

## CSN

CARBON STORAGE  
NEWSLETTER

DECEMBER 2020

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

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DOCUMENTS and  
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- ▷ Carbon Storage Portfolio
- ▷ Systems Analysis
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- ▷ Best Practices Manuals
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## DOE/NETL HIGHLIGHTS

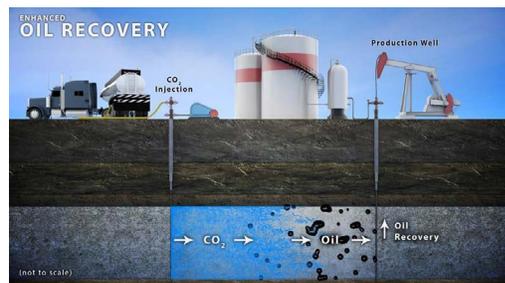
*DOE Issues NOI for Carbon Storage FOA.*

The U.S. Department of Energy's (DOE) Office of Fossil Energy (FE) *issued a notice of intent (NOI)* for a Funding Opportunity Announcement (FOA) in support of the goals of the *Advanced Storage research and development (R&D)* technology area of *DOE's Carbon Storage Program*. The "Emerging CO<sub>2</sub> Storage Technologies: Optimizing Performance Through Minimization of Seismicity Risks and Monitoring Caprock Integrity" FOA would seek projects to develop tools and methods designed to optimize safe, secure, and verifiable carbon dioxide (CO<sub>2</sub>) storage. The FOA intends to achieve three goals: facilitating the development of novel or advanced tools and methods to improve detection and characterization of faults during the site characterization phase; assessing seismic risk associated with large-scale CO<sub>2</sub> injection; and identifying, locating, and quantifying unpredicted CO<sub>2</sub>/native fluid migration through the main caprock layer(s) overlying an injection reservoir. From *Office of Fossil Energy Press Release*, November 2020.

*NETL Explores Expanded Use for CO<sub>2</sub>-EOR.*

A project utilizing National Energy Technology Laboratory (NETL) expertise in CO<sub>2</sub>-enhanced oil recovery (EOR) is underway in southern Michigan (USA). *The project* aims to unlock access to significant resources in the Trenton/Black River play by injecting CO<sub>2</sub> in the subsurface to improve the flow of oil to production wells. NETL's industry partners are drilling an approximately 3,900-foot well near Ann Arbor, Michigan, to collect

data and for later use as a recovery/production well. A second well will be drilled nearby to collect additional data and for use as the injection well. The goals of the project are to help the United States maintain its energy independence and economically use captured CO<sub>2</sub> while reducing emissions and maximizing the lifetime utility of existing infrastructure and wells in mature fields. From *NETL Press Release*, November 2020.



## ANNOUNCEMENTS

*DOE Releases Coal R&D Fact Sheets.*

DOE's *Office of Clean Coal and Carbon Management* posted nine coal R&D fact sheets. The Office of Clean Coal and Carbon Management R&D efforts advance transformative science and innovative technologies that enable the reliable, efficient, affordable, and environmentally sound use of fossil fuels.

*DOE Offers Prize to Design Subsurface Visualization Tool.*

DOE/FE will award up to \$1.5 million to winning innovators in a prize challenge to support the SMART (Science-informed Machine Learning to Accelerate Real-Time Decisions in the Subsurface) Initiative. The SMART Visualization Platform (VP) Challenge prize competition seeks competitors with software development expertise to create a new visualization platform that will assist in making subsurface insights accessible to a wider range of users and stakeholders. *SMART* leverages the expertise of seven national laboratories, as well as industry partners, universities, unconventional field laboratories, and carbon storage regional initiatives, to realize breakthroughs in understanding the subsurface environment through machine learning. Registration information can be found on the *SMART VP Challenge website*. The registration deadline is January 22, 2021.

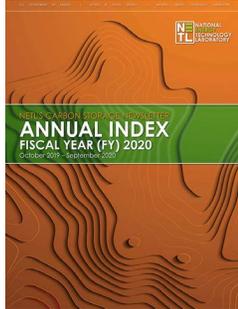
## ANNOUNCEMENTS *(cont.)*

### *DOE/NETL 2020 Virtual Integrated Project Review Meeting Proceedings.*

Proceedings from the DOE/NETL 2020 Virtual Integrated Project Review Meeting are [available on the NETL website](#). The virtual integrated review meeting consisted of a series of virtual sessions organized by DOE/NETL that featured projects from several DOE/FE portfolios, including [Carbon Capture](#) and [Carbon Storage](#).

