NATIONAL ENERGY TECHNOLOGY LABORATORY

DECEMBER 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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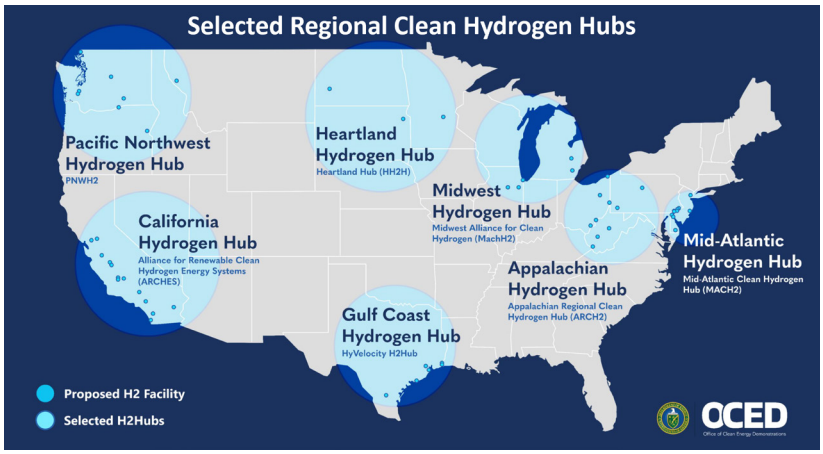
DOE Announces Funding to Accelerate CDR

The U.S. Department of Energy (DOE) Office of Fossil Energy and Carbon Management (FECM) announced up to $35 million, made available through President Biden's Investing in America agenda, to advance technologies that remove carbon dioxide (CO_2) emissions from the atmosphere. Carbon dioxide removal (CDR) is a key component for achieving the Biden administration's historic climate and clean energy agenda. The CDR Purchase Pilot Prize (webinar available here) will enable companies to compete for the opportunity to sell CDR credits directly to DOE. Through this prize, DOE will establish precedent for the level of rigor required to successfully evaluate CDR technologies and demonstrate how CDR purchase contracts can catalyze innovation while strengthening America's CDR objectives. The prize will provide cash awards in the form of offtake agreements from the federal government in four CDR pathways: direct air capture (DAC) with storage, biomass with CDR and storage, enhanced weathering and mineralization, and planned or managed carbon sinks.

Interagency News and Updates

DOE Announces Funding for America's First Clean Hydrogen Hubs, Driving Clean Manufacturing and Delivering New Economic Opportunities Nationwide



DOE announced $7 billion to launch seven Regional Clean Hydrogen Hubs (H2Hubs) across the nation and accelerate the commercial-scale deployment of low-cost hydrogen with carbon capture. This historic milestone is part of the third installment of the Investing in America tour, during which President Biden and Secretary Granholm traveled to Philadelphia, Pennsylvania, to announce the investment in American manufacturing and jobs. Funded by the Bipartisan Infrastructure Law (BIL), the seven H2Hubs will kickstart a national network of clean hydrogen producers, consumers, and connective infrastructure.

NETL and Partners Win Hydrogen Hub Investments

DOE's National Energy Technology Laboratory (NETL) is partnering on three of the seven H2Hubs selected for funding. The Appalachian Hydrogen Hub will use the region's ample access to low-cost natural gas to produce low-cost clean hydrogen and store the associated carbon emissions. The Gulf Coast Hydrogen Hub will help kickstart the clean hydrogen economy with its plans for large-scale hydrogen production using both natural gas with carbon capture and renewables-powered electrolysis. The Heartland Hydrogen Hub will use the region's abundant energy resources to help decarbonize the agricultural sector's production of fertilizer, decrease the regional cost of clean hydrogen, and advance the use of clean hydrogen in electric generation and for cold climate space heating.

Photo: Hygrogen Network

H2Hubs Video

As part of the announcement of investment in the H2Hubs to accelerate the commercial-scale deployment of low-cost hydrogen with carbon capture, a new video features Secretary Granholm giving a brief overview of clean hydrogen.

