

THE NETL CARBON SEQUESTRATION NEWSLETTER: ANNUAL INDEX

SEPTEMBER 2004 – AUGUST 2005

This is a compilation of the past year's monthly National Energy Technology Laboratory Carbon Sequestration Newsletter. The newsletter is produced by the NETL to provide information on activities and publications related to carbon sequestration. It covers domestic, international, public sector, and private sector news. This compilation covers newsletters issued between September 2004 and August 2005. It highlights the primary news and events that have taken place in the carbon sequestration arena over the past year. Information that has become outdated (e.g. conference dates, paper submittals, etc.) was removed.

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SEQUESTRATION IN THE NEWS.....	2
EVENTS & ANNOUNCEMENTS	20
SCIENCE	23
POLICY	29
GEOLOGY	41
TECHNOLOGY.....	44
OCEAN	49
TERRESTRIAL	53
TRADING	59
PUBLICATIONS	66
LEGISLATION.....	75
CONTACT INFORMATION.....	79



Sequestration in the News

September 2004

Business Week Cover Story on Global Warming. Provides a comprehensive overview of the risks of climate change and actions to mitigate greenhouse gas emissions. Regarding sequestration, the article states "Utilities face the greatest threat since the bulk of the power they generate comes from climate-changing fossil fuels. That's why AEP, Cinergy Corp., and others are probing new technologies that would enable them to capture the carbon as coal is burned. That carbon could then be pumped deep into the ground to be stored for thousands of years." "Global Warming," *Business Week*, August 16, 2004, http://www.businessweek.com/magazine/content/04_33/b3896001_mz001.htm

InsideEPA.com, EPA Investigating Regulatory Impacts of CO₂ Storage in Geologic Formations. The U.S. Environmental Protection Agency is forming a workgroup to look into the regulation of CO₂ storage in geologic formations as a means of controlling GHG emissions. EPA and DOE are working collaboratively on the issue, and several representatives from energy-producing states are developing recommendations for the EPA working group on potential state regulatory changes to accommodate CO₂ sequestration. September 3, 2004, <http://www.insideepa.com> (subscription required)

The Observer, UK to Study Carbon Sequestration. The UK government's Department for Trade and Industry launched a national consultation on capture and storage of carbon dioxide from coal and gas-fired power plants. The idea would be viable by 2020, and cavities under the North Sea would be the best location, said UK energy minister Stephen Timms. "Despite progress with 'clean' power such as wind, and promises of greater energy efficiency, 'carbon abatement' is critical to the UK meeting its promise to cut emissions," said Timms. The UK also announced £50 million of support for wave and tidal energy projects over the next three years. A separate report commissioned by the Forum for Renewable Energy Development in Scotland (Fred's) forecasts that wave power could generate as much as 10 percent of Scotland's electricity by 2020. "North Sea burial for greenhouse gases: New wave of marine-based solutions to global warming," August 1, 2004, <http://politics.guardian.co.uk/green/story/0,9061,1273889,00.html>. See also, "Boost to Scotland's renewable energy with £50m investment," *The Herald*, August 2, 2004, <http://www.theherald.co.uk/>

Australian Financial Review, Geosequestration in Australia. ChevronTexaco, Shell, and ExxonMobil are pushing hard for the Australian federal and state governments to approve the injection of greenhouse gases underground so they can start work on what will be the world's largest geosequestration project off the north-west coast of Western Australia. The Australian government has made geosequestration its preferred technique for tackling greenhouse gases, but there are still issues that need to be addressed, such as, who will be responsible for securing or maintaining the carbon dioxide storage sites in the long term, and who will be liable if there is a leak. "Ministers debate CO₂ dumps," July 30, 2004, <http://afr.com>

Newsweek, A New Era For 'Big Oil'. In an interview in the August 16, 2004 issue of *Newsweek*, John Browne, CEO of BP, shares his outlook on the turbulent energy market and the future of the oil and gas business. Browne says high oil prices are here to stay. BP is focused on increasing natural gas reserves, investing in photovoltaics, and hydrogen production from natural gas with carbon sequestration. "The Last Word: A New Era For 'Big Oil'," August 16, 2004, <http://msnbc.msn.com/id/5635162/site/newsweek>

PR Newswire, AEP Releases Emissions Assessment Report. The report evaluates the impact of proposed federal legislation and regulations for reducing regulated emissions and carbon dioxide, including the Clean Air Interstate Rule, the Utility Mercury Reduction Rule, U.S. Sen. Thomas Carper's proposed Clean Air Planning Act of 2003, and U.S. Senators John McCain and Joseph Lieberman's amended Climate Stewardship Act of 2003. The report details the actions that AEP has undertaken to address regulated emissions and emissions of greenhouse gases, including co-founding the Chicago Climate Exchange (CCX), investing in terrestrial carbon projects and geologic sequestration research, and investing in wind generation and biomass. AEP also announced that the company will build at least one commercial-scale, base-load IGCC clean-coal plant by 2010. "AEP Releases Emissions Assessment Report of Board Subcommittee," August 31, 2004, <http://www.prnewswire.com/cgi-bin/stories.pl?ACCT=109&STORY=/www/story/08-31-2004/0002241170&EDATE>. Copies

of AEP's emissions assessment report are available at
<http://www.aep.com/environmental/performance/emissionsassessment/default.htm>

October 2004

The Australian, Carbon Sequestration Leadership Forum (CSLF) meets in Australia. Senior energy officials from 17 countries, including U.S. Deputy Secretary of Energy Kyle McSlarrow, met in Melbourne to advance carbon sequestration research. The forum participants endorsed 10 collaborative geosequestration projects, with the expectation that members of the Leadership Forum would share information from them. France, Germany, and South Africa were new members for this meeting. Said Australian Petroleum Production and Exploration Association chief Barry Jones, "This research on monitoring storage is essential to building public confidence in clean fossil fuel technologies and is an essential precursor to the development of a hydrogen economy." The ministerial communiqué can be found at:

<http://www.csforum.org/documents/Communique.pdf>. "Carbon burying pushed," September 13, 2004, <http://www.theaustralian.news.com.au>. And "Global forum meets to pursue clean energy," *The Advertiser*, September 13, 2004, <http://www.theadvertiser.news.com.au>

Capitol Reports, Weyburn Project Releases Phase 1 Report. A Phase 1 report from the Weyburn CO₂ EOR project was released at the Greenhouse Gas Technologies conference in Vancouver, Canada. The report covers four technical themes: geological characterization of the geosphere and biosphere; prediction, monitoring, and verification of CO₂ movements; CO₂ storage capacity and distribution predictions; and long-term risk assessment of the storage site. "Successful CO₂ sequestration and enhanced oil recovery project heads into phase II," September 22, 2004, <http://www.caprep.com/0904041.htm>

The Age, Australia Report Finds Geosequestration Less Effective than Efficiency Improvements. A report prepared for the Australia Institute finds that geosequestration would be less effective and more expensive than increasing energy efficiency and encouraging renewable energy generation in the years to 2030. "Institute floats new view on CO₂," September 29, 2004, <http://www.theage.com.au/articles/2004/09/28/1096137231989.html> (registration required)

November 2004

Christian Science Monitor, "A Greenhouse Gas Goes Underground" highlights the CO₂ EOR project at Weyburn. "We have been able to show that you can safely capture carbon dioxide that would otherwise go back into the atmosphere," said Ben Rostron, from the University of Alberta. "Everything we've done has shown us this is a good place to store carbon dioxide." October 28, 2004, <http://www.csmonitor.com/2004/1028/p14s01-sten.html>

Point Carbon, "BP Tries Geo-Sequestration in Algeria." BP has started an "industrial-scale" test of geosequestration with Algeria's national oil company. BP and Sonatrach are extracting natural gas from an Algerian field that also contains 10 percent carbon dioxide. One million tons per year of carbon dioxide is separated from the natural gas and re-injected into an underground reservoir. October 28, 2004, <http://www.pointcarbon.com/article.php?articleID=5070&categoryID=147>

Petroleum Economist, "No Longer a Dirty Word" provides an overview of clean coal technology development worldwide. Speculates on a resurgence of coal liquid fuels in light of sustained high crude oil prices. "Carbon capture is also easier from an IGCC plant than from pulverized-coal plants. With seven large-scale, coal-gasification projects operating in the U.S. already, dozens more in development and numerous initiatives in operation worldwide, there is a solid platform on which to build." October 11, 2004, <http://www.petroleum-economist.com> (subscription required)

Salon, "Coal: Clean, green power machine?" With oil and natural gas prices up, the author has noticed coal advocacy commercials recently appearing on television. Article sets forth coal gasification as a way to increase power plant efficiency from 30 to 60 percent and cites criticisms of CO₂ geosequestration offered by

Greenpeace and the Union of Concerned Scientists. October 5, 2004,
http://www.salon.com/tech/feature/2004/10/05/clean_coal/index_np.html

National Public Radio, "U.S. Eyes Burying CO₂ to Battle Climate Change." NPR's October 4th "Morning Edition" describes CO₂ geosequestration and interviews several researchers at the Rocky Mountain Oilfield Testing Center in Wyoming. Audio of the program is available at
<http://www.npr.org/templates/story/story.php?storyId=3917655> [audio]

Summit Daily News, "Keystone Center pioneers climate change education." The Keystone Center, in partnership with DOE, has developed a hands-on, interdisciplinary curriculum on global climate change. The curriculum, aimed at middle school students, includes role-playing, team problem-solving and lab experiments. Said Summit Middle School science teacher Kay Kirkland, "We can make kids aware that what we do affects everyone in the world. That was really big for us – to get our kids conscious of how they use energy." October 13, 2004, <http://www.summitdaily.com/article/20041013/NEWS/110130018/?rs=2> (registration required)

Voice of America, "Texas Scientists Work to Reduce Carbon Dioxide Air Pollution" highlights the Frio geosequestration field test near Dayton, Texas. Said lead researcher, Susan Hovorka, "There are a lot of things that can hold gas underground. We are underneath the Anahuac shale, which should be the best seal in the world. So the CO₂ should stay underground for thousands of years. No problem." October 6, 2004,
<http://www1.voanews.com/article.cfm?objectId=C69F2A89-53B4-46AB-B5DCA1943CC95945&title=Texas%20Scientists%20Work%20to%20Reduce%20Carbon%20Dioxide%20Air%20Pollution#>
(audio available)

Billings Gazette, "CO₂ project could stop Wyoming oil production slide, oil exec says" describes a commercial CO₂ EOR project at Anadarko Petroleum's Salt Creek Oil Field, about 40 miles north of Casper Wyoming. Anadarko will be supplied CO₂ via pipeline from Exxon/Mobil's Shute Creek Gas Processing Plant in southwestern Wyoming. October 19, 2004,
<http://www.billingsgazette.com/index.php?id=1&display=rednews/2004/10/19/build/wyoming/38-co2-oil.inc>

Billings Gazette, "Conference looks at low-grade coal." "We need Western coal," said Rita Bajura during her remarks to open the Western Fuels Symposium. The article states, "Low rank coals also face major challenges, from environmental concerns with mercury and fine particulate emissions to the application of more efficient combustion and gasification technologies." October 12, 2004,
<http://www.billingsgazette.com/index.php?tl=1&display=rednews/2004/10/12/build/local/34-coal-conf.inc>

Wall Street Journal, "Climate Control: As Planet Heats Up, Scientists Plot Innovative Fixes; Appetite for Oil, Coal Drives Search for 'Painless Cure' to Global-Warming Ills; Storing Carbon Inside a Rock." Article debates the impact the Kyoto Protocol will have on atmospheric concentrations of carbon dioxide. Highlights research into technologies that would allow the world to continue burning fossil fuels without exacerbating global warming. Describes Klaus Lackner's idea to use wind-powered machines to remove carbon dioxide directly from the air and store it in rocks or in the earth. October 22, 2004, <http://www.wsj.com>

December 2004

Odessa American, "Basin Energy Leaders Foresee Good Times With 2nd Bush Term: Insiders Predict Release of DOE Exploration Funds." The Permian Basin oil and gas industry stands to benefit from having George W. Bush return to the White House for another four years, according to Bob Kiker, regional director of the Petroleum Technology Transfer Council. Said Kiker, "[Bush is] a strong supporter of the DOE, and he's also a strong supporter of CO₂ sequestration and enhanced oil recovery." November 4, 2004,
<http://www.oaoa.com/news/nw110404b.htm>

Greenbiz, "Cinergy: Awakening a Sustainability Giant." Article provides a transcript of an interview with Cinergy CEO Jim Rogers. When asked about the uncertainty surrounding CO₂ reductions, Rodgers prefaced his response by admitting that one day we will live in a carbon-constrained world. Rodgers said Cinergy is responding by pursuing voluntary CO₂ emissions reductions and investment in IGCC technology. According to Rodgers, Cinergy plans to seek DOE money to apply carbon sequestration technology to the Wabash River Station. "It's not only in a region of Indiana where we have the grid infrastructure, but it's also in a part of the

state where the geology is very receptive to sequestration. There's a lot of debate about whether it can be done, there's a lot of debate about whether it will ever be economic to do, but we feel that we need to experiment," said Rodgers. No Date, http://www.greenbiz.com/news/reviews_third.cfm?NewsID=27409

Pittsburg Tribune Review, "No Carbon Copycats: Scientists Call for Burying Pollution." Highlights the 14th annual Society of Environmental Journalists conference where a panel of emissions experts discussed the potential of carbon sequestration technology to reduce atmospheric levels of carbon dioxide. Article states that DOE has been advancing technology to overcome the costs associated with carbon sequestration. With seven partnerships across the U.S. and 150 companies researching the issue, DOE's Scott Klara said that they are on the path to sequester one million tons of carbon annually. "To put that into perspective," said Klara, "that's roughly enough to fill up the Empire State Building." October 24, 2004, http://pittsburghlive.com/x/tribune-review/trib/newssummary/s_265324.html

Scoop, "Hodgson: Climate Change and Business." Speaking at the 2004 Australia–New Zealand Conference and Trade Expo, Hon Pete Hodgson addressed the business opportunities associated with climate change. Said Hodgson, "Research plays a role, globally, in the quest for a bunch of holy grails, ranging from nuclear fusion, hydrogen storage to carbon sequestration, new biotechnologies for new biofuels, and the like. New Zealand, like many other countries is a participant in that quest. Business opportunities in these areas are prospective, rather than imminent, but if any of those holy grails is approached, significant wealth creation awaits." November 5, 2004, <http://www.scoop.co.nz/mason/stories/PA0411/S00135.htm>

BBC News, "Support Sought for CO₂ Storage." At a meeting of governments to discuss a major international treaty which bans the dumping of waste in the marine environment - the London Convention, set up in 1972 - UK environment minister Elliot Morley asked leading industrial nations to support a plan for storing carbon dioxide under the sea bed. Said Morley, "Our priority is to reduce emissions but, as an interim move, carbon sequestration is an option we should be exploring. If we are to move ahead with this option, we need to involve the international community, particularly to ensure we can be satisfied that it has proper safeguards built in for the marine environment." November 1, 2004, <http://news.bbc.co.uk/go/pr/fr/-/1/hi/sci/tech/3971307.stm>

The Independent, "UK to Pump Greenhouse Gas Under Sea." According to UK environment minister Elliot Morley, storing CO₂ in the seabed could help make deep cuts in the UK's emissions of carbon dioxide. Experts who back Morley claim that the UK could store all its carbon emissions for more than 100 years in exhausted oil and gas fields under the North Sea. October 31, 2004, <http://www.rense.com/general59/pump.htm>

Reuters, "Carbon Storage Comes to Disused Texas Oil Fields." Near the town of Dayton, Texas, a University of Texas team successfully pumped 1,600 tonnes of carbon dioxide into the reservoirs of briny water more than 5,000 feet underground. "We have a lot of oil and gas fields in this area that are in decline," said Susan Hovorka. "The Gulf Coast is one of the best places on earth for this." Said Charles Christopher, BP's liaison with the Texas research project, "This [Texas] is going to be the place in the world where this [sequestration] is done." November 26, 2004, <http://www.planetark.com/dailynewsstory.cfm/newsid/28318/story.htm>

DOE/FE Techline, "Frio Formation Test Well Injected with Carbon Dioxide." In the first U.S. field test to investigate the ability of brine formations to store greenhouse gasses, researchers funded by the U.S. Department of Energy are closely monitoring 1,600 tons of carbon dioxide that were injected into a mile-deep well in Texas. Carbon dioxide has been successfully injected in the region for enhanced oil recovery, and fluid injection for waste disposal is widely accepted. November 19, 2004, http://www.fossil.energy.gov/news/techlines/2004/tl_frio_injection.html

