Carbon Sequestration Newsletter

November 2010

What's Inside?

Introduction

This Newsletter is created by the National Energy Technology Laboratory and represents a summary of carbon sequestration news covering the past month. Readers are referred to the actual article(s) for complete information. It is produced by the National Energy Technology Laboratory to provide information on recent activities and publications related to carbon sequestration. It covers domestic, international, public sector, and private sector news.

Highlights

***Fossil Energy Techline*, "'Sour' Gas Streams Safe for Carbon Sequestration, DOE-Sponsored Study Shows."**

A field test completed by the Plains CO_2 Reduction (PCOR) Partnership, one of seven U.S. Department of Energy (DOE) Regional Carbon Sequestration Partnerships (RCSPs), produced results that show gas streams containing both carbon dioxide (CO_2) and hydrogen sulfide (H_2S) can be safely used for carbon capture and storage (CCS). The findings of PCOR's test, which also demonstrated that carbon storage using "sour" gas streams can be successfully combined with enhanced oil recovery (EOR) and H_2S disposal, will help support national and global efforts to develop and deploy CCS use as an option for mitigating potential climate change. During the four-year field test, a gas stream (70 percent CO_2, 30 percent H_2S) was injected at a depth of 4,900 feet into the Zama oilfield in northwestern Alberta, Canada. Approximately 33,500 tons of sour gas was injected, simultaneously storing CO_2, disposing of H_2S, and increasing oil recovery. All of the project goals were achieved, including: demonstrating the safe and feasible (within existing industry and regulatory standards) capture and injection of a sour gas stream into properly characterized and selected underground reservoirs; designing, implementing, and demonstrating monitoring, verification, and accounting (MVA) strategies; and confirming that sour gas could be successfully used for EOR operations in a previously untested geologic feature. To learn more about DOE's RCSP Program, visit: http://www.fossil.energy.gov/programs/sequestration/partnerships/index.html. September 23, 2010, http://www.fossil.energy.gov/news/techlines/2010/10046-PCOR_Project_Demonstrates_Importan.html.

***Fossil Energy Techline*, "DOE Manual Studies 11 Major CO_2 Geologic Storage Formations."**

DOE issued a new manual containing a comprehensive study of 11 geologic formations suitable for permanent underground CO_2 storage. The National Energy Technology Laboratory (NETL)-developed manual used data from DOE's RCSPs and other research activities to better understand the characteristics of geologic formations that could potentially be used for CCS. One of DOE's program goals is to identify geologic formations that can store large volumes of CO_2, receive CO_2 at an efficient and economic rate of injection, and safely retain it over long periods of time. These three criteria are investigated in the manual for 11 major geologic reservoirs. In addition, the manual builds on lessons learned from CO_2 behavior in geologic reservoirs during earlier investigations. To date, DOE's Carbon Sequestration Program has implemented 28 CO_2 injection field projects in conjunction with the RCSP Initiative, as well as an additional 10 site characterization projects funded through the Recovery Act. The information provided by the manual is expected to allow government

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agencies and their project partners and/or private investors to optimize their storage efforts. (**See Recent Publications section for a portion of the Executive Summary and a link to the "Geologic Storage Formation Classification: Understanding Its Importance and Impacts on CCS Opportunities in the United States."**) To learn more about DOE's Carbon Sequestration Research Program, click: http://www.fossil.energy.gov/programs/sequestration/index.html. October 5, 2010, http://www.fossil.energy.gov/news/techlines/2010/10050-Geologic_Storage_Manual_Issued.html.

***Fossil Energy Techline*, "FutureGen Industrial Alliance Announces Carbon Storage Site Selection Process for FutureGen 2.0,"** and ***NETL News Release*, "Department of Energy Formally Commits $1 Billion in Recovery Act Funding to FutureGen 2.0."**

On October 6, 2010, the FutureGen Industrial Alliance announced details of a site selection process for an Illinois site to store CO_2 collected at FutureGen 2.0. The storage site will be designed to accept and store the 1.3 million metric tons per year of CO_2 captured at Ameren Energy Resources' Meredosia Plant for at least 30 years. The FutureGen Industrial Alliance has released its "Guidance for Prospective Site Offerors" to provide a description of the site selection process and schedule, selection criteria, and type of site-related data and documentation to be provided by applicants. The Alliance plans to issue a Request for Proposals (RFP) in late 2010; the site selection decision will also consider factors ranging from protecting environmental resources and human health and safety; minimizing project costs; and supporting a design, construction, and operation schedule for the project. Following the site selection – expected in early 2011 – the FutureGen Alliance will prepare detailed environmental and technical information for the selected site to comply with the National Environmental Policy Act (NEPA) and its preparation of the Environmental Impact Statement (EIS). The siting guidance follows an announcement in September 2010 that DOE signed final cooperative agreements with the FutureGen Industrial Alliance and Ameren Energy Resources to commit $1 billion in American Recovery and Reinvestment Act of 2009 (Recovery Act) funding to construct FutureGen 2.0. The project partners estimate that FutureGen 2.0 will bring 900 jobs to downstate Illinois and another 1,000 jobs for suppliers across the state. For more information on FutureGen 2.0 Siting Guidance, go to: http://www.futuregenalliance.org/media/FGA_Guidance_100510_Final.pdf. October 6, 2010, http://www.fossil.energy.gov/news/techlines/2010/10051-FutureGen_Site_Selection_Process_A.html, and September 28, 2010, http://www.netl.doe.gov/publications/press/2010/10048-DOE_Formally_Commits_1_Billion_to.html.

