Carbon Storage Newsletter

SEPTEMBER 2015

WHAT'S INSIDE?

HIGHLIGHTS

"DOE Selects Nine Projects to Receive Funding for Carbon Storage Intelligent Monitoring and Well Integrity and Mitigation Research."

Nine projects have been selected by the U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) to receive funding through DOE's Carbon Storage Program to research new carbon dioxide (CO_2) storage technologies devoted to intelligent monitoring systems and advanced well integrity and mitigation approaches. The selected projects focus on the following three research priorities: (1) carbon capture and storage (CCS)-specific intelligent systems for monitoring, controlling, and optimizing CO_2 injection operations; (2) diagnostic tools and methods capable of characterizing borehole release pathways or fluid flow in existing wells; and (3) next-generation materials and methods for mitigating wellbore release. From *energy.gov* on August 17, 2015.

ANNOUNCEMENTS

U.S., China Sign Memorandum of Understanding.

At the U.S.-China Clean Coal Industry Forum (CCIF) in Billings, Montana, USA, DOE and China's National Energy Administration (NEA) finalized a Memorandum of Understanding (MOU) to continue ongoing collaboration on fossil energy technologies, including CCS. U.S. and Chinese partners are currently advancing six CCS pilot projects in China and Chinese companies have invested in CCS projects in the United States.

DOE/NETL Funding Announcements.

The Carbon Capture Program will fund 8 projects for reducing the cost of CO_2 capture and compression, 16 projects for the development and testing of transformational CO_2 capture systems, and 4 projects to assess the geologic storage potential of offshore subsurface depleted oil and natural gas reservoirs and saline formations. Furthermore, six projects will receive funding through NETL's University Coal Research Program, administered by the Crosscutting Technology Research Program, and 12 projects will receive funding through DOE/NETL's Crosscutting Research Program's Transitional Technology Development to Enable Highly Efficient Power Systems with Carbon Management initiative. Project descriptions are available via the above links.

New Zealand Emissions Trading Scheme Reports Released.

New Zealand's Environmental Protection Authority issued their annual data reports on the New Zealand Emissions Trading Scheme (ETS), providing information on the businesses involved in the ETS, including greenhouse gases (GHGs) emitted and reduced, as well as year-by-year comparisons. The three ETS reports issued are available for download.

Announcements (Continued)

Report Released on Secondary Market for RGGI CO_2 Allowances.

On behalf of the states participating in the Regional Greenhouse Gas Initiative (RGGI), independent marketing monitor Potomac Economics released the "Report on the Secondary Market for RGGI CO_2 Allowances: Second Quarter 2015."

Pact Signed to Cut Greenhouse Gas Emissions.

Six New England governors and five premiers of Eastern Canadian Provinces agreed to set a new goal for reducing GHG emissions by 2030. According to the agreement, the respective governments will look to reduce CO_2 emissions in the range of 35 to 45 percent below 1990 levels by 2030.

Carbon Storage in the News

"New Test Campaign Started at TCM, Mongstad."

Technology Center Mongstad (TCM) will conduct new tests of the monoethanolamine (MEA) solvent in their amine plant in order to aid in the advancement of the CCS industry. The tests will result in lessons learned and reduce potential technology risks with the scale-up and operation of a full-scale capture plant. The results of the tests, which will include parameters such as energy consumption, emissions, degradation, and plant operability, will be made public, providing an MEA baseline for CCS applications. Based on TCM's previous MEA tests from November 2013 through February 2014, several other areas will be investigated further, such as CO_2 mass balances, optimized capture rates, and specific energy consumption; plant performance and effect of higher CO_2 concentrations in flue gas; and emission monitoring. From *TCM News Release* on August 12, 2015.

"UK Launches Free Access to National CO_2 Storage Database."

