NATIONAL ENERGY TECHNOLOGY LABORATORY

JULY 2023

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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2023 FECM/NETL Carbon Management Research Project Review Meeting

The U.S. Department of Energy (DOE) Office of Fossil Energy and Carbon Management (FECM)/National Energy Technology Laboratory (NETL) Carbon Management Research Project Review Meeting will be held Aug. 28–Sept. 1, 2023, in Pittsburgh, Pennsylvania. The meeting will provide attendees with a chance to share in the knowledge and insights gained by more than 150 DOE-sponsored research and development (R&D) projects from the following FECM R&D programs: Point Source Carbon Capture (PSCC), Carbon Dioxide Removal (CDR), Carbon Conversion, and Carbon Transport and Storage (CTS). 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 the subject research efforts, both domestic and international. In addition to the project researchers, participants may include employees of other government agencies, electric utilities, research organizations, and industry. The meeting will be co-located with the United States Energy Association's (USEA) inaugural Carbon Management Technology Showcase (CMTS). *Note that registration for the CMTS is separate from the registration for the 2023 FECM/NETL Carbon Management Research Project Review Meeting.*

Interagency News and Updates

DOE Announces Funding for Carbon Capture, Transport, and Storage to Reduce Carbon Pollution

FECM and NETL announced up to $45.5 million in funding available to advance carbon dioxide (CO_2) capture technologies and help establish the foundation for a successful CTS industry in the United States. Projects selected under this funding opportunity announcement (FOA) will focus on two areas: (1) developing lower cost, highly efficient technologies for carbon capture from power and industrial facilities that will capture CO_2 for geologic carbon storage or for conversion into long-lasting products like concrete; and (2) accelerating the deployment of multi-modal transport of CO_2 through the creation of transportation hubs. Preliminary engineering design studies will consider how hubs will connect multiple transport modes of CO_2 with the aim of developing cost-efficient, long-term transportation options for all types of CO_2 sources.

NETL Visits Side-By-Side PSCC Projects

Project leaders from DOE and NETL visited Deer Park Energy Center (near Houston, Texas), a natural gas cogeneration facility, and the neighboring Shell petrochemical plant, which uses steam generated by the cogeneration facility in its production operations. In addition to supplying steam to the adjacent Shell operation, the Deer Park Energy Center generates electric power that is sold to the wholesale market. The front-end engineering design (FEED) study was completed on a modular, commercial-scale post-combustion carbon capture (PCC) system to capture 95% of the total CO_2 emissions from the flue gas generated by the cogeneration facility. A FEED study is being completed for a second PCC system at the Deer Park site to separate and capture more than 820,000 metric tons of CO_2 emissions per year from the co-located Shell Chemicals Complex. The captured CO_2 will be collected, dehydrated, and compressed so that it is the appropriate quality for CTS. Both projects will utilize Shell's CANSOLV technology.

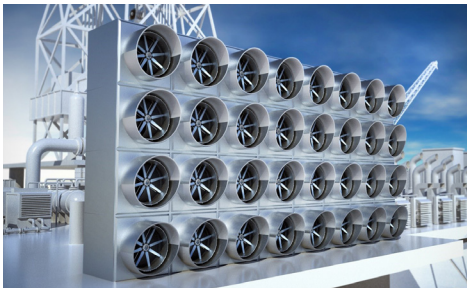
Pictured at the Deer Park Energy Center, from left, are Brent Dueitt (Calpine), Nicole Shamitko-Klingensmith, Mariah Young, Ron Munson, Eric Grol, Raj Gaikwad and Carl Herman (Calpine)

NETL Researcher Honored by NAMS

NETL's Lingxiang Zhu, a researcher who specializes in the development of membranes to capture CO_2 from industrial sources, received the 2023 Young Membrane Scientist Award at the North American Membrane Society (NAMS) annual meeting in May 2023. Zhu was nominated for the award by David Hopkinson, the technical portfolio lead for PSCC at NETL. During his time at NETL, Zhu demonstrated an exceptionally high level of skill and leadership in polymer membrane design for gas separations, with his work consistently being selected for funding through DOE field work proposals.

