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

U.S. DEPARTMENT OF ENERGY | NATIONAL ENERGY TECHNOLOGY LABORATORY

# CTSN CARBON TRANSPORT and STORAGE NEWSLETTER

VOL. 22, NO. 9

## CARBON TRANSPORT and STORAGE PROGRAM DOCUMENTS and REFERENCE MATERIALS

- Carbon Transport and Storage Educational Resources
- Program Reports, Plans, and Roadmaps
- Conference Proceedings
- Carbon Transport and Storage Portfolio
- Systems Analysis
- Peer Review
- Best Practices Manuals
- Fossil Energy and Carbon Management Techlines

This newsletter was compiled by the National Energy Technology Laboratory to provide information on recent activities and publications related to carbon transport and storage. It covers domestic, international, and public and private sector news in the following areas:

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## DOE/FECM/NETL HIGHLIGHTS

### *DOE Announces Set of FOAs to Manage and Store $CO_2$.*

The U.S. Department of Energy (DOE) announced a nearly $4.9 billion set of funding opportunities to bolster investments in the carbon management industry and to significantly reduce carbon dioxide ($CO_2$) 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's Office of Fossil Energy and Carbon Management (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 $CO_2$, along with associated $CO_2$ 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 $CO_2$ and certain types of chemical production facilities. The ***Carbon Dioxide Transport Engineering and Design*** FOA provides up to $100 million to design regional $CO_2$ pipeline networks to safely transport captured $CO_2$ from key sources to centralized locations.

From *energy.gov*. September 2022.

CONTINUE

# ANNOUNCEMENTS

## DOE/NETL Hosts 2022 Carbon Management Project Review Meeting.

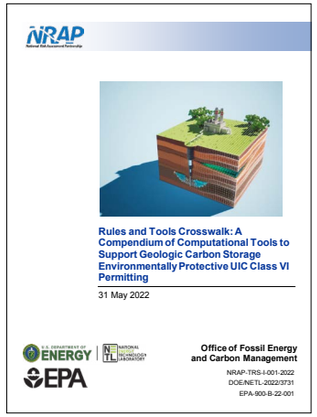
For the first time since 2019, DOE's National Energy Technology Laboratory (NETL) hosted their annual carbon management project review meeting as an in-person event. The 2022 Carbon Management Project Review Meeting was held in Pittsburgh, Pennsylvania (USA), August 15–19, 2022. The meeting included 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.

## NETL, Partners Release Resource on Computational Tools to Complete $CO_2$ Storage Permit Applications.

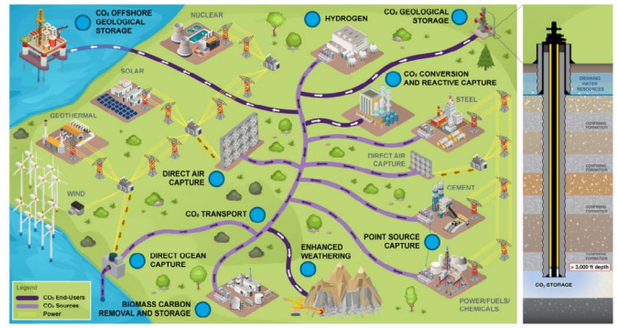
NETL collaborated with the U.S. Environmental Protection Agency (EPA), other contributing national laboratories, and DOE's Regional Initiatives to Accelerate CCUS on a report that identifies computational tools useful for addressing aspects of the dedicated carbon storage (Class VI) well permit application under EPA's Underground Injection Control (UIC) Program. "***Rules and Tools Crosswalk: A Compendium of Computational Tools to Support Geologic Carbon Storage Environmentally Protective UIC Class VI Permitting***" is intended to serve as a resource for industry, regulatory, academic, and public stakeholders.




