



Office of Fossil Energy

Carbon Sequestration Newsletter

FEBRUARY 2012



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approximately 200 megawatts (MWs) of power from TCEP, making it the first U.S. purchase by a utility of low-carbon power from a commercial-scale, coal-based power plant with carbon capture. The 400-MW TCEP plant is a first-of-its-kind integrated gasification combined cycle (IGCC) poly-generation facility capable of capturing 90 percent of the carbon dioxide (CO₂) it produces. The \$2.4-billion plant was a third round selection under DOE's Clean Coal Power Initiative (CCPI), a cost-shared collaboration between the Federal government and private industry aimed at stimulating investment in low-emission, coal-based power generation technologies through successful commercial demonstrations. CCPI will provide \$450 million in funding for the plant, with \$211 million coming from the American Recovery and Reinvestment Act of 2009 (ARRA). The facility is expected to be fully operational in 2015. For more information on DOE's Clean Coal Technology Program and CCPI, visit: <http://www.fossil.energy.gov/programs/powersystems/cleancoal/index.html>. January 17, 2012, http://www.fossil.energy.gov/news/techlines/2012/12002-Utility_To_Purchase_Electricity_fr.html.

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, "Utility to Purchase Electricity from Innovative DOE-Supported Clean Coal Project."

The Texas Clean Energy Project (TCEP) will supply electricity to CPS Energy of San Antonio, the largest municipally owned utility in the United States, under a recently signed Power Purchase Agreement announced by the U.S. Department of Energy (DOE). CPS Energy will purchase

SEQUESTRATION IN THE NEWS

Global CCS Institute Media Release, "Global CCS Institute Supports Key Australian Carbon Capture and Storage Initiatives."

The Global CCS Institute (GCCSI) announced it will fund a package of Australian CCS demonstration projects and research initiatives that highlight the technology's role in reducing greenhouse gas (GHG) emissions. Specifically, the Institute will provide: \$1.84 million in support to Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) to research the impact of CO₂ capture technology on air quality; \$240,000 in support to CarbonNet for a study ensuring emissions are safely stored and accounted for; and \$226,000 to study post-combustion capture deployment impacts on an existing subcritical pulverized fuel power plant (the Loy Yang A power station in Victoria, Australia). GCCSI works with organizations and governments to accelerate the broad deployment of commercial CCS. GCCSI captures knowledge from different stages of the project life cycle, across different technologies and regions, and shares it via workshops, group discussions and meetings, their digital knowledge platform, private and public discussions, case studies, reports, and other communications. January 13, 2012, <http://cdn.globalccsinstitute.com/sites/default/files/media-releases/29356/global-ccs-institute-supports-key-australian-carbon-capture-and-storage-initiatives.pdf>.



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SEQUESTRATION IN THE NEWS (CONTINUED)

Carbon Capture Journal, "Foster Wheeler to Lead Don Valley CCS Project."

Foster Wheeler Energy Limited (Foster Wheeler) has been appointed to lead 2Co Power's CCS power plant development at the planned 650-MW Don Valley Power Project in Yorkshire, England. The Don Valley Power Project will provide low-carbon electricity to approximately 1 million homes, capturing at least 90 percent of its CO₂ output (up to 5 million tonnes a year). When built, the Don Valley Power Project will combine a coal gasification plant with CO₂ capture to a conventional-style, gas-fired power station fired by a hydrogen-rich fuel. Planning permission for the power plant has been granted and main construction activities are planned to start in 2013. To view the 2Co Energy press release, go to: http://www.2coenergy.com/download.aspx?file=resources/pdf/2Co_Power_Foster_Wheeler.pdf. To view the Foster Wheeler news release, click: <http://phx.corporate-ir.net/phoenix.zhtml?c=80422&p=irol-newsArticle&ID=1654478&highlight=>. February 3, 2012, <http://www.carboncapturejournal.com/displaynews.php?NewsID=892&PHPSESSID=ci886gldtb02u208p7omuaces1>.

ANNOUNCEMENTS

"Valuation of Human Health and Ecological Risks Arising from Carbon Capture and Storage (CCS)."

The following is from the Executive Summary of this document: "The public debate as it relates to carbon capture and storage [hereinafter, CCS] has been clouded by subjective perceptions of what is at risk, and whether the consequences of such risks are material from a financial perspective. In [the authors'] view, analytic evaluation of the range of potential impacts and calculation of the financial consequences arising from CCS can illuminate the risks requiring mitigation, the dollar amounts that need to be managed, the set of circumstances under which amounts will present, and the time frame over which these dollars will be needed. Although the probability of a release at a well-sited, well-operated CCS project may be small, prudent risk management requires estimates of the dollars necessary to remediate or compensate for harm, should a release occur. Damages are a function of location, plant design, fuel source, and technology, and therefore must be estimated on a site-specific basis. With the availability of site-specific data, the analytic tools exist to estimate dollar values of potential damages at individual CCS sites." The complete Industrial Economics, Incorporated, report is available at: <http://www.indecon.com/ieccweb/documents/Valuation%20of%20CCS%20Risks.pdf>.

