THE CARBON SEQUESTRATION NEWSLETTER

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March 2007

HIGHLIGHTS

***DOE News Release,* "President Requests $863 Million for Fossil Energy Programs: FY2008 Fossil Budget Request One of Largest Since Taking Office."** President Bush's Fiscal Year (FY) 2008 budget for the Office of Fossil Energy totals $863 million, a 33 percent increase over last year's budget. The proposal focuses on early initiation of an expansion of the Strategic Petroleum Reserve to 1.5 billion barrels by 2027; accelerating the development of carbon sequestration technologies to manage and virtually eliminate emissions of the greenhouse gas carbon dioxide from fossil fuel use in power generation and other industrial activity; and moving forward with the design and early work on the FutureGen Initiative. Funding for the FutureGen Initiative will increase two-fold from $54 million in the FY2007 budget to $108 million in the FY 2008 budget. FutureGen is currently in the site selection phase. The FY 2008 FutureGen funding will be used to support detailed plant design and procurement, ongoing permitting, preliminary design and site characterization work. A core Fossil Energy program receiving heavy emphasis is Carbon Sequestration. Sequestration research and development increases its budget from $74 million in FY 2007 to $79 million in FY 2008. This budget request will allow for continued research and development into carbon dioxide capture and storage, as well asand measurement and monitoring and verification technologies and processes. The program will focus on developing capture and separation technologies in order to lower the costs and energy requirements for reducing carbon dioxide emissions from fossil-based (especially coal) energy generating plants. Of primary importance is to dramatically lower the cost and energy requirements of pre- and post-combustion carbon dioxide capture. The Regional Partnerships Initiative, comprised of the federal government, state agencies, universities and private industry, will continue its work to determine which options for capturing and sequestering carbon dioxide are most feasible for var-

Highlights (continued)

ious regions of the country. The Carbon Sequestration Leadership Forum will continue to execute its mission of gathering data, exchanging information and participating in joint projects to advance carbon sequestration technology. The goal is to have a technology portfolio enabling safe, cost-effective and long-term carbon mitigation, management and storage, which will lead to substantial market penetration after 2012. Technology developments within the Carbon Sequestration Program are expected to significantly contribute to the President's goal of developing technologies to substantially reduce greenhouse gas intensity by 18 percent by 2012 and to fill a critical need in efforts to ultimately stabilize US greenhouse gas emissions. To view a chart of DOE's Fossil Energy Budget for Fiscal Year 2008, go to: http://www.fossil.energy.gov/aboutus/budget/08/FY_2008_Budget.html. February 5, 2007, http://www.fossil.energy.gov/news/techlines/2007/07004-FY_2008_Budget_Request.html.

***DOE Press Release,* "Bush Administration Plays Leading Role in Studying and Addressing Global Climate Change."** The Intergovernmental Panel on Climate Change (IPCC) released its findings on February 2 in Paris in its *Fourth Assessment Report*. The report confirms that climate change is a global challenge that will require continued US leadership in the advancement of climate research, while at the same time maintaining the economic competitiveness of the nation. Energy Secretary Samuel Bodman, Environmental Protection Agency Administrator Stephen Johnson, and National Oceanic and Atmospheric Administration (NOAA) Administrator Vice Admiral Conrad Lautenbacher discussed the findings from the Working Group I, which included significant involvement from US climate science experts in its draft and review. Dr. Susan Soloman, a climate expert from NOAA served as the Working Group I co-chair. In order to meet his goal to reduce greenhouse gas emissions by 18 percent by 2012, President Bush has devoted approximately $29 billion to the cause, which is more than any other nation's expenditures on climate-related science, technology, international assistance, or incentive programs. Through the multi-agency Climate Change Science Program, a total of $9 billion has been spent on climate change science research by the Administration since 2002. Federal funding dedicated to these causes helps US scientists to develop and deploy the types of research efforts summarized in the IPCC report. **(See News section of this newsletter for more information in news item "Science Panel Calls Global Warming 'Unequivocal'.")** *The Summary for Policymakers* can be downloaded from the IPCC's website at: http://www.ipcc.ch/, or by clicking on a direct link to the pdf document at: http://www.ipcc.ch/SPM2feb07.pdf. A webcast of the IPCC Press Conference held on February 2 can be heard by clicking on: http://www.empreinte.com/richmediaevent/20070202/vod/ipc_audio_en_900x540_WindowsLD.htm. To read a Fact Sheet on Global Climate change, see: http://energy.gov/media/FactSheetOnGlobalClimateChange.pdf. February 2, 2007, http://energy.gov/news/4704.htm.

Sequestration in the News

***The New York Times,* "Science Panel Calls Global Warming 'Unequivocal'."** The Intergovernmental Panel on Climate Change (IPCC) released their *Fourth Assessment Report* on February 2 from Paris, concluding for the first time that global warming is "unequivocal" and that carbon dioxide emissions and other greenhouse gas releases from human activities are the main cause. The 20-page *Summary for Policymakers* is the work product of a three-year review of hundreds of climate shift studies, observations of retreating ice, warming and rising seas, and other scientific observations made about the planet. Scientists also used computer modeling to determine the effects of the prolonged presence of greenhouse gases in the atmosphere. The consensus of those who contributed to the report is that although uncertainty surrounds the extent or timing of impending changes, prompt action is critical in delaying the effects of global warming and a shift to alternative energy sources must occur. The main findings of the UPCC are that the temperatures could rise by 3.5 to 8 degrees Fahrenheit, which could also cause a rise in global sea levels. Those estimates predict sea level rises of 7 to 23 inches by 2100, in comparison to 6 to 9 inch increases in the 20th century. Additionally, scientists predict that more precipitation will fall at higher latitudes, while semi-arid subtropical regions could see a twenty percent drop in rainfall totals. A new finding in the report also describes how the buildup of carbon dioxide will adversely impact sea waters by causing an imbalance in pH levels. The panel's full report, which contains thousands of pages of more detailed information, will be released in sections throughout the year. **(See Highlights section of this newsletter, "Bush Administration Plays Leading Role in Studying and Addressing Global Climate Change," for a link to the report.)** February 3, 2007, http://www.nytimes.com/2007/02/03/science/earth/03climate.html?

Announcements

NETL's Bauer Named "Laboratory Director of the Year." Carl O. Bauer, Director of the Office of Fossil Energy's National Energy Technology Laboratory (NETL), has been named a Laboratory Director of the Year by the Federal Laboratory Consortium for Technology Transfer (FLC). The annual award honors directors who have made outstanding contributions supporting technology transfer activities at their laboratories. The award will be presented May 17, 2007, at the FLC National Meeting in Arlington, Texas. To read the full announcement, link to the Department of Energy's Fossil Energy website: http://www.fossil.energy.gov/news/techlines/2007/07006-NETL_Director_Wins_Award.html.