### *FY 2020 Carbon Storage Newsletter Annual Index Available.*

The FY 2020 Carbon Storage Newsletter Annual Index is available. The document is a compilation of NETL's Carbon Storage Newsletters published from October 2019 through September 2020.



### *Open-Access CO<sub>2</sub> Storage Simulator Released.*

Lawrence Livermore National Laboratory (LLNL), Total, and Stanford University released an open-source, high-performance simulator for large-scale geologic CO<sub>2</sub> storage. The GEOSX simulator provides researchers with an open framework to accelerate the development of carbon capture, utilization, and storage (CCUS) technologies by using field data to predict the behavior and impact of CO<sub>2</sub> stored in geologic sources.

## PROJECT and BUSINESS DEVELOPMENTS

### *Wyoming CarbonSAFE Project Enters Phase III.*

The University of Wyoming launched Phase III of their Carbon Storage Assurance Facility Enterprise (CarbonSAFE) project. Phase III of the Wyoming CarbonSAFE project includes finalizing site characterization, completing Class VI permitting, and conducting National Environmental Policy Act (NEPA) analyses. From [University of Wyoming News](#). November 2020.

### *CCS Project Proposed in Denmark.*

Plans for a CCS project in Copenhagen, Denmark, were unveiled. The project—a collaboration between Amager Resource Center (ARC) and Copenhagen Malmö Port—will have the potential to capture approximately 500,000 metric tons of CO<sub>2</sub> from ARC. Once captured, the CO<sub>2</sub> will be transported for storage in underground oil reservoirs. From [Gasworld](#). November 2020.

### *Moomba CCS Injection Trial Conducted.*

Approximately 100 metric tons of CO<sub>2</sub> were injected underground in depleted gas reservoirs as part of the final field trial for the Moomba CCS Project. The injection occurred in the Strzelecki field in the Cooper Basin in South Australia. According to Santos, an Australian gas supplier, the Moomba CCS Project has the potential to store up to 20 million metric tons of CO<sub>2</sub> per year. From [Santos](#). October 2020.

### *CO<sub>2</sub> Storage License Application Submitted.*

Chrysaor, a North Sea oil and gas producer, submitted a license application and will submit an application for a storage lease to store CO<sub>2</sub> in a depleted gas reservoir. The applications support the V Net Zero Project, which seeks to store and transport CO<sub>2</sub> from the Immingham cluster on Humberside. From [Chrysaor News Release](#). November 2020.

### *CCS Project Briefing.*

The Bellona Foundation released a [briefing](#) on Norway's Longship Carbon Capture and Storage (CCS) Project. The briefing provides an overview of the project and the stages of its CCS chain, an analysis of the financial risks and estimated project costs, and a calculation of cost per metric ton of avoided CO<sub>2</sub>.

### *White Paper on Incentivizing Large-Scale CCS in Canada.*

RSM Canada and the International CCS Knowledge Centre released a white paper identifying opportunities within the Canadian tax and grant systems to incentivize large-scale CCS technology. The white paper examines the economic impact related to the development of CCS projects in Canada and recommends policy options for Canadian incentive scenarios.



### *Companies to Partner on CCUS R&D.*

ADNOC and Total signed a strategic framework agreement to explore joint research, development, and deployment partnership opportunities in the areas of CO<sub>2</sub> emissions reduction and CCUS. In the area of CCUS, the companies will further develop joint research into new technologies covering CCS solutions and EOR projects based on CO<sub>2</sub> usage.

### *MOU for Bio-CCS Projects Signed.*

Vattenfall (Sweden) and Aker Carbon Capture (Norway) signed a Memorandum of Understanding (MOU) to accelerate the evaluation of future carbon capture sites in Sweden and Northern Europe. According to Vattenfall, the companies will collaborate to develop solutions for large-scale, commercial bio-CCS plants. The MOU has a two-year timeline. From [Chemical Engineering](#). October 2020.

