



# Carbon Sequestration Newsletter

MAY 2008

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## HIGHLIGHTS

### *Fossil Energy Techline, "DOE Technology Monitors CO<sub>2</sub> Injection in Australian Gas Field."*

On April 2, Australia launched the Otway Basin Pilot Project – the first carbon sequestration project in the southern hemisphere – with the help of technology developed by United States Department of Energy (DOE) researchers. Over a span of one to two years, the \$36 million project will inject up to 100,000 metric tons of carbon dioxide (CO<sub>2</sub>) into a depleted gas field in the Waarre Formation of southeastern Australia's Otway Basin, and an international team will monitor the site's long-term storage viability. The project will use instrumentation sponsored by the DOE's National Energy Technology Laboratory (NETL) and developed at the Lawrence Berkeley National Laboratory (LBNL) that uses seismic techniques to trace the mile deep CO<sub>2</sub> plume before and after injection and provide data about location, migration, and permanent CO<sub>2</sub> storage. In addition, a well sampling technique that taps the reservoir and delivers fluid samples to the surface will be used to determine CO<sub>2</sub> content and to conduct geochemical analyses. The Otway Basin is thought to be an excellent test site, because it is a large source of natural CO<sub>2</sub> and offers plenty of depleted gas fields containing rock formations conducive to

safe, long-term CO<sub>2</sub> storage. Several other international demonstration projects, such as CO<sub>2</sub>SINK near Berlin, Germany and the commercial-scale CO<sub>2</sub> storage operation at In Salah, Algeria, will benefit from the transfer of sequestration technologies by LBNL. The project is one of 19 projects endorsed by the Carbon Sequestration Leadership Forum (CSLF) and is directed by Australia's Cooperative Research Centre for Greenhouse Gas Technologies (CO<sub>2</sub>CRC). For more information about CSLF, go to: <http://www.cslforum.org/>, or visit <http://www.co2crc.com.au/> to read more about Australia's CO<sub>2</sub>CRC. To view a video of the project, click: <http://www.reuters.com/news/video?videoId=79363&newsChannel=environmentNews>. April 3, 2008, [http://www.fossil.energy.gov/news/techlines/2008/08009-Australian\\_CO2\\_Injection\\_Begins.html](http://www.fossil.energy.gov/news/techlines/2008/08009-Australian_CO2_Injection_Begins.html).

## SEQUESTRATION IN THE NEWS

*Environment & Energy Daily*, "DOE May Lower FutureGen Requirement for Capturing CO<sub>2</sub>," and *House Committee on Science and Technology Press Release*, "Subcommittee Reviews DOE's Plans for FutureGen."

On April 8, the Senate Commerce, Science and Transportation Committee held a hearing to discuss the restructured FutureGen project and it was recommended that DOE reduce the 90 percent capture requirement for restructured FutureGen project proposals, because it is uneconomical to increase a gasifier's CO<sub>2</sub> capture rate. Other topics discussed included: the possibility of a "dual track" program combining the original and restructured FutureGen approach, which would cost nearly \$3 billion; a regulatory framework that encourages technological development; economic incentives; carbon pricing; a cost-sharing plan for the first adopters of the technology; and a plan to address liability issues. Another hearing held on April 16 by the House Science and Technology Committee's Energy and Environment Subcommittee reviewed DOE's decision to restructure FutureGen and questioned individuals about DOE's decision making process and whether this approach is the best method to exhibit carbon capture and storage (CCS) technologies. Some committee members also expressed concern that the restructured FutureGen program will delay the development, demonstration, and advancement of CCS technologies after being told they must head in a new direction following five years of thinking FutureGen would solve one of the United States' critical environmental challenges. April 10, 2008, <http://www.eenews.net/EEDaily/2008/04/10/2/>, and April 15, 2008, <http://science.house.gov/press/PRArticle.aspx?NewsID=2157>.



## SEQUESTRATION IN THE NEWS (CONTINUED)

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This newsletter 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.

### ***Business Wire*, “Southern California Edison Launches the Nation’s First Full Commercial Scale Assessment of Advanced Coal Generation Technologies.”**

Following plan approval by the California Public Utilities Commission (CPUC) on April 10, the United States’ first advanced coal technology feasibility study will be conducted by Southern California Edison (SCE) at a commercial-scale, 600-megawatt facility. The two-year, \$50 million project will test the following elements for the first time: capturing as much as 90 percent of CO<sub>2</sub> and sequestering the CO<sub>2</sub> in a deep saline or depleted oil formation for enhanced oil recovery (EOR). On October 9, 2007, SCE received a share of a \$65 million DOE grant, a portion of which also was awarded to the Southwest Regional Partnership (SWP) of DOE’s Regional Carbon Sequestration Partnership (RCSP) Program. SWP plans to inject one million tons of CO<sub>2</sub> in the Western United States’ Entrada Sandstone Formation as part of SCE’s Clean Hydrogen Power Generation program. For more information about the SWP, click: <http://www.southwestcarbonpartnership.org/>. April 10, 2008, [http://www.businesswire.com/portal/site/google/?ndmViewId=news\\_view&newsId=20080410006160&newsLang=en](http://www.businesswire.com/portal/site/google/?ndmViewId=news_view&newsId=20080410006160&newsLang=en).

### ***ZeroGen Media Release*, “Reconfigured ZeroGen Project to Deliver Large Scale Clean Coal Power Plant by 2017,” and *ZeroGen Media Release*, “Coal Industry Funds Revamped ZeroGen Queensland Clean Coal Project.”**

On March 20, ZeroGen Pty Ltd announced that Queensland, Australia’s ZeroGen project is being reconfigured into two stages that will minimize the technological risk associated with building the world’s first coal gasification power plant.



