Carbon Sequestration Newsletter

November 2009

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*, "DOE Partnership Completes Successful CO_2 Injection Test in the Mount Simon Sandstone."**

The Midwest Regional Carbon Sequestration Partnership (MRCSP) has successfully injected 1,000 metric tons of carbon dioxide (CO_2) into the lowest 100 feet of the Mount Simon Sandstone (3,230 to 3,530 feet below ground) at Duke Energy's East Bend Generating Station in Boone County, Kentucky. Preliminary data indicates that the formation has good CO_2 storage potential and could possibly serve as a repository for captured CO_2 emissions. The formation is covered by layers of low permeability rock and possesses several properties that are conducive to CO_2 storage, such as the appropriate depth, thickness, porosity, and permeability. Prior to drilling the test well, MRCSP conducted a seismic survey at the site and obtained necessary permits for the injection test from the U.S. Environmental Protection Agency (EPA) and the Kentucky Division of Oil and Gas. Following the permitting process, the researchers injected clean brine in order to determine formation properties like the maximum injection rate and then injected approximately 1,000 metric tons of CO_2 in two, 500-meter-ton steps. The injection rate, pressure, temperature, and quantity of CO_2 in the formation were measured throughout the test to confirm that the injection proceeded as planned. MRCSP researchers will monitor groundwater at the site for the next two years to ensure that it is unaffected by the injected CO_2. The Eau Clair Shale provides approximately 450 feet of containment above the injection zone. Led by Battelle, MRCSP is one of seven partnerships in the U.S. Department of Energy's (DOE) Regional Carbon Sequestration Partnership (RCSP) Program, which was launched by the Office of Fossil Energy (FE) in 2003 to develop and validate carbon sequestration technologies as part of a national strategy to mitigate global climate change. To learn more about DOE's RCSP program, visit: http://www.fossil.energy.gov/programs/sequestration/partnerships/index.html. October 21, 2009, http://www.fossil.energy.gov/news/techlines/2009/09074-Partnership_Completes_CO2_Injectio.html.

Sequestration in the News

***CH2M HILL News Release*, "CH2M HILL Awarded CO_2 Pipeline Project: Project will Reduce Carbon Emissions and Increase Domestic Energy Supplies."**

Encore Acquisition Company (EAC) has awarded a contract to CH2M HILL for its recently announced Greencore Project, a 230-mile CO_2 pipeline that will transport approximately 1 million metric tons of CO_2 emissions each year from the Lost Cabin Gas Plant in Fremont County, Wyoming. The CO_2 will be used for enhanced oil recovery (EOR) in EAC's Bell Creek Field in southeastern Montana. It is estimated that the project will increase oil production from existing wells from 1,200 barrels per day to a peak response of 7,000 barrels per day. The compressed CO_2 will be transferred by a combination eight-inch and 10-inch diameter

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Sequestration in the News (Continued)

pipeline. CH2M HILL initiated the Greencore Project in August 2009. September 29, 2009, http://www.ch2m.com/corporate/news_room/news_story.asp?story_id=550.

***Carbon Capture Journal*, "Toshiba Completes CCS Pilot Plant."**

Toshiba Corporation has completed the construction of a CO_2 capture pilot plant located at Mikawa Power Plant, in Omuta City, Fukuoka Prefecture, Japan. The Mikawa pilot plant, which will deploy and validate Toshiba's latest separation and capture technology, is designed to capture 10 tons of CO_2 a day. Toshiba will use the plant to verify the performance and operation of the system when applied to thermal power plants, using the data to help design systems and equipment for utility-scale power plants, which will finally be optimally integrated with other power plant equipment, such as turbines and boilers. Toshiba's goal is to establish commercial-scale carbon capture and storage (CCS) systems for thermal power plants by 2015. The company initiated its research and development (R&D) into CCS in 2006, focusing on an amine-based chemical absorption system that consumes less energy in the CO_2 separation and capture process, and has verified, through small-scale testing, that its performance matches the leaving levels in the industry. Toshiba established a new CCS development and promotion organization in October 2008, and is seeking to further accelerate practical application and commercialization of its technology. October 9, 2009, http://www.carboncapturejournal.com/displaynews.php?NewsID=453&PHPSESSID=52erjpl5pkdkhf5oc72nen92p7.