Melbourne Indymedia, "Geosequestration: Burying Carbon or Burying Our Heads in the Sand?" As a part of Australia's vigorous debate on Global Climate Change and options to reduce GHG emissions, this opinion article sets forth arguments against geosequestration. The article is triggered by the Australian government's funding of sequestration research and the Gorgon project, a geosequestration project supported by Shell, Chevron, Texaco, and Exxon. October 29, 2004, <http://melbourne.indymedia.org/news/2004/10/82162.php>

The Charleston Gazette, "\$ Billion FutureGen Plant." According to this article, worldwide attempts to curb CO₂ emissions threaten the future of West Virginia's coal industry. The industry's only hope is investing in clean coal technology and sequestration. Congress formerly earmarked \$237 million for FutureGen, but only \$18 million in planning funds was included in the \$388 billion spending bill passed at the end of November. November 29, 2004, <http://wvgazette.com>

New York Times, “U.S. and 13 Other Countries Agree on Push to Gather Methane Gas.” The United States and 13 other countries signed an agreement during the first Methane to Markets Ministerial meeting, held November 15-17 in Washington. The voluntary program is intended to capture methane gas from landfills, coal mines, and natural gas and oil systems. November 17, 2004, <http://www.nytimes.com>

Yankton Daily Press, A farmer’s take on carbon sequestration. This article, focused mainly on zoning issues related to livestock development, discusses concerns aired by producers at an agricultural Legislative Roundtable in South Dakota. Some producers branched off the subject to carbon sequestration, which allows farmers to collect payments for storing carbon dioxide in crops and soil. The article states that because the U.S. did not sign the Kyoto Treaty the development of carbon sequestration has slowed. Lisa Richardson, executive director of the South Dakota Corn Growers Association, said there are too many unanswered questions and too small of payments offered to the agricultural sector to make carbon sequestration a viable option. Said Richardson, “We need to figure out how to store it and measure it before figuring out a program for it.” “Farmers Voice Concerns Many Unhappy With Livestock Zoning,” December 1, 2004, http://www.yankton.net/stories/120104/com_20041201011.shtml (registration required)

Foreign Affairs, “Out of the Energy Box (replacing oil).” Authors contend that carbon sequestration “may be the only realistic way to satisfy the world’s gargantuan energy needs while responsibly mitigating their side effects.” November- December 2004, <http://www.foreignaffairs.org/20041101faessay83607/s-julio-friedmanthomas-homer-dixon/out-of-the-energy-box.html>

Orlando Weekly, “BREATHE DEEP: A Coal-Burning Power Plant Near Tampa.” Discusses the recently announced clean coal project, a 285-megawatt coal gasification facility in Southeast Orange County. Presents opinions from Governor Jeb Bush and other persons in favor of the project, and also views from people who do not believe that clean coal will address global warming. Floridians’ awareness of the Global Climate Change issue has been raised by the four hurricanes that went through the state this year. “The Coal Paradox,” November 25, 2004, <http://www.orlandoweekly.com>

DOE/FE Techline, NETL Partners with Keystone on Climate Change Education. The Department of Energy’s National Energy Technology Laboratory (NETL) has joined with the Keystone Center in Colorado and teachers from around the nation in a first-of-a-kind effort to teach a new curriculum about climate change and carbon sequestration. Using laboratory experiments, role playing, and problem solving, the curriculum teaches students about local and global influences, carbon sequestration, and sustainability, as well as the economic and environmental results of climate change. “The curriculum was designed to give students the knowledge they need to make quality choices,” said Sarah Forbes, a NETL policy analyst. “Climate change issues aren’t going to be resolved today, so communicating to kids the different options for dealing with climate change needs to start now.” “New Curriculum Promotes Climate Change Education,” December 2, 2004, http://www.fossil.energy.gov/news/techlines/2004/tl_climate_curriculum.html

January 2005

Chemical & Engineering News, “Putting a Lid on Carbon Dioxide.” Provides a comprehensive assessment of carbon sequestration and clean-coal research as it relates to the government’s climate change strategy. Explores everything from the basics of capture and storage science to the economics, including discussion of the technologies, infrastructure, commercial applications, and field tests. December 20, 2004, <http://www.cen-online.org> (subscription required)

Pittsburg Post-Gazette, “Greenhouse gasbags / It’s time for U.S. to get ahead of Kyoto-style emission controls, which surely are coming.” According to this article, some members of Congress have resisted limits on carbon emissions, thinking that coal industry jobs would be jeopardized if carbon emissions caps were to encourage power plants to switch to cleaner burning fuels such as natural gas. Author Joseph Otis Minott, executive director of Clean Air Council, argues that a more realistic scenario is that coal-burning utilities would get the market signals they need to modernize their power plant fleet. Many experts predict that even with carbon capture and sequestration in place, coal will still be the cheapest electricity generating option. December 28, 2004, <http://www.postgazette.com/pg/04363/433272.stm>

China Daily, "Progress made in CBM recovery technology." China has achieved an initial success in using carbon dioxide enhanced coalbed methane (CBM) recovery technology to tap the country's huge CBM resources. Sun Maoyuan, president of China United Coalbed Methane Co Ltd, said a small pilot test carried out with the technology in a single CBM well in the south Qinshui basin of North China's Shanxi Province has been successful. The test was completed earlier this year with a total of 193 tons of carbon dioxide injected into the targeted coal seam of the CBM well. China is estimated to have between 30 trillion and 35 trillion cubic meters of coalbed methane resources, which are located about 2,000 meters underground. December 11, 2004, http://www.chinadaily.com.cn/english/doc/2004-12/11/content_399399.htm

World Gas Intelligence, "Gas Projects Provide Catalyst for Carbon Sequestration." Article explores the link between gas production operations and commercial carbon capture and storage projects. Said Scott Klara, sequestration technology manager at DOE/NETL, "Carbon Sequestration's practical link to gas-producing fields is unlikely to shift greatly in the near future, mainly because separating CO₂ from gas streams is relatively straightforward and inexpensive – around \$1-\$2 per ton – so as yet is not commercially viable." The article highlights Statoil's Sleipner West field, Statoil/BP's In Salah field in Algeria, Statoil's Snohvit LNG project – scheduled to become operational in 2007, the ChevronTexaco-led Gorgon LNG venture in Australia, and a possible project on Alaska's North Slope – proposed by BP, ConocoPhillips, and Exxon Mobil. December 1, 2004, <http://www.energyintel.com> (subscription required)

DOE/FE Techline, "CO₂ Injection Boosts Oil Recovery, Captures Emissions." Until recently, enhanced oil recovery using CO₂ has not been economically feasible in Kansas because CO₂ sources were hundreds of miles away. A newly initiated CO₂ EOR flood at the Hall-Gurney field uses waste CO₂ from the fermentation process of a 25-million gallon per year corn ethanol plant. Waste heat from a 15-megawatt natural-gas-fired turbine generator provides thermal energy for the ethanol plant. January 3, 2005, http://fossil.energy.gov/news/techlines/2005/tl_kansas_co2.html

The Christian Science Monitor, "New coal plants bury 'Kyoto'." China, India, and the U.S. are planning to build nearly 850 new coal-fired plants, which would pump up to five times as much carbon dioxide into the atmosphere as the Kyoto Protocol aims to reduce. "If all those power plants are online by 2012, then obviously it completely cancels out any gains from Kyoto," said Gavin Schmidt, a climate modeler with the Goddard Institute for Space Studies. "The point is that a relatively small number of countries hold the fate of the planet in their hands in terms of climate change," said David Hawkins, director of the Natural Resources Defense Council's climate center. "If the five or six countries building all these power plants were to come together to develop a strategy for carbon capture applied to coal, it would be a huge step toward cutting global warming." December 23, 2004, <http://www.csmonitor.com/2004/1223/p01s04-sten.html>

Harvard University Gazette, "Experts take on climate change." A panel on possible future steps to combat climate change discussed embracing market-based incentives for carbon dioxide reductions and starting a new dialogue between the world's two biggest carbon dioxide emitters - the United States and China. The biggest question now, said Daniel P. Schrag, Professor of Earth and Planetary Sciences at Harvard, is how to replace the billions of tons of coal that appear likely to fuel development in China and India, two populous nations that are rapidly industrializing. Harvard President Lawrence H. Summers encouraged an increase in funding for basic research into technological solutions that will allow the removal of excess carbon from the atmosphere, such as proposals to bury it underground or under the sea. "The one thing that everybody should be able to agree on is the importance of basic research on clean energy use and sequestration," Summers said. December 16, 2004, <http://www.news.harvard.edu/gazette/2004/12.16/01-gore.html>

The Washington File, Four-Part Series on CSLF. The first article entitled, "International Effort Under Way on Emissions- Reducing Technology," focuses on the basics of the greenhouse effect and carbon capture and storage, and it also discusses the emergence of the Carbon Sequestration Leadership Forum. Part two, "Carbon Sequestration Technology Could Help Slow Global Warming," examines the Weyburn Carbon Dioxide Monitoring Project and the Frio Brine Pilot Experiment. The third article, "International Forum Tackles CO₂ Emissions from Power Plants," cites examples of international engagement. Mentions the CO₂SINK project in Potsdam, Germany and the Australian effort to address the regulatory and legal questions associated with CO₂ storage. Part 3 also highlights the CSLF technology roadmap and the Climate Stewardship Act of 2003. The final part in the series, "International Forum Tackles Carbon Dioxide Emission Problem," summarizes the CSLF ministerial meeting in Melbourne, Australia.

Part 1, December 13, 2004: <http://usinfo.state.gov/gi/Archive/2004/Dec/13-874520.html>

Part 2, December 14, 2004: <http://usinfo.state.gov/gi/Archive/2004/Dec/15-595073.html>

Part 3, December 15, 2004: <http://usinfo.state.gov/gi/Archive/2004/Dec/16-627676.html>

Part 4, December 16, 2004: <http://usinfo.state.gov/gi/Archive/2004/Dec/17-674101.html>

***The Herald-Dispatch*, “Cleaning up coal might fuel debate.”** Discusses the report by the National Commission on Energy Policy which suggests an energy future where coal plays an important role. The report – which addresses everything from the security of oil supplies, to climate change, to fuel-economy standards - suggests Congress invest \$7 billion over the next 10 years, partly in existing clean-coal technologies and partly in tax breaks to encourage more companies to adopt technology that will clean up coal-fueled emissions. Said Luke Popovich, spokesman for the National Mining Association, “The race coal is in is not against other fuels. It’s against the environmental expectation of Americans.” Popovich continued, “The only way to do that is to rely on technology to continue to drive emissions down.” December 29, 2004, <http://www.energycommission.org/ewebeditpro/items/O82F4963.pdf>

***The Independent*, “Kyoto will not work, warns climate expert.”** The struggle by developed countries to cut back their emissions of carbon dioxide will always be overtaken by the rising new emissions of the developing nations, led by China and India, who are not parties to the Kyoto treaty, said Professor Wallace Broecker of Columbia University. Extracting CO₂ directly from the air, liquefying it and then storing it, he said, offered the only realistic hope of preventing climate change that would be catastrophic for the world. “Alternative energy and energy conservation ... are going to fall far short of stopping the build-up of CO₂,” he said. “But extracting CO₂ direct from the air can do the job.” December 9, 2004, <http://www.countercurrents.org/cc-mccarthy091204.htm>

February 2005

***Greenwire*, “Utilities brace for climate change pressures but still plan new coal plants.”** A survey of 75 U.S. and 14 Canadian utility companies, conducted by GF Energy, finds that 93 percent expect increasing pressure on CO₂ emissions, but that “Coal is expected to be the generating method of choice given high natural gas prices and other factors.” Said Roger Gale, the president and chief executive officer of GF Energy, “We are faced with a whole new world out there. The amount of investment in infrastructure this industry is going to have to do is huge relative to what they have been used to.” January 6, 2005, <http://www.eenews.net/Greenwire.php> (subscription required)

***Oil & Gas Journal*, “IEA: CO₂ capture, storage offer emissions solution.”** This article highlights an IEA book, “The Prospects for CO₂ Capture and Storage,” released last month at COP-10 in Buenos Aires. According to the book, carbon dioxide capture and underground storage (CCS) could constitute as much as half of the global emissions reduction by 2050. The publication describes the challenges for CCS to reach market introduction and achieve its full potential within 30-50 years. The article also discusses the CCS process, CO₂ sources, and R&D efforts. January 6, 2005, <http://ogj.pennnet.com> (subscription required). “The Prospects for CO₂ Capture and Storage” can be purchased for EUR-100 (EUR-80 for PDF) on IEA's website at <http://www.iea.org/dbtw-wpd/bookshop/add.aspx?id=190>

***The Yomiuri Shimbun*, “Huge CO₂ emission cuts proposed.”** The Japanese government's proposal for long-term energy policy includes a call for reduction of CO₂ emissions in advanced nations to 3.1 billion tons by 2050, one fourth of 2002 levels, and to 600 million tons by 2100, one twentieth of 2002 levels. To achieve these goals, the government proposed research and development of new technologies in three areas: nuclear power, including reprocessing of nuclear fuel; geologic carbon sequestration; and renewable energy sources. January 12, 2005, <http://www.climateark.org/articles/reader.asp?linkid=38033>

***The Washington Times*, “Climate: Low-carbing the atmosphere.”** Article highlights carbon sequestration technology as “the leading weapon in the U.S. government's arsenal against climate change.” Discusses the many different types of storage, including: ocean, soil, depleted oil reservoirs, and trees. Mentions research and field tests performed by the University of Kansas, the University of Alberta, and Anadarko. January 31, 2005, <http://www.washtimes.com/upi-breaking/20050128-124908-5585r.htm>

***EnergyPulse*, “Four Major Events Advance IGCC During 2004.”** Article highlights the DOE-funded demonstration projects at Wabash River, IN and Polk, FL as moving IGCC toward commercial viability. Also cites GE's purchase of Chevron Texaco and its announcement of three financially sound utility launch partners

(Cinergy, AEP, and FPL) as enhancing IGCC prospects. Mentions “the potential sequestration of carbon dioxide” as well. January 6, 2005, http://www.energypulse.net/centers/article/article_display.cfm?a_id=903

Sun & Stars e-magazine, “Greenpeace: Clean coal not possible.” According to Jasper Inventor of Greenpeace, “CCS will not start before 2020, if it materializes at all - and will not become commercially available as a possible effective mitigation option until 2030. The majority of CCS deployment is likely to come in the second half of this century. It will be too late to save the climate.” January 29, 2005, <http://www.sunstar.com.ph/static/ilo/2005/01/29/news/greenpeace.clean.coal.not.possible.html>

Sydney Morning Herald, “Burying CO₂ emissions would aid climate.” Highlights a report by the Australian Bureau of Agricultural and Resource Economics (ABARE) entitled, “Near Zero Emissions Technologies.” “ABARE modeling indicates that using carbon capture and geological storage technologies could significantly reduce the global economic costs of meeting an international carbon emissions constraint,” ABARE said. “Because of Australia's high dependence on fossil fuels and availability of geological carbon storage sites, use of these technologies has the potential to have a larger impact.” This is contrary to the findings of a September 2004 report released by the Australian Institute, as reported in the October 2004 Carbon Sequestration Newsletter. January 18, 2005, <http://www.smh.com.au/news/National/Burying-CO2-emissions-would-aid-climates/2005/01/18/1105810900961.html>

AETF Review, “Regulating Geosequestration.” This is a corporate response to the Draft Regulatory Framework for Geosequestration, which appeared in the October/November 2004 issue of *AETF Review*. In their response, Origin Energy, an Australian utility, supports a broad regulatory framework that provides a carbon signal. “There is currently little impetus for investments in greenhouse gas mitigation technologies as there is no framework which outlines the mechanism by which carbon will be valued in Australia, nor any clear guidelines about the treatment of exiting assets and new entrants.” The topics addressed by Origin include: access and property rights, long term responsibility, environmental issues, authorization and compliance, monitoring and verification, transportation, and financial issues. December/January 2004/05, <http://aetf.emcc.net.au/ContentStore/pdf/ReviewDecJan2004.pdf>

March 2005

Fortune, “Old King Coal Comes Back.” Article contends that coal is here to stay despite the focus on other sources of energy over the last half of the last century. Provides insight into the coal mining operations of the Powder River Basin, focusing on mining and transportation. Article also distinguishes between eastern and western coal and highlights maintenance issues and technological advancements related to the burning of western coal. IGCC is discussed in the context of global warming. Said William Reilly, former EPA administrator, “Coal gasification, when combined with carbon sequestration, has the potential to revolutionize energy production.” February 21, 2005, <http://www.fortune.com/fortune/imt/0,15704,1025886,00.html>

