

CSN

DECEMBER 2018

CARBON STORAGE
NEWSLETTER

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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CARBON STORAGE PROGRAM
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- ▷ Carbon Storage Portfolio
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- ▷ Fossil Energy Techlines



DOE/NETL HIGHLIGHTS

DOE Issues RFP to Advance Coal Plants.

The U.S. Department of Energy's (DOE) Office of Fossil Energy (FE) issued a Request for Proposal (RFP) seeking conceptual designs for coal-based power plants of the future. In addition, the RFP includes an option to conduct preliminary front-end engineering design (Pre-FEED) studies. The RFP is in support of the *Coal FIRST (Flexible, Innovative, Resilient, Small, Transformative) Initiative*, which looks to develop coal plants that provide secure, stable, and reliable power. From *energy.gov* on December 7, 2018.

ANNOUNCEMENTS

DOE Issues NOI for Carbon Storage FOA.

DOE issued a Notice of Intent (NOI) to provide federal funding for innovative research and development (R&D) projects that develop transformational sensing capabilities to reduce uncertainty and enable real-time decision-making for subsurface carbon dioxide (CO₂) storage. The Funding Opportunity Announcement (FOA), "Transformational Sensing Capabilities for Monitoring the Subsurface," will be issued in the second quarter of fiscal year 2019.

Director Appointed to DOE's NETL.

Steven Winberg, DOE's Assistant Secretary for Fossil Energy (ASFE), appointed Brian J. Anderson, Ph.D., as the new director of DOE's National Energy Technology Laboratory (NETL). Dr. Anderson previously served as director of West Virginia University's (WVU) Energy Institute. As part of the move, NETL's Acting Director, Sean Plasynski, Ph.D., will transition into his new role as NETL's Deputy Director and Chief Operating Officer.



Dr. Brian Anderson

DOE Invests to Develop Products from CO₂.

DOE's FE selected 17 projects to receive federal funding for cost-shared R&D to develop technologies to generate novel, marketable products using CO₂ or coal as a feedstock. The projects are supported through DE-FOA-0001849, titled "Novel Methods for Making Products from Carbon Dioxide or Coal."

Conference Discusses Reducing CO₂ Emissions.

An international group of researchers and policymakers met in Australia to discuss global CO₂ emissions. Topics discussed included boosting the carbon stores of soils, carbon storage in coastal wetlands, and the potential of bioenergy carbon capture and storage (BECCS).

European Commission Strategy Paper on CCS.

The European Commission released a *strategy paper* detailing the role of carbon capture and storage (CCS) in emissions reduction. According to the Commission, CCS will be needed for the European Union (EU) to achieve its greenhouse gas (GHG) emissions goal by 2050.

*ADNOC to Expand its CCUS for EOR.*

The Abu Dhabi National Oil Company (ADNOC) announced plans to expand carbon capture, utilization, and storage (CCUS) operations and boost enhanced oil recovery (EOR) from reservoirs. The CO₂ will be captured from either the Habshan-Bab gas processing facilities or the Shah gas plant (both located in the United Arab Emirates [UAE]).

ANNOUNCEMENTS *(cont.)*

Large-Scale CCS Facilities Added to Database.

New large-scale CCS facilities have been added to the Global CCS Institute's CCS database. According to the database, there are now 18 large-scale CCS facilities in operation, as well as 5 under construction globally. Combined, these facilities have the potential to remove 40 million metric tons of CO₂ per year from the atmosphere.



RGGI Releases Secondary Market Report.

The independent market monitor for the Regional Greenhouse Gas Initiative (RGGI) released a report containing information on the secondary market for RGGI CO₂ allowances, including future prices, market activity, and allowance holdings. Potomac Economics' "Report on the Secondary Market for RGGI CO₂ Allowances: Third Quarter 2018" addresses the period from July through September 2018.

PROJECT and BUSINESS DEVELOPMENTS

DOE Awards Grant for CCS Research.

