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



CARBON TRANSPORT and **STORAGE** NEWSLETT

VOL. 22, NO. 10

CARBON TRANSPORT and STORAGE PROGRAM DOCUMENTS and REFERENCE MATERIALS

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DOE/FECM/NETL HIGHLIGHTS

DOE Invests in Programs that Fund CCS Projects.

The U.S. Department of Energy's (DOE) Office of Fossil Energy and Carbon Management (FECM) announced funding for 18 projects to conduct early-stage research and development (R&D) of decarbonization technologies and environmental remediation and develop strategies to enhance the engagement of minority-serving institutions on FECM-related research at eligible U.S. colleges and universities. The investment includes nine projects through the University Coal Research (UCR) Program and nine projects through the Historically Black Colleges and Universities and Other Minority Institutions (HBCU-OMI) Program. Both the UCR and HBCU-OMI Programs, which comprise FECM's University Training and Research (UTR) Program, will fund projects that explore biomass feedstocks blended with waste coal and coupled with carbon capture and storage (CCS) and address the reclamation and remediation of legacy environmental impacts of coal-based production and generation.



From energy.gov. August 2022.

DOE/FECM/NETL HIGHLIGHTS (cont.)

DOE Announces Funding to Advance CCS.

DOE/FECM announced an investment to advance CCS for natural gas power and industrial sectors. The funding will go to 10 projects to develop carbon capture technologies capable of capturing at least 95% of carbon dioxide (CO₂) emissions from natural gas power plants, waste-to-energy power plants, and industrial applications. Deploying these technologies in the power and industrial sectors at a commercial scale will help advance the Biden-Harris administration's goal of a carbon pollution-free power sector by 2035 and a net-zero greenhouse gas (GHG) economy by 2050. DOE's National Energy Technology Laboratory (NETL) will manage *the projects*, which will support the development and testing of transformational carbon capture materials, equipment, and processes for applications in natural gas combined cycle (NGCC), waste-to-energy power generation, and the industrial sector. Other projects will perform front-end engineering design (FEED) studies for industrial plants and NGCC power plants integrated with carbon capture systems.

From energy.gov. August 2022.

DOE Announces Set of FOAs to Manage and Store CO₂.

DOE announced a nearly \$4.9 billion set of funding opportunities to bolster investments in the carbon management industry and to significantly reduce CO₂ emissions released into the atmosphere through power generation and industrial operations. The three Funding Opportunity Announcements (FOAs) will be supported by Bipartisan Infrastructure Law (BIL) funding to help drive the demonstration and deployment of carbon capture systems, along with carbon transport and storage infrastructure. The *Carbon Storage Validation and Testing* FOA supports the *Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Initiative*, managed by DOE/FECM, and provides up to \$2.25 billion to support the development of new and expanded large-scale, commercial carbon storage projects with capacities to store 50 or more million metric tons of CO₂, along with associated CO₂ transport infrastructure. The *Carbon Capture Demonstration Projects Program* FOA provides up to \$2.54 billion to develop six integrated carbon capture, transport, and storage demonstration projects that can be readily replicated and deployed at fossil energy power plants and major industrial sources of CO₂ and certain types of chemical production facilities. The *Carbon Dioxide Transport Engineering and Design* FOA provides up to \$100 million to design regional CO₂ pipeline networks to safely transport captured CO₂ from key sources to centralized locations.

From energy.gov. September 2022.

ANNOUNCEMENTS

Conference Proceedings from DOE/NETL's 2022 Carbon Management Project Review Meeting Available.

Conference proceedings from the DOE/NETL 2022 Carbon Management Project Review Meeting, held in Pittsburgh, Pennsylvania (USA), August 15–19, 2022, are **available online**. The meeting included a mixture of plenary and parallel sessions and poster presentations providing updates on DOE/NETL-funded carbon capture, utilization, and storage (CCUS) research projects being conducted to advance carbon management technologies and ensure a sustainable clean energy future for the nation.

DOE Issues NOI for Carbon Storage FOA.