APEC Releases RFP.

The Asia-Pacific Economic Cooperation (APEC) has released a Request for Proposal (RFP), titled, "Feasibility of accelerating the deployment of carbon capture, utilization, and storage (CCUS) in developing APEC economies." This APEC project will build on the work done by GCCSI by focusing on CO₂ reuse prospects in

ANNOUNCEMENTS (CONTINUED)

developing APEC economies with rapidly growing CO₂ emissions and practical possibilities for CO₂ reuse, especially for enhanced oil or gas recovery, and stimulating interest in exploring the near-term opportunities for CCUS in these economies, in particular for CO₂-enhanced oil recovery (EOR). The deadline for submission of proposals to the APEC Secretariat is March 23, 2012. The RFP is available at: http://www.apec.org/Projects/~//media/Files/Projects/TendersRFPs/2012/20120214_RFP_EWG24_CCUS.ashx.

Big Sky Annual Meeting.

The Big Sky Carbon Sequestration Partnership (BSCSP) will host their annual meeting at the Best Western Heritage Inn in Great Falls, Montana, April 18-19, 2012. Key issues related to the science, policy, and technology of CCS will be addressed. For registration information, visit: <http://www.bigskyco2.org/content/annual-meeting-april-18-19-2012>.

SECARB Annual Meeting.

The Southeast Regional Carbon Sequestration Partnership (SECARB) will hold its 7th Annual Stakeholders' Briefing on March 7-8, 2012, to showcase the carbon storage field tests underway in the region. The briefing will be held at the Battle House Renaissance Mobile Hotel in Mobile, Alabama. For registration information, visit: http://www.secarbon.org/index.php?page_id=16.

IEAGHG 2012 Summer School.

The 6th International Energy Agency Greenhouse Gas Program (IEAGHG) Summer School will be held at Tsinghua University, in Beijing, China, on August 12-18, 2012. Led by international experts in the CCS field, the program will cover the full chain of CCS and provide up-to-date information in each field, including technical information on capture technologies, storage site selection, capacity and modelling, wellbore integrity, and transport, as well as other issues such as regulations, health and safety, and public communication. Interested students can go to: <http://www.ieaghg.org/index.php?/20111222270/summer-school-2012.html> for application information.

FE Releases Newsletter.

DOE's Office of Fossil Energy (FE) has released the latest edition of "Fossil Energy Today," a free quarterly digital newsletter that provides up-to-date information on important activities, progress, and other developments within FE. To download the latest edition, click: <http://www.fossil.energy.gov/news/energytoday.html>.

SCIENCE

Discovery News, "Birds Flying Faster Due to Climate Change."

According to new research, birds are flying at faster speeds over the Southern Ocean due to an increase in wind speed believed to be caused by potential climate change. The study, published in the journal "Science," focused on the wandering albatross, a bird that inhabits the Crozet islands in the Southern Ocean, and found that higher wind speeds are currently having a beneficial impact by shortening the length of foraging trips, improving breeding success, and leading to weight gain. Researchers analyzed years of data from tracking the Crozet albatross population's feeding and breeding; their travels were tracked with satellite transmitters since 1989. They found that winds in the Southern Ocean have increased by an average of 15 percent over the past few decades, with both the male and female albatross flight speeds increasing as well; females alone traveled approximately 124 more miles per day in 2010 than in 1990. However, the research also shows that if wind strength continues to increase, so too will a shift of all animals in the region; by 2080, this could lead to the wind flow currently centered around Crozet to move further south, affecting the birds' ability to reach foraging areas. January 12, 2012, <http://news.discovery.com/animals/birds-flying-faster-wind-speeds-120112.html>.

ABC Science, "Carbon Dioxide Affecting Fish Brains: Study."

According to the Australian Research Council's Centre of Excellence for Coral Reef Studies, rising CO₂ emissions may be affecting the brains and central nervous systems of sea fish. In a paper published in the journal "Nature Climate Change," the researchers claim that CO₂ concentrations predicted to occur in the ocean by the end of this century could interfere with the ability of sea fish to hear, smell, and evade predators. The Australian researchers gathered data by testing the performance of baby clown and damsel fishes alongside their predators in sea water containing higher levels of dissolved CO₂. They found that while the predators were affected, the baby fish experienced more effects, including with their sense of hearing, which they use to locate and hone in on reefs at night and avoid them during the day to evade predators. In addition, the research showed that the fish tended to lose their natural instinct to turn left or right, which is important in schooling behavior. January 16, 2012, <http://www.abc.net.au/science/articles/2012/01/16/3409053.htm>.

Wired.com, "Global Warming May Make Reptiles Smarter."