Sequestration in the News

***Fossil Energy Techline*, "Projects Selected to Boost Unconventional Oil and Gas Resources."**

DOE has selected 10 projects that focus on increasing the Nation's supply of "unconventional" fossil energy, reducing potential environmental impacts, and expanding CO_2 storage options. Four of the projects would develop advanced computer simulation and visualization capabilities to enhance understanding of ways to improve production and minimize

Sequestration in the News (Continued)

environmental impacts associated with unconventional energy development. Production from unconventional fossil energy resources, which are extracted by techniques other than those used for traditional oil or natural gas wells, often has more environmental challenges than traditional methods. Advancements in simulation and visualization technologies can provide improved assessments and understanding of the cumulative environmental and model-improved impacts for advancing unconventional fossil energy recovery. The other six projects would seek to advance next generation CO_2-EOR for small-scale testing. The average recovery factor of oil recovered from U.S. oil fields is estimated at 35 percent. EOR and techniques that use advanced CO_2 injection offers the potential for additional recovery and to produce up to 60 percent more of the reservoir's original oil in place (OOIP). Managed by NETL, the total value of the projects is approximately $12.2 million ($9 million of DOE funding; $3.2 million of non-Federal cost sharing). September 27, 2010, http://www.fossil.energy.gov/news/techlines/2010/10047-Projects_Selected_to_Boost_Unconve.html.

***Platts*, "Petrofac Agrees UK Carbon Storage Plan with Shell,"** and ***BBC News*, "Shell Carbon Capture and Storage Offshore Bid Signed."**

CO2DeepStore, a subsidiary of Petrofac, and Shell UK signed an agreement to redevelop Goldeneye oil and gas field in the North Sea as a potential CO_2 storage facility for a ScottishPower CCS project. As part of the project, CO_2 from the plant will be piped to St. Fergus in Scotland and then transported offshore to the Goldeneye platform. The storage project will be operated by Shell, while Petrofac will provide offshore engineering, modification, and operations services at Goldeneye through its offshore engineering and operations business. October 4, 2010, http://www.platts.com/RSSFeedDetailedNews/RSSFeed/HeadlineNews/ElectricPower/8021351, and October 4, 2010, http://www.bbc.co.uk/news/uk-scotland-north-east-orkney-shetland-11465633.

Announcements

Carbon Management Advisory Service Launched.
Pike Research has launched the Carbon Management Advisory Service – a subscription-based information suite that provides insights for companies seeking to manage their carbon emissions. To view the press release, click: http://www.pikeresearch.com/newsroom/pike-research-launches-carbon-management-advisory-service.

Climate Change Workshop.
The Climate Change and Developed Compendium of Information System (DIMS) Technology Workshop will be held on December 1-3, 2010, at the University of Nottingham Kuala Lumpur Teaching Center in Kuala Lumpur, Malaysia. Objectives of the workshop include the effective use of climate change modeling methods and providing a better understanding of current models and methods. For more information, visit the workshop website at: http://www.globalclimate-engine.org/index.php?option=com_content&view=article&id=69&Itemid=252.

Canada Announces International Climate Change Investment.
The Government of Canada released the details of the country's commitment to international climate change. Funding will support projects that build knowledge and focus on private sector investment in renewable energy and energy efficiency projects. The Environment Canada News Release is available at: http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=454E8F15-55C2-4A70-9FC0-249B35E5DD80. For a complete breakdown of the funding, go to: http://www.climatechange.gc.ca/default.asp?lang=En&n=5F50D3E9-1.

Protocol Released to Support U.S. GHG Accounting.
On October 5, 2010, the World Resources Institute (WRI) and LMI released "The Greenhouse Gas Protocol for the U.S. Public Sector," which outlines how Federal, state, and local governments can account for their GHG emissions. The protocol serves as a reference for implementing Executive Order 13514, which requires Federal agencies to report and reduce their GHG emissions over time. The protocol is available at: http://pdf.wri.org/ghg_protocol_for_the_us_public_sector.pdf.