## White House Nominations for CCUS Task Forces.

The White House Council on Environmental Quality sought nominations for two task forces that will provide input to inform the development of CCUS. The task forces will provide recommendations to the federal government on how to ensure that CCUS projects are permitted in an efficient manner, reflect the input and needs of a wide range of stakeholders, and deliver benefits to local communities. Vacancies for the ***Carbon Dioxide Capture, Utilization and Sequestration Federal Lands and Outer Continental Shelf Permitting Task Force*** and the ***Carbon Dioxide Capture, Utilization and Sequestration Non-Federal Lands Permitting Task Force*** are anticipated to be filled later this year.

## DOE Announces NOIs, Launches Online Resources.




Click on the image above to access the interactive diagram.

DOE issued NOIs to fund two programs funded by the BIL—the ***Carbon Capture Demonstration Projects Program*** and the ***Carbon Dioxide Transport/Front-End Engineering Design (FEED) Program***. Together, these programs help to advance the administration's goal of a net-zero greenhouse gas (GHG) emissions economy by 2050. In addition, DOE/FECM launched two new interactive tools. The ***Carbon Matchmaker Tool*** is an online information resource designed to increase awareness of carbon management funding opportunities; support private sector development of carbon capture, storage, and transportation infrastructure and carbon dioxide removal (CDR) pathways; and facilitate regional business development opportunities and education. The ***Carbon Management Interactive Diagram*** is an online tool that highlights carbon management programs in the BIL and through other DOE funding opportunities, as well as educates users about resources that fall under each program.

## Carbon Negative Shot Summit Recap.


DOE's Carbon Negative Shot Summit was attended by more than 1,700 people from 39 countries. A ***two-minute recap video*** of key moments from the summit is available, as is the ***full recording***.

## 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***.

# ANNOUNCEMENTS *(cont.)*

## Report on Transition to Low-Carbon Energy Sources.

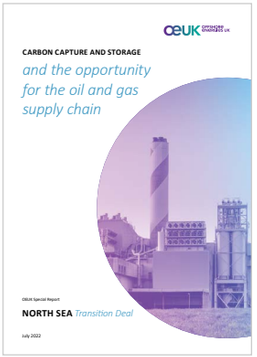
Zenon Research ***released a report*** on transitioning to low-carbon energy sources. Although focused on mature technologies, such as solar and wind energy, the report also calls for investment in other transition areas, such as mobility, electrified heat, storage, and carbon capture and storage (CCS).


## Public Consultation on Core Carbon Principles Completed.

The Integrity Council for the Voluntary Carbon Market held a 60-day public consultation on draft Core Carbon Principles (CCPs), which propose fundamental, interlinked criteria for carbon credits that create verifiable climate impact with social and environmental safeguards. The draft CCPs, and accompanying draft Assessment Framework, are designed to build an understanding of carbon-crediting programs and credit types and establish a pathway for improvement. The public consultation was overseen by the British Standards Institute.

## UK CCS Supply Chain Report Released.

A ***report*** commissioned by the United Kingdom's (UK) Department for Business, Energy, and Industrial Strategy (BEIS) found that CCS in the UK could be worth ~$120 billion to local manufacturing employers. Produced by Offshore Energies UK through the North Sea Transition Deal, the report identified 13 actions for the UK government and industry to undertake to help meet net-zero goals and benefit UK jobs and economy.




## New York DEC Announces Grants to Safeguard Carbon Storage.

The New York Department of Environmental Conservation (DEC) announced nearly $1 million in awards to establish community forests in western and central New York (USA). The inaugural round of the Community Forest Conservation Program grants is expected to help safeguard ecosystem benefits forests provide, including carbon storage.

## Update on Japanese Government's Carbon Credit Report.

The Japanese Ministry of Economy, Trade, and Industry (METI) established the "Study Group on the Preparation of an Operational Environment to Ensure the Proper Use of Carbon Credits to Achieve Carbon Neutrality" in 2021. The study group provided an ***update on their carbon credit report***.

