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

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

CSN CARBON STORAGE NEWSLETTER

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CARBON STORAGE PROGRAM DOCUMENTS and REFERENCE MATERIALS

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

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:

DOE/FECM/NETL HIGHLIGHTS

DOE Announces Funding to Support CCUS.

The U.S. Department of Energy (DOE) announced two funding opportunities for student training and research on remediating legacy pollution from coal-based electricity generation and using carbon capture, utilization, and storage (CCUS) to generate low-carbon power. The ***University Training and Research for Fossil Energy and Carbon Management—UCR*** Funding Opportunity Announcement (FOA) will support DOE's University Coal Research (UCR) Program by providing research and development (R&D) grants to educate and train the next generation of engineers and scientists by supporting novel, early-stage research at U.S. colleges and universities. The ***University Training and Research for Fossil Energy and Carbon Management—Minority Serving Institutions (MSIs)*** FOA will support the Historically Black Colleges and Universities and Other Minority Institutions (HBCU-OMI) Program by providing R&D grants to educate and train the next generation of engineers and scientists by supporting novel, early-stage research at MSIs in the United States. Combined, the two FOAs will support approximately 20 student engineers and scientists working two to three years on research projects related to advancing the Biden-Harris administration's goals of net-zero greenhouse gas (GHG) emissions by 2050.

From *energy.gov*. February 2022.

CONTINUE

ANNOUNCEMENTS

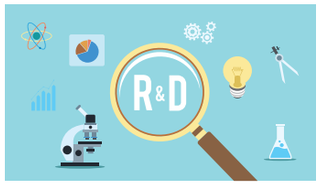
White House Issues CCUS Guidance.

The White House Council on Environmental Quality (CEQ) delivered new guidance to federal agencies to help ensure that the advancement of CCUS technologies is done responsibly, incorporates community input, and reflects the best available science. The guidance builds on CEQ's ***June 2021 CCUS report*** and identifies measures to facilitate sound and transparent environmental reviews for CCUS projects.

NETL Releases CCS Report.

A report authored by the National Energy Technology Laboratory (NETL) analyzed the buildout of America's carbon capture and storage (CCS) technologies in terms of job growth potential and supply chain risks. NETL researchers conducted a supply chain risk analysis by comparing raw material estimates against domestic and global production to search for opportunities and vulnerabilities. The report, titled "***Carbon Capture, Transport, and Storage, Supply Chain Review***," found that one reason for the low risk to the supply chain is because CCS infrastructure can be supplied by components made in the United States. The report also concluded that a CCS industry buildout could create up to 1.8 million jobs through construction, operation, and maintenance of capture, pipeline, and storage sites.

DOE FOA to Develop Carbon-Free Fuel.



DOE's Office of Fossil Energy and Carbon Management (FECM) announced federal funding for R&D and front-end engineering design (FEED) projects that will advance clean hydrogen as a carbon-free fuel. The FOA, titled "***Fossil Energy Based Production, Storage, Transport and Utilization of Hydrogen Approaching Net-Zero or Net-Negative Carbon Emissions***," will leverage innovative approaches to produce clean hydrogen at lower costs from materials that include municipal solid waste, legacy coal waste, waste plastics, and biomass with CCS.

NETL FY 2021 S&T Accomplishments Book Available.

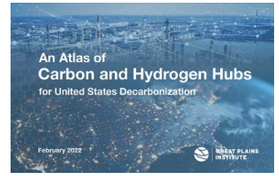
NETL's FY 2021 Science and Technology (S&T) Accomplishments book is available online. The document contains nearly 40 poster presentations that showcase significant accomplishments made by NETL, industries, academia, and other entities, with many projects making progress to meet the Biden administration's clean energy goals calling for a net-zero carbon emissions electricity sector by 2035 and economy-wide net-zero emissions by 2050. Accomplishments in the document include efforts to increase the efficiency and lower the cost to capture carbon dioxide (CO_2) for permanent storage in the subsurface.

FECM/NETL Releases New Version of CCUS Model.

A new, updated version of a CCUS model developed by FECM/NETL has been released. The FECM/NETL CO_2 Transport Cost Model (also known as CO_2_T_COM) is an Excel-based tool that estimates revenues, capital, and operating and financing costs, as well as calculates the break-even cost (in $/tonne) for transporting liquid-phase CO_2 by pipeline. A ***user's manual*** and ***overview presentation*** were also released. Model updates include real (and nominal) dollar cost estimate capability, an update to the CO_2 equation of state, and a refined booster pump determination algorithm. The CO_2_T_COM can help evaluate integrated CCUS networks (i.e., connecting a CO_2 source to a storage site) and costs of large-diameter trunklines or shorter, smaller pipelines (e.g., gathering/distribution).

