



Carbon Sequestration Newsletter



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JANUARY 2009



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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

Lawrence Livermore National Laboratory News Release, “Livermore Lab and American Shale Oil Team to Study Carbon Sequestration,” and *Greenwire*, “DOE Lab to Test Carbon Dioxide Storage in Western Oil Shale.”

On December 3, Lawrence Livermore National Laboratory (LLNL) and American Shale Oil, LLC (AMSO) announced a technical cooperation agreement to develop carbon sequestration technologies for in-ground shale oil production processes. The partners will study the use of

depleted underground oil shale for the permanent storage of carbon dioxide (CO₂) generated during the oil shale extraction process. AMSO, which holds a research, development, and demonstration (RD&D) lease from the U.S. Bureau of Land Management for a 160-acre parcel of Federal land in northwest Colorado’s oil-shale rich Piceance Basin, will provide technical assistance and oil shale core samples. If AMSO can demonstrate an economically viable and environmentally acceptable extraction process, it retains the right to acquire a 5,120-acre commercial lease. When subject to high temperatures and high pressures, oil shale (a sedimentary rock that is rich in hydrocarbons) can be converted into oil. Through mineralization, the CO₂ could be stored in the shale that remains in the ground following the extraction process. LLNL is managed by Lawrence Livermore National Security, LLC for the U.S. Department of Energy (DOE). For more information about LLNL, click: <https://www.llnl.gov/>. December 3, 2008, https://publicaffairs.llnl.gov/news/news_releases/2008/NR-08-12-02.html, and December 4, 2008, <http://www.eenews.net/Greenwire/2008/12/04/9/>.

SEQUESTRATION IN THE NEWS

Washington University News Release, “Washington University Research to Advance Clean Coal Technology,” and *Greenwire*, “Energy, University Consortium Could Make St. Louis Clean Coal Center.”

On December 2, Washington University in St. Louis announced the establishment of the Consortium for Clean Coal Utilization, a partnership tasked with establishing the key priorities and laboratory facilities for clean coal research. The consortium will bring together university researchers, industries, foundations, and government organizations to research clean coal technology by examining the co-combustion of coal with biomass or the combustion of coal in pure oxygen, which can lead to reductions in CO₂ emissions. The consortium may develop pilot-scale facilities where scientists can perform fundamental research and develop new technology related to clean coal combustion and carbon capture and storage (CCS). Arch Coal and Peabody Energy will each contribute \$5 million to the Consortium for Clean Coal Utilization and Ameren will contribute \$2 million over a five-year period. The consortium will operate under the International Center for Advanced Renewable Energy and Sustainability (I-CARES), which Washington University established in June 2007 to advance education and research related



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SEQUESTRATION IN THE NEWS (CONTINUED)

to energy, environment, and sustainability. To view the Consortium for Clean Coal Utilization website, click: <http://cleancoal.wustl.edu/>. December 2, 2008, <http://news-info.wustl.edu/news/page/normal/13050.html>, and December 4, 2008, <http://www.eenews.net/Greenwire/2008/12/04/7/>.

DNV Press Release, "Developing a Unified Approach to Qualifying CO₂ Storage Sites."

DNV, a global provider of risk management services, is developing a standard methodology for characterizing, selecting, and qualifying offshore and onshore sites for the geological storage of CO₂ in collaboration with more than 10 of the world's oil, gas, and coal companies. The joint industry project (JIP) will provide guidance on establishing permanent, safe, and cost-effective storage of CO₂. The current JIP focuses on establishing a transparent, predictable, and cost-effective site selection approach by: (1) providing guidance on the proper management of risks and geological uncertainties; (2) providing guidance for best engineering practices; (3) providing open references to ensure the confidence of stakeholders and the public; (4) simplifying demonstrations of compliance with legal and regulatory requirements and implementation; and (5) explaining how to obtain emission reduction credits. The framework developed by the JIP should also: (1) define the desired storage site attributes; (2) assign and rank risks based on the available data; (3) define an environmentally friendly and economically acceptable site operation procedure, including compliance with standards, legislation, and directives; (4) define requirements for a monitoring, mitigation, and accounting (MVA) program; and (5) provide guidance for managing storage sites with a transparent, consistent, and cost-effective process. For more information about DNV's initiative, click: http://www.dnv.com/press_area/press_releases/2008/developingaunifiedapproachtoqualifyingco2storagesites.asp#.

Shell News Release, "Essent and Shell Take First Step toward Low-CO₂ Power Plant."