The CO_2 Storage database, hosted by the Crown Estate and the British Geological Survey (BGS) and under license from the Energy Technologies Institute (ETI), has been made free for subscribers. The web-enabled database contains geologic data, storage estimates, and risk assessments of nearly 600 potential CO_2 storage units of depleted oil and gas reservoirs and saline formations in the United Kingdom (UK). The outcome of ETI's October 2009 UK CO_2 Storage Appraisal Project, the database went live in 2013 and provides stakeholders with information to enable more informed decisions related to CCS infrastructure in the UK, as well as to reduce the early-stage costs of offshore storage site selection. From *ClickGreen* on August 20, 2015.

"Australian Government Invests in CCS Research Fund."

The Australian government launched a research fund designed to facilitate industry investment and research of CCS technologies. The CCS Research Development and Demonstration Fund, which will focus on transport and storage projects, will address research priorities in CCS, such as subsurface knowledge and mapping, transport infrastructure, whole of chain integration, and development of international collaboration and partnerships. While activities will primarily be based in Australia, support will also be provided to leverage international expertise. From *Carbon Capture Journal* on September 2, 2015.

Science

"CU-Boulder Researchers Use Wastewater Treatment to Capture CO_2 Emissions and Produce Energy."

Engineers from the University of Colorado Boulder have developed a wastewater treatment process that mitigates CO_2 emissions and captures GHGs. While purifying wastewater, the method, called microbial electrolytic carbon capture (MECC), uses an electrochemical reaction that absorbs more CO_2 than it releases, while also creating renewable energy. According to the research, which was funded by the National Science Foundation and recently published in the journal "Environmental Science and Technology," dissolved carbonates and bicarbonates produced by MECC may also have the long-term potential to counter the effects of absorbed CO_2 emissions on oceans. The Abstract of the study, titled "Microbial Electrolytic Carbon Capture for Carbon Negative and Energy Positive Wastewater Treatment," is available in the "Technology" section of this newsletter. From *University of Colorado Boulder News Release* on August 3, 2015.

"Climate Change Could Harm British Butterflies."

According to a recent report, six species of butterflies located in the UK could face local extinction due to potential climate change. Researchers gathered their data by studying 129 sites in which 28 butterfly species are tracked in the United Kingdom Butterfly Monitoring Scheme, and incorporating historical weather data and climate model predictions from the Coupled Model Intercomparison Project. The data showed that, by 2050, populations in dry areas, such as southeastern England, have the potential to disappear. The study was published in the journal "Nature Climate Change." From *The Columbus Dispatch* on August 16, 2015.

Policy

"Korea to Develop Six New Technologies to Counter Climate Change."

The Korean Ministry of Science, ICT, and Future Planning (MSIP) is investing approximately $44 million toward the development of six technologies, including CCS, to address potential climate change. MSIP will look to advance the commercialization of CCS by developing carbon capture technologies such as wet and dry processes and gas separation. In order to demonstrate the technologies, MSIP will construct an underground storage area at Pohang, South Korea, that can hold up to 10,000 tons of CO_2. From *Korea Bizwire* on August 7, 2015.

"State Grants Money for Local Climate Change Studies."

Maine's Coastal Zone Management agency will help fund climate change studies through a joint grant to the Town of Essex, the National Wildlife Federation, the Ipswich River Watershed Association, and the Essex County Greenbelt Association. The grant is part of approximately $2 million given to coastal Massachusetts organizations as part of the state's effort to "advance local efforts to increase awareness and understanding of climate impacts." From *Newbury Port News* on August 22, 2015.

"Climate change policy in Brazil and Mexico: Results from the MIT EPPA model."

The following is the Abstract of this article: "Based on an in-depth analysis of results from the MIT Economic Projection and Policy Analysis (EPPA) model of climate policies for Brazil and Mexico, [the authors] demonstrate that commitments by Mexico and Brazil for 2020—made during the UN climate meetings in Copenhagen and Cancun—are reachable, but they come at different costs for each country. [The authors] find that Brazil's commitments will be met through reduced deforestation, and at no additional cost; however, Mexico's pledges will cost [$4 billion] in terms of reduced GDP in 2020. [The authors] explore short- and long-term implications of several policy scenarios after 2020, considering current policy debates in both countries. The comparative analysis of these two economies underscores the need for climate policy designed for the specific characteristics of each country, accounting for variables such as natural resources and current economic structure. [The authors'] results also suggest that both Brazil and Mexico may face other environmental and economic impacts from stringent global climate policies, affecting variables such as the value of energy resources in international trade." **Claudia Octaviano, Sergey Paltsev, and Angelo Costa Gurgel**, *Energy Economics*. (Subscription may be required.)

