



Carbon Sequestration Newsletter

NOVEMBER 2008

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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 Releases Methodology Used to Estimate Carbon Dioxide Storage Potential."

The US Department of Energy (DOE) released its "Methodology for Development of Geologic Storage Estimates for Carbon Dioxide," a document detailing the procedures used to produce the geologic resource estimates for carbon dioxide (CO₂) storage potential in the 2008 Carbon Sequestration Atlas of the United States and Canada (Atlas II). The document outlines the procedures for estimating CO₂ storage potential

in three types of geological formations found in the United States and Canada: saline formations, unmineable coal seams, and oil and gas reservoirs. The methodologies are based on widely accepted assumptions associated with fluid distribution and displacement processes commonly applied in petroleum and groundwater science. Leadership for this document was provided by the Capacity and Fairways Subgroup, a subcommittee convened in 2006 by the Regional Carbon Sequestration Partnerships' (RCSP) Geological Working Group to develop the first carbon sequestration atlas. The document will be presented as an appendix in Atlas II, which DOE expects to release later this year. The Atlas recently won an APEX Grand Award for publication excellence. (See Recent Publications section for abstract and link to DOE's "Methodology for Development of Geologic Storage Estimates for Carbon Dioxide.") To view the March 2007 Carbon Sequestration Atlas of the United States and Canada (Atlas I), visit: http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlas/index.html. October 1, 2008, http://www.fossil.energy.gov/news/techlines/2008/08055-DOE_Releases_Carbon_Storage_Method.html.

DOE Press Release, "DOE Announces Solicitation for \$8.0 Billion in Loan Guarantees."

DOE announced a solicitation for up to \$8.0 billion in Federal loan guarantees for projects that employ advanced technologies that avoid, reduce, or sequester greenhouse gas (GHG) emissions resulting from coal-based power generation, industrial gasification, or advanced coal gasification facilities. This solicitation, marking the third round of solicitations for DOE's Loan Guarantee Program, will make \$6 billion in loan guarantee authority available for the incorporation of carbon capture and storage (CCS) technologies into industrial gasification activities, as well as retrofitted or new coal-based power generation facilities. An additional \$2 billion in loan guarantee authority will be made available for advanced coal gasification projects, which convert coal into electricity, hydrogen, and other energy products. The selection criteria for the clean energy projects will focus on a project's ability to avoid, reduce, or sequester GHG emissions; the speed that the technologies can be commercialized; the prospect of repayment of the guaranteed debt; and the potential for long-term market success. Authorized by Title XVII of the Energy Policy Act of 2005 (EPAct), DOE's Loan Guarantee Program aims to facilitate commercialization of new or significantly improved technologies in energy-related projects. Additional information regarding this solicitation and DOE's Loan Guarantee Program is available at: <http://www.lgprogram.energy.gov/>. September 22, 2008, <http://www.energy.gov/news/6565.htm>.



National Energy Technology Laboratory

626 Cochran's Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940

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

One West Third Street, Suite 1400
Tulsa, OK 74103-3519

1450 Queen Avenue SW
Albany, OR 97321-2198

2175 University Ave. South, Suite 201
Fairbanks, AK 99709

Sean I. Plasynski
412-386-4867
sean.plasynski@netl.doe.gov

Dawn M. Deel
304-285-4133
dawn.deel@netl.doe.gov

Visit the NETL website at:
www.netl.doe.gov

Customer Service:
1-800-553-7681

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SEQUESTRATION IN THE NEWS

Government of Alberta News Release, "First Field Tests of Carbon Capture and Storage to Begin," and **Edmonton Journal, "Shell Goes Deep with \$20M Carbon Dioxide Research Project."**

The Government of Alberta announced that three test wells will soon be drilled for a large-volume CO₂ sequestration project in Alberta, Canada, to support Alberta's Climate Change Strategy by examining the CO₂ injection capability and storage capacity in formations deep beneath the Earth's surface. Through the Alberta Energy Research Institute (AERI), the Government of Alberta is providing \$6.6 million in funding for the three-year, \$20-million project near Shell Canada's Scotford facility. According to Shell, the first well will be drilled at the Scotford upgrader site and two more wells would be located 10 and 60 kilometers away. Officials acknowledged the possibility that two more wells may have to be drilled to understand the geology of the area, as there are few cores available to study. Shell has already initiated the engineering and design work necessary for the bitumen upgraders to add carbon capture technology and officials project small amounts of CO₂, likely between 50 and 100 tonnes of CO₂ per year, could be captured and injected, eventually increasing to 1.2 million tonnes per year. The field test phase is expected to conclude by June 2010. The funding is independent of Alberta's \$2 billion CCS fund, which seeks to reduce CO₂ emissions by up to 5 million tonnes per year by 2015 through the development of three to five commercial-scale CCS projects. For more information on AERI, visit: <http://www.aeri.ab.ca/>. October 16, 2008, <http://www.alberta.ca/acn/200810/24549060A11EE-A487-6EAB-0BA6A4955D18D734.html>, and October 17, 2008, <http://www.canada.com/edmontonjournal/news/business/story.html?id=15c3deea-5975-42ed-aba0-21dded11ce8>.

