

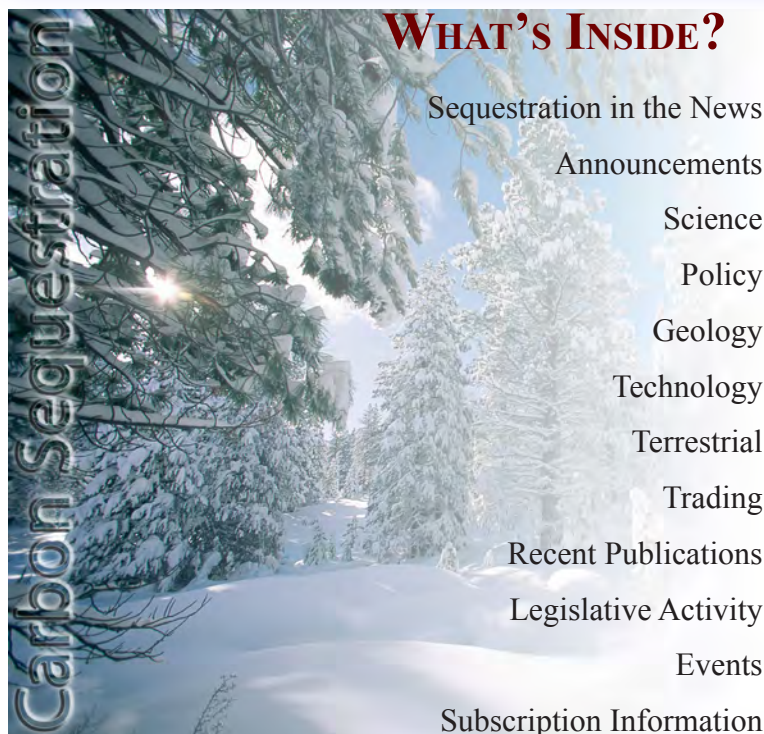


Carbon Sequestration Newsletter



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JANUARY 2010



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a beneficial manner. The three projects will demonstrate technologies that: (1) make progress toward DOE's target CO₂ capture efficiency of 90 percent; (2) make progress toward DOE's capture and sequestration goal of less than 10 percent increase in the cost of electricity for gasification systems and less than 35 percent for combustion and oxy-combustion systems; and (3) capture and sequester, or put to beneficial use, an amount of CO₂ emissions in excess of the minimum of 300,000 tons per year required by the Clean Coal Power Initiative (CCPI). The projects, valued at \$3.18 billion, will enable commercial deployment and ensure the United States has clean, reliable, and affordable electricity and power. An investment of \$979 million, including funds from the American Recovery and Reinvestment Act of 2009 (ARRA), will be combined with more than \$2.2 billion in private capital cost share as part of the third round of the CCPI. These are the second installment of projects awarded under CCPI Round III, which was created in 2005 to reduce the time needed for low-emission coal technologies to be prepared for commercial use. To learn more about DOE's Clean Coal Technology Program, click: <http://www.fossil.energy.gov/programs/powersystems/cleancoal/index.html>. December 4, 2009, http://www.fossil.energy.gov/news/techlines/2009/09081-Secretary_Chu_Announces_CCS_Invest.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

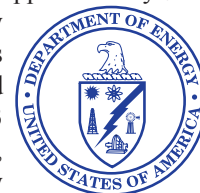
Fossil Energy Techline, "Secretary Chu Announces \$3 Billion Investment for Carbon Capture and Storage."

On Friday, December 4, 2009, the U.S. Department of Energy (DOE) announced that three new projects have been selected to accelerate the development of coal technologies with carbon capture and storage (CCS) at commercial scale. The selected projects demonstrate advanced, coal-based technologies that will capture carbon dioxide (CO₂) emissions and either sequester them or use them in

SEQUESTRATION IN THE NEWS

Canada.com, "Alberta Invests in World's Biggest Carbon-Capture Pipeline," and *Reuters*, "Canada Backs Alberta CO₂ Pipeline Plan."

The Canadian and Alberta governments will invest as much as \$525 million in a pipeline project to carry CO₂ from an industrial region near Edmonton, Alberta, to depleted oilfields. The Alberta Carbon Trunk Line is expected to have an initial capacity of 15,000 tonnes per day, but has the potential to be expanded to 40,000 tonnes per day if secondary lines are added. At maximum pressure, the 149-mile pipeline would carry and store more than 14 million tonnes of CO₂ a year to depleted oilfields for enhanced oil recovery (EOR). The company plans to have lateral lines running off the trunkline to the oilfields, and CO₂ collection lines extending to both Fort McMurray and the coal-fired power plants near Wabamun Lake. The Canadian Government will provide approximately \$59 million and Alberta will spend approximately \$464 million over 15 years. Alberta and Enhance Energy signed a letter of intent that follows previous announcements for Shell's Quest project at Scotford and TransAlta's Pioneer Project at the Keephills 3 coal-fired turbine near Wabamun. Combined, the three projects will receive approximately



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SEQUESTRATION IN THE NEWS (CONTINUED)

\$1.9 billion from Alberta's CCS fund. Enhance Energy will begin construction in 2011 and plans to start operations in 2012. November 24, 2009, <http://www.canada.com/Alberta+invests+world+biggest+carbon+capture+pipeline/2260125/story.html>, and November 24, 2009, <http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE5AN5AS20091124>.

