



# Carbon Sequestration Newsletter

JULY 2011

Carbon Sequestration

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(CCS) technologies. The tabs within NATCARB open different maps for query and analysis capabilities: (1) the RCSP tab shows the seven Regional Carbon Sequestration Partnership (RCSP) regions and provides links to CCS



projects undertaken by DOE's RCSP Initiative; (2) the ATLAS tab is the interactive version of data (carbon dioxide [CO<sub>2</sub>] stationary sources, saline formations, oil and gas reservoirs, unmineable coal areas, and sedimentary basins) contained in the 2010 Carbon Sequestration Atlas of the United States and Canada - Third Edition (Atlas III); (3) the FIELD PROJECTS tab shows the locations of CCS field projects and provides links for more information on these small- and large-scale projects, including the 10 American Recovery and Reinvestment Act of 2009 (ARRA) site characterization projects; and (4) the WCCS tab shows a user-friendly world map with locations for all active, postponed, canceled, and terminated CCS projects. NATCARB is a geographic information system (GIS)-based tool developed to provide a view of CCS potential in the United States and portions of Canada. The updated NATCARB Viewer includes projects and information on the Carbon Sequestration Program's research and development (R&D) initiatives to advance geologic CO<sub>2</sub> storage toward commercialization. The information contained in NATCARB is current as of July 1, 2011, and will be updated quarterly. The NATCARB Viewer is accessible from: [http://www.netl.doe.gov/technologies/carbon\\_seq/natcarb/index.html](http://www.netl.doe.gov/technologies/carbon_seq/natcarb/index.html). June 28, 2011, [http://www.fossil.energy.gov/news/techlines/2011/11029-Redesigned\\_NATCARB\\_Website\\_Launch.html](http://www.fossil.energy.gov/news/techlines/2011/11029-Redesigned_NATCARB_Website_Launch.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.

### ***Fossil Energy Techline, "Confirming CCS Security and Environmental Safety Aim of Newly Selected Field Projects."***

## HIGHLIGHTS

### ***Fossil Energy Techline, "Redesigned CCS Website Offers Wealth of Information on Worldwide Technology, Projects."***

An updated and redesigned version of the National Carbon Sequestration Database and Geographic Information System (NATCARB) was launched on the U.S. Department of Energy's National Energy Technology Laboratory (DOE/NETL) website. The interactive online tool integrates a wealth of information about worldwide efforts to deploy carbon capture and storage

On July 6, 2011, DOE announced the selection of three small-scale CO<sub>2</sub> injection field projects to collectively receive \$34.5 million over four years. The total award value of the new projects, which aim to confirm that long-term geologic CO<sub>2</sub> storage is safe and environmentally secure, is more than \$45 million, with approximately \$10.5 million provided by the recipients. The three projects include: (1) Blackhorse Energy, LLC, plans to inject approximately 53,000 tons of CO<sub>2</sub> into a geologic formation located in Livingston Parish, Louisiana, to assess the suitability of strandplain geologic formations for future large-scale geologic CO<sub>2</sub> storage in association with enhanced oil recovery (EOR); (2)



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the University of Kansas Center for Research, Inc. will inject at least 70,000 metric tons of CO<sub>2</sub> into multiple formations to demonstrate the application of state-of-the-art monitoring, verification, and accounting (MVA) tools and techniques to monitor and visualize the injected CO<sub>2</sub> plume and establish best practice methodologies for MVA and closure in shelf clastic and shelf carbonate geologic formations; and (3) the Virginia Polytechnic Institute and State University will attempt to reduce uncertainty, test the properties of coal seams, and evaluate the potential for enhanced coalbed methane (ECBM) recovery by injecting approximately 20,000 tons of CO<sub>2</sub> into unmineable coalbeds. The data from these projects will be incorporated into NATCARB. July 6, 2011, [http://www.fossil.energy.gov/news/techlines/2011/11032-DOE\\_Selects\\_CCS\\_Field\\_Projects.html](http://www.fossil.energy.gov/news/techlines/2011/11032-DOE_Selects_CCS_Field_Projects.html).

## SEQUESTRATION IN THE NEWS

### ***Fossil Energy Techline, "DOE-Sponsored IGCC Project in Texas Takes Important Step Forward."***

A newly signed memorandum of understanding (MOU) for the purchase of electricity produced by a first-of-a-kind integrated gasification combined cycle (IGCC) power plant represents an important step forward for what is expected to be one of the world's most advanced and cleanest coal-based power plants, funded in part by DOE. Under the MOU, CPS Energy, a municipally owned utility serving San Antonio, Texas, will purchase the electricity generated by the Texas Clean Energy Project (TCEP), a 400-megawatt (MW) IGCC facility located 15 miles west of Odessa, beginning in mid-2014. TCEP will capture approximately 90 percent of its CO<sub>2</sub> emissions (3 million tons annually), which will be used for EOR in the West Texas Permian Basin. TCEP was a third round selection under the Office of Fossil Energy's (FE) Clean Coal Power Initiative (CCPI), a cost-shared collaboration between the Federal government and private industry aimed at stimulating investment in low-emission, coal-based power generation through successful commercial demonstrations. For more information on DOE's CCPI, visit: <http://www.fossil.energy.gov/programs/powersystems/cleancoal/index.html>. To learn more about TCEP, go to: <http://www.texascleanenergyproject.com/>. June 20, 2011, [http://www.fossil.energy.gov/news/techlines/2011/11026-IGCC\\_Project\\_in\\_Texas\\_Moves\\_Forwar.html](http://www.fossil.energy.gov/news/techlines/2011/11026-IGCC_Project_in_Texas_Moves_Forwar.html).