ScottishPower Press Release, "ScottishPower Looks to North Sea Storage Potential for Carbon Emissions," and **New Energy Focus, "ScottishPower Group Investigates North Sea Carbon Storage Site."**

Following its qualification as a participant in the United Kingdom's (UK) competition to develop the nation's first commercial-scale CCS project, a consortium led by ScottishPower is investigating whether a formation under the North Sea could store all of Europe's CO₂ emissions for the next 600 years. The plan calls for two of the four burner units at the Fife-based, 2.3-Gigawatt Longannet Power Station to utilize CCS technology designed by Aker that would strip CO₂ emissions using chemical solvents. The CO₂ would be liquefied for transportation to existing oil and gas pipelines for storage in a formation in the Firth of Forth. ScottishPower officials believe the Longannet Power Station could become a center to handle CO₂ emissions from all of Scotland and the North of England. The proposed activity is one of four entries in the UK Government's Department for Business, Enterprise, and Regulatory Reform (BERR) competition to test a "full chain" of CCS technologies by 2014. The demonstration project requires that 90 percent of CO₂ emissions from a 300- to 400-megawatt generating facility are captured. E.ON, BP Alternative Energy International Ltd, and Peel Power Ltd have also entered the competition. The Longannet Power Station is Europe's third largest coal-based power station. For more details about BERR's CCS demonstration competition, click:

SEQUESTRATION IN THE NEWS (CONTINUED)

<http://www.berr.gov.uk/whatwedo/energy/sources/sustainable/ccs/ccs-demo/page40961.html>. September 16, 2008, http://www.scottishpower.com/PressReleases_1755.htm, and September 19, 2008, http://newenergyfocus.com/do/ecco.py/view_item?listid=1&listcatid=32&listitemid=1709§ion.

Alberta Saline Aquifer Project News Release, “Alberta Saline Aquifer Project Awards Key Contracts to Launch Carbon Sequestration Pilot in Early 2009.”

The Alberta Saline Aquifer Project (ASAP) announced that five companies were awarded contracts for the engineering, design, and environmental-related work needed for Phase I of the initiative. Specifically, Norwest Engineering will identify three potential aquifers in Alberta, Canada, with the assistance of an Athabasca Basin data log donated by ConocoPhillips. Schlumberger Carbon Services will develop a set of monitoring, verification, and accounting (MVA) protocols. Colt WorleyParsons will produce a pre-Front End Engineering Design (FEED) study and cost estimate on the compression and pipeline system to carry the CO₂ in liquid form to the sequestration sites and conduct a preliminary study of any health and safety concerns that could affect the public, wildlife, or the environment. Hatch Energy

will design and prepare a cost estimate for the facilities needed at the sequestration sites. Finally, Oxand Canada will develop risk and mitigation strategies associated with compressing, transporting, and sequestering CO₂. The contracts indicate that Phase I, which includes the identification of viable formation locations and applications for permitting, is on schedule for completion by the end of 2008. Several companies have agreed to donate a reservoir injection simulation and a report containing recommendations on several MVA approaches to achieve the project’s Phase I goals. ASAP believes that Phase II, consisting of constructing the pilot project and initiating CO₂ injection, will begin in 2009 (dependant upon regulatory approval). The initiative’s Phase III activities entail expanding the pilot-scale project to a large-scale, commercial operation. For more information about the 35-member ASAP, visit: <http://www.albertaasap.com/>. September 22, 2008, <http://www.albertaasap.com/pdf/ASAP-News-Release-Sept17.pdf>.



ANNOUNCEMENTS

Panel Addresses Key Regulatory, Liability Issues Associated With CCS.

E&E TV presented a video of a roundtable discussion held at the 2008 Gasification Technologies Conference that addressed non-technical issues associated with CCS, such as economic, legal, regulatory, and liability issues. The video can be found at: http://www.eenews.net/tv/video_guide/870?page=1&sort_type=date. To view a transcript of the discussion, visit: <http://www.eenews.net/tv/transcript/870>.

CO₂ Geological Storage Modeling Workshop.

The International Energy Agency’s Greenhouse Gas R&D Program (IEA GHG) is planning to hold a workshop on the modeling of CO₂ geological storage on February 10-12, 2009, in Orleans, France. The workshop will consist of presentations and discussion sessions, and will also debate the potential benefits of forming an international research network on modeling. Registration is requested by November 23, 2008. To learn more about the workshop, click: <http://www.co2captureandstorage.info/networks/1stmodelling.htm>.

South Africa to Publish Carbon-Storage Atlas in 2010.

South Africa will begin an 18-month investigation into locating and characterizing potential carbon geological-storage sites for the compilation of a CO₂ Geological Storage Atlas. The Atlas will report methodologies and storage-potential evaluations for all of the onshore and offshore basins of South Africa to provide ranking of the basins according to risk and tectonic settings. For more information, visit: http://www.geoscience.org.za/index.php?option=com_content&task=view&id=697&Itemid=337.