DOE issued a Notice of Intent (NOI) for an FOA titled "*Regional Initiative to Accelerate Carbon Management Deployment: Technical Assistance for Large-Scale Storage Facilities and Regional Carbon Management Hubs.*" The objective of the planned FOA is to establish a consistent, effective mechanism for providing technical assistance to develop multiple large-scale carbon storage facilities and regional carbon management hubs that could store hundreds of millions of tons of CO_2 and inject more than 5 million metric tons of CO_2 per year.

DOE's Clean Energy Corps Accepting Applications. (Video)

DOE's Clean Energy Corps comprises staff from more than a dozen offices across DOE to research, develop, demonstrate, and deploy next-generation clean energy technologies. The Clean Energy Corps is dedicated to fighting climate change through public service and supporting American competitiveness on a global scale. To meet this challenge, DOE is hiring a team of industry veterans, experienced technical experts, and the next generation of climate leaders. More information is *available via the Clean Energy Corps webpage*.

DOE/FECM Selects Winner of SMART VP Prize Challenge.



DOE/FECM announced the Phase II winner of its *Science-Informed Machine Learning to Accelerate Real Time (SMART)* Visualization Platform (VP) Prize Challenge. Clean energy technology company Petrolern LLC will receive the prize award for their work in developing the web-based GeoDeck platform, which is a tool to help transform the interaction with the subsurface by providing real-time visualizations of subterranean fluid flows, fractures, and other features. Such visualizations can enhance decision-making for safer subsurface operations, including CO_2 storage.

NETL Tool Attracts International Attention.

An NETL tool for estimating geologic environments for CO_2 storage is attracting attention from institutions of higher education and governments from more than 90 nations, including Norway, Spain, France, South Korea, India, Australia, Mexico, and the United Kingdom (UK). NETL's CO_2 -SCREEN was created to provide a robust, user-friendly tool to estimate CO_2 storage efficiency in a variety of geologic environments, including saline formations, shale formations, and residual oil zones.



ANNOUNCEMENTS (cont.)

Drax, British Steel Sign MOU to Support **BECCS** Development.

Renewable energy company Drax and British Steel signed a Memorandum of Understanding (MOU) to support the development of bioenergy with carbon capture and storage (BECCS). Through the MOU, the companies will explore opportunities for steel to be used to help build Drax's BECCS project, which will be part of the East Coast Cluster-a consortium of Zero-Carbon Humber and Net-Zero Teesside.

Climeworks Wins Award for Innovative Technology at Capture and Storage Plant.

Climeworks received the Innovation in Vacuum Busch *Award* for its advanced use of vacuum technology at its Ocra direct air capture (DAC) and storage plant. Located in Iceland, the plant can capture 4,000 metric tons of CO₂ per year.



Global CCS Market Report.

According to a report by Research and Markets, the global CCS market could reach \$4.9 billion by 2026. The report, "Carbon Capture and Storage - Global Market Trajectory & Analysis," states that the CCS market in the United States is estimated at \$1.1 billion in 2022, accounting for a 33.5% share of the global market. (Purchase may be required to access the report.)

RGGI Releases Report on Secondary Market.



The states participating in the Regional Greenhouse Gas Initiative (RGGI) released the "Report on the Secondary Market for RGGI CO₂ Allowances: Second Quarter 2022." Prepared by independent market

monitor Potomac Economics, the report found no evidence of anticompetitive conduct in the RGGI CO₂ allowance secondary market.

EU Carbon Credits Reach New High.

Carbon allowance prices under the European Union Emissions Trading Scheme (EU ETS) reached an all-time high of approximately \$99 per metric ton of CO₂ equivalent in August 2022.

PROJECT AND BUSINESS DEVELOPMENTS

Industrial Partners Begin CCS Feasibility Project.

Three industrial partners are collaborating on a study to explore the feasibility of an open-access CO₂ storage and liquefaction hub in the Ghent part of North Sea Port, Belgium. The partners-Fluxys, ArcelorMittal Belgium, and North Sea Port-initiated the collaboration to decarbonize several industry sectors. Set for commissioning in 2027, the Ghent Carbon Hub will enable the transport and liquefaction of CO₂ from emitters and provide buffer storage and loading of liquefied CO₂ onto ships for storage.