### ***Reuters, "Toshiba to do Carbon Capture Study in Bulgaria."***

Toshiba Corporation announced plans to conduct a feasibility study in Bulgaria for the possible construction of a coal-fired power plant with CCS facilities. The study, which will be conducted in the Maritsa East lignite coal mining complex in southern Bulgaria, will run from July 2011 through March 2012. The project is part of the European Union (EU) member state's efforts to boost energy efficiency and reduce greenhouse gas (GHG) emissions in line with the region's climate change policies. Schlumberger Carbon Services, Sofia University, and Taisei Corporation will also participate in the study. Currently, thermal power utilities account for approximately 50 percent of electricity generation in Bulgaria. July 5, 2011, <http://www.reuters.com/article/2011/07/05/us-bulgaria-ccs-toshiba-idUSTRE76420V20110705>.

# SEQUESTRATION IN THE NEWS (CONTINUED)

## *The Press*, “CO<sub>2</sub> Pipeline Across Yorkshire is Proposed.”

The National Grid revealed proposals for an underground pipeline to transport CO<sub>2</sub> across Yorkshire into the North Sea to be stored underground. The proposed route would begin by capturing CO<sub>2</sub> emissions from the 2Co Energy Don Valley Power project in Stainforth, near Doncaster, and then run between Goole and Selby, south of Market Weighton and north of Beverley, and finally south of Driffield towards the coast, where it will then go under the sea to a suitable geologic storage site. The infrastructure is expected to be used by other power generators in Yorkshire. June 28, 2011, [http://www.yorkpress.co.uk/news/9108967.Co2\\_pipeline\\_across\\_Yorkshire\\_is\\_proposed/](http://www.yorkpress.co.uk/news/9108967.Co2_pipeline_across_Yorkshire_is_proposed/).

*Conroenews.com*, “Denbury CO<sub>2</sub> Pipeline Scheduled for Late 2013 Start.”

According to officials from Denbury Resources, Inc., enhanced extraction of crude oil from the Conroe field should begin in late 2013. The “Conroe Lateral,” which will commence once Denbury completes the construction of a pipeline through Southeast Texas, is an 87-mile pipeline designed to transport up to 700 million standard cubic feet of CO<sub>2</sub> per day for injection into the Conroe field. The process is projected to recover an additional 125 million barrels of crude oil from the field over the next 25 to 30 years. Denbury’s “Green Pipeline,” a 320-mile pipeline from Donaldsonville, Louisiana, to Alvin, Texas, connects one of the largest reserves of CO<sub>2</sub> in Mississippi to the Hastings oil field, southwest of Houston. Denbury began extracting crude oil from the Hastings field in December 2010. July 8, 2011, [http://www.yourhoustonnews.com/courier/news/article\\_6d52706f-373f-5c5d-991f-36540d3678a6.html](http://www.yourhoustonnews.com/courier/news/article_6d52706f-373f-5c5d-991f-36540d3678a6.html).

## ANNOUNCEMENTS

### **DOE’s Carbon Storage Program Infrastructure Annual Review Meeting.**

DOE’s 2011 Annual Review Meeting, featuring the RCSPs, will be held at the Sheraton Station Square Hotel, Pittsburgh, Pennsylvania, on November 15-17, 2011. This meeting highlights DOE’s carbon storage infrastructure projects, which include the efforts of DOE’s RCSPs; however, it is now expanding to include other U.S. and international projects that are working to characterize storage capacity through exploration and injection operations. An interactive reception and poster sessions will be held to highlight geologic carbon storage and characterization work being performed by the ARRA-supported Regional Carbon Sequestration Training Centers, DOE’s National Laboratories, RCSP subcontractors, and other organizations. For more information, go to: <http://www.netl.doe.gov/events/11conferences/Carbon%20storage%20program/index.html>.

### **DOE EERE Awards \$11.3 Million for Geothermal Technology R&D.**

As part of DOE’s recent Energy Efficiency & Renewable Energy (EERE) awards, Lawrence Berkeley National Laboratory (LBNL) will receive up to \$4.99 million for “The Geothermal Energy Coupled with CCS: Heat Recovery Using an Innovative High Efficiency Supercritical CO<sub>2</sub> Turboexpansion Cycle” project to develop new ways to produce electricity from superheated and pressurized CO<sub>2</sub> in deep geothermal formations. In addition, Lawrence Livermore National Laboratory (LLNL) will receive up to \$874,000 for “The Active Management of Integrated Geothermal—CO<sub>2</sub> Storage Reservoirs: An Approach to Improve Energy Recovery and Mitigate Risk” project to study the technical and economic feasibility of integrating geothermal energy production with CCS. For more details, visit: [http://www1.eere.energy.gov/geothermal/news\\_detail.html?news\\_id=17493](http://www1.eere.energy.gov/geothermal/news_detail.html?news_id=17493).