### *Large-Scale CCUS Plant to be Developed.*

A large-scale CCUS plant will be developed in Almeria, Spain. Carbon Clean, LafargeHolcim, ECCO<sub>2</sub>, and Sistemas de Calor agreed to develop the project, which aims to capture CO<sub>2</sub> emitted through the cement production process and recycle it for agricultural use for accelerated crop production. By accelerating the photosynthesis process, this technique has the potential to increase farm efficiency. According to the companies, the commercial applicability of this process has the potential to leverage 700,000 metric tons of CO<sub>2</sub> and achieve 100% decarbonization at the plant. From [Carbon Capture Journal](#). October 2020.

### *Partnership to Develop Offshore CO<sub>2</sub> Transport, Storage in UK.*

A partnership to develop offshore CO<sub>2</sub> transport and storage infrastructure in the North Sea was formed. The Northern Endurance Partnership (NEP)—comprising BP, Eni, Equinor, National Grid, Shell, and Total—will serve the proposed Net Zero Teesside and Zero Carbon Humber projects that aim to establish decarbonized industrial clusters in Teesside and Humberside, respectively. NEP submitted a bid for funding through the United Kingdom (UK) government's Industrial Decarbonisation Challenge. From [Equinor](#). October 2020.

## LEGISLATION and POLICY

### Legislation to Develop CO<sub>2</sub>-Removal Technology Introduced.

Legislation was introduced in the U.S. House of Representatives that would authorize an approach to research, develop, and demonstrate CO<sub>2</sub>-removal technology. The *Carbon Removal, Efficient Agencies, Technology Expertise (CREATE) Act* would direct federal agencies to include the development of CO<sub>2</sub>-removal technology as part of their annual budget requests and ensure that the work is coordinated across the federal government. From *U.S. Congresswoman Ann McLane Kuster Press Release*. October 2020.

## EMISSIONS TRADING

### EU Commission Reports on CO<sub>2</sub> Emissions.

The European Commission released a report detailing the European Union's (EU) output of greenhouse gas (GHG) emissions under Europe's carbon market. According to the report, EU carbon market emissions fell by 9.1% in 2019 from 2018. Approximately 45% of EU's GHG emissions are regulated by the EU Emissions Trading System (EU ETS). Under the EU ETS, businesses can buy permits through auctions held on behalf of EU member states. From *Reuters*. November 2020.

## SCIENCE NEWS

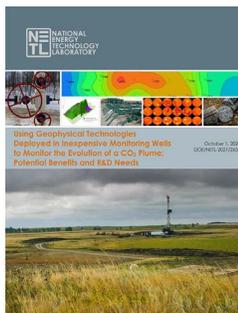
### Wooden Buildings Could Store CO<sub>2</sub>.

A study found that wooden buildings have the potential to store approximately half of the cement industry's CO<sub>2</sub> emissions. In collaboration with the Finnish Environment Institute, researchers from Aalto University in Helsinki, Finland, conducted the study, which estimated the CO<sub>2</sub> storage potential of using wood to construct residential buildings in Europe. According to the analysis, if 80% of new homes were made of wood, the buildings could store 55 million tons of CO<sub>2</sub> a year (equivalent to 47% of the cement industry's annual emissions across Europe). From *Earth.com*. November 2020.

## PUBLICATIONS

### Using Geophysical Technologies Deployed in Inexpensive Monitoring Wells to Monitor the Evolution of a CO<sub>2</sub> Plume: Potential Benefits and R&D Needs.

The following is from the Executive Summary of this DOE/NETL document: "Capturing carbon dioxide (CO<sub>2</sub>) from coal-fired power plants, natural gas-fired power plants and industrial CO<sub>2</sub> sources, and storing this captured CO<sub>2</sub> in deep saline formations is one method for reducing the emissions of CO<sub>2</sub> to the atmosphere. Often referred to as carbon capture, utilization and storage (CCUS), large quantities of CO<sub>2</sub> can be stored using two processes. The first process, known as saline storage of CO<sub>2</sub>, involves injecting CO<sub>2</sub> into deep saline formations. The second process is CO<sub>2</sub> enhanced oil recovery (EOR). This study focuses on saline storage of CO<sub>2</sub>. This technology is regulated by the United States (U.S.) Environmental Protection Agency (EPA) and each CO<sub>2</sub> injection well needs a Class VI permit to comply with the Underground Injection Control Program. As part of the Class VI permit, the operator of a CO<sub>2</sub> injection well must prepare and execute a Testing and Monitoring Plan and this plan must include monitoring the evolution of the injected CO<sub>2</sub> plume over time... This study was completed by the National Energy Technology Laboratory (NETL) which is part of Fossil Energy (FE) within the U.S. Department of Energy (DOE). This study compares the costs of 4-D seismic surveys and [vertical seismic profiling (VSP) using distributed acoustic sensing (DAS) with surface orbital vibrators (SOVs)]. An example CO<sub>2</sub> storage