An Atlas of Carbon and Hydrogen Hubs.

The Great Plains Institute ***published an atlas*** of carbon and hydrogen hubs based on analysis of U.S. industrial activity, emissions, and fuel combustion. The atlas considers geologic storage potential, current hydrogen production, industrial concentration, and other factors that provide opportunities for siting CO_2 removal, as well as carbon capture retrofit and zero-carbon hydrogen production.



An Analysis of Government, Corporate CCS Investment.

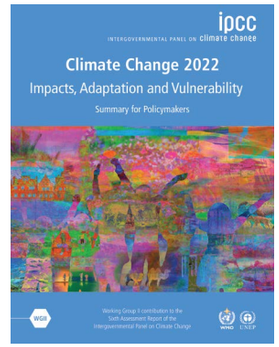
Economic and financial analysts at ***ING's THINK*** discussed how governments are shaping CCS support mechanisms for corporate investment. Included in their analysis is a breakdown of CCS tax credits in the United States and how, globally, CCS has the potential to become a $200 billion market annually.

Public Offset Registry for Engineered CO_2 Removals Launched.

Puro.earth, a business-to-business marketplace focused on carbon removal, launched Puro Registry, a public registry dedicated to carbon removal and CO_2 Removal Certificates (CORCs). Puro Registry enables beneficiaries of CORCs to make their retirements public. According to Puro.earth, the registry is designed to meet industry comments from the 2021 United Nations Climate Change Conference (COP26) and is intended to align with the ***Paris Agreement's Article 6 rules on corresponding adjustments***.

IPCC Releases New Report.

The Intergovernmental Panel on Climate Change (IPCC) released "***Climate Change 2022: Impacts, Adaptation and Vulnerability***," the second installment of its ***Sixth Assessment Report (AR6)***. IPCC is producing AR6 with contributions by its three Working Groups, as well as a Synthesis Report, three Special Reports, and a refinement to its latest Methodology Report. The Working Group I contribution, "***Climate Change 2021: The Physical Science Basis***," was released in August 2021; the Working Group III contribution, as well as the Synthesis Report, are expected to be released later this year.



PROJECT AND BUSINESS DEVELOPMENTS

Companies to Develop CO_2 Capture, Transport, and Storage Service.

Talos Energy signed a Memorandum of Understanding (MOU) with EnLink Midstream to jointly develop an industrial-scale CO_2 capture, transport, and storage service in Louisiana (USA). Portions of EnLink's existing regional pipeline infrastructure will be used, as will Talos' River Bend CCS site, which includes more than 26,000 acres of pore space and provides more than 500 million metric tons of CO_2 storage capacity.

From *Journal of Petroleum Technology*. February 2022.

CCS Projects to Be Developed in Australia.

Santos, SK E&S, K-CCUS Association, CO_2CRC, and Korea Trade Insurance Corporation signed an MOU to support and collaborate on the development of CO_2 storage facilities in the Australia region. CCS at Bayu-Undan has the potential capacity to store approximately 10 million metric tons of CO_2 per year. In addition, Santos ***also announced*** the beginning of the FEED phase of a proposed Bayu-Undan CCS project.

From *Santos Media Release*. February 2022.

Collaboration to Accelerate CCS Projects Across Europe.

Aker Carbon Capture and Northern Lights JV—a CO_2 reduction project developer—signed an MOU to collaborate on the acceleration of CCS projects in Norway and across Europe. The MOU builds on lessons learned from the Longship project—a Norwegian government effort to develop technology for full-scale CCS in Norway. Operations are expected to begin in 2024.

From *gasworld*. February 2022.

Exxon Announces Plans for CCS Project.

ExxonMobil announced plans for a CCS project at its Baytown refinery near Houston, Texas (USA). Along with a planned hydrogen production plant, the complex would be part of the company's effort to create a CCS zone along the Houston Ship Channel. A final investment decision is pending regulatory permits and engineering studies. In addition, Exxon also announced plans to ***expand CCS at its LaBarge, Wyoming, facility***. The expansion project is expected to capture up to an additional 1.2 million metric tons of CO_2 per year (approximately 6–7 million metric tons are currently captured at LaBarge each year).

From *Reuters*. March 2022.

Companies to Develop Flexible CO_2 Transportation Solutions.

