

THE CARBON SEQUESTRATION NEWSLETTER

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Sequestration in the News

The Korea Times, "U.S. Supports Korea's Entry to Climate Change Leadership Forum." According to the Korean Ministry of Commerce, Industry and Energy (MOCIE), the U.S. government will support Korea's decision to join the Carbon Sequestration Leadership Forum (CSLF). The support was expressed in a meeting between MOCIE Minister Lee Hee-beom and U.S. Energy Secretary Samuel Bodman in Washington, DC. "Both ministers have agreed to boost cooperation in the energy sector, especially in the development of new and renewable energy. May 20, 2005, <http://times.hankooki.com/lpage/biz/200505/kt2005052020021611880.htm>

I-Newswire.com, "DOE Celebrates Success of Regional Carbon Sequestration Partnerships." Highlights the Phase I Accomplishments document that NETL released at the Fourth Annual Conference on Carbon Sequestration. May 3, 2005, <http://i-newswire.com/pr18288.html>.

Canadian NewsWire, "Government of Canada Boosts Research into CO2 Storage and Monitoring." The Government of Canada announced the second phase of the Weyburn project with additional funding of \$6.75 million. "This project has shown us the enormous potential of permanently storing CO2 underground to reduce greenhouse gas emissions from fossil fuels," said Ralph Goodale, Minister of Finance. The final phase will broaden the scope of the project by providing information to public policy-makers to allow them to define regulatory frameworks. May 25, 2005, <http://www.newswire.ca/en/releases/archive/May2005/25/c3439.html>

Sunday Telegraph, "Greenhouse gases buried at sea." Sets forth BP's plans to pursue CO2 enhanced oil recovery (EOR) in the North Sea and focuses on the potential project at the Miller field off the north coast of Scotland, which uses Peterhead natural gas-fired power station near Aberdeen as the proposed CO2 source. The natural gas feedstock would be gasified to hydrogen and CO2. The hydrogen would replace the gas used to fuel the power station, while the CO2 would be separated, liquefied, and pumped out to the Miller field. The article discusses hurdles such as cost, leakage, and legal issues. May 1, 2005, <http://www.wbcsd.org/plugins/DocSearch/details.asp?type=DocDet&ObjectId=14517>

CNN, "Storage proposal for carbon emissions." Article relates opinions from both proponents of geologic sequestration and skeptics, citing the rumored CO2 EOR project at the BP-owned Miller field off the north coast of Scotland. On the proponent side is Professor Stuart Haszeldine, a geologist at Edinburgh University. "We need to decarbonize our energy and we can do that by capturing the carbon dioxide and burying it deep in the ground," Haszeldine said. Greenpeace spokesman Paul Johnston was on the skeptical side. "What we are talking about is engineering solutions on a planetary scale and there are a huge number of uncertainties that need to be resolved before we go that way," said Johnston. May 16, 2005, <http://www.cnn.com/2005/TECH/05/12/vision.carbonstorage/index.html>

New York Times, "Dirty Secret: Coal Plants Could Be Much Cleaner." Article discusses integrated coal gasification combined cycle (IGCC) technology. No new IGCC power plants have been built in the U.S. since the Tampa Electric plant was commissioned nearly a decade ago, and nine out of ten coal-fired power plants in the planning stages will use combustion technology. The National Commission on Energy Policy, an independent, bipartisan advisory body, has recommended that the federal government spend an additional \$4 billion over 10 years to speed the power industry's acceptance of IGCC technology. In a recent report, the commission concluded that "the future of coal and the success of greenhouse gas mitigation policies may well hinge to a large extent on whether this technology can be successfully commercialized and deployed over the next 20 years." Edward Lowe, general manager of gasification for GE Energy, estimated that capturing carbon would add about 25 percent to the cost of electricity from a combined-cycle plant burning gasified coal, but that it would add 70 percent to the price of power from conventional plants. May 22, 2005, <http://forests.org/articles/reader.asp?linkid=42074>

Financial Times, "Cleaner coal could have role to play in cutting carbon emissions." According to a report by Mitsui Babcock reducing emissions by retro-fitting existing coal-fired power stations with more efficient technology would be less expensive than using gas, and might be cheaper than wind turbines. Says Les King, director of technology and engineering at Mitsui Babcock, "Retro-fitting a 600MW coal power station would save 470,000 tonnes of carbon dioxide a year at a cost of £116m." May 16, 2005, <http://www.wbcsd.ch/plugins/DocSearch/details.asp?type=DocDet&ObjectId=MTQ2MzA>

TriCities.com, "Perceptions, global warming and coal." Article covers the annual Eastern Coal Council conference where the predominant theme was that coal's poor public perception, coupled with worries about global warming, threaten the industry's newfound prosperity. "Many Americans believe the technology already exists to burn coal without releasing pollutants into the atmosphere but that utility companies won't pay for it," said Steve Miller, head of the Center for Energy and Economic Development. Polls show that most American 50-year-olds don't know anything about coal's uses, he said. When asked to venture a guess, most answer that coal powers locomotives. "You are not communicating your vision," Miller told coal producers. May 25, 2005, http://www.tricity.com/servlet/Satellite?pagename=TRI%2FMSGArticle%2FTRI_BasicArticle&c=MGArticle&cid=1031782907567

New Scientist, "Squeaky clean fossil fuels." Article summarizes CO2 capture and geologic sequestration and relates the EU's embracing of it as a climate mitigation option. Discusses EOR and ECBM as value-added options with private sector interest. April 30, 2005, <http://www.newscientist.com/channel/earth/climate-change/mg18624976.500>