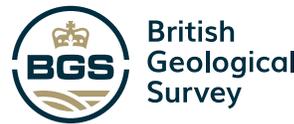


### Net-Zero Initiative Launched.

University of Oxford (Oxfordshire, England) researchers launched the Oxford Net Zero initiative to help address global CO<sub>2</sub> emissions. *Oxford Net Zero* is a collaboration of research and tools to support policy interventions and address questions such as how CO<sub>2</sub> will be distributed among the atmosphere, oceans, biosphere, and lithosphere, and where the CO<sub>2</sub> will be stored. From *Environmental Leader*. November 2020.



### Study to Investigate Potential for CO<sub>2</sub> Storage Testbed.

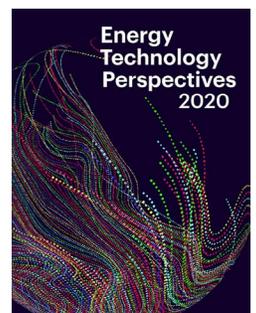


The British Geological Survey (BGS) will conduct a study using preliminary technical and permitting evidence to identify a range of location and design options for a CO<sub>2</sub> storage testbed. Conducted on behalf of the Natural Environment Research Council (NERC), the project aims to define future investment options in CO<sub>2</sub> storage research, outline the CCS landscape for future investment decisions, gather technical and business case evidence to de-risk further investment, and help define the required capabilities and scientific objectives of a testbed. From *BGS News*. October 2020.

project was developed for the cost analysis. The example project involves the injection and storage of 4.33 million metric tons of CO<sub>2</sub> per year for 30 operating years and 50 years of post-injection site care (PISC). The example project is assumed to inject CO<sub>2</sub> into the Mount Simon formation in Illinois which is a good formation for storing CO<sub>2</sub>. A six injection well pattern was devised, and the area that is needed to monitor the evolution of the CO<sub>2</sub> plume was calculated using the FE/NETL CO<sub>2</sub> Saline Storage Cost Model."

### Energy Technology Perspective 2020.

The following is a description of this International Energy Agency (IEA) publication: "*Energy Technology Perspectives 2020* is a major new IEA publication focused on the technology needs and opportunities for reaching international climate and sustainable energy goals. This flagship report offers vital analysis and advice on the clean energy technologies the world needs to meet net-zero emissions objectives. The report's comprehensive analysis maps out the technologies needed to tackle emissions in all parts of the energy sector, including areas where technology progress is still lacking such as long-distance transport and heavy industries. It shows the amount of emissions reductions that are required from electrification, hydrogen, bioenergy and carbon capture, utilisation and storage. It also provides an assessment of emissions from existing infrastructure and what can be done to address them." (Subscription may be required.)



## PUBLICATIONS (cont.)

### *Probabilistic risk-based Area of Review (AoR) determination for a deep-saline carbon storage site.*

The following is from the abstract of this article: "Regulatory oversight of a geologic carbon sequestration (GCS) project relies on iterative estimations, throughout the project lifetime, of the area where increased risks to underground sources of drinking water (USDWs) may occur due to injection of CO<sub>2</sub>. This area, referred to as Area of Review (AoR), is typically delineated by predicting the migration of fluid between the reservoir and the lowermost USDW via an open wellbore using predictions from physics-based reservoir simulators. The inherent uncertainty in input parameters used in reservoir modeling therefore affects the accuracy of determining the AoR for a project. Furthermore, the standard analytical approaches for calculating a critical pressure to delineate the risk area yield an infinite AoR for cases where the injection reservoir is overpressured relative to the USDW. A methodology is presented here to better characterize the risk to USDWs while accounting for the uncertainty in reservoir modeling, with an application to a permitted GCS project with an overpressured injection formation, FutureGen 2.0. The methodology is demonstrated using the National Risk Assessment Partnership's open-source integrated assessment model (NRAP-Open-IAM) to develop a probabilistic estimate of impact risk to USDW quality. CO<sub>2</sub> and pressure predictions from the reservoir modeling conducted using the STOMP-CO<sub>2</sub> simulator for the FutureGen 2.0 site are used in a NRAP-Open-IAM model with reservoir, wellbore, and aquifer components to: (1) assess the extent of potential leakage into the USDW for the predicted reservoir pressure conditions; (2) evaluate the extent of potential impact using 'no-net-degradation' thresholds; and (3) account for uncertainty in reservoir permeabilities." **Diana H. Bacon, Deniz I. Demirkanli, Singe K. White**, *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