Essent Business Development B.V. (Essent) and Shell Gas & Power Developments B.V. (Shell) signed a Memorandum of Understanding (MOU) to study the feasibility of a 1,000-megawatt (MW) power plant that would capture CO₂ emissions and store them underground. Essent and Shell will examine the viability of combining a high-efficiency gasifier, a power generation plant, and equipment to capture and store CO₂. Under this scenario, coal and solid biomass would be gasified to produce synthesis gas, which is used to make hydrogen; the hydrogen would then be used to generate electricity in turbines. A study will also be conducted to assess whether depleted oil and gas fields (both offshore and onshore) would be suitable for CO₂ storage. The companies are investigating potential plant locations in the southwestern portion of the Netherlands. The project supports the European Union's (EU) plan to reduce CO₂ emissions through the demonstration of 10 to 12 large-scale CCS projects starting between 2015 and 2020, and is in line with the vision of the Rotterdam Climate Initiative (details available at:

SEQUESTRATION IN THE NEWS (CONTINUED)

<http://www.rotterdamclimateinitiative.nl/NL/English/?cid=6>).
December 8, 2008, http://www.shell.com/home/content/media/news_and_library/press_releases/2008/essent_shell_lowco2_08122008.html.



Alstom Press Release, “Alstom Teams Up with PGE Elektrownia Belchatów to Reduce CO₂ Output in Poland.”

Alstom and PGE Elektrownia Belchatów S.A. (PGE) have signed an MOU for the development and implementation of CCS technology at the Belchatów power plant in Poland. Under the first phase of the MOU, Alstom will design and construct a pilot carbon capture plant that will be operated by both Alstom and Elektrownia Belchatów at the existing unit 12 of the Belchatów Power Plant. By using advanced amines technology, the plant will capture approximately 100,000 tonnes of CO₂ per year and is expected to be operational by mid-2011. In the second phase, Alstom and PGE will build a larger CCS project to capture CO₂ produced by the new 858-MW lignite-fired unit currently being constructed by Alstom for Elektrownia Belchatów. The Belchatów CCS project plans to be in operation by 2015 and is expected to remove more than 1 million tonnes of CO₂ emissions per year. December 8, 2008, http://www.alstom.com/pr_corp_v2/2008/corp/53961.EN.php?languageId=EN&dir=/pr_corp_v2/2008/corp/&idRubriqueCourante=23132.

ANNOUNCEMENTS



Call for Papers.

The 8th Annual Conference on Carbon Capture and Sequestration, scheduled for May 4-7, 2009, in Pittsburgh, Pennsylvania, is seeking abstracts addressing CCS systems evaluations, EOR utilization of CO₂ emissions from industrial facilities, electric utility proposals to use large-scale CCS, economics of CCS systems, and several other topics. The deadline for submission is January 19, 2009. For abstract information and guidelines, go to: http://www.carbonsq.com/pdf/2009/Call_for_papers.pdf.

Annual NETL CO₂ Capture Technology for Existing Plants R&D Meeting.

Scheduled for March 24-26, 2009, in Pittsburgh, Pennsylvania, the Annual National Energy Technology Laboratory (NETL) CO₂ Capture Technology for Existing Plants R&D Meeting will address the state of technologies for capturing CO₂ emissions from existing coal-fired power plants. The conference will include current progress from existing projects and project details from recent award selections from DOE's CO₂ capture technology research conducted through NETL's Innovations for Existing Plants Program. For more information, visit: <http://www.netl.doe.gov/events/09conferences/co2capture/index.html>.

Global Carbon Capture and Storage Institute to be Launched.

The Australian Government plans to launch the Global Carbon Capture and Storage Institute (GCCSI) in January 2009. GCCSI will aid in Australia's goal of delivering at least 20 commercial-scale CCS plants around the world by 2020 by providing international policy and management oversight. GCCSI will work with government and industry on a global basis to accelerate the development of commercial-scale CCS technology. For more information, go to: <http://www.carboncapturejournal.com/displaynews.php?NewsID=310&PHPSESSID=af607492f06143fc39fdd6753e6a6b50>.

ICLEI and The Climate Registry Partner to Track GHG Emissions.

The International Council for Local Environmental Initiatives (ICLEI) and The Climate Registry have partnered to promote responsible greenhouse gas (GHG) emissions accounting by encouraging governments to use the highest standards of the Local Government Operations Protocol. By becoming members of both ICLEI and The Climate Registry, governments will be given access to the organizations' comprehensive support for building emissions inventories. To view The Climate Registry's press release, click: <http://www.theclimateregistry.org/downloads/press/iclei-the-climate-registry-120208.pdf>.

SCIENCE

USGS Newsroom, “Getting Warmer? Prehistoric Climate Can Help Forecast Future Changes.”