# PROJECT AND BUSINESS DEVELOPMENTS

## Denbury Adds CCS Site in Louisiana.

Denbury

Energy company Denbury announced the expansion of its $CO_2$ storage portfolio with an additional storage site in Louisiana (USA). Denbury signed an agreement with a landowner to lease approximately 18,000 acres of land near Donaldsonville, Louisiana, for future $CO_2$ storage. The site is located less than five miles from Denbury's existing $CO_2$ Green Pipeline and in close proximity to the Louisiana Industrial Corridor. Denbury estimates more than 50 million metric tons per year of existing stationary $CO_2$ emissions are located within 30 miles of the site.

From *Denbury Press Release*. July 2022.

## CCUS MOU Signed in Midwest United States.

Chart Industries and Wolf Carbon Solutions signed a Memorandum of Understanding (MOU) focused on CCUS in the Midwest United States. The MOU will support refineries, cement, steel, and petrochemical companies to capture, transport, and store $CO_2$ emissions from industrial facilities. Chart's Sustainable Energy Solutions technology will be deployed at a number of host sites, where $CO_2$ emissions will be captured and stored in Wolf Carbon Solutions' Mt. Simon Hub pipeline (which will run from Cedar Rapids, Iowa, to central Illinois).


From *gasworld*. July 2022.

## Companies Collaborate to Reduce CCS Costs.

Global technology company ABB and CCS solutions company Captimise are collaborating to assist industrial $CO_2$ emitters with incorporating CCS into their operations. The companies will work with operators to assess alternative technologies and plant configurations available to achieve CCS.

From *Industry and Energy*. July 2022.

## Japanese Companies to Explore CCS in Malaysia.

A trio of Japanese energy companies agreed to explore the viability of CCS technology in Malaysia. Japan Petroleum Co. Ltd. (JAPEX), JGC Corporation, and Kawasaki Kisen Kaisha Ltd. agreed to investigate suitable sites for $CO_2$ storage and methods to capture and transport the $CO_2$ from the Petronas liquified natural gas complex in Malaysia, in addition to the possibility of transporting it from outside the country.

From *gasworld*. August 2022.

## PROJECT AND BUSINESS DEVELOPMENTS *(cont.)*

### CCS Project to Be Developed in Thailand.

PTT Exploration and Production (PTTEP) announced plans to develop a CCS project at the Arthit offshore gas field in Thailand. Currently in the pre-FEED phase, the project is expected to store 1 million metric tons of $CO_2$. A final investment decision is expected in 2023, with the CCS facility projected to be operating by 2026. PTTEP plans to carry out more feasibility studies for CCS projects in Thailand and is also collaborating to establish a Thailand CCUS consortium for the adoption of CCUS in the country's industrial sector.

From *Energy Voice*. August 2022.

### California Carbon Management Projects Net Investment.

A Canadian-based asset management firm agreed to invest in California Resources Corporation's (CRC) plans to develop carbon management projects in California (USA). CRC's joint venture, with a fund run by Brookfield Asset Management Inc., will provide $10 per metric ton of $CO_2$ injected into a geologic formation in the Elk Hills oil field (proposing up to 5 million tons of $CO_2$ per year).

From *The Bakersfield Californian*. August 2022.

## LEGISLATION AND POLICY

### New Bill on EPA $CO_2$ Regulations.

A new bill introduced in the U.S. House of Representatives would require EPA to enforce new fuel carbon-intensity standards for ships—specifically commercial voyages, international and domestic, involving any "U.S ports of call." ***The Clean Shipping Act of 2022*** is modeled on the ***European Union's (EU) Fit for 55*** regulatory framework for shipping. Under the proposed bill, the GHG intensity would be reduced by 20% in 2027, 45% in 2030, 80% in 2035, and 100% in 2040.

From *The Maritime Executive*. July 2022.

### Government of Alberta Investing in CCUS.

The Government of Alberta (Canada), through non-profit ***Emissions Reduction Alberta (ERA)***, is investing in 11 projects focused on advancing CCUS in the province. If successful, the projects could lead to the reduction of approximately 24 million metric tons of $CO_2$ emissions annually. The projects selected under the Carbon Capture Kickstart: Design and Engineering funding opportunity represent industrial sectors such as power generation, cement, fertilizer, forest products, and oil and gas. Projects are expected to be operational by 2030.