FutureGen Alliance website updated. Changes to the website include the addition of Frequently Asked Questions (FAQs), information on the four Candidate Sites to host FutureGen, and an overview of the Alliance organizational structure. These updates can be found at: http://www.FutureGenAlliance.org.

Hear Secretary of Energy Samuel Bodman's remarks for a broadcast on NPR's *All Things Considered*, entitled "U.N. Report: Humans Behind Climate Change." The story follows the *Fourth Assessment Report* released by the Intergovernmental Panel on Climate Change on February 2, 2007. To read a brief article summarizing the main findings of the report and a link to the audio file, go to: http://www.npr.org/templates/story/story.php?storyId=7137290.

Sequestration Leadership Forum to Meet. The Carbon Sequestration Leadership Forum (CSLF), a framework for international cooperation in research and development for the separation, capture, transportation and storage of carbon dioxide, will meet in Paris, France on March 25-28, 2007. For further information about this CSLF meeting and to view detailed information about the organization, see: http://www.cslforum.org/mar252007.htm.

Energy Market and Economic Impacts of a Proposal to Reduce Greenhouse Gas Intensity with a Cap and Trade System. This report was prepared by the Energy Information Administration (EIA), in response to a September 27, 2006, request from Senators Bingaman, Landrieu, Murkowski, Specter, Salazar, and Lugar. The Senators requested that EIA assess the impacts of a proposal that would regulate emissions of greenhouse gases (GHGs) through an allowance cap-and-trade system. The program would set the cap to achieve a reduction in emissions relative to economic output, or greenhouse gas intensity. To read the January 2007 report in its entirety, go to: http://www.eia.doe.gov/oiaf/servicerpt/bllmss/pdf/sroiaf(2007)01.pdf.

Branson, Gore Announce $25 Million "Virgin Earth Challenge." In a joint announcement, Sir Richard Branson and Al Gore have pledged a $25 million prize for viable solutions for carbon sequestration. The award will go to the individual or group who is able to demonstrate a commercially viable design which will remove at least 1 billion tons of atmospheric carbon dioxide per year for at least ten years without harmful effects. The removal must have long term effects and contribute materially to the stability of the Earth's climate. It is the largest science and technology prize ever offered. To read more about the Virgin Earth Prize, go to: http://www.environmentalleader.com/2007/02/09/branson-gore-announce-25-million-virgin-earth-challenge/.

_r=1&th=&oref=slogin&emc=th&pagewanted=print. (Subscription required.)

***DOE News Release,* "Another Milestone Reached in Coal Gasification Revenue-Sharing: DOE Receives $39.2 Million from Dakota Gasification/Basin Electric."** Dakota Gasification Company recently made a payment of $39.2 million to the US Department of Energy (DOE) under a revenue sharing agreement signed in 1988, bringing the total revenue sharing payments to over $285 million. The payments are received from the sale of synthetic natural gas from the Great Plains Synfuels Plant near Beulah, North Dakota. The Great Plains Synfuels Plant transports its carbon dioxide (CO_2) via a 205-mile pipeline to the Weyburn Oil Field in southwestern Saskatchewan, Canada where it is used for enhanced oil recovery (EOR). A large portion of the CO_2 used for EOR remains permanently sequestered. More than 10 million tons of CO_2 has been captured and transported to the Weyburn Oil Field. Dakota Gasification Company is a member of the Plains CO_2 Reduction Partnership, one of seven Carbon Sequestration Regional Partnerships established by DOE. For more information about the Great Plains Coal Gasification Plant, see: http://www.fossil.energy.gov/programs/powersystems/gasification/gasificationpioneer.html. For more information about the Plains CO_2 Reduction Partnership, see: http://www.fossil.energy.gov/programs/sequestration/partnerships/2003sel_gplains.html. February 7, 2007, http://www.fossil.energy.gov/news/technlines/2007/07005-Dakota_Gasification_Milestone_Reac.html.

***Nature,* "India's Carbon Dioxide Trap."** India's Deccan Traps, a thick pile of solidified lava from volcanic eruptions 65 million years ago, has been identified as a prime candidate for storing carbon dioxide (CO_2) captured from coal-fired power stations and injecting it into the porous sedimentary rocks below the basalt layer. The area in India is also the world's largest continental flood-basalt province outside Siberia. The National Thermal Power Corporation (NTPC) in New Delhi, the company that builds and runs India's coal-fired power stations, estimates that the Deccan basalts could potentially hold 150 gigatons of CO_2, an amount equal to what the world's power industry might emit in 15 years. Research scientists at the Pacific Northwest National Laboratory (PNNL) in Richland, Washington, found that water saturated with CO_2 reacts rapidly with basalt to form stable carbonate minerals. PNNL's research findings were reported at a conference on CO_2 capture and storage held in Hyderabad, India in January 2007. The US Pacific Northwest is home to the Columbia River basin basalts, which are similar to the Deccan Traps, but on a scale one-third the size. PNNL, NTPC and the National Geophysical Research Institute will initiate a pilot study to test the storage capability of the Deccan basalt formation. Although the porosity of the basalt layer is not optimal, it has a high reactivity to CO_2. The initial phase of the project will characterize the permeability and porosity of the rock, as well as examine the nature of the faults within the rock to determine how CO_2 would flow through the rock once injected. The actual test would involve pumping supercritical CO_2 into porous sedimentary rocks below the basalt layer. The gas would move upwards through the rock and react with the basalt above, forming a "cap" that would stop any unreacted gas from escaping. India has committed $1.3 million to the Deccan Traps project, which is also being endorsed by the Carbon Sequestration Leadership Forum, of which India was a founding member. Prior to injection tests of CO_2 into the Deccan basalt formations, PNNL will conduct similar tests in the Columbia River basin basalts. January 25, 2007, http://www.nature.com/news/2007/070122/full/445350a.html. (Subscription required.)