From Gasworld. August 2022.

Proposed CCS Ammonia Plant Announced.

CF Industries Holdings Inc. announced plans for a blue ammonia production facility in Ascension Parish, Louisiana (USA). Developed in conjunction with Mitsui & Co. Ltd, the proposed facility would qualify as a "blue" process by employing CCS, reducing the carbon emissions of the ammonia production process compared to conventional ammonia processes. A FEED study is expected to be conducted once the site and technology providers are finalized, with a final investment decision by the companies expected in 2023.

From Louisiana Governor Newsroom. August 2022.

Wyoming Carbon Storage Project Receives Federal Approval.

The U.S. Department of Interior's Bureau of Land Management approved a proposal to store CO₂ underground in Lincoln and Sweetwater Counties, Wyoming (USA). ExxonMobil's proposal includes a CO₂ disposal well pad and pipeline, which once completed will allow for underground storage of CO₂ produced along with natural gas at the existing ExxonMobil Shute Creek Plant (located in Lincoln County, Wyoming). The disposal well will store approximately 60 million cubic feet of CO₂ daily at a depth of approximately 18,000 feet in the water leg of the Madison formation, which is an approved disposal zone.



From Bureau of Land Management Press Release. August 2022.

BP Drilling Appraisal Wells for CCS.

BP has begun drilling appraisal wells in Texas (USA) for CCS operations, with oil and gas company Linde planning to build a site on the Texas coast for the storage of CO2 produced by their manufacturing facility in Houston. BP's role will be to build and handle the permit for geologic storage wells, while Linde will utilize its carbon separation, capture, and compression technologies. The joint Linde-BP project is scheduled to open in 2026.





PROJECT AND BUSINESS DEVELOPMENTS (cont.)

Project Receives Grant to Assess CCS Resources.



The Nebraska Environmental Trust awarded a grant to a University of Nebraska-Lincoln (USA) project to assess CCS resources. The project Environmental Trust objective is to assess CO₂ storage resources and opportunities in the study area (which covers several counties in Nebraska) and near the Nebraska Public Power District's Gerald Gentleman Station. The

Australian Government

Energy and Resources

Department of Industry, Science,

researchers will use laboratory tests and simulations to determine various physical and mechanical parameters, such as porosity, permeability, strength, stiffness, and storage coefficient.

From University of Nebraska-Lincoln, Nebraska Today. August 2022.

MOU to Advance Global Market Using Korea-Developed CCUS Technologies.

DL E&C Co., an engineering, procurement, and construction company, signed an MOU with KEPCO Korea Electric Power Research Institute (KEPRI) to advance the global CCUS market. Under the MOU, the companies will cooperate on the mutual exchange of technologies to enter overseas CCUS markets. DL E&C intends to adopt KEPRI's carbon capture technology when expanding the CCUS market from Korea to other countries.

From Business Wire, August 2022.

Companies Agree to Expand CCUS Efforts.

BKV Corporation and Verde CO₂ CCS LLC have agreed to expand CCUS and GHG emissions reduction efforts through CCUS project identification and evaluation. BKV will leverage Verde's CCUS experience to equip its CCUS business line, BKV Carbon Ventures, with the resources needed to evaluate CCUS projects and build a pipeline of feasible projects moving forward. BKV's initial CCUS project, in partnership with EnLink Midstream, is expected to come online in 2023.

From BKV News Release. August 2022.

Mantel Announces Investment for Industrial CCUS.

Mantel announced an investment to accelerate their technology development, prototype testing, and initial deployment of their high-temperature, liquid-phase carbon capture system solution. Mantel's molten salts selectively absorb CO₂ and regenerate a pure stream of CO₂ that can be stored or utilized. According to the company, combining liquid-phase materials with high operating temperatures can lead to a more than 60% reduction in energy losses and an approximately 50% reduction in costs.