A DOE grant for CCS research will allow the University of Kentucky Center for Applied Energy Research (CAER)



to develop new technologies to lower the cost of capturing CO₂. CAER's project, titled "Advancing Post-Combustion CO₂ Capture through Increased Mass Transfer and Lower Degradation," proposes to "advance deployment of CO₂ capture through enabling technologies that increase CO₂ mass transfer and reduce solvent loss." CAER and partner Lawrence Livermore National Laboratory (LLNL) will develop and fabricate customized dynamic packing and an electrochemical cell, both of which will be tested on CAER's bench-scale CO₂ capture unit. From *Carbon Capture Journal* on November 18, 2018.

BECCS Pilot Plant Underway in Europe.

The commissioning of a BECCS pilot plant at Drax Power Station has been initiated. If successful, the project will capture 1 metric ton of CO₂ per day at Drax, located near Selby in North Yorkshire, United Kingdom (UK). According to estimates by the Royal Academy and Royal Society of Engineers, BECCS technology has the potential to lead to the capture of approximately 50 million metric tons of CO₂ per year by 2050. From *Drax Press Release* on November 26, 2018.



UK Government Announces Plan for CCUS Project.

At a summit of international leaders, UK government officials announced plans for a CCUS project, which could be operational beginning in the mid-2020s. As part of the UK's *Industrial Strategy*, the government action plan will commit the UK to begin identifying opportunities to enable the CCUS facility, invest in supporting construction of CCUS technologies at industrial sites across the UK, and invest in the decarbonizing industry. From *UK Government Press Release* on November 28, 2018.

Agreement Reached on CO₂ Storage Infrastructure.

Crown Estate Scotland announced the signing of a lease option for CO₂ storage with the Acorn CCS project, based at the St. Fergus Gas Terminal on the Aberdeenshire coast. The project is designed to utilize existing oil and gas assets to deliver large-scale, cost-effective CO₂ transport and storage infrastructure in the Central North Sea. When combined with CCUS infrastructure, Scotland's geology below the Central North Sea has the potential to store approximately 75 percent of the UK's capacity of CO₂ emissions, helping to meet UK and Scottish targets. From *Crown Estate Scotland Media Release* on November 27, 2018.

LEGISLATION and POLICY

Carbon Tax Bill Introduced.

A carbon tax bill was introduced into the U.S. House of Representatives. The new bill is considered a "testing ground for a carbon-fee-and-dividend model" that distributes the revenue in the form of a monthly rebate to American households. Under the bill, a \$15/ton of CO₂ tax would be imposed in 2019, increasing by \$10 every year, rising to nearly \$100/ton by 2030. In addition, the bill would create a border carbon adjustment, which would require exporting countries to pay a fee on CO₂-emitting products that come into the United States. According to the bill's authors, the legislation has the potential to reduce U.S. CO₂ emissions 45 percent by 2030 compared to 2015 levels, and 80 to 90 percent by 2050. From *Washington Examiner* on November 27, 2018.

EMISSIONS TRADING

RGGI States Release Results of 42nd Auction.

RGGI Inc.



The RGGI-participating states released the results of their 42nd auction of CO₂ allowances, in which 13,360,649 CO₂ allowances were sold at a clearing price of \$5.35. Bids ranged from \$2.20 to \$7.50 per allowance. None of the 10 million cost containment reserve (CCR) allowances were sold (CCR is a fixed additional supply of allowances only available for sale if CO₂ allowance prices exceed certain price levels [\$10.25 in 2018]). Auction 42 generated \$71.5 million for reinvestment in strategic programs, such as energy efficiency, renewable energy, and GHG abatement. From *RGGI News Release* on December 7, 2018.

Cap-and-Trade Auction Held.

