

## CSN

CARBON STORAGE  
NEWSLETTER

OCTOBER 2019

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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## DOE/NETL HIGHLIGHTS

*DOE Announces Funding for CCUS Projects.*

The U.S. Department of Energy's (DOE) Office of Fossil Energy (FE) announced federal funding for cost-shared research and development (R&D) projects under three Funding Opportunity Announcements (FOAs). The projects will build upon DOE's large-scale carbon capture, utilization, and storage (CCUS) pilot and demonstration projects to test, mature, and prove CCUS technologies at commercial scale. Two of the FOAs were announced earlier this fiscal year (FY); the new FOA, DE-FOA-0001999 "*Carbon Storage Assurance Facility Enterprise (CarbonSAFE)*," is seeking R&D projects that accelerate wide-scale deployment of CCUS through assessing and verifying safe and cost-effective anthropogenic carbon dioxide (CO<sub>2</sub>) commercial-scale storage sites and carbon capture and/or purification technologies (responses are due by January 15, 2020). DOE's National Energy Technology Laboratory (NETL) will manage the projects. From *energy.gov* on September 13, 2019.

## ANNOUNCEMENTS

*US Representatives Visit NETL.*

U.S. Representative Conor Lamb (Chairman of the House Science, Space, and Technology Energy Subcommittee) and U.S. Representative Marcy Kaptur (Chairwoman of the House Appropriations Energy and Water Development Subcommittee) visited NETL-Pittsburgh (Pennsylvania, USA) for briefings and to tour research laboratories. The discussions and tours focused on effective resource development, efficient energy conversion, and environmental sustainability.



From left to right, U.S. Rep. Conor Lamb, NETL Director Brian Anderson, U.S. Rep. Marcy Kaptur.

*DOE Invests in Offshore Projects in Support of EOR.*

DOE's FE selected three projects to receive federal funding for cost-shared R&D in support of enhanced oil recovery (EOR). Under DE-FOA-0002005 "*Advanced Subsea System Technologies to Improve Efficiency and Capabilities for Enhanced Oil Recovery (EOR) in Offshore Wells*," the projects will enhance the potential for EOR in offshore settings by advancing promising proof-of-concept technologies to reduce subsea facility complexity, increase control and monitoring, and enable greater tieback distances to production facilities. NETL will manage the projects.

*DOE Invests in Coal Technology Projects.*

DOE announced award recipients of federal funding for cost-shared R&D projects for advanced coal technologies and research under six separate FOAs. The projects cover a range of topics, including CCUS, rare earth element recovery, coal-to-products, crosscutting coal R&D, steam turbine efficiency, and advanced materials. NETL will manage the selected *projects*.

## ANNOUNCEMENTS *(cont.)*

### *NETL Hosts Inaugural Comprehensive Annual Project Review Meeting.*



NETL hosted the inaugural Carbon Capture, Utilization, Storage, and Oil & Gas Technologies Integrated Project Review Meeting, showcasing research aimed at developing novel technological solutions to the nation's energy challenges. "Addressing the Nation's Energy Needs Through Technology Innovation" combined four FE research programs, offering attendees an opportunity to share in the knowledge and insights gained from more than 200 research projects sponsored by DOE's *Carbon Capture, Utilization, Storage, and Oil and Natural Gas* Programs. The *conference proceedings* are available.

### *FY 2019 Carbon Storage Newsletter Annual Index Available.*

The FY 2019 Carbon Storage Newsletter Annual Index is available. The document is a compilation of NETL's Carbon Storage Newsletters published from October 2018 through September 2019, organized by section.



### *Report Forecasts Role of CCS in Energy Transition.*

DNV GL forecasts the role of carbon capture and storage (CCS) in securing a rapid energy transition in a new report. According to the "*2019 Energy Transition Outlook*," integrated hydrocarbon and renewable energy technologies, with support from CCS, have the potential to help achieve global policy goals.

### *EU Officials Discuss Reducing Emissions with CCS.*

The European Climate Commissioner presented the "Long-Term Strategy to 2050" at the European High-Level Conference on CCS in Oslo, Norway. The plan discusses the role CCS can have in the European Union's (EU) plans to reduce CO<sub>2</sub> emissions.

