

CARBON CAPTURE NEWS LETTER

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



HIGHLIGHTS

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

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DOE Selects 12 Projects to Improve Fossil-Based Hydrogen Production, Transport, Storage, and Utilization

The U.S. Department of Energy (DOE) selected 12 projects to receive federal funding for cost-shared cooperative agreements to help recalibrate the nation's vast fossil-fuel and power infrastructure for decarbonized energy and commodity production. The selected projects will develop technologies for the production, transport, storage, and utilization of fossil-based hydrogen (H₂), with progress toward net-zero carbon emissions. DOE's National Energy Technology Laboratory (NETL) will manage the projects, which fall under several areas of interest (AOIs). The AOIs of particular interest to NETL's Carbon Capture Program and corresponding selected projects are as follows:

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DOE Selects 12 Projects to Improve Fossil-Based Hydrogen Production, Transport, Storage, and Utilization (continued)

AOI 7A: Advanced [Carbon Capture, Utilization, and Storage (CCUS)] Systems from Steam Methane Reforming Plants

Engineering Study of Svante's Solid Sorbent Post-Combustion CO₂ Capture Technology at a Linde Steam Methane Reforming H₂ Plant—Linde Inc. (Danbury, CT) will complete an initial engineering design of a commercial-scale carbon dioxide (CO₂) capture plant that uses the Svante VeloxoTherm™ solid adsorbent CO₂ capture technology to separate CO₂ from a steam methane reformer (SMR), producing blue H₂. The overall system would be designed to capture approximately 1,100,000 tonnes/year net CO₂ with 90% or greater carbon capture efficiency while producing H₂ with 99.97% purity, from an existing Linde SMR H₂ plant along the US Gulf Coast. The project is intended to achieve the overall DOE performance goals of a 90% CO₂ capture rate with 95% CO₂ purity from a SMR plant producing 99.97% H₂ from natural gas.

Initial Engineering Design Study for Advanced CO₂ Capture from Hydrogen Production Unit at Phillips 66 Rodeo Refinery—Phillips 66 (Houston, TX) will complete an initial engineering design of a commercial scale, advanced CO₂ capture and storage (CCS) plant that separates and stores approximately 190,000 tons/year net CO₂ with more than 90% carbon capture efficiency from an existing steam reforming plant at Phillips 66 Rodeo Refinery in California. The goal of this project is to advance the CCS technology for commercialization in a steam reforming plant application.

AOI 7B: Advanced CCUS Systems from [Autothermal Methane Reforming (ATR)] Plants

Blue Bison ATR Advanced CCUS System—Initial Engineering of a 1.66 [million tonnes per year (MTPY)] CO₂ Capture Unit from Tallgrass Planned Blue Bison ATR Producing 220 [million standard cubic feet per day (MMSCFD)] of Pure Hydrogen—Tallgrass MLP Operations LLC (Johnson, KS) will design a commercial-scale carbon capture unit capable of separating and storing 1.66 MTPY of 95% pure CO₂ with more than 97% carbon capture efficiency. As designed, the Blue Bison plant will, for the first time, combine carbon capture, pure H₂ production (220 MMSCFD at 99.97% purity), and H₂ combustion in auxiliary burners. This project would act as a precursor to the proposed development of a replicable world scale ATR blue H₂ plant that could produce a cost competitive, carbon-neutral fuel that can significantly decarbonize the energy economy while simultaneously capitalizing on the nation's vast natural resources.

Interagency News and Updates

NETL Advancing Decarbonization Through Direct Air Capture

NETL researchers are using analytical tools and modeling to determine the efficiency and cost effectiveness of technologies that can pull CO₂ from ambient air and help reduce greenhouse gas (GHG) levels in Earth's atmosphere. NETL is well-positioned to lead the development of direct air capture (DAC) technology. Using advanced process software modeling, simulation, and optimization techniques, NETL is generating process material and energy balances, which enable equipment sizing and cost estimating. While researchers are at work refining and developing DAC technologies, information from these analyses ensure that they are applying their skills to the most worthwhile tasks to keep their research on a successful path toward commercialization. Results obtained from NETL's techno-economic analyses are used to guide research and ensure advanced technologies are on target to meet DOE goals.