Reuters, "Vattenfall Plans CO2-Free Power Plant in Germany." Swedish power group Vattenfall announced plans to spend 40 million euros (\$51.4 million) building an oxyfuel-based brown coal conversion facility in Germany. Klaus Rauscher, chief executive of Vattenfall Europe said the company was breaking new ground. "Nobody in the world has yet realized this kind of power station process," he told reporters. "We're the first here." State-owned Vattenfall said the plant would be built near Spremberg, southeast of Berlin, and be ready for operation in 2008 with a fuel output of 30 megawatts. The pilot will not produce electricity, only heat used by the plant itself. If the plant meets its targets, Vattenfall said it would then go on to build a demonstration station. The plant will exhaust a highly pure stream of CO₂ which is to be stored underground. A decision on a specific geologic formation in which to store the CO₂ has not yet been made. May 20, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsid/30899/story.htm>

Announcements

Funding Opportunity Announcement for capture technologies. On April 28, 2005 DOE/NETL announced funding opportunity DE-PS26-05NT42464 entitled "Oxycombustion and Other CO₂ Capture Technologies Available for Application to the Existing Coal Fired Power Generation Fleet." Application Due Date is June 30, 2005. For additional information visit <http://www.fedgrants.gov/Applicants/DOE/PAM/HQ/DE-PS26-05NT42464/Grant.html>

Request for Carbon Offset Projects. The Climate Trust is pleased to announce the release of its 2005 Request for Carbon Offset Projects (RFP). The Trust encourages project developers with high-quality carbon offset projects to submit a project application. The Trust is interested in offsets from most project sectors. For information on how to apply, please visit http://www.climatetrust.org/solicitations_2005_RFP.php. Initial proposals are due August 24, 2005.

Summer Research Program Opportunity. RECS, Research Experience in Carbon Sequestration is a first-of-its-kind, high-level summer research program on carbon sequestration. It is designed to engage undergraduates, graduates and early career professionals in carbon sequestration science through hands-on field work and data analysis with leading U.S. scientists. RECS will be held July 17-30, 2005 in Santa Fe, NM and the program is seeking between 20-30 applicants. Cost for the program is \$500 which includes meals and lodging. **Applications must be received on or before June 1, 2005.** For more information and application forms, see <http://recs.lanl.gov/index.shtml>

Opportunity to Sponsor Teachers for Climate Change Training. In October 2005, The Keystone Center and NETL will host a second training session for the interdisciplinary middle school climate change curriculum-which highlights sequestration technologies. If you are interested in sponsoring a teacher from your area, please contact Brooke Carson, Keystone's director of teacher training at bcarson@keystone.org or (970) 513-5843. More information about the curriculum can be found at <http://www.keystonecurriculum.org/> or by reading the recent Techline at http://www.netl.doe.gov/publications/press/2004/tl_climate_curriculum.html

"AEP Honored With EPA 2005 Climate Protection Award." American Electric Power was recognized by the U.S. Environmental Protection Agency with a 2005 Climate Protection Award for demonstrating ingenuity, leadership, and public purpose in its efforts to reduce greenhouse gases. "We are very proud that our long-term efforts to serve as a leader in our industry on this issue are being recognized by the U.S. EPA," said AEP Chairman, President and CEO Michael Morris. *Yahoo*, May 4, 2005, <http://biz.yahoo.com/pnews/050504/clw035.html?v=10>

Guidelines for Voluntary Reporting of GHGs comment period extended. DOE has extended the period for public comment on the Interim Final General Guidelines and Draft Technical Guidelines for the Voluntary Reporting of Greenhouse Gases [1605 (b)] Program by 30 days, to June 22, 2005. This extension may cause DOE to extend the scheduled effective date of the guidelines beyond September 30, but a decision on such an extension will not be made until this summer. A Federal Register Notice officially extending the comment period was published on Monday, May 9. In addition, DOE has posted on its website the transcript of its April 26/27 public workshop on the 1605(b) guidelines, along with files containing the slide presentations used during the workshop and a list of participants. The draft Technical Guidelines are available at the following website: <http://www.pi.energy.gov/enhancingGHGregistry/>

"New Global Standard Linking Climate Change, Biodiversity, and Sustainable Development Launched." Standards certifying land-use projects that reduce global warming while helping communities and conserving biodiversity were launched at the 2005 Carbon Expo in Cologne Germany. The Climate, Community & Biodiversity Project Design Standards (CCB Standards) evaluate land-based carbon mitigation projects in the early stages of development, and foster the integration of best-practice and multiple-benefit approaches into project design. *CCB Standards*, May 11, 2005, http://climate-standards.org/news/news_may2005_launch.html

Science

"Earth Has Become Brighter, but No One Is Sure Why." Reversing a decades-long trend toward "global dimming," Earth's surface has become brighter since 1990 scientists report in the May 6 issue of *Science*. By "brighter" it is meant that more of the sun's rays are getting through the atmosphere and warming the planet's surface. It is generally thought that air pollution dimmed the planet in previous decades. Some scientists say that the dimming and the brightening might explain why for many years temperatures on Earth lagged what was predicted by many climate models and then shot upward more recently. "I think what could have happened is the dimming between the 60's and 80's counteracted the greenhouse effect," says Dr. Martin Wild, a climatologist at the Swiss Federal Institute of Technology in Zurich. "When the dimming faded, the effects of the greenhouse gases became more evident. There is no masking by the dimming anymore." *New York Times*, May 6, 2005, <http://www.climateark.org/articles/reader.asp?linkid=41553>. Also see "Clear skies end global dimming," *news @ nature*, May 5, 2005, <http://www.nature.com/news/2005/050502/full/050502-8.html>; and "Global Warming's Link to Clearer Skies on Earth," *Day to Day, NPR*, May 9, 2005, <http://www.npr.org/templates/story/story.php?storyId=4636777> [audio]