### **National Enhanced Oil Recovery Initiative Launched.**

On July 12, 2011, industry, government, and organizational leaders gathered to launch a national EOR initiative aimed at increasing the supply of domestic oil produced through EOR using CO<sub>2</sub>. The group will develop recommendations for Federal and state policymakers on how to ramp up CO<sub>2</sub>-EOR to improve U.S. energy security, create economic opportunities, support job creation, and reduce GHG emissions. The slate of recommendations is expected to be released in early 2012. More information is available at: <http://www.pewclimate.org/press-center/press-releases/members-congress-support-eor-initiative>.

### **NETL Releases Updated Version of the Carbon Sequestration Website.**

DOE’s NETL released a new, user-friendly version of the Carbon Sequestration Program website in early May. The Carbon Sequestration Program website contains both introductory and in-depth information about sequestration fundamentals, supporting technologies, sequestration applications, environmental benefits, and the status of the latest R&D activities. The updated website can be viewed at: [http://www.netl.doe.gov/technologies/carbon\\_seq/index.html](http://www.netl.doe.gov/technologies/carbon_seq/index.html).

### **NETL’s 2011 Carbon Sequestration Project Portfolio Available Online.**

The 2011 Carbon Sequestration Project Portfolio contains selected Carbon Sequestration Program papers and publications; NETL’s Best Practices Manuals (BPMs); Infrastructure fact sheets (RCSP Validation and Development Phases); and Carbon Sequestration Core R&D fact

## ANNOUNCEMENTS (CONTINUED)

sheets (pre-combustion capture; geologic carbon storage; MVA; simulation and risk assessment; and CO<sub>2</sub> utilization). The portfolio is available at: [http://www.netl.doe.gov/technologies/carbon\\_seq/refshelf/project%20portfolio/2011/index.html](http://www.netl.doe.gov/technologies/carbon_seq/refshelf/project%20portfolio/2011/index.html).

### **Richland Community College Sequestration Degree.**

Richland Community College has broken ground for the National Education Center, which will award CCS degrees. Courses are currently being developed, and the program is expected to receive approval by the Illinois Community College Board in time for the 2012 fall semester. For more information, go to: [http://www.herald-review.com/news/local/article\\_a5c8d63a-abb1-11e0-9ae0-001cc4c002e0.html](http://www.herald-review.com/news/local/article_a5c8d63a-abb1-11e0-9ae0-001cc4c002e0.html).

## SCIENCE

### ***The Telegraph*, “Duck-Billed Platypus at Risk from Climate Change.”**

According to researchers at Monash University, the cool rivers and ponds that platypus inhabit could become too warm for their survival due to potential climate change. By using weather and platypus habitat data from the last 100 years, researchers were able to connect declines in populations with droughts and heat events. Currently, the platypus population is able to feed for up to 10 hours in near-freezing water due to its watertight fur. However, researchers have found that in 60 years, approximately one-third of the platypus’ habitat could become too hot. Under a worst-case scenario, the animals could become extinct on the Australian mainland and confined to three of the coolest part of the country – the Tasmania, King, and Kangaroo islands. June 24, 2011, <http://www.telegraph.co.uk/earth/wildlife/8596068/Duck-billed-platypus-at-risk-from-climate-change.html>.

### ***Reuters*, “Climate Change Raising Tick Threat for Northern Moose: Officials.”**

Moose living in northern parts of the United States are being increasingly threatened from blood-feeding ticks and deer-borne parasites due to shorter winters caused by potential climate change, according to U.S. wildlife officials. A recently released study by New Hampshire’s Fish and Game Department states that winter ticks account for 41 percent of all moose deaths in the state – the same percentage killed by hunting and vehicular collisions. The study, which began in 2001, also found that nearly all of the calf deaths were caused by winter ticks. On average, a moose can become infested with approximately 30,000 ticks in normal fall weather conditions. However, in years when the first snowfall is later than usual, one animal can be infested with as many as 160,000 ticks during winter, often leading to malnutrition and eventual death. When ticks are feeding, moose suffer from stresses such as reduced blood volume, a thinner coat due to scratching, and an inability to lie down and rest. According to a recent report by the Union of Concerned Scientists, New Hampshire’s snow season may shrink by 50 percent by mid-century. June 18, 2011,



<http://www.reuters.com/article/2011/06/18/us-moose-ticks-idUSTRE75H1UJ20110618>.