Science

***Popular Science*, "Turning Black Coal Green."** FutureGen, a $1 billion project sponsored by The Department of Energy (DOE) in partnership with 11 leading energy companies, may become the model for future coal-burning power plants. The DOE estimates that 10.6 billion tons of coal will be burned for fuel consumption by 2030, almost doubling the amount burned in 2003. Mike Mudd, CEO of FutureGen, describes how the near-zero emission coal-fired plant will utilize gasification technologies to dramatically reduce emissions and sequester carbon dioxide (CO_2) by pumping captured CO_2 2,700 to 16,000 feet underground into deep saline formations. Typically, when coal is burned it combines with oxygen to release energy, while at the same time producing CO_2 and other emissions. The FutureGen plant will gasify coal to produce a syngas consisting primarily of CO_2, carbon monoxide, hydrogen, and water (steam). Typical power generation facilities burn the syngas (both the carbon monoxide and hydrogen) to fuel the turbines. FutureGen differs from typical coal gasification systems by reacting the carbon monoxide in the syngas stream with steam to produce hydrogen and CO_2. The hydrogen is separated from the CO_2 stream and is used to fuel the turbines. The CO_2 is pumped underground for sequestration. The US has the capacity to store up to 2.2 trillion tons of CO_2 in geological formations, an amount equal to 1,000 years' worth of US power-plant emissions. Locations in Illinois and Texas are under consideration, and site selection for the plant should be decided by the end of the year with the completion of environmental impact assessments on four possible sites. To access a diagram of how FutureGen technology works, click on the link to this article. February 2007, http://www.popsci.com/popsci/science/3e2f391531470110vgnvcm1000004eecbccdrcrd.html.

***The Associated Press,* "Global Warming May Affect Indonesia Isles," and *France24,* "Indonesia Could Lose 2,000 Islands with Rise in Sea Level, Finds Study."** Forecasters predict that Indonesia could lose as many as 2,000 of the nation's islands due to a rise in sea levels as a result of global warming. Scientific studies, including a report to the UN's Intergovernmental Panel on Climate Change, show that by 2030 the Southeast Asian nation could lose many of its lower-lying islands due to sea level rises ranging between three and 12 inches (eight and 29 centimeters). Indonesia is an archipelago made up of more than 17,000 islands, most of them unpopulated. In the short term, rice

shortages are forecast for next year because crops were not planted according to schedule due to abnormal weather patterns. Farmers are seeing significant increases in temperatures and higher than average rainfall in the wet seasons. Indonesia's Environment Minister, Rachmat Witoelar, made the announcement on January 29 at a media conference attended by Yvo de Boar, executive secretary of the UN Climate Treaty Secretariat. De Boer was in Jakarta to discuss plans for the 13th UN Climate Change Conference, where talks are scheduled to begin on global action that will be taken following expiration of the Kyoto Protocol in 2012. The conference will be held in Bali, Indonesia in December 2007 and will bring between 7,000 and 10,000 participants from more than 100 countries. January 29, 2007, http://abcnews.go.com/Technology/wireStory?id=2830876, and January 29, 2007, Link unavailable.

***Reuters,* "13 Percent of Americans Not Heard of Global Warming – Report."** According to a 46-country survey conducted by ACNielsen of more than 25,000 Internet users, thirteen percent of US citizens have never heard or read anything about global warming, even though the US is the top emitter of greenhouse gases. Fifty-seven percent of people around the world consider global warming a "very serious problem" and a further 34 percent rated it a "serious problem." Latin Americans were the most worried about the issue with 75 percent rating it "very serious," while US citizens were the least concerned with only 42 percent rating global warming "very seri-

ous." Overall, 91 percent of people had heard of global warming, with 50 percent attributing it to human activity. People in China and Brazil were most convinced of the link to human activities, with Americans the least convinced. January 30, 2007, http://www.planetark.com/dailynewsstory.cfm/newsid/40057/story.htm.

Policy

***Reuters*, "China Preparing National Plan for Climate Change."** The Chinese government is developing the country's first national program to address global warming. Approval of the comprehensive document on climate change is awaiting official endorsement from China's cabinet, or State Council, and could be released this year. It is expected to outline a broad set of goals for emissions reductions and how the country will cope with abnormal weather patterns. China's President Hu Jintao is faced with the challenge of presenting the idea of continued economic growth and future prosperity, while at the same time advocating a reduction in the use of fossil fuels and greenhouse gas emissions. With

China expected to become the world's third-largest economic power by 2008 and forecasts that it may overtake the United States in greenhouse gas emissions, many Chinese officials are confronted with the reality that global warming is an issue that must be addressed with urgency. In particular, environmental threats to China's northwest could have detrimental effects to the nation's economic development. Climate experts estimate that China's current reduction in yearly GDP by nearly 2 percent will only be exacerbated as a result of floods, droughts, hurricanes and other climate disasters brought about by further climate changes. February 6, 2007, http://www.planetark.com/dailynewsstory.cfm/newsid/40197/story.htm.