From Gasworld. August 2022.

LEGISLATION AND POLICY

Australian Government Releases Consultation Paper to Reduce Emissions.

The Australian government-through its Department of Climate Change, Energy, the Environment and Waterreleased a consultation paper setting out how to reform its safeguard mechanism, which was introduced in 2016 to address industrial emissions. Proposed changes include having the large-emitting facilities covered by the scheme either reduce emissions onsite or purchase carbon credits. According to the consultation paper, the annual rate of emissions cuts is expected to be 3.5-6%. The paper proposes a path to turn the safeguard mechanism into a form of a carbon trading scheme.

From The Guardian. August 2022.

Australian Government Approves Offshore GHG Storage Areas.

The Australian government granted two new offshore

GHG storage permits to explore the potential of CCS in Australia. The first permit was issued to Woodside Energy in the Browse Basin off the coast of the Kimberley in Western Australia's north. The second was issued to a joint venture among INPEX, Woodside Energy, and TotalEnergies in the Bonaparte Basin off the coast of the Northern Territory. Three more permits are expected to be issued at a later date.

From Australian Broadcasting Corporation (ABC). August 2022.



New incentives under the 2022 Inflation Reduction Act (IRA) could impact the deployment of carbon storage and clean fuel development. The IRA extends the available Section 45Q tax credit to any carbon capture, DAC, or carbon utilization project that begins construction before January 1, 2033. In addition, the IRA increases the value of those credits up to (per metric ton) \$85 for captured and stored CO₂ and \$60 for CO₂ that is reused.

From JD Supra. August 2022.

Projects Shortlisted for BEIS CCUS Cluster Process.

The UK Department for Business, Energy, and Industrial Strategy (BEIS) announced a list of 20 projects shortlisted for the next stage of the CCUS cluster process. The UK government's Ten Point Plan for a Green Industrial Revolution sets a goal of deploying CCUS in two industrial clusters by the mid-2020s and in two more by 2030. In November 2021, the HyNet cluster in Northwest England and North Wales



Department for Business, Enerav & Industrial Strategy

and the East Coast Cluster in the Teesside and Humber were selected as Track 1 clusters (for deployment by the mid-2020s) and will be considered for support under the UK government's CCUS Program. The shortlisted projects will also be considered for government funding support.

From UK BEIS News Release. August 2022.

ICe

EMISSIONS TRADING

ICE to Launch UK Carbon Emissions Options.

Subject to regulatory approval, Intercontinental Exchange Inc. (ICE) plans to launch UK carbon emissions allowance options in 2022. ICE expects to list UK options out to March 2024. ICE launched UK carbon allowance futures in May 2021, alongside the launch of emissions auctions on behalf of the UK government as part of the UK's new ETS.

From Yahoo! Finance. August 2022.

Nigeria Initiates National Emissions Framework.

Nigeria initiated the development of a national emissions framework, their government announced. Nigeria's Emission Trading Framework seeks to align itself to international mechanisms such as the EU ETS. According to government officials, Nigeria has "legal framework provided in the Climate Change Act of 2021 for the reduction of [GHG] emissions through a cap and trade-based emissions trading schemes..."

From Vanguard. August 2022.

Carbon Credit Platform Launched.

The International Finance Corporation, Cultivo, Aspiration, and Chia Network launched the Carbon Opportunities Fund—a global investment platform for trading carbon credits. According to the companies, the fund will seek to leverage investments in the voluntary carbon markets and broaden access to finance for certified, nature-based projects. Carbon credit companies Cultivo and Aspiration will lead the fund's strategy and execution, while the fund's carbon credits will be tracked by the World Bank's Climate Warehouse, which was launched on Chia's public blockchain.

From Sustainability Magazine. August 2022.

Collaboration to Accelerate Deployment of Natural Carbon Sink Solutions.

Two companies are working together to accelerate the deployment of natural carbon sink solutions. Through the collaboration, Pledge-a London-based integrated carbon offsetting platform—will offer soil carbon storage credits from Grassroots Carbon—a San Antonio (USA)-based company offering certified soil carbon storage credits. Grassroots Carbon links buyers of carbon credits with landowners interested in employing regenerative practices to store CO_2 in soil.