Under this modified plan, Stage One would entail building an 80-megawatt demonstration plant by 2012 capable of capturing 75 percent of emissions with the state-of-the-art 6-flow turbine. The CO<sub>2</sub> emissions will be transported approximately 137 miles by truck from the plant’s Rockhampton location in Central Queensland to reservoirs in the Northern Denison Trough for injection and safe storage. Stage Two involves building the world’s first large-scale, 330-megawatt plant by 2017 that would be capable of capturing up to 90 percent of CO<sub>2</sub> emissions. A feasibility study to determine the location of the plant will run concurrently to Stage One, with hopes research can be completed by the end of 2009. The Australian Coal Association (ACA) supports the reconfigured project and said it would provide up to \$26 million through the COAL21 Fund to finance the Stage One study. To view the ZeroGen website, click: <http://www.zerogen.com.au/home>. March 20, 2008, [http://www.zerogen.com.au/files/ReconfiguredZeroGenproject\\_0.pdf](http://www.zerogen.com.au/files/ReconfiguredZeroGenproject_0.pdf), and March 20, 2008, <http://www.zerogen.com.au/files/Australian%20Coal%20Association%20media%20release.pdf>.

# SEQUESTRATION IN THE NEWS (CONTINUED)

## ***Environment & Energy Daily*, “Miners Seek \$1 Billion per Year Sequestration Fund.”**

In a letter submitted to John Dingell, the House Energy and Commerce Chairman, the presidents of the United Mine Workers of America (UMWA) and National Mining Association (NMA) asked Congress to fund a new \$1 billion per year sequestration fund that would finance the development of coal-fired power plants fitted with CCS technology. The suggested fund would not be included in Congress’s annual appropriations, but rather the letter offered that fossil fuel energy users be charged a fee to finance the fund. The joint letter arose from a US Environmental Protection Agency (EPA) sponsored report conducted by the Advanced Coal Technology Work Group that advocated funding five to 10 commercial-scale power plants capable of capturing and storing greenhouse gases (GHG). The working group, composed of industry officials, academics, scientists, and environmentalists, also expressed the need to establish a carbon “market driver” and expand EPA outreach efforts regarding health risks and benefits. Representatives Dingell and Rich Boucher, the Energy and Air Quality Subcommittee chairman, have previously communicated their desire to increase incentives for carbon technologies and draft a broader global warming bill as early as this spring. To read the EPA-sponsored

report, go to: [http://www.eenews.net/features/documents/2008/04/01/document\\_daily\\_03.pdf](http://www.eenews.net/features/documents/2008/04/01/document_daily_03.pdf). To view the UMWA-NWA letter, click: [http://www.eenews.net/features/documents/2008/04/01/document\\_daily\\_01.pdf](http://www.eenews.net/features/documents/2008/04/01/document_daily_01.pdf). April 1, 2008, <http://www.eenews.net/EEDaily/2008/04/01/3/>.

## ***Jamestown Post-Journal*, “Budget Includes \$400K for Carbon Capture Testing.”**

A New York state budget bill passed on April 4 includes \$400,000 to fund an in-depth geological study in western New York that will investigate equipping a proposed 43-megawatt coal-fired power plant in Jamestown with CCS technology. With the state matching an earlier \$400,000 grant from the New York State Energy Research and Development Authority (NYSERDA), the study is entirely government funded and will likely be completed within an 18-month period. Battelle Labs, which is already responsible for conducting DOE’s Midwest Regional Carbon Sequestration Partnership (MRCSP) project in Columbus, Ohio, will drill the test wells for the study and examine rock structures located at least 3,000 feet beneath the Earth’s surface. The project, backed by President George W. Bush’s administration, is also supported by the Democrat-controlled Assembly, the Republican-controlled state Senate, and New York Governor David Paterson. For more information about New York’s state-funded, carbon sequestration research projects, click: [http://www.nyserda.org/Press\\_Releases/2008/PressRelease20081401\\_3.asp](http://www.nyserda.org/Press_Releases/2008/PressRelease20081401_3.asp). April 8, 2008, <http://post-journal.com/articles.asp?articleID=26523>.

## ANNOUNCEMENTS

### **Office of Fossil Energy Develops Educational Materials.**

Climate change and fossil energy study guides, online lessons, and classroom activities that target elementary, middle, and high school students are now available courtesy of DOE. The materials offer lessons about where coal, petroleum, and natural gas come from, how these fossil fuels are utilized, and how research will lead to more environmentally friendly fossil fuel usage. The educational materials are available at: [http://www.fossil.energy.gov/news/techlines/2008/08011-FE\\_Develops\\_Educational\\_Materials.html](http://www.fossil.energy.gov/news/techlines/2008/08011-FE_Develops_Educational_Materials.html).

### **IEA GHG CCS Summer School.**

Following the success of last year’s inaugural session, IEA Greenhouse Gas R&D Programme is offering another week long session for young scientists (i.e. PhD students or Post Docs) about CCS. Students will be divided into teams to research the issues surrounding CCS technology development and implementation and give a presentation to their peers at the end of the week. For more information about IEA’s International Interdisciplinary Summer School program, visit: <http://www.co2captureandstorage.info/SummerSchool/SummerSchoolIndex.html>.