Aker Carbon Capture and Dan-Unity CO_2—a Danish CCS-specific shipping entity—will collaborate on the development of CO_2 transport solutions with the aim of establishing a full CCUS value chain. The companies will explore the development potential of future CCS value chains by collaborating on market analysis and insight and utilizing their industry expertise to identify technical and commercial risks across the CCS value chain, including capture and liquefaction technology, loading and offloading operations, offshore offloading, intermediate storage, and subsurface storage.

From *Aker Carbon Capture Press Release*. February 2022.

LEGISLATION AND POLICY

West Virginia Legislature Approves Carbon Storage Bills.

Committees in both chambers of the West Virginia (USA) Legislature approved bills that would set up a regulatory program for the underground storage of CO_2. Under ***House Bill (HB) 4491*** and ***Senate Bill (SB) 622***, the state Department of Environmental Protection would be responsible for setting rules for developing and approving underground CO_2 storage facilities. In addition, the bills would require the storage operator to assess the migration of CO_2 injected for storage. HB 622 was referred to the full Senate by the Senate Energy, Industry, and Mining Commission, and HB 4491 was referred to the House Judiciary Committee by the House Energy and Manufacturing Committee.

From *Charleston Gazette-Mail*. February 2022.

Wyoming Looks to Expand CO_2 Storage Network.

Wyoming (USA) lawmakers have created two bills to expand the state's legal and regulatory framework for advancing underground carbon storage and encouraging CCUS at existing coal-fired power plants. ***Senate File (SF) 47—Carbon Storage and Sequestration Liability*** establishes a process for the state to assume ownership and liability for CO_2 injected into geologic formations. ***SF 64—Carbon Capture and Sequestration*** addresses regulated utilities and retiring coal-fired power plants in favor of either retrofitting the plants with CCUS technology or selling them (to an owner who will install CCUS technology).

From *WyoFile*. February 2022.

EMISSIONS TRADING

Results of RGGI Auction Announced.

The 11 states participating in the Regional Greenhouse Gas Initiative (RGGI) announced the results of their 55th auction of CO_2 allowances, during which 21,761269 CO_2 allowances were sold at a clearing price of $13.50. According to the "***Market Monitor Report for Auction 55***," the auction generated $294 million for states to reinvest in strategic programs, including those focused on energy efficiency, renewable energy, and GHG abatement.

From *RGGI News Release*. March 2022.

Singapore's Carbon Tax to Rise.

Singapore plans to increase its carbon tax fivefold, its finance minister announced. The country's carbon tax, which was implemented in 2019, applies to facilities producing 250,000 metric tons or more of GHGs annually. Beginning in 2024, Singapore businesses can buy international carbon credits to offset up to 5% of their taxable emissions.

From *Reuters*. February 2022.

RGGI Reports Made Available.

The independent market monitor for RGGI released a report on the secondary market for RGGI CO_2 allowances, including future prices, market activity, and allowance holdings. Potomac Economics' "***Report on the Secondary Market for RGGI CO_2 Allowances: Fourth Quarter 2021***" addressed the period from October through December 2021. In addition, RGGI's "***2021 Interim Compliance Summary Report***" was also made available; the report contains data regarding CO_2 allowances provided by CO_2 budget sources to meet their 2021 interim control period compliance obligation. (RGGI's fifth three-year control period took effect on January 1, 2021, and extends through December 31, 2023.)

From *RGGI News Release*. February 2022.

SCIENCE

Researchers Identify CCS Factors.

A researcher from the University of Texas at Austin's Bureau of Economic Geology used supercomputers to understand how CO_2 storage works within the micrometer-wide pores in rock, as well as to determine the characteristics and factors that can help optimize the amount of CO_2 that can be stored. The study, ***published in the International Journal of Greenhouse Gas Control***, explored the trapping efficiency of CO_2 through dissolving the gas into the resident brine in saline aquifers. The results showed that two factors improve the amount of CO_2 that could be stored in the spaces within rocks: wettability and injection rate.

From *Phys.Org*. February 2022.

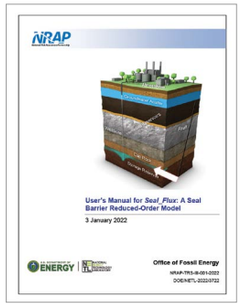
Scientists Study CO_2 Storage Potential of Deep-Ocean Creatures.