Researchers have found that potential warmer temperatures could be making some reptiles smarter. In a study published in the journal "Biology Letters," researchers incubated the eggs of *Bassiana duperreyi*, a mountain-dwelling Australian skink, at warmer temperatures, finding

SCIENCE (CONTINUED)

that the reptile grew up to perform well on a learning task. After incubating two different sets of eggs at different temperatures, researchers tested the hatchlings, sending each lizard running by touching its tail, then measuring the time it took for each to find the open shelter and how often it tried to enter a blocked door. The results showed that the warm-incubated lizards learned to find the open shelter much more readily than the cool-incubated lizards. January 11, 2012, <http://www.wired.com/wiredscience/2012/01/warmer-lizard-intelligence/>.

POLICY

“A Policy Strategy for Carbon Capture and Storage.”

The following is from the Executive Summary of this document: “This guide for policy makers aims to assist those involved in designing national and international policy related to CCS. Covering both conventional fossil-fuel CCS and bioenergy with CCS (BECCS), it explores development of CCS from its early pilot and demonstration project stages through to wide-scale deployment of the technology. The report concentrates on the economic and political economy perspective, leaving legal, safety, environmental and regulatory issues to be addressed by other analysis...The IEA’s *Energy Technology Perspectives* indicates that CCS is an essential part of the portfolio of technologies needed to achieve substantial global GHG emissions reduction in the most cost-effective manner. The technology could - if governments commit to specific policies - account for nearly one-fifth of the emissions reduction required to cut GHG emissions from energy use in half by 2050. The scale of potential future deployment of CCS is enormous, spanning manufacturing, power generation and hydrocarbon extraction worldwide.” The complete International Energy Agency (IEA) report is available for download at: http://iea.org/papers/2012/policy_strategy_for_ccs.pdf.

“Public acceptance of CCS system elements: A conjoint measurement.”

The following is the Abstract of this article: “The aim of the present study is to examine public preferences regarding the characteristics of the three elements of CCS: capture, pipeline, and storage. A random sample of 139 Swiss citizens received basic information about CCS online and then participated in an experiment. A conjoint measurement of CCS acceptance and analysis of variance was used to examine respondents’ preferences for characteristics of CCS elements. This approach allowed respondents to make trade-offs by expressing preferences for complete CCS systems instead of evaluating single elements in isolation. [The authors’] results show that people put most emphasis on pipelines near their homes and on the type of plant the CO₂ originates from. A ‘Not in my backyard [NIMBY] effect’ was found both for pipelines and storage. This NIMBY effect, however, disappears when CO₂ from a biogas-fired plant is used for the injection. [The authors] conclude that it may be possible to avoid the NIMBY effect for geological storage field trials by using BECCS.” **Lasse Wallquist, Selma L’Orange Seigo, Vivianne H.M. Visschers, and Michael Siegrist,**

International Journal of Greenhouse Gas Control, Available online December 30, 2011, doi:10.1016/j.ijggc.2011.11.008, <http://www.sciencedirect.com/science/article/pii/S1750583611002180>. (Subscription may be required.)

“A socio-technical framework for assessing the viability of carbon capture and storage technology.”

The following is the Abstract of this article: “CCS is seen as a key technology to tackle climate change. The principal idea of CCS is to remove carbon from the flue gases arising from burning fuels for electricity generation or industrial applications and to store the carbon in geological formations to prevent it from entering the atmosphere. Policy makers in several countries are supportive of the technology, but a number of uncertainties hamper its further development and deployment. The paper makes three related contributions to the literatures on socio-technical systems and technology assessment: (1) it systematically develops an interdisciplinary framework to assess the main uncertainties of CCS innovation. These include technical, economic, financial, political and societal issues; (2) it identifies important linkages between these uncertainties; and (3) it develops qualitative and quantitative indicators for assessing these uncertainties. This framework aims to help decision making on CCS by private and public actors and is designed to be applicable to a wider range of low carbon technologies. The paper is based on a systematic review of the social science literature on CCS and on insights from innovation studies, as well as on interviews about assessment of new technologies with experts from a range of organizations and sectors.” **Nils Markusson, Florian Kern, Jim Watson, Stathis Arapostathis, Hannah Chalmers, Navraj Ghaleigh, Philip Heptonstall, Peter Pearson, David Rossati, and Stewart Russell,** *Technical Forecasting and Social Change*, Available online January 4, 2012, doi:10.1016/j.techfore.2011.12.001, <http://www.sciencedirect.com/science/article/pii/S0040162511002769>. (Subscription may be required.)

GEOLOGY

“Relationships between CO₂ sorption capacity by coals as measured at low and high pressure and their swelling.”