"Microbes blamed for global warming boost." About one third of the world's soil carbon is located in high latitudes such as the Arctic, and much of this effectively locked away in recalcitrant stores. Recent experiments indicate that microbes with ability to break down the recalcitrant carbon thrive in warmer temperatures. It is postulated that as the Earth warms over the coming decades, the warm-temperatures microbes could cause the release of arctic carbon into the atmosphere in a positive feedback mechanism that could accelerate global warming. Says co-author Andreas Richter who works at the Institute of Ecology and Conservation Biology at the University of Vienna, Austria, "It may be that the whole idea of resistant carbon compounds in arctic soils may only be relevant within a cool world and have no place in a future warmer world." *SciScoop*, May 09, 2005, <http://www.sciscoop.com/story/2005/5/8/4389/44267>. For the original article, see "Temperature-dependent shift from labile to recalcitrant carbon sources of arctic heterotrophs," *Rapid Communications in Mass Spectrometry*, May 9, 2005, <http://www3.interscience.wiley.com/cgi-bin/abstract/110489996/ABSTRACT>

"Warming Is Blamed for Antarctica's Weight Gain." The eastern half of Antarctica is gaining more than 45 billion tons a year in snow and ice, according to a new scientific study. The finding matches expectations that the earth's warming temperatures would increase the amount of moisture in the air and lead to greater snowfall over Antarctica. *New York Times*, May 20, 2005, <http://www.wbcsd.org/plugins/DocSearch/details.asp?type=DocDet&ObjectId=MTQ2OTk>. Also, see "East Antarctica puts on weight," *news @ nature*, May 19, 2005, <http://www.nature.com/news/2005/050516/full/050516-10.html>

Mapping Methane from Space. Researchers have used satellite technology to measure the absorption of sunlight in the atmosphere and thus estimate the magnitude and location of methane emissions worldwide. In general the results confirm rice and cattle farming as important emissions sources, along with the production of fossil fuels in the industrialized Yellow River basin in China. There were a few discrepancies between the satellite measurements and estimates from methane emissions models. The measurements for India were lower than those in the model – which the authors attribute to the model's overestimation of emissions from rice cultivation. Over the tropics, however, the measurements were higher than expected. The authors suggest these extra emissions could be coming from plants in rain forests, and that tropical winds disperse the methane and prevent ocean outposts that monitor these emissions from picking up the total emissions. "Assessing Methane Emissions from Global Space-Borne Observations," *Science*, May 13, 2005, <http://www.sciencemag.org/content/vol308/issue5724/index.shtml> (subscription required)

Policy

"U.S. energy chief wants global push for 'clean coal'." Speaking on the second day of an International Energy Agency ministerial in Paris, U.S. Energy Secretary Sam Bodman called for more international efforts to develop coal as an alternative energy source, and said IEA should be "more proactive" in promoting the development of clean coal technologies. Wider use of coal, Bodman said, would "help relieve some of the pressure on oil markets and natural gas markets." *Associated Press*, May 3, 2005, <http://www.wbcsd.org/plugins/DocSearch/details.asp?type=DocDet&ObjectId=14549>

"U.S. Doubts New Kyoto Climate Deal after 2012." "It's not clear that there's going to be a Kyoto effort beyond 2012," Harlan Watson, U.S. senior climate negotiator, told *Reuters* on the second day of a two-day 190-nation seminar on ways to renew Kyoto beyond a first period running to 2012. "It's going to be very difficult" to renew Kyoto, he said, adding there was such a wide range of views among participants on tackling global warming that it would be difficult for them to reach any consensus beyond 2012. *Reuters*, May 18, 2005, <http://www.climateark.org/articles/reader.asp?linkid=41933>

"Exelon: We'll cut greenhouse gas emissions." Exelon Corp. announced that it will voluntarily cut its greenhouse gas emissions by the end of 2008. The company, the corporate parent of Commonwealth Edison and other utilities, said its goal is to emit 8 percent less greenhouse gases than it did in 2001. That would be 1.3 million metric tons less than the 16 million Exelon generated four years ago. "We accept that limitations on greenhouse gases emissions will prove necessary," said Chief Executive John Rowe. According to Exelon, much of the reduction in greenhouse gases would come from increased use of wind power, dams, and methane from landfills to generate electricity. The company also has a tree-planting program in the works and plans to initiate an aggressive internal energy efficiency program to cut emissions by 25 percent. *Chicago Tribune*, May 7, 2005, <http://www.wbcsd.org/plugins/DocSearch/details.asp?type=DocDet&ObjectId=14571>

"132 Mayors of U.S. cities Embrace GHG Emissions Reductions." Seattle Mayor Greg Nickels says 131 other likeminded mayors have joined a bipartisan coalition to fight global warming on the local level. The mayors, from cities as liberal as Los Angeles and as conservative as Hurst, Texas, are pledging to have their cities reduce heat-trapping gas emissions to levels 7 percent below those of 1990, by 2012. *New York Times*, May 14, 2005, <http://www.climateark.org/articles/reader.asp?linkid=41794>

"GE calls for clear U.S. climate policy." General Electric CEO Jeff Immelt called for the U.S. to develop a clear policy on issues such as climate and renewable energy. Immelt announced a pledge to cut GE emissions of greenhouse gases by 1 percent by 2012, and improve its energy efficiency by 30 percent. In his speech, Mr. Immelt cited the importance of establishing carbon dioxide emission targets and employing market mechanisms in order to spur innovation to meet our environmental and economic goals. Said Sen. John McCain, "Those are precisely the principles behind the Climate Stewardship Act that Senator Joe Lieberman and I introduced." *Point Carbon*, May 10, 2005, <http://www.pointcarbon.com/article.php?articleID=8243&categoryID=703>. Also, see "It Was Just My Ecomagination: GE kicks off ambitious green initiative," *Grist Magazine*, May 10, 2005, <http://www.grist.org/news/muck/2005/05/10/little-ge/>; "G.E. Chief Urges U.S. to Adopt Clearer Energy Policy," *The New York Times*, May 10, 2005, <http://www.climateark.org/articles/reader.asp?linkid=41633>; and "Mega-corporation takes sides on global warming," *The Cincinnati Post*, <http://news.cincypost.com/apps/pbcs.dll/article?AID=/20050511/BIZ/505110335/1001>