Power Engineering International, "EU Grants [\$261 Million] towards Vattenfall CCS Demonstration Plant," and **Vattenfall Press Release**, "Favorable Response from Brussels for CCS Development EU Commission Confirms Support for Jämschalde Demo Project."

Vattenfall's CCS demonstration plant planned at Jämschalde in Brandenburg of eastern Germany will receive up to \$261 million in funding from the European Union (EU) Commission to develop a full-scale CCS plant at an existing coal-fired power plant. The plant will include a lignite drying facility and plans call for the CCS plant to be connected to the grid by 2015. The electrical power capacity of the demonstration plant will be approximately 385-megawatts (MW), with a CO₂ capture rate of more than 90 percent, totaling up to 2.7 million tonnes of CO₂ per year. The funding is derived from the European Energy Programme for Recovery (EPR), a European economic program for energy adopted in June 2009; a total of six CCS projects will be funded under EPR. Vattenfall has been developing, testing, and demonstrating CCS technology since 2000; projects include an oxyfuel pilot plant at Schwarze Pumpe in Germany, the construction of a pre-combustion pilot plant at Buggenum in the Netherlands, and plans for the development of a large-scale CO₂ capture plant at Nuon Magnum in the Netherlands. Vattenfall also plans to explore CCS at Nordjyllandsværket in Denmark after 2020 when CCS technology is expected to be commercially viable. Vattenfall plans to demonstrate the entire CCS process chain and has undertaken seismic research to determine potential locations for the carbon captured from the demonstration facility. December 9, 2009, http://pepei.pennnet.com/display_article/371638/6/ARTCL/none/none/1/EU-grants-€180m-towards-Vattenfall-CCS-demonstration-plant/, and December 9, 2009, <http://www.vattenfall.com/en/press-details-hidden.htm?newsid=6BF14C0B34BD48AD9434DAED79680429>.

ScottishPower Press Release, "Major Breakthrough for ScottishPower Carbon Capture Prototype at Longannet," and **Energy Business Review**, "ScottishPower Tests CCS Technology at Longannet Coal-Fired Station."

ScottishPower has successfully tested CCS technology at its prototype carbon capture unit at Longannet Power Station, demonstrating reduced energy requirements in the improved capture process by approximately one-third from a reference plant. The tests at Longannet have monitored the effectiveness of an amine plant that captures the CO₂ under a range of operating conditions. Testing at the coal-fired power plant will continue through February 2010, as scientists believe the technology is ready to be successfully applied at full scale. The prototype carbon

SEQUESTRATION IN THE NEWS (CONTINUED)

capture unit is monitored 24 hours a day and has been operating

successfully for more than 2,000 hours. The unit has captured approximately 90 percent of the carbon from 1,000 cubic meters an hour of exhaust gas at Longannet Power Station. November 25, 2009, http://www.scottishpower.com/PressReleases_1964.htm, and November 26, 2009, http://fossilfuel.energy-business-review.com/news/scottishpower_tests_ccs_technology_at_longannet_coalfired_station_091126/.

ANNOUNCEMENTS

NETL Launches Online CCS Database.

The National Energy Technology Laboratory's (NETL) CCS Database, which includes 192 proposed and active CCS projects worldwide (38 capture, 46 storage, and 108 capture and storage), provides information about the efforts of various industries, public groups, and governments to develop and deploy CCS technology; lists technologies being developed for capture, testing sites for CO₂ storage, and estimations of costs and anticipated project completion dates; and uses Google Earth to illustrate the location of projects and provide links for further information. The database is available at: http://www.netl.doe.gov/technologies/carbon_seq/database/index.html.

10th International Conference on Greenhouse Gas Control Technologies.

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

Call for Papers.

The 9th Annual Carbon Capture and Sequestration Conference, scheduled for May 10-13, 2010, at the Hilton Pittsburgh in Pittsburgh, Pennsylvania, is currently accepting papers and poster presentations. Abstracts must be submitted online by February 16, 2010. For more information on the requirements and guidelines, visit: <http://www.carbonsq.com/pdf/2010/call%20for%20papers.pdf>.

Nation's First Greenhouse Gas Reporting System/Monitoring to Begin in 2010.

Beginning January 1, 2010, the U.S. Environmental Protection Agency (EPA) will require large facilities in the United States to collect GHG data under a new reporting system that will guide development of the best policies and programs to reduce emissions and fight potential climate change. To learn more about the new reporting system and reporting requirements, visit: <http://www.epa.gov/climatechange/emissions/ghgrulemaking.html>.