### *Germany Industry Seeks CCS Opportunities.*

German industrial companies are seeking opportunities for CCS in light of the German government unveiling policies to meet its emissions reduction targets, including carbon storage and use. The German government *agreed to a climate action plan in September 2019*, which includes a measure to put a price on the emissions of CO<sub>2</sub> beginning in 2021.

## PROJECT and BUSINESS DEVELOPMENTS

### *European Companies Sign MOU on CCS.*

Equinor signed a Memorandum of Understanding (MOU) with seven European companies to develop value chains in CCS. In cooperation with its partners in the Northern Light project, which includes the transport, reception, and storage of CO<sub>2</sub> in a reservoir in the northern part of the North Sea, Equinor is studying the possibilities for developing CO<sub>2</sub> storage on the Norwegian continental shelf. Under the MOU, the companies will evaluate solutions for CO<sub>2</sub> delivery and transport, develop a timeline for possible final investment decisions and start of operations, and cooperate on the CCS dialogue with national authorities and the EU. From *Equinor* on September 5, 2019.

### *Drilling Operations for CCS Project Begin.*

Easternwell commenced drilling operations for CO<sub>2</sub>CRC's Otway Stage 3 project in southwestern Victoria, Australia. The *Otway research facility* demonstrates the geologic storage of CO<sub>2</sub>; the Stage 3 project aims to demonstrate the implementation of solutions for monitoring CO<sub>2</sub>, providing alternative monitoring techniques and enabling faster monitoring. From *Easternwell News* on September 20, 2019.



### *Memorandum of Cooperation Explores CO<sub>2</sub> Reuse.*

Officials from Australia and Japan signed a Memorandum of Cooperation to explore the potential use of CO<sub>2</sub> to manufacture high-value products. The Minister for Resources and Northern Australia and the Japanese Minister for Economy, Trade, and Industry signed the memorandum to spur research into developing technologies that can capture, store, and utilize CO<sub>2</sub> by turning it into an ingredient for the manufacture of products such as carbon fiber, which has the potential for use in the construction and agricultural sectors. From *Manufacturers' Monthly* on September 30, 2019.

### *CO<sub>2</sub> Emissions Reduction Target Revised.*

American Electric Power (AEP) revised its 2030 emissions reduction target to a 70% reduction from 2000 levels; AEP's previous target was a 60% reduction from 2000 levels by 2030. According to AEP, they will achieve future CO<sub>2</sub> emissions reductions through investments in renewable generation and transmission and distribution technologies to enhance efficiency, as well as expanded demand response and energy efficiency programs. Since 2000, AEP has reduced its CO<sub>2</sub> emissions by 59%. From *AEP News Release* on September 10, 2019.

### *OGCI and CEM CCUS Initiative Members Commit to CCUS.*

Members of the *Oil and Gas Climate Initiative (OGCI)* and the *Clean Energy Ministerial (CEM) CCUS Initiative* released joint statements reaffirming their support for a worldwide CCUS industry. OGCI member companies and CEM CCUS Initiative countries intend to explore opportunities to support the commercial development of CCUS through sustained dialogue on policy and regulatory frameworks. The joint declaration builds upon OGCI's "Kickstarter" initiative, which is designed to unlock large-scale commercial investment in CCUS by enabling multiple low-carbon industrial hubs. From *Carbon Capture Journal* on September 23, 2019.



## LEGISLATION and POLICY

### *Businesses Call for Long-Term, Stable Carbon Pricing Policies.*

A report by the High-Level Commission on Carbon Pricing and Competitiveness focuses on the benefits of adopting carbon pricing policies. According to the report, carbon pricing combined with other policies, such as increased investment in low-carbon technologies, can help drive innovation in industries, foster continuous process improvement, and facilitate the transition to a low-carbon economy. The High-Level Commission on Carbon Pricing and Competitiveness includes private sector leaders and senior government officials that explore the evidence base, business concerns, and lessons learned from carbon pricing systems across the world. From *Carbon Pricing Leadership Coalition* on September 21, 2019.

### *EU Officials Discuss CCS Funding.*

European Union agriculture ministers agreed that increasing carbon storage in soil to reduce greenhouse gasses (GHGs) would require funding. The EU farming officials gathered at an informal meeting in Helsinki, Finland, hosted by the current Finnish presidency. In addition to discussing how best to support carbon capture through the post-2020 Common Agricultural Policy, the ministers discussed the need for more flexibility in meeting target measures for CCS. From *EURACTIV* on September 26, 2019.