EPA's Climate Leaders Program Announces New Commitments. With ten new companies making commitments, 37 of the 68 companies in Climate Leaders have set GHG emissions reduction goals. EPA estimates that the 37 Climate Leaders' greenhouse gas reductions will prevent more than 8 million metric tons of carbon emissions equivalent per year. Since its inception in 2002, Climate Leaders has grown to include 68 corporations whose U.S. emissions represent 8 percent of total U.S. greenhouse gas emissions. "Ten U.S. Corporations Pledge Greenhouse Gas Cuts," *GreenBiz.com*, May 12, 2005, http://www.greenbiz.com/news/news_third.cfm?NewsID=28063

"Corporate movement on global warming gains steam with GE, J.P. Morgan plans." Article highlights the slew of recent proposals to address global warming at state pension funds, major banks, and top corporations. Discusses some of the factors motivating companies outside the utility sector to address greenhouse gas emissions, whether it is new business opportunities or regulatory certainty. Article also mentions shareholder influence as a primary driver and addresses the strategic implications of adopting carbon restrictions. *Greenwire*, May 11, 2005, <http://www.wbcsd.org/plugins/DocSearch/details.asp?type=DocDet&ObjectId=14601>

"New York follows California on greenhouse gases." New York Governor George Pataki said his state would introduce the same legislation on greenhouse gases from vehicles later this year as California did in 2004. It is estimated that the legislation will reduce greenhouse gas emissions by the equivalent of nearly 14.9 million tonnes of CO₂ in 2020, and 26.3 million tonnes in 2030, according to *The Associated Press*. *Point Carbon*, May 9, 2005, <http://www.pointcarbon.com/article.php?articleID=8453&categoryID=878>

“Washington State adopts California’s stringent emission rules.” Washington state officials have approved legislation adopting California’s tougher emission standards, including future caps on greenhouse gas emissions. Washington Gov. Christine Gregoire signed the legislation May 6, saying it would produce cleaner air and reduce gasoline use by requiring that cars and light trucks sold in the state in the future meet stricter auto exhaust standards. *Waste News*, May 10, 2005, <http://www.wastenews.com/headlines2.html?id=1115731696>

“New Zealanders to pay global warming tax.” The New Zealander government has announced a greenhouse gas emissions tax of \$NZ11 a tonne of carbon emitted. The tax will come into effect in two years. The New Zealand law, which is expected to add about 6 percent to household energy bills and 9 percent to most business bills, is different than incentives put in place by other countries in that consumers will pay directly. “If we are going to tackle climate change,” says Pete Hodgson the New Zealand minister responsible for climate change technology, “we need to start taking environmental costs into account in the economic choices we make.” *Guardian*, May 6, 2005, <http://www.theage.com.au/news/World/New-Zealanders-to-pay-global-warming-tax/2005/05/05/1115092623162.html?oneclick=true>

“China wants U.S. energy technology cooperation.” The United States and China must cooperate to find high-tech ways to use coal, wind, and other energy sources to allay future energy shortages, officials from the world’s top two oil users say. In the future, China, the world’s seventh-largest economy, will take steps to boost domestic supplies, said Xingshan Li, dean of studies at China’s Central Committee Party School, which trains top and middle-ranking party officials. Li and other officials from the school called for U.S.-Chinese cooperation on technology such as clean-burning coal plants, wind farms, solar, and biomass. *Reuters*, May 10, 2005, http://www.reuters.co.in/locales/c_newsArticle.jsp;:427fdb85:1f81476b8987115d?type=businessNews&localeKey=en_IN&storyID=8431556

Geology

“Sequestration of Carbon Dioxide in Coal with Enhanced Coalbed Methane Recovery: A Review.” This review focuses on geologic sequestration of CO₂ in unmineable coalbeds as the geologic host. The review topics include (1) the estimated CO₂ storage capacity of coal; (2) an evaluation of the coal seam properties relevant to CO₂ sequestration; (3) a treatment of how CBM recovery and CO₂-ECBM recovery are performed; (4) leak detection using direct measurements, chemical tracers, and seismic monitoring; (5) economic considerations using CO₂ injection, flue gas injection, and predictive tools for CO₂ capture/sequestration decisions; (6) environmental safety and health aspects of CO₂-enhanced coalbed methane/sequestration, hydrodynamic flow through the coal seam, accurate gas inventory, ES&H aspects of produced water and practices relative to ECBM recovery/sequestration; (7) an initial set of working hypotheses concerning the chemical, physical, and thermodynamic events initiated when CO₂ is injected into a coalbed; and (8) a discussion of gaps in our knowledge base that will require further research and development. *Energy & Fuels*, Vol. 19, No. 3 (May 18, 2005) 659-724, <http://pubs.acs.org/cgi-bin/abstract.cgi/enfuem/2005/19/i03/abs/ef040047w.html>

“Underground sequestration of carbon dioxide – a viable greenhouse gas mitigation option.” Underground storage of industrial quantities of carbon dioxide in porous and permeable reservoir rocks has been taking place since 1996 at the Sleipner West gas field in the North Sea. Some of the major issues that must be addressed if this technology is to spread to industrial plant such as power stations, and thus make an impact on global CO₂ emissions, are cost of CO₂ capture, demonstration of safety and security of storage and public acceptability. *Energy* (2005) Volume 30, Issues 11-12, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