UN Online Tool to Track Nations' Pledges on Climate Change.

The United Nations Environment Program (UNEP) has launched a new online tool that will keep track of countries' promises and proposals on combating climate change. The Climate Change Tracker, which currently lists the pledges and proposals from 25 countries and the EU's 27 member states, will be updated as new proposals are made, comparing all pledges with the goal of keeping global temperature rise at or less than two degrees centigrade from pre-industrial levels. For more information, visit: <http://www.un.org/apps/news/story.asp?NewsID=33226&Cr=copenhagen&Cr1>.

SCIENCE

***Science Daily*, "Predicting the Fate of Underground Carbon."**

Researchers from the Massachusetts Institute of Technology (MIT) have developed a new modeling methodology for determining the capacity and assessing the risk(s) of leakage in potential underground CO₂ formations. The tool takes into account key aspects of the underlying physics to predict the shape and pattern of flow when CO₂ is injected into a deep underground formation. Before, in a numerical model, each parameter change added hours or days to the time it took

to model a prediction of CO₂ behavior under various circumstances. Engineers and geologists believe that the new methodology will allow them to quickly and inexpensively determine whether CO₂ could escape from a geological formation. MIT researchers presented their findings at the 62nd Annual Meeting of the American Physical Society's (APS) Division of Fluid Dynamics at the Minneapolis Convention Center on November 23, 2009. To view the Abstract of the presentation, titled, "Post-Injection Migration of CO₂ in Saline Aquifers Subject to Groundwater Flow, Aquifer Slope, and Capillary Trapping," visit: <http://meetings.aps.org/Meeting/DFD09/Event/111611>. November 23, 2009, <http://www.sciencedaily.com/releases/2009/11/091123132630.htm>.

SCIENCE (CONTINUED)

United Press International, “Global Warming Threatens Hawaiian Songbird,” and *Endangered Species Coalition Press Release*, “America’s Hottest Species.”

According to a report from the Endangered Species Coalition, the Akikiki (also known as the Kaua’i Creeper), a small honeycreeper prevalent to the Hawaiian island Kaua’i, is at risk of extinction due to potential climate change. A common threat to the Akikiki is avian malaria, which cannot develop in birds in temperatures below 55 degrees Fahrenheit. An increase in temperature of four degrees Fahrenheit would result in an 85 percent decrease in the areas where transmission of the disease is currently limited. The report, titled, “America’s Hottest Species,” states that there is an increasing risk of extinction for 11 U.S. species. The Intergovernmental Panel on Climate Change (IPCC) reports that 20 to 30 percent of the world’s species will be at an increased risk of extinction if global temperatures increase more than three to five degrees Fahrenheit above pre-industrial levels. A climate change of that magnitude could potentially threaten species by eliminating their habitat, increasing diseases, diminishing reproduction, and reducing food supplies. To download the Endangered Species Coalition’s full report, visit: http://www.stopextinction.org/cgi-bin/giga.cgi?cmd=cause_dir_custom&cause_id=1704&page=HottestSpecies. December 1, 2009, http://www.upi.com/Science_News/2009/12/01/Global-warming-threatens-Hawaiian-songbird/UPI-27961259695472/, and December 1, 2009, http://www.stopextinction.org/cgi-bin/giga.cgi?cmd=cause_dir_news_item&cause_id=1704&news_id=78688&cat_id=1012.

POLICY

EPA News Release, “EPA: Greenhouse Gases Threaten Public Health and the Environment.”

EPA announced on December 7, 2009, that GHGs are threatening to the public health and welfare of the American people. EPA’s endangerment findings, which claim that GHGs such as CO₂ can potentially lead to hotter, longer heat waves, are a response to a U.S. Supreme Court decision in 2007 that GHGs fit within the Clean Air Act (CAA) definition of air pollutants. EPA research shows that as a result of human activities, GHG concentrations in the atmosphere are at record high levels and that the Earth has been warming over the past 100 years and at an increased rate in recent decades. The findings lay the groundwork for EPA to develop rules under the CAA that limit GHG emission from vehicles and stationary CO₂ point sources like power plants and other industrial facilities. For more information on EPA’s findings, click: <http://www.epa.gov/climatechange/endangerment.html>. December 7, 2009, <http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/08d11a451131bca585257685005bf252%21OpenDocument>.

“Evaluating the development of carbon capture and storage technologies in the United States.”