The first comprehensive reconstruction of an extreme warm period has shown the climate system’s sensitivity to changes in CO₂ levels, as well as the influence of ocean temperatures, heat transport from equatorial regions, and GHGs on Earth’s temperature. Led by the U.S. Geological Survey (USGS), research conducted by the Pliocene Research, Interpretation, and Synoptic Mapping (PRISM) group has allowed for more accurate predictions of future climate changes. PRISM scientists examined fossils from the mid-Pliocene warm period, which ranges from three to 3.3 million years ago. The mid-Pliocene experienced the most extreme warming over the past 3.3 million years. Global temperatures at that time were 4.5°F greater than today and within the Intergovernmental Panel on Climate Change’s (IPCC) projection for the 21st century, which led PRISM researchers to suggest that a slight increase in the world’s current CO₂ level could have a large impact on temperature change. Research also shows warming as much as 32.4°F in the high latitudes of the North Atlantic and Arctic Oceans during the mid-Pliocene, which raises temperatures from 28.4°F to 60.8°F. Data suggests the likely cause of mid-Pliocene warmth was a combination of several factors, including increased heat transport from equatorial regions to the poles and increased GHGs. To listen to a podcast interview with USGS scientists, go to: <http://www.usgs.gov/corecast/details.asp?ep=77>. November 24, 2008, <http://www.usgs.gov/newsroom/article.asp?ID=2080>.



The Courier Mail, “White Possum Said to be First Victim of Global Warming,” and ClimateWire, “White Possum may be First Victim of Climate Change.”

The white lemuroid possum, a rare creature native to Australia’s Daintree forest, may be the first mammal to become extinct due to climate change, according to scientists. Found only above 3,281 feet in the mountain forests of north Queensland, Australia, this tree-dwelling species has not been seen since 2005; the species had been labeled as highly vulnerable five years ago. Experts believe the disappearance is a result of a 1.4°F rise in temperature. Scientists say the record high temperatures in the summer of 2005 could have caused a massive die-off, as the white possum has not been seen in any nighttime spotlight expeditions since then. Researchers will undertake a mission early next year to find the white possum in the untouched “cloud forests” three hours north of Cairns. Scientists believe some frog, bug, and insect species have already been killed off by climate change, but this would be the first known loss of a mammal and the most significant since the extinction of the Dodo and the Tasmanian Tiger. December 2, 2008, <http://www.news.com.au/couriermail/story/0,23739,24742053-952,00.html>, and December 3, 2008, <http://www.eenews.net/climatewire/2008/12/03/10/>. (Subscription may be required.)

Science Daily, “Climate Change Set Back For Acidified Rivers.”

According to a study by Cardiff University, warmer, wetter winters brought on by climate change is interfering with the long-term recovery of rivers from the effects of acid rain. The research, which took place over a 25-year period around Llyn Brianna and mid-Wales, was carried out in 14 streams and involved assessing the number and variety of stream insects present each year; measuring concentrations of acid and other aspects of stream chemistry; and documenting climatic variation, such as warmer, wetter winters. Due to improvements in the levels of acid rain, average acidity in rivers has fallen and researchers expected that as many as 29 insect species should have re-populated the streams as they improved. However, their findings showed that the biological recovery has been slowed, with just four new species added to the recovering rivers that were sampled. To view the Cardiff School of Biosciences study, entitled, “Restoration and recovery from acidification in upland Welsh streams over 25 years,” go to: <http://www3.interscience.wiley.com/journal/121543652/abstract?CRETRY=1&SRETRY=0>. December 5, 2008, <http://www.sciencedaily.com/releases/2008/12/081202190859.htm>.

POLICY

Reuters, “Mexico Says to Set Climate Targets, Cap and Trade,” and The Associated Press, “Mexico Pledges 50 Percent Cut in Greenhouse Gases.”

Mexico plans to adopt caps on GHG emissions next year according to an announcement at the United Nation (UN) climate talks in Poznań, Poland, where 190 countries met to develop a new climate treaty to replace the Kyoto Protocol, which expires in 2012. In February 2009, Mexican President Felipe Calderon will rule on a binding CO₂ emissions cap from cement and oil refining, with a goal to halve national GHGs by 2050. Subject to presidential approval, a cap-and-trade carbon market would be launched by 2012. Companies that reduce their emissions below the limits could sell their unused allowances on the international carbon market. Although Mexico is a member of the Organization for Economic Cooperation and Development (OECD), it is classified as a “developing country” under the Kyoto Protocol. Therefore, it does not have to cap its carbon emissions until at least 2012. The plan would make Mexico the only developing country to set a voluntary national target below current levels. December 11, 2008, <http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE4BA55T20081211>, and December 11, 2008, http://www.google.com/hostednews/ap/article/ALeqM5jpOWN_kr_fbB4qOx_hrA34eg67LgD950L4580.

“Risk Analysis for Future CO₂ Sequestration Projects Based on over 35 years of CO₂ Enhanced Oil Recovery in the U.S.”