The following is the Abstract of this article: “From a comparison of high and low pressure sorption behavior of 28 bituminous and subbituminous coals for [CO₂], the sorption capacity calculated at high pressure is always substantially greater than that estimated from low pressure sorption measurements. The difference between maximum sorption capacity from high pressure measurements and that from low pressure measurements increases with decreasing rank. This difference can be quantitatively explained by swelling of the coal at high pressure that does not occur during low pressure measurements. When expressed as volume [percent], the maximum sorption capacity calculated from high pressure measurements was found to equal the sum of the maximum sorption capacity calculated from low pressure measurements and the volumetric swelling the coal undergoes on exposure to high pressure. This relationship implies that the volume occupied by the coal molecules is constant when it swells: the greater apparent coal volume that occurs on swelling in gases is entirely taken up completely

GEOLOGY (CONTINUED)

by increased pore volume. Moreover, this relationship provides a natural explanation for the finding that when a coal that is swollen with gas is compressed, the coal releases it. If so, low pressure sorption measurements may provide a more direct estimation of coal sorption capacity in constrained coal seams, provided a robust method of predicting maximum sorption capacity from low pressure sorption [behavior] can be established.” **Richard Sakurovs**, *International Journal of Coal Geology*, Available online December 8, 2011, doi:10.1016/j.coal.2011.11.012, <http://www.sciencedirect.com/science/article/pii/S0166516211002552>. (Subscription may be required.)

“Swelling of coal in carbon dioxide, methane and their mixtures.”

The following is the Abstract of this article: “Swelling of coal, especially in the presence of CO₂, may reduce the permeability of coal seams thus affecting the viability of enhanced coalbed methane production or CO₂ [storage] operations. In this paper [the authors] report laboratory measurements of swelling in four Australian bituminous and sub-bituminous coals in CO₂, methane and various mixtures of the two gases. Measurements were made on unconstrained monolithic samples at 55°C and at pressures up to about 15 MPa. Volumetric swelling at 15 MPa ranged from about 1.9 [percent] to 5.5 [percent] in CO₂ and 1.0 [percent] to 2.5 [percent] in [methane (CH₄)] depending on the rank of coal and the proportion of CO₂ in the gas mixture. Swelling measurements made at a constant pressure of 15 MPa but with varying gas composition showed that even CO₂ with a high affinity for coal could be completely displaced by helium, which does not adsorb, causing the coal sample to shrink to its original dimensions. Similarly, CH₄ was displaced by injecting CO₂ into the system which then caused the coal to swell to the same level as if it had been exposed to pure CO₂. The results of these experiments show that there is no enhanced swelling in mixed gases above that would be observed in the pure CO₂ at the same total pressure. As well, the swelling behavior of coal in mixed gases was determined solely by the partial pressure of the sorbing gas so that weakly or non-sorbing gases are effective at displacing strongly adsorbed gases.” **Stuart Day, Robyn Fry, and Richard Sakurovs**, *International Journal of Coal Geology*, Available online January 31, 2012, doi:10.1016/j.coal.2012.01.008, <http://www.sciencedirect.com/science/article/pii/S0166516212000171>. (Subscription may be required.)

“Process intensification routes for mineral carbonation.”

The following is the Abstract of this article: “Mineral carbonation is a realistic route for capture and storage of [CO₂]. The principal advantages of this approach are the chemical stability and storage safety of mineral carbonates, the opportunities for process integration available, and the potential for conversion of low-value materials into useful products. In this work, the valorization of alkaline waste materials from thermal processes by mineral carbonation utilizing intensified and integrated mineral carbonation routes is explored. Process intensification aims at providing the paradigm-shifting techniques needed to revolutionize the chemical engineering industry in the twenty-first century, particularly focusing on improvements toward process efficiency, yield, and sustainability. The combination of process intensification and process integration strategies has the

potential to produce economically feasible and industrially acceptable carbonation technologies that can soon be implemented large scale, several examples of which are already proven at laboratory scale and are herein discussed.” **Rafael M. Santos and Tom Van Gerven**, *Greenhouse Gases: Science and Technology*, Available online December 2011, doi:10.1002/ghg.36, <http://onlinelibrary.wiley.com/doi/10.1002/ghg.36/abstract>. (Subscription may be required.)

TECHNOLOGY

“Pre-combustion carbon dioxide capture by gas-liquid absorption for Integrated Gasification Combined Cycle power plants.”