The following is the Abstract of this article: “CCS is seen as an important solution to solve the twin challenge of reducing GHG emissions, while utilizing fossil fuel reserves to meet future energy requirements. In this study an innovation systems perspective is applied to review the development of CCS technologies in the [United States] between 2000 and 2009 and to come up with policy recommendations for technology managers that wish to accelerate the deployment of CCS. The analysis describes the successful build-up of an innovation system around CCS and pinpoints the key determinants for this achievement. However, the evaluation of the system’s performance also indicates that America’s leading role in the development of CCS should not be taken for granted. It shows that the large CCS [research and development (R&D)] networks, as well as the extensive CCS knowledge base, which have been accumulated over the past decade, have not yet been valorized by entrepreneurs to explore the market for integrated CCS concepts linked to power generation. Therefore, it is argued that the build-up of the innovation system has entered a critical phase that is decisive for a further thriving development of CCS technologies in the [United States]. This study provides a clear understanding of the current barriers to the technology’s future deployment and outlines a policy strategy that (1) stimulates technological learning; (2) facilitates collaboration and coordination in CCS actor networks; (3) creates financial and market incentives for the technology; and (4) provides supportive regulation and sound communication on CCS.” **Klaas van Alphen, Paul M. Noothout, Marko P. Hekkert, and Wim C. Turkenburg**, *Renewable and Sustainable Energy Reviews*, Available online November 18, 2009, doi: 10.1016/j.rser.2009.10.028, <http://www.sciencedirect.com/science/article/B6VMY-4XR4GV8-1/2/019d09178bbd1377e4b2dd8998a7c2de>. (Subscription may be required.)

GEOLOGY

“Sequestering carbon dioxide in a closed underground volume.”

The following is the Abstract of this article: “The capture and subsequent geologic sequestration of CO₂ has been central to plans for managing CO₂ produced by the combustion of fossil fuels. The magnitude of the task is overwhelming in both physical needs and cost, and it entails several components including capture, gathering and injection. The rate of injection per well and the cumulative volume of injection in a particular geologic formation are critical elements of the process. Published reports on the potential for sequestration fail to address the necessity of storing CO₂ in a closed system. [The authors’] calculations suggest that the volume of liquid or supercritical CO₂ to be disposed cannot exceed more than about [one percent] of pore space. This will require from [five] to 20 times more underground reservoir volume than has been envisioned by many, and it renders geologic sequestration of CO₂ a profoundly non-feasible option for the management of CO₂ emissions. Material balance modeling shows that CO₂ injection in the liquid stage (larger mass) obeys an analog of the single-phase, liquid material balance, long-established in the petroleum industry for forecasting undersaturated oil recovery. The total volume that can be stored is a function of the initial reservoir pressure, the fracturing pressure of the formation or an adjoining layer, and

GEOLOGY (CONTINUED)

CO₂ and water compressibility and mobility values. Further, published injection rates, based on displacement mechanisms assuming open [formation] conditions are totally erroneous because they fail to reconcile the fundamental difference between steady state, where the injection rate is constant, and pseudo-steady state where the injection rate will undergo exponential decline if the injection pressure exceeds an allowable value. A limited [formation] indicates a far larger number of required injection wells for a given mass of CO₂ to be sequestered and/or a far larger reservoir volume than the former.” **Michael J. Economides and Christine Ehlig-Economides**, *Journal of Petroleum Science and Engineering*, Available online November 20, 2009, doi: 10.1016/j.petrol.2009.11.002, <http://www.sciencedirect.com/science/article/B6VDW-4XRJX7V-1/2/5ad2e833c9ea78891ed0a96a8e7f5472>. (Subscription may be required.)

“Laboratory characterization of coal reservoir permeability for primary and enhanced coalbed methane recovery.”

The following is the Abstract of this article: “Coal permeability is highly sensitive to the stress. Meanwhile, coal swells with gas adsorption, and shrinks with gas desorption. Under reservoir conditions these strain changes affect the cleat porosity and thus permeability. Coal permeability models, such as the Palmer and Mansoori and Shi and Durucan models, relate the stress and swelling/shrinkage effect to permeability using an approximate geomechanical approach. Thus, in order to apply these models, stress-permeability behavior, swelling/shrinkage behavior and the geomechanical properties of the coal must be estimated. This paper presents a methodology for the laboratory characterization of the Palmer and Mansoori and Shi and Durucan permeability models for reservoir simulation of [enhanced coalbed methane (ECBM)] and CO₂ sequestration in coal. In this work a triaxial cell was used to measure gas permeability, adsorption, swelling and geomechanical properties of coal cores at a series of pore pressures and for [methane (CH₄)], CO₂, and helium with pore pressures up to 13 MPa and confining pressures up to 20 MPa. Properties for the permeability models such as cleat compressibility, Young’s modulus, Poisson’s ratio and adsorption-induced swelling are calculated from the experimental measurements. Measurements on an Australian coal are presented. The results show that permeability decreases significantly with confining pressure and pore pressure. The permeability decline with pore pressure is a direct result of adsorption-induced coal swelling. Coal geomechanical properties show some variation with gas pressure and gas species, but there is no direct evidence of coal softening at high CO₂ pressures for the coal sample studied. The experimental results also show that cleat compressibility changes with gas species and pressure. Then the measured properties were applied in the Shi and Durucan model to investigate the permeability behavior during CO₂ sequestration in coal.” **Zhejun Pan, Luke D. Connell, and Michael Camilleri**, *International Journal of Coal Geology*, Available online November 10, 2009, doi: 10.1016/j.coal.2009.10.019, <http://www.sciencedirect.com/science/article/B6V8C-4XNF6BB-1/2/385b16f78cdaeb9e2c2f27fa5bb2c083>. (Subscription may be required.)