## EMISSIONS TRADING

### *Global Carbon Index Launched.*

IHS Markit launched its Global Carbon Index, a benchmark for the global price of carbon credits. The *IHS Global Carbon Index* tracks the performance of tradable carbon markets, such as the EU Emissions Trading System, the California Cap-and-Trade Program, and the Regional Greenhouse Gas Initiative. According to the index, the global weighted average price of carbon credits is \$23.65, with the data showing the total return potentially gained by investors in global carbon since the beginning of 2018 is 132%. From *IHS Markit Press Release* on September 25, 2019.

### *California and Québec Release Results of Joint Cap-and-Trade Auction.*



California (USA) and Québec (Canada) released results of the 20<sup>th</sup> joint cap-and-trade auction of CO<sub>2</sub> allowances. All 66,289,515 current vintage allowances (2016, 2017, and 2019) offered were sold at a settlement price of \$17.16. All 9,038,000 advance vintage allowances (2022) were sold at a settlement price of \$16.85. The 21<sup>st</sup> Joint Auction will be held on November 19, 2019. From *California Air Resources Board* on August 27, 2019.

## SCIENCE NEWS

### *Concrete Program Piloted.*

Hawaii's Department of Transportation initiated a pilot program to test the use of a carbon-storing form of concrete in road construction. CarbonCure's concrete manufacturing process injects CO<sub>2</sub> from an industrial emitter into a concrete mix, creating a chemical reaction that converts the CO<sub>2</sub> into solid calcium carbonate. The resulting concrete mix is incorporated with other ingredients to form carbon-infused concrete. Honolulu's City Council passed a resolution requesting that all new city infrastructure projects consider using carbon-infused concrete. From *ZME Science* on September 11, 2019.

### *Company Developing Personal Carbon Storage Device.*

Hyper Industries, an artificial intelligence-focused tech company, is developing a personal-sized bioreactor that uses algae to capture and store CO<sub>2</sub>. According to the company, the Eos Bioreactor has the potential to store as much CO<sub>2</sub> as an acre of trees. Currently a prototype, the closed system works indoors and connects with an HVAC system to reduce the CO<sub>2</sub> levels. From *Fast Company* on September 17, 2019.

### *Researchers Study Peatlands Carbon Storage Potential.*

French researchers studied the effects of climate on the survival of peatlands, which store one-third of the soil carbon trapped in soils globally. The scientists came to their conclusions by studying the carbon uptake by the two main species of moss in Eastern France. The results of the study were published in the journal *Global Change Biology*. From *Phys.org* on September 16, 2019.

## JOURNAL ARTICLES

### *Reconsidering CCS in the US fossil fuel fired electricity industry under section 45Q tax credits.*

The following is the abstract of this article: "CO<sub>2</sub> capture and storage (CCS) can be an important feature of a decarbonization strategy involving electricity generation. According to the recently revised Section 45Q tax credits, said credits will be provided for implementing CCS, which is motivating some United States (US) electricity generation companies to revisit their business strategies for CCS. This paper discusses alternative business models being considered by companies for undertaking CCS, including providing a 'template' for evaluating the cost effectiveness of CCS with Section 45Q tax credits and storage in saline reservoirs. Using stylized illustrative examples, the paper indicates how use of Section 45Q tax credits should be expected to change dispatch at an electricity generating unit. For situations similar to the examples, the paper suggests that Section 45Q tax credits may need to be modified to achieve its intended impact. Modifications can include extending the time period of tax credit availability beyond the current 12 years. In addition, continued R&D investments in CCS and specific support for first of a kind CCS demonstrations would be valuable complements for the deployment of the Section 45Q tax credit." **Richard A. Esposito, Vello A. Kuuskraa, Charles G. Rossman, and Michele M. Corser**, *Greenhouse Gases Science and Technology*. (Subscription may be required.)