***Energy Technologies Institute News Release*, "ETI Project to Put UK at the Leading Edge of Carbon Storage Capacity Appraisal."**

The Energy Technologies Institute (ETI) initiated an approximately $5.7 million project, titled the United Kingdom CO_2 Storage Appraisal Project (UKSAP), to review potential sites that are suitable for storing CO_2 offshore and estimate CO_2 storage capacity in the United Kingdom (UK). Although the UK possesses many offshore depleted oil and gas reservoirs and saline formations, capacity estimates are widely varied. The UK government, CO_2 emitters, storage operators, and infrastructure and technology developers will use the estimates to select sites for CCS in the UK. Led by Senergy Alternative Energy Ltd., UKSAP also involves technical contributions from the British Geological Survey, the Scottish Centre for Carbon Storage, Durham University, GeoPressure Technology Ltd., Geospatial Research Ltd., Imperial College London, RPS Energy, and Element Energy Ltd. The project, which started in October 2009, will be completed by March 2011. October 9, 2009, http://www.energytechnologies.co.uk/home/news/09-10-09/ETI_project_to_put_UK_at_the_leading_edge_of_Carbon_Storage_Capacity_Appraisal.aspx.

Sequestration in the News (Continued)

***The Guardian*, "Britain's First Carbon Capture and Storage Plant to Be Built in Yorkshire."**

After receiving a $266 million award from the European Union (EU), the UK will build its first CCS demonstration plant at Hatfield in Yorkshire. The money, which will also be matched by the UK, was awarded to Powerfuel Power for a 900-megawatt, coal-fired electricity plant that could be operating as early as 2014. Through the use of pre-combustion CCS technology, the company will remove CO_2 from the coal before it is burned and pipe it for storage in an offshore gas field 100 miles away. Money from the fund will help to finance eight other CCS demonstration plants across Germany, the Netherlands, Poland, Spain, and Italy. The EU hopes to have 12 commercial CCS projects in operation by 2015 with the funding coming from an economic recovery program that will provide an additional $1.5 billion in 2010. October 16, 2009, http://www.guardian.co.uk/environment/2009/oct/16/carbon-capture-storage-hatfield/print.

Announcements

DOE Announces FOA for Carbon Capture.

On October 13, 2009, U.S. Energy Secretary Steven Chu announced that $55 million will be made available to develop advanced technologies that can capture CO_2 from flue gases at existing power plants so that greenhouse gases (GHGs) may be sequestered or put to beneficial use. To read the Funding Opportunity Announcement (FOA), visit: http://www.fossil.energy.gov/programs/sequestration/publications/foa_0000131.pdf.

10th International Conference on Greenhouse Gas Control Technologies.

he 10th International Conference on Greenhouse Gas Control Technologies (GHGT-10) will be held in Amsterdam, Netherlands, on September 19-23, 2010. This conference will provide a platform for discussions on overcoming barriers involved in the implementation of GHG mitigation technologies. For more information, visit the conference website at: http://www.ghgt.info/ghgt10.html.

CO_2 Geological Storage: Latest Progress.

The European Science Foundation (ESF) will hold a conference on November 22-27, 2009, at Obergurgl University Centre in Obergurgl, Austria, aimed at outlining future challenges facing the industrial implementation of geological CO_2 storage. The conference will examine modeling techniques; risk assessment; site monitoring; and site design, injection, and closure practices. To learn more, visit the conference website at: http://www.esf.org/activities/esf-conferences/details/2009/confdetail293.html#c28304.

Poland Joins International CCS Group.

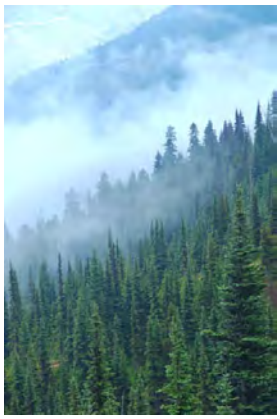
On October 12, 2009, the Carbon Sequestration Leadership Forum (CSLF) announced Poland as its 24th member. CSLF is a voluntary climate initiative of developed and developing nations that represents more than 3.5 billion people, or approximately 60 percent of the world's population. To read the CSLF news release, go to: http://www.cslforum.org/pressroom/publications/pr_poland_101209.pdf.

Exchanges Plan CO_2 Trading Market.

The Tokyo Stock Exchange and the Tokyo Commodity Exchange have announced plans to create Japan's first market for trading GHG emissions. The market, expected to begin as early as next year, will allow for companies to purchase credits for GHG emission reduction projects in developing countries. For more information, visit: http://www.tse.or.jp/english/index.html and http://www.tocom.or.jp/.

Science

***Science Daily*, "Global Warming May Spur Increased Growth In Pacific Northwest Forests."**



Potential climate change could cause a significant increase in the productivity of high-elevation forests of the Pacific Northwest, according to a study conducted by researchers from the College of Forestry at Oregon State University and the Pacific Northwest Research Station. The study also claims that forests at lower elevations, which in recent years have accounted for more than 80 percent of the region's timber harvest, could face a decline in growth. Based on the predictions of computer models, the potential changes would affect the state of Washington the hardest, where high-elevation forests could see their productivity increase from 35 percent a year to as much as 500 percent, depending on which climate scenario was used. Overall, forest productivity could see an annual increase of approximately seven percent in forests west of the Cascade Range and 20 percent in forests east of them. According to the study, most of the climate scenarios that were used showed increases in temperatures (from one to eight degrees), but precipitation projections varied widely. The productivity of forests affects a range of issues, such as potential timber harvest, habitat for wildlife, fuels that increase fire risk, and carbon sequestration. The researchers' findings were published in the journal "Forest Ecology and Management." October 19, 2009, http://www.sciencedaily.com/releases/2009/10/091019163020.htm.