“Role and impact of CO₂-rock interactions during CO₂ storage in sedimentary rocks.”

The following is the Abstract of this article: “Before implementing CO₂ storage on a large scale its viability regarding injectivity, containment and long-term safety for both humans and environment is crucial. Assessing CO₂-rock interactions is an important part of that as these potentially affect physical properties through highly coupled processes. Increased understanding of the physical impact of injected CO₂ during recent years including buoyancy driven two-phase flow and convective mixing elucidated potential CO₂ pathways and indicated where and when CO₂-rock interactions are potentially occurring. Several areas of interactions can be defined: (1) interactions during the injection phase and in the near well environment, (2) long-term reservoir and caprock interactions, (3) CO₂-rock interactions along leakage pathways (well, caprock, and fault), (4) CO₂-rock interactions causing potable [formation] contamination as a consequence of leakage, (5) water-rock interactions caused by [formation] contamination through the CO₂ induced displacement of brines and finally engineered CO₂-rock interactions (6). The driving processes of CO₂-rock interactions are discussed as well as their potential impact in terms of changing physical parameters. This includes dissolution of CO₂ in brines, acid induced reactions, reactions due to brine concentration, clay desiccation, pure CO₂-rock interactions and reactions induced by other gases than CO₂. Based on each interaction environment the main aspects that are possibly affecting the safety and/or feasibility of the CO₂ storage scheme are reviewed and identified. Then the methodologies for assessing CO₂-rock interactions are discussed. High priority research topics include the impact of other gaseous compounds in the CO₂ stream on rock and cement materials, the reactivity of dry CO₂ in the absence of water, how CO₂ induced precipitation reactions affect the pore space evolution and thus the physical properties and the need for the development of coupled flow, geochemical and geomechanical models.” **Irina Gaus**, *International Journal of Greenhouse Gas Control*, Available online November 2, 2009, doi: 10.1016/j.ijggc.2009.09.015, <http://www.sciencedirect.com/science/article/B83WP-4XKSY3T-1/2/1607d6daddb03048627d59695f95f2e5>. (Subscription may be required.)

TECHNOLOGY

“Quantitative risk assessment of CO₂ transport by pipelines – a review of uncertainties and their impacts.”

The following is the Abstract of this article: “A systematic assessment, based on an extensive literature review, of the impact of gaps and uncertainties on the results of quantitative risk assessments (QRA) for CO₂ pipelines is presented. Sources of uncertainties that have been assessed are: failure rates, pipeline pressure, -temperature, -section length, -diameter, orifice size, type and direction of release, meteorological conditions, jet diameter, vapour mass fraction in the release and the dose-effect relationship for CO₂. A sensitivity analysis with these parameters is performed using release, dispersion and impact models. The results show that the knowledge gaps and uncertainties have a large effect on the accuracy of the assessed risks of CO₂ pipelines. In this study it is found that the individual risk

TECHNOLOGY (CONTINUED)

contour can vary from [zero] to 124 m from the pipeline depending on assumptions made. In existing studies this range is found to be between <1 m and 7.2 km. Mitigating the relevant risks is part of current practice, making them controllable. It is concluded that QRA for CO₂ pipelines can be improved by validation of release and dispersion models for high pressure CO₂ releases, definition and adoption of a universal dose-effect relationship and development of a good practice guide for QRAs for CO₂ pipelines.” **Joris Koornneef, Mark Spruijt, Menso Molag, Andrea Ramírez, Wim Turkenburg, and André Faaij**, *Journal of Hazardous Materials*, Available online November 18, 2009, doi: 10.1016/j.jhazmat.2009.11.068, <http://www.sciencedirect.com/science/article/B6TGF-4XR5N97-2/2/fe68a2a9dfa1ae5d884f3ca9ed2a8cd6>. (Subscription may be required.)

“Accelerating the deployment of carbon capture and storage technologies by strengthening the innovation system.”

The following is the Abstract of this article: “In order to take up the twin challenge of reducing CO₂ emissions, while meeting a growing energy demand, the potential deployment of CCS technologies is attracting a growing interest of policy makers around the world. In this study [the authors] evaluate and compare national approaches towards the development of CCS in the United States, Canada, Norway, the Netherlands, and Australia. The analysis is done by applying the functions of innovation systems approach. This approach posits that new technology is developed, demonstrated and deployed in the context of a technological innovation system. The performance assessment of the CCS innovation system shows that the extensive knowledge base and knowledge networks, which have been accumulated over the past years, have not yet been utilized by entrepreneurs to explore the market for integrated CCS concepts linked to power generation. This indicates that the build-up of the innovation system has entered a critical phase that is decisive for a further thriving development of CCS. In order to move the CCS innovation system through this present difficult episode and deploy more advanced CCS concepts at a larger scale it is necessary to direct policy initiatives at the identified weak system functions, i.e. entrepreneurial activity, market creation and the mobilization of resources. Moreover, in some specific countries it is needed to provide more regulatory guidance and improve the legitimacy for the technology. [The authors] discuss how policy makers and technology managers can use these insights to develop a coherent policy strategy that would accelerate the deployment of CCS.” **Klaas van Alphen, Marko P. Hekkert, and Wim C. Turkenburg**, *International Journal of Greenhouse Gas Control*, Available online November 3, 2009, doi: 10.1016/j.ijggc.2009.09.019, <http://www.sciencedirect.com/science/article/B83WP-4XKXRW7-1/2/d96755887e1846e49f59e18b7a723637>. (Subscription may be required.)