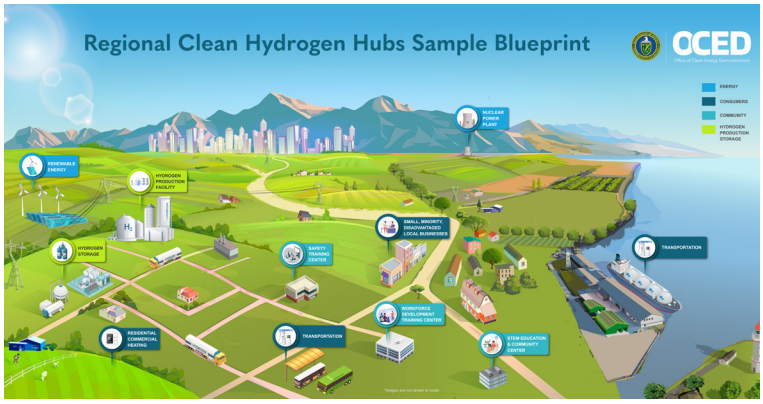
Clean Hydrogen 101 Video

Clean hydrogen energy has the power to reduce emissions from multiple carbon-intensive sectors and open a world of economic opportunity for communities across the country. Learn about its many benefits and how the Office of Clean Energy Demonstrations is helping commercialize and scale it in the Clean Hydrogen 101 Video.

Interagency News and Updates (continued)

Regional Clean Hydrogen Hubs Selections National Briefing

A video of the Regional Clean Hydrogen Hubs Selections Webinar National Briefing, held on Oct. 16, 2023, features senior DOE officials as they discuss the seven H2Hubs. Additional videos cover the Regional Clean Hydrogen Hubs Selections National Environmental Justice Briefing and National Labor & Workforce Briefing.



New System Uses Seawater to Capture and Store CO_2

A new system is removing acid from seawater at DOE's Pacific Northwest National Laboratory (PNNL) facility in Sequim, Washington, allowing seawater to take up and store CO_2 from the atmosphere. The technology behind the CDR system was developed by start-up company Ebb Carbon, which is partnering with PNNL; the National Oceanic and Atmospheric Administration (NOAA) Pacific Marine Environmental Laboratory; the NOAA Cooperative Institute for Climate; and Ocean and Ecosystem Studies and the Salish Sea Modeling Center, both at the University of Washington. Funding was provided by NOAA's Ocean Acidification Program, DOE's Water Power Technologies Office, and the ClimateWorks Foundation.

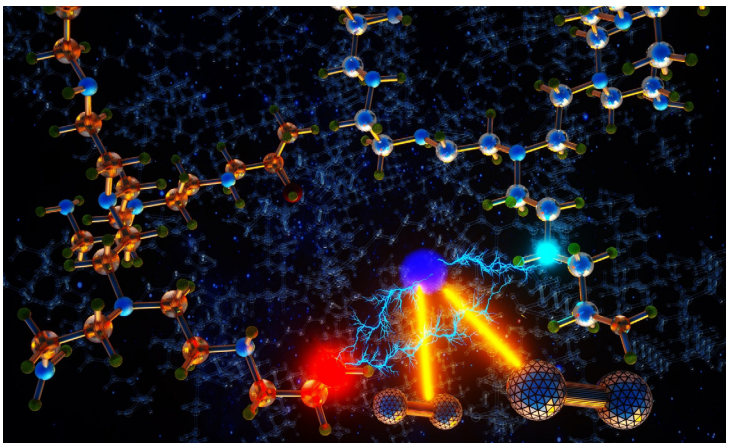
Proceedings from the 2023 FECM/NETL Carbon Management Research Project Review Meeting Available

Proceedings from the 2023 FECM/NETL Carbon Management Research Project Review Meeting are now available, organized by NETL program: PSCC, CDR, Carbon Conversion, and Carbon Transport and Storage.