The following is the abstract of this article: “This paper is the first of a series that attempts to assess the possible health and safety risks associated with large scale CO₂ sequestration in deep brine reservoirs. The approach is based on analysis of available data on the operational track record from CO₂ transportation and injection associated with CO₂-EOR in the [United States]. This paper is particularly concerned with identification of the main business risks facing a company engaged in

POLICY (CONTINUED)

geological sequestration. Such risks include both the operational risks of capturing, compressing, transporting and injecting CO₂, as well as the risk of accidental, rapid CO₂ release from wells (including an analysis of blow out data from CO₂ injection wells, worked over wells as well as abandoned wells). Observations of the outcomes from accidents in real pipelines and CO₂ injection wells in CO₂-EOR projects provide the most concrete basis to predict the future safety of the above ground operations of CO₂ sequestration in deep brine reservoirs.” **Ian J. Duncan, Jean-Philippe Nicot, and Jong-Won Choi**, Presented at the 9th International Conference on Greenhouse Gas Control Technologies (GHGT-9), held November 16-20, 2008, at the Omni Shoreham Hotel in Washington DC, United States, <https://www4.eventsinteractive.com/iea/viewpdf.asp?id=270005&file=%5C%5Cserenity%5CEP11%24%5CEventwin%5CPool%5Coffice27%5Cdocs%5Cpdf%5Cghgt%5F9Final100647%2Epdf>.

GEOLOGY

“Integrated modeling and experimental approach for caprock integrity, risk analysis, and long term safety assessment.”

The following is the abstract of this article: “A global safety assessment of geological storage of CO₂ involves looking both at the direct protection of the populations with respect to health and sanitary risks, and at the mitigation of CO₂ with respect to global warming. A set of safety criteria can be defined in order to assess the impact on human and environment of CO₂ leaking from the reservoir. These criteria have to take into account the fact that CO₂ can either take the form of gas and cause a threat in case of inhalation or affect the global climate; or it can be dissolved in the water and cause a direct threat to health measurable according to drinking water criteria ([potential hydrogen (pH)], dissolved elements). The nature and amount of potential leakage are calculated by modeling the evolution of the reservoir-caprock system which has to include the most important physico chemical phenomena and which can be organized according to (1) a reference case scenario for the performance assessment, and (2) to different scenarios in altered conditions for the safety assessment. In this exercise, exhaustiveness is often not possible because of the complexity of the system, the coupling between the different phenomena, or the lack of value for some parameters. Dedicated experiments are needed to determine the most critical parameters but simplifying hypotheses may still be required. In this case, they have to be justified in terms of their conservative character, especially with respect to uncertainties and heterogeneities. Such an approach is illustrated by looking at a crucial element of the performance of CO₂ storage: the integrity of the caprock overlying the reservoir. The safety function of the caprock is to oppose the migration of CO₂ by stopping, limiting, or delaying the fluxes towards the geosphere, relying on adequate petrophysical, geochemical, and geomechanical properties. Even if the caprock initially presents the expected confinement properties of a continuous barrier, it may also contain natural heterogeneity to some degree (in composition and/or in properties, i.e. the presence of fractures) and will also evolve in time due to perturbations such as mechanical stress and aggressive fluids. The different leakage scenarios that are identified result from a

phenomenological analysis of the situations encountered in the evolution of the global system. They involve the diffusion of dissolved CO₂, the migration of a CO₂ gas bubble through the matrix of the caprock or through fractures. A first series of calculations is shown which intends to assess the flux of CO₂ out of the storage system in the nominal, or reference situation. These results are then compared with calculations in degraded conditions including data from geochemical experiments in order to investigate the effect of the CO₂ reactivity with the caprock on transport and geomechanical properties.” **Olivier Bildstein, Michel Jullien, Anthony Crédoz, and Jocelyne Garnier**, Presented at GHGT-9, held November 16-20, 2008, at the Omni Shoreham Hotel in Washington DC, United States, <https://www4.eventsinteractive.com/iea/viewpdf.asp?id=270005&file=%5C%5Cserenity%5CEP11%24%5CEventwin%5CPool%5Coffice27%5Cdocs%5Cpdf%5Cghgt%5F9Final100241%2Epdf>.

“Real-Time Assessment of CO₂ Migration Direction during Geologic Storage.”

The following is the abstract of this article: “Minimizing the cost of large-scale geologic storage of CO₂ is a paramount concern, and consequently many aquifer storage projects may be implemented without a detailed characterization of the target formation. On the other hand, CO₂ migration beyond the volume designed for effective trapping is a paramount risk. Thus, inexpensive methods of monitoring the plume movement will be valuable for operators and regulators alike. Unanticipated heterogeneities within the target formation, whether high-permeability channels or low permeability barriers, are one of the most likely causes of migration beyond the design volume. [The authors] propose that routine measurements of injection rate and injection pressure in each well can be used to infer the existence of heterogeneities large enough to affect the plume path. [The authors] do not seek from these measurements a detailed spatial distribution of permeability in the formation, but merely an indication of features that affect the overall migration path. The advantage of this approach is that these measurements will be acquired routinely, frequently and cheaply in all projects, whereas methods yielding higher resolution (time-lapse seismic surveys, electromagnetic surveys, cross-well seismic, monitoring wells, etc.) are specialized and expensive. [The authors] have implemented this idea by combining (1) previously developed research software (Pro-HMS) which carries out geologically consistent parameter estimation from injection and production data and (2) a commercial compositional simulator (GEM from CMG) as a forward model which has been tuned to the full physics and phase behavior of the CO₂/brine/rock system. In this paper [the authors] test the approach on model aquifers that exhibit permeability heterogeneity prescribed by a spatial correlation model. The permeability estimation process is performed within a fully probabilistic framework. [The authors] include the noise typical of pressure/rate data from real wells and find that signal of large heterogeneities can still be discerned.” **Cesar A. Matilla, YagnaDeepika Oruganti, Steven L. Bryant, and Sanjay Srinivasan**, Presented at GHGT-9, held November 16-20, 2008, at the Omni Shoreham Hotel in Washington DC, United States, <https://www4.eventsinteractive.com/iea/viewpdf.asp?id=270005&file=%5C%5Cserenity%5CEP11%24%5CEventwin%5CPool%5Coffice27%5Cdocs%5Cpdf%5Cghgt%5F9Final100465%2Epdf>.