The following is the Abstract of this article: “Among various configurations of fossil fuel power plants with [CO₂] capture, this paper focuses on pre-combustion capture technology applied to an [IGCC] power plant using gas–liquid absorption. The paper proposes a detailed study and optimization of plant design (column height and packed dimensions) with CO₂ capture process using different solvents as: aqueous solutions of alkanolamine, dimethyl ethers of polyethylene glycol, chilled methanol and N-Methyl-2-pyrrolidone. By developing simulations in Aspen Plus, the following performance results of these physical and chemical solvents, mentioned above, are discussed: overall energy consumption (power consumption, heating and cooling agent consumption), CO₂ specific emissions, net electric power output and plant efficiency. The paper presents as well, the total investment capital cost of an IGCC coal mixed with biomass (sawdust) power plant generating 425–450 MW net electricity with (70 [percent] CO₂ capture, 80 [percent] CO₂ capture and 90 [percent] CO₂ capture) and without pre-combustion CO₂ capture. Simulation results show that for evaluated solvents for CO₂ capture, the physical solvent, dimethyl ethers of polyethylene glycol, is more energy efficient than the other physical and chemical solvents investigated. Regarding the economic study, implementation of pre-combustion CO₂ capture on IGCC plant, using dimethyl ethers of polyethylene glycol, leads to an increase of the capital cost with about 19.55 [percent] for 70 [percent] CO₂ capture, 20.91 [percent] for 80 [percent] CO₂ capture and 22.55 [percent] for 90 [percent] CO₂ capture.” **Anamaria Padurean, Calin-Cristian Cormos, and Paul-Serban Agachi**, *Industrial Journal of Greenhouse Gas Control*, Available online January 18, 2012, doi:10.1016/j.ijggc.2011.12.007, <http://www.sciencedirect.com/science/article/pii/S1750583611002350>. (Subscription may be required.)

“A methodology to estimate maximum probable leakage along old wells in a geological sequestration operation.”

The following is the Abstract of this article: “This study presents a computational methodology to estimate the maximum probable leakage of CO₂ along old wells in a geological [storage] operation. The methodology quantifies the maximum probable CO₂ leakage as a function of the statistical characterization of existing wells. [The authors] use a Monte Carlo approach based on a computationally efficient simulator to run many thousands of realizations. Results from the Monte Carlo simulations are used to determine maximum leakage rates at 95 [percent] confidence. Uncertainty in the analysis is due to leaky well parameters, which are known to be highly uncertain.

TECHNOLOGY (CONTINUED)

[The authors] consider a wide range of parameter values, with [their] focus on assignment of effective well permeability values and the correlation of those values along individual wells. [The authors] use a specific location in Alberta, Canada, to demonstrate the methodology using a hypothetical injection and an assumed probability structure for the well permeabilities. [The authors] show that for a wide range of parameter values, the amount of leakage is within the bounds suggested as acceptable for climate change mitigation.” **Juan P. Nogues, Benjamin Court, Mark Dobossy, Jan M. Nordbotten, and Michael A. Celia**, *International Journal of Greenhouse Gas Control*, Available online January 20, 2012, doi:10.1016/j.ijggc.2011.12.003, <http://www.sciencedirect.com/science/article/pii/S1750583611002313>. (Subscription may be required.)

“Transient CO₂ leakage and injection in wellbore-reservoir systems for geologic carbon sequestration.”

The following is the Abstract of this article: “At its most basic level, the injection of CO₂ into deep reservoirs for geologic carbon [storage] (GCS) involves a system comprising the wellbore and the target reservoir, the wellbore being the only conduit available to emplace the CO₂. Wellbores in general have also been identified as the most likely conduit for CO₂ and brine leakage from GCS sites, especially those in sedimentary basins with historical hydrocarbon production. [The authors] have developed a coupled wellbore and reservoir model for simulating the dynamics of CO₂ injection and leakage through wellbores, and [they] have applied the model to situations relevant to geologic CO₂ storage involving upward flow (e.g. leakage) and downward flow (injection). The new simulator integrates a wellbore-reservoir system by assigning the wellbore and reservoir to two different sub-domains in which flow is controlled by appropriate laws of physics. In the reservoir, [the authors] model flow using a standard multiphase Darcy flow approach. In the wellbores, [the authors] use the drift-flux model and related conservation equations for describing transient two-phase non-isothermal wellbore flow of CO₂-water mixtures. Applications to leakage test problems reveal transient flows that develop into quasi-steady states within a day if the reservoir can maintain constant conditions at the wellbore. Otherwise, the leakage dynamics could be much more complicated than the simple quasi-steady-state flow, especially when one of the phases flowing in from the reservoir is near its residual saturation. A test problem of injection into a depleted (low-pressure) gas reservoir shows transient behavior out to several hundred days with sub-critical conditions in the well disappearing after 240 days.” **Lehua Pan, Curtis M. Oldenburg, Karsten Pruess, and Yu-Shu Wu**, *Greenhouse Gases: Science and Technology*, Available online December 2011, doi:10.1002/ghg.41, <http://onlinelibrary.wiley.com/doi/10.1002/ghg.41/abstract>. (Subscription may be required.)



TERRESTRIAL

“Prediction of vertical soil organic carbon profiles using soil properties and environmental tracer data at an untilled site.”