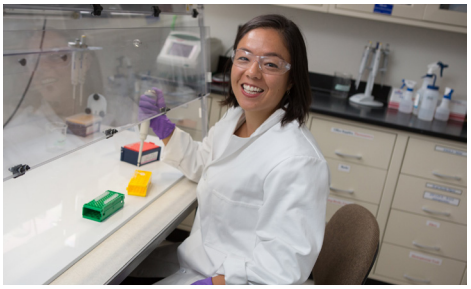
Interagency News and Updates (continued)

DOE Addressing Climate Change by Removing Carbon Pollution from Air



In addition to funding R&D of CDR technologies, DOE is collaborating with industry and organizations on both the national and global levels to help spur innovation and reduce costs to expand the market for these technologies. DOE launched Carbon Negative Shot—a call for innovation in CDR pathways that will capture CO_2 from the atmosphere and store it at gigaton scales for less than $100/net metric ton of CO_2-equivalent. Check out the video, which provides more information about the importance of CDR. As a co-lead of the CDR Launchpad, DOE and a coalition of countries, including Canada, the European Commission, Iceland, Japan, Norway, and the United Kingdom, are working to reduce the costs and accelerate the development of CDR technologies.

NETL Goes Deep to Develop New Biocatalysts for Carbon Conversion



NETL researcher Djuna Gulliver

NETL researchers are growing versatile biocatalysts using microbes from a coalbed methane (CBM) well to convert industrial CO_2 wastes and other single-carbon compounds into useful chemicals to manufacture biofuel, food additives, and other high-value products while reducing emissions of greenhouse gas (GHG). In testing completed at NETL, researchers found the microbes from the CBM well, which was drilled in an Appalachian coal seam as part of a mining operation, generated a biocatalyst that outperformed other biocatalysts from microbes collected at oil and natural gas well sites and other locations. The recently developed biocatalyst converts the CO_2 feedstock into "bio-acetate," which can then be used to produce food additives, a pickling agent, a laboratory reagent, and other useful products. It also can act as a feedstock to be further converted into butanol, a biofuel.

Carbon Capture Large-Scale Pilots Notifications

In May 2023, DOE's Office of Clean Energy Demonstrations (OCED) responded to concept papers submitted for the Carbon Capture Large-Scale Pilot Projects Program. Funded by the Bipartisan Infrastructure Law (BIL), this program will help de-risk transformational carbon capture technologies and catalyze significant follow-on investments for commercial-scale demonstrations on carbon emission sources across the power and industrial sectors. In February 2023, DOE announced an $820 million funding opportunity for up to 10 projects designed to further the development of transformational technologies that capture carbon emissions from existing coal or natural gas electric generation facilities and existing industrial facilities not purposed for electric generation. For the first stage of this process, OCED required concept paper submittals and reviewed 30 submissions, of which 19 were encouraged to submit a full application. The full application deadline has been extended to July 7, 2023, at 5 p.m., ET, and DOE expects to select projects for awards negotiations in September 2023.

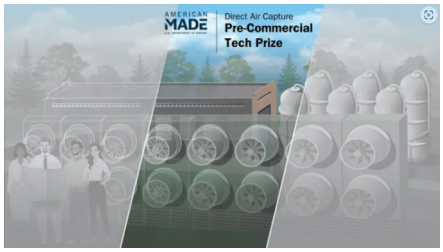
OCED
Office of Clean Energy Demonstrations

Interagency News and Updates (continued)

Salt Lake City, Utah, Regional Carbon Management Applicant Education Workshop Held

The third and final in-person Regional Carbon Management Applicant Education Workshop supported implementation of the BIL and targeted potential applicants interested in developing commercial-scale storage facilities, PSCC demonstration projects, DAC hubs, hydrogen production hubs with carbon capture and storage (CCS), carbon utilization, and CO_2 transport. DOE will address various components of large-scale projects, such as atmospheric carbon capture and PSCC; commercial CTS; developing teams for integrated projects; DOE procurement requirements and processes; National Environmental Policy Act requirements and processes; lessons learned from past demonstration projects; alternate opportunities for carbon management; environmental justice and community engagement requirements; energy jobs; partnering with tribal nations; regulatory requirements; and land and pore space access opportunities. The presentations from this event have been posted on the website.

DAC Pre-Commercial Technology Prize



The DAC Pre-Commercial Technology Prize awards up to $3.2 million in cash prizes and $800,000 in technical assistance vouchers to teams that identify a critical need in the DAC industry, develop a solution to address this gap, and test the idea to a degree of scale. It focuses on the steps of ideation and entrepreneurship needed to prepare technologies and businesses for commercialization. The DAC Pre-Commercial Technology Prize is part of a suite of interconnected competitions in the American-Made DAC Prize program. Understanding that there are several steps to move from an idea to a marketable product, the DAC Prizes are a suite of prizes that work together to advance CDR technologies and the incubators that make this process possible. The deadline to apply for the first phase is Sept. 29, 2023.