## POLICY

### ***DNV Press Release*, “New DNV Well Integrity Guideline Provides Solution to CO<sub>2</sub> Storage Challenges.”**

Det Norske Veritas (DNV) released a new guideline for CCS projects, describing a framework process for managing the risks associated with existing wells at both onshore and offshore CO<sub>2</sub> storage sites. When coupled with the previously released CO2QUALSTORE guideline, the CO2WELLS guideline provides a process for CCS projects designed to qualify geologic storage sites through risk and uncertainty reducing measures. The guideline includes direction on: (1) risk assessment of active and abandoned wells during the initial screening of candidate storage sites, and (2) the qualification of wells for continued or modified use in a CCS project. The guideline is consistent with the ISO31000 international standard for risk management and current and emerging regulations for CO<sub>2</sub> geologic storage in the United States, Canada, Europe, and Australia. The CO2WELLS guideline is available for download at: [http://www.dnv.com/binaries/CO2WELLS\\_guideline\\_tcm4-465269.pdf](http://www.dnv.com/binaries/CO2WELLS_guideline_tcm4-465269.pdf). July 14, 2011, [http://www.dnv.com/press\\_area/press\\_releases/2011/newdnvwellintegrityguidelineprovidessolutiontoco2storagechallenges.asp](http://www.dnv.com/press_area/press_releases/2011/newdnvwellintegrityguidelineprovidessolutiontoco2storagechallenges.asp).

### **“Influencing attitudes towards carbon capture and sequestration: a social marketing approach.”**

The following is the Abstract of this article: “[CCS] is seen as promising because it will allow the United States to continue using its vast fossil fuel resources in a carbon constrained world. The public is an important stakeholder in the national debate about whether or not the [United States] should include CCS as a significant part of its climate change strategy. Understanding how to effectively engage with the public about CCS has become important in recent years, as interest in the technology has intensified. [The authors] argue that engagement efforts should be focused on places where CCS will first be deployed, i.e. places with many ‘energy veteran’ (EV) citizens. [The authors] also argue that, in addition to information on CCS, messages with emotional appeal may be necessary in order to engage the public. In this paper [the authors] take a citizen-guided social marketing approach towards understanding how to (positively or negatively) influence EV

## POLICY (CONTINUED)

citizens' attitudes towards CCS. [The authors] develop open-ended interview protocols, and a 'CCS campaign activity,' for Wyoming residents from Gillette and Rock Springs. [The authors] conclude that [their] participants believed expert-informed CCS messages, embedded within an emotionally self-referent (ESR) framework that was relevant to Wyoming, to be more persuasive than the expert messages alone. The appeal to core values of Wyomingites played a significant role in the citizen-guided CCS messages." **Gabrielle Wong-Parodi, Hadi Dowlatabadi, Tim McDaniels, and Isha Ray**, *Environ. Sci. Technol.*, Available online July 5, 2011, DOI:10.1021/es201391g, <http://pubs.acs.org/doi/abs/10.1021/es201391g>. (Subscription may be required.)

### **"Public perceptions of CCS: Emergent themes in pan-European focus groups and implications for communications."**

The following is the Abstract of this article: "This paper reports on European public perceptions of CCS as determined through six focus groups, one held in each of the UK, the Netherlands, Poland, Germany, Belgium and Spain. The development of opinion and the emergence of concerns were observed via phased exposure to a specially commissioned film providing an overview of CCS technology, its rationale and associated debates, supplemented by additional information on national energy mixes. In general there was a high level of commonality in opinion and concerns across the six countries, with only minor differences. The concerns that emerged were not allayed by the information provided. On the contrary, there was evidence of a shift from initial uncertainty about CCS to negative positions. CCS was generally perceived as an uncertain, end-of-pipe technology that will perpetuate fossil-fuel dependence. Noting the political context to CCS, [the authors] conclude that advocates will likely find the European public opinion context a challenging one in which to achieve deployment, particularly for onshore storage, except where local communities perceive real economic or other benefits to CCS." **Paul Upham and Thomas Roberts**, *International Journal of Greenhouse Gas Control*, Available online July 6, 2011, doi:10.1016/j.ijggc.2011.06.005, <http://www.sciencedirect.com/science/article/pii/S1750583611001149>. (Subscription may be required.)

## GEOLOGY

### **"A natural analogue for CO<sub>2</sub> mineral sequestration in Miocene basalt in the Kuanhsi-Chutung area, Northwestern Taiwan."**

The following is the Abstract of this article: "In general, CO<sub>2</sub> sequestration by carbonation is estimated by laboratory experimentation and geochemical simulation. In this study, however, estimation is based on a natural analogue study of the Miocene basalt in the Kuanhsi-Chutung area, Northwestern Taiwan. This region has great potential in terms of geological and geochemical environments for CO<sub>2</sub> sequestration. Outcropping Miocene basalt in the study area shows extensive serpentinization and carbonation. The carbon stable isotopes of carbonates lie on the depleted side of the Lohmann meteoric calcite line, which demonstrates that the carbonates most probably precipitate