From *Emissions Reduction Alberta*. July 2022.

## EMISSIONS TRADING

### International Soil Carbon Credit Issued in UK.

BCarbon, a Houston-based (USA) carbon credit registry, issued an international soil credit to Future Food Solutions in the UK, which created the Futures Carbon Bank to sell credits on the voluntary carbon market. Under the carbon bank program, farmers are encouraged to grow cover crops that store atmospheric $CO_2$ in the soil while employing no-till practices.

From *British Consulate General Houston*. July 2022.

### Cambodia Successfully Sells Carbon Credits.

According to a state official, Cambodia sold carbon credits in the voluntary carbon market, earning ~$11 million from 2016–2020. The kingdom sold three carbon credit projects at the Keo Seima Wildlife Sanctuary in Mondulkiri province, the REDD+ Project at the Southern Cardamom National Park in Koh Kong province, and the Prey Lang Wildlife Sanctuary in Stung Treng province.

From *The Manila Times*. July 2022.

# SCIENCE

## Researchers Study Plankton's Ability to Store $CO_2$.

According to researchers at the University of Bristol and the National Oceanography Centre, the amount of $CO_2$ stored by microscopic plankton may increase in the coming century. ***Published in the journal Proceedings of the National Academy of Sciences***, the researchers' findings suggest the "biological pump"—a process where phytoplankton take up carbon and then die and sink into the deep ocean where carbon is stored for hundreds of years—may account for 5–17% of the total increase in carbon uptake by the oceans by 2100.

From *Phys.org*. July 2022.

## LLNL Leads Research on Soil Carbon Storage Capacity.

A team of researchers led by Lawrence Livermore National Laboratory (LLNL) studied the potential of carbon storage in soils. ***Published in the journal Nature Communications***, the study found that regions under agricultural management and having deeper soil layers contain the largest undersaturation of mineral-associated carbon; the degree of undersaturation can help inform storage efficiency over years to decades. The team showed that across 103 carbon accrual measurements spanning management interventions globally, soils furthest from their mineralogical capacity are more effective at accruing carbon. Storage rates average three times higher in soils at one-tenth of their capacity compared to soils at one-half of their capacity.

From *LLNL News*. July 2022.

## Data Shows UK Forests Not Storing as Much $CO_2$.

According to data collected by researchers, the amount of $CO_2$ captured and stored annually by trees in the UK peaked in 2009, and has fallen every year since. Official projections, which are based on the forestry stocks and policies in place in 2019, forecast the carbon they absorb will fall by 25% a year by 2025. In the absence of any further forests being planted, that could fall by half by 2038, the forecasts show.

From *The Guardian*. July 2022.

## Lab Chip Developed to Accelerate Carbon Storage Efforts.

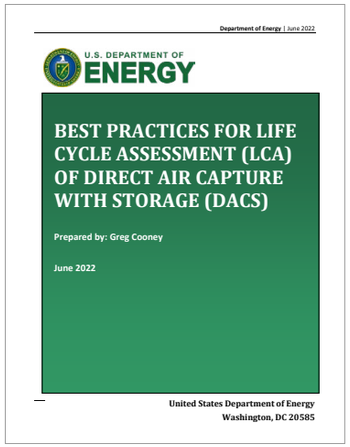
Scientists at Stanford University (USA) developed a device that enables assessments of sites for underground storage of $CO_2$, hydrogen, and industrial waste. To demonstrate the microfluidics device, the researchers used eight rock samples from the Marcellus shale in West Virginia and the Wolfcamp shale in Texas. They then cut and polished the slivers of rock to bits no bigger than a few grains of sand, with each one containing varying amounts and arrangements of reactive carbonate minerals. The researchers placed the samples into a polymer chamber sealed in glass, with two tiny inlets left open for injections of acid solutions. High-speed cameras and microscopes enabled them to study how chemical reactions caused individual mineral grains in the samples to dissolve and rearrange.