### *Carbon dioxide management via exergy-based sustainability assessment: Carbon Capture and Storage versus conversion to methanol.*

The following is the abstract of this article: "Carbon Capture and Storage and Carbon Capture and Utilization refer to carbon dioxide management technologies for its removal from flue-gases, followed by carbon recycling or storage, aiming at limiting global warming. For large-scale deployment, geological storage is the most promising alternative but imposes an economic penalty to the emitting process, while the utilization monetizes carbon dioxide contributing to compensate for the large capture costs. The exergy concept builds a suitable framework to measure useful power according to the Second Law of Thermodynamics, such that maximizing exergy efficiency necessarily promotes sustainability. This work applies a novel framework for exergy assessment of processes with chemical reactions, which is employed to evaluate the performance of two methanol production routes from carbon dioxide from power plant flue-gas: the direct hydrogenation and the indirect conversion through natural gas bi-reforming for synthesis gas production. Exergy efficiency of the direct route is about 66.3%, against 55.8% for the indirect one, indicating the lower sustainability of the latter. Carbon capture and storage had the worst Exergy efficiency, even lower than the emission scenario, accounting for 44.8% against 53.5%. Exergy metrics pinpoint low scalability as the main drawback of the utilization technologies, despite high exergy and capture efficiency." **Igor Lapenda Wiesberg, George Victor Brigagão, Ofélia de Queiroz F. Araújo, and José Luiz de Medeiros**, *Renewable and Sustainable Energy Reviews*. (Subscription may be required.)

### *Comparative evaluation of two biomass direct-fired power plants with carbon capture and sequestration.*

The following is from the abstract of this article: "The biomass direct-fired power plant with carbon capture and sequestration is promising to remove CO<sub>2</sub> from air whilst generate electricity. However, the efficiencies of such power plants are usually low, and the life cycle CO<sub>2</sub> emission of such power plants is seldom determined. To solve these issues, a novel chemical looping oxy-fired power plant with carbon capture and sequestration is proposed in this work. The proposed system is then modeled and compared with the conventional biomass air-fired plant in terms of thermodynamics and economics. All the sub-unit models of the two power plants are validated by reported data in literature. Sensitivity analyses are then implemented to investigate the effects of different key operation parameters on the system essential performance indicators. Under the optimum conditions, the power generation efficiency, the leveled cost of electricity, the CO<sub>2</sub> capture rate, the annual power generation and the annual CO<sub>2</sub> mitigation of the proposed system (or the conventional system) are 35.7% (31.5%), 0.0522\$/kWh (0.0601\$/kWh), 100% (98%), 1443.7 × 10<sup>9</sup> kWh/year (1241.81 × 10<sup>9</sup> kWh/year) and 1.191 × 10<sup>9</sup> t/year (1.159 × 10<sup>9</sup> t/year), respectively. The key findings of this work are of reference value for the construction, operation and optimization of the biomass direct-fired power plants with carbon capture and sequestration." **Linbo Yan, Ziqi Wang, Yang Cao, and Boshu He**, *Renewable Energy*. (Subscription may be required.)