Geology

"Impacts of CO_2 [release] into shallow formations on groundwater chemistry."

The following is the Abstract of this article: "Geological storage of CO_2 is one option for mitigating atmospheric emissions of [CO_2]. However, the injected CO_2 has the possibility of [release]. The [released] CO_2 may move upward into shallow formations and thereby affects shallow groundwater. To investigate this effect, 27 tonnes of gaseous CO_2 was injected into [a formation] about 180 m below a surface. Periodic groundwater samples were studied to identify shift of hydro-chemical parameters, including pH, TDS, ORP, Ca, Mg, Na, HCO_3, Cl, SO_4, Pb, Fe, and F. The results indicated that CO_2 dissolution and reaction concurrently reduced aquifer pH levels and increased concentrations of TDS, Ca, Mg, HCO_3, and F. ORP level and SO_4 concentration remained static. Pb and Fe concentrations were lower than the detection limit 1 mg/L and 0.02 mg/L, respectively. After the CO_2 breakthrough, Cl concentration increased to a stable level slightly higher than the background concentration. The shift in groundwater levels of Ca and Mg was attributed to dolomite (or Mg-rich calcite) and calcite-dominant dissolution processes. Results indicated linear approximations between concentrations of F vs. HCO_3 (slope 0.0036) and F vs. Ca (slope 0.013). Additionally, the TDS and the total molar concentration of Ca and Mg showed linear correlations with increased levels of HCO_3." **Qianlin Zhu, Xiaochun Li, Zhenbo Jiang, and Ning Wei**, *Fuel Processing Technology*. (Subscription may be required.)

Technology

"CO_2 storage associated with CO_2 enhanced oil recovery: A statistical analysis of historical operations."

The following is the Abstract of this article: "This work analyzes a database of 31 existing CO_2 enhanced oil recovery (EOR) projects that was compiled for the estimation of oil reserves to better understand the CO_2 retention, incremental oil recovery, and net CO_2 utilization for these oil fields. The measured data begin at the start date of the CO_2 flood and extend through the year 2007. Cumulative CO_2 retention (in the formation), incremental oil recovery factors, and net CO_2 utilization factors were calculated for each of the sites. To express all site data on a common dimensionless scale, the data were extrapolated to 300 [percent] cumulative hydrocarbon pore volume (HCPV) by fitting nonlinear functions. Summary statistics were then calculated from 0 [percent] to 300 [percent] HCPV. Across all 31 sites, the 10th, 50th (median), and 90th percentile values for the three factors at 300 [percent] HCPV were: CO_2 retention: 23.1 [percent], 48.3 [percent], and 61.8 [percent] retained; incremental oil recovery: 5.3 [percent], 12.2 [percent], and 21.5 [percent] of OOIP (original oil in place); and net CO_2 utilization: 4.8, 8.7, and 10.5 Mscf/STB (stock-tank barrel). This work employs a novel approach that incorporates nonlinear functions to quantify uncertainty in the estimated values as a function of HCPV and to describe the shape of the CO_2 retention or incremental oil recovery response with a handful of parameters, providing insight into the behavior of the reservoir across the entire timeline of the CO_2 flood. These nonlinear curve fits are focused on statistical inference – i.e., what is the likely outcome and uncertainty ranges for CO_2 retention, incremental oil recovery, and net CO_2 utilization given the historical data from the 31 CO_2 EOR sites? However, the approach described in this work also provides useful information for prediction – i.e., given a set of inputs from another site with similar geology, what are plausible ranges in outcomes for each of these factors? Consequently, the results of this work can be used to estimate the potential range of expected performance for similar candidate oil fields that are not currently undergoing CO_2 injection, including estimates of the associated CO_2 storage potential