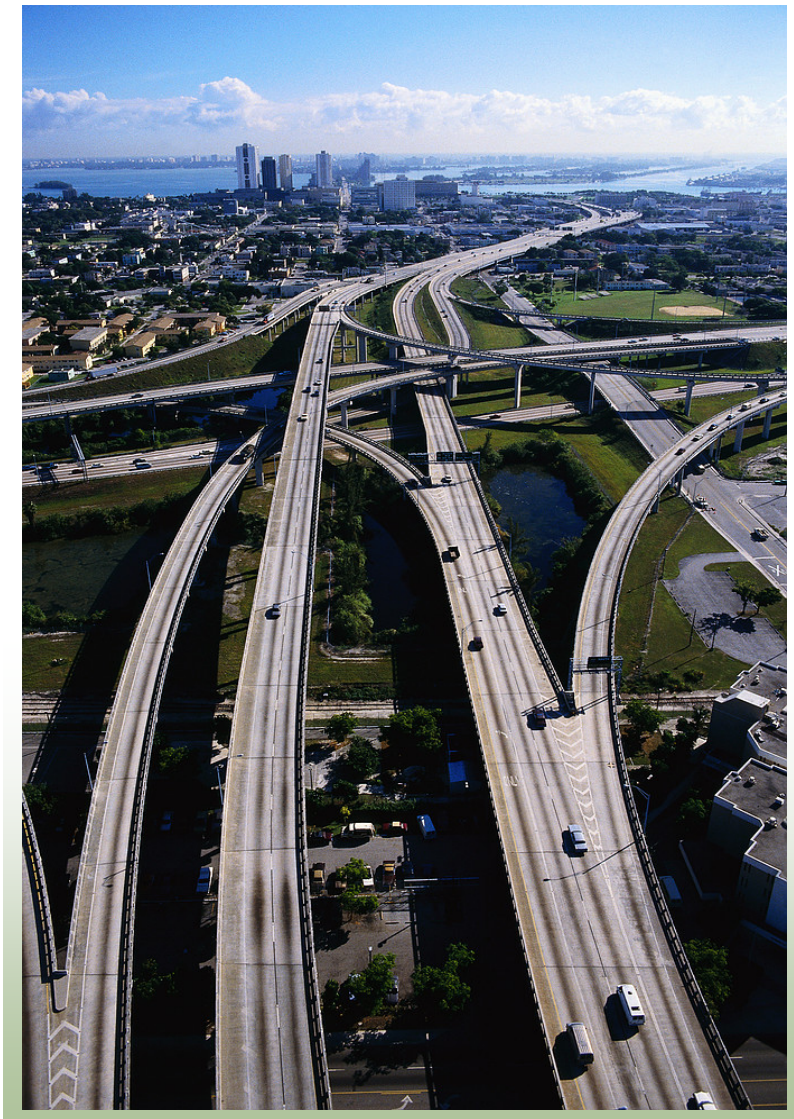
***Reuters,* "EU Commission Approves Slovenia's Carbon Plan**." The European Commission approved Slovenia's Emissions Trading Scheme CO_2 plan for the second phase (2008-2012) of the Kyoto Protocol, allowing for a carbon quota of 8.3 million tons of carbon dioxide emissions, and representing a 9 percent cut in allowances from the first phase (2005-2007). Though the European Commission has reviewed 13 plans of European Union (EU) nations thus far for the 2005-2007 trading phase, only Slovenia and Britain have had their quota approved. The other EU nations are required to lower their carbon quotas and resubmit. Slovenia with its population of 2 million people, accounted for less than one percent of the EU's emissions under the scheme in 2005. Brussels is being pressured to create scarcity in the market for emissions permits after 2005 data revealed that EU states had given more allowances to industry than needed, leading to a crash in carbon prices for the 2005-2007 trading phase. Denmark and Cyprus have not yet submitted their 2008-2012 plans, which, though due in June, were turned in late by many member states. February 6, 2007, http://www.planetark.com/dailynewsstory.cfm?newsid=40200&newsdate=06-Feb-2007.

"Social acceptance of carbon dioxide storage." This article discusses public acceptance of carbon capture and storage (CCS). Responses by citizens are described in relation to responses by professionally involved actors. Interviews with members of the government, industry and environmental non-government organizations (NGOs) showed that these professional actors are interested in starting up storage projects, based on thorough evaluation processes, including discussions on multi-actor working groups. As appeared from a survey among citizens living near a potential storage site (*N*=103), public attitudes in general were slightly positive, but attitudes toward storage nearby were slightly negative. The general public appeared to have little knowledge about carbon dioxide storage, and have little desire for more information. Under these circumstances, trust in the professional actors is particularly important. NGOs were found to be trusted most, and industry least by the general public. Trust in each of the three actors appeared to depend on perceived competence and intentions, which in turn were found to be related to perceived similarity of goals and thinking between trustee and trustor. Implications for

communication about CCS are discussed. **Nicole M.A. Huijts, Cees J.H. Midden and Anneloes L. Meijnders,** *Energy Policy,* Published online February 1, 2007, http://www.sciencedirect.com/science/article/B6V2W-4MYFG16-1/2/674d5590b3027c2acd4184908aa5d8c0. (Subscription may be required.)

Geology

"Geologic Carbon Sequestration: CO_2 Transport in Depleted Gas Reservoirs." Chapter on geologic carbon sequestration from book entitled *Gas Transport in Porous Media* in the series, *Theory and Applications of Transport in Porous Media*. The book presents a compilation of state-of-the-art studies on gas and vapor transport processes in porous and fractured media. A broad set of models and processes is presented, including advection/diffusion, the Dusty Gas Model, enhanced vapor diffusion, phase change, coupled processes, solid/vapor sorption and vapor-pressure lowering. Numerous applications are also presented that illustrate these processes and models in current problems facing the scientific community. This book fills a gap in the general area of transport in porous and fractured media – an area that has historically been dominated by studies of liquid-phase flow and transport. This book identifies gas and vapor transport processes that may be important or dominant in various applications, and it exploits recent advances in computational modeling and experimental methods to present studies that distinguish the relative importance of various mechanisms of transport in complex media. Pages 419-426, Edited by **Clifford K. Ho and Stephen W. Webb**, Published by Springer Netherlands, ISBN 978-1-4020-3961-4 (Print), ISNB 978-1-4020-3962-1 (Online), Copyright 2006, http://www.springerlink.com/content/w756753702262h538/?p=c2d10807ce06412caa5a09f81ceb13cf&pi=0. (Subscription required.)