New Data Highlights the Role of Forests in Climate Change.
The U.S. Department of Agriculture (USDA) Forest Service released new estimates of data highlighting U.S. forests' role in preventing potential climate change. According to the report, the Nation's forests currently store 41.4 billion metric tons of CO_2. An additional 192 million metric tons are stored annually, offsetting approximately 11 percent of the country's industrial GHG emissions. For more information, view the USDA News Release at: http://www.fs.fed.us/rmrs/docs/forest-carbon/news-release.pdf.

Science

***Science Daily*, "Climate Change Affects Horseshoe Crab Numbers."**

According to a recent study by researchers from the University of Gothenburg in the scientific journal "Molecular Ecology," potential climate change is affecting the horseshoe crab population. Having survived for more than 400 million years, the horseshoe crab's body design and lifestyle have remained consistent. Researchers studied the four species of horseshoe crabs (one in North America and three in South East Asia) to gather data, and noted a decline in the number of horseshoe crabs at the end of the Ice Age. The researchers believe that future changes in sea level and water temperature could lead to a similar result in horseshoe crabs' distribution and reproduction. October 6, 2010, http://www.sciencedaily.com/releases/2010/10/101004101330.htm.

***Science Daily*, "Turtle, Dugongs 'at Risk Under Climate Change.'"**

The northern Great Barrier Reef (GBR) and Torres Strait region, referred to as the "turtle and dugong capital of the world," is facing increased pressure due to potential climate change. According to scientists, a potential shift in climate could decrease the region's turtles' hatching success, cause them to lose nesting areas, overheat their beaches, and decrease reproduction. In addition, potential climate change could affect the gender balance of the turtle population, which is determined by the temperature of the beach sand. Potential climate change could indirectly affect dugongs through the negative impact it has on seagrass, their main food source. Seagrass diebacks are linked to lower reproduction, increased mortality, and emigration of dugongs. Scientists have been monitoring turtle numbers and the movement of dugongs to provide short- and long-term measures to protect them from potential climate change, as they believe the loss of these species would have an impact on the northern Australian marine environment. October 10, 2010, http://www.sciencedaily.com/releases/2010/10/101008082926.htm.

Policy

***Reuters*, "EU to Set CO_2 Offset Limits in ETS…"**

The European Commission announced they will set restrictions on the use of United Nation (UN)-backed carbon offsets in the third phase of its emissions trading scheme (ETS). The 27-nation alliance plans to propose how to restrict the number of certified emissions reductions (CERs) from industrial gas projects that can be used in its carbon market from 2013 to 2020. If approved, the European Union (EU) proposals will likely be applied to offsets being used in the post-2012 period – which is expected to impact carbon credit supply and impact. According to the European Commission, action was taken to prevent manipulation of the system and to preserve the credibility of the UN's Clean Development Mechanism (CDM). October 19, 2010, http://www.reuters.com/article/idUSTRE69I3U620101019.

"Geologic and infrastructure factors for delineating areas for clean coal: examples in Texas, USA."

The following is the Abstract of this article: "Texas has a wide variety of areas that can be targeted for new clean-coal facilities. These areas are delineated by mapping spatial linkages between coal- and lignite-bearing formations, groundwater and surface-water resources, and CO_2 sinks in brine formations for long-term CO_2 storage or in mature oil fields with potential for EOR. However, a variety of infrastructure factors make it feasible to also target numerous areas outside coal and lignite basins in Texas. These infrastructure factors include pipelines for delivery of CO_2 to subsurface sinks and delivery of coal-produced hydrogen to refineries, ease of connection to existing transmission lines, distribution of nonattainment areas where new clean-coal facilities could be constructed and be compliant with strict air-quality standards, and railroads that can transport coal and other feedstock to new clean-coal facilities. Primary regions in Texas where favorably co-located CO_2 source-sink factors related to coal and lignite trends include the Gulf Coast, the Eastern Shelf of the Permian Basin, and the Fort Worth Basin. However, areas outside coal and lignite basins, particularly the Permian Basin where a new clean-coal facility is being planned, also have clean-coal potential because of existing CO_2 pipelines and proximity to EOR fields that can economically sustain new clean-coal facilities." **W. A. Ambrose, C. Breton, S. D. Hovorka, I. J. Duncan, G. Gülen, M. H. Holtz, and V. Núñez-López**, *Environmental Earth Sciences*, Available online August 29, 2010, doi:10.1007/s12665-010-0720-2, http://www.springerlink.com/content/t47tl05221336p61/. (Subscription required.)

"Environmental analysis of a German strategy for carbon capture and storage of coal power plants."