### **California Registry Launches Website.**

The nonprofit California Climate Action Registry launched the “Climate Action Reserve,” a system designed to provide the public and CO<sub>2</sub> emitters with an open venue to track, list, register, and retire carbon offsets. The California Registry is as a voluntary GHG registry that has several internationally proven elements to protect and promote actions that reduce emissions. To view the Climate Action Reserve, click: <http://www.climateregistry.org/offsets.html>.

### **FutureGen Alliance Website Updated.**

Changes to the non-profit consortium’s website include: press releases posted regarding testimonies given by the FutureGen Alliance to US Senate and House of Representatives, full testimonies of FutureGen Alliance CEO and Chairman of the Board (posted under Publications), FutureGen Alliance’s response to the DOE’s Request for Information on the restructured FutureGen (posted under Announcements), and updates to the Siting description (posted under About FutureGen). Updates are available at: <http://www.FutureGenAlliance.org>.

## ANNOUNCEMENTS - CONTINUED

### **Video Interview on the Challenges Facing Carbon Capture.**

Hank Courtright, vice president of the Electric Power Research Institute (EPRI), talked about the challenges facing the electric power sector relating to CCS technology, public acceptance issues, public education, safety and security concerns, and the economics of CCS projects in an interview with E&E TV. The interview concludes with a discussion about new EPRI research that is testing the viability of using chilled ammonia to capture CO<sub>2</sub>. To watch the video, visit: [http://www.eenews.net/tv/video\\_guide/763](http://www.eenews.net/tv/video_guide/763).

## SCIENCE

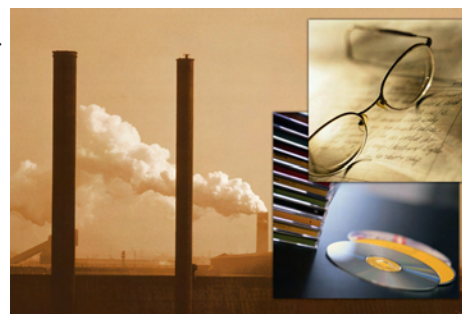
### **Science Daily, "Satellite Makes First Ever Observation of Regionally Elevated Carbon Dioxide from Manmade Emissions," and Science Daily, "'Revolutionary' Carbon Dioxide Maps Zoom In On Greenhouse Gas Sources."**

Through the use of the SCIAMACHY instrument on the European Space Agency's (ESA) Envisat environmental satellite, scientists have detected regionally elevated levels of atmospheric CO<sub>2</sub> caused by manmade emissions for the first time. Data analyzed from 2003 to 2005 shows a large plume over Europe's most heavily populated region, which stretches from Amsterdam in the Netherlands to Frankfurt, Germany. The scientists acknowledged that detecting regional manmade CO<sub>2</sub> emissions can be difficult due to natural CO<sub>2</sub> fluxes, but they hope a better understanding of the Earth's carbon cycle will aid scientists in their efforts to project future climate change. Another CO<sub>2</sub> mapping project, called Vulcan, revealed the southeastern United States is responsible for a much larger portion of GHGs than previously estimated. The three-year, DOE and National Aeronautics and Space Administration (NASA) funded project is able to depict CO<sub>2</sub> emissions at more than 100 times more detail than was previously available, because the Vulcan model examines CO<sub>2</sub> emissions at local levels on an hourly basis. In particular, Vulcan tracks CO<sub>2</sub> emissions from coal-fired power plants, factories, roadways, neighborhoods, and commercial districts and merges this data with geographic information systems (GIS) data to attribute CO<sub>2</sub> emissions to specific roads and regions. To view the satellite images, click: [http://www.esa.int/esaCP/SEM1DUQ08ZE\\_Protecting\\_0.html](http://www.esa.int/esaCP/SEM1DUQ08ZE_Protecting_0.html). The Vulcan data is available for download at: <http://www.eas.purdue.edu/carbon/vulcan>. March 20, 2008, <http://www.sciencedaily.com/releases/2008/03/080318110330.htm>, and April 8, 2008, <http://www.sciencedaily.com/releases/2008/04/080407172656.htm>.

### **Science Daily, "Carbon Dioxide Removed From Smokestacks Could Be Useful In DVD And CD-ROM Manufacture."**

Two chemists presented separate reports at an American Chemical Society (ACS) meeting on April 8 about how removing CO<sub>2</sub> from smokestack emissions could be useful in making polycarbonate plastics for consumer products in a less expensive, safer, and greener fashion than is currently used. One paper researched at the Catalytic Center (CAT) stressed the fact that CO<sub>2</sub> is readily available and a cheap starting material capable of replacing more expensive starting materials and becoming an economic driving force in the process. In addition, it

was pointed out that millions of tons of polycarbonates are sold every year and consumer products, such as eyeglass lenses, automotive headlamp lenses, DVDs and CDs, and beverage bottles, possess great potential as CO<sub>2</sub> sinks.



Another presentation, given by Japan's National Institute of Advanced Industrial Science and Technology (AIST), suggested using CO<sub>2</sub> as an alternative feedstock to convert carbonates and urethanes into plastics and battery components. The scientists believe it is only a matter of years before CO<sub>2</sub>-derived polymers are available to the public. To learn more about CAT, visit: <http://www.catalyticcenter.rwth-aachen.de/>, or for further information about AIST, click: [http://www.aist.go.jp/index\\_en.html](http://www.aist.go.jp/index_en.html). April 9, 2008, <http://www.sciencedaily.com/releases/2008/04/080408144824.htm>.