From *Stanford News*. August 2022.

# PUBLICATIONS

## Best Practices for Life Cycle Assessment (LCA) of Direct Air Capture with Storage (DACS).

The following is from the Executive Summary of this DOE report: "As the one of the performance elements of the Carbon Negative Shot, robust life cycle greenhouse gas (GHG) accounting is a critical element for Carbon Dioxide Removal (CDR). Life Cycle Analysis/Assessment (LCA) is an existing framework that is well suited to evaluate the environmental implications of CDR. By design, LCA provides a holistic perspective of the potential environmental impacts of a product or process across the different life cycle phases. Not only can LCA be used to help determine the net $CO_2$e removal of a CDR approach, but it can also help with the assessment of potential tradeoffs with other environmental impacts. Even though the approaches for LCA are codified in the ISO 14040/14044 standards, [the authors] recognize the need to establish specific best practices for the subjective elements in those standards to harmonize data and methods to allow for consistent assessments of CDR approaches…"




## A scoping study for a deep geological carbon dioxide storage research facility.

The following is from a description of this British Geological Survey (BGS) report: "A new report from a carbon storage scoping study demonstrates the importance of community engagement to define the research agenda to achieve the UK national climate change targets. Carbon capture and storage is 'a necessity, not an option, in meeting net-zero', according to the UK Committee on Climate Change. A NERC-funded carbon storage scoping study, commissioned in October 2020, identifies a strategic need for a national research infrastructure in carbon dioxide ($CO_2$) storage and developed the key research and innovation challenges it could address…"

# PUBLICATIONS *(cont.)*

## Dawsonite as a Temporary but Effective Sink for Geological Carbon Storage.

The following is from the abstract of this article: "The possibility of using dawsonite mineral trapping as a carbon capture and storage (CCS) strategy intrigues many. In this study, [the authors] used a dawsonite-rich (~10%) $CO_2$ gas reservoir in the Hailar basin in northern China as a natural analogue of a $CO_2$ storage site, along with numerical modeling, to demonstrate that a large amount of dawsonite can be generated in sandstone formations, provided sufficient Na-rich feldspar and $CO_2$ gas are available. While precipitated dawsonite can be preserved only in a hydrodynamically-closed system in the long term under high $CO_2$ fugacity and $\log((Na^+)/(H^+))$ activities in solution, short-term trapping of $CO_2$ in dawsonite (on the order of 10 kyr) is possible and lowers $CO_2$ pressure, which mitigates the risk of $CO_2$ leakage to the ground surface or overlying drinking water aquifers. The re-dissolution of dawsonite after a few thousand years facilitates progressive dissipation of the gas phase $CO_2$ over time. Consideration of reservoirs or saline aquifers with minerals or formation water that can provide a high abundance of dissolved sodium, significantly increases the number of potential CCS sites globally. Furthermore, alternating water-and-gas injection regimens could enhance the precipitation of dawsonite in Na-rich aquifers. Future editions of the Carbon Storage Atlas should consider aquifer geochemistry in the site selection for secure long-term carbon storage in addition to the volumetric considerations for short-term operation."

**Peng Lu, Guanru Zhang, Yi Huang, John Apps, and Chen Zhu,** *International Journal of Greenhouse Gas Control.* (Subscription may be required.)

## Effects of Hydrogeological Heterogeneity on $CO_2$ Migration and Mineral Trapping: 3D Reactive Transport Modeling of Geological $CO_2$ Storage in the Mt. Simon Sandstone, Indiana, USA.