The following is the Abstract of this article: "This paper combines an existing projection of the development of electricity production with a technology-specific environmental assessment. The combination of these two approaches, which so far have only been performed separately, allows a discussion about environmental effects of CCS implementation strategies on a national level. The results identify the future role of lignite and hard coal in German power production. The implementation of CCS technology leads to a considerable loss of efficiency. Due to CCS, about 50 million t of lignite will be additionally required in 2030 in comparison to the reference case without CCS in 2010. Increasing demand, the replacement of old plants and the compensation of efficiency losses lead to highly ambitious expansion rates. In the case of CCS implementation, the global warming potential (GWP) can be reduced by up to 70 percent. However, other environmental impacts increase in part considerably. Compliance with national ceilings for [nitrogen oxide (NO_X)] emissions can only be reached by compensation measures in other sectors. The results of the environmental assessment demonstrate the significant role of the coal composition, coal origin and the required transport. [Carbon dioxide] pipeline transport and CO_2 storage make a fairly minor contribution to the overall environmental impact." **A. Schreiber, P. Zapp, P. Markewitz, and S. Vögele**, *Energy Policy*, Available online October 5, 2010, doi:10.1016/j.enpol.2010.09.006, http://www.sciencedirect.com/science/article/B6V2W-515RHPT-2/2/2b076ac73f368a13d22740fe8ca36cfb. (Subscription may be required.)

Geology

"CO_2 storage potential of deep saline [formations]: The case of Italy."

The following is the Abstract of this article: "CCS, along with improvements in energy efficiency and a wider use of renewable resources, can represent a key instrument for the reduction of CO_2 emissions to the atmosphere. Deep saline [formations] offer the largest storage potential of all the geological CO_2 storage options and are widely distributed throughout the Earth. This study proposes that CO_2 geological storage is a viable option in Italy and provides the first systematic evaluation of the potential reservoirs in the country. An estimation of the potential CO_2 storage capacity of the selected Italian deep saline [formations] is presented. Most of the 14 identified areas lie in the major Italian sedimentary basins, i.e. the Apennine foredeep and the Adriatic foreland, which are characterized by thick accumulations of sediments. The potential reservoirs mainly comprise permeable terrigenous deep saline formations, whose capacity ranges from 30 to more than 1,300 Mt. Based on very conservative estimates these areas would be able to contain the entire volume of CO_2 emitted in Italy for at least the next [50] years. Although these evaluations have not been considered as definitive, this study highlights the great potential of such formations in terms of application of the CCS techniques, even in complex tectonic settings such as those found in Italy." **F. Donda, V. Volpi, S. Persoglia, and D. Parushev**, *International Journal of Greenhouse Gas Control*, Available online September 19, 2010, doi:10.1016/j.ijggc.2010.08.009, http://www.sciencedirect.com/science/article/B83WP-5124YMH-2/2/b345bc59ed47438842d7408e4bd810ff. (Subscription may be required.)

"High-pressure methane and carbon dioxide sorption on coal and shale samples from the Paraná Basin, Brazil."

The following is the Abstract of this article: "An experimental study has been conducted to assess the potential for coalbed methane [(CBM)] production and [CO_2] storage in coals, carbonaceous shales and source rocks in the Paraná Basin in Brazil. High-pressure sorption tests with methane and [CO_2] were performed on coal and carbonaceous shales from the Santa Terezinha Coalfield and samples from two principal petroleum source rocks. Measured excess sorption capacities ranged from 0.03 to 0.47 mmol/g for methane and 0.14 to 0.81 mmol/g for [CO_2], showing a decrease with decreasing organic matter content. Linear regression lines for methane sorption capacity vs. TOC extrapolated to approximately zero, whereas for [CO_2] the intercept of the regression line indicated a residual sorption capacity of ~0.2 mmol/g on the mineral matter. Present-day gas contents of coals collected from the first CBM well in the Santa Terezinha Coalfield correspond to 13-38 [percent] of the measured maximum sorption capacities. Carbon dioxide sorption capacities exceed methane sorption capacities by a factor of 1.9 to 6.9 for these coals. Free sorption capacities of the under-saturated coals in combination with preferential sorption of [CO_2] could favor CO_2-enhanced methane recovery and CO_2 storage in coals and shales of the study area. Based upon the calculated coal reserves, gas contents and measured sorption capacities, a total storage potential of 15.4 Gt CO_2 was estimated for an area of 20×40 km^2 in the Santa Terezinha coal field, assuming a combined CO_2 enhanced coalbed methane (ECBM) production and CO_2 storage operation. To fully evaluate the potential for [CO_2] storage and [CBM] production, further studies are required to assess producibility of methane and efficiency of long-term CO_2 storage in the study area." **Philipp Weniger, Wolfgang Kalkreuth, Andreas Busch, and Bernhard M. Krooss**, *International Journal of Coal Geology*, Available online August 26, 2010, doi:10.1016/j.coal.2010.08.003, http://www.sciencedirect.com/science/article/B6V8C-50W1T8B-1/2/512b3342e0aca74e91dd0851ff96faa0. (Subscription may be required.)

Technology

"Design and operation of pilot plant for CO_2 capture from IGCC flue gases by combined cryogenic and hydrate method."