directly from meteoric fluid, and water-rock interaction is less involved in the carbonation process. Oxygen stable isotope examinations also show much depleted ratios, representative of product formation under low temperatures (50-90°C). This translates to a depth of 1-2 km, which is a practical depth for a CO<sub>2</sub> sequestration reservoir. According to petrographic observation and electron microprobe analysis, the diopside grains in the basalt are resistant to serpentinization and carbonation; therefore, the fluid causing alteration is likely enriched with calcium and there must be additional sources of calcium for carbon mineralization. These derived geochemical properties of the fluid support the late Miocene sandstone and enclosed basalts as having high potential for being a CO<sub>2</sub> sequestration reservoir. Moreover, the existing geochemical environments allow for mineralogical assemblages of ultramafic xenoliths, indicating that forsterite, orthopyroxene and feldspar minerals are readily replaced by carbonates. Based on the mineral transformation in xenoliths, the capacity of CO<sub>2</sub> mineral sequestration of the Miocene basalt is semi-quantitatively estimated at 94.15 kg CO<sub>2</sub> chemically trapped per 1 m<sup>3</sup> basalt. With this value, total CO<sub>2</sub> sequestration capacity can be evaluated by a geophysical survey of the amount of viable Miocene basalt at the potential sites. Such a survey is required in the near future." **Hsueh-Yu Lu, Cheng-Kuo Lin, Wayne Lin, Tai-Sheng Liou, Wen-Fu Chen, and Ping-Yu Chang**, *International Journal of Greenhouse Gas Control*, Available online June 28, 2011, doi:10.1016/j.ijggc.2011.05.037, <http://www.sciencedirect.com/science/article/pii/S1750583611000971>. (Subscription may be required.)

### **"In Situ Infrared Spectroscopic Study of Forsterite Carbonation in Wet Supercritical CO<sub>2</sub>."**

The following is the Abstract of this article: "Carbonation reactions are central to the prospect of CO<sub>2</sub> trapping by mineralization in geologic reservoirs. In contrast to the relevant aqueous-mediated reactions, little is known about the propensity for carbonation in the key partner fluid: supercritical [CO<sub>2</sub>] containing dissolved water ('wet' scCO<sub>2</sub>). [The authors] employed in situ mid-infrared spectroscopy to follow the reaction of a model silicate mineral (forsterite, Mg<sub>2</sub>SiO<sub>4</sub>) for 24 [hours] with wet scCO<sub>2</sub> at 50°C and 180 atm. The results show a dramatic dependence of reactivity on water concentration and the presence of liquid water on the forsterite particles. Exposure to neat scCO<sub>2</sub> showed no detectable carbonation reaction. At 47 [percent] and 81 [percent] water saturation, an nanogram-thick liquid-like water film was detected on the forsterite particles and less than 1 [percent] of the forsterite transformed. Most of the reaction occurred within the first [three hours] of exposure to the fluid. In experiments at 95 [percent] saturation and with an excess of water (36 [percent] above water saturation), a nanometer-thick water film was detected, and the carbonation reaction proceeded continuously with approximately 2 [percent] and 10 [percent] conversion, respectively. [The authors'] collective results suggest constitutive links between water concentration, water film formation, reaction rate and extent, and reaction products in wet scCO<sub>2</sub>." **John S. Loring, Christopher J. Thompson, Zheming Wang, Alan G. Joly, Deborah S. Sklarew, H. Todd Schaeff, Eugene S. Ilton, Kevin M. Rosso, and Andrew R. Felmy**, *Environ. Sci. Technol.*, Available online June 23, 2011, DOI:10.1021/es201284e, <http://pubs.acs.org/doi/abs/10.1021/es201284e>. (Subscription may be required.)

# TECHNOLOGY

## “Probabilistic Design of a Near-Surface CO<sub>2</sub> Leak Detection System.”

The following is the Abstract of this article: “A methodology is developed for predicting the performance of near-surface CO<sub>2</sub> leak detection systems at geologic sequestration sites. The methodology integrates site characterization and modeling to predict the statistical properties of natural CO<sub>2</sub> fluxes, the transport of CO<sub>2</sub> from potential subsurface leakage points, and the detection of CO<sub>2</sub> surface fluxes by the monitoring network. The probability of leak detection is computed as the probability that the leakage signal is sufficient to increase the total flux beyond a statistically determined threshold. The methodology is illustrated for a highly idealized site monitored with CO<sub>2</sub> accumulation chamber measurements taken on a uniform grid. The TOUGH2 code is used to predict the spatial profile of surface CO<sub>2</sub> fluxes resulting from different leakage rates and different soil permeabilities. A response surface is fit to the TOUGH2 results to allow interpolation across a continuous range of values of permeability and leakage rate. The spatial distribution of leakage probability is assumed uniform in this application. Nonlinear, nonmonotonic relationships of network performance to soil permeability and network density are evident. In general, dense networks (with 10-20 m between monitors) are required to ensure a moderate to high probability of leak detection.” **Ya-Mei Yang, Mitchell J. Small, Egemen O. Ogretim, Donald D. Gray, Grant S. Bromhal, Brian R. Strazisar, and Arthur W. Wells**, *Environ. Sci. Technol.*, Available online July 6, 2011, DOI:10.1021/es104379m, <http://pubs.acs.org/doi/abs/10.1021/es104379m>. (Subscription may be required.)

## “Techno-economical and environmental evaluations of IGCC power generation process with carbon capture and storage (CCS).”