***Discovery Channel News*, "Melting Arctic Could Unleash Vast CO_2 Stores."**

According to a recent study of the Arctic carbon cycle, Arctic land and seas may soak up as much as a quarter of the carbon absorbed globally each year. Researchers believe that climate change threatens the potential of this carbon repository to continue its sequestering of carbon, as the warming temperatures may cause the Arctic to begin releasing its carbon stores, which in turn may lead to an increase in global temperature. On land, CO_2 is absorbed by plants through photosynthesis; when the released CO_2 is in the ocean, it dissolves directly into the water or through uptake by algae and other marine plants. These carbon sinks are tempered on land by naturally occurring events, such as plant decomposition and wildfires. In the oceans, however, when the waters warm, the dissolved CO_2 is released, increasing the rate of photosynthesis by marine organisms. The net of these processes make up approximately half of the CO_2 released worldwide being removed from the atmosphere, of which the Arctic is responsible for absorbing anywhere from zero to 25 percent. According to the study, which was published in "Ecological Monographs," as the Arctic warms, permafrost melts, allowing for faster decomposition, thus releasing the CO_2. October 21, 2009, http://dsc.discovery.com/news/2009/10/21/arctic-carbon-warming.html.

Policy

***EPA News Release*, "EPA Finalizes the Nation's First Greenhouse Gas Reporting System/Monitoring to begin in 2010."**

Beginning on January 1, 2010, EPA will require large GHG emitters to begin collecting data under a new GHG reporting system that will cover approximately 85 percent of the Nation's GHG emissions and apply to roughly 10,000 facilities. The new reporting system is expected to guide the development of the best possible policies and programs to reduce such emissions by providing a better understanding of where GHGs are coming from. Businesses will also use the data to track their own emissions, compare them to similar facilities, and provide assistance in identifying cost-effective methods to reduce their GHG emissions in the future. The largest emitting facilities will send their first annual reports, covering calendar year 2010, to EPA in 2011. For more information on the new reporting system and reporting requirements, visit: http://www.epa.gov/climatechange/emissions/ghgrulemaking.html. September 22, 2009, http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/194e412153fcffea8525763900530d75!OpenDocument.

***Reuters*, "Norway Plans Record 2010 Carbon Capture Spending."**

The Norwegian Government announced plans to raise its investment in CO_2 capture, transport, and storage to nearly $621 million in 2010. Under the newly announced plans, the Norwegian Government would contribute funding to projects like the construction of a CO_2 capture center at Mongstad. Norway, the world's sixth highest oil exporter, would also raise investments in renewable energies. Under that plan, a fund for developing renewable energy and energy efficiency would receive approximately $874 million. The Norwegian Government is discussing the possibility of raising national cuts in GHGs to 40 percent below 1990 levels by 2020 to help a new United Nations (UN) climate pact. Norway is also planning to make the nation "carbon neutral" by 2030. Norway has been storing CO_2 offshore at the Sleipner gas field since 1986. October 13, 2009, http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE59C1RC20091013.

"Moving from misinformation derived from public attitude surveys on carbon dioxide capture and storage towards realistic stakeholder involvement."

The following is the Abstract of this article: "Stakeholder involvement (SI) can include many activities, from providing information on a website to one-on-one conversations with people confronting an issue in their community. For CCS, there are now quite a few surveys of public attitudes towards CCS that are being used to inform the design of SI efforts. These surveys, focused on the nascent commercial deployment of CCS

Policy (Continued)

that are being used to inform the design of SI efforts. These surveys, focused on the nascent commercial deployment of CCS technologies, have demonstrated that the general public has little knowledge about CCS – yet the surveys go on to collect what are known as 'pseudo opinions' or 'non-attitudes' of respondents who know little or nothing about CCS. Beyond establishing the lack of knowledge about CCS, the results of these surveys should not be relied upon by the larger CCS community and public and private decision makers to inform the critical task of implementing and executing SI activities. The paper discusses the issues involved in providing information as part of the survey, maintaining that such information is never unbiased and thus tends to produce pseudo opinions that reflect the pollster's or researcher's bias. Other content and methodological issues are discussed, leading to the conclusion that most of the survey results should be used neither as a gauge of public attitudes nor as an indication of public acceptance. Then the framing of SI in CCS is examined, including the assumptions that clear stakeholder acceptance is a realistic goal and that the public has a decisive say in choosing the energy technologies of the present and the future. Finally, a broader suite of SI activities is recommended as more suited to realistic and contextual goals." **Elizabeth L. Malone, James J. Dooley, and Judith A. Bradbury**, *International Journal of Greenhouse Gas Control*, Available online September 25, 2009, doi: 10.1016/j.ijggc.2009.09.004, http://www.sciencedirect.com/science/article/B83WP-4X9NCKW-2/2/d88343083fd8401d25539277947c6be5. (Subscription may be required.)