NETL Director to Present Keynote on Energy Decarbonization Efforts

NETL Director Brian Anderson, Ph.D., presented the [keynote address](#), "Paving the Way to a Decarbonized Energy Future," on June 23, 2021, during the POWERGEN+ Series: The Future of Electricity. By undertaking a diverse mix of critical projects, NETL is leading efforts to meet the goals of the Biden Administration calling for a carbon emission-free electricity sector by 2035 and economy-wide net-zero emissions by 2050.

Decarbonizing Through DAC

Throughout June 2021, NETL highlighted work in DAC and a related technology called bioenergy with carbon capture and storage (BECCS), which involves the use of biomaterials that naturally remove CO₂ during their life cycle and then are burned to generate power in systems with CCS or converted to fuels or chemicals. For example, NETL researchers are using analytical tools and modeling to determine the efficiency and cost effectiveness of DAC technologies to help reduce GHG levels in Earth's atmosphere. NETL researchers are using experimental and computational methods to design and synthesize novel materials that can become part of viable, affordable DAC processes. NETL is advancing DAC and BECCS by engaging in extramural collaborations with the private sector, academia, and other national laboratories.

What Biden's Budget Plan Means for Energy

President Biden's first full budget request positions DOE and related agencies toward efforts to reach zero carbon emissions by 2050. Biden's budget request would dedicate \$890 million to the Office of Fossil Energy and Carbon Management (FECM)— an 18.7% increase from 2021's \$750 million. Programs with increased funding from 2021 include CCS as well as natural gas technologies. The proposed budget increases for carbon capture and removal reflect the administration's priority to orient the office around its climate goals. The budget has a dedicated line for carbon dioxide removal, or CDR, for the first time, listing \$63 million for the technology. CDR refers to activities that pull CO₂ from the atmosphere, which can then be stored underground or used in products. DOE's "Budget in Brief" document said the "reallocations will enable near-term work to develop and deploy carbon solutions for the power and industrial sectors." (*Subscription may be required.*)

Interagency News and Updates

Secretary Granholm Testifies Before U.S. Senate Committee on Energy and Natural Resources

Secretary Granholm testified before the Senate Committee on Energy and Natural Resources on June 15, 2021, to discuss President Biden's 2022 discretionary budget for DOE. Secretary Granholm made note of the Energy Earthshots initiative, which is a series of ambitious, achievable targets aimed at commercializing zero-carbon technologies. (The first Energy Earthshot, launched June 7, 2021—Hydrogen Shot—seeks to reduce the cost of clean hydrogen by 80% to \$1 per 1 kilogram in 1 decade.) She also announced the \$12 million funding opportunity to advance DAC technologies. The budget would also enable the DOE National Labs to expand research in clean energy and carbon reduction and to continue efforts already underway: strengthening national security and accelerating progress toward a net-zero economy.



Acting Assistant Secretary for FECM Gives Remarks at First Asia CCUS Network Forum

On June 22, 2021, DOE's Acting Assistant Secretary for FECM, Dr. Jennifer Wilcox, provided remarks at the First Asia CCUS Network Forum, an event that convened government officials, industry, and academia from across the globe to discuss the shift to a cleaner energy landscape. The event focused on global goals and expectations for CCUS and how advances in the technology can help combat the global climate crisis. Dr. Wilcox focused her remarks on the need for global participation and coordination to advance solutions and respond to the threats of climate change. She went on to state that a global focus on CCUS technology advancement is important for the transition to a clean energy economy—highlighting efforts to date, as well as the potential to keep moving CCUS technologies forward.

U.S. to Launch DAC Research Challenge at Climate Change Conference

Elizabeth Urbanas, DOE's Acting Assistant Secretary for International Affairs, said DOE wants to launch a research program at the 26th Climate Change Conference of the Parties (COP26; scheduled for November 2021 in Glasgow, Scotland) for research in DAC technologies, and will open it up to European scientists.