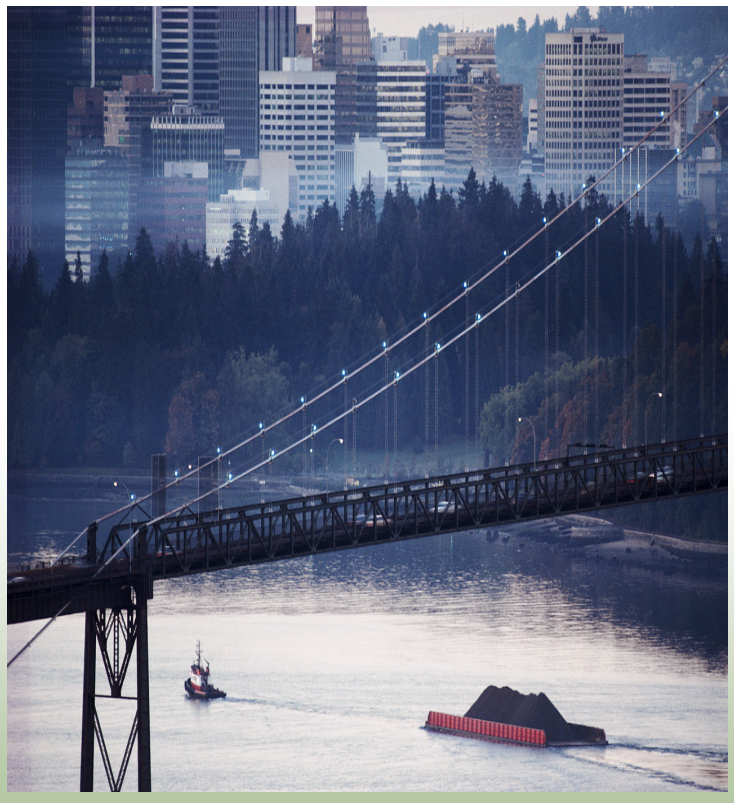
Technology

"Use of a vehicle-modeling tool for predicting CO_2 emissions in the framework of European regulations for light goods vehicles." The reduction of carbon dioxide (CO_2) emissions and fuel consumption from road transportation constitutes an important pillar of the EU commitment for implementing the Kyoto Protocol. Efforts to monitor and limit CO_2 emissions from vehicles can effectively be supported by the use of vehicle modeling tools. This paper presents the application of such a tool for predicting CO_2 emissions of vehicles under different operating conditions and shows how the results from simulations can be used for supporting policy analysis and design aiming at further reductions of the CO_2 emissions. For this purpose, the case of light duty goods (N1 category) vehicle CO_2 emissions control measures adopted by the EU is analyzed. In order to understand how certain design and operating aspects affect fuel consumption, a number of N1 vehicles were simulated with ADVISOR for various operating conditions and the numerical results were validated against chassis dynamometer tests. The model was then employed for analyzing and evaluating the new EU legislative framework that addresses CO_2 emissions from this vehicle class. The results of this analysis have shown the weaknesses of the current regulations and revealed new potential in CO_2 emissions control. Finally, the TREMOVE model was used for simulating a possible scenario for reducing CO_2 emissions at fleet level. **Georgios Fontaras, Hariton Kouridis, Zissis Samaras, Daniel Elst and Raymond Gense**, *Atmospheric Environment,* Pub-

lished online January 22, 2007. http://www.sciencedirect.com/science/article/B6VH3-4MW95P7-2/2/efd45e603c94132287cb82f4714e8bb5. (Subscription may be required.)

Terrestrial/Ocean

"Optimizing carbon sequestration in commercial forests by integrating carbon management objectives in wood supply modeling." This paper provides a methodology for generating forest management plans, which explicitly *maximize* carbon sequestration at the forest-landscape level. This paper takes advantage of concepts first presented in a paper by Meng et al. (*2003*; Mitigation Adaptation Strategies Global Change 8:371–403) by integrating carbon sequestration objective functions in existing wood supply models. Carbon-stock calculations performed in Woodstock™ (RemSoft Inc.) are based on carbon yields generated from volume table data obtained from local Forest Development Survey plots and a series of wood volume-to-carbon content conversion factors specified in von Mirbach (*2000*). The approach is used to investigate the impact of three demonstration forest-management scenarios on the carbon budget in a 110,000 hectare (ha) forest in south-central New Brunswick, Canada. Explicit demonstration scenarios addressed include (1) maximizing timber extraction either by clearcut or selection harvesting for greatest revenue generation, (2) maximizing total carbon storage in the forest landscape and in wood products generated from harvesting, and (3) maximizing carbon storage together with revenue generation. The level of clearcut harvesting was greatest for *scenario 1* (≥15 Ã— 10^4 cubic meter (m^3) of wood and ≥943 ha of land per harvesting period), and least for *scenario 2* (=0 m^3 per harvesting period) where selection harvesting dominated. Because softwood saw logs were worth more than pulpwood ($60 m^{-3} vs. $40 m^{-3}) and were strategic to the long-term storage of carbon, the production of softwood saw logs exceeded the production of pulpwood in all scenarios. Selection harvesting was generally the preferred harvesting method across scenarios. Only in *scenario 1* did levels of clearcut harvesting occasionally exceed those of selection harvesting, mainly in the removal of old, dilapidated stands early in the simulation (i.e., during periods 1 through 3). *Scenario 2* provided the greatest total carbon-storage increase over 80 years (i.e., 14 Ã— 10^6 Milligrams (Mg) carbon, or roughly 264 Mg per hectare) at a cost of $111 per Mg carbon due to lost revenues. *Scenarios 3* and *1* produced reduced storage rates of roughly 9 Ã— 10^6 Mg carbon and 3 Ã— 10^6 Mg carbon, respectively; about 64 percent and 22 percent of the total, 80-year carbon storage calculated in *scenario 2*. The bulk of the carbon in *scenario 2* was stored in the forest, amounting to about 76 percent of the total carbon sequestered. **Charles P.-A. Bourque, Eric T. Neilson, Chris Gruenwald, Samantha F. Perrin Jason C. Hiltz, Yvon A. Blin Geoffrey V. Horsman, Matthew S. Parker, Christie B. Thorburn, Michael M. Core, Fanrui Meng and D. Edwin Swift,** *Mitigation and Adaptation Strategies or Global Change,* Published online January 30, 2007, http://www.springerlink.com/content/g72174242g122184 46/?p=d2ed7fa071cf41ccb2355292e08ceb17&pi=6#ContactOfAuthor1. (Subscription required.)



"Simulation of fluxes of greenhouse gases from European grasslands using DNDC model." Agricultural management of grasslands results in sequestration and emission of greenhouse gases (GHGs, particularly carbon dioxide [CO_2], nitrous oxide [N_2O] and methane [CH_4]). Here, the authors used a process-based model (DNDC) to estimate the fluxes of the major GHGs from grasslands at 0.5° resolution across Europe,

and combined these to produce a spatially explicit estimate of the total global warming potential (GWP, expressed in CO_2 equivalents). The DNDC model [Li, C., Frolking, S., Crocker, G.J., Grace, P.R., Klir, J., Korchens, M., Poulton, P.R., 1997. Simulating trends in soil organic carbon in long-term experiments using the DNDC model. Geoderma 81, 45–60] simulates carbon and nitrogen cycling in agro-ecosystems at a sub-daily time step and consists of four interacting submodels: soil and climate (including water flow and leaching), plant growth, decomposition, and denitrification. Input data sets for grassland area, climate, nitrogen deposition, and soil properties were collated. The typical current grassland management regime was established for ten biogeographical regions on the basis of questionnaires sent to national experts, and used to derive model input data. A 20-year simulation was carried out using DNDC for each site. Simple estimates of methane emissions from grazing livestock were made according to the IPCC Tier 1 method. Most grassland areas are net sources for GHGs in terms of total global warming potential—the beneficial effect of sequestering carbon in soil is outweighed by the emissions of N_2O from soil and (predominantly) CH_4 emissions from livestock. The net effect of European grasslands on GWP (emission of 23 teragrams of carbon per year) corresponds to a 2.5 percent increase on the EU-15 fossil fuel CO_2 emissions (907 teragrams of carbon per year). **P.E. Levy, D.C. Mobbs, S.K. Jones, R. Milne, C. Campbell and M.A. Sutton,** *Agriculture, Ecosystems and Environment,* Published online January 23, 2007, http://www.sciencedirect.com/science/article/B6T3Y-4MWGYBX-2/2/8d7c4db3af9e50f9e9792df227522107. (Subscription may be required.)