According to a study published in the journal *Science Advances*, scientists have learned that seafloor sediments are home to vast populations of previously unknown organisms that may have an impact on carbon storage. By analyzing DNA sequences detected in ocean floor sediments, researchers were able to determine that the biodiversity of tiny marine organisms in seabed sediments was at least three times greater than in the ocean above. Their conclusions were reached by generating a database of DNA sequences from 418 samples of deep ocean sediments collected from 2010 to 2016. Those sequences were then compared to DNA taken from organisms residing at different ocean depths, allowing the scientists to determine which organisms live in seafloor sediments and which had come to rest there after descending from upper zones of the ocean.

From *The Japan Times*. February 2022.

PUBLICATIONS

User's Manual for *Seal_Flux*: A Seal Barrier Reduced-Order Model.



The following is from the Executive Summary of this National Risk Assessment Partnership (NRAP) report: "This report provides a brief description on the use of the *Seal_Flux* computer program developed as part of the effort to quantify the risk of geologic storage of carbon dioxide (CO_2) under the U.S. Department of Energy's (DOE) National Risk Assessment Partnership (NRAP). The *Seal_Flux* code simulates the flow of CO_2 through a low permeability rock horizon or seal formation overlying the storage reservoir into which CO_2 is injected. A two-phase, relative permeability approach with Darcy's law is used for one-dimensional (1D) flow computations of CO_2 through the horizon in the vertical direction. The code also allows the simulation of time-dependent processes that can influence such flow. However, as part of its design, *Seal_Flux* is what can be termed a 'reduced-order model' (ROM) and is not intended as a full-functioning flow code. The theory and simulation in the code is stream-lined and directed towards the implementation of Monte Carlo risk analyses of CO_2 transport or as termed in this context as 'leakage.' While presented in this report as a stand-alone tool, the *Seal_Flux* code is intended to function in the future as one of several models as part of an integrated, systems-level model of CO_2 storage performance. Finally, the code is written in Python 3.8 to provide an open framework for further development by others and to assist in linking the code with other modules in an integrated assessment model."

Distilling data to drive carbon storage insights.

Energy Data eXchange

The following is from the abstract of this article: "Wide-spread implementation of carbon capture and storage has the potential to decrease carbon emissions and aid in meeting global climate change mitigation goals. Data availability is one of the biggest challenges faced by the carbon capture and storage (CCS) community for modeling risks associated with CCS, necessary for wide-spread implementation in coming years. Collecting, integrating, and intuitively managing data is a time-consuming process, but one which is fundamental to establishing necessary access to carbon storage data. The US Department of Energy (US DOE) has been a major supporter of energy research in the US, including significant investment into carbon capture and storage research and technology development over the last ten years. The US DOE investments into the Regional Carbon Sequestration Partnerships, the National Risk Assessment Partnership, and other CCS related research has resulted in a large volume of data, of which much has been made public through the National Energy Technology Laboratories data repository, the Energy Data eXchange (EDX). Researchers at the National Energy Technology Laboratory have developed workflows, tools, and other methods that leverage EDX, open-source software, machine learning, and natural language processing to discover, curate, label, organize and visualize available data. This paper describes the available data on EDX for carbon storage applications, describes the results of a spatial and temporal analysis of the data, describes where it is most geographically available, makes a general assessment of the quality of the available data, and discusses visualization tools and natural language processing tools developed for understanding, discovering and reusing the data." **Paige Morkner, Jennifer Bauer, C. Gabriel Creason, Michael Sabbatino, Patrick Wingo, Randall Greenburg, Samuel Walker, David Yeates, and Kelly Rose,** *Computers & Geosciences*. (Subscription may be required.) [***Click here to access NETL's EDX***.]

Numerical analysis of fracture deformation and instability during CO_2 geological sequestration using a THM-XFEM coupled model.

The following is from the abstract of this article: "Fracture deformation and instability during long-term CO_2 geological sequestration in abandon reservoirs is simulated with a thermal-hydro-mechanical model. The two-phase in non-isothermal condition is used both in matrix and fracture, and thermoelastic and poroelastic deformation are all taken into account. The extended finite element method is employed to solve the strong discontinuity problem involving thermal-hydro-mechanical coupling. The S-W equation of state and transport equation are chosen to characterize CO_2 phase change. CO_2 geological sequestration in abandoned-fractured reservoir with high water-cut is discussed with a two-dimensional model. The analysis of fracture deformation shows that CO_2 geological sequestration has a great effect on fracture deformation and instability. Fracture aperture, deformation and the effective fluid pressure in fracture are highly affected by the water residual saturation and injected temperature difference. The analysis of fracture instability presents that mode I mainly appears in the fracture propagation, and propagation prefers to occur in fracture near the injection wellbore. The higher CO_2 phase pressure when cold CO_2 injection into reservoirs with low water residual saturation can promote fracture propagation 1–2 years in advance. Fracture aperture is enhanced but fracture instability time would be delayed due to the thermal stress." **Long Cheng, Zhifeng Luo, Liqiang Zhao, and Yaozeng Xie,** *Computers and Geotechnics*. (Subscription may be required.)