DE-FOA-0002989: Sensing Exports of Anthropogenic Carbon Through Ocean SEA-CO_2

DOE's Advanced Research Projects Agency—Energy (ARPA-E) has released a FOA on Marine CDR (mCDR). mCDR will be an essential component of a future negative emissions industry. The Sensing Exports of Anthropogenic Carbon Through Ocean Observation (SEA-CO_2) Program seeks to accelerate the development of the mCDR industry through the development of scalable MRV technologies. MRV must be of sufficient quality to quantify carbon drawdown magnitudes, the degree of permanence, and bound the uncertainties associated with these parameters so that carbon markets can ascertain credit quality and financial institutions can make informed decisions regarding investment risk.

Interagency News and Updates (continued)

CEQ Announces Members of Task Forces to Inform Responsible Development and Deployment of CCUS

The White House Council on Environmental Quality (CEQ) announced members of two new task forces that will provide input to inform the responsible development of carbon capture, utilization, and storage (CCUS). The task forces will provide recommendations to the federal government on how to ensure that CCUS projects, including CO_2 pipelines, are permitted in an efficient manner, reflect the input and needs of a wide range of stakeholders, and deliver benefits rather than harms to local communities. CEQ sought applications from a diverse range of candidates. The members of the new committees have experience with CCUS, including on matters of environmental justice and CO_2 pipeline safety, and represent state, local, and tribal governments; federal agencies; environmental non-governmental organizations (NGOs); and developers or operators of CCUS projects.

Biden-Harris Administration Releases Updated Fact Sheets Highlighting BIL Investments

As part of President Biden's Investing in America agenda, the Biden-Harris administration has announced more than $220 billion in BIL funding, including more than 32,000 specific projects and awards. The White House released updated state-by-state fact sheets that highlight how across the country, the administration is rebuilding roads and bridges; replacing lead pipes to provide clean water; cleaning up legacy pollution; expanding access to affordable, high-speed internet; and ushering in a new era of clean energy. In addition to announced funding to date, the fact sheets include key project highlights for all 50 states, D.C., and territories.

DOE Funds Four National Laboratory-Led Teams to Accelerate Commercialization of CDR Technologies

DOE's Office of Technology Transitions (OTT), in partnership with FECM and OCED, announced the selection of four projects at DOE national laboratories—Lawrence Livermore National Laboratory (LLNL), Pacific Northwest National Laboratory, and National Renewable Energy Laboratory (NREL)—totaling $15 million in federal funding, to accelerate commercializing CDR technologies, including direct air capture (DAC). The lab call sought proposals for collaborative projects with industry, academia, and other CDR experts to advance measurement, reporting, and verification (MRV) best practices and capabilities.

Interagency News and Updates (continued)

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-Harris administration's climate goals. FECM's Engagement page includes links to upcoming events, news and blogs, and other resources.

Carbon Capture Interactive Project Map

The Carbon Capture interactive project map contains information for active and inactive projects managed under NETL's PSCC 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/or environmental justice.

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.

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

CEM14

As a parallel event to the G20 Energy Transition Working Group meeting to be held July 22, 2023, in Goa, India, the 14th Clean Energy Ministerial (CEM14) is scheduled for July 21, 2023. The CEM is a high-level global forum to promote policies and programs that advance clean energy technology, to share lessons learned and best practices, and to encourage the transition to a global clean energy economy. Initiatives are based on areas of common interest among participating governments and other stakeholders.

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 over four days, all offered both in-person and virtually.

FECM/NETL Carbon Management Research Project Review Meeting

The FECM/NETL 2022 Carbon Management Project Review Meeting will be held Aug. 28–Sept. 1, 2023, in Pittsburgh, Pennsylvania. This meeting will share knowledge and insights from the following FECM R&D programs: Point Source Carbon Capture, 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 the subject research efforts, both domestic and international.

USEA's Carbon Management Technology Showcase

The United States Energy Association's (USEA) inaugural CMTS will be co-located with the FECM/NETL 2023 Carbon Management Project Review Meeting. It will be held Aug. 28–30, 2023, in Pittsburgh, Pennsylvania, and will showcase the latest technology developments in PSCC, CDR, carbon conversion, and carbon transport and storage. Note that registration for the CMTS is separate from the registration for the 2023 FECM/NETL Carbon Management Research Project Review Meeting. For pricing information of CMTS and to reserve a booth or table, see website.