Technology

Method for extracting and sequestering carbon dioxide. Ken Caldeira (LLNL) and Greg Rau (UC Santa Cruz) were awarded a patent for a wet-limestone flue gas scrubbing method for CO₂ mitigation. According to the patent holders, the spontaneous reaction of CO₂, water, and calcium carbonate to form calcium bicarbonate in solution presents a simple, safe, low-cost means of stripping CO₂ out of flue gas for subsequent ocean or underground aquifer storage as bicarbonate. The storage of the carbon as bicarbonate (rather than molecular CO₂) avoids the significant pH depression associated with CO₂ addition to the ocean, and substantially reduces the CO₂ leakage potential from marine or underground reservoirs. This form of mitigation is best suited to mitigating CO₂ sources that are in close proximity to limestone and water (e.g., coastal power plants, or sources with access to saline aquifers). *United States Patent 6,890,497*, May 10, 2005, http://portal.uspto.gov/external/portal/lut/pl_s.7_0_A/7_0_CH/cmd/ad/ar/sa.getBib/c/6_0_69/ce/7_0_1ET/p/5_0_18L/d/3#7_0_1ET

“Adsorption of CO₂ on Zeolites at Moderate Temperatures.” Article investigates Zeolite sorbents for use in pressure swing adsorption (PSA) and temperature swing adsorption (TSA) for removing carbon dioxide at moderate or high temperatures from high-pressure fuel gas streams (such as those from IGCC systems). Competitive gas adsorption tests with gas mixtures representing both coal combustion and coal gasification gas streams were conducted in an atmospheric flow reactor with five zeolites at 120 °C. Promising results of preferential adsorption of CO₂ were observed with two of these zeolites. However, the CO₂ adsorption capacity was significantly lower at 120 °C than at ambient temperature. Volumetric gas adsorption tests of CO₂ and nitrogen on these two zeolites were conducted at 120 °C, up to a pressure of 300 psi. Both showed high CO₂ adsorption capacity at high pressure. High-pressure flow reactor studies also indicated the preferential adsorption of CO₂ from gas mixtures at 120 °C. *Energy & Fuels* (May 18, 2005) 19, 1153-1159, <http://pubs.acs.org/cgi-bin/abstract.cgi/enfuem/2005/19/i03/abs/ef040059h.html>

“The mix master.” Article highlights “eco-cement,” invented by John Harrison, an Australian businessman. Harrison says he was inspired by nature’s method of dealing with carbon in the atmosphere- it’s stored away in solid forms such as limestone, coal, and trees. Harrison says it has the capacity to transform our city streets into a massive greenhouse-gas repository. “Putting carbon into building materials makes a lot of sense,” Harrison says. The sinks aren’t presently there for the carbon we’re putting into the air, so we have to think about sequestration on a massive scale. “There is a huge carbon sink waiting to happen in the built environment.” Eco-cement is a composite of magnesite (a magnesium compound), recycled industrial waste, and ordinary cement. As it sets and hardens, it absorbs carbon dioxide from the atmosphere and converts it to carbonate. *The Age*, May 22, 2005, <http://www.theage.com.au/news/Business/The-mix-master/2005/05/21/1116533577851.html?oneclick=true>

“Texas landowner perceptions regarding ecosystem services and cost-sharing land management programs.” A mail survey was conducted in 2003 in the Western Edwards Aquifer area of Texas to assess landowner perceptions regarding the supply of ecological services – including watershed functions, wildlife habitat, and carbon sequestration – from rangelands and their willingness to participate in various land management programs aimed at enhancing such services, which are receiving increasing public consideration. In general, landowners favorably viewed programs that would reduce woody plant (brush) cover in an effort to increase water yields or to improve wildlife habitat, but they disapproved of programs that would encourage the proliferation of woody plants in an attempt to increase atmospheric carbon sequestration. *Ecological Economics*, 53 (April 15, 2005) 247–260, <http://www.sciencedirect.com/science/journal/09218009> (subscription required)

“Entergy to Expand Tensas River National Wildlife Refuge.” In an effort to improve relations with the conservation community, Entergy is adding 29-hundred acres to help restore the refuge. Entergy invested up to 1.5 million dollars to help acquire, reforest and manage the new 2,900 acre tract. The reforestation effort will help offset the company's power plant emissions. “It's called ‘Carbon Sequestration’... a way of storing carbon in natural ecosystems. In other words, keeping the carbon in trees instead of in the atmosphere,” says Brent Dorsey, the Director of Entergy's Corporate Environment Program. “Over the next 70 years we expect about 800 thousand tons of CO₂ to be sequestered or captured by the growing trees and turned into carbon that will be on the ground,” said Dorsey. *MSNBC*, May 24, 2005, <http://msnbc.msn.com/id/7957353/>

“Creating Carbon Offsets in Agriculture Through No-Till Cultivation: A Meta-Analysis of Costs and Carbon Benefits.” Terrestrial carbon sinks are often seen as a low-cost alternative to fuel switching and reduced fossil fuel use for lowering atmospheric CO₂. To determine whether this is true for agriculture, one meta-regression analysis examines the costs of switching from conventional tillage to no-till, while another compares carbon accumulation under the two practices. Costs per ton of carbon uptake are determined by combining the two results. The viability of agricultural carbon sinks is found to vary by region and crop, with no-till representing a low-cost option in some regions (costs of less than \$10 per tC), but a high-cost option in others (costs of 100-\$400 per tC). *Climatic Change* (2005) 68: 41–65, <http://www.ingentaconnect.com/content/klu/clim/2005/00000068/F0020001/00006010;jsessionid=19bdd4waske0f.henrietta> (subscription required)

“Nitrogen Cycling and the Spread of Shrubs Control Changes in the Carbon Balance of Arctic Tundra Ecosystems.” Climate warming may result in carbon loss by accelerating the decomposition of soil organic matter (SOM). Nitrogen release from SOM may also enhance plant growth, which is limited by N availability in tundra ecosystems. Since N acquisition varies by plant species, changes in plant community composition resulting from climate change may alter carbon cycling in tundra soils. Shrubs are growing in predominance in tundra communities in response to warming. Since they are the woodiest plants in the tundra, this may increase ecosystem C storage, because wood has the highest C:N ratio of any plant tissue and decomposes slowly. *BioScience* (May 2005) Vol. 55, No. 5, <http://www.bioone.org/bioone/?request=get-abstract&issn=0006-3568&volume=055&issue=05&page=0408> (subscription required)