### *The North Dakota integrated carbon storage complex feasibility study.*

The following is the abstract of this article: "The Energy & Environmental Research Center is investigating the feasibility of safely, permanently, and economically storing 50 million tonnes of CO<sub>2</sub> in central North Dakota, United States, over a 25-year operational period, should a business case for CO<sub>2</sub> storage emerge. The study is part of the U.S. Department of Energy (DOE) National Energy Technology Laboratory CarbonSAFE initiative and addresses the technical and nontechnical challenges of commercially deploying a CO<sub>2</sub> storage project. Evaluation of cores from two stratigraphic test wells demonstrate that the Broom Creek Formation (sandstone) is an excellent candidate for the geologic storage of CO<sub>2</sub> and the overlying Opeche Formation a competent cap rock." **Wesley D. Peck, Scott C. Ayash, Ryan J. Klapperich, and Charles D. Gorecki**, *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

### *Analysis of carbon tax efficiency in energy industries of selected EU countries.*

The following is from the abstract of this article: "A carbon tax is one of economic policy instruments of environmental protection supposed to contribute to the reduction of greenhouse gas (GHG) emissions. A functional carbon tax aims at incorporating costs for elimination of environmental harm into the pricing decisions. ... the carbon tax is usually imposed on the production, distribution or consumption of carbon-content fossil fuels. The main aim of the study is to evaluate the carbon tax environmental effectiveness in the energy industries of selected EU countries, namely Sweden, Finland, Denmark, Ireland and Slovenia. To achieve the principal research objective, the multiple panel regression method for the selected variables was used, the synergy of other environmental policy tools being taken into account. Control variables employed were emission allowance price, household final consumption expenditure, corporate investments, solid fuel consumption and renewable energy consumption. The analysis results suggest that the carbon tax in the energy industry is environmentally efficient, an increased tax rate allowing to reduce GHG production, which is statistically significantly affected by the consumption of fossil fuels. Based on the estimated partial regression coefficient (-0.01158), raising the carbon tax by one euro per tonne can cut annual per capita emissions by 11.58 kg." **Miroslav Hájek, Jarmila Zimmermannová, Karel Helman, and Ladislav Rozenský**, *Energy Policy*. (Subscription may be required.)

### *Understanding gas-phase breakout with high H<sub>2</sub> content in CCS pipeline gathering networks.*

The following is the abstract of this article: "An accurate understanding of the behaviour of impure carbon dioxide (CO<sub>2</sub>) during pipeline transport stage is required for commercial scale deployment of Carbon Capture and Storage (CCS) networks. Impurities in the CO<sub>2</sub> stream modify phase behaviour and change the thermophysical and transport properties of the stream. CO<sub>2</sub> streams containing hydrogen (H<sub>2</sub>) are a particular challenge due to the unique physical properties of H<sub>2</sub>. In a CCS gathering network where CO<sub>2</sub> is sourced from processes such as pre-combustion capture or hydrogen production, H<sub>2</sub> with a concentration of 2% mol can be expected to be present in the mixture. This paper describes foreseeable operating scenarios where gas breakout in single-phase CCS gathering networks might occur, leading to pockets of gas with high H<sub>2</sub> concentration. Multiphase flow modelling of a CCS gathering network with impure CO<sub>2</sub> containing H<sub>2</sub> has been performed, demonstrating these operating scenarios and providing a basis for design. The H<sub>2</sub> content of the gas breakout is shown to be >20% mol when the conditions are close to bubble point. High concentrations of H<sub>2</sub> due to gas breakout must be considered as part of a single-phase CCS gathering network design, whenever H<sub>2</sub> is present. This paper provides practical guidelines for understanding, quantifying and, managing the worst design cases for H<sub>2</sub> exposure due to gas breakout. Specific recommendations for what must be included in the project design basis are presented. Potential mitigating factors and engineering measures that can be taken to manage high H<sub>2</sub> concentration in a CCS system are also discussed." **Matthew Healey, Ketan Mistry, Thomas Jones, and Eduardo Luna-Ortiz**, *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

### *Bioenergy and full carbon dioxide sinking in sugarcane-biorefinery with post-combustion capture and storage: Techno-economic feasibility.*