CBC News, “Apache to spend \$95M to flush out oil with CO₂.” Apache Canada Ltd. is planning a CO₂ enhanced oil recovery project using anthropogenic CO₂. The project is located in Southeast Saskatchewan, in the same region of Canada that contains the Weyburn Field, and will tap into the pipeline running up from Dakota Gasification. The provincial Industry and Resources Department said it encouraged the Apache project by offering breaks on taxes and royalties. Even with those breaks, the government says, it hopes to collect an additional \$106 million in royalties and taxes over the life of the project (incremental oil production estimated to be 45 million barrels over 25 years). The article states, “The government says the process is safe, referring to a scientific study that projected only about 0.2 percent of the CO₂ stored underground would leak out into the atmosphere over 5,000 years.” February 23, 2005, <http://www.cbc.ca/sask/story/midale-project050223.html>

The Wall Street Journal, “Burial Plan.” Highlights a geologic CO₂ sequestration project, In Salah, being undertaken by BP in a remote region of Algeria. One million tons of CO₂ will be captured from a natural gas processing plant and re-injected into the natural gas-bearing formation. The cost of the CO₂ capture and compression equipment was \$100 million. A history of the project is given, planning for CO₂ injection began in 1997. Also, strategies for CO₂ injection and practical hurdles including land access for injection wells and compressor breakdowns are related. February 4, 2005, <http://www.wsj.com> (subscription required)

The Guardian, "CO₂ gases may be buried at sea." The UK's chief scientist Sir David King, speaking at a climate change conference revealed the British plan to capture carbon dioxide and pump it underground as one of the potential ways of solving a global problem. He also raised concerns that the Chinese were building a large number of coal-fired power stations which would make the problem worse. He said he had asked the Chinese authorities to design the new stations so that if the British carbon sequestration scheme worked, the technology to capture carbon dioxide could be fitted to the Chinese stations. Said Sir David, "The North Sea scheme is an experiment to see if oil wells that are running out could be utilized to store carbon dioxide deep underground. The gas would be taken in tankers to the oilfields and pumped under pressure into the oil wells, which would turn it into a liquid and force out the oil. In the longer term, if the experiment was successful, the world would soon run out of oil wells for all the carbon dioxide being produced. There were, however, many salt water aquifers in the world into which carbon dioxide could be pumped. Producers who wanted to continue using coal and gas could use this method to dispose of the carbon dioxide and their businesses would pay for the costs." February 3, 2005, http://www.guardian.co.uk/uk_news/story/0,3604,1404644,00.html

Scientific American, "Capturing Carbon Dioxide." Article discusses the potential of carbon capture and storage (CCS) to cut emissions of carbon dioxide in light of the Kyoto Protocol which came into force on February 16th. Sleipner and Weyburn are cited as examples of commercially viable CCS operations, but the article is quick to point out that CCS is expensive. "There's still a gap between the marketplace and the technology," says Howard Herzog of the Laboratory for Energy and the Environment at MIT. The best way to make CCS cheaper is for government to provide incentives to use it, asserts David Hawkins of NRDC. "Learning by doing is the thing that drives the cost down, not R&D dollars," he adds. DOE carbon sequestration program manager, Scott Klara says he is confident that even for traditional coal plants the cost of CCS can be reduced to \$20 per ton. February 14, 2005, <http://www.sciam.com/article.cfm?chanID=sa004&articleID=0000492C-072B-120D-872B83414B7F013B>

Islam-online.net, "Horrors of Global Warming Highlighted." According to conference participants, global warming would boost outbreaks of infectious disease, worsen shortages of water and food in vulnerable countries and create an army of climate refugees fleeing uninhabitable regions. Scientists even gave a detailed timetable of the destruction and distress that global warming is likely to cause to the world. The conference, however, ended on a positive note, with the forum showing how far the argument for carbon sequestration has come, with a series of experts insisting it can be transformed from fiction to fact. February 3, 2005, <http://www.islam-online.net/English/News/2005-02/03/article08.shtml>

The Daily Texan, "Solution to warming: Go underground." The article highlights the Frio project and efforts to model CO₂ storage in geologic formations. The article states, "One way to reduce these [greenhouse gas] emissions is to drill wells deep into the Earth's crust and pump pressurized carbon dioxide into salt water aquifers, where it is sequestered for geologic time scales. This might sound bizarre, but researchers feel it is a viable option." Justin Ferrell, a researcher at the University of Texas has performed modeling, simulations, and cost analyses of geologic storage and is quoted, "The cost is about \$1.15 per ton of carbon dioxide, surface to ground. Surface to ground means the price to put the gas down there - any other significant cost is from the pipelines to get the carbon dioxide to the well." February 22, 2005, <http://www.dailytexanonline.com>

E/The Environmental Magazine, "Hiding the Bad Gas." Says Einar Haandlken from the Oslo-based environmental group Zero, "Reducing the world's dependency on fossil fuels will take too long. We don't have enough time to do this because we need to cut greenhouse gases immediately." Zero is working with Norway's oil and power industry to remove millions of tons of CO₂ from Norway's fossil-fuelled power plants and pipe them deep under the North Sea into old and existing oil fields. January/February 2005, <http://www.emagazine.com/view/?2167>

Oil & Gas Journal, "Acid-gas injection due at LaBarge plant." ExxonMobil Corp. has drilled two wells with state and U.S. Environmental Protection Agency approval to be used to inject a combined 60-67 MMcf of 65% CO₂ and 35% H₂S below the Madison gas-water contact at 17,500 ft. Injecting the H₂S will allow the company to shut down the aging sulfur recovery unit, which has high operating and maintenance costs, and exit the weak market for sulfur. Of the plant's output of 250 MMcf of CO₂, 80% is sold to three operators of enhanced oil recovery projects in Wyoming and Colorado. Anadarko Petroleum Corp. expects to take nearly all of the rest of the available CO₂ when it boosts injection into its Salt Creek and West Sussex oil fields in the Powder River basin later this year. January 28, 2005, <http://ogj.pennnet.com> (subscription required)

Fuel Cell Works, “Agni Receives Order for 1MW Integrated Fuel Cell Engine Power Plant.” Agni Inc. confirmed receiving an order for a 1MW Integrated Fuel Cell Engine power plant with carbon dioxide sequestration from a regional oil & gas company. Agni’s 1MW Integrated Fuel Cell Engine power plant is comprised of an internal combustion engine, waste heat recovery system, natural gas steam reformer, PEM fuel cells, balance of plant, power inverters, and carbon dioxide recovery system. This plant will recover 6,360 tonnes per annum of Carbon Dioxide. Agni Inc and the client will release more details of the installation within the next 60 days. February 9, 2005, <http://www.fuelcellsworks.com/Supppage2027.html>

Financial Times, “The race to curb greenhouse gases heats up.” Emerging technologies would provide the solution to the problem of climate change, George W. Bush said during a visit to Europe. He outlined a way forward based on more collaboration with European researchers and “technologies, such as hydrogen-powered vehicles, electricity from renewable energy sources, and clean coal technology (that) will encourage economic growth that is environmentally responsible.” Contemplating about whether there is enough time to wait for emerging technologies to mature, Peter Challoner of Southampton University said, “It’s not just that we can’t wait for these new technologies. It’s that the problem has reached such an extent that we need to think about radical solutions. I’ve started to think that carbon sequestration might be the best answer.” February 25, 2005, <http://news.ft.com/cms/s/28c49c32-868d-11d9-8075-00000e2511c8.html> (subscription required)

April 2005

The Star Ledger (Newark, New Jersey), On March 6, 2005, there was a special section on energy with numerous stories on carbon and mitigation. Some of the articles are summarized below. To view the special energy edition visit <http://www.nj.com/business/energy/>

The Star Ledger, “To Bury a Gas: Shots in the Dark.” Article focuses mainly on Weyburn with Michael Monea of the Petroleum Research Technology Centre saying, “This is one of the most-studied 8 square kilometers in the world.” According to the article, “every day, enough CO₂ to fill almost 1,500 Olympic swimming pools whooshes through a 1-footwide pipe to Weyburn from a synfuels production plant 200 miles away in North Dakota.” March 6, 2005, <http://www.nj.com/business/energy/ledger/index.ssf?business/ledger/stories/0306renegades.html>

The Star Ledger, “A design team says the way to control CO₂ is: Suck it up.” Article highlights Global Research Technologies’ quest to build a device to suck CO₂ from the sky. Columbia University physicist Klaus Lackner, architect of the idea, says CO₂ can be captured from the air via collectors, each spanning an area of roughly 165 feet by 200 feet – about the size of a large wind turbine. Lackner figures about 250,000 towers would capture all of humanity’s CO₂ emissions. March 6, 2005, <http://www.nj.com/business/energy/ledger/index.ssf?business/ledger/stories/0306designteam.html>

The Star Ledger, The Dangers of CO₂ Explored. Article discusses historical natural leaks of CO₂ in the U.S., Japan, Indonesia, Italy, and Cameroon. Focuses on the effects of CO₂ releases, which have been blamed for tree kills and the death of bears and humans. Highlights the worst known CO₂ disaster at Nyos, a crater lake in west-central Africa that erupted in 1986 killing 1,800 nearby villagers. “Death of a skier points to an invisible danger,” March 06, 2005, <http://www.nj.com/business/energy/ledger/index.ssf?business/ledger/stories/0306deathskier.html>

Pittsburgh Post Gazette, “Goal: Make abundant coal clean.” Article discusses the abundance and low cost of coal relative to natural gas, and the need for improved technology for coal-fired power plants. Sets forth the National Energy Technology Laboratory as leading an important coal technology research effort – one that is aligned with the interests of the coal-rich Pittsburgh region. Regarding sequestration the article states, “The challenge with carbon dioxide is to find somewhere to put it where it is unlikely to do damage.” March 22, 2005, <http://www.post-gazette.com/pg/05081/475101.stm>

PR Newswire, “President George W. Bush Views Energy Innovations During Visit to Battelle.” President Bush observed demonstrations of a number of technologies with energy-related applications during a tour of Battelle in early March. The demonstrations included significant developments in pipeline safety and security, next-generation nuclear power, energy-efficient appliances, grid reliability, and clean coal. The discussion on clean coal included carbon sequestration technology, a key component of the President’s FutureGen initiative.

March 9, 2005, <http://www.prnewswire.com/cgi-bin/stories.pl?ACCT=109&STORY=/www/story/03-09-2005/0003159600&EDATE>

he Boston Globe, “Cleaning up coal.” “Coal could be part of the solution to climate change if builders of new plants would use technology that captures and stores CO₂ and makes mercury cleanup much simpler...advocates of global warming action could have allies among utility CEOs who know that the only thing more expensive than building gasified-coal plants with CO₂ controls is adding CO₂ controls to a conventional plant after it is running. That might be required if global warming reaches a sudden tipping point and causes such drastic effects on climate or agriculture that action cannot be delayed.” March 17, 2005, <http://www.boston.com> (subscription required)

EurekaAlert, “Climate change poorly understood by U.S. public, MIT survey finds.” The average American knows nearly nothing about efforts to reduce greenhouse gases, according to a Massachusetts Institute of Technology survey that researchers say has serious policy implications. The 1,200 participants in the poll were asked whether they had read about or heard of a wide range of technologies in the previous year. While most of those surveyed were familiar with more fuel efficient vehicles, solar power, and other options, very few had heard of carbon sequestration. “The recognition of carbon capture and storage and carbon sequestration is minimal,” Howard Herzog of MIT said he and fellow researchers at the University of Cambridge concluded. “Less than 4 percent of respondents were familiar with the terms carbon dioxide capture and storage or carbon sequestration.” March 23, 2005, http://www.eurekaalert.org/pub_releases/2005-03/miot-ccp032305.php

Greenwire, “Clean Coal Key to U.S. Greenhouse Strategy, Utilities Say.” Industry experts attending the Sustainable Energy Institute roundtable said coal gasification and other “clean coal” technologies offer the most feasible ways of reducing greenhouse gas emissions in the absence of a carbon cap-and-trade system in the United States. The roundtable also highlighted a new partnership formed by utilities last fall to spur innovations in coal technology. The “Coal Fleet for Tomorrow” aims to encourage development of integrated gasification combined cycle coal plants, or IGCC – the Holy Grail of clean coal development, said John Novak of the Electric Power Research Institute. The article goes on to discuss IGCC and calls it a stepping-stone towards carbon sequestration. March 2, 2005, <http://www.eenews.net/Greenwire.php> (subscription required)

Energy Washington, “Activists Say Sequestration Pivotal To Future Energy From Coal.” Speaking at the Senate energy committee coal conference on March 10, 2005, David Hawkins of the Natural Resources Defense Council (NRDC) stated that the future use of coal for electricity generation must depend upon use of only those clean-coal technologies that can sequester and monitor carbon, like integrated gasification combined cycle (IGCC) technology, and that the only way to ensure sequestering and monitoring of carbon is implementation of a mandatory carbon cap strict enough to drive sequestration. Hawkins said that technologies to reduce carbon emissions will not be brought to market in the absence of policies that require strict limits on CO₂ emissions. But government and industry analyses show that a mandatory carbon cap, which would drive sequestration, could also push the cost of coal-fired electricity to a level higher than that of new nuclear generation. March 16, 2005, <http://www.energywashington.com/> (subscription required)

Oil & Gas Journal, “Inert gas injection set in Athabasca oil sands.” Paramount Resources Ltd., Calgary, plans to inject as much as 3 MMcfd of inert compressor exhaust gases in the Surmont area into the Cretaceous Wabiskaw-McMurray oil sands in an attempt to maintain reservoir pressure while allowing the production of a similar volume of natural gas to be produced from previously shut-in gas pools. The pilot project, to start up in April, would also enable the sequestration of as much as 400 Mcfd of carbon dioxide. “If successful, Paramount is hopeful that this experiment will offer some resolution at Surmont to the ‘gas over bitumen’ issue as well as provide for sequestration opportunities for carbon dioxide,” the company said. March 10, 2005, <http://ogj.pennnet.com> (subscription required)

CNW, “Penn West Petroleum Ltd. Announces the Commencement of Carbon Dioxide Injection into the Pembina Oil Field.” The plan is to start with a small \$15 million pilot test and proceed to a larger-scale injection if the initial results are encouraging. March 31, 2005, <http://www.newswire.ca/en/releases/archive/March2005/31/c0833.html>

Australian Broadcasting Corporation, “Fossil fuels could slow climate change: environment roundtable.” The world's biggest carbon dioxide emitters are now proposing that fossil fuels could be part of the solution, and help slow climate change. Australia's Environment Minister, Senator Ian Campbell, says that was the conclusion after two days of talks in London with other environment and energy ministers from around the

world. Says Campbell, "The best thing we can do, in the medium-term at least, is to focus on making the use of coal, for example, and other fossil fuels far more energy efficient, go to cleaner coal technologies, and ultimately to zero emissions use of fossil fuels by using, for example, gasification, cleaning up of coal, and ultimately the sequestration of the carbon from it." March 17, 2005, <http://www.abc.net.au/worldtoday/content/2005/s1325870.htm>

The New Zealand Herald, Missed opportunity for sequestration in Australia. A New Zealand utility company put on hold plans to build two coal-fired power plants citing the "lack of available technology for carbon capture and separation" as a key reason for its decision. By implication the utility will meet growing demand with natural gas and renewable energy. "Northland reassured over power station plans," March 4, 2005, http://www.nzherald.co.nz/index.cfm?c_id=3&ObjectID=10113588

BBC News, "A coal-dependent future?" Article explores the market forces behind China's preference for coal. Highlights a coal-mine methane capture project at the Sihe mine, one of China's largest and most modern coal mines, which expects to produce 10 million tones of coal before the end of the year. Before, the methane was sent straight into the atmosphere. Now, it's diverted into a small gas-fired power station. In addition to making the mine safer, the article says the scheme generates paper credits that the mine group has sold to the World Bank, for \$20 million. Article also discusses some of China's current environmental problems and some that are looming in the near future, including burning coal seams, desertification, sea-level rise, and access to fresh water. March 9, 2005, <http://news.bbc.co.uk/go/pr/fr/-/1/hi/programmes/newsnight/4330469.stm>