“The role of carbon capture technologies in greenhouse gas emissions-reduction models: A parametric study for the U.S. power sector.”

The following is the Abstract of this article: “This paper analyzes the potential contribution of CCS technologies to [GHG]

emissions reductions in the U.S. electricity sector. Focusing on capture systems for coal-fired power plants until 2030, a sensitivity analysis of key CCS parameters is performed to gain insight into the role that CCS can play in future mitigation scenarios and to explore implications of large-scale CCS deployment. By integrating important parameters for CCS technologies into a carbon-abatement model similar to the EPRI Prism analysis, this study concludes that the start time and rate of technology diffusion are important in determining emissions reductions and fuel consumption for CCS technologies. Comparisons with legislative emissions targets illustrate that CCS alone is very unlikely to meet reduction targets for the electric-power sector, even under aggressive deployment scenarios. A portfolio of supply and demand-side strategies is needed to reach emissions objectives, especially in the near term. Furthermore, model results show that the breakdown of capture technologies does not have a significant influence on potential emissions reductions. However, the level of CCS retrofits at existing plants and the eligibility of CCS for new subcritical plants have large effects on the extent of [GHG] emissions reductions.” **John E. Bistline and Varun Rai**, *Energy Policy*, Available online November 27, 2009, doi:10.1016/j.enpol.2009.11.008, <http://www.sciencedirect.com/science/article/B6V2W-4XT2CT3-2/2/f8b2b8098d7b1deb7ff0278c18db235e>. (Subscription may be required.)



TERRESTRIAL

“Rapid Assessment of U.S. Forest and Soil Organic Carbon Storage and Forest Biomass Carbon Sequestration Capacity.”

The following is the Abstract of this article: “This report provides results of a rapid assessment of biological carbon stocks and forest biomass carbon sequestration capacity in the conterminous United States. Maps available from the U.S. Department of Agriculture are used to calculate estimates of current organic carbon storage in soils (73 petagrams of carbon, or PgC) and forest biomass (17 PgC). Of these totals, 3.5 PgC of soil organic carbon and 0.8 PgC of forest biomass carbon occur on lands managed by the U.S. Department of



of the Interior (DOI). Maps of potential vegetation are used to estimate hypothetical forest biomass carbon sequestration capacities that are 3-7 PgC higher than current forest biomass carbon storage in the conterminous United States. Most of the estimated hypothetical additional forest biomass carbon sequestration capacity is accrued in areas currently occupied by agriculture and development. Hypothetical forest biomass carbon sequestration capacities calculated for existing forests and woodlands are within ± 1 PgC of estimated current forest biomass carbon storage. Hypothetical forest biomass sequestration

TERRESTRIAL (CONTINUED)

capacities on lands managed by the DOI in the conterminous United States are 0-0.4 PgC higher than existing forest biomass carbon storage. Implications for forest and other land management practices are not considered in this report. Uncertainties in the values reported here are large and difficult to quantify, particularly for hypothetical carbon sequestration capacities. Nevertheless, this rapid assessment helps to frame policy and management discussion by providing estimates that can be compared to amounts necessary to reduce predicted future atmospheric [CO₂] levels.” Eric T. Sundquist, **Katherine V. Ackerman, Norman B. Bliss, Josef M. Kelldorfer, Matt C. Reeves, and Matthew G. Rollins**, *U.S. Geological Survey Open-File Report 2009-1283*, Available online December 2009, <http://pubs.usgs.gov/of/2009/1283/pdf/ofr20091283.pdf>.

TRADING

Carbon Market Update, December 11, 2009

CCX-CFI 2009 (\$/tCO ₂) \$0.15 (Vintage 2009)	EU ETS-EUA DEC 2009 (\$/tCO ₂) \$21.30
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(Converted from € to US\$)

RGGI News Release, “RGGI States Complete Sixth Successful CO₂ Auction.”