TECHNOLOGY

“Comparing Existing Pipeline Networks with the Potential Scale of Future U.S. CO₂ Pipeline Networks.”

The following is the abstract of this article: “Interest is growing regarding the potential size of a future US-dedicated CO₂ pipeline infrastructure if CCS technologies are commercially deployed on a large scale within the United States. This paper assesses the potential scale of the



CO₂ pipeline system needed under two hypothetical climate policies (WRE450 and WRE550 stabilization scenarios); a comparison is then made to the extant US pipeline infrastructures used to deliver CO₂ for enhanced oil recovery and to move natural gas and liquid hydrocarbons from areas of production and importation to markets. The analysis reveals that between 11,000 and 23,000 additional miles of dedicated CO₂ pipeline might be needed in the United States before 2050 across these two cases. While either case represents a significant increase over the 3,900 miles that comprise the existing national CO₂ pipeline infrastructure, it is important to realize that the demand for additional CO₂ pipeline capacity will unfold relatively slowly and in a geographically dispersed manner as new dedicated CCS-enabled power plants and industrial facilities are brought online. During the period 2010-2030, this analysis indicates growth in the CO₂ pipeline system on the order of a few hundred to less than 1000 miles per year. By comparison, during the period 1950-2000, the US natural gas pipeline distribution system grew at rates that far exceed these growth projections for a future CO₂ pipeline network in the United States. This analysis indicates that the need to increase the size of the existing dedicated CO₂ pipeline system should not be seen as a major obstacle for the commercial deployment of CCS technologies in the United States. While there could be issues associated with siting specific segments of a larger national CO₂ pipeline infrastructure, the sheer scale of the required infrastructure should not be seen as representing a significant impediment to US deployment of CCS technologies.” **JJ Dooley, RT Dahowski, and CL Davidson**, Presented at GHGT-9, held November 16-20, 2008, at the Omni Shoreham Hotel in Washington DC, United States, https://www4.eventsinteractive.com/iea/viewpdf.asp?id=270005&file=\\serenity\EP11%24\Eventwin\Pool\office27\docs\pdf\ghgt_9Final00612.pdf.

“Validation of CO₂ Injection Simulations with Monitoring Well Data.”

The following is the abstract of this article: “The multiphase flow and solute transport simulator STOMP has been used to assess potential CO₂ injection rates into saline formations at several sites for the Midwest Regional Carbon Sequestration Partnership (MRCSP). An injection test of approximately 10,000 metric tons into the Bass Islands Dolomite with CO₂ injection rates from 250-500 tons per day, was performed in the test well at the MRCSP geologic field test site in Otsego County, Michigan, USA. Reservoir simulations were performed to estimate injection parameters, such as bottom hole pressures and pressure response over time in the storage formation,

and compared to measurements taken during the test.” **Diana H. Bacon, Joel R. Sminchak, Jacqueline L. Gerst, and Neeraj Gupta**, Presented at GHGT-9, held November 16-20, 2008, at the Omni Shoreham Hotel in Washington DC, United States, <https://www4.eventsinteractive.com/iea/viewpdf.asp?id=270005&file=\\serenity\CEP11%24%5CEventwin%5CPool%5Coffice27%5Cdocs%5Cpdf%5CGHGT%5F9pdfdocument00402%2Epdf>.



TERRESTRIAL/OCEAN

“A disconnect between O horizon and mineral soil carbon – Implications for soil C sequestration.”