California (USA) and Québec (Canada) held a joint cap-and-trade auction in which all of the current and future vintage GHG emissions allowances were sold. Organized by the California Air Resources Board (CARB) and Québec's Ministry of the Environment and Climate Change (MELCC), a total of 78.8 million current allowances and 9.4 million advance allowances were sold, generating approximately \$813 million for a GHG reduction fund. The auction, which included current allowances for 2016, 2017, and 2018, as well as vintage 2021 credits, was the seventh consecutive CARB auction to sell out, with bids coming in both U.S. and Canadian dollars. From *Natural Gas Intelligence* on November 27, 2018.

China's Carbon Trading Valued.

China's carbon trading saw transaction values exceed approximately \$860 million since June 2013, with traded emission quotas exceeding 270 million metric tons, according to officials. China's government has committed to reducing its carbon emissions per unit of GDP by 60 to 65 percent by 2030 from the 2005 level. From *Xinhuanet* on November 26, 2018.

CLIMATE and SCIENCE NEWS

Researchers Turn CO₂ Into Useful Product.



A WVU-led research team is focusing on converting CO₂ in power plant flue gas into commercial-quality sodium bicarbonate (baking soda). Current techniques can increase costs on a clean, coal-fired ultrasupercritical power plant by more than 50 percent, according to data collected by the National Renewable Energy Laboratory. Potential product sales of the converted baking soda would be used to lower the cost of CCS technology. From *West Virginia University Energy Institute* on November 15, 2018.

Researchers Locate Carbon Reserve.

Researchers from Washington State University (USA) conducted a survey to understand the role potential climate change could have on soil's ability to store carbon. By analyzing climate data and soil samples from 65 different dig sites across the world, researchers created a global map of soil-based carbon storage, detailing the way carbon physically and chemically binds to minerals in soil. The data showed that while minimal amounts of carbon are stored in the sediments of deserts and dry forests, an abundance of carbon bound to reactive minerals is stored beneath the surfaces of wet forests. According to the research, *published in the journal Nature Climate Change*, potential climate change won't impact the carbon stored beneath the surface of wet forests, but it may alter the pathway by which new carbon is stored. From *UPI.com* on November 26, 2018.

Researchers Study Arctic Carbon Balance.

New research shows that damage to arctic vegetation can impact its ability to absorb CO₂. In a study *published in the journal Global Change Biology*, a team of researchers from the UK, Norway, and Italy discovered a decline in the amount of CO₂ absorbed by plants affected by an extreme climatic event. The study focused on the Lofoten archipelago in northern Norway. From *Physics World* on November 26, 2018.

JOURNAL ARTICLES

Probabilistic evaluation of multi-fluid-phase carbon dioxide storage capacities of saline formations in the Pohang Basin, Korea using three-dimensional geologic modeling and grid-based Monte Carlo simulation.