The following is from the abstract of this article: "[The authors] used three-dimensional (3D), high-resolution simulations facilitated by parallel computation to assess the effect of hydrogeological heterogeneity in the Mt. Simon Sandstone on $CO_2$ plume evolution and storage and geochemical reactions in a portion of the Illinois Basin, Indiana. Two scenarios were selected to investigate the effects of the hydrogeological heterogeneity in 3D reactive transport simulations: a heterogeneous case with variable porosity and permeability, and a homogenous case with constant porosity and permeability. The initial pressure, temperature, and mineralogical distributions are consistently applied in both the heterogeneous case and the homogeneous case. Results indicate that including hydrogeological heterogeneity in 3D reservoir simulations for geological $CO_2$ storage significantly impacts modeling results for plume migration patterns, $CO_2$-water-mineral interaction, reservoir quality, and $CO_2$ plume containment. In particular, results indicate that (1) the $CO_2$ plume reached the top of the Mt. Simon Sandstone in the homogeneous case, but was restrained to the lower third of the formation when hydrogeologic heterogeneity was considered; (2) the dominant trapping mechanism in the heterogeneous case was mineral trapping (43%), while it was solubility trapping (47%) in the homogeneous case (at 10,000 years); (3) incorporating reservoir heterogeneity in the model leads to a higher likelihood of long-term containment."

**Babak Shabani, Peng Lu, Ryan Krammer, and Chen Zhu,** *Energies.* (Subscription may be required.)

## Assessment of chemo-mechanical impacts of $CO_2$ sequestration on the caprock formation in Farnsworth oil field, Texas.

The following is from the abstract of this article: "This study evaluates the chemo-mechanical influence of injected $CO_2$ on the Morrow B sandstone reservoir and the upper Morrow shale caprock utilizing data from the inverted 5-spot pattern centered on Well 13-10A within the Farnsworth unit (FWU). This study also seeks to evaluate the integrity of the caprock and the long-term $CO_2$ storage capability of the FWU. The inverted 5-spot pattern was extracted from the field-scale model and tuned with the available field observed data before the modeling work. Two coupled numerical simulation models were utilized to continue the study. First, a coupled hydro-geochemical model was constructed to simulate the dissolution and precipitation of formation minerals by modeling three intra-aqueous and six mineral reactions. In addition, a coupled hydro-geomechanical model was constructed and employed to study the effects of stress changes on the caprock's porosity, permeability, and ground displacement. The Mohr–Coulomb circle and failure envelope were used to determine caprock failure. In this work, the $CO_2$-WAG injection is followed by the historical field-observed strategy. During the forecasting period, a Water Alternating Gas (WAG) injection ratio of 1:3 was utilized with a baseline bottom-hole pressure constraint of 5500 psi for 20 years. A post-injection period of 1000 years was simulated to monitor the $CO_2$ plume and its effects on the $CO_2$ storage reservoir and caprock integrity. The simulation results indicated that the impacts of the geochemical reactions on the porosity of the caprock were insignificant as it experienced a decrease of about 0.0003% at the end of the 1000-year post-injection monitoring. On the other hand, the maximum stress-induced porosity change was about a 1.4% increase, resulting in about 4% in permeability change. It was estimated that about 3.3% of the sequestered $CO_2$ in the formation interacted with the caprock. Despite these petrophysical property alterations and $CO_2$ interactions in the caprock, the caprock still maintained its elastic properties and was determined to be far from its failure."

**Benjamin Adu-Gyamfi, William Ampomah, Jiawei Tu, Qian Sun, Samuel Erzuah, and Samuel Acheampong,** *Scientific Reports.* (Subscription may be required.)

## Cost-benefit analysis of Gencos market trading with carbon-tax and cap-and-trade policies.

The following is from the abstract of this article: "Environmental issues have made reducing carbon emissions a consensus among all countries. The electricity market provides a competitive environment and at the same time makes it possible to reduce the carbon emissions of the electricity system through market-oriented means. Firstly, this paper focuses on carbon-tax and cap-and-trade market policies and introduces the quotation models of power generation companies with the two market policies. Then, in a specific market scenario, the bidding strategies, cost-benefit changes, and the carbon emission changes of the power system are analyzed when the Gencos are affected by carbon-tax policies with different tax rates or cap-and-trade policies with different carbon quota allocation methods. The results show that with the increase of the carbon-tax rate, the market-clearing price rises; except for the coal-fired power plants with high carbon emissions, the profits of other Gencos increase, and the carbon emissions in the system decrease significantly. Using the baseline method, historical emission method, and carbon emission reduction intensity method to allocate carbon allowances among Gencos can all achieve carbon emission reduction effects, and the carbon emission reduction intensity method has the best effect. Finally, the trading strategy of coal-fired Gencos with the cap-and-trade policy is proposed to increase their profits."