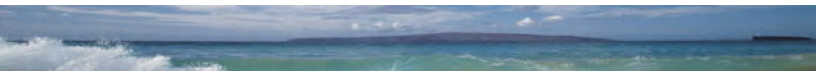
The following is the Abstract of this article: "This project is a trial conducted under contract with CO_2CRC, Australia of a new CO_2 capture technology that can be applied to integrated gasification combined cycle power plants and other industrial gasification facilities. The technology is based on combination of two low temperature processes, namely cryogenic condensation and the formation of hydrates, to remove CO_2 from the gas stream. The first stage of this technology is condensation at −55°C where CO_2 concentration is expected to be reduced by up to 75 mol%. Remaining CO_2 is captured in the form of solid hydrate at about 1°C reducing CO_2 concentration down to 7 mol% using hydrate promoters. This integrated cryogenic condensation and CO_2 hydrate capture technology hold promise for greater reduction of CO_2 emissions at lower cost and energy demand. Overall, the process produced gas with a hydrogen content better than 90 mol%. The concentrated CO_2 stream was produced with 95–97 mol% purity in liquid form at high pressure and is available for re-use or sequestration. The enhancement of [CO_2] hydrate formation and separation in the presence of new hydrate promoter is also discussed. A laboratory scale flow system for the continuous production of condensed CO_2 and [CO_2] hydrates is also described and operational details are identified." **Daria Surovtseva, Robert Amin, and Ahmed Barifcani**, *Chemical Engineering Research and Design*, Available online September 6, 2010, doi:10.1016/j.cherd.2010.08.016, http://www.sciencedirect.com/science/article/B8JGF-50YF6PM-1/2/4d34e18c6c15262d5177b69acf0b3c8e. (Subscription may be required.)

"CO_2SINK – From site characterization and risk assessment to monitoring and verification: One year of operational experience with the field laboratory for CO_2 storage at Ketzin, Germany."

The following is the Abstract of this article: "The CO_2SINK pilot project at Ketzin is aimed at a better understanding of geological CO_2 storage operation in a saline aquifer. The reservoir consists of fluvial deposits with average permeability ranging between 50 and 100 mDarcy. The main focus of CO_2SINK is developing and testing of monitoring and verification technologies. All wells, one for injection and two for observation, are equipped with smart casings (sensors behind casing, facing the rocks) containing a Distributed Temperature Sensing (DTS) and electrodes for Electrical Resistivity Tomography (ERT). The in-hole Gas Membrane Sensors (GMS) observed the arrival of tracers and CO_2 with high temporal

Technology (Continued)

resolution. Geophysical monitoring includes Moving Source Profiling (MSP), Vertical Seismic Profiling (VSP), crosshole, star and 4-D seismic experiments. Numerical models are benchmarked via the monitoring results indicating a sufficient match between observation and prediction, at least for the arrival of CO_2 at the first observation well. Downhole samples of brine showed changes in the fluid composition and biocenosis. First monitoring results indicate anisotropic flow of CO_2 coinciding with the 'on-time' arrival of CO_2 at observation well one (Ktzi 200) and the later arrival at observation well two (Ktzi 202). A risk assessment was performed prior to the start of injection. After one year of operations about 18,000 t of CO_2 were injected safely." **Hilke Würdemann, Fabian Möller, Michael Kühn, Wolfgang Heidug, Niels Peter Christensen, Günter Borm, Frank R. Schilling, and the CO2SINK Group**, *International Journal of Greenhouse Gas Control*, Available online October 15, 2010, doi:10.1016/j.ijggc.2010.08.010, http://www.sciencedirect.com/science/article/B83WP-517PW5R-1/2/2faba0f2a2ec05f5222a921216548c45. (Subscription may be required.)



Terrestrial

"Effects of carbon sequestration rewards on forest management – An empirical application of adjusted Faustmann Formulae."

The following is the Abstract of this article: "This paper assesses the effects that different economic instruments to reward carbon sequestration services might have on forest management, especially on the optimal rotation period. Three different carbon crediting schemes are considered, which are based on different accounting rules. The schemes are different with respect to the question whether and how to account for carbon emissions. The forest valuation method used for calculation is based on the land expectation value (LEV), which was adjusted for the value of carbon sequestration services. Changes in the LEV and optimal rotation are expected to be induced by the amount and interactions of carbon and timber prices, harvesting and regeneration costs, and interest rates. The optimal economic rotation period is calculated for single stands as well as for whole forest enterprises (fully regulated 'normal' forests). Crediting the carbon sequestration of single stands – starting from the time of regeneration – is comparable to rewarding afforestation projects. When crediting forest enterprises with existing timber and carbon stocks, additional carbon sequestration compared to a reference is rewarded. The findings reveal that, depending on the carbon price level, the optimal rotation period is increased in all considered crediting schemes, but with different intensity. If wood removals have to be accounted as carbon emissions this has the most significant effect on the optimal rotation period for forest stands and enterprises. In this case the increase of the optimal rotation period by rising carbon prices is boosted additionally by rising interest rates. Different thinning regimes, however, have only little impact on the time of maximum LEV under carbon crediting schemes." **Margret Köthke and Matthias Dieter**, *Forest Policy and Economics*, Available online September 6, 2010, doi:10.1016/j.forpol.2010.08.001, http://www.sciencedirect.com/science/article/B6VT4-50YFH45-1/2/67c70cb2188db7cc6722d47daf1e547b. (Subscription may be required.)