May 2005

Anchorage Daily News, DOE Report: Carbon dioxide injection can boost Alaska oil production by 12 billion barrels. A new U.S. Department of Energy report considered Alaska's oil fields on the North Slope and in Cook Inlet and determined that carbon dioxide flooding could dislodge 12 billion barrels of oil that otherwise would remain stuck in the ground. Nationwide, the technique could add 43 billion barrels to U.S. supply, according to the report. Carbon dioxide flooding isn't done now on the North Slope, but Congress already has laid the groundwork for encouraging it. In a law passed last fall that provides incentives for an Alaskan natural gas pipeline, lawmakers included a tax break for a massive plant on the North Slope to purify raw natural gas. Part of its job would be to strip carbon dioxide out of the gas. "Use of natural gas could yield more oil: Carbon dioxide injection can boost production," April 23, 2005, <http://www.adn.com/front/story/6411546p-6290064c.html> (registration required)

New York Times, "Coal in a nice shade of green." This oped discusses the negative attributes associated with burning of fossil fuels, but recognizes that current renewable technology is not sufficient to satisfy America's energy needs economically. Authors pitch gasification as a bridge technology saying, "The combination of gasified coal plants and geologic storage can be our bridge to the clean energy of the 22nd century and beyond." March 26, 2005, <http://www.homerdixon.com/articles/20050325-nytimes-coalgreen.html>

The Observer, "Seabed supplies a cure for global warming crisis." British scientists say they have found the solution to the global warming crisis. They want to bury millions of tonnes of carbon dioxide under the bed of the North Sea at BP's Miller oilfield. "Production at the Miller is coming to an end, so we have a wonderful opportunity to develop techniques that could control global warming," said Professor Stuart Haszeldine, a geologist at Edinburgh University. "This is a once-in-a-decade opportunity," said Haszeldine. "We have the right gear in the right place at the right time. If we don't take advantage of it and allow the Miller to be closed down, we will have lost a wonderful chance to conquer global warming." To make it feasible BP is asking the government to reduce its oil taxes from £7 from every £10 worth of North Sea oil to £3. April 24, 2005, <http://www.guardian.co.uk/climatechange/story/0,12374,1469049,00.html>

The Star Ledger, "As CO₂ market expands, company steps on the gas." Article highlights BOC's new plant in west Texas that supplies liquid CO₂ to boost production of natural gas wells. The gas is piped from a natural reservoir in Colorado and pumped underground at high pressure; the CO₂ fractures rock formations to increase gas flow. "It dramatically increases the amount of natural gas you get from the life of the well," says John Miller, BOC's national manager for oil field services. The article says, "In a few places, CO₂ is being entombed inside oil and gas wells – a process called "sequestration" that may offer a solution to global warming." April 12, 2005, <http://www.nj.com>

The Australian, "Shell deal fires up Gorgon gas hopes." The \$11 billion Gorgon gas project, off the West Australia coast, moved a step closer with project partner Shell saying it had finalized the sale of 2.5 million tonnes of Gorgon LNG a year to the U.S. west coast. Shell will supply up to 2.5 million tonnes of Gorgon LNG a year to the Energia Costa Azul terminal in Baja California, with first deliveries expected in 2010. In addition to gas production, the project scope includes the capture and sequestration of 5 million tonnes CO₂ per year in a saline reservoir located 2300m below Barrow Island. April 12, 2005, <http://www.energybulletin.net/5286.html>

Rigzone, Production Cost of Crude Oil from CO₂ EOR on Norwegian Shelf Estimated to be 30 \$/bbl. The Norwegian Petroleum Directorate (NPD) studied 20 Norwegian oil platforms and estimates that CO₂ EOR could help extract an additional 150 to 300 million cubic meters of oil in total. "However, the threshold costs for establishing a delivery chain for injection of CO₂ are so high that other methods of improving recovery emerge as being more attractive for the licensees at this time," the authors said. "Norway CO₂ Study: Too Expensive & Risky," April 26, 2005 http://www.npd.no/English/Emner/Ytre+miljo/co2rappport_pm_260405.htm. Also see, "Injecting CO₂ into oil fields to boost production is too pricey: report," *Agence France Presse*, April 26, 2005, <http://www.petroleumworld.com/story05042706.htm>. Statoil's senior vice president for the environment, Tor Fjaeran, was at the meeting where the NPD report was announced and reaffirmed his company's commitment to carbon storage. "Statoil Continues Commitment to Carbon Storage," *Rigzone*, April 26, 2005, http://www.rigzone.com/news/article.asp?a_id=22075

Energy Bulletin, "Carbon sequestration - the hottest topic on the planet." Article offers an in-depth discussion of the proposed Gorgon LNG project in Western Australia, and calls it "the template for proving up a regulatory framework for geologic sequestration." The article says, "outside of the economy and events in the Middle East, global warming or more importantly, prospective action to inhibit its progress is just about the hottest inter-governmental topic on the planet. At the top of the list of mitigation strategies is carbon sequestration." Article addresses the need for monitoring and a regulatory framework and attempts to rouse public debate with numerous parallels to nuclear waste disposal. A published overview of how the International Energy Agency categorizes the Gorgon project is shown at the end of the article. April 12, 2005, <http://www.energybulletin.net/newswire.php?id=5220>. This issue also included "**Australia: Gorgon Gas Project – Ugly by name,**" which takes the opposite viewpoint and states that there are many boundaries being tested with the Gorgon Gas project (technical, geoscientific, economic, legal, political, and geographic) and there are just as many questions that need to be addressed before the project commences. The article says that the introduction of a regulatory framework for the project will "inadvertently also create the necessary legal framework for the subterranean disposal/storage of other more noxious substances, ones that have been rejected in the past, at least in the public eye." April 12, 2005, <http://www.energybulletin.net/newswire.php?id=5219>

Australian Broadcasting Corporation, "Coal-21 group debates clean power options." This transcript of an Australian radio broadcast discusses the Coal-21 program, which is exploring the possibilities of geo-sequestration. According to Coal-21's Tim Besley, costs are falling and he's optimistic they'll be able to trial the new technology by the end of the year. Coal-21 is currently assessing sites for a project. Says Besley, "Some of those geologically good sites are not economically viable because they're too far away from a major source, like a big power station." April 6, 2005, <http://www.abc.net.au/pm/content/2005/s1339741.htm>

CNN, "Seeking solutions to a cooler planet." Article mentions carbon sequestration as one of many current technologies that could dramatically turn down the heat of global warming over the next 50 years. Highlights the Mountaineer project in West Virginia and BP's In Salah project in Algeria and states, "These carbon sequestration projects send millions of tons of carbon dioxide gas into underground geologic formations such as aquifers or gas beds now filled with water, natural gas or oil. The risks of such techniques include leakage of carbon dioxide from underground reservoirs that may endanger human life and the environment. Scientists are studying techniques to find which rock formations permanently store gases such as carbon dioxide." April 15, 2005, <http://www.cnn.com/2005/TECH/science/04/15/earth.solutions/>

June 2005

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 policymakers 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.climateark.org/articles/reader.asp?linkid=41349>

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 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.ccchina.gov.cn/english/source/ab/ab2005051703.htm>

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>

July 2005

Scientific American, "Can We Bury Global Warming?" In the cover story of the July issue of *Scientific American*, Robert H. Socolow of Princeton University maintains that "pumping carbon dioxide underground to avoid warming the atmosphere is feasible, but only if several key challenges can be met." Socolow presents an excellent overview of the science and economics of CO₂ capture and storage, providing insight into the current state of the technology and the challenges to be overcome. July 2005, <http://www.sciam.com/article.cfm?chanID=sa006&collID=1&articleID=0001D260-6966-12B9-9A2C83414B7F0000> (subscription required)

Reuters, BP and Partners Plan "Carbon-Free" electricity from hydrogen. BP and its partners ConocoPhillips, Shell Transport & Trading Co., and Scottish and Southern Energy announced they plan to build a clean energy plant near Peterhead in Scotland at a cost of \$600 million. The plant, which could come online in 2009, would convert natural gas to hydrogen and carbon dioxide gases, then use the hydrogen gas as fuel for a 350MW power station. The carbon dioxide would be exported through existing pipelines to the mature BP-operated Miller oilfield. The field is due to cease production in 2006/7 but the injection of carbon dioxide could increase oil recovery by up to 40 million barrels and extend the field's life by 15-20 years, BP said. Initial engineering feasibility studies have been completed and the partners will now begin detailed design work to make sure the project is economically viable. June 30, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsid/31490/story.htm>

San Francisco Chronicle, "Funds granted to test underground storage near Rio Vista." Article highlights the West Coast Regional Carbon Sequestration Partnership (Westcarb), which received a \$14.3 million DOE grant. The partnership has already spent two years looking for underground locations that could safely store the gas. In the next phase of testing, Westcarb researchers will inject 4,000 tons of carbon dioxide – bought from a commercial source, such as a refinery – into a depleted natural gas reservoir and a brine formation near Rio Vista, California. The group, led by the California Energy Commission, also will study how much carbon dioxide can be removed from the atmosphere by replanting or better managing forests. Westcarb's tests will focus on monitoring the gas once it's underground, said Larry Myer, the partnership's technical director. June 10, 2005, <http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2005/06/10/BUG2VD67EC1.DTL>

The Christian Science Monitor, SaskPower to Build a "CO₂ Capture Ready" PC Power Plant. Article discusses "capture ready" coal-fired power plants and highlights a proposed plant in Saskatchewan, Canada. The plant, slated to go on-line in 2013, located about 110 miles south of Regina, will sport a few million dollars of extras – everything from extra ductwork and bigger boilers to extra open space right next to key areas of the plant – to become one of the world's first "capture ready" plants. "We're building a plant that will last for a number of decades, so it seems prudent to recognize that at some point during that time, carbon will have to be managed," says Rick Patrick, SaskPower's vice president of planning, environment, and regulatory affairs. "We think a capture-ready design will give us maximum flexibility for whatever comes at us." The article questions the benefits of adding capture ready technology to conventional coal-fired power plants. "An escape valve for greenhouse gas," June 2, 2005, <http://www.csmonitor.com/2005/0602/p14s02-sten.html>

***The Springfield News-Leader*, Possibility of Carbon Taxes Factors into Power Plant Investment**

Decision. American Electric Cooperative (AEC), which is planning to build a pulverized coal power plant in Missouri by 2011 has looked at the impact of possible carbon taxes on the plant economics. "A tax of \$10 per ton of carbon dioxide emissions still leaves coal as the least-costly option. But if the tax were set at \$12.30 per ton, "suddenly nuclear power becomes the cheapest base load source," said Jim Jura, general manager of AEC. "We think base load coal is still the way to go, but if something were to happen to carbon dioxide rules in the next two or three years, we'd still have enough flexibility to move to an IGCC plant," said Jura. "Nuclear one day may be cheapest," June 21, 2005, <http://www.news-leader.com/apps/pbcs.dll/article?AID=/20050621/NEWS04/506210383/1095>

BBC News, "Funds for greenhouse gas storage." The UK government announced £25m of funding for a plan to capture greenhouse gases and store them under the North Sea. Carbon storage could be up and running within a decade, said the government. The money is part of a £40m package to tackle climate change that covers not only carbon sequestration, but projects for cleaner electricity generation from coal and gas, as well as for hydrogen and fuel cell technology. "We've consulted the industry closely and it's clear that the long-term benefits of capture and storage, which could reduce emissions from power plants by up to 85 percent, merit significant investment now," said energy minister Malcolm Wicks. June 14, 2005, <http://news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/4089538.stm>. For background information, visit "Ministers back carbon dumping," *Guardian Unlimited*, June 15, 2005, <http://politics.guardian.co.uk/green/story/0,9061,1506620,00.html>. Also see, "Britain Tries to Capture Greenhouse Gases," *Discovery Channel*, June 15, 2005, <http://dsc.discovery.com> and "Gov't supports greenhouse gas storage projects," *Reuters*, June 14, 2005, <http://www.tiscali.co.uk/news/newswire.php/news/reuters/2005/06/14/topnews/govrsquotssupportsgreenhousegasstorageprojects.html>

UKOOA Press Release, "Carbon Storage under North Sea feasible but challenging." According to the UK Offshore Operators Association (UKOOA) – the industry body representing oil and gas producers in the North Sea – capturing CO₂ from an onshore location and transporting it offshore for reinjection through existing oil and gas pipelines and installations is an entirely different and much more costly matter than any of the commercial projects currently under way. In the North Sea it would require significant investment in new infrastructure both on and offshore, including substantial retrofitting of the offshore installations, where there are weight and space limitations. A further hurdle is the legality of transferring carbon dioxide, officially designated a "waste" product, from one location to another for disposal offshore, which is not allowed under current international law (OSPAR and the London Convention). June 14, 2005, <http://www.ukooa.co.uk/media/view-press.cfm/365>

Technology Review, "Carbon Dioxide for Sale." Article chronicles the Dakota Gasification Company from its conception during the energy shortages of the 1970s, through the turbulent period of natural gas deregulation in the mid-1980s, to an industrial beast that operates a 300-kilometer CO₂ pipeline, which supplies CO₂ for EOR projects in Saskatchewan, in addition to converting 18,000 tons of lignite coal into 170 million cubic feet of synthetic natural gas per day (enough to heat 2,500 homes for a year). According to the article, "Dakota survived by becoming a recycler: the by-products of its waste streams bring in more than \$150,000 a day. And its most lucrative by-product – the one that finally secured its future – is carbon dioxide." July 2005, http://www.technologyreview.com/articles/05/07/issue/brief_carbon.asp

The Guardian (London), "How will carbon capture and storage work?" According to this article, capturing carbon dioxide from power plants is more technically demanding than storage. Article addresses the negative aspects associated with capture, including cost and parasitic load. Mentions gasification technology and oxyfuel plants like Vattenfall as alternatives to post-combustion capture, but argues that both processes are in their infancy. On the storage side, the article uses Statoil's Sleipner project to illustrate the maturity of storage technology, but adds that the issues here are long-term safety and short-term legality. June 16, 2005, <http://www.guardian.co.uk/life/thisweek/story/0,12977,1506967,00.html>

Financial Times (London), "The day of reckoning nears for energy markets." Article contends that high oil and natural gas prices signify a fundamental shift in world energy markets, led by cultural and social changes in developing countries that make acquiring motor vehicles and appliances more desirable and acceptable. To ease tight markets the author suggests: building more nuclear power capacity; re-examining the regulatory constraints on exploration in areas that hold vast reserves of oil and natural gas; enhancing international energy partnerships (especially with Canada, Mexico, and Australia); and increasing international investments in clean

coal, carbon sequestration, renewables, and hydrogen technology. "The best chance America has to lessen its dependence on energy imports and increase supply is to ensure that coal remains an integral and environmentally safe part of its energy mix and to introduce new sources - from wind and solar to hydrogen fuel cells," says the article. June 3, 2005, <http://news.ft.com/cms/s/15cafee6-d3cc-11d9-ad4b-00000e2511c8.html>

News & Star, Wind and Carbon Sequestration Crucial in Cutting CO₂ Emissions, Friends of the Earth. In an article focusing on a proposed 27 turbine wind farm near Tebay in the UK, Friends of the Earth's executive director, Tony Juniper says, "Some objectors have questioned the reality of climate change, but future generations will not thank them for this blinkered view. Wind energy will have a crucial role in cutting carbon dioxide emissions in the next few years. The Government must also help the development of emerging technologies, such as wave energy, tidal power and carbon sequestration, so we can develop a low carbon economy... The nuclear lobby is doing its best to push nuclear energy, but this would be a dangerous and expensive diversion in the fight against climate change." June 7, 2005, <http://www.newsandstar.co.uk/news/viewarticle.aspx?id=251215>

Petroleum Economist, "Canada: EOR schemes offer CO₂- sequestration opportunities." According to this article, the drive to coax as much oil as possible from Western Canada's ageing fields is also yielding environmental benefits – now that producers have developed ways to inject carbon dioxide to rebuild reservoir pressures and, as the CO₂ mixes with oil, allow the oil to flow more easily to the surface. The article highlights the following CO₂ sequestration projects: the EnCana-led Weyburn project; Apache Canada's plans to recover 45m barrels of oil and store up to 8.75m tonnes of CO₂ in the Midale field, near Weyburn; a Penn West Petroleum project in central Alberta, injecting 3 mcf/d of CO₂ to generate 700 barrels a day of light oil and gain 15 percent incremental recovery; and an Anadarko Petroleum pilot EOR project in central Alberta. In addition, the article also looks at the incentives offered by the governments of Saskatchewan and Alberta. June 2005, <http://www.petroleum-economist.com/default.asp?Page=5&ISS=16209> (subscription required)