Geology

"Life Cycle Inventory of CO_2 in an Enhanced Oil Recovery System."

The following is the Abstract of this article: "EOR has been identified as a method of sequestering CO_2 recovered from power plants. In CO_2-flood EOR, CO_2 is injected into an oil reservoir to reduce oil viscosity, reduce interfacial tension, and cause oil swelling which improves oil recovery. Previous studies suggest that substantial amounts of CO_2 from power plants could be sequestered in EOR projects, thus reducing the amount of CO_2 emitted into the atmosphere. This claim, however, ignores the fact that oil, a carbon rich fuel, is produced and 93 percent of the carbon in petroleum is refined into combustible products ultimately emitted into the atmosphere. In this study [the authors] analyze the net life cycle CO_2 emissions in an EOR system. This study assesses the overall life cycle emissions associated with sequestration via CO_2-flood EOR under a number of different scenarios and explores the impact of various methods for allocating CO_2 system emissions and the benefits of sequestration." **Paulina Jaramillo, W. Michael Griffin, and Sean T. McCoy**, *Environmental Science and Technology*, Available online September 30, 3009, doi: 10.1021/es902006h, http://pubs.acs.org/doi/abs/10.1021/es902006h. (Subscription may be required.)

"Carbonation of wellbore cement by CO_2 diffusion from caprock."

The following is the Abstract of this article: "To evaluate the risk of corrosion of cement by geosequestered CO_2, samples are being retrieved from wells placed in natural CO_2 deposits. If the cement passing through the cap rock is carbonated, it may indicate that annular gaps or cracks have allowed carbonic acid to come into contact with the cement. However, it must be recognized that the pore water in the cap rock has become saturated with CO_2 over geological time. After the well is placed, the CO_2 will diffuse toward the cement and react with it. A simple analysis of the diffusion kinetics demonstrates that carbonation depths of millimeters to centimeters can be expected from this reaction within the lifetime of a well, in the absence of any cracks or gaps. Therefore, the occurrence of carbonation in cement sealing natural CO_2 deposits must be interpreted with caution." **George W. Scherer and Bruno Huet**, *International Journal of Greenhouse Gas Control*, Available online September 24, 2009, doi:10.1016/j.ijggc.2009.08.002, http://www.sciencedirect.com/science/article/B83WP-4X9DB94-1/2/2d5c1e0673c00dc05737a2b82a7c5223. (Subscription may be required.)

Technology

"Feasibility of storing CO_2 in the Utsira formation as part of a long term Dutch CCS strategy: An evaluation based on a GIS/MARKAL toolbox."

The following is the Abstract of this article: "This study provides insight into the feasibility of a CO_2 trunk line from the Netherlands to the Utsira formation in the Norwegian part of the North Sea, which is a large geological storage reservoir for CO_2. The feasibility is investigated in competition with CO_2 storage in onshore and near-offshore sinks in the Netherlands. Least-cost modeling with a MARKAL model in combination with ArcGIS was used to assess the cost-effectiveness of the trunk line as part of a Dutch GHG emission reduction strategy for the Dutch electricity sector and CO_2 intensive industry. The results show that under the condition that a CO_2 permit price increases from \$37 per tCO_2 in 2010 to \$89 per tCO_2 in 2030, and remains at this level up to 2050, CO_2 emissions in the Netherlands could reduce with 67 [percent] in 2050 compared to 1990, and investment in the Utsira trunk line may be cost-effective from 2020–2030 provided that Belgian and German CO_2 is transported and stored via the Netherlands as well. In this case, by 2050 more than 2.1 $GtCO_2$ would have been transported from the Netherlands to the Utsira formation. However, if the Utsira trunk line is not used for transportation of CO_2 from Belgium and Germany, it may become cost-effective 10 years later, and less than 1.3 $GtCO_2$ from the Netherlands would have been stored in the Utsira formation by 2050. On the short term, CO_2 storage in Dutch fields appears more cost-effective than in the Utsira formation, but as yet there are major uncertainties related to the timing and effective exploitation of the Dutch offshore storage opportunities." **Machteld van den Broek, Andrea Ramírez, Heleen Groenenberg, Filip Neele, Peter Viebahn, Wim Turkenburg, and André Faaij**, *International Journal of Greenhouse Gas Control*, Available online September 26, 2009, doi:10.1016/j.ijggc.2009.09.002, http://www.sciencedirect.com/science/article/B83WP-4X9V345-1/2/13e67d72f667b7fc5f082159e897a470. (Subscription may be required.)