2023 FECM / NETL
Carbon Management
Research Project Review Meeting

New Chemistry Leads to More Robust Carbon Capture Materials

Lawrence Livermore National Laboratory (LLNL) scientists have uncovered how some carbon capture materials have improved lifetime compared to others. These materials are key in addressing greenhouse gas (GHG) emissions and potential global warming concerns. Researchers have shed light on the mechanism that empowers these materials, extending their operational lifespan and effectiveness in capturing harmful CO_2 emissions. This research is featured on the cover of Chemical Communications.



Conceptual illustration demonstrating the antioxidative impact of epoxide-amine hydrogen bonding on aminopolymer-based direct air capture adsorbents. Image courtesy of Ella Maru Studio.

Interagency News and Updates (continued)

FECM Announces Funding to Advance Hydrogen Technology That Converts Waste to Clean Energy

FECM announced up to $19 million in funding for research that will develop innovative technology solutions to make hydrogen with carbon capture a more available and affordable fuel for electricity generation, industrial decarbonization, and transportation. The funding opportunity will focus on using hydrogen systems to convert various waste materials into clean energy. The funding opportunity solicits applications in three areas of interest: (1) advancing toward commercialization viable gasification energy systems that convert varied waste feedstock materials such as coal waste, biomass, waste plastics, municipal solid waste, and industrial waste into clean energy; (2) improving the performance of gasification-based systems that use waste feedstock materials through wireless sensing technology; and (3) developing technology components that advance monitoring, detection, and security for integrated hydrogen-based systems with carbon capture.

FECM Announces Funding to Advance Technologies That Capture Carbon Emissions to Decarbonize Industrial Processes and Produce Valuable Products

FECM announced up to $17.5 million in funding to advance technologies that capture CO_2 from industrial facilities and power plants and convert those CO_2 emissions into valuable products. Projects selected under this funding opportunity announcement (FOA) will focus on two areas: advancing research and development to use CO_2 captured from sources such as industrial and power generation facilities, as well as from legacy CO_2 emissions captured directly from the atmosphere, to produce algae-derived value-added products; and developing projects that advance oxygen-based approaches such as oxy-combustion and chemical looping, which lead to reductions in CO_2 emissions associated with industrial production processes.

FECM Announces Funding to Use CO_2 for Enhanced Oil Recovery in Unconventional Reservoirs, Combined with Carbon Storage

FECM announced up to $17.2 million to evaluate the potential for unconventional oil production through a combined process that uses captured CO_2 emissions to recover residual oil while storing that CO_2 underground in the oilfield. The research targeted through this funding will help to accelerate carbon storage operations in depleted domestic oilfields, repurposing existing infrastructure.

DOE Announces Funding for LDES Projects to Increase Grid Resilience and Protect America's Communities

DOE announced up to $325 million for 15 projects across 17 states and one tribal nation (the Columbia Energy Storage Project) to accelerate the development of long-duration energy storage (LDES) technologies. Funded by the BIL, these demonstration projects will increase community control of local power systems, mitigate risks associated with disruptions to the grid, and help communities develop reliable and affordable energy systems. The announcement will help DOE realize its Long Duration Storage Shot goal of reducing the cost of LDES by 90% by 2030.

Interagency News and Updates (continued)

DOE STEM Portal

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

Explore Career Opportunities with FECM

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

Explore Career Opportunities at NETL

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

Bipartisan Infrastructure Law Hub

The BIL represents the most dramatic changes to DOE since its founding in 1977. 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

UNFCCC COP 28

The 2023 United Nations Climate Change Conference (UNFCCC), to be held Nov. 30–Dec. 12, 2023, in Dubai, United Arab Emirates, will comprise the 28th meeting of the Conference of the Parties (COP 28); the fifth meeting of the COP serving as the Meeting of the Parties to the Paris Agreement; the 18th meeting of the COP serving as the Meeting of the Parties to the Kyoto Protocol; the 59th meeting of the Subsidiary Body for Implementation; and the 59th meeting of the Subsidiary Body for Scientific and Technological Advice.

2023 CO_2 Conference

The 2023 CO_2 Conference, to be held Dec. 4–7, 2023, in Midland, Texas, provides a forum for highlighting the best practices the industry utilizes in all CO_2 applications, emphasizing plenary technical and business sessions. The agenda includes presentations covering CO_2 enhanced oil recovery; carbon capture, utilization, and storage (CCUS)/carbon management; CO_2 reservoir cyclic injection; and residual oil zone exploitation.