Climate Change Exhibit.

The exhibit, “Climate Change: The Threat to Life and A New Energy Future,” opened on October 18, 2008, at the American Museum of Natural History in New York City, New York, USA. The exhibition examines how climate change could affect humans, the atmosphere, polar ice caps, ecosystems, sea levels, drought, storms, and temperatures. Included is a spotlight on CO₂, featuring an illustration of technological advances since the Industrial Revolution and the corresponding rise in CO₂ levels in the atmosphere. For detailed information, visit: <http://www.amnh.org/exhibitions/climatechange/>.

SCIENCE

Science Daily, “Tropical Rainforest And Mountain Species May Be Threatened By Global Warming,” and *Reuters*, “Climate Change May Threaten Biodiversity in Tropics.”

According to a recent report by the University of Connecticut, tropical plant and animal species living in some of the warmest places on Earth may be threatened by potential climate change. The report claims that tropical climates have warmed more than three-fourths of a degree



Celsius (1.4 degrees Fahrenheit) since 1975 and climate models predict an additional increase of more than three degrees Celsius (nearly six degrees Fahrenheit) over the next century in the tropical forests of Central and South America. This warming would cause temperature zones to shift approximately 2,000 feet above sea level. Data was analyzed on nearly 2,000 species of plants, insects, and fungi in Costa Rica and it was found that nearly half of the species would have to move to higher ground. As a result, since no other species are adapted to the climate, lowland populations in the tropics may experience decreases in biodiversity and species at higher elevations may run out of room to climb higher due to human land use. To view the report, titled, “Global Warming, Elevational Range Shifts, and Lowland Biotic Attrition in the Wet Tropics,” go to: <http://www.sciencemag.org/cgi/content/abstract/322/5899/258>. (Subscription may be required). October 10, 2008, <http://www.sciencedaily.com/releases/2008/10/081009143700.htm>, and October 9, 2008, <http://www.reuters.com/article/environmentNews/idUSTRE4989MY20081009?pageNumber=1&virtualBrandChannel=10279>.

ClimateWire, “Temperature Spikes Cramp Plants’ Ability to Absorb CO₂, Study Finds.”

A new study has concluded that one year of warmth can reduce some plants’ and soils’ ability to capture CO₂ from the air for up to two years. The study, conducted by the Nevada-based Desert Research Institute, is based on a four-year experiment that involved placing 12 large chunks of a grassland ecosystem (plants, soil, and soil microbes) in four climate-controlled containers. Computers were used to adjust the temperature and humidity to simulate days, nights, and seasons. After a year, the heat was turned up on half of the grassland chunks, warming them by approximately 7.2 degrees Fahrenheit, the high end of temperature rise the Intergovernmental Panel on Climate Change (IPCC) predicts could occur by the end of this century. The results showed that the heated plants absorbed two-thirds less CO₂ than the plants growing in normal conditions. When the temperatures returned to normal, the once-heated ecosystems still absorbed less CO₂ because the activity of CO₂-producing soil microbes increased. According to the report, the research suggests that an increase in the number of warm years could possibly create a new climate feedback loop at the extreme end, turning some ecosystems from carbon sinks into carbon sources. The study, titled, “Prolonged suppression of ecosystem carbon dioxide uptake after an anomalously warm year,” can be accessed at:

<http://www.nature.com/nature/journal/v455/n7211/full/nature07296.html>. (Subscription may be required). September 18, 2008, <http://www.eenews.net/climatewire/2008/09/18/4/>.

POLICY

Norwegian Ministry of Petroleum and Energy Press Release, “Nearly Two Billion NOK for Carbon Capture and Storage in 2009,” and *Reuters*, “Norway Earmarks \$309 Mln for Carbon Storage in ‘09.”



As part of its 2009 draft budget, the Norwegian government proposed spending ~\$287 million on CCS technology in order to capture CO₂ emissions from power plants and other industrial sources and to bury the emissions underground or below the North Sea. In terms of domestic CCS projects, ~\$139 million would be allocated to a CCS test center at the Mongstad power plant located on Norway’s North Sea coastline and ~\$29 million would finance another carbon capture project at the Kårstø gas-processing unit before an investment decision anticipated by the end of 2009, according to ministry officials. In addition, the draft budget calls for ~\$86 million dedicated to the “planning and preparations of the transportation and storage of captured [CO₂].” Norway’s national program to fund research, development, and demonstration (RD&D) of CCS technologies, CLIMIT, would receive approximately \$23 million in 2009. Most of the remaining funds, estimated at \$3 million, would be spent on an action plan for international research and on the promotion of Norway’s goal to encourage the acceptance of CCS as a viable tool to reduce CO₂ emissions. More information about Norway’s CCS-related initiatives can be found at: <http://www.regjeringen.no/en/dep/oed/Subject/Carbon-capture-and-storage.html?id=86982>. October 7, 2008, <http://www.regjeringen.no/en/dep/oed/press-center/Press-releases/2008/nearly-two-billion-nok-for-carbon-capture.html?id=528880>, and October 7, 2008, <http://www.reuters.com/article/rbssEnergyNews/idUSL76861120081007>.