Technology (Continued)

of these candidate fields. The results of this work allow estimation of CO_2 storage capacity in CO_2-EOR operations with various degrees of confidence. The sites in the dataset reflect water – alternating gas CO_2 floods – all within the continental United States and heavily dominated by the West Texas carbonate floods. Other floods outside of this region, where the data were available, are also included in this study (i.e., the Rocky Mountain region and the State of Oklahoma)." **Nicholas A. Azzolina, David V. Nakles, Charles D. Gorecki, Wesley D. Peck, Scott C. Ayash, L. Stephen Melzer, and Sumon Chatterjee**, *International Journal of Greenhouse Gas Control*. (Subscription may be required.)

"Microbial Electrolytic Carbon Capture for Carbon Negative and Energy Positive Wastewater Treatment."

The following is the Abstract of this article: "Energy and carbon neutral wastewater management is a major goal for environmental sustainability, but current progress has only reduced emission rather than using wastewater for active CO_2 capture and utilization. [The authors] present here a new microbial electrolytic carbon capture (MECC) approach to potentially transform wastewater treatment to a carbon negative and energy positive process. Wastewater was used as an electrolyte for microbially assisted electrolytic production of H_2 and OH– at the cathode and protons at the anode. The acidity dissolved silicate and liberated metal ions that balanced OH^-, producing metal hydroxide, which transformed CO_2 in situ into (bi)carbonate. Results using both artificial and industrial wastewater show 80–93 [percent] of the CO_2 was recovered from both CO_2 derived from organic oxidation and additional CO_2 injected into the headspace, making the process carbon-negative. High rates and yields of H_2 were produced with 91–95 [percent] recovery efficiency, resulting in a net energy gain of 57–62 kJ/mol-CO_2 captured. The pH remained stable without buffer addition and no toxic chlorine-containing compounds were detected. The produced (bi)carbonate alkalinity is valuable for wastewater treatment and long-term carbon storage in the ocean. Preliminary evaluation shows promising economic and environmental benefits for different industries." **Lu Lu, Zhe Huang, Greg H. Rau, and Zhiyong Jason Ren**, *Environmental Science and Technology*. (Subscription may be required.)

"Fracture-based modeling of complex flow and CO_2 migration in three-dimensional fractured rocks."

The following is the Abstract of this article: "The fractures and pores in rock formations are the fundamental units for flow and contaminant-transport simulations. Modeling and meshing a fractured rock system are challenging tasks because mesh generations of fractured networks typically involve complex procedures in conducting topological transformations, and the modeling of such a complex mesh system is computationally expensive. The objective of this study was to develop a three-dimensional (3D) discrete fracture network (DFN) model and an associated unstructured mesh generation (UMG) model to simulate flow and transport for fractured rock systems. This study employed coupled multicomponent, multiphase fluids in a 3D porous and fractured media simulator (the TOUGH2/ECO2N model) to analyze flow and CO_2 migration in fracture formations. The developed DFN and UMG models were first tested using a single and horizontal fracture plate to evaluate the results based on various mesh types. The models were then implemented in multiple DFN realizations to assess the behavior of equivalent permeability of a rock block influenced by various fracture intensities. By exploiting the well-developed TOUGH2/ECO2N model, the developed DFN and UMG models were applied to problems of flow and CO_2 migration in fracture formations. The simulation results showed that the developed models can capture behaviors of the flow and transport in fractured formations. Different types of mesh led to slight variations in pressure distribution near injection wells. However, such pressure variations can be reduced with refined mesh around the injection wells. The results based on 52 DFN realizations indicated that the value of equivalent permeability for the simulated rock block shows three to four orders of magnitudes lower than the value of the specified fracture permeability. The injection of supercritical CO_2 exhibited a rapid migration of gaseous and aqueous phase CO_2 along connected fractures." **I-Hsein Lee and Chuen-Fa Ni**, *Computers & Geosciences*. (Subscription may be required.)

