APRIL 2023

GARBON 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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NETL Pittsburgh Site to Host New DAC Center

A new facility will be established at the U.S. Department of Energy/Office of Fossil Energy and Carbon Management's (DOE/FECM) National Energy Technology Laboratory (NETL) Pittsburgh campus with the goal of jumpstarting the development of direct air capture (DAC) technologies that can provide new economic opportunities while lowering the quantities of carbon dioxide (CO_2) in the planet's atmosphere. Last year, Congress authorized \$25 million for the new NETL DAC Center. Scheduled to come online during the summer of 2024, the new facility will accelerate the commercialization of DAC technologies beyond the conceptual stage. The facility will provide developers with the ability to operate over a wide range of conditions, which will enable better understanding of how various DAC technologies respond in different climates, from summer to winter and arid to tropical. Testing systems at three scales will be included at the DAC Center: lab-scale systems designed to examine the longterm stability of DAC materials, bench-scale module testing systems capable of probing flow dynamics, and small pilotscale skid rooms able to test prototype DAC units under a broad range of climate conditions.

Interagency News and Updates

NETL's DAC Research Focuses on Key Decarbonization Goals

NETL's Carbon Dioxide Removal (CDR) Program is fostering applied research and development (R&D) focused on DAC that includes emerging research in biomass carbon removal and storage, enhanced weathering and mineralization, and ocean-based and terrestrial approaches to remove CO₂ that has accumulated in the atmosphere. Sponsored research supports DOE's Carbon Negative Shot—a pathway-neutral "Energy Earthshot" that aims to develop less than \$100/net metric ton CO₂-equivalent removal by 2032, with costs including ongoing monitoring, reporting, and verification (MRV).



NETL Uses Microwaves to Reduce Costs of DAC Technologies

NETL researchers have reported the successful use of microwaves to accelerate sorbent regeneration—results that can lead to substantial reduction of expensive water and energy requirements of some DAC technologies. The study developed a near-room temperature microwave-accelerated regeneration of sorbents process using a basic immobilized amine sorbent for CO_2 capture. The research team published their work in the January 2023 issue of *Materials Today Sustainability*, and discussed it in a Spotify podcast.



NETL Providing Technical Expertise for DAC Prize Competitions

NETL will provide technical support and expertise to award the American-Made DAC Prizes, a series of interconnected competitions offering funding to advance CDR technologies from hard-to-decarbonize sectors of the U.S. economy. Funded by FECM, the DAC Pre-Commercial Prizes offer up to \$15 million split among two competitions: the DAC Pre-Commercial Energy Program for Innovation Clusters (EPIC) Prize offering cash prizes, is open to incubators and accelerators with impactful ideas to develop resources for energy startups and DAC entrepreneurs; and the DAC Pre-Commercial Technology Prize, offering cash prizes and technical assistance, is accepting applications for innovative, scalable technology solutions that address critical needs in the DAC industry. Two informational webinars are scheduled this spring: The DAC Pre-Commercial EPIC Prize webinar, Apr. 12, 2023, and the DAC Pre-Commercial Technology Prize webinar, May 16, 2023.

DOE Announces Funding to Validate Marine CDR Techniques

DOE announced up to \$45 million in funding to support a new program aimed at facilitating the development of the marine carbon dioxide removal (mCDR) industry through scalable MRV technologies. Quantifying and validating ocean carbon capture enables the identification of mCDR techniques that are the most effective and energy efficient in CDR, increasing their value in carbon markets. mCDR has the potential to be a key component in achieving America's net-zero goals.



DOE Announces Funding to Support Transformative Energy Technologies

DOE announced up to \$10 million in funding to identify and support disruptive energy technologies that have the potential to shore up domestic energy production, improve energy efficiency and reliability, reduce GHG emissions, and increase America's resiliency and security. The funding is part of the Advanced Research Projects Agency-Energy (ARPA-E) Exploratory Topic, Creating Revolutionary Energy and Technology Endeavors (CREATE). CREATE projects are intended to help establish potential new areas of technology development and provide ARPA-E with information that could lead to new focused funding programs.