The following is the Abstract of this article: “IGCC is a power generation technology in which the solid feedstock (coal, lignite, biomass etc.) is partially oxidized with oxygen and steam to produce syngas. In a conventional IGCC design for power generation without carbon capture, the syngas is purified for dust and hydrogen sulphide removal and then sent to a Combined Cycle Gas Turbine (CCGT) for power production. CCS technologies are expected to play a significant role in the coming decades for reducing the [GHG] emissions. IGCC is one of the power generation technologies having the highest potential to capture [CO<sub>2</sub>] with low penalties in term of plant energy efficiency, capital and operational costs. This paper investigates the most important techno-economical and environmental indicators (e.g. net and gross power output, ancillary power consumption, plant efficiency, specific capital cost investment, operational costs, specific [CO<sub>2</sub>] emissions etc.) for power generation with CCS applied to an IGCC scheme. The coal-based IGCC case study investigated in the paper produces around 400 MW net electricity with 90 [percent] carbon capture rate. Similar power plant schemes without carbon capture step were used as references for comparison.” **Calin-Cristian Cormos, Ana-Maria Cormos, and Paul Serban Agachi**, *Computer Aided Chemical Engineering*, Available online June 12, 2011, doi:10.1016/B978-0-444-54298-4.50114-8, <http://www.sciencedirect.com/science/article/pii/B9780444542984501148>. (Subscription may be required.)

## “CO<sub>2</sub> Sustainable Recovery Network Cluster for Carbon Capture and Sequestration.”

The following is the Abstract of this article: “Sustainable CCS is becoming a transnational goal aiming at reducing global warming effects. Several large European projects focus on developing capture and geological sequestration technologies and sustainable transport networks of dedicated pipelines. This work proposes a model to collect the CO<sub>2</sub> captured in a sustainable cluster of medium range facilities, at close distance from the future input site for the transnational transport networks. The model considers a hyper-structure that involves all viable alternative transport modes as well as all associated CO<sub>2</sub> capture processes. The Eco-indicator 99 methodology is included to perform a life cycle impact assessment (LCIA) allowing the model to achieve individual optimization of economic and environmental objectives or, instead, to optimize both objectives simultaneously by using a weighted sum approach. An illustrative example considers a given input location to gather the CO<sub>2</sub> produced by neighboring medium size facilities, with capture technology selection focused on the producer’s economic /environmental interests. A combination of all possible alternative transports modes (water, train, road and pipeline) is considered for establishing cluster’s routes. Results give the optimized network design and the corresponding environmental damages/impacts. This model can be used either as a decision making tool to test strategies for raising CO<sub>2</sub> capture without aggravating pollution or operational costs, or to perform sensitivity studies on several network parameters.” **J. Duque, A.P.F.D. Barbosa-Póvoa, and A.Q. Novais**, *Computer Aided Chemical Engineering*, Available online June 12, 2011, doi:10.1016/B978-0-444-54298-4.50017-9, <http://www.sciencedirect.com/science/article/pii/B9780444542984500179>. (Subscription may be required.)



# TERRESTRIAL

## “Carbon Sequestration in Soil by in Situ Catalyzed Photo-Oxidative Polymerization of Soil Organic Matter.”

The following is the Abstract of this article: “Here [the authors] describe an innovative mechanism for carbon sequestration in soil by in situ photopolymerization of soil organic matter under biomimetic catalysis. Three different Mediterranean soils were added with a synthetic water-soluble iron-porphyrin, irradiated by solar light, and subjected first to 5 days incubation and, then, 15, and 30 wetting and drying (w/d) cycles. The *in situ* catalyst-assisted photopolymerization of soil organic carbon (SOC) increased water stability of soil aggregates both after 5 days incubation and 15 w/d cycles, but not after 30 w/d cycles. Particle-size distribution of all treated soils confirmed the induced soil physical improvement, by showing a concomitant lower yield of the clay-sized fraction and larger yields of either coarse sand- or fine sand-size fractions, depending on soil texture, though only after [five] days incubation. The gain in soil physical quality was reflected by the shift of OC content from small to large soil aggregates, thereby suggesting that photopolymerization stabilized OC by both chemical and physical processes. A further

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evidence of the carbon sequestration capacity of the photocatalytic treatment was provided by the significant reduction of CO<sub>2</sub> respired by all soils after both incubation and w/d cycles. [The authors'] findings suggest that 'green' catalytic technologies may potentially be the bases for future practices to increase soil carbon stabilization and mitigate CO<sub>2</sub> emissions from arable soils." **Alessandro Piccolo, Riccardo Spaccini, Antonio Nebbioso, and Pierluigi Mazzei**, *Environ. Sci. Technol.*, Available online June 29, 2011, DOI:10.1021/es201572f, <http://pubs.acs.org/doi/abs/10.1021/es201572f>. (Subscription may be required.)

## TRADING

**RGGI News Release, "RGGI States Initiate Bidding Process for September 2011 CO<sub>2</sub> Allowance Auction."**

The states participating in the Regional Greenhouse Gas Initiative (RGGI) released the Auction Notice and application materials for their 13th quarterly CO<sub>2</sub> allowance auction, providing potential participants with information needed to submit a Qualification Application and

indicate their intent to bid. A total of 42,189,685 CO<sub>2</sub> allowances will be offered for sale for the current control period (2009-2011), and 1,864,951 will be offered for the future control period (2012-2014). A reserve price of \$1.89 will be used for all allowances in the auction, which is scheduled for September 7, 2011, three years since the debut of RGGI auctions. RGGI, the Nation's first market-based regulatory program to reduce GHG emissions, has auctioned more than 375 million CO<sub>2</sub> allowances to date. For information on previous auction results, visit: [http://www.rggi.org/market/co2\\_auctions/results](http://www.rggi.org/market/co2_auctions/results). July 12, 2011, [http://www.rggi.org/docs/Auction\\_13%20Notice\\_News\\_Release.pdf](http://www.rggi.org/docs/Auction_13%20Notice_News_Release.pdf).