The following is the Abstract of this article: "A series of probabilistic evaluation is performed sequentially using three-dimensional geologic modeling and grid-based Monte Carlo simulation as a linked methodology to estimate multi-fluid-phase (i.e., individual gas-, liquid-, supercritical-, and whole fluid-phase) CO₂ storage capacities of the target clastic saline formations in the Pohang Basin, Korea. The Pohang Basin is subdivided into the six geologic formations including the two clastic saline formations, which are the sandstone-dominant Fluvial Conglomerate and Sandstone (FCSS) and Shallow Marine Sandstone (SMSS) in ascending order. The results of the three-dimensional geologic modeling show that the six geologic formations are distributed very complicatedly both onshore and offshore with irregular depths and thicknesses, and they are partly dissected and offset by the eight major faults. The two clastic saline formations FCSS and SMSS are deep and thick at the three prospective areas such as Areas 1, 2, and 3 in the modeling domain. The results of the grid-based Monte Carlo simulation show the following three main contents. First, in the two clastic saline formations SMSS and FCSS, CO₂ exists as gas, liquid, and supercritical phases with the corresponding distinctive density ranges depending on the pressure and temperature with depth. Second, the theoretical multi-fluid-phase CO₂ storage capacities of the SMSS and FCSS all show asymmetric normal distributions. On the other hand, the effective multi-fluid-phase CO₂ storage capacities of the saline formations all show log-normal distributions, and their values are much lower than the values of the theoretical multi-fluid-phase CO₂ storage capacities. The mean theoretical fluid-phase CO₂ storage capacities of the SMSS and FCSS are equal to 2,511.60 Mton and 1,370.91 Mton, respectively. The mean effective fluid-phase CO₂ storage capacities of the SMSS and FCSS are equal to 64.19 Mton and 35.32 Mton, respectively. Third, in the SMSS, the grid-wise (elemental) median theoretical and effective multi-fluid-phase CO₂ storage capacities are probabilistically higher at Area 1 (mainly as supercritical and liquid phases), intermediate at Area 2 (mainly as liquid and gas phases), and lower at Area 3 (mainly as a gas phase). However, in the FCSS, the grid-wise median theoretical and effective multi-fluid-phase CO₂ storage capacities are probabilistically higher at Area 2 (mainly as supercritical and liquid phases), intermediate at Area 1 (mainly as a supercritical phase), and lower at Area 3 (mainly as a gas phase). Finally, four key criteria (parameters) for selecting or ranking the optimal CO₂ storage locations are decided by summarizing and analyzing the results of the three-dimensional geologic modeling and grid-based Monte Carlo simulation. On the basis of the four key criteria (parameters), the overall suitability ranks of Areas 1, 2, and 3 for geologic CO₂ storage are determined to be the first, second, and third, respectively." **Jai-Yong Park, Sungho Lee, Jung-Hwi Kihm, Jun-Mo Kim, and Yong Il Lee**, *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

Cost-efficient climate policies for interdependent carbon pools.

The following is the Abstract of this article: "The purpose of this paper is to investigate cost-effective climate policy instruments for bioenergy and timber, adapted to the impacts on interdependent forest carbon pools, and applied in the [European Union (EU)] climate policy to 2050. [The authors] develop a discrete time dynamic model including forest carbon pools in biomass, soil, and products, as well as fossil fuel consumption. The analytical results show that the optimal taxes on forest products depend on the growth in the respective carbon pool. The application to the EU 2050 climate policy for emission trading shows that total costs for target achievement can be reduced by 33 percent if all carbon pools are included, and the carbon tax on fossil fuel can be reduced by 50 percent. Optimal taxes on forest products differ among countries and over time depending on the potential for increased carbon sequestration over the planning period." **Katarina Elofsson and Ing-Marie Gren**, *Environmental Modelling & Software*. (Subscription may be required.)

Reducing emissions in transportation and inventory management: (R, Q) Policy with considerations of carbon reduction.

The following is the Abstract of this article: "In this study, [the authors] examine three approaches on the effects of controlling carbon emissions in transportation and inventory management. A Business-As-Usual Scenario Model (BAUSM), which delineates how carbon footprints from inventory storage and related transportation are captured, is firstly developed as the benchmark model. Based on BAUSM, [the authors] then develop three models with different carbon reduction approaches. The first one is constructed by adding a constraint to represent the percentage target of emission reduction. The second one integrates carbon taxes (or cap-and-trade scheme) into inventory management, and the last one takes both reduction target and carbon offset opportunities into account. [The authors'] work provides new analytical models, which integrate cost and emissions in transportation and storage under the framework of continuous inventory review (R, Q) policy for stochastic demand. Optimization algorithms are developed for solving models and related properties are investigated to examine the effects of carbon reduction and associated costs of three models. The policy implications of the models are examined and discussed to provide insights for reference of the practitioners and the policy makers." **Tang, Shaolong; Wang, Wenjie; Cho, Stella; and Yan, Hong**, *European Journal of Operational Research*. (Subscription may be required.)

Residual trapping of carbon dioxide during geological storage —Insight gained through a pore-network modeling approach.