Terrestrial

"Effects of Greenhouse Gas Mitigation on Drought Impacts in the United States."

The following is the Abstract of this article: "The authors present a method for analyzing the economic benefits to the United States resulting from changes in drought frequency and severity due to global GHG mitigation. The method begins by constructing reduced-form models of the effect of drought on agriculture and reservoir recreation in the contiguous United States. These relationships are then applied to drought projections based on two climate stabilization scenarios and two twenty-first-century time periods. Drought indices are sector specific and include both the standardized precipitation index and the Palmer drought severity index. It is found that the modeled regional effects of drought on each sector are negative, almost always statistically significant, and often large in magnitude. These results confirm that drought has been an important driver of historical reductions in economic activity in these sectors. Comparing a reference climate scenario to two GHG mitigation scenarios in 2050 and 2100, the authors find that, for the agricultural sector, mitigation reduces both drought incidence and damages through its effects on temperature and precipitation, despite regional differences in the sign and magnitude of effects under certain model scenarios. The current annual damages of drought across all sectors have been estimated at $6–$8 billion (U.S. dollars), but this analysis shows that average annual benefits of GHG mitigation to the U.S. agricultural sector alone reach $980 million by 2050 and upward of $2.2 billion by 2100. Benefits to reservoir recreation depend on reservoir location and data availability. Economic benefits of GHG mitigation are highest in the southwestern United States, where drought frequency is projected to increase most dramatically in the absence of GHG mitigation policies." **Brent Boehlert, Ellen Fitzgerald, James E. Neumann, Kenneth M. Strzepek, and Jeremy Martinich**, *Weather, Climate, and Society*. (Subscription may be required.)

Trading

"Trading Program Linked to Significant Emissions Reductions."

According to a new study, the RGGI emissions trading program in the northeastern United States that limits CO_2 emissions is responsible for approximately half of the region's emissions reductions. The study, led by Duke University and published online in the journal "Energy Economics," examined how RGGI performed once it was introduced in 2009 through 2012. The researchers then used various data from the 48 continental U.S. states from 1990 onward, allowing them to separate emissions reduction factors in RGGI states after the program went into effect from factors that affected emissions in other states and time periods. The study found that RGGI was responsible for the largest emissions drop. The Abstract of the study, titled "Why Have Greenhouse Gas Emissions in RGGI States Declined? An Econometric Attribution to Economic, Energy Market, and Policy Factors," is available below. From *The Nicholas Institute for Environmental Policy Solutions at Duke University* on August 21, 2015.

"Why Have Greenhouse Emissions in RGGI States Declined? An Econometric Attribution to Economic, Energy Market, and Policy Factors."

The following is the Abstract of this article: "RGGI is a consortium of northeastern U.S. states that limit [CO_2] emissions from electricity generation through a regional emissions trading program. Since RGGI started in 2009, regional emissions have sharply dropped. [The authors] use econometric models to quantify the emissions reductions due to RGGI and those due to other factors such as the recession, complementary environmental programs and lowered natural gas prices. The analysis shows that after the introduction of RGGI in 2009 the region's emissions would have been 24 percent higher without the program, accounting for about half of the region's emissions reductions during that time, which were far greater than those achieved in the rest of the United States." **Brian C. Murray and Peter T. Maniloff**, *Energy Economics*. (Subscription may be required.)

"China Hubei Carbon Market Reports 100 [Percent] Compliance Rate."

All 138 companies obligated to reduce their CO_2 emissions under the first year of Hubei's carbon market complied in full. According to the China Hubei Emissions Exchange, participants reduced their CO_2 emissions by 7.8 million metric tons during the trading year. China's three-year pilot trading phase is set to expire in mid-2016; however, work is ongoing on preparing unified trading rules for the launch of a nationwide scheme (under the current phase, China's seven pilot carbon markets operate independently). From *Economic Times* on August 21, 2015.

"China's carbon-emissions trading: Overview, challenges and future."