“Regional abatement action and costs under allocation schemes for emission allowances for achieving low CO₂-equivalent concentrations.”

The following is the abstract of this article: “This paper assesses regional abatement action and costs for two scenarios in which atmospheric [GHG] concentrations stabilize at 450 and 550 ppm CO₂-equivalent. It evaluates two allocation schemes: Multi-Stage and Contraction [and] Convergence. It was found that abatement costs as percentages of GDP vary significantly by region, with high costs for the Middle East and the former Soviet Union, medium costs for the OECD regions and low costs or even gains for (other) developing regions. In addition to the abatement costs they incur, fossil-fuel-exporting regions are also likely to be affected by losses of coal and oil exports while the former Soviet Union and South America could experience increased bio-energy exports. Especially in the former Soviet Union and Asia, non-CO₂ abatement options are important in the short term in reducing their emissions. [CCS], energy efficiency improvements, bio-energy use,

POLICY (CONTINUED)

and the use of renewables dominate reductions in the long term in all regions. It was found that the regional costs are influenced more by the assumed stabilization level and baseline scenario than by the allocation regimes explored or the assumptions for different technologies.”

Michel G. J. den Elzen, Paul L. Lucas, and Detlef P. van Vuuren, *Earth and Environmental Science*, Available online September 3, 2008, doi:10.1007/s10584-008-9466-1, <http://www.springerlink.com/content/q14328j1822q4723/?p=e3df9ac86e184d70b71eae53812d5575&pi=4>. (Subscription required.)

GEOLOGY

“Gravity Currents with Residual Trapping.”

The following is the abstract of this article: “Motivated by geological CO₂ storage, [the authors] present a vertical-equilibrium sharp-interface model for the migration of immiscible gravity currents with constant residual trapping in a two-dimensional confined aquifer. The residual acts as a loss term that reduces the current volume continuously. In the limit of a horizontal aquifer, the interface shape is self-similar at early and at late times. The spreading of the current and the decay of its volume are governed by power-laws. At early times the exponent of the scaling law is independent of the residual, but at late times it decreases with increasing loss. Owing to the self-similar nature of the current the volume does not become zero, and the current continues to spread. In the hyperbolic limit, the leading edge of the current is given by a rarefaction and the trailing edge by a shock. In the presence of residual trapping, the current volume is reduced to zero in finite time. Expressions for the up-dip migration distance and the final migration time are obtained. Comparison with numerical results shows that the hyperbolic limit is a good approximation for currents with large mobility ratios even far from the hyperbolic limit. In gently sloping aquifers, the current evolution is divided into an initial near-parabolic stage, with power-law decrease of volume, and a later near-hyperbolic stage, characterized by a rapid decay of the plume volume. [The authors’] results suggest that the efficient residual trapping in dipping aquifers may allow CO₂ storage in aquifers lacking structural closure, if CO₂ is injected far enough from the outcrop of the aquifer.” **M. A. Hesse, F. M. Orr Jr., and H. A. Tchelepi**, *Journal of Fluid Mechanics*, Available online August 26, 2008, doi:10.1017/S002211200800219X, <http://pangea.stanford.edu/~mhese/papers/TrappingJFM.pdf>. (Subscription may be required.)

“Large-scale impact of CO₂ storage in deep saline aquifers: A sensitivity study on pressure response in stratified systems.”

The following is the abstract of this article: “Large volumes of CO₂ captured from carbon emitters (such as coal-fired power plants) may be stored in deep saline aquifers as a means of mitigating climate change. Storing these additional fluids may cause pressure changes and displacement of native brines, affecting subsurface volumes that can be significantly larger than the CO₂ plume itself. This study aimed at determining the three-dimensional region of influence during/after injection of CO₂ and evaluating the possible implications for shallow

groundwater resources, with particular focus on the effects of interlayer communication through low-permeability seals. To address these issues quantitatively, [the authors] conducted numerical simulations that provide a basic understanding of the large-scale flow and pressure conditions in response to industrial-scale CO₂ injection into a laterally open saline aquifer. The model domain included an idealized multilayered groundwater system, with a sequence of aquifers and aquitards (sealing units) extending from the deep saline storage formation to the uppermost freshwater aquifer. Both the local CO₂-brine flow around the single injection site and the single-phase water flow (with salinity changes) in the region away from the CO₂ plume were simulated. [The authors’] simulation results indicate considerable pressure buildup in the storage formation more than 100 km away from the injection zone, whereas the lateral distance migration of brine is rather small. In the vertical direction, the pressure perturbation from CO₂ storage may reach shallow groundwater resources only if the deep storage formation communicates with the shallow aquifers through sealing units of relatively high permeabilities (higher than 10–18 mD). Vertical brine migration through a sequence of layers into shallow groundwater bodies is extremely unlikely. Overall, large-scale pressure changes appear to be of more concern to groundwater resources than changes in water quality caused by the migration of displaced saline water.” **Jens T. Birkholzer, Quanlin Zhou, and Chin-Fu Tsang**, *International Journal of Greenhouse Gas Control*, Available online October 8, 2008, doi:10.1016/j.ijggc.2008.08.002, <http://www.sciencedirect.com/science/article/B83WP-4TMHM10-1/2/838188a7dcb1a98bf8cd9edb74ae8c5c>. (Subscription may be required.)