The following is the Abstract of this article: "To reduce emissions of the [GHG] CO₂ to the atmosphere, sequestration in deep saline aquifers is a viable strategy. Residual trapping is a key containment process important to the success of CO₂ storage operations. While residual trapping affects CO₂ migration over large scales, it is inherently a pore-scale process. Pore-network models (PNMs), capturing such processes, are useful for... understanding of residual trapping, and for upscaling trapping parameters for larger scale models. A PNM for simulation of quasi-static two-phase flow; CO₂ intrusion (drainage) followed by water flooding (imbibition) was developed. It accounts for pore-scale displacement mechanisms, and was used to investigate residual CO₂ trapping. The sensitivity of the residual CO₂ saturation to several parameters was studied, to validate a trapping behavior in agreement with earlier studies. Then the PNM was calibrated to core sample data and used to simulate drainage-imbibition scenarios with different turning point saturations. From these the initial-residual saturation curves of CO₂ in Heletz sandstone were estimated, essential for future macroscopic-scale simulations. Further, the occurrence of different pore-scale mechanisms were quantified and the size distribution of the residual clusters was shown to exhibit a bimodal appearance. The findings improve the understanding of residual trapping in Heletz sandstone." **K. Rasmusson, M. Rasmusson, Y. Tsang, S. Benson, F. Hingerl, F. Fagerlund, and A. Niemi**, *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

JOURNAL ARTICLES *(cont.)*

On the variability of CO₂ feed flows into CCS transportation and storage networks.

The following is the Abstract of this article: "The flexible operation of CO₂ injection wells presents significant challenges. To avoid premature degradation of wells or loss of integrity it is imperative to understand the feed flow patterns that future CO₂ transportation and storage networks will face. [The authors] use a unit commitment economic dispatch (UCED) model to study CCS operating regimes in low carbon energy systems scenarios that are [characterized] by high shares of weather dependent renewable power generation. Using the case study of Great Britain, [the authors] determine the extent to which flexible operation of CCS plants is required, resulting in variable CO₂ flows that need to be accommodated by future CO₂ transportation and storage networks. [The authors] find that around 21% and 12% of the net flow rate changes over 6h-periods in the core scenario have greater amplitudes than 30% and 50% of nominal flow, respectively. When changes are averaged over two consecutive blocks of 6 h, representing the smoothing effect achievable via line-packing over a pipeline of reasonable length and diameter, around 9% of the net changes have greater amplitudes than 40% of nominal flow. Given the high and frequent fluctuations in feed flows across all considered scenarios, further research is urgently required on the capability of transportation and storage networks to accommodate variable CO₂ flow rates." **T. Spitz, V. Avagyan, F. Ascui, A.R.W. Bruce, H. Chalmers, and M. Lucquiaud**, *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

The role of CCS and biomass-based processes in the refinery sector for different carbon scenarios.

The following is the Abstract of this article: "This paper studies technological pathways in the refinery sector, such as fuel switching, CCS, energy efficiency as well as retrofit decisions (i.e. upgrading, scaling-up, and equipment [modernization]) with the aim of [decarbonization]. A global refinery outlook is presented for a 2.5°C and 2°C climate target scenario from 2010 through to 2050. The results highlight that a full portfolio of technologies (non-conventional processes, gas-/coal-based, with/without CCS, and biomass-based process) is necessary. Among the conventional refineries, only the most efficient ones or those investing in CCS to increase competitiveness and reducing emissions, can stay in the market." **Julia Sachs, Sukma Hidayat, Sara Giarola, and Adam Hawkes**, *Computer Aided Chemical Engineering*. (Subscription may be required.)

Analysis of the contribution of CCS to achieve the objectives of Mexico to reduce GHG emissions.