PCCC-7 Call for Abstracts

The call for abstracts is now open for the 7th Post Combustion Capture Conference (PCCC-7), which will take place Sept. 25–27, 2023, as an in-person conference in Pittsburgh, Pennsylvania. All work must be submitted using the PCCC-7 abstract template. Abstracts, including any diagrams and references, are expected to total no more



than one to two pages in length. Seven themes will underpin the content of PCCC-7: Separation Technologies, Process Configurations, Process Applications, Environmental Impacts, Cost Assessment, Process Modelling, and Demonstration Activities. All abstracts must be submitted no later than April 16, 2023. Once the review process is complete, submitting authors will be notified during the first week of May 2023.

DOE Announces Funding to Drastically Reduce Industrial Emissions and Create Healthier Communities

DOE announced approximately \$6 billion in funding to accelerate decarbonization projects in energy-intensive industries and provide American manufacturers a competitive advantage in the emerging global clean energy economy. Funded by the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act and managed by the Office of Clean Energy Demonstrations, the Industrial Demonstrations Program will focus on the highest emitting industries where decarbonization technologies will have the greatest impact. For this funding announcement— *DE-FOA-0002936: Industrial Decarbonization and Emissions Reduction Demonstration-to-Deployment Funding Opportunity Announcement*—DOE seeks first-of-a-kind or early-stage commercial-scale projects and expects to award projects from the highest emitting industries involving cross-cutting technologies that have the greatest potential, directly or indirectly, to achieve significant decarbonization domestically and globally. Concept papers are due Apr. 21, 2023.

NETL Science Bowl Volunteers Inspire Tomorrow's Engineers and Scientists

The volunteers who serve at the annual NETL Science Bowl competitions, (in February and March 2023) all share an unwavering commitment to help the laboratory present exciting, high-quality tournaments that generate enthusiasm for science, technology, engineering, and mathematics (STEM) and encourage middle and high school students to explore STEM-related careers.



DOE Announces Funding for Research on the Science Foundations for Energy Earthshots

DOE announced \$150 million in funding, provided by the Office of Science, to support fundamental research to accelerate breakthroughs in support of the Energy Earthshots Initiative. The awards supported by this

funding opportunity will bring together small teams focused on the crosscutting scientific challenges addressing multiple Energy Earthshots. Research will support basic science to seed innovations or to provide the scientific understanding to support existing technology development pathways for the needed portfolio of Energy Earthshot solutions. The submission deadline for pre-applications is Apr. 25, 2023; submission deadline for applications is June 21, 2023.

DOE Launches Foundation for Energy Security and Innovation

DOE released a Request for Information (RFI) seeking public and stakeholder input on the department's first ever agency-related foundation. Authorized by President Biden's bipartisan CHIPS and Science Act of 2022, the Foundation for Energy Security and Innovation (FESI) will support DOE to carry out its critical mission to ensure America's continued security and prosperity through transformative science and technology solutions. A key aim of FESI is to accelerate the commercialization of new and existing energy technologies by raising and investing funds through engagements with the private sector and philanthropic communities.

Latest Edition of NETL SSAE Newsletter Now Available

The Strategic Systems Analysis and Engineering (SSAE) directorate provides the decision science and analysis capabilities necessary to evaluate complex energy systems. SSAE's capabilities address technical, economic, resource, policy, environmental, and market aspects of the energy industry. These capabilities are critical to strategic planning, direction, and goals for technology R&D programs and the generation of market, regulatory, and technical intelligence for NETL senior management and DOE. SSAE offers a range of multi-criteria and multi-scale decision tools and approaches for this support.

GHGT-16 Summary Brochure Available

The International Energy Agency Greenhouse Gas R&D Programme (IEAGHG) Greenhouse Gas Control Technologies (GHGT) Conference Series is the principal international conference on greenhouse gas (GHG) mitigation technologies, focusing on carbon capture, utilization, and storage (CCUS). IEAGHG's GHGT-16 brochure gives a comprehensive summary of the four days of the 2022 conference, and presents reflections and outcomes, key learnings, and discussion points.







Latest Edition of NETL Edge Now Available

NETL released the latest edition of its semiannual publication that showcases research on emerging energy technologies. *NETL Edge* shares the latest developments in the laboratory's mission to drive innovation and deliver solutions for an environmentally sustainable and prosperous energy future. This issue features work underway at NETL to develop and deploy safe, effective, wide-spread hydrogen-related technologies, including advancements to enable co-gasification technology, coupled with carbon capture, utilization,



and storage, to produce cleaner hydrogen for a net-zero carbon emissions future. Check out the newly released edition of *NETL Edge* to learn more about how NETL is positioned as a key research partner for advancing a hydrogen energy economy.