From Carbon Herald. August 2022.



Study Reveals Changeable Tendency of SOC in Dryland.

Researchers from the Northwest Institute of Eco-Environment and Resources of the Chinese Academy of Sciences studied the dynamics of soil organic carbon (SOC) and soil total nitrogen (STN) in drylands. The results, published in *Journal of Environmental Management*, showed that climate factors in the dryland north of China were the main factors affecting SOC and STN. According to the study, dryland should be considered a potential region for carbon storage.

From phys.org. August 2022.

Restoring Dried-Out Wetlands Could Increase CO₂ Storage Potential.

Restoring dried-out wetlands could avoid emissions equivalent to more than 100 billion metric tons of CO_2 by the end of the century, according to researchers. The amount of GHGs emitted by wetlands depends on the amount of water in them; when wetland soil is covered in water, it emits methane, when dry, it emits less methane but instead releases CO_2 and nitrous oxide. By studying 3,704 records of water levels and emissions from wetlands throughout the world, the researchers calculated the precise water level at which wetlands produce the fewest net emissions. The results, *published in the journal Nature Geoscience*, found that the amount of carbon stored in wetlands offset nearly all the methane emitted when the water level was a few centimeters beneath the surface.



Scientists Discover Process to Gauge CO₂ Storage in Plants.

Scientists from the University of Western Australia School of Molecular Sciences discovered a previously unknown process that determines how much CO_2 plants release into the atmosphere. *Published in the journal Nature Plants*, the study focused on plant respiration and proposed a new process to slow it down in plants, and thus reduce their release of CO_2 . By blocking pyruvate pathways, the scientists hope to prioritize energy sources within plants that limit the release of CO_2 , redirecting the carbon into biomass instead of CO_2 .

From Phys.org. August 2022.

New York DEC to Fund CCS Research Project.

The New York (USA) Department of Environmental Quality (DEC) awarded a grant to a Cornell professor to study how small bodies of water contribute to CCS. The study will be conducted in ponds and wetlands in Ithaca and surrounding areas, aiming to quantify how much carbon the small bodies of water can store in their sediment. The goal is to find sustainable ways to implement carbon-friendly ponds, either naturally or artificially.

From The Cornell Daily Sun. August 2022.

From New Scientist. August 2022.

SCIENCE (cont.)

Ohio State University to Lead Carbon Farming Project.

Ohio State University (USA) is leading a project to study carbon farming as a potential climate change solution. Funded in part by a grant from the Foundation for Food & Agriculture Research, the project will measure how much organic and inorganic carbon gets stored in the soil under different farming practices in key regions across the western hemisphere. The project, titled "Enhanced Soil Carbon Farming as a Climate Solution," will measure carbon storage on croplands, rangelands, and grasslands, including soils used to produce a wide and representative range of crops and animals, as well as soils being managed through both traditional and enhanced carbon-farming methods.



From Ohio State University News. August 2022.

PUBLICATIONS

Fracture Adjacent Matrix Permeability: Insights from a Direct Experimental Approach.

The following is from the Introduction of this DOE/NETL product: "Characterizing the permeability of a rock matrix immediately adjacent to a fracture is critical for understanding migration of fluids (gases and liquids) as this zone undergoes reaction/mechanical degradation during storage and production. The issue with traditional approaches is that they are designed on the premise of using a cylindrical core sample where pressure or flow is measured across the entire sample, rather than adjacent to or immediately on a fracture plane. Measuring across the entire sample means that heterogeneity, and thus the anisotropic nature of permeability in mudrocks, is integrated into one permeability measurement and fails to capture how fluids migrate in and out of the matrix along the primary flow path, be it in fractures or bedding planes. The measurement of permeability in shale and mudrock has



been conducted using a variety of techniques and methods; with resulting typical absolute permeability values ranging from 0.001 to 1uD. The more successful attempts have occurred in fractured media, which lends itself well to traditional core flood experiments that use Darcy flow approximations when describing the physics of flow. In the non-fractured cases, methods have generally centered around the principle of pressure pulse decay, whereby a pressure differential is induced across a core plug and the rate at which the upstream and downstream pressure equilibrates is used to calculate permeability. The pressure pulse decay methodology is well documented and generally accepted as the best approach to experimentally derive permeability in tight, unfractured systems."