## POLICY

### **Reuters, "U.N. Approves Thousandth Kyoto Clean Energy Project," and UNFCCC Press Release, "Kyoto Protocol Clean Development Mechanism Passes 1000th Registered Project Milestone."**

On April 14, the United Nations (UN) approved the 1,000th project initiated under the Kyoto Protocol's Clean Development Mechanism (CDM). The project is an energy efficiency program in Andhra Pradesh, India that is expected to reduce CO<sub>2</sub> emissions by some 34,000 tonnes; as a whole, the 1,000 CDM-registered projects will likely result in an annual reduction of 200 million tonnes in 49 countries. Thus far, CDM projects have produced over 135 million certified emission reductions (CERs) – a figure that is expected to increase to 2.7 billion CERs in the Kyoto Protocol's first commitment period. The CDM, which is supervised by the UN Framework Convention on Climate Change (UNFCCC), allows rich nations to meet their GHG targets under the Kyoto Protocol by purchasing carbon offsets issued to clean energy projects in developing nations. Nearly half of all CDM projects take place in India and China. For CDM-related project activity, click: <http://cdm.unfccc.int/Projects/index.html>. April 14, 2008, <http://www.reuters.com/article/environmentNews/idUSL1426496820080414>, and April 14, 2008, [http://unfccc.int/files/press/news\\_room/press\\_releases\\_and\\_advisories/application/pdf/pressrel\\_080414\\_1000.pdf](http://unfccc.int/files/press/news_room/press_releases_and_advisories/application/pdf/pressrel_080414_1000.pdf).

## POLICY (CONTINUED)

### “Implications of carbon cap-and-trade for US voluntary renewable energy markets.”

Many consumers today are purchasing renewable energy in large part for the greenhouse gas (GHG) emissions benefits that they provide. Emerging carbon regulation in the US has the potential to affect existing markets for renewable energy. Carbon cap-and-trade programs are now under development in the Northeast under the Regional Greenhouse Gas Initiative (RGGI) and in early stages of development in the West and Midwest. There is increasing discussion about carbon regulation at the national level as well. While renewable energy will likely benefit from carbon cap-and-trade programs because compliance with the cap will increase the costs of fossil fuel generation, cap-and-trade programs can also impact the ability of renewable energy generation to affect overall CO<sub>2</sub> emissions levels and obtain value for those emissions benefits. This paper summarizes key issues for renewable energy markets that are emerging with carbon regulation, such as the implications for emissions benefits claims and voluntary market demand and the use of renewable energy certificates (RECs) in multiple markets. It also explores policy options under consideration for designing carbon policies to enable carbon markets and renewable energy markets to work together. **Lori A. Bird, Edward Holt and Ghita Levenstein Carroll**, *Energy Policy*, Available online April 8, 2008, doi:10.1016/j.enpol.2008.02.009, <http://www.sciencedirect.com/science/article/B6V2W-4S7HSFM-1/2/3037809ff849d75329630e58723267e8>. (Subscription may be required.)

## GEOLOGY

### “A method for quick assessment of CO<sub>2</sub> storage capacity in closed and semi-closed saline formations.”

Saline aquifers of high permeability bounded by overlying/underlying seals may be surrounded laterally by low-permeability zones, possibly caused by natural heterogeneity and/or faulting. Carbon dioxide (CO<sub>2</sub>) injection into and storage in such “closed” systems with impervious seals, or “semi-closed” systems with non-ideal (low permeability) seals, is different from that in “open” systems, from which the displaced brine can easily escape laterally. In closed or semi-closed systems, the pressure buildup caused by continuous industrial-scale CO<sub>2</sub> injection may have a limiting effect on CO<sub>2</sub> storage capacity, because geomechanical damage caused by overpressure needs to be avoided. In this research, a simple analytical method was developed for the quick assessment of the CO<sub>2</sub> storage capacity in such closed and semi-closed systems. This quick-assessment method is based on the fact that native brine (of an equivalent volume) displaced by the cumulative injected CO<sub>2</sub> occupies additional pore volume within the storage formation and the seals, provided by pore and brine compressibility in response to pressure buildup. With non-ideal seals, brine may also leak through the seals into overlying/underlying formations. The quick-assessment method calculates these brine displacement contributions in response to an estimated average pressure buildup in the storage reservoir. The CO<sub>2</sub> storage capacity and the transient domain-averaged pressure buildup estimated through the quick-assessment method were compared with the “true” values obtained using detailed numerical simulations of CO<sub>2</sub> and brine

transport in a two-dimensional radial system. The good agreement indicates that the proposed method can produce reasonable approximations for storage–formation–seal systems of various geometric and hydrogeological properties. **Quanlin Zhou, Jens T. Birkholzer, Chin-Fu Tsang and Jonny Rutqvist**, *International Journal of Greenhouse Gas Control*, Available online March 21, 2008, doi:10.1016/j.ijggc.2008.02.004, <http://www.sciencedirect.com/science/article/B83WP-4S3P8H1-1/2/fc763c66646cd0191604c6ca29933710>. (Subscription may be required.)

## TECHNOLOGY

### “Pipeline design for a least-cost router application for CO<sub>2</sub> transport in the CO<sub>2</sub> sequestration cycle.”