The following is the abstract of this article: “Changing inputs of carbon to soil is one means of potentially increasing carbon sequestration in soils for the purpose of mitigating projected increases in atmospheric CO₂



concentrations. The effect of manipulations of aboveground carbon input on soil carbon storage was tested in a temperate, deciduous forest in east Tennessee, USA. A 4.5-year experiment included exclusion of aboveground litterfall and supplemental litter additions (three times ambient) in an upland and a valley that differed in soil nitrogen availability. The estimated decomposition rate of the carbon stock in the O horizon was greater in the valley than in the upland due to higher litter quality (i.e., lower C/N ratios). Short-term litter exclusion or addition had no effect on carbon stock in the mineral soil, measured to a depth of 30 cm, or the partitioning of carbon in the mineral soil between particulate- and mineral-associated organic matter. A two-compartment model was used to interpret results from the field experiments. Field data and a sensitivity analysis of the model were consistent with little carbon transfer between the O horizon and the mineral soil. Increasing aboveground carbon input does not appear to be an effective means of promoting carbon sequestration in forest soil at the location of the present study because a disconnect exists in carbon dynamics between O horizon and mineral soil. Factors that directly increase inputs to belowground soil carbon, via roots, or reduce decomposition rates of organic matter are more likely to benefit efforts to increase carbon sequestration in forests where carbon dynamics in the O horizon are uncoupled from the mineral soil.” **Charles T. Garten Jr.**, *Acta Oecologica*, Available online November 22, 2008, doi:10.1016/j.actao.2008.10.004, <http://www.sciencedirect.com/science/article/B6VR3-4V053MR-1/2/af2f1faf56d069ae6aa89ef4050aab78>. (Subscription may be required.)

TRADING

Carbon Market Update, December 10, 2008

CCX-CFI 2008 (\$/tCO ₂)	EU ETS-EUA DEC 2008
\$1.65 (Vintage 2008)	(\$/tCO ₂) \$19.36

(Converted from € to US\$)

Reuters, “UK Sells 4 Mln EU CO₂ Emissions Permits in Auction,” and **Power Engineering, “UK Holds Europe’s First Phase II EU ETS Carbon Auction.”**

The British Government sold 4 million EU carbon emission permits in Europe’s first such auction to allocate GHG allowances as part of

Phase II (2008-2012) of the EU Emissions Trading Scheme (EU ETS). The auction was open to participants globally and was held by the United Kingdom’s (UK) Department of Energy and Climate Change. The permits sold for ~\$21.91 per tonne and raised ~\$81.55 million for the British Treasury. To better prepare for Phase III, when allowances will no longer be issued for free to most participants, the European Commission allows governments to auction up to 10 percent of the allowances issued in Phase II. The EU ETS puts a cap on emissions from energy and heavy industrial sectors throughout the EU, which are collectively responsible for nearly half of the EU’s CO₂ emissions. During 2009, Britain plans to auction 25 million more EU carbon allowances. To view the UK Department of Energy and Climate Change website, go to: <http://www.decc.gov.uk/>. November 19, 2008, <http://in.reuters.com/article/oilRpt/idINLJ58992920081119>, and November 19, 2008, http://pepei.pennnet.com/display_article/345767/6/ARTCL/none/none/1/UK-holds-Europe’s-first-Phase-II-EU-ETS-carbon-auction/.

RECENT PUBLICATIONS

“Addressing Emissions From Coal Use in Power Generation.”

The following is the Introduction of this document: “Coal is a cheap and abundant resource, and CO₂ from coal use is responsible for about 40 percent of global GHG emissions from fossil fuel use. The United States and China are by far the largest emitters of CO₂ from coal consumption, accounting for nearly 60 percent of global CO₂ emissions from coal, with India a distant third. The United States currently relies on coal for roughly half of its electricity generation resulting in roughly one third of total U.S. emissions. China generates 80 percent of its electricity from coal, and in recent years, emissions from coal use have grown five times faster in China than in the United States. With enough coal reserves to meet current consumption levels for centuries, the United States and the rest of the world face the challenge of reconciling the realities of coal use with the dangers posed by climate change. CCS is a means to meet this challenge. If widely deployed, CCS could allow the world both to continue to exploit its cheap and abundant supply of coal and to adequately address the threat of climate change. CCS works by separating CO₂ from other gases in the exhaust stream at power plants and industrial facilities, compressing the CO₂ to pressures suitable for pipeline transport, and injecting the CO₂ into deep geologic formations where it can be safely and indefinitely stored. Although components of the CCS suite of technologies have been used in a variety of situations, the entire suite has not been deployed at a commercial scale at any coal-fueled power plant to date. Deployment has not proceeded for a number of reasons, primarily the high costs of installing and operating CCS technologies and the absence of government policies that place a financial cost on GHG emissions. In addition, uncertainties remain concerning actual cost and performance of CCS technologies at commercial scale. Finally, CCS deployment requires an appropriate regulatory system for CO₂ storage, including long-term liability. This brief describes the potential role of government in facilitating widespread and more rapid deployment of CCS through a number of means including: providing financial incentives for initial CCS projects through the use of bonus allowances under a cap-and-trade program, or a fund generated by charges on electricity or fossil-fuel based sources of electricity; setting GHG emission performance standards for coal generators or electricity providers; and establishing the required regulatory and liability frameworks for CO₂ storage.” To read the complete Congressional Policy Brief from the Pew Center for Global Climate Change, go to: <http://www.pewclimate.org/docUploads/DDCF-Coal.pdf>.

“CO₂ Emissions from Fossil Fuel Combustion (2008 Edition).”