**ABC Central West NSW, "Australia's First Carbon Trading Pilot Set for Lachlan Valley."**

Approximately 300 farmers in the Canowindra, Cudal, and Manildra areas will be eligible to participate in Australia's first soil carbon trading pilot scheme at Lachlan Valley. Farmers who best demonstrate increases in the amount of CO<sub>2</sub> stored in their soil will be able to bid for funding under the five-year scheme from the Lachlan Catchment Management Authority. The trial is expected to provide a better understanding of how farmers can store CO<sub>2</sub> while still keeping their properties profitable. June 23, 2011, <http://www.abc.net.au/news/stories/2011/06/23/3251073.htm?site=centralwest&section=news>.

## RECENT PUBLICATIONS

**"DOE/NETL Advanced Carbon Dioxide Capture R&D Program: Technology Update."**

The following is from the Introduction of this document: "The purpose of this report is to provide an update on the R&D of advanced CO<sub>2</sub> capture technologies for coal-based power systems being conducted by DOE/NETL. While efforts are focused on capturing CO<sub>2</sub> from the flue gas or synthesis gas (syngas) of coal-based power plants, these capture technologies should be applicable to natural-gas and oil-fired power plants and other industrial CO<sub>2</sub> sources. Intended to be updated annually, the report tracks the progress of DOE/NETL's CO<sub>2</sub> capture related technology developments. DOE/NETL's CO<sub>2</sub> capture R&D program currently funds a broad portfolio of research projects in three primary technology pathways—pre-, post-, and oxy-combustion. Although the majority of the technology options being considered are still in the laboratory- and bench-scale stages of development, a limited number of small pilot-scale field tests have been initiated." For more information, as well as a link to the full Technology Update, visit: <http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/CO2Handbook/>.

**"IEAGHG Storage Research Networks."**

The following is from the Introduction of this document: "The IEA Greenhouse Gas R&D Programme (IEAGHG) published a series of small booklets for GHGT-9 in Washington D.C. in 2008, outlining the activities of its storage based research networks on Wellbore Integrity (WBI), Risk Assessment (RA) and Monitoring. Since then, the range of networks coordinated by IEAGHG has grown to incorporate Modeling of Geological Storage and Social Research as well as the [three] pre-existing networks. The storage based networks that IEAGHG coordinate aim to address various aspects of CO<sub>2</sub> geological storage. The broad aims of the research networks are to provide a platform for the expertise and experience of those [organizations] in the forefront of research, development and demonstration of [GHG] mitigation technologies to come together and share experiences and knowledge, to determine a way forward from research to reality. This brochure will provide a short introduction to each of these storage based research networks, and outline the main achievements of each network over its existence, and the aims for the future." To view the complete IEAGHG report, go to: [http://www.ieaghg.org/docs/General\\_Docs/Publications/IEAGHG\\_Storage\\_Research\\_Networks\\_LR.pdf](http://www.ieaghg.org/docs/General_Docs/Publications/IEAGHG_Storage_Research_Networks_LR.pdf).

**"The Social Cost of Carbon in U.S. Climate Policy."**

The following is from the Introduction of this document: "As the U.S. federal government uses its rulemaking authority to address [GHG] emissions, it is important to understand the social cost of carbon (SCC) and its role within the process. When the federal government considers regulation, many values are at play, and the process engages various expertise including law, climate science, engineering, economics, and public policy as well as reaching out to consider the views of stakeholders. SCC provides a dollar figure, or range of dollar figures, that estimate the value of social benefits accrued by acting to reduce climate change. Because of the internal government process for

## RECENT PUBLICATIONS (CONTINUED)

evaluating proposed regulations, the SCC dollar figure, which is a tool devised by economists, can have significant impacts on decision makers if they approach regulation from the point of view that the cost per tonne to curb CO<sub>2</sub> should not be greater than its presumed effectiveness in achieving the result. The SCC value can also be misused if the limitations and caveats inherent in its estimation are not considered.” The complete World Resources Institute (WRI) Policy Brief is available at: [http://pdf.wri.org/more\\_than\\_meets\\_the\\_eye\\_social\\_cost\\_of\\_carbon.pdf](http://pdf.wri.org/more_than_meets_the_eye_social_cost_of_carbon.pdf).

## LEGISLATIVE ACTIVITY

### *Reuters*, “German Parliament Set to Okay Clean Coal Bill.”

As of July 7, 2011, Germany’s lower house was considering the passage of legislation that would provide EU funding for clean coal

technologies. The bill lays the foundation for testing and demonstration efforts only; broader funding opportunities would be subject to consultation with local residents. Vattenfall Europe applied for EU funding for a pilot plant in the Brandenburg region. Germany has committed to reducing its carbon footprint by 40 percent in 2020 compared to 1990 levels. July 7, 2011, <http://www.reuters.com/article/2011/07/07/us-germany-coal-idUSTRE7663ZY20110707>.