"Quantification of the regional carbon cycle of the biosphere: Policy, science and land-use decisions." This paper addresses some issues related to the carbon cycle and its utilization by society. Traditional uses for agriculture, forestry, as a source of fuel and other products, and for pastoral farming, among others, have recently been supplemented by identifying its potential for mitigating the increasing concentration of greenhouse gases in the atmosphere. Through the Kyoto Protocol, carbon has become a commodity and the carbon dioxide-absorbing capability of the vegetation and soils an economically valuable asset. The multi-facetted roles of the carbon cycle and its sensitivity to human activities present a demand for techniques that permit accurate, timely and affordable characterization of the various components of this cycle, especially on land where most human activities take place. Such techniques must satisfy a range of demands in terms of purpose, clients for the information, and biosphere properties. However, if successful, they offer the potential to support monitoring, reporting, policy setting, and management of terrestrial biospheric resources. The context for these requirements and possibilities is illustrated with reference to the China Carbon Sequestration Project and its findings. **Josef Cihlar,** *Journal of Environmental Management,* Published online January 2, 2007, http://www.sciencedirect.com/science/article/B6WJ7-4MR1RS5-1/2/bc67cc500fbaa370d52a17c5b0085ff9. (Subscription may be required.)

Trading

Carbon Market Update, February 12, 2007	
CCX-CFI 2007 ($/tCO2) **$3.70 (Vintage 2007)**	EU ETS-EUA DEC 2007 ($/tCO2) **$ 1.73** **(Converted from € to US$)**

***Chicago Climate Exchange Press Release*, "Kodak Joins Chicago Climate Exchange."** Eastman Kodak Company announced that it will become a member of the Chicago Climate Exchange (CCX). CCX is the world's first and North America's only legally binding rules-based greenhouse gas emissions allowance trading system, as well as the world's only global system for emissions trading based on all six greenhouse gases. Dr. Richard Sandor, CCX Chairman and CEO, welcomed the company and expressed his gratitude for Eastman Kodak's commitment to reduce their greenhouse gas emissions. As part of Kodak's "Responsible Growth" goals program, the company has made a commitment to achieve a 20 percent reduction in carbon dioxide (CO_2) emissions between 2003 and 2008. A ten percent reduction in CO_2 emissions has already been reached during 2003-2005. Adding to the company's reputation for addressing the environmental impacts of their operation, Kodak is a charter partner in the US Environmental Protection Agency's Climate Leaders Program. Kodak was recognized in 2006 by the California Climate Action Registry for becoming that agency's first participant to report all six greenhouse gases identified by the Kyoto Protocol on a worldwide basis. Eastman Kodak Company specializes in imaging products and services to the photographic, graphic communications, and healthcare markets and reported sales of $14.3 billion in 2005. To read more about Kodak (NYSE: EK), go to: www.kodak.com. For a full list of CCX members, daily prices and other program infor-

mation, see www.chicagoclimateexchange.com. January 30, 2007, http://www.chicagoclimateexchange.com/news/press/release_20070130_Kodak.pdf.

"A laboratory investigation of compliance behavior under tradable emissions rights: Implications for targeted enforcement." This paper uses laboratory experiments to test theoretical predictions concerning compliance behavior in competitive emissions trading programs. The authors test the hypotheses that both the violations of competitive risk neutral firms and the marginal effectiveness of increased enforcement across firms are independent of differences in their benefits from emissions (abatement costs) and their initial permit allocations. This conclusion suggests that regulators have no conceptual justification for targeting their enforcement effort based on firm-level characteristics. Consistent with theory, the authors find that violations were independent of parametric differences in emissions benefits. However, subjects who were predicted to buy permits tended to have higher violation levels than those who were predicted to be sellers. Nevertheless, the authors find no evidence that the marginal effectiveness of enforcement depends on any firm-specific characteristic. The authors also examine the determinants of compliance behavior under fixed emissions standards. As expected, the authors find significant differences between compliance behavior under fixed standards and emissions trading programs. **James J. Murphy and John K. Stranlund,** *Journal of Environmental Economics and Management,* Published online January 26, 2007, http://www.sciencedirect.com/science/article/B6WJ6-4MX4VMD-1/2/67300411559329d45f4b2f6c81cf841c. (Subscription may be required.)

Recent Publications

"President Bush Plans to Strengthen America's Energy Security." The White House Office of Communications has released a fact sheet as a companion document to President Bush's 2007 State of the Union Address. The document outlines the President's "Twenty in Ten" initiative, whose goal is to reduce US gasoline usage by 20 percent in the next ten years. The report states that the President's plan will help confront climate change by stopping the projected growth of carbon dioxide emissions from cars, light trucks and SUVs within ten years. By 2017, the renewable fuel and fuel efficiency components of the plan would cut annual emissions from cars and light trucks by as much as ten percent, about 175 million metric tons—equal to zeroing out the annual emissions of 26 million automobiles. The plan could cumulatively prevent the buildup of more than 600 million metric tons of carbon dioxide emissions. The President has set a target of cutting our greenhouse gas intensity by 18 percent through the year 2012 and his budgets have devoted nearly $29 billion to climate-related science, technology, international assistance, and incentive programs. January 23, 2007. To view the complete document, go to: http://usinfo.state.gov/xarchives/display.html?p=washfile-english&y=2007&m=January&x=20070123170347eaifas0.7542993. To read the State of the Union address in its entirety or to view a video webcast of the speech, go to: http://www.whitehouse.gov/news/releases/2007/01/20070123-2.html#.