Global Issues, United States Backs Efforts to Develop Methane as Energy Source. Article discusses the importance of methane both as a major component of natural gas and as a greenhouse gas, identifies potential methane reduction opportunities, and describes the Methane to Markets Partnership. "Methane to Markets" appears in the June 2005 issue of the U.S. State Department's electronic journal, *Global Issues*. The entire issue, "Protecting the Environment: Thirty Years of U.S. Progress," can be viewed at <http://usinfo.state.gov/journals/itgic/0605/ijge/ijge0605.htm>

La Société, "Shell selected for major new coal gasification opportunity in Australia." An IGCC project with carbon dioxide sequestration is under study in Australia. Stanwell Corp., owned by the Queensland government, named Shell Gas & Power the preferred coal gasification technology provider for the project. It would be the world's first IGCC power generation plant to geosequester nearly all the produced CO₂. June 17, 2005, <http://www.edubourse.com/finance/actualites.php?idActus=22034>. Also see, "IGCC plant with CO₂ sequestration studied." *Oil & Gas Journal*, June 21, 2005, <http://ogj.pennnet.com> (subscription required)

August 2005

Popular Science, "How Earth-Scale Engineering Can Save the Planet." According to the article, a growing number of physicists, oceanographers, and climatologists around the world are seriously considering technologies for the deliberate manipulation of Earth's climate in order to counteract adverse human influences. Article explores the cost, feasibility, and risk associated with several proposed solutions. Underground storage of captured carbon dioxide is listed first in a group of options including planetary air-conditioning devices such as orbiting space mirrors that deflect sunlight away from Earth, ships that intensify cloud cover to block the sun's rays, fertilizing the ocean with iron to promote CO₂ consuming plankton blooms, and CO₂ mineralization. Geologic sequestration is described as highly feasible with moderate cost, though the article emphasizes asphyxiation risk associated with CO₂ leakage. August 2005, <http://www.popsci.com/popsci/aviationspace/3afd8ca927d05010vgnvcm1000004eecbccdrd.html>. For an alternative perspective on the same topic, see "Terraforming Earth," *WorldChanging.com*, July 14, 2005, <http://www.worldchanging.com/archives/003121.html>

Tri-City Herald (Washington), “Energy NW OKs \$1 billion project.” The board of directors for Energy Northwest, a public utility in Washington State, approved a resolution to build two 300 MW coal-fired integrated gasification combined cycle power plants. The power plants are expected to cost \$1 billion to build and will produce power at a cost of \$35 to \$45 per MWh. The plants will be sequestration-ready. The plants would come on line in 2011 and the plan is contingent on Energy Northwest being able to secure long-term contracts for the power output. July 28, 2005, <http://www.tri-cityherald.com/tch/local/story/6754756p-6642957c.html>

Oil & Gas Journal, “Statoil laying CO₂ pipeline to Snøhvit field.” Statoil ASA is laying a 151-km, 8-in. carbon dioxide injection pipeline from the Melkøya gas terminal in northern Norway to Snøhvit natural gas field in the Barents Sea. Work on the line, which is slated for completion by the end of July, began in early June with 10-20 km of pipe per day being laid. The pipelines to Snøhvit, which will carry 700,000 tonnes per year of CO₂ marks the first offshore injection of CO₂ from a land-based plant. July 8, 2005, <http://ogj.pennnet.com> (subscription required)

Tech Central Station, “Green Coal?” Article summarizes the first hearing held by the Senate Committee on Energy and Natural Resources to review all aspects of the debate over climate change. While many news reports following the event focused on senators “acknowledging” the climate problem and “struggling” with what to do about it, this article focuses on the lack of any practical solutions offered by the scientists in their testimony. According to the article, nuclear can help, but nuclear facilities take a long time to site, plan and build. They are not going to help in the near term. The author, Duane Freese writes, “The most near-term economically and, oddly enough, environmental friendly alternative could well rest on a fuel that the United States has in greatest abundance but also one with the dirtiest reputation – coal.” July 16, 2005, <http://www.techcentralstation.com/072605E.html>

ResearchResearch, Fossil Generation with Sequestration Makes Closed-Loop Nuclear Competitive. The U.S. House of Representatives Subcommittee on Energy took testimony on nuclear waste reprocessing as a means to address issues associated with fuel supplies and waste disposal. Said Donald Jones, vice-president of marketing and senior economist at RCF Economic and Financial Consulting in his testimony, “If carbon sequestration were to be required for fossil-fired generation, even the first new nuclear plants with reprocessing would be competitive.” “Experts clash over the costs of nuclear waste processing,” July 14, 2005, <http://www.researchresearch.com/news.cfm?pagename=newsStory&type=default&elementID=53379>

Edinburgh Evening News, “BP boss asks for cash to help oil giants go green.” BP’s Lord Browne said “carbon capture” can reduce greenhouse gases significantly, but that BP stands to make only a “very moderate” return from its investments in the technology. He said that given the investment needed and the higher costs involved, a subsidy is necessary “in order to be able to compete.” Lord Browne justified his claim by saying that other emissions reduction technologies, such as wind energy, attract a subsidy. July 12, 2005, <http://edinburghnews.scotsman.com/business.cfm?id=817332005>

news@nature.com, “Low-carbon power plant planned for Scotland.” Article highlights the BP-led CO₂-enhanced oil recovery project at the Miller Field in the North Sea. The CO₂ will be captured from a natural gas-fired combined cycle power plant. The project is set to begin a \$20 million engineering phase next year, pending a financial analysis in 2006. Says John Gibbins, who studies fuel policies at Imperial College London, “This project is really a first: the first time carbon dioxide has been taken out of electricity production.” July 1, 2005, <http://www.nature.com/news/2005/050627/full/050627-17.html> (subscription required)

Events & Announcements

November 2004

NETL Outlines Strategy for Environmental Review of CO₂ Sequestration. The Public Scoping Document for the Carbon Sequestration Program's programmatic EIS has been posted on the NETL website at <http://www.netl.doe.gov/coal/Carbon%20Sequestration/eis/documents.html>.

DOE presents geologic sequestration efforts at GWPC Annual Forum. The Groundwater Protection Council's (GWPC) October 2004 Quarterly Report highlights the GWPC Annual Forum, which took place September 19-22, 2004, in Charleston, SC. The Annual Forum was attended by 170 representatives of state and federal agencies, associations, industry, and other concerned parties. A link to a presentation entitled, "U.S. Department of Energy's Ongoing Research and Pilot Test Efforts to Sequester CO₂ in Targeted Geological Formations," can be found at <http://www.gwpc.org/e-Library/Proceedings/AF04/AF04-Proceedings.pdf> (presentation by Charles Byrer).

"Department of Energy Funds 26th Year of University Coal Grants." The Department of Energy's University Coal Research Program will make available nearly \$3 million for projects that explore ways to use coal while protecting the environment. Oxygen combustion with CO₂ recycling is one area of work called out in the program announcement. *DOE Press Release*, October 27, 2004, http://www.doe.gov/engine/content.do?PUBLIC_ID=16825&BT_CODE=PR_PRESSRELEASES&TT_CODE=PRESSRELEASE

U.S. Sponsors Project to Cut GHG Emissions in New Mexico. The U.S. Department of Energy will provide more than \$4.1 million to New Mexico for five new research and development projects that aim to strengthen energy security, reduce greenhouse gas emissions, and protect human health. One of the projects will examine the health affects of fine particulates emitted from coal-fired power plants, while four will promote enhanced oil and gas recovery. "Department of Energy Grants New Mexico \$4.1 Million for Research and Development Projects," *DOE Press Release*, October 8, 2004, http://www.doe.gov/engine/content.do?PUBLIC_ID=16742&BT_CODE=PR_PRESSRELEASES&TT_CODE=PRESSRELEASE

December 2004

"Industry Announces Collaboration to Accelerate Deployment of Advanced Coal-Based Power Plants." The Electric Power Research Institute (EPRI) announced a new initiative, "CoalFleet for Tomorrow," to accelerate the deployment of clean, efficient, advanced coal technology and to develop options for managing the carbon dioxide emitted from power plants. Said Hank Courtright, an EPRI vice president, "During the first year of this program, we will concentrate much of our effort on accelerating integrated gasification combined cycle (IGCC) technology into the market in the 2005 to 2015 timeframe." Courtright continued, "We will also be increasing our understanding of the options for capturing and sequestering carbon dioxide, and determining potential beneficial uses for it. We plan to ensure the commercial availability and operation of all these technologies by 2015 to 2020." *EPRI Press Release*, November 11, 2004, http://www.eprweb.com/public/corp_CoalFleet.pdf

Regional Partnership Conference Proceedings Available. The conference proceedings for the Regional Carbon Sequestration Partnerships Annual Program Review Meeting are available on the NETL Sequestration website at <http://www.netl.doe.gov/publications/proceedings/04/RCSP/rcsp04.html>

Workshop on Geological Storage of CO₂. The OSPAR workshop on the environmental impact of placement of carbon dioxide in geological structures in the maritime area took place in Trondheim, Norway on October 26-27, 2004. The workshop brought together 60 participants from nine countries. Links to presentations given at the workshop and the workshop findings can be found at <http://odin.dep.no/md/engelsk/aktuelt/pressem/022051-210039/dok-bn.html>

February 2005

“Carbon Dioxide Capture and Storage Projects Receive Funding.” The Minister of Natural Resources Canada announced the awarding of \$10.8 million in funding under the CO₂ Capture and Storage Incentive Program to four Canadian companies. Said Minister Efford, “It will be exciting to see the results of these projects - CO₂ storage is an important part of our climate change strategy, and we need to continue supporting new approaches that significantly reduce harmful emissions.” The four projects are located in Alberta and involve converting and reconfiguring existing wells or using new processes to explore the potential and benefits of CO₂ storage. *CNW Telbec*, January 17, 2005, <http://www.cnw.ca/fr/releases/archive/January2005/17/c3545.html>

March 2005

“DOE's Carbon Sequestration Partnership Program Adds Canadian Provinces.” The Department of Energy announced that the Provinces of Alberta and British Columbia have joined Saskatchewan and Manitoba as Canadian partners in the Regional Carbon Sequestration Partnership program. The Province of Alberta became part of the Plains CO₂ Reduction Partnership in January 2005, and British Columbia joined the West Coast Regional Carbon Sequestration Partnership (WestCarb) in December 2004. *U.S. Newswire*, February 17, 2005, <http://releases.usnewswire.com/GetRelease.asp?id=43282>

“Xcel Energy Joins Carbon Dioxide Reduction Partnership.” Xcel Energy joined the Plains CO₂ Reduction Partnership, which is one of seven regional carbon sequestration research projects funded by the U.S. Department of Energy National Energy Technology Laboratory. “We are serious about following a multi-faceted approach to addressing emissions of carbon dioxide,” said Xcel Energy Chairman and CEO Wayne Brunetti. “Joining the Plains Partnership is an approach that will dovetail nicely with our own carbon management policy and other carbon sequestration projects.” Xcel Energy also participates in another of these regional partnerships in the Southwestern U.S., as well as a carbon sequestration tree-planting project in the Southern U.S. *Business Wire*, February 8, 2005, http://www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-1_15531_18513-17580-0_0-0,00.html. More information is available on the group's Internet site at <http://www.undeerc.org/pcor/>

April 2005

“U.S Energy Department Announces \$62.4M in “Clean Coal” R&D Awards.” Secretary of Energy Samuel Bodman announced the award of \$62.4 million for 32 clean coal research projects. Sequestration related awards are as follows:

- Southern Research Institute (Birmingham, Ala.) - \$863,724
- University of Michigan (Ann Arbor, Mich.) - \$501,205
- University of Delaware (Newark, Del.) - \$599,373
- University of North Carolina at Charlotte (Charlotte, N.C.) - \$417,645
- Battelle Memorial Institute (Columbus, Ohio) - \$1,819,700
- Geological Survey of Alabama (Tuscaloosa, Ala.) - \$399,889
- U. of Kentucky Research Foundation (Lexington, Ky.) - \$276,232
- Winrock International (Morrilton, Ark.) - \$398,720

All American Patriots, March 16, 2005, <http://www.allamericanpatriots.com/m-news+article+storyid-8118-PHPSESSID-86966f8c4475d698581cbe552b7515c9.html>

Free Climate Graphics. UNEP/GRID-Arendal in Norway has updated their popular Vital Climate Graphics series. The first edition was launched at the COP in Den Haag in 2000. That one was based on IPCC's second assessment report. The updated edition is based on IPCC's third assessment report. You can download and use the graphics for presentations, websites, etc, but please give credit to UNEP/GRID-Arendal when using the graphics. These graphics and other graphics can be found at <http://www.vitalgraphics.net>

May 2005

“Nicholls opens Navy’s databank for small businesses.” A program to open the U.S. Navy’s databank of technologies to small businesses in south Louisiana is under way at Nicholls State University. The program will provide online access to more than 600 unclassified patents. The databank will include technologies for hydrogen extraction from seawater, methane hydrate processing, carbon sequestration, extremely high pressure valves and seals, sensors and monitoring systems and advanced power sources such as fuel cells for marine applications. Additional information is available at <http://www.nicholls.edu/stp>

June 2005

“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. *AEP Newsroom*, May 4, 2005, <http://www.aep.com/newsroom/newsreleases/default.asp?dbcommand=displayrelease&ID=1203>

“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

July 2005

“DOE to Establish National Center for Hydrogen Technology.” The U.S. Department of Energy announced the award of \$2.7 million to the University of North Dakota to establish a National Center for Hydrogen Technology. The new center will focus on obtaining hydrogen from coal, and will test a range of technologies from hydrogen production to transportation to utilization. Research conducted at the center will advance President Bush’s Hydrogen Fuel Initiative, which calls for developing the technology needed for commercially viable hydrogen-powered fuel cells, and FutureGen. Initial projects will address coal refining, hydrogen carriers, end-of-pipe reforming, and strategic studies to identify the research areas most likely to overcome barriers to the deployment of hydrogen-from-coal technologies. *Fuel Cell Works*, June 24, 2005, <http://www.fuelcellworks.com/Suppage2918.html>

Australian program offsets GHG emissions from transport. Greenfleet is a not for profit organization that provides a simple way to reduce your car’s impact on the environment. For \$40, Greenfleet will plant 17 native trees on your behalf. These trees will help to create a forest, and as they grow will absorb the greenhouse gases that your car produces in one year. Since 1997 Greenfleet has planted more than 2 million trees on behalf of Australian motorists and fleets. These forests will not be harvested and will create an investment in rural Australia for future generations. For additional information, visit <http://www.greenfleet.com.au/>. For information on how to offset your vehicles emissions in the U.S., visit the TerraPass website at <http://www.terrapass.com>

August 2005

“The Climate Change Budget Tracking and Analysis Project.” Georgetown University professor Tom Brewer and the Centre for European Policy Studies (CEPS) in Brussels has launched a web page with charts, data, analyses, and links to resources for an on-going project on the U.S. government’s climate change budget. The project materials will be updated three times during each annual budget cycle. A file of materials is available

at <http://explore.georgetown.edu/faculty/index.cfm?Action=ViewPublications&NetID=brewert>. Publications from the project are available at the CEPS website at http://www.ceps.be/Article.php?article_id=15

Science

September 2004

“Narrowing uncertainty in global climate change.” This article discusses how a series of linked computer models at the Massachusetts Institute of Technology is being used to predict the likelihood of serious climate change with and without policies to stabilize atmospheric concentrations of carbon dioxide. Emphasis is placed on quantifying the uncertainty in future climate change projections. *The Industrial Physicist*, August- September 2004, Volume 10, Issue 4, <http://www.aip.org/tip/INPHFA/vol-10/iss-4/p20.html>

“Climate predictions gain surer footing.” Researchers who have devised a new approach to calculating global warming say they have reduced the uncertainty about the extent of warming to expect over the next 100 years. The method, which predicts a temperature rise of at least 2.4°C over the next century, is not dependent on guessing the values of unknown factors. “This should put climate modeling on a more solid footing and give policy makers a more rational basis for making decisions about preventing climate change and dealing with its consequences,” says study leader James Murphy from the Hadley Centre for Climate Prediction and Research in Exeter. The results, presented in *Nature*, suggest that if carbon dioxide concentrations double over the next hundred years - as many believe they will - the planet will warm by between 2.4 and 5.4°C. A previous estimate released by the Intergovernmental Panel on Climate Change (IPCC), predicted a 1.4 to 5.8°C range. *news@nature.com*, August 11, 2004, <http://www.nature.com/news/2004/040809/full/040809-9.html> (subscription required). For the original article, “Quantification of modeling uncertainties in a large ensemble of climate change simulations,” see Murphy, et al. *Nature*, 430. 768 - 772 (2004).

