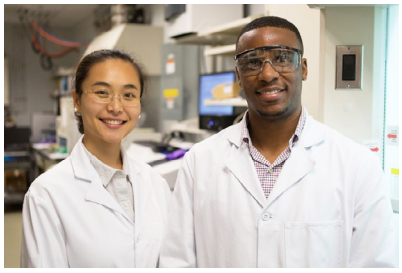
DOE is building pathways for a diverse workforce to pursue careers in science, technology, engineering and mathematics (STEM). DOE seeks to engage learners at all levels to promote STEM and energy literacy and to attract, inspire and develop a STEM identity and a sense of belonging in STEM. DOE is committed 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. Learn more about FECM's *Workforce Programs* and sign up for FECM career alerts 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 is expanding 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.

BIL HUB
Resources for the Bipartisan Infrastructure Law

# U.S. and International Events

## Conference: Carbon Capture APAC 2024

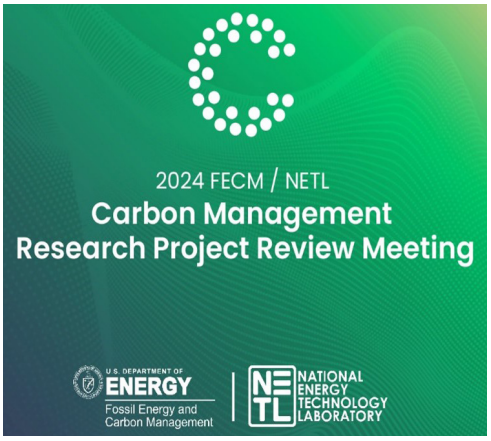
Carbon Capture APAC 2024, to be held July 9–10, 2024, in Melbourne, Australia, is Asia-Pacific's (APAC) leading event for CCUS. This conference brings together international governments and CCUS industry decision-makers to foster regional exchange and enhance industry dynamics. The discussions cover dialogues on topics such as policy, market models, supply chain, technology, international cooperation and the carbon+ economy.

## Conference: 11th International Carbon Dioxide Conference

The 11th International Carbon Dioxide Conference (ICDC11), to be held July 29–Aug. 2, 2024, in Manaus, Brazil, represents an opportunity to consider how improved understanding of terrestrial and oceanic carbon fluxes can inform carbon management and mitigation policy. The conference will provide the platform for a dialogue between communities focused on understanding the latest science, exploring technological capabilities and discussing the needs, priorities and open questions of the policy and management communities.


## Conference: FECM/NETL Carbon Management Research Project Review Meeting

The FECM/NETL Carbon Management Research Project Review Meeting, to be held Aug. 5–9, 2024, in Pittsburgh, Pennsylvania, will provide attendees with a chance to share in the knowledge and insights gained by more than 150 DOE-sponsored R&D projects from the FECM R&D programs: PSCC, CDR, Carbon Conversion, and Carbon Transport and Storage. A mixture of plenary, multi-topic breakout, and interactive poster sessions will be used to share research results and provide opportunities for discussion and collaboration on research efforts, both domestic and international.




## Conference: Climate Week NYC

Climate Week NYC, to be held Sept. 22–29, 2024, in New York, New York, is one of the key summits on the international calendar and has been driving climate action forward since it was first launched by Climate Group in 2009. Climate Week NYC brings together international leaders from business, government and civil society to showcase the unstoppable momentum of global climate action.

# U.S. and International Events (continued)

## 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.

## Carbon Capture Technology Expo Europe

Carbon Capture Technology Expo Europe, to be held Oct. 23–24, 2024, in Messe Hamburg, Germany, is a solutions-driven forum that will discuss the development of new carbon capture technologies and propel carbon capture into the mainstream for stationary and mobile applications. The two-day event will explore how to rapidly accelerate the deployment and commercialization of CDR technologies as a key solution on the pathway to net-zero carbon emissions.

## 2024 National Carbon Capture Conference & Expo

The 2024 National Carbon Capture Conference & Expo, to be held Nov. 19–20, 2024, in St. Paul, Minnesota, is designed for companies and organizations advancing technologies and policy that support CDR from all sources, including fossil fuel-based power plants, ethanol production plants and industrial processes, as well as directly from the atmosphere. The program will focus on research, data, trends and information on all aspects of CCUS with the goal to help companies build knowledge, connect with others and better understand the market and carbon utilization.

## Conference: Deploy24

Hosted by DOE, Demonstrate Deploy Decarbonize 2024 (Deploy24) will be held Dec. 4–5, 2024, in Washington, D.C. Deploy24—the second annual gathering of decision-makers from across the private and public sectors—is focused on accelerating the deployment of critical energy and decarbonization technologies and supply chains in the United States. Deploy24 builds this private-public dialogue through a range of formats, all with a focus on the immediate opportunities and challenges to accelerating domestic energy transformation.

# Business and Industry News

## NCCC Welcomes Chevron as a New Member

The National Carbon Capture Center (NCCC) finalized an agreement welcoming Chevron as the project's newest industrial member. The NCCC's private-industry membership now includes four of the world's top 10 largest energy companies. Chevron's membership reinforces the center's growing focus on advancing the deployment of carbon management technologies. The NCCC, the internationally known DOE facility, provides a neutral research environment to advance technologies that reduce GHG emissions from industrial sources and to promote carbon conversion and DAC solutions. Managed and operated by Southern Company, the NCCC announced it had surpassed 150,000 hours of technology testing earlier this year. By testing and developing more than 80 new technologies, NCCC and its partners have already reduced the projected cost of $CO_2$ capture from fossil-based power generation by more than 40%.