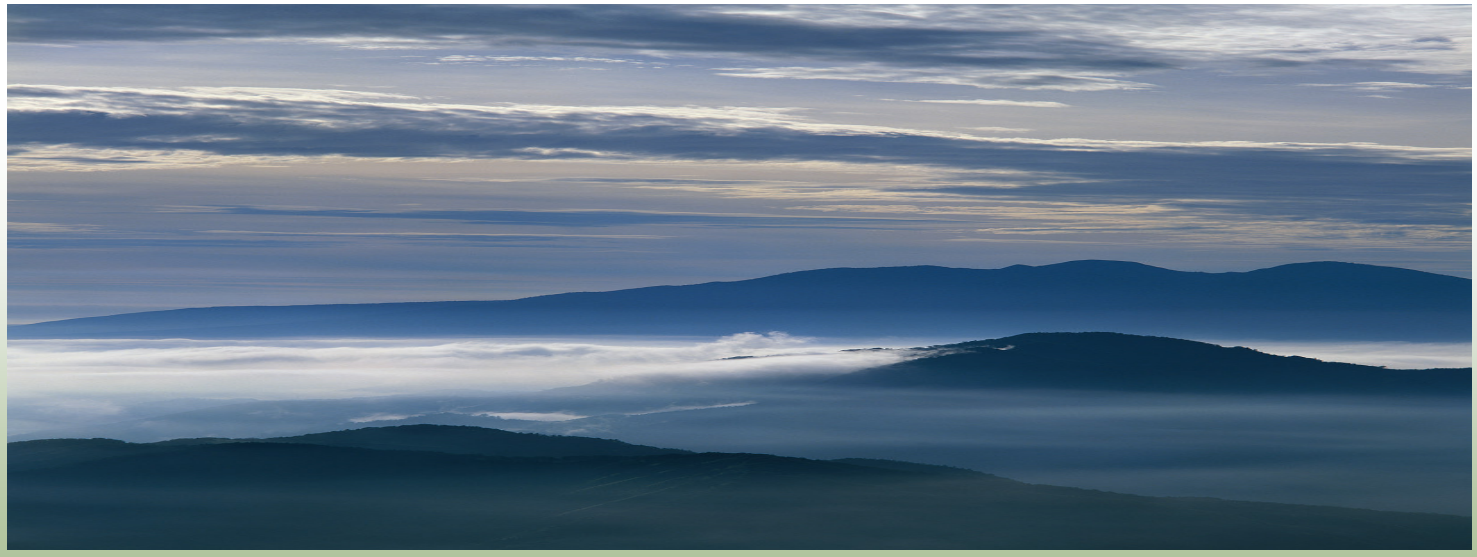
Tackling Climate Change in the U.S., Potential Carbon Emissions Reductions from Energy Efficiency and Renewable Energy by 2030, American Solar Energy Society, Charles F. Kutscher, Ph.D., P.E., Editor, January 2007. For SOLAR 2006, the 35th Annual National Solar Energy Conference last July, the American Solar Energy Society (ASES) chose to address global warming. Under the theme "Renewable Energy: Key to Climate Recovery," climate experts James Hansen of the National Aeronautics and Space Administration (NASA), Warren Washington of the National Center for Atmospheric Research (NCAR), Robert Socolow of Princeton University, and Marty Hoffert of New York University (NYU) described the magnitude of the global warming crisis and what is needed to address it. A key feature of the conference was a special track of nine invited presentations by experts in energy efficiency and renewable energy that detailed the potential for these technologies—in an aggressive but achievable climate-driven scenario—to address the needed US carbon emissions reductions by the years 2015 and 2030. These presentations covered energy efficiency in buildings, industry, and transportation, as well as the following renewable technologies: concentrating solar power, photovoltaics, wind, biomass, biofuels, and geothermal. Since the conference, these studies were subjected to additional review and were revised for publication in this special ASES report. Also included are sections on Carbon Capture and Storage and Carbon Sequestration in Soils. To download the report as a pdf file, see: http://www.ases.org/climatechange/climate_change.pdf.

"A Call for Action: Consensus Principles and Recommendations from the U.S. Climate Action

Partnership: A Business and NGO Partnership." A diverse group of US-based businesses and leading environmental organizations today called on the federal government to quickly enact strong national legislation to achieve significant reductions of greenhouse gas emissions. The group said any delay in action to control emissions increases the risk of unavoidable consequences that could necessitate even steeper reductions in the future. This alliance, called the US Climate Action Partnership (US-CAP), consists of companies Alcoa, BP America, Caterpillar, Duke Energy, DuPont, FPL Group, General Electric, Lehman Brothers, PG&E, and PNM Resources, along with four non-governmental organizations – Environmental Defense, Natural Resources Defense Council, Pew Center on Global Climate Change, and World Resources Institute. At a news conference January 22 at the National Press Club, US-CAP issued a landmark set of principles and recommendations to underscore the need for a policy framework on climate change. The report includes recommendations for carbon capture and storage. The solutions-based report, titled *A Call for Action*, lays out a blueprint for a mandatory economy-wide, market-driven approach to climate protection. **(See Legislative Activity section of this newsletter for more information.)** Read the report at: http://www.us-cap.org/ClimateReport.pdf. Read a related press release at: http://www.us-cap.org/media/release.pdf.

Legislative Activity

***Voice of America,* "Private Coalition Calls for Swift US Action on Global Warming," and *Voice of America,* "US Businesses, Environmental Groups Join Forces to Push for Action on Global Warming."** A coalition of US-based businesses and non-governmental environmental organizations are joining forces to confront the problem of global warming. The US Climate Action Partnership, or US-CAP, is made up of chief executives from some of the country's largest corporations, such as General Electric, DuPont, Alcoa, and Legman Brothers, who have teamed up with environmental groups including Environmental Defense, Natural Resources Defense Council, Pew Center on Global Climate Change, and World Resources Institute. Both parties are calling on the US government to address the issue of climate change by enacting national legislation to require significant reductions in greenhouse gas emissions. The proposal describes a market driven approach that places caps on emissions, while at the same time providing economic incentives to reach those targets. The goal is to see a reduction in carbon dioxide emissions by 30 percent in the next 15 years. Similar plans are in place in Europe where goals to reduce carbon dioxide emissions to pre-industrial levels by the year 2020 have been proposed by the European Commission. US-CAP supports the enactment of a number of climate change bills currently being presented to Congress. **(See Recent Publications section of this newsletter for a link to the report, *A Call for Action,* in news item "A Call for Action: Consensus Principles and Recommendations from the U.S. Climate Action Partnership: A Business and NGO Partnership.")** January 22, 2007, http://www.voanews.com/english/2007-01-22-voa46.cfm, and January 24, 2007, http://www.voanews.com/english/2007-01-24-voa31.cfm.



Events

May 7-10, 2007, **Sixth Annual Conference on Carbon Capture and Sequestration,** *Sheraton at Station Square, Pittsburgh, PA.* This conference will bring together the experts directly involved in developing, demonstrating and deploying carbon capture, separation and sequestration technologies as part of the Administration's Climate Change Technology Program. In addition, this year the Carbon Sequestration Leadership Forum Task Force on Capacity Building in Emerging Economies will sponsor a Workshop in conjunction with the conference devoted to possible approaches that can be undertaken to build capacity in the governmental and industrial sector to facilitate the development, deployment and public acceptance of carbon capture and sequestration. For conference and registration information, see: http://www.carbonsq.com/.