## EVENTS

August 17-19, 2011, **COAL-GEN**, *Greater Columbus Convention Center, Columbus, Ohio, USA*. Covering the latest topics affecting the design, development, upgrading, operation, and maintenance of coal-fired power plants, COAL-GEN is the industry’s largest event focused on the present and future of coal-fired generation. Visit the conference website at: <http://www.coal-gen.com/index.html>.

August 22-26, 2011, **NETL CO<sub>2</sub> Capture Technology Meeting**, *Sheraton Station Square Hotel, Pittsburgh, Pennsylvania, USA*. This conference will present CO<sub>2</sub> capture technology developments and accomplishments made under NETL’s Innovations for Existing Plants (IEP), Carbon Sequestration, and Demonstration Programs. Topics to be discussed include post-, oxy-, and pre-combustion carbon capture, as well as chemical looping and CO<sub>2</sub> compression technologies. For more information, click: <http://www.netl.doe.gov/events/11conferences/co2capture/>.

September 12-15, 2011, **2011 International Pittsburgh Coal Conference**, *David L. Lawrence Convention Center, Pittsburgh, Pennsylvania, USA*. This conference will feature technical and business discussions about major clean coal technology demonstration projects. In addition, three business sessions are offered that cover financing CCS and other clean coal technologies, investing in energy and power, and insurance and risk management strategies. For more information, go to: <http://www.engr.pitt.edu/pcc/>.

October 9-11, 2011, **Reservoir Characterization and Simulation Conference and Exhibition**, *Beach Rotana Hotel, Abu Dhabi, UAE*. SPE is hosting the third edition of the Reservoir Characterization and Simulation Conference and Exhibition (RCSC), focusing on reservoir applications and different technologies for characterizing, modeling, and simulating reservoir characteristics. To learn more, visit: <http://www.spe.org/events/rcsc/2011/>.

October 9-14, 2011, **CO<sub>2</sub> Storage: Will we be ready in time?**, *The Algarve, Portugal*. This forum, designed for professionals in the oil and gas, power, and alternative energy industries who focus on CCS schemes, will address the opportunities and challenges related to the development of CO<sub>2</sub> geologic storage activities that would be several orders of magnitude larger than current demonstration projects. For more information, visit: <http://www.spe.org/events/11fse3/pages/about/index.php>.



## EVENTS (CONTINUED)

October 19-20, 2011, **Carbon Capture and Storage – The Leading Edge**, *London, United Kingdom*. This Institution of Mechanical Engineers seminar will discuss carbon capture technology and the implications across the regulatory, financial, and process technology fields. The following areas will also be covered: properties of CO<sub>2</sub>, European Union competition, and front-end engineering design (FEED) case studies. Seminar details are located at: <http://events.imeche.org/EventLocation.aspx?EventID=1204>.

October 20-21, 2011, **The Carbon Show 2011, Business Design Center**, *London, England*. This conference offers a program dedicated to the following topics: climate finance, CRC energy efficiency scheme, carbon management, and green technology and renewables. Industry experts will share best practices and offer attendees the opportunity to debate and discuss carbon and carbon market developments. Conference details are available at: <http://www.thecarbonshow.com>.

November 15-16, 2011, **Low-Carbon Energy Technologies: Innovations in Efficiency and Greenhouse Gas Reduction Science and Technology Seminar**, *Southwest Research Institute, San Antonio, Texas, USA*. This seminar will focus on alternative energy technologies, carbon reduction through improvements in efficiency, and carbon conversion and storage. Topics include: efficiency improvements to reduce carbon footprint, alternative power (wind, solar, and energy storage), low-carbon emission power plant cycles, CO<sub>2</sub> compression and storage, and CO<sub>2</sub> conversion and utilization. For more information, go to: <http://www.swri.org/mailler/Div18/2011/IndLectureFlyr-4.pdf>.

November 15-17, 2011, **DOE's Carbon Storage Program Infrastructure Annual Review Meeting**, *Sheraton Station Square, Pittsburgh, Pennsylvania, USA*. This meeting highlights DOE's carbon storage infrastructure projects, which include the efforts of DOE's RCSPs; however, it is now expanding to include other U.S. and international projects that are working to characterize storage capacity through exploration and injection operations. For more information, go to: <http://www.netl.doe.gov/events/>.

## FOR SUBSCRIPTION DETAILS...

Please visit <http://listserv.netl.doe.gov/mailman/listinfo/sequestration>, enter your email address, and create a password. This will enable you to receive a pdf version of the Carbon Sequestration Newsletter at no cost.

To view an archive with past issues of the newsletter, see: [http://www.netl.doe.gov/technologies/carbon\\_seq/refshelf/subscribe.html](http://www.netl.doe.gov/technologies/carbon_seq/refshelf/subscribe.html).

To learn more about DOE's Carbon Sequestration Program, please contact John Litynski at [john.litynski@netl.doe.gov](mailto:john.litynski@netl.doe.gov), or Dawn Deel at [dawn.deel@netl.doe.gov](mailto:dawn.deel@netl.doe.gov).