Global Carbon Capture and Storage Market Research Report with Opportunities and Strategies to Boost Growth- COVID-19 Impact and Recovery.

The following is a description of this document: "Carbon capture and storage (CCS) is the process of capturing and storing carbon dioxide (CO₂) before it is released into the atmosphere. The technology can capture up to 90% of the CO₂ released by burning fossil fuels in electricity generation and industrial processes such as cement production. Growing concerns about the detrimental effect of carbon emissions on the environment have driven the adoption of carbon capture and storage (CCS) technology. Several governments are encouraging the implementation of the technology through pilot projects in various industries due to the ability of carbon capture and storage technology to serve as a large-scale solution to achieve CO_2 emission reduction and climate control goals. A2Z Market Research announces the release of the Carbon Capture and Storage Market research report. The market is predicted to grow at a healthy pace in the coming years. Carbon Capture and Storage Market 2022 research report present an analysis of market size, share, growth, trends, cost structure, and statistical and comprehensive data of the global market. The report gives a clear picture of the current market circumstance [...] As analytics have become an inherent part of every business activity and role, form a central role in the decision-making process of companies these days is mentioned in this report. In the next few years, the demand for the market is expected to substantially rise globally, enabling healthy growth of the Carbon Capture and Storage Market is also detailed in the report. This report highlights the manufacturing cost structure includes the cost of the materials, labor cost, depreciation cost, and the cost of manufacturing procedures. Price analysis and analysis of equipment suppliers are also done by the analysts in the report."

Integration of supply chain management of hybrid biomass power plant with carbon capture and storage operation.

The following is from the abstract of this article: "Bioenergy Carbon Capture and Storage (BECCS) is thought to be one of the most important technologies to realize the deep carbon emission reduction. An integrated model that combines biomass inventory management and carbon capture and storage (CCS) construction is built to analyze the operation management of BECCS plants. Biomass supply level and structure, operation costs, warehousing scale, and application restrictions are considered in the inventory management. The operation costs, learning effects, investment path, and capture efficiency of CCS are considered in the process of CCS construction. These two processes are integrated to maximize the total profit for biomass power plants under inter-temporal conditions. Jiangsu Province is selected for numerical simulation. The results show that the supply level of biomass has a great influence on the results, and the corresponding CCS technology needs to fully consider this factor for expansion. In addition, under strict carbon emission constraints, to avoid the high cost of CCS, policymakers are more inclined to achieve emission reduction targets by reducing power generation levels. Therefore, appropriate policy subsidies are needed to ensure the development of BECCS at this time."

Jian-Xin Guo, Xianchun Tan, Baihe Gu, and Kaiwei Zhu, Renewable Energy. (Subscription may be required.)

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PUBLICATIONS (cont.)

Heat pulse testing at monitoring wells to estimate subsurface fluid velocities in geological CO₂ storage.