CMTS
CARBON MANAGEMENT TECHNOLOGY SHOWCASE
U.S. DEPARTMENT OF ENERGY | Fossil Energy and Carbon Management | USEA United States Energy Association

PCCC-7

The 7th International Energy Agency Greenhouse Gas R&D Program Post Combustion Capture Conference (PCCC-7) will be in person, Sept. 25–28, 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. NETL and DOE will co-host PCCC-7, bringing together post-combustion capture experts to share knowledge, findings, and expertise.

Pittsburgh Coal Conference

The 2023 International Pittsburgh Coal Conference, to be held in Istanbul, Turkey, Oct. 4–6, 2023, is an outgrowth of a series of conferences spanning more than three decades, dealing with coal utilization, both in the United States and internationally. The conference will provide 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

VIDEOS

De-Risking CCS

Battelle and USEA release their Fiscal Year 2022 Report assisting stakeholders to address the risks associated with development of an integrated CCS program.

Fireside Chats with Michael Moore

The USEA series "Fireside Chats" with Michael Moore begins with "*Biomass + CCS, Is a Business Case for Energy & Climate Becoming Real?*," discussing the latest trends for biomass and CCS in the United States with Sasha Mackler (Executive Director, Bipartisan Policy Center Energy Program in Washington, D.C.). The Fireside Chat series continues with "*Utilizing Risk Management & Insurance to Support CCUS Project Enablement*," discussing the misconceptions surrounding the risk of CCUS with Marsh McLennan and Hunton Andrews Kurth, LLP.

NETL's Updated Performance & Cost Estimates, Power Generation Facilities Equipped w/Carbon Capture

Alex Krowka (USEA) and Marc Turner (NETL support contractor) present an overview of NETL's recently updated study "Cost and Performance Baseline for Fossil Energy Plants, Volume 1: Bituminous Coal and Natural Gas to Electricity."

Business and Industry News

Tipping the Scale on CO_2 Levels: Fast-Tracking Bioeconomy Decarbonization

Various methods exist to achieve decarbonization of industrial processes, including substituting non-petroleum feedstocks, recycling petroleum-based feedstocks, and CO_2 capture. With funding from NETL for PSCC, ION Clean Energy aims to capture 1 billion tons of CO_2 by 2050 with its low-cost CO_2 capture technology, projecting to capture 1.9 million tons of CO_2 per year at an estimated cost capture of $32.50/ton.

Business and Industry News (continued)

ASU to Lead New DOE Clean Energy Manufacturing Innovation Institute

DOE is providing funding to Arizona State University (ASU) to establish a new Clean Energy Manufacturing Innovation Institute. ASU will lead the multi-institution effort known as Electrified Processes for Industry Without Carbon (EPIXC). The new institute will support expanded use of clean electricity for process heating and a dramatic reduction of CO_2 emissions across industrial sectors, including iron and steel, chemicals, petroleum, food and beverage, forest products, and cement. Key partners include the University of Texas at Austin, Texas A&M University, Pennsylvania State University, Stanford University, Missouri University of Science and Technology, Tuskegee University, North Carolina State University, Navajo Technical University, Idaho National Laboratory, NETL, NREL, and the SLAC National Accelerator Laboratory (formerly the Stanford Linear Accelerator Center).

DOE Selects Heidelberg Materials' New Cement Plant in Mitchell for CCDP Program Funding

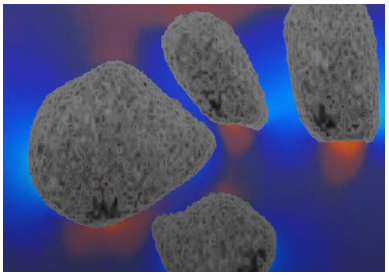
Heidelberg Materials North America will receive approximately $5 million in funding from OCED's Carbon Capture Demonstration Projects (CCDP) Program to study the integration of carbon capture and CTS at the new state-of-the-art cement plant in Mitchell, Indiana. The funding will provide significant support to the work that began under prior awards from DOE and catalyze further efforts to successfully complete the FEED work necessary to verify the project's technical feasibility. The new Mitchell cement plant will more than triple its current capacity and incorporate features to minimize energy consumption and enable the use of alternative fuels and raw materials to reduce GHG emissions.