Trading

Carbon Market Update, October 27, 2010	
CCX-CFI 2010 ($/tCO$_2$) $0.05 (Vintage 2009)	EU ETS-EUA DEC 2010 ($/tCO$_2$) $20.94 (Converted from € to US$)

***RGGI News Release*, "RGGI States Issue Notice for December 2010 CO_2 Allowance Auction."**

The 10 Northeast and Mid-Atlantic states participating in the Regional Greenhouse Gas Initiative (RGGI) released the Auction Notice and application materials for the 2010 fourth quarter CO_2 allowance auction. A total of 43,173,648 CO2 allowances for the current control period (2009 to 2012) and 2,137,991 CO_2 allowances for the future control period (2012 to 2014) will be offered for sale in CO_2 Allowance Auction 10; states will continue to use the reserve price of $1.86. The released application materials provide potential auction participants with the information needed to submit a Qualification Application and indicate their intent to bid on the allowances. Since the debut of the RGGI auctions on September 25, 2008, more than 290 million CO_2 allowances have been auctioned by the participating states in nine total auctions. To download auction materials, as well as a recorded version of a webinar reviewing the auction format and qualification process, visit: http://www.rggi.org/market/co2_auctions/information. October 5, 2010, http://www.rggi.org/docs/Auction_10_Notice_NR.pdf.

Recent Publications

"Geologic Storage Formation Classification: Understanding Its Importance and Impacts on CCS Opportunities in the United States."
The following is from the Executive Summary of this manual: "A need exists for further research on carbon storage technologies to capture and store CO_2 from stationary sources that would otherwise be emitted to the atmosphere. CCS technologies have the potential to be a

Recent Publications (Continued)

key technology for reducing CO_2 emissions and mitigating global climate change. Deploying these technologies on a commercial-scale will require geologic storage formations capable of: (1) storing large volumes of CO_2; (2) receiving CO_2 at an efficient and economic rate of injection; and (3) safely retaining CO_2 over extended periods. Eleven major types of depositional environments, each having their own unique opportunities and challenges, are being considered by DOE for CO_2 storage. The different classes of reservoirs reviewed in this study include: deltaic, coal/shale, fluvial, alluvial, strandplain, turbidite, eolian, lacustrine, clastic shelf, carbonate shallow shelf, and reef. Basaltic interflow zones are also being considered as potential reservoirs. DOE has recently completed this study which investigated the geology, geologic reservoir properties and confining units, and geologic depositional systems of potential reservoirs and how EOR and CBM are currently utilizing CO_2. The study looked at the classes of geologic formations, and their potential to serve as CO_2 reservoirs, distribution, and potential volumes. This study discussed the efforts that DOE is supporting to characterize and test small- and large-scale CO_2 injection into these different classes for reservoirs. These tests are important to better understand the directional tendencies imposed by the depositional environment that may influence how fluids flow within these systems today, and how CO_2 in geologic storage would be anticipated to flow in the future. Although diagenesis has modified fluid flow paths during the intervening millions of years since they were deposited, the basic architectural framework created during deposition remains. Geologic processes that are working today also existed when the sediments were initially deposited. Analysis of modern day depositional analogs and evaluation of core, outcrops, and well logs from ancient subsurface formations give an indication of how formations were deposited and how fluid flow within the formation is anticipated to flow." To view the NETL-developed manual, click: http://www.netl.doe.gov/technologies/carbon_seq/refshelf/Geologic_Storage.pdf.

"Carbon Capture and Storage: Mobilizing Private Sector Finance."