March 5-6, 2007, **2007 Global CO_2 Cap-and-Trade Forum - Pacific**, *Marriott Fisherman's Wharf, San Francisco, California*. This conference is the only event covering policy, regulatory issues, and practical emissions reduction solutions with international emissions markets and CO_2 mitigation experts at the forefront of the efforts, sharing their experiences and observations. For further information, see: http://www.srinstitute.com/conf_page.cfm?pt=includes/webpages/webwysiwyg.cfm&web_page_id=6927&web_id=947&instance_id=25&pid=554.

March 5-6, 2007, **Managing Electric Utility and Natural Gas Interdependency**, *Omni Hotel, Houston, Texas*. This conference is suited to executives, managers, system operators, federal and state regulators, and professionals in the energy industry that wish to learn about the current state of how electric utilities, regional transmission organizations, and regulators are addressing the increasing interdependency between electricity and natural gas. Sessions will include topics such as how the natural gas market will be impacted by a potential carbon tax and effects of greenhouse gas regulation in California. To view the complete conference brochure online, go to: http://www.pmaconference.com/3.5.07b.pdf.

March 13-15, 2007, **Carbon Markets Insights 2007**, *Bella Center*, *Copenhagen, Denmark.* This event will reflect on, amongst other major issues, the opening up of the EU emissions trading scheme to the global carbon markets. Former vice president Al Gore has confirmed his attendance as a keynote speaker and over 130 knowledgeable carbon market experts will attend as speakers as well. Over 1500 participants from 65 countries, representing more than 600 companies, organizations and governments are expected to attend. For information, see: http://www.pointcarbon.com/Events/Carbon%20Market%20Insights/category401.html.

March 20-22, 2007, **Americana 2007**, *Montréal Convention Centre, Montréal (Québec), Canada*. The objectives of Americana 2007, The International Environmental Technology Trade Show and Conference, are to promote and share knowledge, techniques, solutions and technologies enabling the participants to better the global situation of the environment industry. It is recognized as one of the most important events of its type in North America and will host 10,000 participants from more than 60 countries, 400 exhibitors and 150 speakers. The conference will examine the unique opportunity for businesses to thrive in a context of environmental regulation and explore other exciting themes linked to economic development. To view the preliminary program and for further information, see: http://www.americana.org/tiki-index.php?page=Home.

Events

March 22-23, 2007, **Optimising the Back Office in the Energy Trading Market**, *Central London, England*. This conference will examine the issues affecting the back office and provide strategies from energy firms and financial institutions. Looking across power, gas, oil and CO_2 asset classes, the event will provide solutions in order to get closer to the standardization required to significantly automate back office processes. For further information or to receive a brochure, see: http://www.marcusevans.com/events/CFEventinfo.asp?EventID=11740.

April 3-4, 2007, **Carbon Markets Americas**, *Hotel Sofitel, Rio de Janeiro, Brazil*. International Carbon Markets experts will meet in Rio de Janeiro to address the challenges and opportunities of launching new carbon mitigation projects across the region. Additionally, an intensive one-day seminar will be held that will provide project developers with the expertise and knowledge to successfully enter the carbon market. Combining expert presentations with practical case study analysis, the seminar will serve as an excellent introduction to anyone wanting to further their knowledge or embark on a Clean Development Mechanism project. To download a conference brochure, go to: http://www.greenpowerconferences.com/carbonmarkets/documents/CarbonMarketsAmericasBrochure_001.pdf.

April 19-20, 2007, **The 18th Global Warming and International Conference and Expo (GW18)**, *Sheraton Miami Mart Hotel and Convention Center, Miami Florida.* Historically, GW represents the oldest and most consistently sustained conference dedicated to the exchange of scientific data, governmental assessments, and public policies concerning global climate change, including global warming and extreme climatic events. More detailed information can be found at: http://www.gw18.globalwarming.net/index.php.

April 22-26, 2007, **AIChE 2007 Spring National Meeting**, *Hilton Americas Houston, Houston, Texas.* A session on carbon dioxide (CO_2) capture and storage will concentrate on new or improved methods of CO_2 capture from advanced power systems and large industrial plants that can significantly reduce CO_2 capture costs and associated energy requirements. Separations involving both gas phase and liquid phase operations, as well as hybrid processes such as adsorption/membrane systems, will be included. This session will deal not only with the capture of CO_2 from flue gas and other streams, but also with the behavior and interactions of CO_2 after it has been injected into a geologic formation. For conference and registration information, go to: http://www.aiche.org/Conferences/SpringMeeting/index.aspx.

May 1-3, 2007, **Electric Power 2007**, *Donald E. Stephens Convention Center, Chicago, Illinois.* The Electric Power Conference is programmed by the power industry–for the power industry. Electric Power brings the industry a conference program that meets the needs of the power plant owner/operator companies and project developers. Sessions include “Coal Power Plants – Upgrades and New Capacity,” “Integrated Gasification Combined Cycle (IGCC), Advanced Combustion and CO_2 Capture Technologies,” and “Environmental Regulatory Issues, Strategies and Technologies.” For complete conference and registration information, see: http://www.electricpowerexpo.com/index.asp.

May 2-4, 2007, **Carbon Expo**, *Koelnmesse, Cologne, Germany.* Carbon Expo is the global carbon market event that combines the up-to-date content of a high-level conference with the advantages of a trade fair. Participants will be able to interact with real market players representing supply and demand in the carbon market. For conference details, see: http://www.carbonexpo.com/wEnglisch/carbonexpo2/index.htm.

Events (continued)

May 15-17, 2007, **Third International Conference on Clean Coal Technologies for our Future**, *T Hotel and Conference Centre, Cagliari and Sotacarbo Coal Research Centre, Carbonia, Sardinia, Italy.* The ability to use coal in an environmentally acceptable and sustainable manner is an important issue to consider. This conference will allow participants to share in the debate and formulate the important decisions that the individuals involved in the coal industry must make for the future. For further information and to visit the conference website, see: http://www.cct2007.it/.

May 29-31, 2007, **Corporate Climate Response**, *CBI Conference Centre, London, England*. Through a series of corporate case studies and expert panels this conference will highlight and benchmark how leading companies are responding to the challenges and opportunities of climate change. Issues to be covered include: Implications of the Energy Performance Commitment, offsetting, renewables, benchmarking, strategy and senior management. For event details, go to: http://www.greenpowerconferences.com/corporateclimateresponse/ccr_london07.html.

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