**Jingrong Guo and Yue Xiang,** *Energy Reports.* (Subscription may be required.)

## PUBLICATIONS *(cont.)*

### Dynamic estimates of extreme-case $CO_2$ storage capacity for basin-scale heterogeneous systems under geological uncertainty.

The following is from the abstract of this article: "Geological $CO_2$ storage is expected to grow dramatically in the coming decades to meet global climate targets. Assessment of worldwide storage resources using static methods indicates significant theoretical potential for large-scale deployment. Dynamic capacity estimates are needed at the basin-scale that fully capture the impact of geological uncertainty and account for regional limits on pressure buildup. Accurate quantification of the risk of low or critically low capacity under extreme occurrences of heterogeneity will be increasingly important. There are significant challenges associated with efficient computation of low probability capacity within Monte Carlo frameworks at these scales. In this paper, [the authors] propose a workflow for uncertainty quantification that is able to efficiently estimate increasingly outer percentiles of dynamic capacity such as P1, P0.1, or even lower probability events. [The authors'] approach is based on the rare-event methodology that uses a subset simulation approach to concentrate sampling of the parameter space in the tail regions of the capacity distributions. This approach greatly speeds up uncertainty quantification for very small probabilities compared to standard Monte Carlo. [The authors] demonstrate the method by introducing a correlated heterogeneity field to a highly prospective basin-scale system that can support regional injection rates of 100 million tons annually. [The authors] find that the outer quantiles are more sensitive to the underlying geostatistical model compared to the median P50 capacity. This implies that for large-scale systems, well characterized heterogeneity is essential to identify the likelihood of very rare yet still relevant dynamic estimates of storage capacity."

**Per Pettersson, Svenn Tveit, and Sarah E. Gasda,** *International Journal of Greenhouse Gas Control.* (Subscription may be required.)

### Carbon capture penetration in Mexico's 2050 horizon: A sustainability assessment of Mexican CCS policy.

The following is from the abstract of this article: "Mexico is expected to become the 6th largest economy in 2050. According to EDGAR database, in 2019 it was the largest polluting country in Latin America and the 13th in the world, regarding Greenhouse Gas (GHG) emissions. Lately, the new Administration has shifted its energy strategy from a renewable path into the reinforcement of conventional energy sources. In this context, new policies have to be deployed to meet the Paris Agreement goals. In such scenario, carbon capture and storage (CCS) technology may contribute reducing $CO_2$ emissions as a way to transform Mexico into a low-carbon economy in the long term. However, the construction and operation and maintenance phases will embody environmental impacts that should be considered. This paper assesses the carbon capture investments required for the expected increasing capacity of natural gas power plants up to 2050 and their impact on production, value added, employment, climate change, acidification, water consumption and human health effects. An environmentally extended multi-regional the input-output analysis (EMRIO) is used to address Mexican policies for the period 2020–2050. Results show that the investment in capture technologies in Mexico allows a net reduction of the carbon emissions in Mexico that is pursued at a low cost (33 EUR/t$CO_2$). This mitigation policy has important additional co-benefits in terms of domestic value added and employment creation of medium and high qualification. As for the environmental impacts, most of them are produced in the power plant due to the burning of the natural gas consumed."

**Santacruz Banacloche, Yolanda Lechon, and Antonio Rodríguez-Martínez,** *International Journal of Greenhouse Gas Control.* (Subscription may be required.)

## 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***.

### Get Social with Us

There are several ways to join the conversation and connect with NETL's Carbon Transport and Storage Program:

### Disclaimer



## 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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