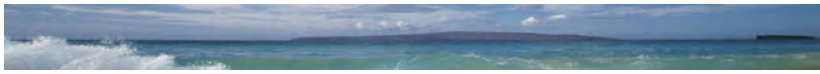
Technology (Continued)

"CCS scenarios optimization by spatial multi-criteria analysis: Application to multiple source sink matching in Hebei province."

The following is the Abstract of this article: "A method, based on spatial analysis of the different criteria to be taken into consideration for building scenarios of CCS, has been developed and applied to real case studies in the Hebei province. Totally 88 point sources (42 from power sector, [nine] from iron and steel, 18 from cement, 16 from ammonia, and [three] from oil refinery) are estimated and their total emission amounts to 231.7 $MtCO_2$/year with power, iron and steel, cement, ammonia and oil refinery sharing 59.13 [percent], 25.03 [percent], 11.44 [percent], 3.5 [percent], and 0.91 [percent], respectively. Storage opportunities can be found in Hebei province, characterized by a strong tectonic subsidence during the Tertiary, with several kilometers of accumulated clastic sediments. Carbon storage potential for 25 hydrocarbon fields selected from the Huabei complex is estimated as 215 $MtCO_2$ with optimistic assumption that all recovered hydrocarbon could be replaced by an equivalent volume of CO_2 at reservoir conditions. Storage potential for aquifers in the Miocene Guantao formation is estimated as 747 $MtCO_2$ if closed aquifer assumed or 371 $MtCO_2$ if open aquifer and single highly permeable horizon assumed. Due to poor knowledge on deep hydrogeology and to pressure increase in aquifer, injecting very high rates requested by the major CO_2 sources (>10 $MtCO_2$/year) is the main challenge, therefore piezometry and discharge must be carefully controlled. A source sink matching model using ArcGIS software is designed to find the least-cost pathway and to estimate transport route and cost accounting for the additional costs of pipeline construction due to landform and land use. Source-sink matching results show that only 15–25 [percent] of the emissions estimated for the 88 sources can be sequestrated into the hydrocarbon fields and the aquifers if assuming sinks should be able to accommodate at least 15 years of the emissions of a given source." **Wenying Chen, Yves-Michel Le Nindre, Ruina Xu, Delphine Allier, Fei Teng, Kim Domptail, Xing Xiang, Laura Guillon, Jiyong Chen, Lingyan Huang, and Rongshu Zeng**, *International Journal of Greenhouse Gas Control*, Available online September 25, 2009, doi:10.1016/j.ijggc.2009.09.001, http://www.sciencedirect.com/science/article/B83WP-4X9NCKW-1/2/31a6884596948594c5f4d805cf52507f. (Subscription may be required.)

"The potential for increased atmospheric CO_2 emissions and accelerated consumption of deep geologic CO_2 storage resources resulting from the large-scale deployment of a CCS-enabled unconventional fossil fuels industry in the U.S."

The following is the Abstract of this article: "Desires to enhance the energy security of the United States have spurred renewed interest in the development of abundant domestic heavy hydrocarbon resources including oil shale and coal to produce unconventional liquid fuels to supplement conventional oil supplies. However, the production processes for these unconventional fossil fuels create large quantities of CO_2 and this remains one of the key arguments against such development. Carbon dioxide capture and CCS technologies could reduce these emissions and preliminary analysis of regional CO_2 storage capacity in locations where such facilities might be sited within the U.S. indicates that there appears to be sufficient storage capacity, primarily in deep saline formations, to accommodate the CO_2 from these industries. Nevertheless, even assuming wide-scale availability of cost-effective CO_2 capture and geologic storage resources, the emergence of a domestic U.S. oil shale or coal-to-liquids (CTL) industry would be responsible for significant increases in CO_2 emissions to the atmosphere. The authors present modeling results of two future hypothetical climate policy scenarios that indicate that the oil shale production facilities required to produce 3 MMB/d from the Eocene Green River Formation of the western U.S. using an in situ retorting process would result in net emissions to the atmosphere of between 3000 and 7000 $MtCO_2$, in addition to storing potentially 900–5000 $MtCO_2$ in regional deep geologic formations via CCS in the period up to 2050. A similarly sized, but geographically more dispersed domestic CTL industry could result in 4000–5000 $MtCO_2$ emitted to the atmosphere in addition to potentially 21,000–22,000 $MtCO_2$ stored in regional deep geologic formations over the same period. While this analysis shows that there is likely adequate CO_2 storage capacity in the regions where these technologies are likely to deploy, the reliance by these industries on large-scale CCS could result in an accelerated rate of utilization of the nation's CO_2 storage resource, leaving less high-quality storage capacity for other carbon-producing industries including electric power generation." **James J. Dooley, Robert T. Dahowski, and Casie L. Davidson**, *International Journal of Greenhouse Gas Control*, Available online September 21, 2009, doi:10.1016/j.ijggc.2009.08.004, http://www.sciencedirect.com/science/article/B83WP-4X8V5CK-1/2/aa08e5cd96d550fcb1a15ef586837173. (Subscription may be required.)