### *A first look at social factors driving CCS perception in Brazil: A case study in the Recôncavo Basin.*

The following is from the abstract of this article: "Carbon Capture and Storage (CCS) is a promising technology to help greenhouse gas emission mitigation. However, one of the greatest challenges for this technology implementation is the opposition from the population living near the potential sites. Despite the Brazilian geological potential for carbon dioxide injection, research investigating social site characterization or CCS public perception is almost non-existent in Brazil. Thus, this research aims to address this gap and analyze social factors driving CCS perception of the population living near potential sites in the Recôncavo Basin, state of Bahia, this being one of the first steps for social site characterization. Fifty-seven interviews were carried out near 10 CCS potential injection fields, focusing on questions about climate change knowledge, people's previous relationship with oil exploration, trust in public and private stakeholders, belief in citizens' influence and CCS perception. The results showed that the previous history of the community with oil companies is an important factor influencing people's perception of private companies in general and CCS projects in particular. Another relevant social factor is the sense of empowerment in some communities that may respond with riots and obstruction of the project if they feel harmed by the companies. The results also suggest that communication can be a relevant factor for CCS perception, correcting some wrong assumptions about the technology. It is important to educate people not only about CCS but also about climate change and other environmental issues and, ethically, address all aspects, positive and negative, of CCS implementation." **Anna Luisa Abreu Netto, George Câmara, Expedito Rocha, Aldo Luiz Silva, José Célio Silveira Andrade, Drielli Peyerl, and Paulo Rocha**, *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

## PUBLICATIONS (cont.)

### *Parametric study and geomechanical design of Ultra-deep-water Offshore Salt Caverns for Carbon Capture and Storage in Brazil.*

The following is from the abstract of this article: "This article describes a new concept to reduce carbon dioxide emissions of offshore oil production of high gas-to-oil ratio reservoirs and high content of CO<sub>2</sub>, denominated Offshore Salt Cavern Ultra-deep Water CCS (Carbon Capture and Storage) System. This hybrid system is intended for natural gas storage, the gravitational separation between CO<sub>2</sub>/CH<sub>4</sub>, and CO<sub>2</sub> confinement for final destination. This development emerged from a current demand of some Brazilian pre-salt reservoirs to destinate a gas stream with high CO<sub>2</sub> contamination, produced during the oil extraction. These reservoirs have a continuous salt rock layer of 2000 m as caprock making the construction possible of salt caverns by leaching using seawater. In the first stage of technology development, the system will only store a gas stream contaminated with a high concentration of CO<sub>2</sub>. In the second stage of its development, it will allow not only the separation of natural gas from the CO<sub>2</sub> but also its storage and the monetization of CH<sub>4</sub>. This paper presents the conceptual design of this technology, showing the steps from the parametric study to select the best relation between flowrate, leaching time, structural stability, and the volume of gas with the high content of CO<sub>2</sub> storage, up to the final geomechanical design using the set of parameters selected." **Pedro Vassalo Maia da Costa, Alvaro Maia da Costa, Julio R. Meneghini, Kazuo Nishimoto, Claudio M. Sampaio, Gustavo Assi, Edgard Malta, Mariana B.R. Goulart, Andre Bergsten, Okhiria D. Udebhulu, Ricardo Cabral Azevedo, Sérgio M. de Eston, Giorgio de Tomi, Nelson F.F. Ebecken, Luiz Pinguelli Rosa, Antonio C.O. Miranda, Camila Brandão, and Alexandre Breda**, *International Journal of Rock Mechanics and Mining Sciences*. (Subscription may be required.)

### *The impact of energy trade patterns on CO<sub>2</sub> emissions: An emergy and network analysis.*

The following is from the abstract of this article: "Fossil fuel is considered to be the major cause of CO<sub>2</sub> emissions, and it flows across countries through the international energy trade. In this paper, [the authors] analyse the impact of energy trade patterns on CO<sub>2</sub> emissions for a global sample from 2000 to 2014. [The authors] construct an international fossil fuel trade network based on emergy theory and calculate some corresponding structural parameters. Then, [the authors] systematically evaluate the impact of energy trade on CO<sub>2</sub> emissions from the trade volume and trade relationships perspectives. [The authors] obtain the following results: (1) Trade strength mainly affects CO<sub>2</sub> emissions through the scale effect, composition effect and technique effect. (2) Trade security and trade-centre status of one country will significantly affect CO<sub>2</sub> emissions. (3) For high economic-level (HE) countries, concentrating the trade volume on several finite countries will destroy the environment; low economic-level (LE) countries that are proximal to the important countries of the energy market will experience an increase in pollution. This research also discusses some implications for policy makers." **Hongwei Zhang, Ying Wang, Xuehong Zhu, and Yaoqi Guo**, *Energy Economics*. (Subscription may be required.)