The following is from the Executive Summary of this document: "The Climate Group and the Ecofin Research Foundation are working on a joint initiative to assess, and possibly stimulate, private sector financing for first generation industrial scale CCS projects. This brief report provides an overview of initial findings from a European perspective. [The authors] canvassed over 30 private sector capital providers about the risks and returns of a post-combustion, new build, coal-fired power station. The following messages are emerging: (1) *Debt… not yet*. Ample debt may be available but only if three prerequisites can be addressed: (a) An indicator of performance across the whole capture and generation chain must be provided by a well-regarded equipment supplier or contractor; (b) Major sponsors who have successfully managed sizeable and complicated construction projects must be involved; (c) Economics of CCS must have a route to being competitive with other forms of generation, without public funding; (2) *Not for specialist equity*. Specialist equity, such as private equity or infrastructure funds, will not be mobilized to finance demonstration projects. Private equity sees demonstration of CCS, like technology funding – requiring high returns across a spread of projects. Infrastructure funds don't take the construction and integration risk inherent in demonstration CCS projects; (3) *On the balance sheet… but limited in scale*. Bond holders or equity holders from the big pension funds or insurance companies are comfortable with corporates using their balance sheets to finance CCS, but only as long as the scale is limited to just a couple of percent of group assets. Across the European utilities, though, this would enable a maximum of [$6.97 billion] of funds to be available, and even then it is questionable if those utilities would be prepared to invest that much in CCS demonstrations whilst balance sheets are being delivered and capital budgets are being cut; (4) *Demonstrations helped by the private sector… but for two not eight projects*. Limited private sector funding means that a multitude of CCS demonstration projects cannot be pursued. It is generally agreed that government sources will provide part of the funding for CCS demonstration projects and that will be topped up by private sector sources. However, the initial findings of [the authors'] initiative indicate that private sector funds will be adequate to support maybe just two CCS demonstrations – and that's across the whole of Europe. This is clearly a long way short of the UK's plans to have up to four demonstration projects, let alone Europe's ambition to see eight and hopefully [12] demonstration projects; and (5) *Government funding needs to focus on fewer CCS demonstration projects*. Public sector financial support for CCS from European sources needs to be focused on far fewer projects instead of being spread over numerous CCS technologies. This will ensure some of the challenges are faced – and hopefully overcome – rather than attempting to initiate CCS in a variety of settings which may simply result in none of the challenges being properly addressed. Once the concerns of private sector debt market participants are addressed, the need for government funds would be sharply reduced." To view the full document, click: http://www.theclimategroup.org/_assets/files/CCS-report.pdf.

"Report on the Secondary Market for RGGI CO_2 Allowances: First Quarter 2010."

The following is from the Introduction of this document: "The primary market for RGGI CO_2 allowances consists mainly of the auctions where allowances are initially sold. Once an allowance is purchased in the primary market, it can then be resold in the secondary market. The secondary market for RGGI CO_2 allowances comprises the trading of physical allowances and financial derivatives, such as futures and options contracts. The secondary market is important for several reasons. First, it gives firms an ability to obtain CO_2 allowances at any time during the three months between the RGGI auctions. Second, it provides firms a way to protect themselves against the potential volatility of future auction clearing prices. Third, it provides price signals that assist firms in making investment decisions in markets affected by the cost of RGGI compliance. This report provides a summary of activity in the secondary market in the first quarter of 2010 and discusses the results of [the] market power screens. Several patterns

Recent Publications (Continued)

have emerged in this period in the secondary market: (1) CO_2 allowance prices remained stable in the first quarter as the price of 2009 vintage futures contracts averaged $2.15. The quarter began with 2009 vintage futures contracts trading at a small (up to [three] percent) premium over 2010 vintage futures contracts, but the premium fell to [zero] percent by late February; (2) the volume of futures trading decreased 83 percent from 127 million allowances in the fourth quarter of 2009 to 22 million allowances in the first quarter of 2010. Although most of the trading volume was for 2009 vintage contracts, the share associated with 2010 vintage contracts increased to 31 percent in the first quarter; (3) 27.6 million allowances were exchanged between unaffiliated firms in the first quarter of 2010. [Eighty-two] percent of the allowances were exchanged in the first week of January, likely as a result of the final settlement of futures and forward contracts with December 2009 delivery; and (4) the number of participants in the market for RGGI CO_2 allowance derivatives was relatively constant as approximately 20 firms maintained significant positions in contracts related to 2009 vintage allowances during the first quarter of 2010. Participation in the market for 2010 vintage allowance derivatives increased following the March auction as up to 20 firms held significant positions." The complete document is available at: http://www.rggi.org/docs/MM_Secondary_Market_Report_2010_Q1.pdf.

Legislative Activity

***ABC News*, "ACT Sets Ambitious Emissions Target,"** and **ACT *News Release*, "Greenhouse Gas Emissions Targets Adopted."**

The Australian Capital Territory (ACT) government has set a target to reduce CO_2 emissions by 40 percent by 2020, based on 1990 levels, and by 80 percent by 2050. The legislation will also mandate periodic reporting to the Legislative Assembly on ACT GHG emissions trends, establish a Climate Change Council to provide independent advice, and encourage private organizations and industries to take action through voluntary sector agreements. ACT plans to meet the emissions reduction target by making buildings more energy efficient, encouraging public transportation, and increasing renewable energy use. The legislation provides framework for helping the territory realize the government's goal for the ACT region of zero net emissions by 2060. October 17, 2010, http://www.abc.net.au/news/stories/2010/10/27/3049154.htm, and October 17, 2010, http://www.environment.act.gov.au/__data/assets/pdf_file/0020/207335/Greenhouse_Gas_Legislation_Passes_Media_Release.pdf.