Terrestrial

"Wetland uses in the tropics and their implications on the world carbon cycle."

The following is from the Introduction of this article: "[Mankind's] understanding of the ecology of wetlands has long been based on their bioenergetics and habitat functions. More recently, emphasis has been made on their value as major carbon sinks. It has been recently recognized that the alterations of wetlands results in the oxidation of stored carbon. The release of CO_2 could create a net carbon source that can be significant enough to cause imbalance in the carbon cycle of the biosphere. Thus, the ways by which the wetlands of the world are used presently have attained a new dimension of global implication. The aim of this paper is to summarize the uses of wetlands in the tropics, to discuss some ecological implications of these uses, and to illustrate two contrasting uses relative to the carbon cycle. The materials presented in this paper were based on [the author's] studies in Southeast Asia and Papua New Guinea under two grants from the International Division of the U.S. National Science Foundation, and on [the author's] observations." **Armando A. de la Cruz**, *Wetlands*, Available online September 29, 2009, doi:10.1007/BF03160545, http://www.springerlink.com/content/q25g714922n12137/?p=2f065847cb434343981eba58d3c78749&pi=1. (Subscription may be required.)

Carbon Market Update, October 14, 2009	
CCX-CFI 2009 ($/tCO$_2$) $0.10 (Vintage 2009)	EU ETS-EUA DEC 2009 ($/tCO$_2$) $21.56 (Converted from € to US$)

Trading

***RGGI News Release*, "RGGI States Initiate Bidding Process for December 2009 Auction."**

On October 6, 2009, the 10 Northeast and Mid-Atlantic states participating in the Regional Greenhouse Gas Initiative (RGGI) released the Auction Notice and application materials for their sixth regional CO_2 allowance auction, which is scheduled for December 2, 2009. According to the release, the participating states will offer more than 28.5 million allowances for the 2009 vintage and more than 2.1 million allowances for the 2012 vintage. The reserve price for allowances in Auction 6 will continue to be $1.86. Potential bidders must complete the qualification process in order to participate in the December auction; the necessary documentation is available on the RGGI website at: http://www.rggi.org/co2-auctions/information. Auction 6 will be the fourth such auction since compliance obligations under each member state's CO_2 Budget Trading Program took effect on January 1, 2009. The participating states have auctioned more than 140 million allowances to date. Created in September 2007, RGGI has designed and implemented the first market-based, mandatory cap-and-trade program in the United States to reduce GHG emissions. Power sector CO_2 emissions are capped at 188 million short tons per year through 2014; the cap will then be reduced by 2.5 percent each year through 2018, for a total reduction of 10 percent. October 6, 2009, http://www.rggi.org/docs/Auction_6_Notice_Release_FINAL.pdf.

Recent Publications

"Investigating the prospects for Carbon Capture and Storage technology in India."