The following is the Abstract of this article: "Mexico has a strong commitment to reduce its GHG emissions. The electrical and the industrial sectors have been the second and third largest contributors to GHG emissions—excluding fugitive emissions-. This paper analyzes the potential contributions of CCS systems on the electrical sector, as well as the participation of the cement, metal and chemical industries. This study was carried out using a computational mathematical model, the MEM70, which is a partial equilibrium model that represents the Mexican energy system. It was found that, even considering energy efficiency measures, a high penetration of electric vehicles and the electrical sector with high participation of low carbon emission technologies such as renewable and nuclear sources. Further, it is necessary to implement CCS to achieve the goal for reducing national greenhouse gas emissions." **David Castrejón, Alan M. Zavala, Jesús A. Flores, Marco Polo Flores, and Diana Barrón**, *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

Tracking carbon transfers embodied in Chinese municipalities' domestic and foreign trade.

The following is the Abstract of this article: "Cities are the major contributors to global [CO₂] emissions; however, the carbon transfers embodied in cities' domestic and foreign trade have not been fully discussed. As carbon emissions from different domestic and foreign trade partners have not been distinguished, and since China's four municipalities (Beijing, Tianjin, Shanghai and Chongqing) carry an increasingly significant responsibility for carbon reduction in China, a multi-scale and multi-regional carbon emission assessment is applied to identify their emission transfers to and from 26 domestic provinces and 184 foreign economies. The results show that the intensities of the four municipalities are mainly above the international standard (0.14 kg/CNY) but beneath the Chinese average (0.24 kg/CNY). 71.72%, 55.35%, 65.34% and 33.65% of their emissions are imported from other regions. Generally, the four municipalities are net recipients of domestic carbon transfers and suppliers of foreign carbon transfers. Carbon transfers from Hebei to Beijing and Tianjin, Zhejiang to Shanghai, and Sichuan to Chongqing as well as from Beijing and Tianjin to Japan and South Korea and from Shanghai and Chongqing to the United States and Germany are identified in domestic and foreign supply chains. The multi-scale and multi-regional simulation and assessment in this work allows [the authors] to identify the carbon emissions not only within a city's boundaries but also via inter- and intra-national trade, providing a solid foundation for the carbon emission assessments of Chinese mega cities from an embodied perspective." **Y.L. Li, Bin Chen, M.Y. Han, Michael Dunford, Weidong Liu, and Zhi Li**, *Journal of Cleaner Production*. (Subscription may be required.)

Can carbon cap and trade mechanism be beneficial for remanufacturing?

The following is the Abstract of this article: "Remanufacturing is an environmentally friendly and profitable way to conduct production operations. For environmental protection, carbon cap and trade mechanism, which is conventionally considered a burden for manufacturers, is a viable approach to reduce carbon emissions. This paper explores the possibility of a monopolistic manufacturer involved in both manufacturing and remanufacturing to profit under carbon cap and trade mechanism in a single period. [The authors] develop a model to derive the [favorable] conditions under which carbon cap and trade is beneficial for the manufacturer in ordinary markets and green markets and obtain the manufacturer's optimal decisions. Furthermore, [the authors analyze] the influence of carbon emissions-related parameters on the manufacturer's optimal decisions and carbon trading quantity. The results show that carbon cap and trade can be valuable for remanufacturing in both the ordinary market and the green market. Policy makers should focus on carbon trading prices to reduce carbon emissions and improve the manufacturers' profits in both markets. In addition, the low carbon emissions characteristics of remanufactured products allow for better profits for manufacturers under carbon cap and trade, and their investments in low carbon production technology should be expanded. Finally, the proportion of green consumers has important performance implications for remanufacturing in green markets. Specifically, excessive green consumers in a monopolistic market are not always a blessing when the carbon trading price is high." **Qiangfei Chai, Zhongdong Xiao, Kee-hung Lai, and Guanghui Zhou**, *International Journal of Production Economics*. (Subscription may be required.)

REPORTS and OTHER PUBLICATIONS

Delivering Clean Growth: CCUS Cost Challenge Taskforce Report.