“Study of liquid CO₂ droplet formation under simulated mid-depth ocean conditions.” An international field experiment at an open ocean site is being planned to investigate the dispersion, dissolution, and transport phenomena of CO₂ ocean sequestration. To support this effort, complementary laboratory experiments are being pursued to examine CO₂ droplet formation processes and to calibrate and to assess the performance of injector designs that will be used in the field experiment. Some of these complementary experiments are reported in this paper and were carried out in laboratory facilities that can simulate conditions in the deep ocean. Liquid CO₂ was injected through a variety of removable, single, and multiple orifice injectors mounted in pressure vessels filled with salt water. Injection velocity was varied and measurements of the resulting droplets were performed. Tests also were conducted to address operational concerns about possible hydrate blockage of injector orifices and the submerged CO₂ conduit during system start-up and shutdown. *Energy* (2005) Volume 30, Issues 11-12, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

“Ireland faces big chill as ocean current slows.” Climate change researchers have detected the first signs of a slowdown in the Gulf Stream. They have found that one of the “engines” driving the Gulf Stream – the sinking of supercooled water in the Greenland Sea – has weakened to less than a quarter of its former strength. The weakening, apparently caused by global warming, could herald big changes in the current over the next few years or decades. Paradoxically, it could lead to Ireland, Britain, and northwestern Europe undergoing a sharp drop in temperatures. *The Sunday Times* (Ireland), May 8, 2005, <http://www.oceanconserve.info/articles/reader.asp?linkid=41590>

North Sea species are moving towards the Arctic to dodge climate change. Fish are shifting their homes northwards, according to an analysis of North Sea populations. The authors warn that climate change is probably to blame for the move, which could drive some commercially fished species out of the sea completely. Allison Perry of the University of East Anglia in Norwich, UK, and her colleagues looked at data for 36 species of fish that live near the bottom of the North Sea. Between 1962 and 2001, the North Sea warmed by about 0.6 °C. The team found that, in response, 15 species had shifted as much as 400 kilometers into cooler waters. A further six species had moved into deeper waters in their search for cooler living conditions. “Fish get hooked on cooler waters,” *news @ nature.com*, May 12, 2005, <http://www.nature.com/news/2005/050509/full/050509-11.html>

Trading

“State and Trends of the Carbon Market.” Prepared by the World Bank Carbon Finance Business and the International Emissions Trading Association, this report provides an overview of the activity on the emerging carbon markets as of May 2005. It covers JI, CDM, and other project-based transactions, as well as allowance markets, most notably the EU ETS. The report can be accessed directly at <http://carbonfinance.org/Router.cfm?Page=DocLib&Dtype=28&ActionType=ListItems>

“Greenhouse gas trade growing sharply-World Bank.” According to a World Bank study, trade in carbon dioxide permits surged this year. Dealing volumes in the first three months of 2005 were 3.5 times higher than in the whole of last year. This year's growth comes after a five-fold increase in 2004, the study showed. “The carbon market is responding to the ratification of the Kyoto Protocol and to the beginning of operation of the European Union's emissions trading scheme,” World Bank economist Franck Lecocq said on presentation of the study during a carbon trade fair in Cologne. “Further growth was extremely likely in the coming years,” he said. *Reuters*, May 11, 2005, <http://www.reuters.com/newsArticle.jhtml?type=scienceNews&storyID=8457415>

"European Emissions Trade Takes Off as World Watches."

Article discusses the market for carbon dioxide in Europe and says American participation is a missing link in the market's development. "We're looking at the big piece that is missing to make this a truly global market, and that is the US," said Andrei Marcu, president of the Geneva-based International Emissions Trading Association. "This is the probably one of the few if not the only major markets that has emerged over the last decades that has not started in the US," he said. He would be surprised if major US companies, which foresee carbon restrictions, would be content to miss out on the experience that their European competitors were getting in carbon "cap and trade" systems. *Reuters*, May 16, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsid/30809/story.htm>

Events

June 1-3, 2005, **Coal Power Project Development**, Denver, CO. The conference will bring together policy planners, utility executives, and leading coal power project developers to examine current plans and future prospects for project development. They will provide the details of how public policy decisions, transmission planning and expansion, and technological advancement will affect utility resource planning and project financeability. To register or obtain more information, please visit the event website at <http://www.infocastinc.com/coal.html>, or call (818) 888-4444.

June 6-8, 2005, **Carbon from Space**, Frascati, Italy. The workshop will be targeted at obtaining information on gaseous concentrations of carbon in the atmosphere from space-based observations and the development of new sensors and programs. Workshop website: <http://www.congrex.nl/05c21/>

June 8-9, 2005, **Global Warming Solutions 2005**, Roosevelt Hotel, New York City, NY. The conference will focus on the risks and benefits for businesses, investors, and financial institutions with regard to global warming. For more information, visit http://www.cleanair-coolplanet.org/conference_GWS05/index.php

June 9, 2005, **Meeting the Climate Challenge in the Arctic Region**, 8:00 a.m.-1:00 p.m., 124 Dirksen Senate Office Building, Washington, DC. The Royal Norwegian Embassy and Environmental and Energy Study Institute invite you to a transatlantic symposium on the emerging and widespread range of climate challenges that face the Arctic Region. For more information, please contact Anders Skandsen of the Royal Norwegian Embassy at ansk@mfa.no or (202) 333-6000, or Fred Beck of EESI at fbeck@eesi.org or (202) 662-1892.