TECHNOLOGY

“Electrolysis and heat pretreatment methods to promote CO₂ sequestration by mineral carbonation.”

The following is the abstract of this article: “As a new mineral carbonation process for CO₂ sequestration, electrolysis of NaCl solution and serpentine as the source of Mg²⁺ to adsorb CO₂ in the simulating flue gas is introduced, which used the electrolyze NaCl solution to produce the HCl solution and NaOH solution. The HCl solution was used to dissolve Mg²⁺ from serpentine, and the NaOH solution was used to adsorb CO₂ in simulation smoke, then these two solutions were mixed to form MgCO₃ deposition at 358 K, which could be processed at relative low temperature and pressure. In order to further increase the solubility of Mg²⁺ from serpentine, the heat pretreatment of serpentine under nitrogen was investigated. The results indicated that the heat activation dramatically enhanced serpentine carbonation. [X-ray diffraction (XRD), thermogravimetric analysis (TGA), Fourier transform infrared (FT-IR), and inductively coupled plasma atomic emission spectroscopy (ICP-AES)] analyses indicated that the best activation temperature was 650°C, at which the crystalline features were changed from lizardite to amorphous followed the decomposition of hydroxyl groups. The dissolved capacity decreased with further increasing heat activation temperature, which might be related to the formation of a new crystalline feature. The XRD and TGA analyses showed that the solid product was mainly pure basic magnesium carbonate.” **Wenzhi Li, Wen Li, Baoqing Li, and Zongqing Bai**, *Chemical Engineering Research and Design*, Available online September 17, 2008, doi:10.1016/j.cherd.

TECHNOLOGY (CONTINUED)

2008.08.001, <http://www.sciencedirect.com/science/article/B8JGF-4TG2963-1/2/69596194c91bb0af07c65d068807958c>. (Subscription may be required.)

“Modeling of Coal Bed Methane (CBM) Production and CO₂ Sequestration in Coal Seams.”

The following is the abstract of this article: “A mathematical model was developed to predict the coalbed methane (CBM) production and CO₂ sequestration in a coal seam accounting for the coal seam properties. The model predictions showed that, for a CBM production and dewatering process, the pressure could be reduced from 15.17 MPa to 1.56 MPa and the gas saturation increased up to 50 [percent] in 30 years for a 5.4x10⁵ m² of coal formation. For the CO₂ sequestration process, the model prediction showed that the CO₂ injection rate was first reduced and then slightly recovered over [three] to 13 years of injection, which was also evidenced by the actual in seam data. The model predictions indicated that the sweeping of the water in front of the CO₂ flood in the cleat porosity could be important on the loss of injectivity. Further model predictions suggested that the injection rate of CO₂ could be about 11x10³ m³ per day; the injected CO₂ would reach the production well, which was separated from the injection well by 826 m, in about 30 years. During this period, about 160x10⁶ m³ of CO₂ could be stored within a 21.4x10⁵ m⁶ of coal seam with a thickness of 3 meters.” **Ekrem Ozdemir**, *International Journal of Coal Geology*, Available online September 16, 2008, doi:10.1016/j.coal.2008.09.003, <http://www.sciencedirect.com/science/article/B6V8C-4TFW960-2/2/dc8fa31f2b545cc74f82f3f8c5afb720>. (Subscription may be required.)

-wheat except that the amounts of N, P₂O₅ and K₂O were 100, 50 and 50 kg ha⁻¹, respectively. In rice-wheat system, the SOC concentration at different depths in 0–60 cm soil profile was higher (1.8–6.2 g kg⁻¹) in FYM-treated plots followed by 1.7–5.3 g kg⁻¹ in NPK plots, compared to 0.9–3.0 g kg⁻¹ in unfertilized plots. Balanced fertilization improved the SOC concentration. Similar trend was found in maize-wheat system. In the 60-cm soil profile the total SOC stocks in both the cropping systems were highest in FYM (31.3 and 23.3 Mg ha⁻¹ in rice-wheat and maize-wheat system) followed by balanced fertilization (29.6 and 21.3 Mg ha⁻¹) and lowest in unfertilized control (21.4 and 18.7 Mg ha⁻¹). The SOC concentration in rice-wheat soils was 54 and 30 [percent] higher in FYM and NPK plots than in maize-wheat system. Improved SOC content enhances soil quality, reduces soil erosion and degradation, and increases soil. The soils under rice-wheat sequestered 55 [percent] higher SOC in FYM plots and 70 [percent] higher in NPK plots than in maize-wheat. These results document the capacity of optimally fertilized rice-wheat system to sequester higher C as compared to maize-wheat system.” S.S. **Kukul, Rehana-Rasool, and D.K. Benbi**, *Soil and Tillage Research*, Available online September 6, 2008, doi:10.1016/j.still.2008.07.017, <http://www.sciencedirect.com/science/article/B6TC6-4TCPN08-1/2/70af19034e27fea01361321482686148>. (Subscription may be required.)