CO<sub>2</sub> capture and geological storage (CCS) is considered as a viable option to mitigate greenhouse gas emissions during the transition phase towards the use of clean and renewable energy. This paper concentrates on the transport of CO<sub>2</sub> between source (CO<sub>2</sub> capture at plants) and sink (geological storage reservoirs). In the cost estimation of CO<sub>2</sub> transport, the pipeline diameter plays an important role. In this respect, the paper reviews equations that were used in several reports on CO<sub>2</sub> pipeline transport. As some parameters are not taken into



account in these equations, alternative formulas are proposed which calculate the proper inner diameter size based on flow rate, pressure drop per unit length, CO<sub>2</sub> density, CO<sub>2</sub> viscosity, pipeline material roughness and topographic height differences (the Darcy–Weisbach solution) and, in addition, on the amount and type of bends (the Manning solution). Comparison between calculated diameters using the reviewed and the proposed equations demonstrate the important influence of elevation difference (which is not considered in the reviewed equations) and pipeline material roughness-related factor on the calculated diameter. Concerning the latter, it is suggested that a Darcy–Weisbach roughness height of 0.045 mm better corresponds to a Manning factor of 0.009 than higher Manning values previously proposed in literature. Comparison with the actual diameter of the Weyburn pipeline confirms the accuracy of the proposed equations. Comparison with other existing CO<sub>2</sub> pipelines (without pressure information) indicate that the pipelines are designed for lower pressure gradients than 25 Pa/m or for (future) higher flow rates. The proposed Manning equation is implemented in an economic least-cost route planner in order to obtain the best economic solution for pipeline trajectory and corresponding diameter. **V. Vandeginste and K. Piessens**, *International Journal of Greenhouse Gas Control*, Available online March 17, 2008, doi:10.1016/j.ijggc.2008.02.001, <http://www.sciencedirect.com/science/article/B83WP-4S2VG6V-1/2/d001a8db2783a44c86b12251d19be3ad>. (Subscription may be required.)

## TECHNOLOGY (CONTINUED)

### “Implications of generator siting for CO<sub>2</sub> pipeline infrastructure.”

The location of a new electric power generation system with carbon capture and sequestration (CCS) affects the profitability of the facility and determines the amount of infrastructure required to connect the plant to the larger world. Using a probabilistic analysis, [the authors] examine where a profit-maximizing power producer would locate a new generator with carbon capture in relation to a fuel source, electric load, and CO<sub>2</sub> sequestration site. Based on models of costs for transmission lines, CO<sub>2</sub> pipelines, and fuel transportation, [the authors] find that it is always preferable to locate a CCS power facility nearest the electric load, reducing the losses and costs of bulk electricity transmission. This result suggests that a power system with significant amounts of CCS requires a very large CO<sub>2</sub> pipeline infrastructure. **Adam Newcomer and Jay Apt**, *Energy Policy*, Available online March 14, 2008, doi:10.1016/j.enpol.2008.01.038, <http://www.sciencedirect.com/science/article/B6V2W-4S26K5P5/2/2168a29dc95f0e05ceb33b20ee3479fe>. (Subscription may be required.)



## TERRESTRIAL/OCEAN

### *New Scientist*, “Greenhouse Double Whammy for Some Crops... While Others Lock Carbon Away for Years.”

A report in *New Scientist* suggests that one method for cutting GHG levels may be to grow grasses like wheat and sorghum, which are capable of capturing large amounts of CO<sub>2</sub> in their phytoliths, or “plantstones.” Phytoliths are microscopic balls of silica that form around a plant’s cells as they absorb minerals from the soil and trap scraps of plant material. As a result, scientists believe that the practically indestructible phytoliths have the potential to sequester CO<sub>2</sub> for thousands of years. Two scientists from Southern Cross University found that soil buried longer contained a higher proportion of CO<sub>2</sub> than the rest of the soil and that sugar cane is the best carbon capturer at 0.66 tonnes of CO<sub>2</sub> equivalents per hectare per year. Scientists now plan to examine how such CO<sub>2</sub> capturing plants fare in terms of crop yield and quality. January 7, 2008, <http://environment.newscientist.com/channel/earth/mg19726374.800-plantstones-could-help-lock-away-carbon.html>. (Subscription required.)

### “Tillage and wind effects on soil CO<sub>2</sub> concentrations in muck soils.”

Rising atmospheric carbon dioxide (CO<sub>2</sub>) concentrations from agricultural activities prompted the need to quantify greenhouse gas emissions to better understand carbon (C) cycling and its role in environmental quality. The specific objective of this work was to determine the effect of no-tillage, deep plowing and wind speeds on the soil CO<sub>2</sub> concentration in muck (organic) soils of the Florida

Everglades. Miniature infrared gas analyzers were installed at 30 cm and recorded every 15 min in muck soil plowed with the Harrell Switch Plow (HSP) to 41 cm and in soil Not Tilled (NT), i.e., not plowed in last 9 months. The soil CO<sub>2</sub> concentration exhibited temporal dynamics independent of barometric pressure fluctuations. Loosening the soil resulted in a very rapid decline in CO<sub>2</sub> concentration as a result of “wind-induced” gas exchange from the soil surface. Higher wind speeds during mid-day resulted in a more rapid loss of CO<sub>2</sub> from the HSP than from the NT plots. The subtle trend in the NT plots was similar, but lower in magnitude. Tillage-induced change in soil air porosity enabled wind speed to affect the gas exchange and soil CO<sub>2</sub> concentration at 30 cm, literally drawing the CO<sub>2</sub> out of the soil resulting in a rapid decline in the CO<sub>2</sub> concentration, indicating more rapid soil carbon loss with tillage. At the end of the study, CO<sub>2</sub> concentrations in the NT plots averaged about 3.3 [percent] while that in the plowed plots was about 1.4 [percent]. Wind and associated aerodynamic pressure fluctuations affect gas exchange from soils, especially tilled muck soils with low bulk densities and high soil air porosity following tillage. **D.C. Reicosky, R.W. Gesch, S.W. Wagner, R.A. Gilbert, C.D. Wente and D.R. Morris**, *Soil and Tillage Research*, Available online March 26, 2008, doi:10.1016/j.still.2008.02.006, <http://www.sciencedirect.com/science/article/B6TC6-4S4S5GT-1/2/93d474e24ccdf36edf8a448b86bcc22>. (Subscription may be required.)