DOE Invests Funding in CCS Technologies

FECM is providing the funding for three CO_2 storage projects and two carbon conversion projects selected under the Accelerating Carbon Capture and Storage Technologies (ACT) initiative's fourth call for projects. The ACT is a multi-national program to facilitate international collaboration on R&D and technology innovation to accelerate the global deployment of carbon capture and storage (CCS) and carbon conversion technologies. The three selected CO_2 storage projects will explore options for geologic storage sites, and solutions for CO_2 transport, injection, and monitoring.

FECM's Engagement Home Page

FECM fosters and leverages connections with international and domestic partners; collaborates within DOE and the broader U.S. government; supports community, tribal, and stakeholder engagement; and encourages public-private partnerships to assist in meeting the Biden administration's climate goals. FECM's Engagement page includes links to upcoming events, news and blogs, and other resources.

CDR Interactive Project Map

The CDR interactive project map contains information for active and inactive projects managed under NETL's Point Source Carbon Capture and CDR programs. The map data can be filtered to view specific information related to projects with certain criteria, such as the point source capture approach, technology, ending scale, application type, and key technology.



Apply to Review FECM Funding Opportunity Applications

FECM is looking for a diverse pool of individuals to review the equity, justice, jobs, and community engagement sections of funding opportunity applications. To apply to review, send a resume to SCI_FECM@NETL.DOE.GOV. Reviewers should have academic, subject matter, and/or practitioner experience in at least one of following areas: diversity, equity, inclusion, and accessibility; community and stakeholder engagement; workforce development and quality jobs; and environmental justice.

DOE STEM Portal

DOE is building pathways for a diverse workforce to pursue 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.

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. In the next few 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 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

CCUS 2023

CCUS 2023, to be held Apr. 25–27, 2023, at the University of Houston in Houston, Texas, will highlight current CCUS work and address related challenges, including subsurface geologic storage and site selection; CO_2 enhanced hydrocarbon recovery and utilization; reservoir modeling monitoring and risk assessment; case studies; industry applications; economics, incentives, and policy; infrastructure; and non-technical considerations.

GRC on Carbon Capture, Utilization, and Storage

The fifth edition of the Gordon Research Conference (GRC) on Carbon Capture, Utilization, and Storage— "Transformative Science for the New Carbon Economy"—will be held May 28–June 2, 2023, in Les Diablerets, Switzerland. The conference will examine scientific advances covering all dimensions of the anthropogenic carbon cycle, from capturing hard-to-abate CO_2 emissions to using CO_2 as feedstock and generating negative emissions by removing CO_2 from the atmosphere and oceans.



BIL*HUB Resources for the Bipartisan Infrastructure Law



U.S. and International Events (continued)

2023 IEW

The 41st edition of the International Energy Workshop (IEW), to be held in Golden, Colorado, June 13–15, 2023, will be co-hosted by the Colorado School of Mines and the National Renewable Energy Laboratory. Researchers and practitioners from countries around the world are invited to submit original papers with new and innovative results on scientific, technical, and practical experience on the economics of energy and climate systems.

Carbon Capture Summit 2023

The key focus for the Carbon Capture Summit 2023, to be held June 26–27, 2023, in Amsterdam, The Netherlands, will be "working in collaboration

CO2 CARBON CAPTURE SUMMIT

with industry" by sharing expertise, building capacity, and providing advice and support so CCUS can play an integral role in reducing carbon emissions. Government agencies, global corporations, research bodies, and non-government organizations (NGOs) committed to learning and adopting CCUS technologies will participate in the event.

Carbon Capture Technology Expo

The Carbon Capture Technology Expo, to be held June 28–29, 2023, in Houston, Texas, 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 NGOs, consultants, and government bodies to explore how to rapidly accelerate the deployment and commercialization of CDR technologies as a key solution on the pathway to net-zero carbon emissions.

Hydrogen Technology Conference & Expo

The Hydrogen Technology Conference & Expo, to be held June 28–29, 2023, in Houston, Texas, is dedicated to discussing advanced technologies for the hydrogen and fuel cell industry. The event brings together the entire hydrogen value chain to focus on developing solutions and innovations for low-carbon hydrogen production, efficient storage and distribution, as well as applications, in a variety of stationary and mobile applications.