TRADING

Carbon Market Update, October 17, 2008

CCX-CFI 2008 (\$/tCO ₂)	EU ETS-EUA DEC 2008
\$1.80 (Vintage 2008)	(\$/tCO ₂) \$29.22

(Converted from € to US\$)

TERRESTRIAL/OCEAN

“Soil organic carbon sequestration in relation to organic and inorganic fertilization in rice-wheat and maize-wheat systems.”

The following is the abstract of this article: “Soil organic carbon (SOC) pool is the largest among the terrestrial pools. The restoration of SOC pool in arable lands represents a potential sink for atmospheric CO₂. The management and enhancement of SOC is important for sustainable agriculture. The cropping system and soil type influence crop biomass under different fertilization. Data from two long-term field experiments on rice-wheat and maize-wheat systems in progress since 1971 were analyzed to assess the impact of fertilization practices on SOC stocks in sandy loam soils (typic ustipsament). The treatments in rice-wheat included (i) farmyard manure (FYM alone [at] 20 t ha⁻¹, applied at the time of pre-puddling tillage), (ii) N₁₂₀P₃₀K₃₀ (120 kg N, 30 kg P₂O₅ and 30 kg K₂O ha⁻¹), (iii) N₁₂₀P₃₀ (same as in (ii) except that K application was omitted), (iv) N₁₂₀ (same as in (ii) except that P and K application was omitted) and (v) control (without any FYM or inorganic fertilizer). Similar treatments were studied in maize

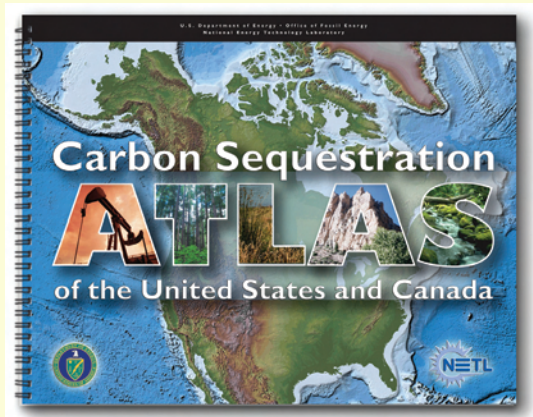
ClimateWire, “States Open First Carbon Auction,” and Reuters, “First U.S. Carbon Auction Brings States \$39 Mln.”

The Regional Greenhouse Gas Initiative (RGGI) began accepting bids on September 25, 2008, for permits that utilities must have for every ton of CO₂ they emit from their facilities. Designed to limit the amount of CO₂ that power plants can expel along the upper East Coast, the United States’ first carbon auction program raised nearly \$39 million in its first day of auctioning. All of the more than 12.5 million permits offered in the auction were purchased by the 59 participants from the energy, financial, and environment sectors. According to RGGI, the permits sold for \$3.07 per ton, which was lower than the \$4.00 to \$4.50 per ton that the permits had brought in previous weeks on future markets. Carbon prices in the European Union (EU), where countries have national carbon limits under the Kyoto Protocol and have had a GHG allowance market since 2005, were approximately \$34 per tonne on RGGI’s first day of trading. The second RGGI auction for CO₂ allowances is expected to offer more than 31.5 million allowances and will be held on December 17, 2008. To view the RGGI press release, go to: http://www.rggi.org/docs/October_14_release_final.pdf. September 25, 2008, <http://www.eenews.net/climatewire/2008/09/25/3/>, and September 29, 2008, <http://www.reuters.com/article/bondsNews/idUSN2937223920080929>.

RECENT PUBLICATIONS

“Methodology for Development of Geologic Storage Estimates for Carbon Dioxide.”

The following is from the Foreword of this document: “This document is an update to the 2006 ‘Methodology for Development of Carbon Sequestration Capacity Estimates’ published in the 2007 Carbon Sequestration Atlas of the United States and Canada (Atlas I). This document describes the methodologies used to produce the geologic resource estimates for CO₂ storage in the 2008 Carbon Sequestration Atlas of the United States and Canada (Atlas II). The rationales presented were used to simplify assumptions for estimating the amount of CO₂ that can be stored in subsurface geologic environments of the United States and parts of Canada. The primary focus of Atlas II is to add additional basins and formations to the CO₂ storage portfolio, update information on the DOE’s Carbon Sequestration Program as well as the RCSPs, and provide definitions of CO₂ resource versus CO₂ capacity that reflect the uncertainty of geologic storage estimates for CO₂ across the RCSPs.” To read the document, go to: http://www.fossil.energy.gov/programs/sequestration/publications/Project_Reports/carbonstorage_method08.pdf.