## TRADING

### Carbon Market Update, April 16, 2008

CCX-CFI 2008 (\$/tCO <sub>2</sub> )	EU ETS-EUA DEC 2008
\$6.00 (Vintage 2008)	(\$/tCO <sub>2</sub> ) \$39.43

(Converted from € to US\$)

### *Boston Globe*, “States’ Inaugural CO<sub>2</sub> Allowance Auction Set for Sept. 10,” and *Carbon Control News*, “RGGI Announces Rules, Date for First CO<sub>2</sub> Allowance Auction.”

The 10 states participating in the Regional Greenhouse Gas Initiative (RGGI) – Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont – announced plans to hold their CO<sub>2</sub> allowance auction on September 10, 2008, less than four months before the cap-and-trade program officially takes effect on January 1, 2009. Although some states’ pending legislation has prevented the finalization of several design elements, the participants have agreed that all market participants will be eligible to participate in the initial auction; participants will be limited to purchasing 25 percent of the allowances offered in any single auction; an initial price of \$1.86 per allowance (equivalent to one ton of CO<sub>2</sub>) will be set for the first auction; any unsold allowances will be available for sale in future auctions; and a decision will be made regarding the retirement of any unsold allowances in 2012. Under the RGGI program, states have established an initial emissions cap of about 188 millions tons – the expected amount of CO<sub>2</sub> power plants will emit in 2009 – and plan to annually reduce the cap 2.5 percent starting in 2015. The cap-and-trade program will ultimately result in a 16 percent decrease in emissions and allow for excess

## TRADING (CONTINUED)

allowances to be sold on the secondary market. For more details about RGGI's design elements, go to: [http://www.rggi.org/docs/20080317auction\\_design.pdf](http://www.rggi.org/docs/20080317auction_design.pdf). March 17, 2008,

[http://www.boston.com/news/local/vermont/articles/2008/03/17/states\\_inaugural\\_co2\\_allowance\\_auction\\_set\\_for\\_sept\\_10/](http://www.boston.com/news/local/vermont/articles/2008/03/17/states_inaugural_co2_allowance_auction_set_for_sept_10/), and March 17, 2008, [http://carboncontrolnews.com/index.php/ccn/show/rggi\\_announces\\_rules\\_date\\_for\\_first\\_co2\\_allowance\\_auction/](http://carboncontrolnews.com/index.php/ccn/show/rggi_announces_rules_date_for_first_co2_allowance_auction/). (Subscription required.)

## RECENT PUBLICATIONS

### **“Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006.”**

An emissions inventory that identifies and quantifies a country's primary anthropogenic sources and sinks of greenhouse gases is essential for addressing climate change. This inventory adheres to both 1) a comprehensive and detailed set of methodologies for estimating sources and sinks of anthropogenic greenhouse gases, and 2) a common and consistent mechanism that enables Parties to the United Nations Framework Convention on Climate Change (UNFCCC) to compare the relative contribution of different emission sources and greenhouse gases to climate change. In 1992, the United States signed and ratified the UNFCCC. As stated in Article 2 of the UNFCCC, “The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.” To download the complete version of EPA's annual national GHG inventory, click: [http://www.epa.gov/climatechange/emissions/downloads/08\\_CR.pdf](http://www.epa.gov/climatechange/emissions/downloads/08_CR.pdf).

### **“Clean Coal Technologies - Accelerating Commercial and Policy Drivers for Deployment.”**

Coal is and will remain the world's most abundant and widely distributed fossil fuel. Burning coal, however, can pollute and it produces carbon dioxide. Clean coal technologies address this problem. The widespread deployment of pollution-control equipment to reduce sulphur dioxide, [nitrogen oxide (NO<sub>x</sub>)] and dust emissions from industry is just one example which has brought cleaner air to many countries. Since the 1970s, various policy and regulatory measures have created a growing commercial market for these clean coal technologies, with the result that costs have fallen and performance has improved. More recently, the need to tackle rising CO<sub>2</sub> emissions to address climate change means that clean coal technologies now extend to include those for CO<sub>2</sub> capture and storage (CCS). To read the complete International Energy Agency (IEA) publication, click: [http://www.iea.org/textbase/papers/2008/Clean\\_Coal\\_CIAB\\_2008.pdf](http://www.iea.org/textbase/papers/2008/Clean_Coal_CIAB_2008.pdf).

### **“Analysis of the Lieberman-Warner Climate Security Act (S. 2191) Using the National Energy Modeling System (NEMS/ACCF/NAM).”**

The American Council for Capital Formation (ACCF) and the National Association of Manufacturers (NAM) believe it important to fully and realistically examine the potential costs that enactment of Lieberman-Warner Climate Security Act (S. 2191) would impose on the U.S. economy. It is becoming increasingly recognized that the cost to U.S. consumers and employers of implementing greenhouse gas (GHG) emission reductions is highly dependent on the market penetration achieved by key technologies and the availability of carbon offsets by 2030. Understanding the potential economic impacts at the national, state and individual household levels can help guide choices on climate change policy to minimize the impacts on economic growth and maximize the benefits to the environment. Greenhouse gas reduction policies need to include consideration of impacts on energy security, economic growth, and U.S. competitiveness. To view the report, written by Science Applications International Corporation (SAIC), go to: <http://www.accf.org/pdf/NAM/fullstudy031208.pdf>.