The following is the Abstract of this article: "Because China has emerged as the largest GHG emitter in total annual emissions, to accelerate the pace of GHG emission reduction in China is important to the success of global efforts in addressing climate change. Carbon trading is a market mechanism and key instrument in the mitigation of climate change. This paper explores the policy process and development state to date of China's carbon-trade market to understand the emergence and development of that market and to understand what barriers are hampering China's carbon-trade market development. To achieve this goal, this paper introduces and analyzes China's status in the international market, examines the factors driving carbon-market launching by the Chinese government, and traces the development of mandatory carbon-emission trading and voluntary emission trading. It is argued that China's carbon-trading market is confronted with challenges such as the absence of a functional carbon-trading market, inaccuracy of the quota allocation, an imperfect trading mechanism, and lagging legislation. At the present stage, shortcomings such as having no real-time carbon price and dominated spot transactions differentiate China's trade market substantially from a functional system. A quick market integration of China's carbon market appears remote. It is suggested that specific measures be taken to promote the development of the Chinese carbon-trading market." **Liwei Liu, Chuxiang Chen, Yufei Zhao, and Erdong Zhao**, *Renewable and Sustainable Energy Reviews*. (Subscription may be required.)

Recent Publications

"CCS Deployment in the Context of Regional Developments in Meeting Long-Term Climate Change Objectives."

The following is from the Executive Summary of this document: "According to the most recent assessment of the Intergovernmental Panel on Climate Change (IPCC), without additional efforts to reduce emissions, global mean surface temperatures are likely to increase between 3.7 and 4.8°C by 2100 compared to pre-industrial levels. Scenarios that keep the atmospheric concentration of CO_2 to around 450 ppm by 2100 (66 percent chance) are consistent with holding a rise in global temperatures to below 2°C – the long-term goal of the United Nations Framework Convention on Climate Change (UNFCCC). Such scenarios involve deep cuts in GHG emissions over the coming decades, requiring radical changes to energy systems and a step-change in the uptake of low carbon technologies. CCS represents a potentially important technology within a portfolio of abatement options available to help achieve the 2°C goal. The technology represents a key mitigation option in most of the emission reduction pathways described by the IPCC – as well as in other scenarios of global GHG mitigation such as the 2DS (2°C Scenario) developed by the International Energy Agency (IEA). Studies also show that both the total investment cost and the cost of emissions reduction are higher for scenarios that exclude CCS from the list of mitigation options. As alternative mitigation options are deployed over the coming decades, CCS will be increasingly needed to meet climate goals. Current forecasts assume

Recent Publications (Continued)

fossil-based power generation and industrial output from major emitting sectors such as cement, and iron and steel to rise globally, driven by economic growth in emerging economies. CCS is the only technology available that can achieve deep cuts in CO_2 emissions across fossil-fired power generation and many carbon-intensive industries - for example those where there are no realistic alternatives to using fossil fuels, or to producing CO_2 as part of the industrial process. Furthermore, CCS can be deployed with other low carbon technologies to achieve significant emissions reductions, including the potential for achieving so-called 'negative emissions', for example through the use of bioenergy combined with carbon capture and storage (BECCS or Bio-CCS). CCS projects are technically feasible at scale and have costs that are comparable with other mitigation technologies. A number of industries routinely capture and transport CO_2 worldwide as part of their commercial activities. In North America for example, injection of CO_2 into geological formations has successfully taken place over several decades, principally for the purposes of EOR. CCS involves integrating the separate components of the CCS chain (capture; transport; storage) into projects deployed at scale to move beyond the technical demonstration phase. There are currently 22 large-scale CCS projects in operation worldwide, capturing up to 40 million tonnes of CO_2 per year across a range of sectors."

"Projected emissions of non-CO_2 greenhouse gases."