“Development of a Policy Framework for CO₂ Carbon Capture and Storage in the States.”

The following is from the Executive Summary of this document. “This paper presents the background and policy issues surrounding development of a commercial market for captured CO₂, and seeks to foster among policymakers a deeper understanding of 1) both the generation and CCS technologies involved, as well as their costs; 2) the technical and regulatory barriers to deployment of those technologies, and 3) the opportunities CCS may offer for increased employment and income. [Enhanced oil recovery (EOR)] offers one potential pathway to large-scale, widespread use of captured CO₂, and Ohio seems particularly well-positioned to take advantage of these emerging opportunities. There are a number of state-specific actions that Ohio and other states might initiate to facilitate the deployment of next-generation coal technologies. States can compensate for, or even remove, many of the barriers facing first movers by recognizing CCS, and CO₂ stored through EOR, as clean energy options. States can provide various incentives for CO₂ capture, transportation, and storage, and, since public acceptance of storage of CO₂ in deep saline formations (DSFs) may be years away, adoption of CO₂-EOR as a recognized CCS activity could facilitate new projects today and set the stage for deeper, more permanent injection and storage in the future.” To view the complete paper, prepared for the Pew Center on Global Climate Change, visit: http://www.pewclimate.org/docUploads/Pew_Melzer_08_08.pdf.

“Carbon Capture & Storage: Assessing the Economics.”

The following is from the Introduction of this document: “There is growing consensus among climate scientists, economists, and policymakers that the link between man-made emissions of GHGs and climate change is sufficiently likely to motivate global actions. Energy use and energy generation are at the heart of the problem, with the [International Energy Agency (IEA)] forecasting that global electricity generation will nearly double from 2005 to 2030. The Agency says that fossil fuels will remain a significant part of the energy mix up to 2030, comprising roughly 70 percent of global and 60 percent of European energy generation. One of the solutions being discussed to reduce GHG emissions from fossil fuel energy generation is CCS. CCS is a group of technologies for capturing the CO₂ emitted from power plants and industrial sites; compressing this CO₂; and transporting it to suitable permanent storage sites, such as deep underground. CCS is in a relatively early phase of development, with several key questions remaining, including about its costs, timing, and relative attractiveness versus other low carbon opportunities. Public understanding of CCS is low, and there is some confusion around its true economics, exacerbated by the wide range of cost numbers quoted and the limited information on how they are derived.” To read the complete McKinsey & Company report, click: http://www.mckinsey.com/client/service/ccsi/pdf/CCS_Assessing_the_Economics.pdf.

LEGISLATIVE ACTIVITY

Greenwire, “Dingell, Boucher Release Draft Cap-and-Trade Bill.”

Energy and Commerce Chairman John Dingell and Energy and Air Quality Subcommittee Chairman Rick Boucher released a 461-page draft climate change bill proposing the creation of a cap-and-trade system that would cover about 88 percent of US GHG emissions. The Dingell-Boucher plan would place restrictions on electric utilities, petroleum producers and importers, large industrial plants, bulk gas producers and importers, natural gas and local distribution companies, and geologic sequestration sites. In addition, the US Environmental Protection Agency (EPA) would retain the authority to handle smaller industries that release less than 25,000 tons of GHGs per year. The proposal calls for US GHG emissions to decline six percent below 2005 levels by 2020, 44 percent below 2005 levels by 2030, and 80 percent below 2005 levels by 2050. The money earned from the auctioning of permits would be used to finance energy efficiency initiatives and clean technologies; eventually all profits would be redirected back to taxpayers, barring Congressional amendment(s). The bill will not be subject to legislative hearings or a markup until 2009. The Dingell-Boucher draft bill is available at: http://www.eenews.net/features/documents/2008/10/07/document_gw_04.pdf. October 7, 2008, <http://www.eenews.net/Greenwire/2008/10/07bn/>.

The New York Times, “Chicago Unveils Multifaceted Plan to Curb Emissions of Heat-Trapping Gases,” and *Greenwire*, “Chicago Unveils Plan to Slash Greenhouse Gases.”

Chicago Mayor Richard M. Daley unveiled the “Chicago Climate Action Plan” to promote energy efficiency with hopes of cutting GHG emissions 25 percent from 1990 levels by 2020 and 80 percent of 1990 levels by 2050. Chicago emits 34.6 million metric tons of GHGs each year and according to researchers who were commissioned by the city to study climate change, summer heat indexes could climb as high as 105 degrees by the end of the century. Some parts of the initiative have already been put into effect and, according to modelers of the plan, this will be the first time a major American city has produced models to show local effects of potential climate change. The initiative involved 18 months of research and discussion with business and labor leaders, scientists, and environmentalists. To view the Chicago Climate Action Plan, go to: <http://www.chicagoclimataction.org/filebin/pdf/finalreport/CCAPREPORTFINAL.pdf>. September 18, 2008, http://www.nytimes.com/2008/09/19/us/19chicago.html?_r=3&ref=environment&oref=slogin&oref=slogin&oref=slogin (Subscription required), and September 19, 2008, <http://www.eenews.net/Greenwire/2008/09/19/22/>.