### **“Measuring Forest Carbon: Strengths and Weaknesses of Available Tools.”**

Policy makers at every level recognize the importance of forests in the global carbon cycle, and there is a growing consensus that protecting forestland and enhancing its carbon stores will be an important component of any attempt to mitigate climate change. Whether it's Congress considering a national cap-and-trade system, the Regional Greenhouse Gas Initiative (scheduled for the northeastern U.S. in 2009), or the California Climate Action Registry Forest Project Protocol, forests will play an important role in carbon storage and mitigating climate change. As these efforts unfold, it's important to develop accurate measures of the carbon stored in forests and the changes in those stores over time. To read the complete policy brief, compiled by The Wilderness Society, click: <http://wilderness.org/Library/Documents/upload/FR7-28carbonbrief.pdf>.

## LEGISLATIVE ACTIVITY

*Environment & Energy Daily*, “Quick Fix Makes Lieberman-Warner Bill Deficit Neutral – CBO.”

Following an earlier Congressional Budget Office (CBO) report that

Senate bill S. 2191, “America's Climate Security Act,” would add \$15 billion over 10 years to the Federal government's record budget deficit, Senators Barbara Boxer, Joe Lieberman, and John Warner drafted an amendment rearranging the way that money raised from auctioning off GHG emission credits can be spent. The amendment created the “Climate Change Deficit Reduction Fund,” which would set aside about six percent of the cap-and-trade program's annual revenue in 2012

# LEGISLATIVE ACTIVITY (CONTINUED)

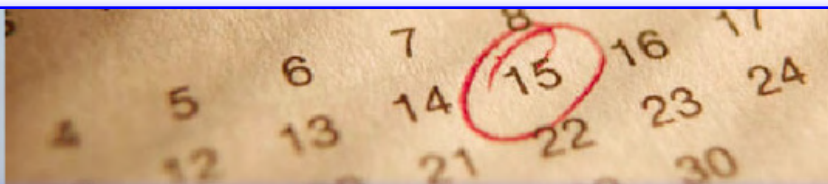
and increase to 16 percent by 2031, resulting in some \$78 billion over 10 years that would go toward the US Treasury. The April 10, 2008, CBO report states that S. 2191 would increase government revenue by \$1.21 trillion from 2009 to 2018, when direct government spending is expected to total \$1.13 trillion.



CBO officials contend the projected deficit figure is derived from their option to count the free distribution of the bill's emission credits as the government giving away money as part of a new \$100 billion market. To read the new CBO report, click: [http://www.eenews.net/features/documents/2008/04/11/document\\_daily\\_03.pdf](http://www.eenews.net/features/documents/2008/04/11/document_daily_03.pdf), or click [http://www.eenews.net/features/documents/2008/04/11/document\\_daily\\_04.pdf](http://www.eenews.net/features/documents/2008/04/11/document_daily_04.pdf) for the original CBO report, dated December 5, 2007. The Boxer-Lieberman-Warner amendment is available at: [http://www.eenews.net/features/documents/2008/04/11/document\\_daily\\_02.pdf](http://www.eenews.net/features/documents/2008/04/11/document_daily_02.pdf). April 11, 2008, [http://www.eenews.net/EEDaily/most\\_read/2008/04/11/2/](http://www.eenews.net/EEDaily/most_read/2008/04/11/2/).

## Reuters, "Bush Urges Halt of CO<sub>2</sub> Emission Growth by 2025."

On April 16, President George W Bush called for the United States to stop the growth of GHG emissions by 2025 and said coal-fired power plants need to develop new methods for reducing GHGs. Some view the 2025 timeframe as an essential first step in the United States' efforts to reduce GHG emissions, although some feel that his position falls significantly short of scientific recommendations. While President Bush's approach does not go to the extent of European emissions goals or domestic lawmakers' proposals, his speech was aimed to influence the upcoming mandatory CO<sub>2</sub> rules debate in June and global climate change talks that took place April 16-18 in Paris, France. President Bush added that he does not believe measures like new taxes, abandoning nuclear power, or adopting trade barriers would resolve the GHG issue; instead, he favors strong new laws, appropriate incentives, and adherence to the principles he discussed. In the past, President Bush has opposed setting mandatory emissions caps, because of the possible threat to the US economy and lack of action from developing nations like China and India. For a transcript of President Bush's speech, click: [http://www.eenews.net/features/documents/2008/04/16/document\\_pm\\_02.pdf](http://www.eenews.net/features/documents/2008/04/16/document_pm_02.pdf). April 16, 2008, <http://www.reuters.com/article/environmentNews/idUSN1518272120080416>.



## EVENTS

May 5-8, 2008, **7<sup>th</sup> Annual Carbon Capture and Sequestration Conference**, *Sheraton at Station Square, Pittsburgh, PA, USA*. This conference brings together experts directly involved in developing, demonstrating and deploying CO<sub>2</sub> capture, separation, and sequestration technologies. The 7th annual conference will address the knowledge, policy, regulatory, and technology gaps hindering expedited CCS deployment. Attendees will have the opportunities to discuss carbon capture, separation, and sequestration technologies and share experiences on developing the necessary capacity within the public and private sector to move the technology base forward. To browse the conference website, click: <http://www.carbonsq.com/>.