DOE Announces Intent to Fund Direct Air Capture FEED Studies

The U.S. Department of Energy's (DOE) Office of Fossil Energy and Carbon Management (FECM) issued a Notice of Intent (NOI) for a Funding Opportunity Announcement (FOA) to support front-end engineering design (FEED) studies of direct air capture (DAC) combined with dedicated storage and coupled to existing low-carbon energy. If the FOA is issued, it will support the advancement of DAC technologies that remove carbon dioxide (CO₂) directly from the atmosphere. Additionally, a minimum of 20% cost share will be required. The NOI, issued in collaboration with the Office of Nuclear Energy and the Office of Energy Efficiency and Renewable Energy's Geothermal Technology Office, provides additional time to obtain non-federal resources. Read the full Notice of Intent [here](#).

U.S. and International Events

2021 Carbon Management and Oil and Gas Research Project Review Meeting

The NETL 2021 Carbon Management and Oil and Gas Research Project Review Meeting will be held virtually Aug. 2–31, 2021. This [project review meeting](#) will allow researchers to present results from projects funded through a wide variety of DOE’s program areas. The Integrated CCUS Projects and FEED Studies webinar will be held Aug. 2–3, 2021 ([register online](#)). The Point Source Capture—Lab, Bench, and Pilot-Scale Research webinar will be held Aug. 12–13 and 16–17 2021 ([register online](#)). The Carbon Dioxide Removal Research webinar will be held Aug. 18–19, 2021 ([register online](#)). This [project review meeting](#) will allow researchers to present results from projects funded through a wide variety of DOE’s program areas. The meeting will provide updates and results for more than 250 DOE-sponsored projects.

International Pittsburgh Coal Conference

The 2021 International Pittsburgh Coal Conference (PCC), sponsored by the University of Pittsburgh, Swanson School of Engineering, will be held virtually Sept. 20–23, 2021. The annual event is focused on all aspects of coal, energy, and the environment. It aims at fulfilling the ultimate goal of efficient and effective use of coal while protecting the environment. The PCC provides a unique opportunity for in-depth and focused exchange of technical information and policy issues among representatives from industry, government, and academia throughout the world.



**INTERNATIONAL PITTSBURGH
COAL CONFERENCE**
University of Pittsburgh · Swanson School of Engineering

Global Energy Show Exhibition & Conference

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



IEAGHG 6th Post-Combustion Capture Conference

The IEA Greenhouse Gas R&D Programme’s (IEAGHG) 6th Annual Post-Combustion Capture Conference will be held in the United Kingdom Oct. 19–21, 2021. The event will gather post-combustion capture experts to share their knowledge, findings, and expertise.

Carbon Capture Technology Conference and Expo

The Carbon Capture Technology Conference and Expo is a two-day event to be held Oct. 20–21, 2021, in Stuttgart Messe, Germany. Experts from around the world will discuss the latest advances in new technology for carbon capture, storage, and transport, as well as unique ways of utilizing CO₂ to produce net-zero fuels and for other manufacturing processes.

U.S. and International Events (continued)

Gordon Research Conference: Permanently Removing CO₂ from Our Emissions and Atmosphere

The fourth installation of the CCUS Gordon Research Conference series, to be held Oct. 24–29, 2021, in Waterville Valley, New Hampshire, will examine the following questions: (1) *Can the United States decarbonize safely and with a variety of approaches appropriate for the assortment of power and industrial challenges?* and (2) *Can the United States develop methods to clean up the atmosphere in time to keep within reasonable temperature limits?*

26th UN Climate Change Conference of the Parties

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

Business and Industry News

Dastur Selected by DOE to Design and Engineer Industrial-Scale Carbon Capture Project

Dastur International, Inc. has been selected for DOE funding for a study of the design and engineering of a carbon capture project for a large integrated steel producer in North America. The project is designed to enable the production of low-carbon emissions steel through CO₂ capture of up to 2 million tonnes per year from the available blast furnace gases. Dastur is the Prime Recipient of the funding and will be supported by Boulder, Colorado-based ION Clean Energy, Inc. and Austin, Texas-based University of Texas at Austin's Jackson School of Geosciences. Addressing a major share of carbon emissions in the integrated steelmaking process, the project aims to design an industrial-scale and cost-effective solution for the capture and disposition of CO₂ and provide an H₂-rich gas stream for meeting the energy needs of the host steel plant. Dastur's proposed approach and design targets to bring down the cost of capture and disposition to approximately \$40/metric ton of CO₂, a significant improvement over incumbent solutions in the \$60–100/metric ton range.