The following is the Abstract of this article: “Soil organic carbon (SOC) has considerable spatial and temporal variability both at the hillslope and catchment scale as well as down the soil profile. In recent years the distribution of SOC down the soil profile has become an area of interest in the understanding of the carbon [storage] potential of soils. Most studies however have concentrated on highly disturbed agricultural sites with little data available for untilled locations. In this study the vertical distribution of SOC is examined at a grassland site in the Young River area of Western Australia that has remained undisturbed by human activity for 50 years. Soil physical properties (texture, rock content) as well as the distribution of the environmental tracers ¹³⁷Cs and ²¹⁰Pb were assessed with the aim of better understanding the transport processes which produce the observed vertical distribution of SOC. While no consistent relationship was found between SOC and soil physical properties significant relationships were found between the distribution of SOC and the environmental tracers, ¹³⁷Cs and ²¹⁰Pb. Finite element simulations based on a diffusion/convection/decay model showed that the transport of ¹³⁷Cs and ²¹⁰Pb down the soil profile is likely to be driven by the same (primarily diffusive) processes. The same model used in conjunction with plant input and decay data generated from the RothC-26.3 soil carbon model revealed that transport of SOC down the soil profile, while also a diffusion process, was significantly slower indicating that different processes and/or pathways are involved in SOC transport at this site.” **T. Wells, G.R. Hancock, C. Dever, and D. Murphy**, *Geoderma*, Available online December 27, 2011, doi:10.1016/j.geoderma.2011.11.006, <http://www.sciencedirect.com/science/article/pii/S0016706111003247>. (Subscription may be required.)

TRADING

ANSI News Release, “Ernst & Young Achieves ANSI Accreditation for Greenhouse Gas Emission Verification.”

The American National Standards Institute (ANSI) announced the accreditation of Ernst & Young under their Accreditation Program for Greenhouse Gas Validation/Verification Bodies, which oversees the professional conduct of third-parties responsible for verifying the accuracy of emission assertions. Ernst & Young will verify GHG assertions related to GHG emissions and removals at the organizational level, and, as a third-party verification body, assess how organizations measure and quantify their GHG inventory, as well as how they report results against established protocol. ANSI, the coordinator of the U.S. standards and conformity assessment system, is a member of the International Accreditation Forum (IAF) and is the only U.S. body accrediting against ISO 14065:2007, “Greenhouse gases – Requirements for greenhouse

TRADING (CONTINUED)

gas validation and verification bodies for use in accreditation or other forms of recognition.” January 23, 2012, http://www.ansi.org/news_publications/news_story.aspx?menuid=7&articleid=3126.

Reuters, “Global CO₂ Market Totals [\$122.28 Billion] in 2011.”

According to analysts at Thomson Reuters Point Carbon, worldwide carbon markets were valued at \$122.28 billion in 2011, up four percent from 2010. In addition, the value of the European Union (EU) Emissions Trading System (ETS), the world’s largest carbon market, grew by 6 percent, and overall traded volume in EU Allowances (EUAs), including options and auctions, increased by 17 percent. The ETS, the 27-nation bloc’s main policy instrument to address potential climate change, caps CO₂ emissions on more than 10,000 power and industrial plants, covering approximately half of the bloc’s GHG emissions.

January 10, 2012, <http://www.reuters.com/article/2012/01/10/us-carbon-value-pointcarbon-idUSTRE8091N720120110>.

Platts, “California and Quebec Working on Joint Carbon Auction.”

California and Quebec have tentatively agreed to host a joint auction to sell CO₂ allowances as part of a coordinated GHG cap-and-trade program set to begin in 2013. Quebec adopted its cap-and-trade regulations in December and plans on linking its program with California before the first quarterly auction, which is scheduled to take place August 15, 2012. Compliance entities falling under the cap are required to hold enough allowances to cover their respective GHG emissions. The Western Climate Initiative (WCI) is currently conducting a search for a company to oversee the auction. January 12, 2012, <http://www.platts.com/RSSFeedDetailedNews/RSSFeed/ElectricPower/6854723>.

RECENT PUBLICATIONS

“Basin Resource Management for Carbon Storage.”

The following is from the Executive Summary of this document: “The Collie Hub in the Southern Perth Basin in Western Australia, CarbonNet in the Gippsland Basin in Victoria, and Wandoan in the Surat Basin in Queensland are being investigated as potential sites for CO₂ storage under an Australian Government flagship program. Each of the three CCS projects is located in resource-rich sedimentary basins, which contain high quality groundwater, oil and gas, unconventional gas, coal and geothermal resources. The Collie Hub CCS site is situated in the Southern Perth Basin in the south west of Western Australia. It is planned to eventually inject up to 10 Mt/yr of CO₂ into the lower Lesueur Sandstone from CO₂ sources in Collie and Kwinana. The CarbonNet CCS site is located in the nearshore and offshore areas of the Gippsland Basin in southeastern Victoria. Initial CO₂ storage of about 1-5 Mt/yr is planned in the Gippsland Basin, with a potential of scaling up to 20 Mt/yr. The Surat Basin in Queensland has been identified for geologic storage of [CO₂] for the Wandoan CCS Project which plans to eventually capture and store up to 2.5 Mt/yr of CO₂. The location of injection wells is yet to be selected at these sites. CSIRO and its [Western Australia Energy Research Alliance (WA:ERA)] research partner, Curtin University, are jointly conducting an assessment of the site specific resources that are geographically co-located with proposed carbon storage. The project also aims to understand the structural, stratigraphic and geomechanical aspects at these sites to assess the potential impacts of CO₂ injection on adjacent resources.” The full report is available for download at: <http://www.globalccsinstitute.com/publications/basin-resource-management-carbon-storage>.