June 19-22, 2005, **2005 American Association of Petroleum Geologists Annual Convention**, Calgary, Canada. The purpose of this combined oral and poster session is to bring together researchers active in the field of CO₂ and acid gas injection in oil and gas reservoirs, coal beds and deep saline aquifers, whether for EOR, ECBM or sequestration, to present current operations, field and laboratory experiments, and integrated studies for the evaluation of sequestration sites and the long-term fate of the injected gases. For more information about the meeting and submission of abstracts please visit <http://www.aapg.org/calgary/technical/index.cfm>

July 17-29, 2005, **Research Experience in Carbon Sequestration (RECS)**. RECS is a first of-its-kind, high-level summer research program on carbon sequestration. It is designed to engage undergraduates, graduates and early career professionals in carbon sequestration science through hands-on field work and data analysis with leading U.S. scientists. Applications can be downloaded from the web site and are due by **June 1, 2005**. For additional information, visit <http://reecs.lanl.gov>

August 2-11, 2005, **IAMAS 2005 Conference: Carbon Cycle and Climate Symposium**, Beijing, China. The aim of this session is to encourage multiple-disciplinary approach in studying carbon cycles and its interactions with climate. Topics of relevance include: regional and national carbon inventories, CO₂ emissions from land use change and fires, measurements or modeling of net CO₂ exchange of terrestrial ecosystems, land surface models including carbon dynamics in global climate models, interactions between carbon cycle and climate in the past, present and future and applications of model-data fusion in regional and global carbon cycle studies. Conference website: <http://www.iamas2005.com> Contact: Ying Ping Wang – Yingping.wang@csiro.au

September 15-16, 2005, **Reduction of Emissions and Geological Storage of CO₂: Innovation and Industrial Stakes**, Paris, France. The symposium intends to bring together researchers, industrialists, economists, and financiers to examine the role the geological storage of CO₂ can play in reducing emissions of greenhouse gases, and the means to be used to finance such operations. For additional information visit <http://www.CO2symposium.com>

September 26-30, 2005, **7th International CO₂ Conference**, Broomfield, CO. The purpose of this conference is to bring together scientists from different disciplines to communicate the most recent results pertinent to the global carbon cycle, with an emphasis on the contemporary increase of atmospheric carbon dioxide. Topics will include atmospheric and oceanic measurements and monitoring networks, terrestrial ecosystems and land use change, carbon cycle process models, source/sink inverse models, the ice core record, new observational techniques, long-term potentials and vulnerabilities of carbon sequestration, and more generally, the human impact on the carbon cycle. For more information: <http://www.cmdl.noaa.gov/info/icdc7/>

October 9-14, 2005, **2005 International Conference on Coal Science and Technology (ICCS&T)**, Okinawa, Japan. The conference will cover the latest aspects of coal including, combustion, conversion, co-use with biomass and waste, reduction/elimination of environmental load from coal use, and clean coal technologies. For more information regarding the conference please visit the conference website at <http://unit.aist.go.jp/energy/iccst>

November 13-17, 2005, **Greenhouse 2005: Action on Climate Control**, Melbourne, Australia. There is a clear need for industry, scientists, and government at all levels to work closely together to tackle this significant environmental issue. Demand is strong for the latest information on the science, the likely impacts of climate change, adaptation strategies, and approaches to reducing atmospheric greenhouse gas concentrations. The Conference will cover these themes as well as international issues, policy development, communication and education. For more information: <http://www.greenhouse2005.com> Contact: Paul Holper - paul.holper@csiro.au

New Yorker Releases Three Part Series on Climate Change.

The New Yorker's political correspondent Elizabeth Kolbert spoke with numerous scientists and traveled to the Arctic to compile information for a three part assessment of climate change issues, totaling over 30 pages, covering a wide range of subjects including climate history, science, modeling, impacts, and implications. *The New Yorker*: "The Climate of Man-I," April 25, 2005, http://www.newyorker.com/fact/content/?050425fa_fact3; "The Climate of Man-II," May 2, 2005, http://www.newyorker.com/fact/content/?050502fa_fact3; and "The Climate of Man-III," May 9, 2005, http://www.newyorker.com/online/content/?050425on_onlineonly01

"Cost of wind approaches coal-fired generation." The levelized cost to generate electricity from wind turbines can be as low as US\$35 per MWh, compared with \$25 for coal-fired power plants, according to a report, "Projected Costs of Generating Electricity," by OECD Nuclear Energy Agency and the International Energy Agency. The study provides generation cost estimates for 130 power plants powered by coal (27), gas (23), nuclear (13), solar (6) and wind (19) plants, as well as 34 combined heat and power plants that use coal, gas, and combustible renewables. The data were provided by 22 countries and were based on technologies available today and considered by participating countries as candidates for commissioning by 2010-2015 or earlier. *Refocus Weekly*, May 11, 2005, http://www.globe-net.ca/new_products/listing.cfm?ID_Report=513. A summary of the study can be found at <http://www.iea.org/textbase/npsum/ElecCostSUM.pdf>. The report can be ordered at <http://www.oecdbookshop.org>

"Climate Crash: Abrupt Climate Change and What it Means for Our Future." What are the mechanisms for triggering a significant climate change? In what ways should we expect this change to manifest itself? When will it likely happen? This book seeks to answer these questions, breaking the story of rapid climate change to a general public that is already intensely curious about what science has to say on the topic. *The National Academies Press*, http://www.nap.edu/catalog/10750.html?ee_18

"Key Legal and Regulatory Considerations for the Geosequestration of Carbon Dioxide in Australia." This paper provides a general overview of geosequestration technology, identifies key existing regulations that are likely to impact Australian geosequestration projects, and discusses possible legislative reform in the context of the work that has been conducted by the Ministerial Council on Mineral and Petroleum Resources through the Carbon Dioxide Geosequestration Regulatory Working Group. This article was first published in *Australian Resources and Energy Law Journal* (2005) 24: 45-73, and is available on the DOE/Sequestration website at <http://www.netl.doe.gov/coal/Carbon%20Sequestration/pubs/Geosequestration%20Article.pdf>