The following is the abstract of this article: "Sugarcane plantations promote impressive drainage of atmospheric carbon dioxide reaching 781 t/h for a 1000 t/h sugarcane-biorefinery. For first-generation bioethanol sugarcane-biorefineries, only 10% of sugarcane carbon dioxide equivalent leaves as hydrous-ethanol, while 90% return to atmosphere through bagasse-fired power cogeneration in steam-Rankine cycles. Thus, a sugarcane-biorefinery exports two bioenergy flows – electricity and hydrous-ethanol – and its impressive Bioenergy Carbon Capture and Storage potential is wasted. Capture of fermentation carbon dioxide merely means 5% of Bioenergy Carbon Capture and Storage efficiency. This work assesses a new sugarcane-biorefinery concept dramatically raising the Bioenergy Carbon Capture and Storage efficiency. With fermentation carbon dioxide already captured, it is advocated to implement 90% post-combustion capture of flue-gas carbon dioxide. Then, captured carbon dioxide is compressed and traded as Enhanced Oil Recovery agent transported to deep-water offshore oil fields via high-pressure pipelines counting on topographic gravitational effects to lower compression power. Aggregating pipeline/compression investment to the biorefinery, it is shown that such new Plantation-Biorefinery-Post-Combustion-Pipeline-Oil-Recovery enterprise is technically feasible for 5.22 MtCO<sub>2</sub>/y of Bioenergy Carbon Capture and Storage capacity and is economically feasible under certain conditions: (i) idle pipeline capacity rental to fossil carbon emitters at 10–20 USD/tCO<sub>2</sub>; (ii) recovered oil revenues traded at 1–2 bbl/tCO<sub>2</sub> and 50–80 USD/bbl; (iii) carbon-taxation at 40–80 USD/tCO<sub>2</sub>; and (iv) carbon Cap-and-Trade at 30–70 USD/tCO<sub>2</sub>. Under such conditions the Plantation-Biorefinery-Post-Combustion-Pipeline-Oil-Recovery can attain 7 MMMUSD net value and 6 years payback-time." **Hudson Bolsoni Carminati, Raquel de Freitas D. Milão, José Luiz de Medeiros, and Ofélia de Queiroz F. Araújo**, *Applied Energy*. (Subscription may be required.)

## JOURNAL ARTICLES *(cont.)*

### *Feasibility of carbon dioxide storage in post-burn underground coal gasification cavities.*

The following is the abstract of this article: "Supplementary to the prospect of carbon storage in the geological formations for carbon emission mitigation, the deep post-burn underground coal gasification (UCG) cavities are proposed to be good venues for carbon dioxide storage, albeit without substantial validation in any form. Using a modelling methodology, this paper intends to bridge that knowledge gap by exploring the feasibility of storing CO<sub>2</sub> in the post-UCG venues. A 3D post-burn UCG cavity model was constructed taking into account of the various char walls and rubble floor. To better utilize the subsurface space, the migration of CO<sub>2</sub> in a supercritical state was modelled for a span of 10,000 days. The modelling results show that it is possible to inject CO<sub>2</sub> into UCG cavities for storage. Insight was achieved concerning the transport pattern of CO<sub>2</sub> plume in the UCG cavity under various effects, e.g. CO<sub>2</sub> buoyant flow, diffusion and adsorption are coupling behaviours, and coal adsorption and swelling have a complex effect on CO<sub>2</sub> transport." **Liangliang Jiang, Zhangxin Chen, and S.M. Farouq Ali**, *Applied Energy*. (Subscription may be required.)

### *Profiting from CCS innovations: A study to measure potential value creation from CCS research and development.*

The following is the abstract of this article: "Globally, large private and public funds are invested into CO<sub>2</sub> capture and storage (CCS) research to provide the knowledge and technology required to mitigate CO<sub>2</sub> emissions below a sustainable level. A pertinent question to ask is whether this is the best way of spending limited resources. This paper presents a study aiming to quantify the potential economic gains from selected CCS innovations created in the international research centre BIGCCS and its successor NCCS. Development of CCS technology is currently driven by technology push and the lack of a market makes it hard to predict future potentials for increased revenue. Consequently, the study investigates potential cost reductions from implementing the innovations in full-scale industry projects based on qualified assumptions. The results show that even with limited deployment of CCS the potential cost savings from implementation of the innovations by far exceed the research investment. Additional value not considered in this work is expected from commercialisation of the technologies for the technology providers, improved competitive edge for providers of CO<sub>2</sub> free products and enhanced safety for people, equipment and environment. By developing illustrative examples from technology innovations, the study aims to contribute to a broader public CCS debate addressing also potential gains and commercial opportunities in addition to the current focus on costs and safety." **Sigmund Ø. Størset, Grethe Tangen, David Berstad, Peder Eliasson, Karl Anders Hoff, Øyvind Langørgen, Svend Tollak Munkejord, Simon Roussanaly, and Malin Torsæter**, *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