“The Carbon Plan: Delivering our low carbon future.”

The following is from the Executive Summary of this document: “This plan sets out how the UK will achieve decarbonization within the framework of [their] energy policy: to make the transition to a low carbon economy while maintaining energy security, and [minimizing] costs to consumers, particularly those in poorer households. Emissions are down by a quarter since 1990. Current policies put the UK on track to cut emissions by over a third, on 1990 levels, by 2020. In the next [10] years, [the UK] will develop and deploy the technologies that will be needed to halve emissions in the 2020s. This will put the UK on a path towards an 80 [percent] reduction by 2050. By moving to a more efficient, low carbon and sustainable economy, the UK will become less reliant on imported fossil fuels and less exposed to higher and more volatile energy prices in the future.” To view the entire UK Department of Energy and Climate Change (DECC) document, visit: <http://www.decc.gov.uk/assets/decc/11/tackling-climate-change/carbon-plan/3702-the-carbon-plan-delivering-our-low-carbon-future.pdf>.

“Clean Coal Technologies Markets and Trends Worldwide, 2nd Edition.”

The following is from the Summary of this document: “Global Clean Coal Technologies and Markets provides a detailed discussion of the key technologies, deployed or in development, to address the environmental impact of coal. The various clean coal technologies that hold the most promise for commercial deployment are discussed in the report. CCS and other clean coal technologies are reviewed from the point of view of their current status, likely future performance and [research and development (R&D)] needs, and potential for commercial adoption. The report also includes a broad review of the market for clean coal technologies for coal-fired electricity generation. The global market

RECENT PUBLICATIONS (CONTINUED)

demand for coal, electricity, and clean coal-fired electricity is quantified and projections for growth in demand are provided, along with the key factors influencing this growth in leading coal consuming nation around the world. Global Clean Coal Technologies and Markets details the current and projected percentage of electricity generated by clean coal technologies. The historical and projected market value of the clean coal technologies is also covered. The report includes profiles of 15 companies actively engaged in the clean coal market, and also details current and potential U.S. employment in the sector. The ongoing research, development, commercialization and deployment of clean coal technologies is expected to generate a significant number of direct, indirect and induced jobs over the next 10 to 15 years. The construction and operation of coal-fired power plants that incorporate clean coal technologies will also result in the creation of tens of thousands of jobs across a variety of sectors. The report provides an overview of coal- and electricity-related employment and details projections for expected growth.” The full report is available at: <http://www.reportlinker.com/p0750344-summary/Clean-Coal-Technologies-Markets-and-Trends-Worldwide-Edition.html>. (Subscription required.)

“CCS in New Zealand.”

The following is the Executive Summary of this document: “CCS has global significance as it is one of a range of options available for reducing [CO₂] emissions. This report considers whether CCS has the potential to deliver value to New Zealand as [it] moves to a low carbon future. CCS involves the capture of [CO₂] emissions from large emitters such as power stations and processing plants. That [CO₂] is then transported (usually through a pipeline) to a reservoir, very deep underground, where it is injected into porous rock. Although integrated CCS is in its infancy internationally, the individual components (capturing [CO₂], transporting it in pipelines, and injecting gas into reservoirs) have all been used internationally and in the New Zealand oil and gas industry for decades. The NZCCS Partnership [recognized] the need to investigate the implications of CCS should it be deployed in New Zealand. This study, led by Transfield Worley Ltd, considered the technical, commercial, legal/legislative, environmental, and social aspects of CCS fits into the international and New Zealand responses to climate change. It includes two case studies considering the viability of CCS for existing and new plants, along with analysis of legislative, environmental, social and economic barriers to the adoption of CCS.” To download the full document, visit: http://www.straterra.co.nz/uploads/files/ccs_in_new_zealand_summary_report_2011.pdf.

LEGISLATIVE ACTIVITY

Billings Gazette, “Wyoming Lawmakers Want State Regulation of Gases,” and *The Republic*, “Wyoming Legislative Committee Moves Toward State Regulation of Greenhouse Gases.”