May 5-8, 2008, **Carbon Constraint**, *Baltimore Convention Center, Baltimore, Maryland, USA*. Carbon Constraint is an executive conference addressing the power industry's management of CO<sub>2</sub> in an increasingly carbon-constrained world. The conference includes presentations on GHG legislative challenges, EPA administrative actions, the global carbon cycle in a changing climate, keys aspects of site selection for power plants with carbon capture, and the status and implications of GHG policy developments. Conference agenda and a brochure are available at: <http://www.carbonconstraint.com/>.

May 7-9, 2008, **Carbon Expo 2008**, *Exhibition Center, Cologne, Germany*. Carbon Expo 2008 offers attendees a total of eight plenary sessions and 22 workshops divided into three parallel "streams" – Project, Traders, or Global – about the state of the global carbon market, Joint Implementation (JI), Clean Development Mechanism (CDM), European Union Emissions Trading Scheme (EU ETS), carbon markets, non-Kyoto markets, and market outlook. For a conference brochure, visit: [http://www.carbonexpo.com/wEnglisch/carbonexpo2/img/dokumente/Conferenz\\_Programm.pdf](http://www.carbonexpo.com/wEnglisch/carbonexpo2/img/dokumente/Conferenz_Programm.pdf) or <http://www.carbonexpo.com/> for general conference information.

May 15-16, 2008, **Navigating the New Carbon World**, *San Diego Marriott Hall & Marina, San Diego, California, USA*. This annual conference allows over 1,000 climate change leaders to discuss evolving climate policies, standards, and trends. Topics include: National Climate Registry developments, carbon Markets, plans to curb emissions, international standards and reduction projects, carbon capture and sequestration technologies, and new and emerging climate change issues. To register for Navigating the Carbon World, click: <http://www.pointcarbon.com/Events/Navigating%20the%20Carbon%20World/category1538.html>.





## EVENTS (CONTINUED)

May 28-30, 2008, **Carbon Finance & Investment Summit**, *Embassy Suites Hotel, New York City, New York, USA*. The 2008 Summit will focus on the growing opportunities in the budding carbon project market and advise how market players can position themselves to profit from the potential flow of carbon deals in 2008 and beyond. Attendees will learn from experts about the types of opportunities they are pursuing, the strategies they are adopting, the type of relationships they are seeking to establish, the drivers that will determine which type of deals they are willing to pursue, and what they plan to do in 2008. For more information, visit: <http://www.infocasting.com/index.php/conference/carbon08>.

June 1-5, 2008, **The Clearwater Coal Conference**, *Sheraton Sand Key, Clearwater, Florida, USA*. This five day conference, coined as the most comprehensive program on coal technologies, will highlight the issues currently impacting the electric utility industry, such as: coal and CO<sub>2</sub> for the future; coal quality issues; coal-related opportunities in developing countries; advanced energy conversion systems; and pre-combustion, post-combustion, and Oxyfuel CO<sub>2</sub> solutions. To view the conference program, click: <http://www.coaltechnologies.com/2008%20Program%20Announcement.pdf>.

June 5-6, 2008, **The Myth and Reality of the Carbon Market**, *Washington, DC, USA*. Active Communications International presents “The Myth and Reality of the Carbon Market,” a new forum for individuals to meet and discuss the financial and practical implications of the carbon trading market. Panel discussions and workshops will focus on the status of North American carbon markets and how they are likely to develop, opportunities for North American investors, long term global and North American carbon prices, and CCS, among other topics. For more information, visit: <http://acius.net/Conferences/Upcoming?view=overview&id=57>.

June 12-13, 2008, **Global CO<sub>2</sub> Summit**, *Millennium Gloucester Hotel, London, England*. In order to help the energy sector respond to an ever-changing environment, the Global CO<sub>2</sub> Summit will enhance engagement and collaboration amongst policymakers, raise awareness concerning GHG reduction, leverage the business opportunities arising from global actions to reduce CO<sub>2</sub>, reduce exposure to future portfolio and regulatory risk, and teach how to transform CO<sub>2</sub> emissions liabilities into financial assets. For detailed information and a conference brochure, visit: [http://www.thecwcgroup.com/conf\\_detail\\_home.asp?FP=1&CID=186](http://www.thecwcgroup.com/conf_detail_home.asp?FP=1&CID=186).

June 25-26, 2008, **Carbon Capture and Sequestration**, *Renaissance Hotel, Houston, Texas, USA*. This conference provides attendees the latest information on new projects in different US and Canadian regions. Among the many topics to be discussed: project development, including retrofits, syngas, and transportation via pipeline; geological sequestration, including EOR and suitable formations; and the latest trends in permitting, including jurisdiction over underground storage and the rights of involved parties. For conference details, go to: <http://www.platts.com/Events/2008/pc819/>.

July 1-3, 2008, **COAL-GEN Europe**, *EXPO XXI, Warsaw, Poland*. This conference offers attendees presentations about the latest issues affecting the design, development, upgrading, and operation and maintenance of coal-fired power plants. Attendees have the option of taking one of three different tracks, including, “Environmental Technologies and Issues,” which includes presentations on CO<sub>2</sub> reduction and technical issues. A detailed Pre-Show Guide is available for download at: [http://downloads.pennnet.com/events/cge08/1108\\_cge08preshowguide.pdf](http://downloads.pennnet.com/events/cge08/1108_cge08preshowguide.pdf).

## 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](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](mailto:sean.plasynski@netl.doe.gov), or Dawn Deel at [dawn.deel@netl.doe.gov](mailto:dawn.deel@netl.doe.gov).