PowerGen International

PowerGen International, to be held Jan. 23–25, 2024, in New Orleans, Louisiana, is a networking and business hub for power generation professionals and solution providers. Bringing together power producers, utilities, consultants, manufacturers, and large-scale energy users, it serves as a platform to explore innovative solutions amid the shift toward cleaner and more sustainable energy sources.

Carbon, Capture, Utilization, and Storage

Carbon, Capture, Utilization, and Storage, to be held March 11–13, 2024, 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; and infrastructure.

CO_2 Capture, Storage & Reuse 2024

CO_2 Capture, Storage & Reuse 2024, to be held May 15–16, 2024, in Copenhagen, Denmark, will focus on presentations, interesting industry panel discussion, technical insights, and many hours of networking.

Carbon Capture & Storage Summit

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

U.S. and International Events (continued)

Carbon Capture Technology Expo

The Carbon Capture Technology Expo, to be held June 26–27, 2024, in Houston, Texas, will unveil the latest current and emerging technologies from some of the sector's leading experts and energy leaders while providing a showcase for innovative models that can capture carbon's potential by turning CO_2 byproducts into profitable applications for concrete, carbon fiber, polymers, food, fertilizers, liquid fuels, chemicals, graphene, and more.

GHGT-17

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

Business and Industry News

Cal State to Develop Porous Nanomaterials for Carbon Capture

California State University, Los Angeles (Cal State LA), received a $750,000 grant from DOE to research climate change with the goal of developing smart, porous nanomaterials that act as sponges and can be reused thousands of times to absorb CO_2. Cal State LA is teaming up with Ames National Research to capture CO_2 in a multitude of tiny pores that scientists will create on the surface of nanomaterials the size of a tablespoon. The CO_2 that is captured in the nanomaterial could be injected underground to prevent the pollutant from returning to Earth's atmosphere, or the captured pollutants could be transformed into fuels.

NETL Personnel Participate in Pittsburgh-Based Electric Power Transformation Symposium

NETL personnel played key roles in Electric Power Transformation: 2023 MEGA Symposium—a national event focused on the transition of the energy generation industry to cleaner and climate-resilient electric power that is cost-effective and reliable. NETL Associate Director Peter Balash participated in a plenary session dedicated to key issues for clean and reliable energy, and NETL research engineer Greg Hackett presented on the status and challenges of carbon capture technologies.

Business and Industry News (continued)

Pulling CO_2 from the Air

New research from Northwestern University shows a novel approach to capture carbon from ambient environmental conditions that looks at the relationship between water and CO_2 in systems to inform the moisture-swing technique, which captures CO_2 at low humidities and releases it at high humidities. The approach incorporates innovative kinetic methodologies and a diversity of ions, enabling CDR from virtually anywhere. The study was published in Environmental Science and Technology.

WVU Engineers Study How to Pull Carbon Out of Building Air to Make Methanol

Researchers at West Virginia University (WVU) have taken the first steps toward developing technology that can capture CO_2 in the air and use it for eco-friendly manufacturing of methanol. The equipment could harvest carbon from the air pulled from the building's heating and air conditioning systems, and could also make its own carbon-free hydrogen using a rooftop solar panel or other renewable energy source to power solid oxide electrolysis cells. The process could increase the sustainable supply of methanol while removing GHG from the atmosphere. The Phase I project is supported by $400,000 in DOE funding.