Clearwater Clean Energy Conference

The 47th Clearwater Clean Energy Conference, to be held July 23–28, 2023, in Clearwater, Florida, provides essential information to power generators who must meet the challenges of energy utilization in the 21st century. The conference will include more than 200 technical presentations in four days, all offered both in-person and virtually.

PCCC-7

The next PCCC-7 will be in person, Sept. 25–27, 2023, in Pittsburgh, Pennsylvania. The conference format will consist of a two-stream program for oral presentations, a poster session, and a small exhibition area.



Business and Industry News

CarbonSAFE Study at Cement Plant Funded by DOE

Heidelberg Materials North America has been awarded \$8.9 million in funding from DOE's Carbon Storage Assurance Facility Enterprise (CarbonSAFE) initiative to study the subsurface geology for suitability for the storage of CO_2 at its new state-of-the-art cement plant in Mitchell, Indiana. The award, managed by NETL, will be issued to the Illinois State Geological Survey at the University of Illinois (ISGS) as the prime contractor, with the company acting as a technical and industrial partner. The new Mitchell cement plant will more than triple its current capacity and incorporates features to minimize energy consumption and enable the use of alternative fuels and raw materials to reduce GHG emissions.



New Heidelberg Materials Cement Plant in Mitchell, Indiana (Source: Heidelberg Materials North America)

UC Merced to Join DOE-Funded EFRC

Through a DOE grant, a group of scientists, including a chemist from the University of California (UC) Merced, plans to address the problem of energy- and cost-intensive CO_2 conversion by coupling carbon capture sorbents and carbon conversion catalysts, both of which were developed independently but now will be integrated into one material. Led by a professor at UC Irvine, Department of Chemistry and Biochemistry Professor Michael Findlater is part of the group that has formed a new DOE Energy Frontier Research Center (EFRC). UC Irvine's Center for Closing the Carbon Cycle plans to advance the understanding of sorbents and catalysts so they can be co-designed to work cooperatively to achieve more active, efficient, and durable systems for reactive capture, turning the CO_2 into materials such as fuels and industrial chemicals.

Incorporation of market signals for the optimal design of post combustion carbon capture systems

Radhakrishna Tumbalam Gooty, Jaffer Ghouse, Quang Minh Le, Bhurisa Thitakamol, Sabereh Rezaei, Denis Obiang, Raghubir Gupta, James Zhou, Debangsu Bhattacharyya, David C. Miller, Applied Energy, Volume 337, May 1, 2023. (Subscription may be required.)

Facilitated transport membranes for CO₂/CH₄ separation - State of the art *Hongfang Guo, Jing Wei, Yulei Ma, Jing Deng, Shouliang Yi, Bangda Wang, Liyuan Deng, Xia Jiang, Zhongde Dai,* Advanced Membranes, Volume 2, 2022.

Ultra-selective membrane composed of charge-stabilized fixed carrier and amino acid-based ionic liquid mobile carrier for highly efficient carbon capture

Huanghe Li, Fan Wang, Huazheng Li, Bratin Sengupta, Dinesh Kumar Behera, Shiguang Li, Miao Yu, Chemical Engineering Journal, Volume 453, Part 2, Feb. 1, 2023. (Subscription may be required.)

A multi-criteria CCUS screening evaluation of the Gulf of Mexico, USA Anna Wendt, Alana Sheriff, Chung Yan Shih, Derek Vikara, Tim Grant, International Journal of Greenhouse Gas Control, Volume 118, July 2022.

Engineering Design of a Linde-BASF Advanced Post-Combustion CO₂ Capture Technology at a Linde Steam Methane Reforming H₂ Plant

Minish M. Shah, Bradley McClean, Krish Krishnamurthy, Mary Uselmann, Jason Haley, Torsten Stoffregen, Torsten Richter, Hans-Joerg Grindel, John Nichols, NETL, Nov. 3, 2022.

Large-Scale Commercial Carbon Capture Retrofit of the San Juan Generating Station

Cindy A. Crane, FECM, Sept. 30, 2022.









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 and the Carbon Dioxide Removal Program.



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 Dioxide Removal Program Fact Sheet
- Carbon Capture Infographics
- Compendium of Carbon Capture Technology
- Carbon Dioxide Capture Handbook
- CCSI²
- Systems Analysis
- Conference Proceedings
- Accomplishments Posters
- Fossil Energy Techlines

Contact Us

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