The following is from the abstract of this article: "Monitoring the injected CO_2 during geological CO_2 storage (GCS) is essential to assure containment and identify CO₂ leakage. In this work, a new approach is introduced to estimate the evolution of the downhole fluid velocity at a monitoring well and identify CO₂ arrival time using in-well heat pulse/tracer test. The proposed technique involves using a downhole heater to generate a series of heat pulses and measuring their corresponding temperature response. The surface temperature of the downhole heater is controlled by the supplied electrical power and the heat loss by convection to the surroundings. Convective heat transfer is well described using Newton's law of cooling in which the temperature difference between the heater and the surrounding fluids drives the heat transfer, for which the convection heat transfer coefficient (h) controls the magnitude of heat loss. Among various factors that control h, it depends on the type of the flowing fluid and its velocity. Through analyzing the measured temperature at different heat pulses, the changes in h - due to mobilization of the in-situ brine or CO₂ arrival - can be estimated. Consequently, the velocity of the flowing fluid across the heater can be obtained. Since heat transfer by convection is sensitive to the type of the surrounding fluid, intrusion of CO₂ can be detected from the relatively higher surface temperature obtained at CO₂ arrival. Churchill and Bernstein (1977)'s correlation is adopted to estimate the change of fluid velocity in terms of the change in h. To demonstrate the validity of the proposed technique, the results are applied and validated against those of COMSOL Multiphysics simulation tool for single-phase brine (before CO₂ arrival) and single-phase CO₂ (after CO₂ arrival). The observed temperature heating is sensitive to the flowing fluid velocity and fluid type. The temperature signal observed at CO₂ arrival is large and easily detectable using temperature monitoring tool which provides reliable indication for tracking CO₂ arrival at monitoring wells compared with passive temperature monitoring. The results obtained using the proposed technique agree very well with the numerical results obtained from the simulation tool with a maximum estimation error of 7 percent."

Refaat G. Hashish and Mehdi Zeidouni, *Journal of Petroleum Science and Engineering.* (Subscription may be required.)

Effect of the carbon emissions trading policy on the co-benefits of carbon emissions reduction and air pollution control.

The following is from the abstract of this article: "Achieving the co-benefits of carbon emissions reduction and air pollution control is significant for pursuing a sustainable and low-carbon economy in China. This study applies the difference-in-differences method to explore the local and spillover impact of the carbon emissions trading policy (2011) on China's carbon emissions and air quality, based on city-level data. The results show that the carbon emissions trading policy significantly affects the co-benefits of the total carbon emissions reduction and air quality improvement. In addition to this direct effect, the carbon emissions trading policy could indirectly affect carbon emissions and air quality by changing the innovation ability of cities and location choice of local industries. Though the policy does not significantly affect the overall carbon emissions intensity in China, it is seen to be effective for Central China. [The authors'] further spatial analysis indicates that the policy increases the carbon emissions in neighboring cities, which supports the 'pollution haven hypothesis.' Thus, this study contributes to the existing climate policy literature and provides a more comprehensive picture of the policy effect by integrating the co-benefits of the carbon emissions reduction and air pollution control, estimating both local and spillover effects and exploring the underlying mechanisms."

Zhaoyingzi Dong, Chuyu Xia, Kai Fang, and Weiwen Zhang, *Energy Policy*. (Subscription may be required.)

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About DOE'S CARBON TRANSPORT and STORAGE **PROGRAM**

The **Carbon Transport and Storage Program** at the National Energy Technology Laboratory (NETL) is focused on developing and advancing technologies to enable safe, cost-effective, permanent geologic storage of CO_2 , both onshore and offshore, in different depositional environments. The technologies being developed will benefit both industrial and power sector facilities that will need to mitigate future CO_2 emissions. The program also serves to increase the understanding of the effectiveness of advanced technologies in different geologic reservoirs appropriate for CO_2 storage—including saline formations, oil reservoirs, natural gas reservoirs, unmineable coal, basalt formations, and organic-rich shale basins—and to improve the understanding of how CO_2 behaves in the subsurface. These objectives are key to increasing confidence in safe, effective, and permanent geologic CO_2 storage.

The **Carbon Transport and Storage Program Overview** webpage provides detailed information of the program's structure, as well as links to the webpages that summarize the program's key elements.

Carbon Transport and Storage Program Resources

Newsletters, program fact sheets, best practices manuals, roadmaps, educational resources, presentations, and more information related to the Carbon Transport and Storage Program is available on *DOE's Energy Data eXchange (EDX) website*.



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About NETL'S CARBON TRANSPORT and STORAGE **NEWSLETTER**

Compiled by the National Energy Technology Laboratory, this newsletter is a monthly summary of public and private sector carbon transport and storage news from around the world. The article titles are links to the full text for those who would like to read more (note that all links were active at the time of publication).

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