The following is the background of this document: “In recognition of fundamental changes in the way governments approach energy-related environmental issues, the [International Energy Agency (IEA)] has prepared this publication on CO₂ emissions from fuel combustion. This annual publication was first published in 1997 and has become an essential tool for analysts and policy makers in many international fora such as the Conference of the Parties. The fourteenth session of the Conference of the Parties to the Climate Change Convention (COP 14), in conjunction with the fourth meeting of the Parties to the Kyoto Protocol (CMP 4), will be meeting in Poland from [December 1-12, 2008]. The data in this book are designed to assist in understanding the evolution of the emissions of CO₂ from 1971 to 2006 for more than 140 countries and regions by sector and by fuel. Emissions were calculated using IEA energy databases and the default methods and emission factors from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.” This IEA publication is available for purchase at: <http://www.iea.org/w/bookshop/add.aspx?id=36>. The Table of Contents can be viewed at: http://www.iea.org/Textbase/nptoc/CO2_TOC.pdf.

RECENT PUBLICATIONS - CONTINUED

“Building a Low-Carbon Economy – The UK’s Contribution to Tackling Climate Change.”

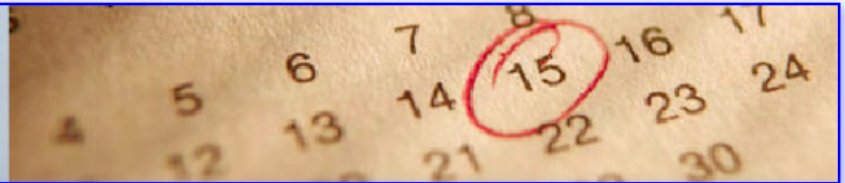
The following is the Executive Summary of this document: “Climate change resulting from CO₂ and other GHG emissions poses a huge threat to human welfare. To contain that threat, the world needs to cut emissions by about 50 [percent] by 2050, and to start cutting emissions now. A global agreement to take action is vital. But a global agreement will not be possible unless the countries of the rich, developed world provide leadership. A fair global deal will require the UK to cut emissions by at least 80 [percent] below 1990 levels by 2050. The good news is that reductions of that size are possible without sacrificing the benefits of economic growth and rising prosperity. Technologies are available or with appropriate support could be developed which deliver low-carbon energy; opportunities to increase the efficiency with which [energy is used] are huge; lifestyle changes which will not undermine welfare can produce significant cuts in energy consumption. And many of the actions required to tackle climate change [the UK] should want to do anyway because these have economic, wider environmental and security of supply benefits. But the potential will not be achieved without appropriate policies: financial incentives through carbon prices, taxes and subsidies; support for technology innovation; information and encouragement; and regulation when needed. The challenge is not the technical feasibility of a low-carbon economy but making it happen. Ensuring action will require strong leadership from government and a concerted response from individuals and businesses. It will require policy commitment to cutting emissions steadily over time, sticking on the path to an 80 [percent] reduction, and reacting to any diversion with new policies to get back on track. The UK’s Climate Change Act makes that commitment, establishing a system of five year ‘carbon budgets’. The Committee on Climate Change is charged with recommending the level of those budgets.” The document is available at: <http://hmccc.s3.amazonaws.com/pdf/TSO-ClimateChange.pdf>.

LEGISLATIVE ACTIVITY

AZoCleantech, “Illinois Law Means Clean Coal Power Plant Will Have to be Clean as Natural Gas.”

On November 20, the Illinois Senate passed SB 1987, the Clean Coal Portfolio Standard, which would enable the development of coal gasification with CCS projects in Illinois. SB 1987 provides a framework for the development of clean coal projects and would require project developers to capture and store more than 50 percent of CO₂ emissions. The legislation calls for electric utilities that serviced at least 100,000 customers in the state as of December 31, 2005, to enter into contracts to obtain at least five percent of their supply from facilities

employing CCS. The Clean Coal Portfolio Standard Law defines clean coal facilities as those scheduled to begin operations before 2016 that capture and sequester at least 50 percent of total CO₂ emissions; for facilities scheduled to begin operations after 2017, at least 90 percent of total CO₂ emissions must be captured and sequestered. Electric facilities in operation that fail to meet these targets would have to purchase offsets accordingly. Furthermore, the legislation creates the Illinois Power Agency, which would develop, finance, construct, or operate electric generation and co-generation facilities and be located near a site suitable for geologic storage. The Clean Coal Portfolio Standard is available at: <http://www.ilga.gov/legislation/95/SB/09500SB1987lv.htm>. November 20, 2008, <http://www.azocleantech.com/Details.asp?newsID=3974>.



EVENTS

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>.

January 22-23, 2009, **Voluntary Carbon Markets USA**, *Westin, New York City, New York, USA*. Focused solely on the US voluntary carbon market, the second edition of this conference will bring together carbon market experts to discuss the current status of the voluntary carbon market and the latest developments in standardization. Included in the two-day event is a session focused on the future of the Regional Greenhouse Gas Initiative’s (RGGI) auction. To view a detailed agenda, visit the conference website at: http://www.greenpowerconferences.com/carbonmarkets/vcm_us09.html.