The following is the Executive Summary of this document: "The use of CCS technologies to mitigate the risk of climate change has received relatively little attention until recent years. They are, however, increasingly being proposed as potentially important contributors in global action on climate change. For example, the Stern Review notes that: '[CCS] is a technology expected to deliver a significant portion of the emission reductions. The forecast growth in emissions from coal, especially in China and India, means CCS technology has particular importance.' Chinese companies have recently started planning and constructing pilot scale (and larger) CCS schemes. The Indian Government and industry has, however, tended to take a more cautious approach. In this context, this study aims to examine whether CCS could be a suitable option for India and, if so, what role would be appropriate for various stakeholders, including developed countries, to play in its development within India. The primary research reported here is a survey-based exploration of stakeholder views on the suitability of CCS for India and how CCS could be developed and deployed. There is a lively debate about whether CCS should be deployed in India. It is expected that coal will play a significant role in providing energy and electricity in India until 2050, at least, despite measures to significantly increase the role of other energy sources. Although CCS is not seen as an immediate priority for Indian Government or industry, survey respondents do expect it to become more important in the future, particularly for industry. Thus, it is appropriate to consider whether CCS is a technically feasible option for India and, if so, if and when it should be used. Although there are some significant challenges, it seems likely that introducing CO_2 capture at Indian power plants could be technically feasible especially in locations where it is considered appropriate to apply 'capture ready' concepts for new build plants before CCS is deployed. Identifying both suitable storage sites and routes for transporting captured CO_2 safely to these sites also requires careful consideration. One important factor in shaping views on whether CCS is an appropriate option for India is the proposed timing of any deployment of possible projects. In particular, survey respondents typically suggest that it is necessary for developed countries to demonstrate CCS at commercial scale before any commercial-scale CCS projects in India are considered. In fact, most survey respondents suggested that any consideration of deployment of CCS in India should be within an appropriate international framework, including measures for knowledge sharing and technology transfer that consider local conditions carefully. The importance of establishing reasonable methods to help with early engagement on CCS between India and developed countries was also noted by some respondents. For example, one respondent suggested that consideration should be given to establishing local knowledge/training centers within India. Survey respondents also suggested that it was reasonable for developed country governments to contribute to financing of both initial projects and wider deployment of CCS in India. This could partly be through international finance institutions such as the World Bank, the International Monetary Fund and the Asian Development Bank." To view the rest of the document, go to: http://www.geos.ed.ac.uk/sccs/India__CCS_Report-Oct2009.pdf.

"IEA Technology Roadmap: Carbon Capture and Storage."

The following is the Forward of this document: "Current trends in energy supply and use are patently unsustainable – economically, environmentally and socially. Without decisive action, energy-related emissions of CO_2 will more than double by 2050 and increased oil demand will heighten concerns over the security of supplies. We can and must change our current path, but this will take an energy revolution and low-carbon energy technologies will have a crucial role to play. Energy efficiency, many types of renewable energy, CCS, nuclear

Recent Publications (Continued)

power and new transport technologies will all require widespread deployment if we are to reach our greenhouse gas emission goals. Every major country and sector of the economy must be involved. The task is also urgent if we are to make sure that investment decisions taken now do not saddle us with suboptimal technologies in the long-term. There is a growing awareness of the urgent need to turn political statements and analytical work into concrete action. To spark this movement, at the request of the G-8, the International Energy Agency (IEA) is developing a series of roadmaps for some of the most important technologies. These roadmaps provide solid analytical footing that enables the international community to move forward on specific technologies. Each roadmap develops a growth path for a particular technology from today to 2050, and identifies technology, financing, policy and public engagement milestones that need to be achieved to realize the technology's full potential. Roadmaps also include special focus on technology development and diffusion to emerging economies. International collaboration will be critical to achieve these goals. This roadmap on CCS identifies, for the first time, a detailed scenario for the technology's growth from a handful of large-scale projects today to over three thousand projects by 2050. It finds that the next decade is a key "make or break" period for CCS; governments, industry and public stakeholders must act rapidly to demonstrate CCS at scale around the world in a variety of settings. The roadmap concludes with a set of near-term actions that stakeholders will need to take to achieve the roadmap's vision. The IEA presents this roadmap not only to provide additional focus and urgency to the international discussions about the importance of CCS as a technology solution, but to chart the course to make CCS a reality worldwide." The complete technology roadmap is available at: http://www.iea.org/papers/2009/CCS_Roadmap.pdf.

Legislative Activity

***U.S. Senator John Barrasso Press Release*, "Barrasso Bill Builds Framework for Carbon Capture."**

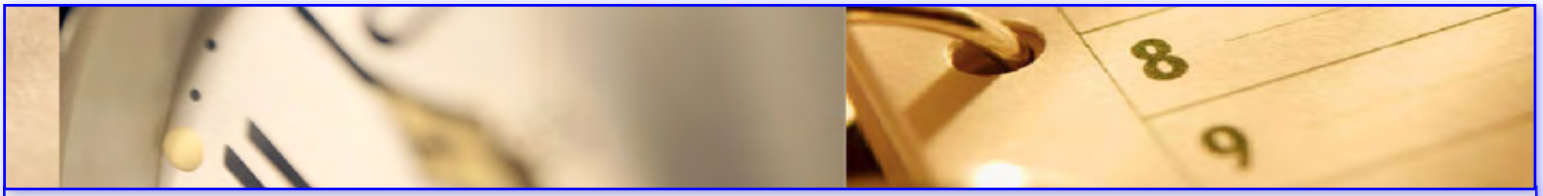
Wyoming Senator John Barrasso recently introduced a bill to ensure the long-term viability of coal by establishing a framework for long-term storage of CO_2 and addressing pore space ownership below Federal lands. Modeled after similar legislation that was approved at the state level in Wyoming, the bill states that pore space under Federal lands belongs to the Federal government and that the mineral estate will be dominant over the space estate, meaning the mineral owner's use would take precedence over the use by the pore space owner. To view the bill, go to: http://climate.alston.com/files/docs/Barrasso_Pore_Space_bill.pdf. October 23, 2009, http://barrasso.senate.gov/public/index.cfm?FuseAction=PressOffice.PressReleases&ContentRecord_id=8221b0c4-c872-ab72-2106-f8df2492a5c5.