The following is the Executive Summary of this document: "This report presents the 2015 update to [the U.K.'s Department of Energy and Climate Change's (DECC)] projections of non-CO_2 [GHG] emissions for the UK, as well as the methodologies used to derive them and the associated uncertainties. The non-CO_2 gases are methane (CH_4), nitrous oxide (N_2O) and the fluorinated gases (HFCs, PFCs, SF_6 and NF_3). The projections are a best estimate of future emissions, accounting for expected technological developments, key drivers such as population and known policy commitments. It is important to note that policies affecting these projected emissions are still being developed and will be incorporated in future updates. All non-CO_2 emissions sources are covered, with the exception of some non-CO_2 emissions produced as a result of combustion activities. These projections feed into DECC's Energy and Emissions Projections, which cover all UK GHG emissions and will be published later in the year. Total non-CO_2 GHG emissions within the scope of this report were 95.8 million tonnes CO_2 equivalent ($MtCO_2e$) in 2013, which represented 17 [percent] of all GHG emissions. They are projected to reduce to 71.1 $MtCO_2e$ in 2035; a projected 26 [percent] decrease between 2013 and 2035, or a 65 [percent] reduction on 1990 levels… Most of the projected reduction in emissions from 2013 to 2035 comes from decreases in CH_4 emissions from gas network [release], CH_4 emissions from landfill and hydrofluorocarbon (HFC) emissions from refrigeration and air-conditioning. Since last year's projections there have been significant changes to both the emissions baseline, following the introduction of updated guidelines from the Intergovernmental Panel on Climate Change (IPCC), and also to the projection methodologies used… The 2015 projections start from a higher baseline, but decrease more rapidly. The most significant changes to emissions projections since 2014 have been to the agriculture, waste and F-gas projections."

"Applying carbon capture and storage to a Chinese steel plant."

The following is a description of this document: "The Global CCS Institute presents a feasibility study report on applying CCS to a steel plant in China. Toshiba was commissioned to conduct the study through its business partner Tongfang Environment in collaboration with Shougang Jingtang United Iron & Steel of China. The study examined the application of CCS onto the Caofeidian steel plant. The report covers the concept of capturing CO_2 from a Chinese steel plant, transportation and potential storage in an oilfield for EOR. The study suggests that carbon capture in Chinese steel plants is a cost effective means of reducing carbon emissions compared with similar plants around the world. This report is authored by Toshiba for the Global CCS Institute."

Legislative Activity

"Carbon Tax Bill Introduced Into Assembly."

A bill that would tax carbon emissions in New York State was entered into the Assembly. The carbon tax bill would implement a tax starting at $40 per metric ton of CO_2, increasing in $10 annual increments up to $180 per metric ton. In addition, the bill proposed to refund approximately 60 percent of its revenue to lower-income classes; the remaining 40 percent would be utilized to support the transition to clean energy within the state. From *PR Newswire* on August 28, 2015.

About DOE's Carbon Storage Program

The Carbon Storage Program is implemented by the U.S. Department of Energy's Office of Fossil Energy and managed by the National Energy Technology Laboratory. The program is developing technologies to capture, separate, and store CO_2 in order to reduce greenhouse gas emissions without adversely influencing energy use or hindering economic growth. NETL envisions having a technology portfolio of safe, cost-effective, carbon dioxide capture, transport, and storage technologies that will be available for commercial deployment.

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

The **National Energy Technology Laboratory's CCS Database** includes active, proposed, and terminated CCS projects worldwide. The information is taken from publically available sources to provide convenient access to information regarding efforts by various industries, public groups, and governments towards development and eventual deployment of CCS technology. NETL's CCS Database is available as a Microsoft Excel spreadsheet and also as a customizable layer in Google Earth.

Newsletters, program fact sheets, best practices manuals, roadmaps, educational resources, presentations, and more are available via the Carbon Storage Reference Shelf.

Get answers to your carbon capture and storage questions at NETL's Frequently Asked Questions webpage.

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

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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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626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880

13131 Dairy Ashford Road, Suite 225
Sugar Land, TX 77478

420 L Street, Suite 305
Anchorage, AK 99501

1450 Queen Avenue SW
Albany, OR 97321-2198

Contacts

Traci Rodosta
304-285-1345
traci.rodosta@netl.doe.gov

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