EVENTS (CONTINUED)

January 28-29, 2009, **The Petroleum Economist Forum on CCS**, *London, England, UK*. This forum will bring together industry experts and senior energy decision makers to discuss the regulatory framework needed to achieve a reduction in CO₂ emissions and the challenges facing the implementation of CCS projects. Included is a session focusing on key drivers behind energy companies adopting CCS technology. To learn more, visit: <http://www.petroleum-economist.com/default.asp?page=19&searchtype=6&productid=10032>.

January 29, 2009, **CO₂ Storage: Geology for Engineers**, *Raeburn Room, Old College, The University of Edinburgh, City of Edinburgh, UK*. The aim of this short course is to provide an up-to-date introduction of the geological and physical aspects of CO₂ storage for those with limited geological knowledge. Attendees have the opportunity to stay an optional second day to review reservoirs, seals, structures, and faults. To learn more about this short course, click: <http://www.geos.ed.ac.uk/sccs/cpd>.

February, 1-4, 2009, **EUEC 2009 – 12th Annual Energy & Environment Conference & Expo**, *Phoenix Convention Center, Phoenix, Arizona, USA*. This event offers attendees more than 400 technical presentations by leading experts in concurrent sessions on clean air, mercury, global warming, the environment, and renewable energy. Among the topics to be addressed: risks and opportunities in emerging climate change law and policy; global climate change; and global carbon markets. To view the extensive conference agenda, visit: <http://www.euec.com/downloads/DraftProgram2009.pdf>.

February 3-4, 2009, **Carbon & Climate Change Conference**, *AT&T Conference Center, Austin, Texas, USA*. This program covers carbon markets, the emerging technologies and economics of CO₂ capture, regulation of emissions, and storage and transport. There will also be a special project development panel addressing the financial and legal issues in combined EOR/sequestration projects. Impacts on the power sector, smart grids, and the measurement and benchmarking of carbon footprints will also be covered. To view the event program, go to: <http://www.utcle.org/conferences/CH09>.

February 10-12, 2009, **CO₂ Geological Storage Modeling Workshop**, *BRGM, Orleans, France*. This workshop will unite specialist modeling practitioners from industrial and research organizations across the world to address current approaches to modeling, available software tools for modeling, whether current models provide the necessary results to inform risk assessments, whether modeling technologies can fulfill likely regulatory requirements, current knowledge gaps, and future research. The scale effects of various processes, parameterization, and the incorporation of leakage pathways to overburden into reservoir models will also be discussed. Further details and a workshop agenda are available at: <http://www.co2captureandstorage.info/networks/1stmodelling.htm>.

February 18-19, 2009, **International Conference on CCS Regulation for the EU and China**, *Centre Albert Borschette, Brussels, Belgium*. This conference will examine the opportunities and challenges to CCS regulation in the EU and the possibilities of future cooperation between the EU and China on this issue. The primary agenda discussions will include: safety and liability, site qualification, incentivization, and EU-China Cooperation. For more information, go to: <http://www.euchina-ccs.org/events.php>.

February 26-27, 2009, **3rd Annual Carbon Capture and Storage**, *Hilton Brussels, Brussels, Belgium*. Platts' 3rd Annual European Capture and Storage conference will bring together members of the CCS community to debate and discuss topics to secure the future of CCS. Some of the issues to be discussed: international CCS case studies; creating value in CCS through finance and investment; the importance of mobilizing the supply chain to the successful deployment of CCS; and storage selection and liability. For more information, go to: <http://www.platts.com/Events/2009/pc965/index.xml>.

March 6-7, 2009, **MIT Energy Conference**, *Marriott Hotel in Kendall Square, Cambridge, Massachusetts, USA*. The goal of this Massachusetts Institute of Technology (MIT) conference is to develop solutions for the challenges facing today's energy markets. To learn more about the conference, visit: <http://www.mitenergyconference.com/friday.htm>.



EVENTS (CONTINUED)

March 17-19, 2009, **Carbon Market Insights 2009**, *Bella Center in Copenhagen, Denmark*. This event will examine the impacts that the global economy is having on carbon markets and the effects international policy will have on reaching a new climate agreement. All market aspects – from carbon trading to the voluntary carbon trading market – will be covered. For more information, go to: <http://www.pointcarbon.com/events/conferences/cmi09/1.986082/>.

March 19-21, 2009, **ENVIROENERGY 2009: International Conference on Energy and Environment**, *Taj Chandigarh, Chandigarh, India*. This international conference aims at addressing the challenges related to energy and environment. The conference agenda will focus on environmental policies, identification of green technologies, and their subsequent implementation for sustainable development. To learn more about ENVIROENERGY 2009, click: <http://www.enviroenergy2009.org/>.

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.