EVENTS

November 5-7, 2008, **Power Plant Summit 2008**, *Radisson Hotel Delhi, New Delhi, India*. This National Energy Technology Laboratory (NETL)-supported summit will provide India’s power and energy with an exhibition of current services and state-of-the-art technologies offered by US service providers for operation and maintenance performance improvements in thermal power plants, with a focus area on clean coal technologies. For more information, visit: <http://www.netl.doe.gov/events/08conferences/ppsIndia/index.html>.

November 12, 2008, **Commercializing CCS in the EU & Japan**, *Museum of Natural Sciences, Brussels, Belgium*. This half-day seminar will bring together individuals from the European Union (EU) and Japan to discuss new regulatory frameworks and CCS regulation. It will also elaborate upon CCS demonstration project strategies and financing options. To view a detailed agenda, visit the seminar website at: <http://www.eu-japan.eu/global/ccsseminar.html>.

November 12-13, 2008, **Carbon Forums Asia**, *Suntec International Convention and Exhibition Centre, Suntec City, Singapore*. This conference will cover innovations in sustainable energy technology and CO₂ emissions policies and regulations. There will be a workshop session divided into three areas: national and regional market initiatives, project implementation, and offset mechanisms and technology. Also included is a program focusing on CCS and renewable energies. To view the conference website, click: <http://www.carbonforumasia.com/>.

November 12-14, 2008, **Carbon Market Insights Americas 2008**, *Marriott Wardman Park Hotel, Washington DC, USA*. This event will provide participants with analysis on climate policy and carbon markets in North America. Included in the three-day event will be sessions on carbon risk management, communicating climate change, and carbon offset trends. To view the conference website, which includes a program overview, go to: <http://www.pointcarbon.com/events/conferences/cmiam08/1.934587>.



EVENTS (CONTINUED)

November 16-20, 2008, **9th International Conference on Greenhouse Gas Technologies**, *The Omni Shoreham Hotel, Washington, DC, USA*. MIT and the IEA Greenhouse Gas R&D Programme (IEA GHG) have teamed with DOE to present this conference series on GHG mitigation technologies. Attendees will be presented with 50 technical sessions that examine issues such as CO₂ transport infrastructure, coalbed methane (CBM) storage, CCS policy, CO₂ storage capacity, long-term liability, and risk assessment. To learn more, click: <http://mit.edu/ghgt9/index.html>.

November 17-19, 2008, **Carbon Markets Africa**, *Cape Town, South Africa*. Carbon Markets Africa provides a platform for businesses to learn about the latest developments for CDM in Africa. Talks will centralize around CDM and new investment and market developments. Among the many topics to be discussed is a session focused on the future of CCS in Africa. To view the conference website, go to: http://greenpowerconferences.com/carbonmarkets/carbonmarkets_africa_2008.html.

December 2-4, 2008, **2nd Annual European Carbon Capture and Storage Summit**, *Thistle Marble Arch, London, England, United Kingdom*. This two-day event focuses on CCS demonstrations in Europe. Attendees can listen to panel discussions on the latest developments in CCS and several other topics, including: CO₂ capture, transport, and storage technologies; economics of commercial CCS; and EU and European national policies. To view the online brochure, click: <http://www.cityandfinancial.com/conferences/index.asp?id=227>.

December 3-5, 2008, **Carbon Capture: Status and Outlook**, *Almas Temple Club, Washington DC, USA*. This conference provides a global update on technical, economic, financial, and policy developments in implementing carbon capture for power plants and other industrial applications. Included is a discussion on the challenges facing carbon capture. For more information, go to: <http://www.infocastinc.com/static/capture.html>.

December 15-19, 2008, **AGU Fall Meeting**, *The Moscone Center, San Francisco, California, USA*. The AGU Fall Meeting provides an opportunity for individuals to review the latest issues affecting the Earth, the planets, and their environments in space. This meeting will cover topics in all areas of Earth and space sciences. Included is a session titled, "Geologic Carbon Sequestration: The Vital Links Between Risk Assessment, Monitoring, and Mitigation Design." To view the conference website, which includes the detailed scientific program, visit: <http://www.agu.org/meetings/fm08/index.php/Main/HomePage>.

January 15-16, 2009, **Carbon Markets North America 2009**, *The Westin Colonnade Coral Gables, Coral Gables, Florida, USA*. In its second year, this conference will address the ways current emissions trading systems are creating business opportunities, fostering technology development and innovation, and influencing global finance. The following topics will be discussed: carbon policy, carbon trading and investments, and carbon finance and project development. To view the complete program, visit the conference website at: <http://www.environmental-finance.com/conferences/2009/Miami09/intro.htm>.

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.