Study Disputes Idea that Trees can 'Relocate' Quickly in Response to Climate Change. In a study with implications for how North American trees might respond to a changing climate, molecular information collected by Duke University researchers refutes a widely accepted theory that many of the continent's tree species migrated rapidly from the deep South as glaciers retreated at the end of the last Ice Age. *Duke News*, August 2, 2004, http://www.dukenews.duke.edu/2004/08/treemove_0804.html

October 2004

Global Warning, *National Geographic* Cover Story on Climate Change. The September 2004 issue of *National Geographic Magazine* featured four articles on evidence of climate change and its effects on plants and animals. “Signs from Earth,” *National Geographic*, September 2004, <http://magma.nationalgeographic.com/ngm/0409/feature1/index.html>

“Scientists Debunk Global Warming Effect on Hurricanes.” In a letter to Sen. John McCain a group of climatologists, scientists, professors, and other experts in climate change pointed out two “misconceptions” reported in the press about hurricanes and their relation to climate change. “First is the erroneous claim that hurricane intensity or frequency has risen significantly in recent decades in response to the warming trend seen in surface temperature. Second is the claim that a future surface warming trend would lead to more frequent and stronger storms. We believe that both of these are demonstrably false,” the scientists wrote. They noted the National Hurricane Center reports in the last century the decade with the largest number of hurricanes to hit the U.S. was the 1940s, and the frequency of hurricanes has gone down since then. In addition, according to the United Nations Environment Programme of the World Meteorological Organization, “Reliable data ... since the 1940s indicate that the peak strength of the strongest hurricanes has not changed, and the mean maximum intensity of all hurricanes has decreased.” *Cybercast News Service*, September 15, 2004, <http://www.cnsnews.com/ViewNation.asp?Page=%5CNation%5Carchive%5C200409%5CNAT20040915c.html>. A different

point of view is set forth in "Global Warming May Spur Fiercer Hurricanes – Experts," *Reuters*, September 15, 2004, <http://www.planetark.com/dailynewsstory.cfm/newsid/27169/story.htm>

Study Shows Dramatic Global Warming Impacts on Arctic Species. Four years ago, the United States and other nations launched the Arctic Climate Impact Assessment, a comprehensive regional study involving more than 300 scientists. The scientific analysis concluded that many of the arctic region's species that depend on sea ice - such as polar bears, seals, walrus and some birds - will decline and may become extinct as a result of climate change. Sheila Watt-Cloutier, chair of the Inuit Circumpolar Conference, told the Senate Commerce Committee that State Department officials are blocking the release of a second report that contains policy recommendations on how to prevent the species extinctions. "U.S. trying to ice report on global warming, senate told," *Scripps Howard News Service*, September 15, 2004, <http://www.knoxstudio.com/shns/story.cfm?pk=CLIMATEIMPACTS-09-15-04&cat=WW>

"Climate Impact on Plankton Ecosystems in the Northeast Atlantic." Article shows that sea surface warming in the Northeast Atlantic is accompanied by increasing phytoplankton abundance in cooler regions, and decreasing phytoplankton abundance in warmer regions. This impact propagates up the food web (bottom-up control) through copepod herbivores to zooplankton carnivores because of tight trophic coupling. Future warming is therefore likely to alter the spatial distribution of primary and secondary pelagic production, affecting ecosystem services and placing additional stress on already-depleted fish and mammal populations. *Science*, Vol 305, Issue 5690, 1609-1612, September 10, 2004, <http://www.sciencemag.org/cgi/content/abstract/305/5690/1609> (subscription required)

DNA analysis shows how some deep-sea microbes limit global warming. By analyzing the DNA of an entire community of microorganisms in deep-sea sediment, researchers at MBARI and the Joint Genome Institute have shown how some of these microbes could consume methane, an important contributor to global warming. Microbes in marine sediments are known to produce huge quantities of methane, but very little reaches the atmosphere. Scientists have speculated that most of this methane is consumed by other microbes that also live in the sediment. "Microbes and methane - DNA analysis shows how some deep-sea microbes limit global warming," *MBARI press release*, September 5, 2004, <http://www.spaceref.com/news/viewpr.html?pid=14959>

November 2004

CO₂ concentrations in the atmosphere observed to be increasing at a more rapid rate. In 2002 and 2003, the concentration of GHGs in the atmosphere increased by 1.08 ppm and 2.54 ppm respectively. For ten years prior the rate of increase had averaged 1.5 ppm. The increased rate could be an anomaly, perhaps due to increased forest fires in the Northern Hemisphere. But it has scientists wondering if the natural CO₂ sinks (forests and oceans) that currently absorb roughly half of net anthropogenic CO₂ emissions are becoming saturated. Other scientists worry that "positive feedback loops" caused by increased global temperature are the cause. "Climate fear as carbon levels soar," *The Guardian*, October 11, 2004, http://grist.org/cgi-bin/forward.pl?forward_id=3298

Study challenges whether tree rings reveal past climate. The Earth's temperature may have fluctuated more wildly during the past 1,000 years than previously thought, according to a study that challenges how researchers use tree rings and corals to give us a picture of the Earth's past. If true, the study suggests that recent warming might not be as unique as was thought previously, and might partly be due to natural temperature cycles, rather than humans spewing carbon dioxide into the atmosphere. "Past climate change questioned," *Nature*, September 30, 2004, <http://www.nature.com/news/2004/040927/full/040927-16.html> (subscription required)

"Plants' role in global warming reevaluated." Researchers from McGill University, Montreal have studied the responses of several growth lines of the alga *Chlamydomonas reinhardtii* grown under ambient and elevated CO₂ concentrations, to high doses of CO₂. Instead of observing an amplified growth rate and increased biomass, no discernable difference was determined between the cell lines. If the researchers' theory is correct, the net result of rising atmospheric carbon levels for the photosynthetic microorganisms will be very little. *Felix*, October 7, 2004, <http://www.felixonline.co.uk/2002-04/article.php?aid=1698>

December 2004

“Alaska’s Tundra Now Releasing Carbon Dioxide.” A study from the Pew Center on Global Climate change says the Arctic tundra is no longer absorbing carbon dioxide, it is now releasing it. Said Camille Parmesan of the University of Texas, “For many thousands of years Alaska has sucked up quite a lot of carbon from the atmosphere and put it into long-term storage as part of the frozen tundra. The carbon bank has now turned into a carbon exhaust.” *Energy Bulletin*, November 13, 2004, <http://www.energybulletin.net/newswire.php?id=3154>. The PEW report entitled, “Observed Impacts of Climate Change in the U.S.,” can be downloaded at http://www.pewclimate.org/docUploads/final_ObsImpact.pdf

“Greenhouse Gas Growth Rates.” Hypothesizes that reversal of the growth of atmospheric CH₄ and other trace gases would provide a vital contribution toward averting anthropogenic interference with global climate. Such trace gas reductions may allow stabilization of atmospheric CO₂ at an achievable level of anthropogenic CO₂ emissions. Increased “natural” emissions of CO₂, N₂O, and CH₄ are expected in response to global warming. These emissions, an indirect effect of all climate forcings, are small compared with human-made climate forcing and occur on a time scale of a few centuries, but they tend to aggravate the task of stabilizing atmospheric composition. *Proceedings of the National Academy of Sciences*, November 16, 2004, <http://www.pnas.org/cgi/content/abstract/101/46/16109> (subscription required)

January 2005

“Human contribution to the European heat wave of 2003.” This study estimates the contribution of human-induced increases in atmospheric concentrations of greenhouse gases and other pollutants to the risk of the occurrence of unusually high mean summer temperatures throughout a large region of continental Europe. The authors estimate it is very likely that human influence has at least doubled the risk of a heat wave exceeding the mean summer temperatures of 2003. *Nature*, December 2, 2004, <http://www.nature.com/cgi-taf/DynaPage.taf?file=/nature/journal/v432/n7017/index.html> (subscription required)

Related articles appearing during the month are as follows: “Global Warming Has Doubled Risk of Fatal Heat Waves, Study Says,” *Bloomberg*, December 1, 2004,

http://www.bloomberg.com/apps/news?pid=10000103&sid=axl8L7_u59E0&refer=us#

“Heat wave Study May Fuel Global Warming Lawsuits,” *Reuters*, December 2, 2004,

<http://enn.com/today.html?id=523>

“Heat wave risk rising with emissions,” *The Christian Science Monitor*, December 2, 2004,

<http://www.csmonitor.com/2004/1202/p03s01-sten.html>

“The cloud conundrum.” Short article summarizes work conducted in response to the analysis of the effect of airborne particulate matter on clouds. Climate modelers are unsure of the degree to which aerosols may have been dampening the full climate effects of increasing atmospheric greenhouse gas concentrations. Such effects could push future global temperatures to the high end of the range. The author states that, although the net effects of aerosols remain unquantified, some of the worst case scenarios have been eliminated. *Nature*, December 23/30, 2004, <http://www.nature.com/nature/journal/v432/n7020/abs/432962a.html> (subscription required)

“Abrupt Temperature Changes in the Western Mediterranean over the Past 250,000 Years.” A continuous high-resolution Western Mediterranean sea surface temperature record spanning the past 250,000 years shows that abrupt changes were more common at warming than at cooling. Some of the most prominent events occurred after prolonged warm periods of high stability. *Science*, December 3, 2004, <http://www.sciencemag.org/content/vol306/issue5702/index.shtml> (subscription required)

February 2005

The topic of climate change appeared frequently in the news coverage due to events unfolding in February 2005 (i.e. the tsunami that struck Asia and Tony Blair’s promise to advance global climate change policy as head of both the G8 and EU). Some of the articles are as follows:

“Global warming to reach point of no return in 10 yrs – report.” A study by a US-UK-Australian taskforce entitled, “Meeting the Climate Challenge,” says global warming is 10 years away from the point of no return, with widespread drought, crop failure, and water shortages the likely result. “There is an ecological time bomb ticking away,” said Stephen Byers, former British transport minister, who co-chaired the taskforce that produced the report. The report urges all G8 countries to agree to generate a quarter of their electricity from renewable sources by 2025, and to double their research spending on low-carbon energy technologies by 2010. AFX, January 24, 2005, <http://www.fxstreet.com>. To download the report visit http://www.tai.org.au/Publications_Files/Papers&Sub_Files/Meeting%20the%20Climate%20Challenge%20FV.pdf

“Biggest-ever climate simulation warns temperatures may rise by 11 °C.” The greenhouse effect could be far more severe than experts had previously predicted, according to results from the world's biggest climate-modeling study. In the worst-case scenario, doubling carbon-dioxide levels compared with pre-industrial times increases global temperatures by an average of more than 11 °C (19.8 °F). The results are the first from climateprediction.net, a project that harnesses the world's desktop computers to predict climate change. More than 90,000 people have downloaded software that uses the spare capacity of their computers to run global climate simulations. *Nature*, January 26, 2005, <http://www.nature.com/news/2005/050124/full/050124-10.html> (subscription required)

“Biggest mass extinction tied to global warming.” Two studies published in the journal *Science* challenge the theory that an asteroid triggered the extinction of the dinosaurs 65 million years ago. One report offers new evidence that global warming caused by massive and prolonged volcanic activity may have been the chief culprit. A second set of findings suggested that the warming also crippled the oceans' ability to refresh their oxygen supply, causing the seas to go sterile, destroying marine life and allowing anaerobic bacteria to release poisonous hydrogen sulfide into the air. *San Francisco Chronicle*, January 21, 2005, <http://sfgate.com/cgi-bin/article.cgi?file=/c/a/2005/01/21/MNG0GAU75D1.DTL>

“Fossil fuel curbs may speed global warming-scientists.” According to a BBC documentary, reducing fossil fuel pollution could accelerate global warming and help turn parts of Europe into desert by 2100. The piece describes research suggesting fossil fuel by-products like sulphur dioxide particles reflect the sun's rays, “dimming” temperatures and almost canceling out the greenhouse effect. The researchers say cutting down on the burning of coal and oil, one of the main goals of international environmental agreements, will drastically heat rather than cool climate. *Reuters*, January 13, 2005, http://www.eroei.com/articles/13_jan_05_fossil_fuel.html see, “Why the Sun seems to be 'dimming',” *BBC News*, January 13, 2005, <http://news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/4171591.stm>

“Drought's growing reach: NCAR study points to global warming as key factor.” The percentage of Earth's land area stricken by serious drought more than doubled from the 1970s to the early 2000s, according to a new analysis by scientists at the National Center for Atmospheric Research (NCAR). Widespread drying occurred over much of Europe and Asia, Canada, western and southern Africa, and eastern Australia. “Rising global temperatures appear to be a major factor,” says NCAR's Aiguo Dai, lead author of the study. Interestingly, “the United States has bucked that trend, becoming wetter overall during the last 50 years,” says Dai. *EurekAlert*, January 10, 2005, http://www.eurekalert.org/pub_releases/2005-01/ncafa-dgr011005.php

“Global warming will impact nitrogen use.” Agricultural Research Service (ARS) scientists have been trying to determine whether higher CO₂ levels will increase the amount of nitrogen that wheat and other crops need in order to grow. The results of a two-year study - reported in the January/February 2005 issue of *Agronomy Journal* - found that wheat grown under elevated levels of carbon dioxide over the next half century will need slightly more nitrogen to grow, but not as much as previously predicted. *Grand Island Independent*, January 23, 2005, http://www.theindependent.com/stories/012305/new_warming23.shtml (registration required)

March 2005

“Assumptions Of Effects Of Rising Carbon Dioxide Probed.” A paper in the February 10 issue of the journal *Nature* entitled, “Abrupt Rise in Atmospheric CO₂ Overestimates Community Response in a Model Plant-Soil System,” takes a closer look at how rising levels of carbon dioxide influence ecosystems. Scientists exposed a mycorrhizal fungal community to either an abrupt or gradual increase in CO₂. The group exposed to a slow rise in CO₂ concentration showed less of a decline in the number of species per sample of the fungi than did the

group exposed to the abrupt change, but the difference was not statistically significant. The findings suggest that previous work has overestimated the magnitude of community and ecosystem responses to carbon dioxide changes, the researchers say. *Science Daily*, February 21, 2005, <http://www.sciencedaily.com/releases/2005/02/050218162213.htm>

April 2005

“Global Warming Sparks Plankton Migration.” Scientists working on the Continuous Plankton Recorder survey, which has been monitoring near surface plankton in the North Atlantic and North Sea for the past 70 years, have found that the warm water plankton in the North Sea are migrating northwards while cold water plankton are moving even further north as seawater temperature rises. *The Scotsman*, March 1, 2005, <http://news.scotsman.com>

“Climate Threshold May Alter Economic Picture of Climate Change.” Typical economic analysis applied to global warming may be biased because they neglect climate thresholds, according to Penn State researchers. “Economic analyses typically neglect that greenhouse gas emissions might trigger climate thresholds with potentially significant ecological and economic impacts,” says Klaus Keller, assistant professor of geosciences, Penn State. *GreenBiz.com*, March 4, 2005, http://www.greenbiz.com/news/news_third.cfm?NewsID=27738

May 2005

“Carbon dioxide continues its rise.” The atmospheric concentration of the greenhouse gas carbon dioxide has reached a new high, say U.S. researchers at the Climate Monitoring Diagnostics Laboratory, part of the National Oceanic and Atmospheric Administration. The figures - 378 parts per million – were gathered by a Hawaiian lab regarded by experts as one of the most reliable in climate research. The rise in the past year is smaller than it was in the previous two years. *BBC News*, March 31, 2005, <http://news.bbc.co.uk/1/hi/sci/tech/4395817.stm>

“Researchers: Data validates global warming projections.” Climate scientists, with the aid of diving robots probing the world's warming seas, have found the heat exchange between Earth and space is seriously out of balance – what the researchers called a “smoking gun” discovery that validates forecasts of global warming. They said the findings confirm that computer models of climate change are on target and that global temperatures will rise 1 degree Fahrenheit (0.56 degree Celsius) this century, even if greenhouse gases are capped tomorrow. *CNN*, April 28, 2005, <http://forums.seds.org/showthread.php?t=740>