## Northwestern to Lead Midwestern Carbon Capture Hub

Northwestern University is leading one of DOE's Regional DAC Hubs with nearly $4 million invested by DOE and partner companies. The award will be administered through the Paula M. Trienens Institute for Sustainability and Energy. The DOE-funded projects will work to demonstrate the capture, processing, delivery and storage or end-use plans for captured carbon. Called the Midwest Nuclear DAC Hub (MINDAC), the Northwestern-led program will unite a diverse group of research and commercial partner institutions to test the feasibility of using a zero-emission nuclear fleet to power air handling units that remove $CO_2$ from the atmosphere. MINDAC, which officially started on May 1, 2024, is one of only two DAC hubs located in the Midwest, as well as one of two hubs with plans to harness nuclear energy as a power source.

## DOE Study to Assess Shipping Carbon Emissions from Japan for Storage in Alaska

DOE is initiating a formal study of the possibility of capturing carbon emissions in Japan and storing them underground in Alaska, building on recently announced cooperative agreements between Japan and the United States. For years, Alaska exported liquefied natural gas to Japan, contributing to substantial carbon emissions. There is now a proposal to capture these emissions, transport them back to Alaska, and store them underground in Cook Inlet, near Anchorage, as a measure to mitigate climate change. Alaska is currently debating legislation to establish a legal framework for carbon capture and storage (CCS), while Japanese companies are closely monitoring developments in the state. DOE's study will assess the technical and economic feasibility of shipping carbon emissions to Alaska for storage, and also explore potential synergies with Alaska's energy exports, such as hydrogen, to create a comprehensive energy value chain.

# Business and Industry News

## PCCC-7 Proceedings Are Now Available

The 7th edition of the Post-Combustion Capture Conference (PCCC-7) was held in September 2023 and was hosted by the International Energy Agency Greenhouse Gas R&D Programme, DOE and NETL and sponsored by Worley, Shell and Mitsubishi Heavy Industries. Conference proceedings now available online include essential highlights from the conference keynotes, technical sessions and side events.

## Ebb Carbon to Expand mCDR Work

*A view of the Ebb system from within PNNL's lab, courtesy of Ebb Carbon.*

Ebb Carbon has been operating a 100-ton-per-year ocean CDR system at the marine labs at PNNL in Sequim Bay since 2023. The company is now ready to expand to Port Angeles Harbor in a broader study of their new process. The new facility will draw in seawater, pass it through a series of filters that remove the acid, and reintroduce the water into a small area of the harbor. Studying its potential impacts on marine life, such as oysters and eel grass, is a big part of the program. The facility is designed to remove up to 500 tons of $CO_2$ per year from the ocean, and de-acidify up to 70 million gallons of seawater over the two-year program. Once approved, Ebb Carbon could have its new facility operating as early as this fall.

# Publications

## The Impact of Cement Plant Air Ingress on Membrane-Based $CO_2$ 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, ISSUE C, JUNE 2024.

## Experimental Demonstration of Alkalinity Concentration Swing for Direct Air Capture of $CO_2$

*Anatoly Rinberg, Andrew M. Bergman, Michael J. Aziz, Daniel P. Schrag,* NETL, DEC. 21, 2023.

## The Open DAC 2023 Dataset and Challenges for Sorbent Discovery in Direct Air Capture


Anuroop Sriram, Sihoon Choi, Xiaohan Yu, Logan M. Brabson, Abhishek Das, Zachary Ulissi, Matt Uyttendaele, Andrew J. Medford, and David S. Sholl, ACS CENTRAL SCIENCE, VOLUME 10, ISSUE 5, MAY 1, 2024.

## AI for Materials Design and Discovery Using Atomistic Scale Information [Industrial and Governmental Activities]

*Massimiliano Lupo Pasini,* IEEE COMPUTATIONAL INTELLIGENCE MAGAZINE, VOLUME 19, ISSUE 2, APR. 5, 2024. (SUBSCRIPTION MAY BE REQUIRED.)

## Accelerated screening of carbon dioxide capture by liquid sorbents


*Ryan J. R. Jones, Yungchieh Lai, Kevin Kan, Dan Guevarra, Joel A. Haber, Natalia M. Ramirez, Alessandra Zito, Clarabella Li, Jenny Y. Yang, Aaron M. Appe, John M. Gregoire,* DIGITAL DISCOVERY, ISSUE 4, APR. 17, 2024. (SUBSCRIPTION MAY BE REQUIRED.)

## Techno-economic and environmental life cycle assessment of next-generation fiber-encapsulated nanoscale hybrid materials for direct air carbon capture


*Prashant Nagapurkar, Kiran Thirumaran, Michelle K. Kidder,* SUSTAINABLE MATERIALS AND TECHNOLOGIES, VOLUME 39, DEC. 23, 2023. (SUBSCRIPTION MAY BE REQUIRED.)

# About DOE Carbon Capture:

DOE/NETL is developing the next generation of advanced $CO_2$ capture technologies through NETL's Point Source Carbon Capture Program (PSCC) and advancing a diverse set of CDR approaches to directly remove $CO_2$ 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
- CCSI$^2$
- Systems Analysis
- Conference Proceedings
- Accomplishments Posters: PSCC and CDR

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

**www.netl.doe.gov**

**Click here to subscribe or unsubscribe to the CCN.**

**Click here to submit questions, feedback or SUGGESTIONS.**

# Get Social with Us

There are several ways to join the conversation and connect with NETL's Carbon Capture activities:

U.S. DEPARTMENT OF ENERGY | NETL NATIONAL ENERGY TECHNOLOGY LABORATORY