WVU researchers, led by Xingbo Liu at the Benjamin M. Statler College of Engineering and Mineral Resources, are developing technology that harvests carbon from air that gets sucked out of buildings by heating and air conditioning systems. Their model leads to the manufacturing of carbon-neutral methanol. (WVU Illustration/Savanna Leech)

New Hydrogen Hub Will Create 20,000 Jobs and May Power SEPTA Buses and Trash Trucks

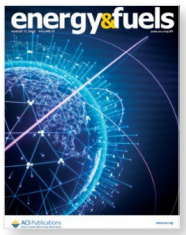
Pennsylvania Governor Josh Shapiro said that a new hydrogen hub could make the Philadelphia region "the center of the clean energy universe" and create 20,000 union jobs. Hydrogen produced with carbon capture in the hub is expected to power 1,400 Southeastern Pennsylvania Transportation Authority (SEPTA) buses and 300 Philadelphia garbage trucks. A portion of those workers will be trained through unions in a partnership with local colleges and universities, including Cheyney University of Pennsylvania, the nation's first Historically Black College and University (HBCU) located in the Philadelphia suburbs.

Yale Awarded Energy Earthshot to Study Natural Carbon Capture

Yale scientists are exploring climate solutions that accelerate natural processes that remove and store CO_2 from the atmosphere, including enhanced mineral weathering and ocean alkalinity enhancement. This effort is one of the flagship initiatives of the Yale Center for Natural Carbon Capture, a university-wide effort within Yale's Planetary Solutions Project. The study is part of DOE's Energy Earthshot Initiative that supports research in CDR and clean energy technologies.

Publications

Big Data Analysis and Technical Review of Regeneration for Carbon Capture Processes



WALTER C. WILFONG, TUO JI, ZHENGHONG BAO, HAIBO ZHAI, QIUMING WANG, YUHUA DUAN, YEE SOONG, BINGYUN LI, FAN SHI, MCMAHAN L. GRAY, ENERGY FUELS, VOLUME 37, ISSUE 16, JULY 27, 2023. (SUBSCRIPTION MAY BE REQUIRED.)

Carbon Capture Membranes Based on Amorphous Polyether Nanofilms Enabled by Thickness Confinement and Interfacial Engineering

GENGYI ZHANG, VINH BUI, YIFAN YIN, ESTHER H.R. TSAI, CHANG-YONG NAM, AND HAIQING LIN, ACS APPL. MATER. INTERFACES, VOLUME 15, ISSUE 29, JULY 13, 2023. (SUBSCRIPTION MAY BE REQUIRED.)

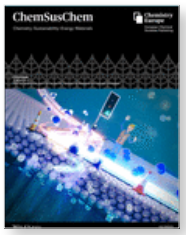
Parametric simulations of hierarchical core–shell MOF materials for direct air capture

AUSTIN R. LIEBER, PAUL BOONE, YIWEN HE, JANICE A. STECKEL, NATHANIEL L. ROSI, CHRISTOPHER E. WILMER, KATHERINE M. HORNBOSTEL, SEPARATION AND PURIFICATION TECHNOLOGY, VOLUME 322, OCT. 1, 2023. (SUBSCRIPTION MAY BE REQUIRED.)

Gas Separation Membrane Module Modeling: A Comprehensive Review

MARCOS DA CONCEICAO, LEO NEMETZ, JOANNA RIVERO, KATHERINE HORNBOSTEL, GLENN LIPSCOMB, MEMBRANES (BASEL), VOLUME 13, ISSUE 7, JUNE 30, 2023. (SUBSCRIPTION MAY BE REQUIRED.)

Microwave Regeneration and Thermal and Oxidative Stability of Imidazolium Cyanopyrrolide Ionic Liquid for Direct Air Capture of Carbon Dioxide



YUN-YANG LEE, EDA CAGLI, AIDAN KLEMM, YENSIL PARK, RUTH DIKKI, MICHELLE K. KIDDER, BURCU GURKAN, CHEMSUSCHEM, VOLUME 16, ISSUE 13, JULY 7, 2023.

Enhancing CO_2 Transport Across a PEEK-Ionene Membrane and Water-Lean Solvent Interface

ERIC D. WALTER, DIFAN ZHANG, YING CHEN, KEE SUNG HAN, J. DAVID BAZAK, SARAH BURTON, KATHRYN O'HARRA, DAVID W. HOYT, JASON E. BARA, DEEPIKA MALHOTRA, SARAH I. ALLEC, VASSILIKI-ALEXANDRA GLEZAKOU, DAVID J. HELDEBRANT, ROGER ROUSSEAU, CHEMSUSCHEM, VOLUME 16, ISSUE 13, JULY 7, 2023.