“Impact of Humans on the Flux of Terrestrial Sediment to the Global Coastal Ocean.” Study provides global estimates of the seasonal flux of sediment, on a river-by-river basis, under modern and pre-human conditions. According to the article, humans have simultaneously increased the sediment transport by global rivers through soil erosion yet reduced the flux of sediment reaching the world's coasts because of retention within reservoirs. Over 100 billion metric tons of sediment and 1 to 3 billion metric tons of carbon are now sequestered in reservoirs constructed largely within the past 50 years. *Science*, April 15, 2005, <http://www.sciencemag.org/content/vol308/issue5720/index.shtml> (subscription required)

“Global Iron Connections Between Desert Dust, Ocean Biogeochemistry, and Climate.” The iron cycle, in which iron-containing soil dust is transported from land through the atmosphere to the oceans - affecting ocean biogeochemistry and hence having feedback effects on climate and dust production – is an important part of the “Earth system.” In this study the authors review the key components of this cycle, identifying critical uncertainties and priorities for future research. *Science*, April 1, 2005, <http://www.sciencemag.org/content/vol308/issue5718/index.shtml> (subscription required)

June 2005

“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. Experiments indicate that microbes with the 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-temperature 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> (subscription required)

“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 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.nytimes.com>. Also, see “East Antarctica puts on weight,” *news@nature*, May 19, 2005, <http://www.nature.com/news/2005/050516/full/050516-10.html> (subscription required)

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)

July 2005

“Earth's Energy Imbalance: Confirmation and Implications.” A NASA Goddard Institute climate model – driven mainly by increasing human-made greenhouse gases and aerosols, among other forcings – calculates that Earth is now absorbing 0.85 ± 0.15 watts per square meter more energy from the Sun than it is emitting to space. This imbalance is confirmed by precise measurements of increasing ocean heat content over the past 10 years. Implications include: the expectation of additional global warming of about 0.6-C without further change of atmospheric composition; the confirmation of the climate system's lag in responding to forcings, implying the need for anticipatory actions to avoid any specified level of climate change; and the likelihood of acceleration of

ice sheet disintegration and sea level rise. *Science*, June 3, 2005, <http://www.sciencemag.org/content/vol308/issue5727/index.shtml> (subscription required)

“Space Measurements of Carbon Offer Clearer View of Earth's Climate Future.” Article summarizes the proceedings of the “Carbon from Space” workshop held in Italy during the first week of June. “Direct satellite measurements of carbon dioxide will have as dramatic an impact as the Hubble Space Telescope within the Earth science field,” said Philippe Ciais of the Laboratory for Climate Sciences and the Environment (LSCE) in Gif-sur-Yvette, France. “It should give us a completely new picture of something more or less completely unknown, showing us the carbon flux across tropical areas such as South America and Africa, where we basically have no data available right now.” In the near future, the capacity to measure CO₂ from space will increase, because the Japan Aerospace Exploration Agency (JAXA) is gearing up for the launch of its Greenhouse gases Observing Satellite (GOSAT) in 2008, while NASA prepares its own CO₂-detecting mission called the Orbiting Carbon Observatory (OCO) for 2007. *ScienceDaily*, June 13, 2005, <http://www.sciencedaily.com/releases/2005/06/050612111201.htm>

August 2005

“Methane May Pack Double the Climate Punch of Earlier Estimates.” Calculations by Dr. Drew Schindell, a NASA scientist, show that methane emissions may account for up to a third of all climate warming between the 1750s and today. Dr. Schindell's calculations include the impact of methane emissions on tropospheric ozone, another greenhouse gas. *Environment News Service*, July 19, 2005, <http://www.ens-newswire.com/ens/jul2005/2005-07-19-01.asp>. To find out more, visit Dr. Schindell's web page at <http://www.giss.nasa.gov/~dshindel/>

Policy

September 2004

Evidence of Warming Cited in Report. A report to Congress suggests that evidence of global warming has begun to affect animal and plant populations in visible ways, and that rising temperatures in North America are due in part to human activity. Although the government issues this report each year, in this instance the overview covers two years of research on climate change and it is accompanied by a letter signed by the secretaries of energy and commerce and the President's science adviser. “Administration Shifts on Global Warming,” *Washington Post*, August 27, 2004, <http://www.washingtonpost.com/wp-dyn/articles/A37232-2004Aug26.html>. See also, “White House Shifts Its Focus on Climate,” *The New York Times*, August 26, 2004, <http://www.nytimes.com/2004/08/26/science/26climate.html?hp>

“China, Australia Sign Climate Change MOU.” The Australian Government and China signed a Memorandum of Understanding on cooperation in climate change action. The Memorandum covers areas such as adapting to climate change, capacity-building, and public awareness. *Point Carbon*, August 16, 2004, <http://www.pointcarbon.com/article.php?articleID=4307&categoryID=147>

Solving the Climate Problem with Current Technologies. Writing in the August 13th issue of the journal *Science*, Princeton researchers contend existing technologies and conservation efforts can curb rising emissions of carbon dioxide until cleaner energy solutions emerge. Princeton suggests doubling the fuel efficiency of cars, driving half as many miles, and boosting efficiency of power plants. Other recommendations include carbon sequestration, substituting cleaner-burning natural gas for coal, replacing lost forests to absorb carbon, and more careful farming methods to retain carbon in soil. “Study says U.S. shouldn't wait to curb carbon emissions,” *The Star Ledger*, August 13, 2004, <http://www.nj.com>

CNN, "CO₂ rules set for California's cars." California released a plan to reduce greenhouse gas emissions from cars and trucks by about 30 percent by requiring hundreds of dollars in technology to control air pollution in new cars. The initial phase, from 2009 through 2012, calls for regulation requiring technology to reduce emissions by about 25 percent for cars and light trucks, and by about 18 percent for larger trucks and sport-utility vehicles. After 2016, when the plan is fully implemented, the recommended regulation would reduce emissions by up to 34 percent for cars and light trucks, and by 25 percent for larger vehicles. The initial phase is expected to add about \$292 to the cost of each car and small truck, and about \$308 to the cost of every large pickup and SUV. CNN, August 9, 2004, http://www.bluewaternet.org/news_stories/gw_8-9-04_cnn.pdf

UK Climate change policy 'off course,' says government report. Government targets for reduced carbon dioxide emissions to the atmosphere will not be met, and environmental taxes, particularly on road traffic, are falling rather than rising, the Commons environmental audit committee says. Petrol and oil cost the same in real terms as they did in 1974, and the overall cost of motoring is slightly less. Bus travel is 50% more expensive, and rail 70%. "Climate change policy 'off course'," *The Guardian*, August 12, 2004, <http://www.guardian.co.uk/climatechange/story/0,12374,1281198,00.html>

New German Renewable Energy Law to Reduce CO₂ Emissions. A new law on renewable energy came into effect in Germany in August. The law is expected to contribute to a reduction of CO₂ emissions of 40 million tonnes annually by 2010. The law aims to improve the investment framework within solar power, wind and hydro power, bio energy, and geothermal power. Germany's ambition is to produce 12.5 percent of its total power from renewables by 2010 and at least 20 percent by 2020. *Point Carbon*, August 2, 2004, <http://www.pointcarbon.com/article.php?articleID=4199&categoryID=147>

"Iran to Ratify the Kyoto Protocol." The Iranian Government ratified a bill for joining Iran to the Kyoto Protocol, Head of the Environment Protection Organization said. The Islamic Republic of Iran Broadcasting (IRIB) reported that through changing its process of industrial technology and energy production, the country has already made efforts to meet the Protocol's objectives. *Point Carbon*, August 4, 2004, <http://www.pointcarbon.com/article.php?articleID=4215&categoryID=147>

October 2004

"Blair calls for 'immediate action' to tackle global warming." Immediate action is needed to tackle global warming if the world is to avoid facing "catastrophic consequences," the Prime Minister warned in a strongly worded speech. Blair said that the "irreversible and destructive" effects of global warming could "radically alter" human existence within his own lifetime. As part of the drive to reduce the impact of modern living on the environment, Mr. Blair said that new schools and housing in the UK would be built in a way that is environmentally sustainable. *Northern Ireland on the Internet*, September 15, 2004, <http://www.4ni.co.uk/nationalnews.asp?id=33208>

West Virginia Governor Bob Wise Speaks on Global Climate Change. Governor Wise made statements in support of action on climate change during a meeting of southern governors and energy leaders, "As governor of one of this nation's largest coal-producing states, I want to see our coal resources used well into the future in the most effective, efficient, and environmental friendly manner as possible." Wise noted that greenhouse gases released by the burning of fossil fuels are becoming an escalating problem for all nations. "Some have predicted that global emissions of these gases must be reduced by 60 to 90 percent over the next 50 years," he said. Governor Wise highlighted the pilot launch of the Carbon Offset Opportunity Program (CO-OP), <http://www.offsetopportunity.com>, an Internet-based tool that helps industry, government, and other organizations develop energy and environmental projects that offset or reduce greenhouse gas emissions. "Wise Touts State's Energy and Environmental Leadership," September 13, 2004, <http://www.wvgov.org>

Canadian Environment Minister Dion endorses CO₂ EOR. Environment Minister Stephane Dion says Canada lags behind the rest of the world in seizing economic opportunities from the environment and challenged energy executives to take a lead role in what he termed a new Industrial Revolution. Dion said more attention must be focused on innovative science. For example, cleaner production methods for oil and gas must be developed. "We need to support research such as the sequestration of carbon dioxide that could one day replace water as a means of enhancing oil recovery, a true win-win situation for our environment and our economy...Nations that manage to reconcile the environment and the economy will derive an enormous

economic opportunity, while those who continue to view the environment as a barrier to competitiveness will fall behind," he said. "Environment Minister Dion says Canada trailing in environmental initiatives," *Cnews*, September 10, 2004, <http://cnews.canoe.ca>

"Airline Passengers Asked to Pay Voluntary CO₂ Levy." The British Government proposed that passengers on airlines should be encouraged to voluntarily offset greenhouse gas emissions from their flights by funding GHG emissions reductions projects. Several organizations and companies around the world offer the chance to sponsor such projects, e.g., forestry projects. *Point Carbon*, September 24, 2004, <http://www.pointcarbon.com/article.php?articleID=4627&categoryID=147>

"Yemen ratifies Kyoto Protocol." Yemen has ratified the Kyoto Protocol, the UNFCCC Secretariat said. It is formally listed as having acceded to the Protocol on September 15, 2004. Yemen is a small, Annex II country, but it is noteworthy that an oil-rich middle eastern state is ratifying a protocol to limit GHG emissions. *Point Carbon*, September 29, 2004, <http://www.pointcarbon.com/article.php?articleID=4659&categoryID=147>

"Cinergy Announces Greenhouse Gas Reduction Projects." Cinergy announced the first series of projects in its voluntary program of reducing greenhouse gas emissions by five percent below 2000 levels between 2010 and 2012. Fourteen projects totaling nearly \$3 million have been selected for 2004 and will provide reductions and offsets of approximately 360,000 tons annually of carbon dioxide. The 2004 projects include: eight projects that will improve the efficiency of Cinergy's electricity generating units, three renewable energy projects, an energy conservation project in concert with a Cinergy customer, a carbon sequestration project, the purchase of five hybrid gasoline/electric energy vehicles, and a research project to analyze greenhouse gas emissions limitations and related technology. In the carbon sequestration area, Cinergy is funding the purchase of trees for a 300-acre reforestation project being managed by the Nature Conservancy in Harrison County, Indiana. The project will sequester approximately 75,000 tons of carbon dioxide annually. *Cinergy Corporate News*, September 15, 2004, http://www.cinergy.com/News/default_corporate_news.asp?news_id=455

New Jersey Redefines CO₂ as Air Contaminant. Governor James E. McGreevey proposed new rules that redefine carbon dioxide as an air contaminant, clearing the way for New Jersey to participate in the Regional Greenhouse Gas Initiative (RGGI). "As a coastal state, New Jersey is especially vulnerable to the consequences of global warming," said McGreevey. "McGreevey Announces New Proposal to Address Global Warming," *NJ Governor's Office*, September 17, 2004, http://www.state.nj.us/cgi-bin/governor/njnewsline/view_article_archives.pl?id=2144

November 2004

Ford to improve fuel efficiency by 80% by 2030. Top executives at the Ford Motor Company have privately endorsed an aggressive goal to rein in global warming emissions from the automaker's vehicles. The goal was laid out by the company's chairman, William Ford Jr., who sees environmental initiatives as a critical part of the company's business strategy and is concerned about Toyota's aggressive strategy to lead in fuel-efficient technologies as regulations around the world tighten. "Ford becomes latest company to tackle global warming emissions," *Taipei Times*, October 3, 2004, <http://www.taipetimes.com/News/biz/archives/2004/10/03/2003205406>

U.S. Power Companies Expect CO₂ Restrictions. A survey of U.S. electric generating companies shows that nearly 60 percent of the respondents believe that Congress will enact mandatory limits on carbon dioxide emissions within the next ten years. *Point Carbon*, October 26, 2004, <http://www.pointcarbon.com/article.php?articleID=4996&categoryID=147>

California adopts forest-saving plan. California became the first state to reward landowners for leaving forests standing to help control global warming. "In California alone, forest loss is equivalent to 2.5 million new cars going on the roads every year," said Laurie Wayburn, president of the Pacific Forest Trust who helped develop the program. "State adopts forest-saving plan," *The Register-Guard*, October 24, 2004, <http://www.registerguard.com>

December 2004

Putin signs Kyoto. Russia gave final approval to the Kyoto Protocol on global warming as President Vladimir Putin signed legislation ratifying the pact. Economist Yuri Safonov with the Russian Higher School of Economics says that Russia should be able to sell quotas for the discharge of about 2.2 billion tons of greenhouse gases without hurting its economy. "Russian president signs ratification of Kyoto Protocol on global warming," *San Francisco Chronicle*, November 5, 2004, <http://sfgate.com/cgi-bin/article.cgi?file=/news/archive/2004/11/05/international1511EST0589.DTL>

"Kyoto Can't do the Job Alone Says Expert." Eileen Claussen, President of the Pew Center for Global Climate Change, says more than just the Kyoto Protocol is needed to tackle climate change. Something other than Kyoto is needed to deal with coal. Said Claussen, "Some of the biggest emitters, including the United States, China and India, have huge coal resources. They are going to use them. We have to find a way to use coal so that it does not create a climate problem. That will require a huge research and development effort on carbon capture and sequestration." *New Zealand Herald*, November 8, 2004, <http://www.nzherald.co.nz/storydisplay.cfm?reportID=57030&storyID=3607930>

"Cost of Kyoto 'Five Times Above EU Estimate'." Implementing the Kyoto protocol might hit the EU economy five times harder than predicted by the European Commission, according to research presented by the lobby group Unice. A study by the consultants COWI found that current EU policies to meet Kyoto targets would most likely shave 0.48% off the bloc's GDP by 2010, predicting a drop in exports of around 0.5%, rising to as much as 5.1% for "energy-intensive" exports. The European Commission has forecast a drop in GDP of only 0.1%, though its study used a very different economic model. *Environment Daily*, November 18, 2004, http://www.edie.net/news/news_story.asp?id=9208&channel=6

State Actions to Address Climate Change. According to this article, nearly every U.S. state now has programs to reduce global warming pollution, and many have moved to the next step by working together in regional blocs. The article cites the cap-and-trade system developed by nine northeastern and Mid-Atlantic States, the alliance to boost energy efficiency and the use of renewables in the power grids of 19 western states, and California's tailpipe legislation as examples of state actions to address GHG emissions. Other states are seeking technological innovations to solve the problem. For example, the Ohio Coal Development Office funds projects that capture and sequester carbon dioxide emissions from coal combustion, while the South Carolina Hydrogen Coalition is promoting economic development by building expertise in hydrogen technology. "States Steam Ahead on Climate Change," *Inter Press Service*, November 24, 2004, <http://www.commondreams.org/headlines04/1124-08.htm>

Canada to adopt California-style tailpipe rules. By following California's new fuel-efficiency standards, Canada pledges to cut greenhouse gas emissions from road vehicles by 25 percent by 2010. Such a move to require carmakers to improve the efficiency of their vehicles means that the auto industry faces steep cuts in greenhouse gases in Canada as well as in California and the Northeastern United States, covering one third of the cars and trucks sold in North America. "Canada to follow California's lead on cars," *Point Carbon*, November 18, 2004, <http://www.pointcarbon.com/article.php?articleID=5351&categoryID=147>