### *CO<sub>2</sub> storage potential in sedimentary basins of Kazakhstan.*

The following is from the abstract of this article: "The terms of the Paris Agreement oblige Kazakhstan to decrease its Greenhouse Gas (GHG) emissions by 2030. Annual GHG emissions of the country already went beyond the limit set by the Paris agreement in 2014 and this number is expected to increase with a growing economy showing that current measures of GHG mitigation in the country are insufficient. Despite the energy sector of the country being heavily dependent on its coal and substantial land resources, CCS was not featured in the 'Green Economy' plan of the country. To investigate the applicability of this technology, six selected Kazakhstan sedimentary basins (the Precaspian, Mangyshlak, South-Torgay, Ustyurt, Chu-Sarysu, and Zaysan basins) were evaluated and ranked for geologic CO<sub>2</sub> storage deployment in terms of containment, capacity, and feasibility. The effective CO<sub>2</sub> storage capacities in oil reservoirs, gas reservoirs, and saline aquifers were estimated for each basin using the Carbon Sequestration Leadership Forum (CSLF) and USDOE methods. The evaluations revealed that the Precaspian Basin is the most suitable for geological CO<sub>2</sub> storage, followed by the Mangyshlak, South Torgay, and Ustyurt basins. The total effective CO<sub>2</sub> storage capacity of the country is estimated to be ~583 Gt, of which ~539 Gt corresponds to the abovementioned four suitable basins where most of injected CO<sub>2</sub> is expected to be stored in the hydrodynamic traps. The results suggest that four sedimentary basins identified in this study have prospectivity to reduce GHG emissions of Kazakhstan significantly and thus enable the decarbonization of national economy to achieve the goals set by the Paris Agreement." **Yerdaulet Abuov, Nurlan Seisenbayev, and Woojin Lee**, *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

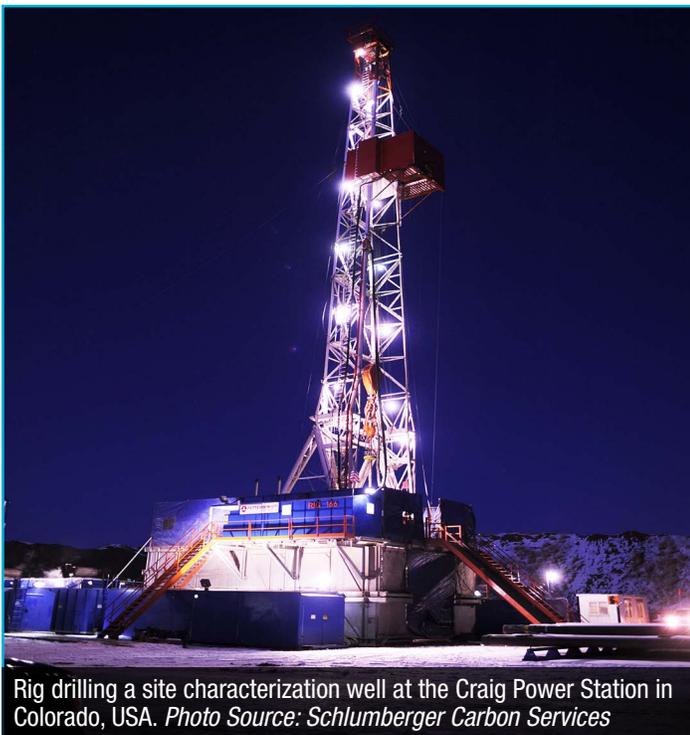
## ABOUT DOE'S CARBON STORAGE PROGRAM

The **Carbon 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<sub>2</sub>, 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<sub>2</sub> emissions. The program also serves to increase the understanding of the effectiveness of advanced technologies in different geologic reservoirs appropriate for CO<sub>2</sub> 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<sub>2</sub> behaves in the subsurface. These objectives are key to increasing confidence in safe, effective, and permanent geologic CO<sub>2</sub> storage.

The [Carbon 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 Storage Program Resources

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



Rig drilling a site characterization well at the Craig Power Station in Colorado, USA. Photo Source: Schlumberger Carbon Services

## ABOUT NETL'S CARBON STORAGE NEWSLETTER

Compiled by the National Energy Technology Laboratory, this newsletter is a monthly summary of public and private sector carbon 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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There are several ways to join the conversation and connect with NETL's Carbon Storage Program:



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