Analytical and numerical modeling for the assessment of CO_2 storage in the Pariñas geological formation - Talara, Peru.

The following is from the abstract of this article: "This research evaluates the CO_2 storage capacity of the Pariñas Formation belonging to the Talara basin in Peru through analytical modeling based on mass balance equations and numerical modeling using IMEX CMG. Pariñas Formation has several depleted hydrocarbon reservoirs that presents favorable conditions for CO_2 geological storage. It has an average porosity of 17.6% and a permeability of 640 mD in the horizontal direction consisting of sandstones with interspersed lutites layers. The study evaluates the depleted Bellavista oil deposits involving CO_2 storage capacity estimation with CO_2 and reservoir fluid (oil and water) interaction. It involves numerical modeling based on the reservoirs properties and CO_2 injection simulation not exceeding the fracture pressure of the reservoir rock. This approach is the first one carried out in Peru and provides the chance to evaluate the CO_2 storage capacity in a hydrocarbon reservoir in this part of the world, as a strategy to mitigate future global change impacts. The results indicate a storage capacity of 35.37 million tons of CO_2, approximately. Besides, the sandstone reservoir of the Pariñas geological formation has adequate characteristics to serve as a CO_2 storage reservoir. C_{30+} pseudo component shows greater sensitivity in its properties (temperature and critical pressure) adjusting the fluid properties with the experimental data (saturation pressure, viscosity and minimum miscibility pressure)." **Rafu Pomar-Castromonte, Eusebio Ingol-Blanco, Jose Santos, and Sandra Santa-Cruz,** *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

PUBLICATIONS *(cont.)*

Effects of long-term (70 years) nitrogen fertilization and liming on carbon storage in water-stable aggregates of a semi-arid grassland soil.

The following is from the abstract of this article: "Grasslands cover up to 40.5% of the world's landmass and store 30% terrestrial carbon (C). Various practices, including mineral fertilization and liming, are used to manage these ecosystems with potential long-term effects on the size and distribution of soil aggregates and inevitably carbon dynamics. The objective of this study was to examine the long-term effects of nitrogen fertilization and liming on soil carbon storage and its dynamics in water-stable aggregates of a semi-arid grassland. Soil samples (0–10 cm) were collected from Ukulinga long-term grassland trial in Pietermaritzburg, South Africa where nitrogen fertilizers have been applied annually and lime every five years for 70 years. Ten treatments were studied: the control (0 kgN/ha and unlimited), lime at 2250 kg/ha (L), ammonium sulphate at 70 kg/ha (AS70) and 211 kg/ha (AS211); ammonium nitrate at 70 kg/ha (AN70) and 211 kg/ha (AN211); AS70 + lime (AS70L); AS211 + lime (AS211L); AN70 + lime (AN70L) and AN211 + lime (AN211L) …" **Kwenama Buthelezi and Nkosinomusa Buthelezi-Dube,** *Heliyon*. (Subscription may be required.)

Dynamics of plantation forest development and ecosystem carbon storage change in coastal Bangladesh.

The following is from the abstract of this article: "Plantation forest has an immense potential for significantly contributing to the global carbon cycle for regulating climate change. Assessing the spatio-temporal distribution of plantation forest vegetation by analyzing Landsat land use/land cover (LULC) data can provide a logical basis for developing ecological and environmental policies to effectively manage ecosystem carbon storage in the future. The study aimed at assessing and predicting dynamics of plantation forest development and ecosystem carbon storage change in coastal Bangladesh over 1988–2041 under three future land management scenarios: business-as-usual (BAU), economic development (ED), and ecological protection-afforestation (EPA) by linking CA-Markov and InVEST models. Findings from LULC change analysis revealed that during 1988–2018, plantation forest increased by 984.9 km^2 (68.34%) leading to an overall increase in regional carbon storage, of 3.30 Tg C. Over 2018–2041, plantation forest land could be increased by 249.90, 361.24, and 472.14 km^2 under the BAU, ED, and EPA scenarios, respectively, that may potentially increase future carbon storage by 0.64 Tg C, 0.91 Tg C, and 3.77 Tg C, respectively. However, the three future land management scenarios may lead to shortages of regional food supply, of 5.96%, 13.69%, and 11.06% respectively. The suitability maps of different LULC types created in this study could be useful to find out the potential areas of plantation forest development in the future and would provide a scientific basis for further discussion by policymakers on future land use planning, to minimize the trade-offs between food security and climate change adaptation." **Muhammad Ziaul Hoque, Shenghui Cui, Imranul Islam, Lilai Xu, and Shengping Ding,** *Ecological Indicators*. (Subscription may be required.)