The 10 Northeast and Mid-Atlantic states participating in the Regional Greenhouse Gas Initiative (RGGI) completed the sixth regional auction of CO₂ allowances on December 2, 2009. All of the allowances for the 2009 vintage offered in the auction (28,591,698) sold at a price of \$2.05; 1,599,000 of the 2,172,540 allowances for the 2012 vintage sold at a price of \$1.86. In total, the auction yielded \$61,587,120.90, increasing the total amount of proceeds from RGGI auctions to more than \$494.4 million. The participating states chose to auction nearly all allowances and to invest the proceeds in a variety of programs aimed at reducing emissions and consumer costs, creating jobs, and building the clean energy economy. The states participating in RGGI designed and implemented the first market-based, mandatory cap-and-trade program in the United States to reduce GHG emissions. Power sector CO₂ emissions are capped at 188 million short tons per year through 2014, at which point the cap will then be reduced by 2.5 percent in each of the four years through 2018, for a total reduction of 10 percent. For more information, visit: <http://www.rggi.org/>. To learn more about how each state is investing RGGI auction proceeds, click: http://www.rggi.org/states/program_investments. December 4, 2009, http://www.rggi.org/docs/Auction_6_Results_Release_MMrep.pdf.

RECENT PUBLICATIONS

Clean Coal/CCS Technology Development Pathways.

The following is from the Executive Summary of this document: “Senator Byron L. Dorgan believes that further R&D as well as larger-scale deployment will be essential for the continued use of [the] Nation’s fossil energy resources, especially coal, in a carbon-constrained world. He has clearly heard the message from a range of interests that technology research, development, and demonstration (RD&D) are critical to resolve the twin challenges of energy security and climate change. Because a consensus on coal technology direction has been lacking in discussions about climate change, Senator Dorgan invited a wide-ranging group of organizations to participate in a meeting to better develop a strategic pathway for clean coal and CCS technology approaches. Each of these expert panels comprised representatives from industry, academia, government, and non-governmental organizations and was asked to focus on a specific area or issue regarding the Nation’s path toward effective and economic CCS deployment. The areas and issues addressed included: (1) Funding Levels and Timelines; (2) Financial Mechanisms; (3) Industrial Sector Interests and Application; (4) Addressing Economic Impacts; (5) Administration and Implementation; (6) Overcoming the CCS Penalty; (7) Domestic and International Deployment; and (8) Metrics for Success.” More information about Senator Dorgan’s Clean Coal and Carbon Capture and Sequestration Technology Development Pathways Initiative is available at: <http://dorgan.senate.gov/issues/energy/cleancoal/index.cfm>. The complete report can be found at: <http://dorgan.senate.gov/issues/energy/cleancoal/cleancoal.pdf>.

National and Sectoral GHG Mitigation Potential: A Comparison Across Models.

The following is from the Executive Summary of this document: “This paper focuses on mitigation potential to provide a comparative assessment across key economies. GHG mitigation potential is defined here to be the level of GHG emission reductions that could be realized, relative to the projected emission baseline in a given year, for a given carbon price. Estimates of GHG mitigation potential projected in the future can be obtained via models. These estimates vary depending on the type of model employed and on the parameters and underlying assumptions used. This comparative analysis of model results aims to: identify areas of agreement in results across different models; enhance understanding of what is driving any differences in results; and indicate possible gaps and areas for improvement in data or modeling

RECENT PUBLICATIONS (CONTINUED)

analysis. Overall, such a comparative analysis can enhance transparency and contribute to a better informed climate change policy-making process. This paper compares model estimates of national and sectoral GHG mitigation potential across six key OECD GHG-emitting economies around the world: Australia, Canada, the EU, Japan, Mexico and the [United States]. Data for these countries were obtained across the time horizon of 2005-2050 from a total of 19 models, including models that are used to inform climate policymakers in each of these economies. For these six economies, this paper examines the model structure, baseline and policy assumptions, and then compares GHG mitigation potential estimates across the available models. Due to differences in regional and economy-wide aggregation across these models, GHG mitigation potential is compared across [five] models for Australia, [nine] models for Canada, 12 models for the [EU], [eight] models for Japan, [five] across Mexico, and 13 models across the [United States].” To view the full document, click: http://www.iaea.org/papers/2009/Mitigation_potentials.pdf.

LEGISLATIVE ACTIVITY

U.S. Senator Susan Collins Press Release, “Senators Collins, Cantwell Propose Carbon Auction: Bill Reduces Emissions, Returns Revenue to Consumers.”