The Wyoming Legislature’s Joint Minerals, Business, and Economic Development Interim Committee has endorsed a bill authorizing the Wyoming Department of Environmental Quality to begin drafting regulations that would amend the Wyoming Clean Air Act to give the state primacy over GHGs that otherwise would be regulated

by the U.S. Environmental Protection Agency (EPA). The Federal government has been regulating GHGs in Wyoming since 2000, when the Legislature adopted a policy that the state wouldn’t regulate GHGs; currently, Wyoming only regulates non-GHGs. Wyoming cannot begin regulating GHGs until the Legislature gives its approval, or until a Federal court rules on Wyoming’s claims in a pending lawsuit against EPA. February 11, 2012, http://billingsgazette.com/news/state-and-regional/wyoming/wyoming-lawmakers-want-state-regulation-of-gases/article_43b2f569-4f3d-5d07-ab1e-73e7b32a3231.html, and February 11, 2012, <http://www.therepublic.com/view/story/cd2bafdb7113413b983249caf10b0642/WY--Greenhouse-Gases/>.



EVENTS

February 29-March 2, 2012, **First Australian Summer Study on Energy Efficiency & Decentralized Energy**, *Manly Beach, Sydney, Australia*. This three-day event includes discussions, presentations, and working sessions on shaping the future of energy efficiency in Australia. The program consists of three concurrent “streams”: Markets and Regulation, which includes a discussion on carbon mitigation policy; Technology and Practice, which will discuss implementing energy efficiency programs; and Carbon and Communication, which includes a session on communicating low-cost carbon policy. The full brochure is available for download at: <http://www.a2se.org.au/activities/events/summer-study>.



EVENTS (CONTINUED)

March 12-14, 2012, **Optimising Enhanced Oil Recovery**, *Venue to be Determined, Abu Dhabi, United Arab Emirates*. While the focus of this conference is on maximizing oil production in the Middle East by discussing efficient EOR strategies used worldwide, it commences with a one-day session dedicated to the development, technology, investment, and strategy of making CCS a reality. Topics covered include deployment of CCS facilities in the Middle East, CO₂ capture and EOR case studies, and CO₂ transportation strategies. For more information, go to: <http://v11.vuturevx.com/exchange-sites/Whitmore%20Group/59/events-pdfs-eu/eor2-mktg-agenda.pdf>.

April 24-25, 2012, **Carbon Capture and Storage Conference**, *Venue to be Determined, Calgary, Alberta, Canada*. This event provides an opportunity for attendees to hear from regulators, scientists, and industry players on the latest in CCS-related legislation, overcoming geologic challenges, devising business models for commercialization, gaining public acceptance, and other topics. Visit: <http://www.canadianinstitute.com/2012/338/carbon-capture-and-storage-conference/> for more details.

April 30-May 2, 2012, **11th Annual Conference on Carbon Capture, Utilization, and Sequestration**, *David L. Lawrence Convention Center, Pittsburgh, Pennsylvania, USA*. The intent of this conference is to: (1) provide a forum for the exchange of experience among scientific and engineering communities working on such technologies and systems; (2) facilitate the necessary dialogue between technology developers/purveyors, industry, and the public on the development and deployment of viable technologies; and (3) share experience on developing the necessary capacity within the public and private sector to move the technology base forward. More information is available at: <http://www.carbonsq.com/>.

May 21-23, 2012, **Global Conference on Oceans, Climate, and Security**, *Seaport Hotel and World Trade Center, Boston, Massachusetts, USA*. This three-track conference will focus on mitigating the effects of potential climate change on coastal and ocean ecosystems, as well as the security interests of the Nation. Included is a Science and Technology Needs track, which will discuss, among other topics, technologies and innovations, modeling solutions and simulations, and emerging sciences. For more information, visit: <http://www.gcocs.org/>.

July 8-12, 2012, **Global Conference on Global Warming 2012**, *Istanbul Technical University, Maslak, Istanbul, Turkey*. The themes of this conference cover potential climate change across a broad range of disciplines, such as ecology, education, social sciences, economics, management, political sciences, and information technology. Among the topics to be discussed are carbon storage, carbon tax, climate change modeling and simulations, and GHGs. For more information, go to: <http://www.gcgw.org/gcgw12/index.php?conference=gcgw&schedConf=gcgw12>.

July 23-25, 2012, **Carbon Capture and Storage: Science, Technology, and Policy**, *MIT, Cambridge, Massachusetts, USA*. This energy short course covers the science, technology, and policy aspects of CCS, focusing on the role of CCS in the climate change mitigation portfolio; the technical approaches to CO₂ capture; the science behind geologic storage, site selection, and risk evaluation; and the role of policy in establishing a market and business opportunities for CCS. For more information, visit the course website at: http://web.mit.edu/professional/short-programs/courses/carbon_capture_storage.html.

November 18-22, 2012, **International Conference on Greenhouse Gas Technologies 11 (GHGT-11)**, *Kyoto International Conference Center, Japan*. This will be the second visit to Kyoto by the GHGT conference series, with more than 1,600 delegates expected to attend. A formal agenda has not yet been developed; however, planning for GHGT-11 is underway. The call for papers has expired. Visit: <http://www.ghgt.info/index.php/Content-GHGT11/ghgt-11-overview.html> for more details.

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