The following is the Executive Summary of this independent report to the UK government: “The Clean Growth Strategy reaffirms the UK Government’s commitment to lead the way to a low carbon future and underlines the enormous opportunity for the UK that is emerging from the global transition to a low carbon economy. The Clean Growth Strategy sets out the Government’s new approach to carbon capture usage and storage (‘CCUS’), and [recognizes] the potential importance of CCUS to support the [decarbonization] of the UK’s economy. The CCUS Cost Challenge Taskforce was established in January 2018 with the remit of informing and proposing a strategic plan to Government for supporting the development of CCUS in the UK, in order to meet Government’s stated ambition of ‘having the option to deploy CCUS at scale during the 2030s, subject to costs coming down sufficiently.’ In this report, the Taskforce proposes a range of measures and actions to inform a new approach to CCUS deployment that will enable cost reductions to be secured. By demonstrating that CCUS can deliver [decarbonization] across industry, power, and provide solutions for heat and transport, the report focuses on building a long term, commercially sustainable and cost-effective [decarbonization] service industry for the UK. This, in turn, can bring new industrial opportunities, secure long-term jobs, deliver new economic development across industrial heartlands and secure international competitiveness through new [decarbonized] products and services. [The authors] have identified viable business models, funding mechanisms, and an innovation pathway, as well as suggesting options to support the lowest cost delivery of a potentially transformative technology, underpinned by a series of short, medium and longer term recommendations.”

The Carbon Capture and Storage Readiness Index 2018: Is the world really ready for carbon capture and storage?

The following is from this Global CCS Institute document: “The 2018 edition of the Global CCS Institute’s (the Institute) CCS Readiness Index (CCS-RI) identifies those nations which are leaders in the creation of an enabling environment for the commercial deployment of CCS. However, no nation, including the leaders, have yet established the conditions necessary to drive deployment at the rate required to meet ambition climate targets. It is clear that more must be done. The Institute actively monitors the progress of CCS deployment, through a series of targeted ‘indicators’, which consider a country’s: Inherent CCS interest; Policy developments; Legal and regulatory frameworks; [and] Geological CO₂ storage development. Collectively, these indicators establish the CCS-RI. The 2018 CCS-RI examines over 50 countries using 70 discrete criteria and enables a comparative assessment of countries globally.”



Report cover image courtesy of <https://www.gov.uk/>.

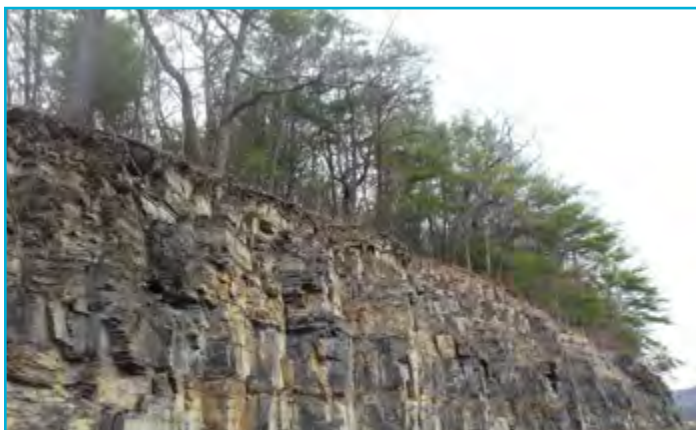
ABOUT DOE'S CARBON STORAGE PROGRAM

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 CO₂, 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 CO₂ emissions. The program also serves to increase the understanding of the effectiveness of advanced technologies in different geologic reservoirs appropriate for CO₂ 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 CO₂ behaves in the subsurface. These objectives are key to increasing confidence in safe, effective, and permanent geologic CO₂ 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](#).



Parallel, vertical, orthogonal natural fracture faces (joint sets) in an outcrop of organic-rich Millboro Shale (Marcellus equivalent), Clover Creek, VA. Photo by Dan Soeder, 2014.

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.



National Energy Technology Laboratory

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