On Friday, December 11, 2009, U.S. Senators Susan Collins (Maine) and Maria Cantwell (Washington) introduced legislation to address potential climate change and spur job growth in clean energy technologies. The Carbon Limits and Energy for American Renewal (CLEAR) Act aims to achieve a 20 percent reduction in GHG emissions by 2020 and 83 percent by 2050. The CLEAR Act will set up a mechanism for selling carbon shares and return most of the revenue to consumers. According to a report released by Senator Cantwell, a typical family of four would receive tax-free monthly checks from the government averaging \$1,100 per year (or

\$21,000 from 2012 to 2030) from the CLEAR Act, opposed to a net cost increase of \$175 per year under the cap-and-trade bill passed by the U.S. House of Representatives. By establishing a predictable price on the carbon, the bill would provide an incentive for businesses to develop and deploy clean energy technology. Producers would bid in monthly auctions for CO₂ shares, with the resulting revenue split for two functions: 75 percent would be refunded to American citizens; and 25 percent would be used towards clean energy R&D, assistance for communities and workers transitioning to a clean energy economy, energy efficiency programs, and reductions in non-CO₂ GHGs. A video of the bill’s introduction and links to other relevant CLEAR Act background documents are available at: <http://cantwell.senate.gov/issues/CLEARAct.cfm>. December 11, 2009, http://collins.senate.gov/public/continue.cfm?FuseAction=PressRoom.PressReleases&ContentRecord_id=7f22c3c6-802a-23ad-4b2b-8f9bf16148e2&CFID=18273045&CFTOKEN=65256272.



EVENTS

January 21-22, 2010, **3rd Annual Carbon Trading: Opportunities and Risks in a National Cap-and-Trade System**, *Sheraton Suites Hotel, Houston, Texas, USA*. This event offers in-depth information on new and potential carbon regulations in the United States and how they can affect business decisions. Among the topics to be discussed are carbon liabilities, carbon regulations, and forest and natural resource projects. For more information, visit the conference website at: <http://www.platts.com/ConferenceDetail.aspx?xmlpath=2010/pc003/index.xml>.

January 25-27, 2010, **4th Carbon Trading Summit**, *New York, New York, USA*. This conference is designed to provide insight into carbon trading markets by covering new investment trends, strategies, and legal and compliance issues. Included is a workshop that discusses CO₂ storage opportunities in the timberland market. For more information, visit the conference website at: <http://www.carbontradingevent.com/Event.aspx?id=232662>.

January 26-27, 2010, **4th Annual Carbon Capture and Storage Conference**, *Calgary Telus Convention Centre, Calgary, Alberta*. This conference will focus on the long-term viability and execution of CCS. Designed to address the vital issues concerning the commercial success of CCS, the agenda also includes discussions on the risks of carbon storage, optimal conditions to transport CO₂, and reliable CO₂ capture technologies. To view the full agenda, visit the conference website at: <http://www.canadianinstitute.com/CCS.htm>.



EVENTS (CONTINUED)

January 27-29, 2010, **The 6th Annual Clean Energy Forum – Clean Coal 2010**, *Renaissance Tianjin TEDA Hotel and Convention Centre, Tianjin, China*. This forum brings together policymakers, project developers, technology and equipment companies, investors, and non-government organizations (NGOs) to collaborate and accelerate clean coal opportunities in coal rich nations. To learn more, visit the conference website at: <http://www.cleancoalforum.com/>.

January 28-29, 2010, **Bridging Carbon: Building the Bridge from Pre-Compliance to Compliance**, *Hyatt Regency Crystal City, Washington DC, USA*. The Bridging Carbon Conference (BCC) focuses on the corporate policy and implementation measures that will be necessary to build the “bridge” between GHG emission pre-compliance and compliance requirements. To download the brochure, which includes the full agenda, visit: <http://www.euci.com/pdf/0110-BCC.pdf>.

February 17-18, 2010, **Carbon and Climate Change**, *AT&T Conference Center - Hotel at the University of Texas, Austin, Texas, USA*. This two-day conference covers topics such as U.S. climate policies and regulations, carbon taxes, and the economics of carbon capture and mitigation. It also includes a presentation by DOE about the need to reduce GHGs. To view the entire program, go to: http://www.utcle.org/conference_overview.php?conferenceid=840#Travel.

February 23-24, 2010, **4th Annual European Carbon Capture and Storage**, *Hilton Park Lane, London, UK*. This event will provide an update on Europe’s developing CCS market, funding allocation, policy changes, lessons learned from European and international case studies, and practical solutions to the challenges of commercialization. For more information, visit the conference website at: <http://www.platts.com/ConferenceDetail.aspx?xmlpath=2010/pc065/index.xml>.

March 5-6, 2010, **2010 MIT Energy Conference**, *Sheraton Boston Hotel, Boston, Massachusetts, USA*. This student-run conference brings together leaders in the fields of technology, policy, industry, and finance to develop solutions for the world’s energy challenges. Fundamental changes in the way energy is produced and consumed will be explored and technology and policy pathways that have potential to make a significant impact on energy solutions across the global energy landscape will be presented. To learn more, visit the conference website at: <http://www.mitenergyconference.com/index.php>.

May 10-13, 2010, **9th Annual Conference on Carbon Capture & Sequestration**, *Hilton Pittsburgh, Pittsburgh, Pennsylvania, USA*. Following in the footsteps of the previous eight events, this annual, DOE-hosted conference will focus on the potential of present and future CCS technologies deployed in the United States and North America. Members from the U.S. and international scientific and engineering communities will be present to share experiences on such technologies and systems. For more information, visit the conference website at: <http://www.carbonsq.com/>.

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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.