Analysis of the effect of environmental protected areas on land-use and carbon storage in a megalopolis.

The following is from the abstract of this article: "Carbon storage in terrestrial ecosystems plays a vital role in climate control. However, urban expansion and damage to natural areas, especially the rise of megalopolises, have affected carbon storage. To mitigate this damage, various policies have been established by international, domestic, and local governments. This study focuses on the establishment and management of environmental protection areas and analyzes their impact on carbon storage. The study targets the cities of Gyeonggi-do province, South Korea, which make up a representative megalopolis, and the effectiveness of protected areas was analyzed by typifying the cities based on the proportion of available development areas and environmentally protected areas. In this study, the SLEUTH (Slope, Land-use, Excluded Area, Urban, Transportation, Hillshade) land-use change model was used to predict future land-use changes, and carbon storage was estimated using the InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) Carbon model. When operating the model, [the authors] tested a control group scenario that only preserves the water zone, a scenario that preserves the legally protected areas, and a scenario that protects the areas with high environmental value. There are two significant effects of setting up protected areas: First, the 'development inhibition effect' of reducing the development area itself. Second, the 'development replacement effect' of moving development to relatively low environmental value areas. These two effects differ depending on the availability of development areas, with 'development replacement effects' prominent in areas with high development availability and 'development inhibition effects' predominant in areas with low development availability. Future policies for setting up and managing protected areas can be used in megalopolis in conjunction with policies focusing on securing the area of carbon sinks." **Jinhoo Hwang, Yuyoung Choi, Yoonji Kim, Lim No Ol, Young-Jae Yoo, Hyo Jin Cho, Zhemin Sun, and Seongwoo Jeon,** *Ecological Indicators*. (Subscription may be required.)

Spatial distribution characteristics of carbon storage density in typical mixed fir and broadleaf forests.

The following is from the abstract of this article: "In order to further improve the vegetation utilization rate of typical Chinese fir and broad-leaved mixed forest, increase the carbon storage in the ecological environment, protect and improve the ecological environment, the spatial distribution characteristics of carbon storage in typical Chinese fir broad-leaved mixed forest were analyzed. The weight set of subjective estimation of carbon storage density of vegetation carbon storage factor was modified, and the fuzzy evaluation matrix of vegetation carbon storage was obtained. The evaluation vector of the matrix was calculated to evaluate the carbon storage density, and the spatial distribution characteristics of carbon storage density of typical mixed fir and broad-leaved forest were obtained. The carbon content in tree layer, shrub layer, herb layer and litter layer was detected through the sample investigation in Ganzhou City, Ji'an City, Jiujiang City, Yichun City and Shangrao City of Jiangxi Province under the same climate environment. At the same time, the soil samples of each layer were collected for analysis. The results showed that under the same age, density and site conditions, there were significant differences in the carbon storage of vegetation layer and litter layer between Chinese fir mixed forest and Chinese fir pure forest, and the carbon fixation capacity of Chinese fir mixed forest was greater than that of Chinese fir pure forest. In order to enhance the carbon storage in the ecological environment, [the authors] can consider a variety of Chinese fir mixed forest, which is of great significance to the maintenance of the ecosystem environment." **Tianyao Lan, Jiancai Gu, and Zhehua Wen,** *Energy Reports*. (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_2, both onshore and offshore, in different depositional environments. The technologies being developed will benefit both industrial and power sector facilities that will need to mitigate future CO_2 emissions. The program also serves to increase the understanding of the effectiveness of advanced technologies in different geologic reservoirs appropriate for CO_2 storage—including saline formations, oil reservoirs, natural gas reservoirs, unmineable coal, basalt formations, and organic-rich shale basins—and to improve the understanding of how CO_2 behaves in the subsurface. These objectives are key to increasing confidence in safe, effective, and permanent geologic CO_2 storage.

The ***Carbon 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***.

Get Social with Us

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

Disclaimer

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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