"The Climate Change Benefits of Reducing Methane Emissions." In this study, an integrated assessment model is used to calculate the marginal benefit of immediate cutbacks in methane emissions, and compare them with the benefits of carbon dioxide reductions and the costs of methane reduction measures. The main result is that immediate cutbacks of methane bring a marginal benefit of between \$30 and \$260 per tonne, with a mean value of \$110 per tonne. This compares to a benefit of between \$10 and \$50 per tonne of carbon, with a mean value of \$20, for immediate cutbacks of carbon dioxide. A sectoral and regional breakdown finds that two-thirds of the benefit is non-economic and only about 5 percent of the benefit occurs in the European Union (EU) and 8 percent in the USA; the vast majority of the benefit is felt in other regions, particularly in the developing world. *Climatic Change* (2005) 68: 21-39, <http://www.ingentaconnect.com/content/klu/clim/2005/00000068/F0020001/00001052> (subscription required)

"Alternatives to the Global Warming Potential for Comparing Climate Impacts of Emissions of Greenhouse Gases." The Global Warming Potential (GWP) is used within the Kyoto Protocol to the United Nations Framework Convention on Climate Change as a metric for weighting the climatic impact of emissions of different greenhouse gases. The GWP has been subjected to many criticisms because of its formulation, but nevertheless it has retained some favor because of the simplicity of its design and application, and its transparency compared to proposed alternatives. In this study, two new metrics are proposed, which are based on a simple analytical climate model. *Climatic Change* (2005) 68: 281-302, <http://www.nersc.no/MACESIZ/Papers/shi05.pdf>

"Southern Company Issues Report on Climate Change Actions." The report reiterates Southern Company's position that the development and commercialization of new technologies is the appropriate way to deal with the long-term challenge of climate change. It also examines the company's plans to continue voluntary efforts to reduce or avoid emissions of carbon dioxide, while focusing as well on developing near carbon-free electric generation technologies and methods of carbon sequestration. The report also notes Southern Company is planning to build an IGCC plant in Florida and participate in FutureGen. *PRNewswire-FirstCall*, May 12, 2005, <http://www.mysan.de/article103356.html>. To download the full report visit <http://www.southerncompany.com/planetpower/pdfs/earsall.pdf>

"Carbon dioxide emissions and climate change: policy implications for the cement industry." This paper discusses climate change, the current and proposed actions for mitigating its effects, and the implications of such actions for the cement industry. International negotiations on climate change are summarized and mechanisms available under the Kyoto Protocol for reducing greenhouse gas emissions are explained. The paper examines some of the traditional and emerging policy instruments for GHG emissions and analyzes their merits and drawbacks. *Environmental Science & Policy*, 8 (April 2005) 105-114, <http://www.sciencedirect.com/science/journal/14629011> (subscription required)

Legislative Activity

Gov. Schwarzenegger Vows Attack on Global Warming.

Declaring climate change to be an indisputable threat, Gov. Arnold Schwarzenegger unveiled a plan June 2 to combat global warming by setting goals for reducing California's emissions of greenhouse gases. "Today, California will be a leader in the fight against global warming," Schwarzenegger told a United Nations conference on the environment being held in San Francisco. "I say the debate is over. We know the science, we see the threat and we know the time for action is now," he said. Under the executive order, by 2010 California would reduce its greenhouse gases to 2000 levels, or about 11 percent less than they would be without taking action. By 2020, California would reduce the emissions to 1990 levels, or about 25 percent. By 2050, the state would reduce the emissions to 80 percent below 1990 levels. "Gov. Vows Attack on Global Warming," *Los Angeles Times*, June 2, 2005, <http://www.latimes.com/news/science/environment/la-me-greenhouse2jun02,1,1260554.story?coll=la-news-environment&ctrack=1&csset=true> (registration required)

“Energy Bill Moves To Senate Floor.” The Senate Energy and Natural Resources Committee approved the energy bill on May 26 on a 22-to-1 vote. The bill includes provisions to modernize and expand the U.S. electric grid, require an inventory of offshore oil and gas resources, double use of ethanol in gasoline, and establish national energy efficiency measures to reduce use of natural gas, oil, and electricity over the next decade and a half. The debate is likely to be intense when the full Senate takes up comprehensive energy legislation later this month. Amendments are expected on offshore oil and gas drilling, renewable energy requirements, vehicle fuel efficiency, oversight for placement of liquefied natural gas facilities, climate change, and more. *Chemical & Engineering News*, June 2, 2005, <http://pubs.acs.org/cen/news/83/i23/8323energybill.html>

“Bill would provide \$4 billion to promote cleaner coal.” U.S. Sen. Lamar Alexander is pitching a wide-ranging energy bill that includes \$4 billion to promote clean-coal technology, and some experts say that might be just what's needed to get the industry moving. The legislation would offer \$2 billion in construction assistance for six new commercial gasification plants built before 2013 to be used for power. Another \$2 billion in loan guarantees, tax incentives or other payments would go to industrial plants over a five-year period. “One of the problems with ... clean coal gas, is that it just has to get forced into the marketplace. And this big huge market has to make some adjustments to deal with it,” said Alexander, R-Tenn. The bill is S.B. 726. *Lexington Herald-Leader*, May 11, 2005, <http://www.kentucky.com/mld/kentucky/news/local/11621439.htm>

“Senate panel seeks loans for nuclear, coal projects.” A Senate panel on May 24 proposed making billions of dollars in federal loans available to the power industry to fund a new generation of nuclear and clean-burning coal power plants. The legislation crafted by Republican and Democratic lawmakers on the Senate Energy and Natural Resources Committee would allow the Bush administration to issue federally backed loans covering up to 80 percent of the cost of energy projects that “avoid, reduce or sequester” harmful greenhouse gases. Sen. Lamar Alexander, R-Tenn., a member of the committee and supporter of clean coal technology, called the proposal an “ingenious and bold” effort to produce carbon-free energy. *Investor's Business Daily*, May 24, 2005, <http://www.investors.com/breakingnews.asp?journalid=27821917&brk=1>