Sempra, DOE Looking to Partner on Low-Carbon Solutions

DOE's National Renewable Energy Laboratory (NREL) signed a memorandum of understanding (MOU) with San Diego-based Sempra Energy to work on decarbonization strategies. In the MOU, Sempra and NREL agreed to focus on advancing artificial intelligence to scale solutions across the United States. They also plan to integrate low-carbon fuel solutions, including H₂, renewable natural gas, CCS, and fuel cells. In addition, they are exploring 100% renewable energy communities, as well as enhancing electric grids. Sempra's Southern California Gas Co. (SoCalGas) and San Diego Gas and Electric Co. (SDG&E) intersect with the broader economy through the ports of Los Angeles and Long Beach and through U.S. Navy operations in San Diego. The MOU builds off of 10 years of collaboration and is intended to advance net-zero energy systems, which already are underway.

Publications

Model Development, Validation, and Optimization of an MEA-Based Post-Combustion CO₂ Capture Process under Part-Load and Variable Capture Operations

PAUL AKULA, JOHN ESLICK, DEBANGSU BHATTACHARYYA, DAVID C. MILLER, IND. ENG. CHEM. RES., VOLUME 60, ISSUE 14, MARCH 31, 2021. (SUBSCRIPTION MAY BE REQUIRED.)

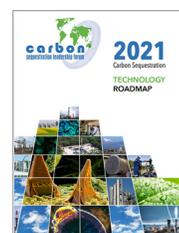


Scalable Polymeric Few-Nanometer Organosilica Membranes for Pre-Combustion CO₂ Capture

LINGXIANG ZHU, LIANG HUANG, SURENDAR R. VENNA, ADRIENNE BLEVINS, YIFU DING, DAVID HOPKINSON, MARK T. SWIHART, HAIQING LIN, JOULE, FEBRUARY 2, 2021. (SUBSCRIPTION MAY BE REQUIRED.)

2021 Carbon Sequestration Technology Roadmap

CARBON SEQUESTRATION LEADERSHIP FORUM, MAY 2021.

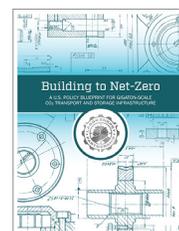


Advances and emerging techniques for energy recovery during absorptive CO₂ capture: a review of process and non-process integration-based strategies

KELVIN O. YORO, MICHAEL O. DARAMOLA, PATRICK T. SEKOAI, EDWARD K. ARMAH, UWEMEDIMO N. WILSON, RENEWABLE AND SUSTAINABLE ENERGY REVIEWS, VOLUME 147, SEPTEMBER 2021. (SUBSCRIPTION MAY BE REQUIRED.)

Building to Net-Zero: A U.S. Policy Blueprint for Gigaton-Scale CO₂ Transport and Storage Infrastructure

LABOR ENERGY PARTNERSHIP, JUNE 30, 2021.



Carbon dioxide capture with aqueous amino acids: Mechanistic study of amino acid regeneration by guanidine crystallization and process intensification

ABISHEK KASTURI, JORGE GABITTO, COSTAS TSOURIS, RADU CUSTELCEAN, SEPARATION AND PURIFICATION TECHNOLOGY, VOLUME 271, SEPTEMBER 15, 2021. (SUBSCRIPTION MAY BE REQUIRED.)

About DOE's Carbon Capture Program

NETL's Carbon Capture Program is developing the next generation of advanced carbon dioxide (CO₂) 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 CO₂ 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
- Carbon Capture Interactive Project Map
- Compendium of Carbon Capture Technology
- Carbon Dioxide Capture Handbook
- CCSI²
- Systems Analysis
- Conference Proceedings
- Accomplishments Posters
- Fossil Energy Techlines

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