Events

November 2-4, 2009, **Carbon Market Insights Americas 2009**, *Marriott Marquis Hotel, New York City, New York, USA*. This conference will focus on international negotiations and domestic legislation in the carbon market. The program will also focus on the trading and market dynamics of carbon as an emerging commodity. To download a detailed program, visit the conference website at: http://www.pointcarbon.com/events/conferences/cmia09/.

November 5-6, 2009, **3rd International Symposium: Capture and Geological Storage of CO_2 - Accelerating Deployment**, *Paris, France*. This symposium takes a global and cross-disciplinary approach that focuses on the industrial deployment of CCS. Included in the agenda is a discussion on DOE's RCSPs. For more information, including a detailed program, visit the conference website at: http://www.co2symposium.com/.

November 9-11, 2009, **Carbon Capture and Storage for Utilities**, *Omni Hotel at CNN Center, Atlanta, Georgia, USA*. This conference will discuss and review how to accurately estimate reliable capacities of CO_2 storage; examine developing pore space ownership issues from leading law firms; interpret strategies from current CCS project developers; and analyze critical public outreach, water issues, technological advancements, and MVA best practices. For more information, go to: http://www.euci.com/conferences/1109-ccs/index.php?ci=824, or click: http://www.co2symposium.com/CO2symposium-2009_Registration-Form.pdf to view the registration form.



Events (Continued)

November 10-11, 2009, **Impacts of Climate Change on Natural Resources**, *Ismailia, Ismailia, Egypt*. Sponsored by the Egyptian Society for Environmental Sciences (ESES), the fourth edition of this conference will discuss the ecological impacts of recent climate change from polar terrestrial to tropical marine environments. Among the topics to be discussed are the impacts of potential climate change on natural resources, deserts, water resources management, and risk assessment. To view the conference website, which includes a downloadable brochure, visit: http://www.eses-catrina.com/?news=179.

November 12, 2009, **Green Business Summit II: The Business Case for Green Investments**, *Morgan, Lewis & Bockius LLP, Washington D.C., USA.* This conference will focus on the business case for green investments, such as: clean technologies, renewable, and low-carbon energy; financing CleanTech enterprises; government policy; and the impact of climate change o business. To learn more, visit the conference website at: http://www.whartondc.com/article.html?aid=1756.

November 18-19, 2009, **3rd Annual European Carbon Capture and Storage Summit**, *Le Méridien Piccadilly Hotel, London, England.* This summit will cover some of the key challenges and opportunities currently facing CCS. The agenda focuses on economic climate; European projects and UK demonstration projects; public perception of CCS; environmental issues; and topics such as technology, legislation, and risk management. To view the detailed agenda, visit the conference website at: http://www.cityandfinancial.com/conferences/index.asp?id=266.

November 25, 2009, **Carbon Capture and Storage Forum**, *Le Méridien Piccadilly, London, England*. This forum will take a look at how large-scale CCS can become a commercial reality. Some of the topics that will be addressed include the latest developments, the future of coal in the UK, international progress, the financial viability of CCS, the national grid's outlook on transportation and storage networks, and the future CCS regulatory structure. To view the conference website, which includes a downloadable brochure, visit: http://www.marketforce.eu.com/Conferences/ccs09/.

November 25-26, 2009, **Carbon Cycling in Tropical Ecosystems**, *Yanling Hotel, Guangzhou, China*. The 23rd New Phytologist Symposium will help its attendees define the issues of carbon cycling in tropical environments at global and regional scales. The program includes sessions on the following topics: the global carbon cycle and climate change; changes in biomass carbon stocks of global tropical forests; a comprehensive assessment of carbon productivity; and the mitigation potential of reducing GHG emissions from deforestation and degradation. To view the conference website, go to: http://www.newphytologist.org/carbon/default.htm.

December 11-12, 2009, **Carbon Credit International Conference**, *New Delhi, India*. Attendees of this international conference will develop knowledge of the Clean Development Mechanism (CDM) through the trading of carbon credits. In addition, attendees will be provided with carbon financing opportunities and have the chance to network with individuals working in the CDM market. To learn more, visit the conference website at: http://www.onlinecarbonfinance.com/.

For subscription details...

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.

To learn more about DOE's Carbon Sequestration Program, please contact Sean Plasynski at sean.plasynski@netl.doe.gov, or Dawn Deel at dawn.deel@netl.doe.gov.