Publications (continued)

Topic: Air Quality/Emissions and Capture Systems

DISCLAIMER

On a monthly basis, the Office of Fossil Energy and Carbon Management (FECM) will be publishing links to a small collection of peer-reviewed journal articles and reports by authors who are not affiliated with the Department nor a recipient of U.S. Department of Energy (DOE) funding. These resources, not found in DOE's Office of Scientific and Technical Information (OSTI) database, are chosen by FECM HQ staff based on their credibility, relevance, and potential applicability to stakeholders. Selection criteria is not dependent upon an authors' viewpoint and instead represent timely developments and study findings that are informative and influential when considering the deployment of carbon management technologies. While in the past we have linked to government-funded studies, this new effort focuses on research that is not available through OSTI.

A review by FECM and NETL technical experts will be conducted before links are published, however, the content in the studies does not represent official Government positions and should not be interpreted as having been endorsed by any official within the Department of Energy. Moreover, neither the U.S. Government nor DOE, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Likewise, references in the studies to any specific commercial product, process, or services by trade name, trademark, manufacturer, or otherwise, do not constitute or imply an endorsement, recommendation, or favoring by the U.S. Government or DOE or its contractors or subcontractors.

Due to resource constraints with internal reviewers, each topic-specific collection should not be considered an exhaustive or comprehensive representation of the literature or subject area. Unlike publications found in OSTI, some articles may remain behind journal subscription paywalls indefinitely, with access only feasible through payment directly to the publisher, with whom DOE does not have any relationship.

Controlling Nitrosamines, Nitramines, and Amines in Amine-Based CO_2 Capture Systems with Continuous Ultraviolet and Ozone Treatment of Washwater

NING DAI, WILLIAM A. MITCH, ENVIRONMENTAL SCIENCE TECHNOLOGY, VOLUME 49, ISSUE 14, JUNE 19, 2015.

A review of degradation and emissions in post-combustion CO_2 capture pilot plants

VANJA BUVIK, KAREN K. HØISÆTER, SORUN J. VEVELSTAD, HANNA K. KNUUTILA, INTERNATIONAL JOURNAL OF GREENHOUSE GAS CONTROL, VOLUME 106, MARCH 2021.

Machine learning for industrial processes: Forecasting amine emissions from a carbon capture plant

KEVIN MAIK JABLONKA, CHARITHEA CHARALAMBOUS, EVA SANCHEZ FERNANDEZ, GEORG WIECHERS, JULIANA MONTEIRO, PETER MOSER, BEREND SMIT, SUSANA GARCIA, SCIENCE ADVANCES, VOLUME 9, ISSUE 1, JAN. 4, 2023.

A methodology for the heuristic optimization of solvent-based CO_2 capture processes when applied to new flue gas compositions: A case study of the Chilled Ammonia Process for capture in cement plants

JOSÉ-FRANCISCO PÉREZ-CALVO, DANIEL SUTTER, MATTEO GAZZANI, MARCO MAZZOTTI, CHEMICAL ENGINEERING SCIENCE: X, VOLUME 8, NOVEMBER 2020.

Aerosol Emissions of Amine-Based CO_2 Absorption System: Effects of Condensation Nuclei and Operating Conditions

NINGTONG YI, MENGXIANG FANG, WENTAO DI, ZHIXIANG XIA, TAO WANG, QINHUI WANG, ENVIRONMENTAL SCIENCE TECHNOLOGY, VOLUME 55, ISSUE 8, JAN. 25, 2021. (SUBSCRIPTION MAY BE REQUIRED.)

Trace-level quantification of N-nitrosopiperazine in treated wastewater using supported liquid extraction and hydrophilic interaction chromatography mass spectrometry

ANTHONY LAPOINTE, STÉPHANIE GALLANT, SIMON COMTOIS-MAROTTE, ALEXANDRA FURTOS, KAREN C. WALDRON, CANADIAN JOURNAL OF CHEMISTRY, VOLUME 98, NUMBER 9, SEPTEMBER 2020. (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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