Biden-Harris Administration Invests in Carbon Capture

The Biden-Harris administration announced $251 million for CCS projects in seven states, aiming to reduce carbon emissions from power plants and other industrial facilities. The projects are funded through DOE, with funds from the BIL, which set aside $12 billion for carbon management projects. The awardees include universities, one major oil corporation, and come from several states, such as Texas, Illinois, Georgia, and Wyoming.

Exascale to Burst Bubbles that Block Carbon Capture

DOE's Exascale Computing Project (ECP) MFIX-Exa: Performance Prediction for Multiphase Energy Conversion Device project pairs ECP-developed visualization and analytics capabilities with MFIX-Exa, a particle-based multiphase computational fluid dynamics simulation capable of running at exascale. The project researchers use MFIX-Exa to model fuel reactors in NETL's 50-kW chemical looping reactor (CLR), interactively detecting the formation of large bubbles that inhibit gas-solids mixing and tracking their features, such as volume and velocity. Model simulation output fields are used to create images representing bubble evolution over time. These images are linked to a database and visualized though a specialized viewer, letting domain experts perform post-simulation analyses that focus on specific parameters and then visualize bubble dynamics along those dimensions.



A visualization of CO_2 bubbles forming in a chemical looping reactor. As the bubbles rise, they form large low-density regions that can hinder a reactor's efficiency. (image: Los Alamos National Laboratory)

Publications

CCS-EJ-SJ Database

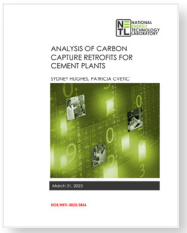
MANEESH SHARMA, CASEY CLEAVELAND, CASEY WHITE, LUCY ROMEO, KELLY ROSE, JENNIFER BAUER, NETL, MARCH 31, 2023.

Eliminating the Derate of Carbon Capture Retrofits - Revision 2

KYLE L. BUCHHEIT, ALEX ZOELLE, ERIC LEWIS, MARC TURNER, TOMMY SCHMITT, NORMA KUEHN, SALLY HOMSY, SHANNON MCNAUL, SARAH LEPTINSKY, ALLISON GUINAN, MARK WOODS, TRAVIS SHULTZ, TIMOTHY FOUT, GREGORY HACKETT, NETL, MARCH 31, 2023.

Analysis of Carbon Capture Retrofits for Cement Plants

SYDNEY HUGHES, PATRICIA CVETIC, SALLY HOMSY, ALEX ZOELLE, MARK WOODS, CHARLES WHITE, SANDEEP PIDAPARTI, NORMA KUEHN, HANNAH HOFFMAN, KATIE FORREST, TRAVIS SHULTZ, TIMOTHY FOUT, ERIC GROL, ROBERT E. JAMES, III, RICHARD BOHAN, NETL, APRIL 17, 2023.

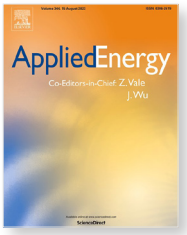


Sharing the Benefits: How the Economics of Carbon Capture and Storage Projects in California Can Serve Communities, the Economy, and the Climate

BENJAMIN GROVE, GEORGE PERIDAS, LLNL, MAY 2023.

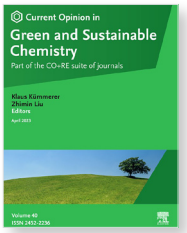
The impact of climate on solvent-based direct air capture systems

KEJU AN, AZHARUDDIN FAROOQUI, SEAN T. MCCOY, OAK RIDGE NATIONAL LABORATORY (ORNL), SEPT. 6, 2022.



Strategies for design and synthesis of porous liquids toward carbon capture and separation

NARGES MOKHTARINORI, ZHENZHEN YANG, SHENG DAI, ORNL, SEPT. 21, 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 (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 provide a technical summary of the DOE/NETL's Carbon Capture Program, assembling carbon dioxide capture technology research and development descriptions in a searchable database.

Carbon Capture Reference Materials

- 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

Contact Us

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Andrew Jones, Carbon Dioxide Removal Technology Manager, 412.386.5531

Amishi Claros, Acting Director, CO_2 Removal and Conversion, 202.586.1888

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

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

CUSTOMER SERVICE: 1-800-553-7681

www.netl.doe.gov

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