Events

November 14-17, 2010, **2010 Behavior, Energy & Climate Change Conference**, *Hyatt Regency, Sacramento, California, USA*. The fourth annual Behavior, Energy & Climate Change (BECC) Conference focuses on the practical applications of social and behavioral research to achieve viable solutions for meeting long-term energy and GHG emissions reduction targets. Topics to be discussed include current policy issues; program/communication strategies; and collaboration across government, utility, business, and research sectors in order to accelerate the transition to an energy efficient, low-carbon economy. For more information, visit the conference website at: http://www.beccconference.org/.

November 15-17, 2010, **Cooling the Earth: Tactics for Restoring Climate Order and Saving the Living Planet**, *Pantnagar, Uttarakhand, India*. This international conference will provide analyses and discussions regarding strategies to address potential climate change. For more information, visit: http://www.gbpuat.ac.in/news/International_Conference-_COOLING_THE_EARTH_1010.pdf.

November 17-19, 2010, **International Conference on Biodiversity and Climate Change, Philippine International Convention Center**, *Manila, Philippines*. This conference will serve as a venue for the sharing of knowledge on the two-way interactions of biodiversity and climate change. Included in the program is a theme focused on climate change mitigation and adaption. For more information, visit the conference website at: http://www.icbdcc.com/index.php?option=com_content&view=article&id=54&Itemid=64.

Events (Continued)

November 18, 2010, **Westminster Energy, Environment & Transport Forum Keynote Seminar: Engaging the Public on Climate Change**, *London, United Kingdom*. This seminar explores ways the government and scientific community can engage the public on potential climate change issues. Topics to be discussed include developing climate change policy and the media's role in the perception of potential climate change. To view the full agenda, visit the seminar website at: http://www.westminsterforumprojects.co.uk/forums/event.php?eid=155.

November 19-21, 2010, **2010 Pilot International Conference on Global Sustainable Development**, *Commonwealth Resort Hotel, Munyonyo, Kampala, Uganda*. This international conference will cover the impact realities of potential climate change and sustainable development. Attendees will be presented with real examples of low-carbon businesses, and policy and programs necessary for scaleup will be discussed. For more information, go to: http://www.pilotinternationalconferences.org/index.html.

November 23-24, 2010, **CO_2 Transportation Summit**, *The Manhattan Hotel, Rotterdam, Netherlands*. In its first year, this summit will bring together industry stakeholders to identify the safest and most cost-effective methods for transporting CO_2. The program will provide an overview of CO_2 transportation, combining topics such as regulations, policy, safety, and technology. Other topics to be covered include implementing CO_2-EOR in offshore fields and an Emission Trading Scheme (ETS). For more information, click: http://www.c5-online.com/Carbontransport.htm.

November 28-30, 2010, **National CCS Conference**, *Park Hyatt Melbourne Victoria, Australia*. The inaugural National CCS Conference will bring together stakeholders from all areas of CCS development to discuss the barriers to deployment of CCS technology. The conference aims to facilitate knowledge sharing and networking opportunities between CCS stakeholders – including technical, economic, social, and policy issues – and raise awareness of CCS among the community. Other topics to be discussed include: international collaboration and knowledge sharing; global deployment of CCS; and networking opportunities. For more information, go to: http://www.nationalccs.com.au/conference.html.

November 29-30, 2010, **Law and Policy to Advance Renewable Energy: A Comparative Colloquium, ANU Centre for European Studies**, *The Australian National University, Canberra, Australia*. This workshop will examine the different legal and policy frameworks implemented to remove barriers to, and to promote investment in, renewable energy and climate policy. Among the topics to be discussed are the interactions between carbon pricing laws and renewable energy laws. For more information, visit: http://law.anu.edu.au/cclp/Call_for_papers.pdf.

November 29-December 1, 2010, **CCS World MENA 2010**, *Mövenpick Hotel, Jumeirah Beach, Dubai*. In its first year, this conference will provide a forum to create new value chains to commercially develop CCS projects in the MENA region. Topics to be addressed include: global case studies demonstrating CCS pilot and commercial projects, partnership models to advance CCS innovation and deployment, and site exploration and management. For more information, visit the conference website at: http://www.terrapinn.com/2010/ccsmena/.

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Please visit http://listserv.netl.doe.gov/mailman/listinfo/sequestration, enter your email address, and create a password. This will enable you to receive a pdf version of the Carbon Sequestration Newsletter at no cost.
To view an archive with past issues of the newsletter, see: http://www.netl.doe.gov/technologies/carbon_seq/refshelf/subscribe.html.

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