### *Game analysis of carbon emission verification: A case study from Shenzhen's cap-and-trade system in China.*

The following is the abstract of this article: "Carbon emission verification is one of the key factors required for proper implementation of a cap-and-trade (C&T) system. However, to obtain more revenue, emission generating companies (GCs) may collude with third-party verifiers (3 PVs) and conceal real carbon emission data. Based on actual practice of Shenzhen's C&T system, a three-player game model has been devised in this paper to analyze the behaviors among GCs, 3 PVs and government. Given the government's current piecewise linear re-verification policy, the optimal reported carbon intensity for GCs has been provided. [The authors'] research reveals that if the actual carbon intensity is larger than historical carbon intensity GCs may report less carbon intensity and conceal actual carbon emission. To deal with this issue, a new exponential re-verification policy is proposed. Based on authentic data from Shenzhen's C&T system, the experimental results show that the government should devote more attention to GCs with a decreasing industrial product output value-added (IVA) than to those with high carbon emissions when selecting GCs for re-verification. [The authors'] experiments also illustrate that the new policy outperforms the current one on both total concealed amount of carbon emission and total re-verification cost if the initial re-verification probability is set within a specific range." **Yanchun Pan, Wen Yang, Nan Ma, Zhimin Chen, Ming Zhou, and Yi Xiong**, *Energy Policy*. (Subscription may be required.)

## REPORTS and OTHER PUBLICATIONS

***Financing BECCS in developing countries.***

The following is from the Introduction of this document: "BECCS is a promising class of technologies for carbon dioxide (CO<sub>2</sub>) removal and consists of the capture and permanent geological storage of CO<sub>2</sub> stemming from biomass transformation or combustion. Several industrial sectors can implement this technology, including the biofuel sector which is predominantly made up of bioethanol production. Bioethanol is one of the few renewable alternatives to oil and gas-based liquid fuel, with which it can be easily blended to be used as a transportation fuel. As countries seek to decarbonise transport, demand for bioethanol is set to grow globally. By integrating CCS into the production process for bioethanol, negative emissions can be created. It is forecast that a significant proportion of the world's bioethanol production will come from developing countries. This paper focuses on how the production of bioethanol with CCS can be supported by climate finance providers, and the pivotal role Brazil can play in facilitating this process."

**GLOBAL  
CCS  
INSTITUTE*****Lessons and Perceptions: Adopting a Commercial Approach to CCS Liability.***

The following is a description of this document: "Liability has long been raised as a significant barrier to the wide scale deployment of carbon capture and storage (CCS). Despite regulatory developments, the topic of liability continues to be considered by some CCS project developers, policy-makers and regulators as a critical issue and potential 'show-stopper' for the technology's deployment. This report, through policy and regulatory analysis as well as interviews with policy makers, regulators, lawyers, project proponents and representative from the insurance sector, seeks to challenge these views and make the case for a more commercially-minded view of liability. The report's findings reveal that many of the liabilities borne under CCS-specific models are both familiar and eminently manageable. Furthermore, the report demonstrates proposed solutions and examples available in addressing liability for those seeking to invest in or operate CCS projects. The report also examines the meaning of liability throughout the CCS lifecycle and the unique challenges presented by greenhouse emissions/climate liabilities. The critical role of government and the private sector in allocating and managing risks across the CCS project lifecycle, as well as the essential requirement for further engagement of the insurance sector to assist operators manage liabilities are also topics addressed through this timely report. The report will be of particular interest to government policy makers, regulatory bodies, CCS project proponents, investors and those in the insurance sector wishing to further understand the topic of liability, the reasons why it is perceived as a barrier to CCS deployment and gain insights into how these barriers have been - and may continue to be - managed and overcome."

## 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](#).



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 (note that all links were active at the time of publication).

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