EU urges emissions cut in aviation. A House of Lords report urges the British government to use its power as president of both the EU and G8 to curb the growth in carbon dioxide emissions from Europe's rapidly expanding aviation industry. Said Lord Renton, chairman of the Lords EU environmental sub-committee, "Carbon sequestration in oil wells or under the sea, macro-engineering to alter our planet's ability to reflect the sun's rays or to make the oceans soak up more carbon dioxide, and other radical measures are being considered by scientists and industry, but are far from viable at present. Policies to reduce greenhouse gas emissions from cars, airplanes, landfills, electricity and other sources are therefore crucial precautions." "Jet pollution must be cut in climate fight, warn peers," *The Guardian*, November 10, 2004, http://www.guardian.co.uk/uk_news/story/0,3604,1347326,00.html

"Curbing the U.S. Carbon Deficit." Article compares scenarios of land-based sequestration to emissions reductions arising from increased fuel efficiency in transportation, targeting ways to reduce net U.S. emissions by 10 percent (0.16 Pg of carbon per year). One-third of U.S. croplands or 44 million hectares would be converted to no-till for plantations to reach the target of 0.16 Pg of carbon per year. A doubling of fuel efficiency

for cars and light trucks would also provide a reduction of 0.16 Pg of carbon per year. *Proceedings of the National Academy of Sciences*, November 9, 2004, <http://www.pnas.org/cgi/content/abstract/101/45/15827>

January 2005

“Europe Seeks New Accords With U.S. on Global Warming.” According to this article the European Union is seeking new agreements with the U.S. to slow climate change without relying on the Kyoto Protocol. Said Paula Dobriansky, U.S. under secretary of state for global affairs, at the United Nations conference on climate change in Buenos Aires, “The U.S. is ‘committed’ to the UN Convention on Climate Change it signed, which calls for voluntary reductions in greenhouse gases. One important goal is agreements with other governments to develop and promote technology to reduce emissions, such as separating and injecting carbon dioxide from coal burning power plants into the earth.” *Bloomberg*, December 15, 2004, http://www.bloomberg.com/apps/news?pid=10000086&sid=a2kmax6pOOV8&refer=latin_america#

“Temporary Sequestration Credits: An Instrument for Carbon Bears.” Temporary crediting of carbon storage is a proposed instrument that allows entities with emissions reductions obligations to defer some obligations for a fixed period of time. According to this study, temporary carbon storage credits must sell at a discount compared to a permanent credit because the user of the temporary credit takes on the liability of renewing it, or replacing it with a permanent credit. The authors show that the discount depends on the expected change in price of a permanent credit. Temporary credits have value only if restrictions on carbon emissions are not expected to tighten substantially. *Climate Policy* 4 (1, 2004): 65-74, <http://ideas.repec.org/p/wbk/wbrwps/3181.html>

U.S. power companies set voluntary GHG targets. A group comprised of seven U.S. power organizations and companies have signed a voluntary agreement with the Department of Energy to reduce their greenhouse gas emissions intensity. The group has signed a Memorandum of Understanding to cut their emissions per unit of output by an equivalent of 3 to 5 percent below 2000-2002 baseline levels, as measured over the 2010-2012 period. “Department of Energy-U.S. Power Sector Sign MOU on Voluntary Efforts to Reduce Greenhouse Gas Emissions,” *U.S. Newswire*, December 13, 2004, <http://releases.usnewswire.com/GetRelease.asp?id=40642>

“Edison International Asks Regulators to Address Global Warming on a National Level.” “A deliberate and coordinated effort is needed to reduce greenhouse gas emissions across the entire energy sector,” said John Bryson, chairman of Edison International. “Neither greenhouse emissions nor electricity stop at state borders. We believe the broader view can lead to a new national policy on global warming.” Edison advocates developing policies to reduce greenhouse gas emissions based on a comprehensive consideration of renewable energy and low carbon-emitting technologies, energy conservation and energy efficiency programs, conventional generation, and new carbon-dioxide emission-removal technologies. *Business Wire*, December 7, 2004, <http://www.newsbackup.com/about277679.html>

“Industry concerns get increased attention at COP-10.” Executives from a wide range of companies at the conference say business interest in climate change issues is on the uptake and policymakers at the conference seem more prepared to listen to their concerns this year. At previous COP meetings, it was primarily power utility executives representing the business community. But, attendees from energy-intensive industries, chemical companies, and other industries likely to be the most affected by carbon dioxide regulations have begun attending. At some side events, business representatives provided their thoughts on specific policy matters. *Greenwire*, December 15, 2004, <http://www.eenews.net/Greenwire.php> (subscription required)

“Australia distances itself from U.S. climate change policy.” Australian Environment Minister Ian Campbell made moves to distance the Australian government’s views from U.S. policies on linking production to carbon emissions in order to reduce greenhouse gas emissions. Campbell reportedly told *The Age* newspaper that Australia did not agree with U.S. policies of relative targets i.e., reducing each unit of CO₂ per unit produced, which the U.S. claims curbs relative emissions while protecting economic growth. *Point Carbon*, December 22, 2004, <http://www.pointcarbon.com/article.php?articleID=5832&categoryID=147>. Also see, “Australia draws line with United States on global warming: report,” *Terra Wire*, December 20, 2004, <http://www.terradaily.com/2004/041220025632.4fgeexln.html>

“China defends economic growth at climate conference.” Speaking at the UN climate change conference in Buenos Aires, a top official of the Chinese foreign ministry, Gao Feng said, “We are a developing country, we’re not yet making international commitments. We will continue to attend to our energy needs. We will need to increase our energy consumption for the next 30 to 50 years.” Gao continued, “People are saying, you’ll have to curb your energy needs...that developing countries must curb their energy needs, I cannot accept that, it is something totally wrong.” Gao noted that China’s per capita CO₂ emissions were only one eighth of U.S. emissions. According to Gao, U.S. participation in any accord is necessary before any post-Kyoto agreement is considered by China. *Agence France-Presse*, December 14, 2004, <http://www.climateark.org/articles/reader.asp?linkid=37262>

February 2005

“Plan would let big polluters put money into research rather than cut emissions.” One of the latest proposals for implementing the Kyoto climate treaty in Canada would allow large industrial polluters to put money into research and development rather than cutting greenhouse emissions. Instead of requiring a 55-megatonne cut from the large emitters, as originally proposed, the proposal suggests a cut of 20 to 25 megatonnes. Big polluters could earn emissions credits by contributing to a Technology Investment Fund intended to foster clean energy and environment-friendly innovation. The fund could also support infrastructure projects, for example pipelines to carry carbon dioxide from large emitters to places where it could be used in underground oil and gas recovery. *The Canadian Press*, January 19, 2005, <http://www.cp.org/>

“Auto makers wouldn’t sell guzzlers in Canada to meet Kyoto target.” Auto industry representatives claim that gas-guzzling luxury cars and big SUVs could be withheld from the Canadian market in coming years if Ottawa makes good on threats to impose fuel-efficiency standards. They say it is technically impossible to redesign cars in time to meet the fuel-efficiency target set out in Canada’s Kyoto implementation plan, so withholding some models could be the only alternative. *The Calgary Herald*, January 21, 2005, <http://www.canada.com>

“Pacific Gas & Electric Company to certify and report GHG emissions.” PG&E has certified its greenhouse gas emissions inventory with the California Climate Action Registry. PG&E is a charter member of the Registry and is now publicly and voluntarily reporting its GHG emissions from generation, transmission, and distribution of gas and electricity in California. Starting in 2006, all of the electric power companies and utilities in the Registry program will also report efficiency metrics along with their inventories. *Point Carbon*, January 20, 2005, <http://www.pointcarbon.com/article.php?articleID=6102&categoryID=147>

March 2005

“CA. Moves to Protect Ratepayers from Future Greenhouse Gas Regulations.” A decision by the California Public Utilities Commission (PUC) directs the state’s largest electric utilities to include CO₂ costs between \$8-25 per ton when evaluating the economics of future energy resource additions. The GHG value will be added to the prices bid in future request for offers (RFOs), and will be used to develop a more accurate price comparison between and among fossil, renewable, and demand- side bids. The PUC order states, “Regardless of which bid is ultimately selected, the adder will not be paid to that generator or charged to ratepayers; it is an analytic tool only...Thus, the effect of the adder is to potentially change which bids and resources are selected - not to change the price of selected bids.” *ILSR Newsletter*, February 14, 2005, <http://www.newrules.org/de/archives/000041.html>

“CEQ Chairman Jim Connaughton discusses climate change.” Jim Connaughton, chairman of the White House Council on Environmental Quality, defends the Bush administration’s efforts on global warming in a discussion with *E&E Daily*. Connaughton addresses criticism from the United Kingdom and other nations that are pressuring the White House to take stronger action on climate change, while also describing the administration’s efforts to spur the development of new technologies such as carbon sequestration. *E&E TV*, February 2, 2005, <http://www.eande.tv/main/?date=020205>

“Connecticut to release climate change action plan.” The Connecticut Governor’s Steering Committee released a climate change action plan that expands programs to use electric, natural gas, and fuel oil more efficiently, and limits CO₂ emissions from power plants through a regional emissions trading program. “This Action Plan is a great step forward as we in Connecticut fight global warming, caused by carbon and other pollutants. Our state government can and must take action to protect the air we breathe and the health of our citizens,” said State Senate President Pro Tempore Donald Williams. “Breathing clean air is the right of every citizen in the state. And they expect nothing less.” *Point Carbon*, February 15, 2005, <http://www.pointcarbon.com/article.php?articleID=6601&categoryID=471>. To review the plan, visit Connecticut’s Official Climate Change Website at <http://www.ctclimatechange.com/>

“Japan urges industry to cut emissions further.” Japan’s Ministry of Economy, Trade and Industry (METI) has asked power producers and the industrial sectors for steel, electrical machinery, rubber, paper, industrial vehicle, automotive body, automotive component, machine tool, industrial machinery, and construction machinery to step up action to cut emissions. Companies in Japan have only had voluntary emissions targets, and emissions from 1990 have increased, putting Japan well off its 6 percent reduction target under Kyoto. Twelve sectors including the oil, chemical, and aluminum industries have achieved their voluntary goals, while those singled out by METI now haven’t. Policy-makers in Japan have been discussing a carbon tax as well as a domestic emissions trading scheme for some time, but opposition is significant against both within industry. *Point Carbon*, February 2, 2005, <http://www.pointcarbon.com/article.php?articleID=6376&categoryID=471>

April 2005

“EC advocates sequestration and storage of CO₂ from coal activities.” Due to coal’s high CO₂ emissions, energy commissioner Andris Piebalgs wants to invest €100 million in sequestration and storage of CO₂ from coal. “Coal in itself is not bad. The problem is the high CO₂ emissions. Therefore, that will be our focus,” said Piebalgs. He also urged Member States and utilities to invest in clean coal technology, hoping to establish a large, Europe-wide research project in the field. *Point Carbon*, March 18, 2005, <http://www.pointcarbon.com/article.php?articleID=7290&categoryID=471>

“IOGCC taskforce issues CO₂ sequestration proposals.” A new Interstate Oil & Gas Compact Commission report says U.S. states and Canadian provinces should play a critical part as a carbon dioxide sequestration regulatory regime develops. States and provinces already have 30 years of experience regulating CO₂ used in enhanced oil recovery, an IOGCC task force noted in preparing the report. The group also recommends that CO₂ remain a commodity covered by state laws and not be classified as a waste or pollutant. “State laws protect resources and maximize recovery. The IOGCC merely is saying that CO₂ should have the same designation. Classifying CO₂ as a waste would limit CCGS [carbon capture and geological storage] development,” said Arkansas Oil & Gas Commission Director Lawrence E. Bengal, who led the task force. *Oil & Gas Journal*, March 10, 2005, <http://ogj.pennnet.com> (subscription required). To download the full report visit <http://www.iogcc.oklaosf.state.ok.us/PDFS/Final%20Report,%201-28-05.pdf>

“Climate group: Guidelines a 'charade'.” In response to new government guidelines for reporting greenhouse gas emissions and carbon sequestration in the forest and agriculture sectors, David Hawkins of NRDC called the reporting registry a “charade that is intended to allow the government and the participants to portray that they are doing something about global warming, when they are not.” *CNN*, March 23, 2005, <http://www.cnn.com>

“China committed to building lower carbon economy.” China is committed to building a lower carbon (emission) economy to combat climate change over the coming decades, a Chinese official said at a meeting in London. In his key-note speech, Liu Jiang, vice-chairman of China’s National Development and Reform Commission, said that as a rapidly-developing country, China has been challenged by climate change and energy scarcity. China is among a few nations in the world that rely on coal as their major energy source. “Coal amounts to 67 percent of primary energy consumption in the country,” which made it more difficult to slow down the growth momentum of carbon emission, Liu said. Technology development and transfer is the ultimate solution to the challenge of climate change, he said. *People’s Daily*, March 16, 2005, http://english.people.com.cn/200503/16/eng20050316_177048.html

“EU Ministers Want Tough Post-Kyoto Emissions Target.” European Union environment ministers proposed that developed nations make sweeping cuts in greenhouse gas emissions in the years following 2012, when the first period covered by the Kyoto Protocol ends. Their recommendations go against those of the EU's executive Commission, which said in February it was too early to set post-2012 targets. A statement agreed by the ministers said developed nations ought to aim for cuts “in the order of 15-30 percent by 2020 and 60-80 percent by 2050, compared to the levels envisaged in the Kyoto Protocol.” *Reuters*, March 11, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsid/29895/story.htm>

“Global Warming Threat Central to Policy-Britain.” Britain told the world's biggest polluters including the United States that only by placing the environment at the heart of economic policy could they prevent a crisis caused by global warming. “We must make climate stability, energy investment and energy security central to economic policies,” said British Chancellor of the Exchequer Gordon Brown. “International cooperation is again the only way forward.” Brown said he would study the costs and feasibility of so-called carbon sequestration – the capture and burial deep underground of millions of tons of the carbon dioxide emitted by fossil fuel burning power stations. *Reuters*, March 15, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsid/29948/story.htm>

“UK's Brown freezes climate change levy, buys into sequestration.” The UK Chancellor of the Exchequer Gordon Brown said the government would freeze the climate change levy, an energy tax on business. The government also said it would lower duties on natural gas, bioethanol, biodiesel and liquefied petroleum gas for the next three years to encourage lower emissions. As expected, Brown also offered to plough money into research and development for carbon dioxide geosequestration. *Point Carbon*, March 17, 2005, <http://www.pointcarbon.com/article.php?articleID=7261&categoryID=478>

“U.S. Oil/Gas Companies Take Action to Reduce Climate Change Risks.” After extensive negotiations with shareholders, Anadarko Petroleum, Apache, ChevronTexaco and three other leading U.S. oil and gas companies have taken far-reaching actions in recent months to disclose their potential financial exposure from climate change and develop strategies to improve their strategic positioning as international pressure grows to reduce greenhouse gas emissions and promote renewable energy sources. The article summarizes the specifics of the company commitments and actions. *CSR Wire*, March 18, 2005, <http://www.csrwire.com/article.cgi/3648.html>

“Canada to introduce bill on greenhouse gases.” The Canadian federal government intends to introduce a bill to bring greenhouse gases under the Canadian Environmental Protection Act. The Canadian federal government's decision to impose regulations on greenhouse gas emissions on heavy industries has angered Alberta premier Ralph Klein. The greenhouse gas regulations would then come under the same act that regulates toxic chemicals such as PCBs. *Point Carbon*, March 18, 2005, <http://www.pointcarbon.com/article.php?articleID=7296&categoryID=471>

Swiss Govt Adopts CO₂ Tax on Fossil Fuels. The Swiss government has decided to impose a tax on heating oil and raise a levy on petrol and diesel imports as of next year, to help cut CO₂ emissions. The “Climate Penny” will be introduced on a trial basis, making a large amount of money available for the purchase of credits from CDM and JI projects. The environment minister, Moritz Leuenberger, warned though that if greenhouse gas levels were not curbed, motor fuel could also be taxed later. “Compromise solution to slash CO₂ emissions,” *Swissinfo*, March 24, 2005, <http://www.nzz.ch/2005/03/24/eng/article5624432.html>

May 2005

EIA study finds that GHG emission caps safe for economy. Senator Jeff Bingaman (D-NM) asked the EIA to study the possible effects of a proposal by the National Commission on Energy Policy. Under the proposal, beginning in 2010, businesses that pollute more than their allotment would have to pay up to \$7 a ton to those that pollute less. EIA estimates the commission's plan would cut greenhouse gases by 7 percent, or 622 million tons, from what is forecast for 2025. EIA found coal use would increase 22 percent over that time, while total electricity prices would rise less than 5 percent and gasoline prices would go up by a few pennies a gallon. “Emission limits safe for economy, agency says,” *Star Tribune*, April 16, 2005, <http://www.startribune.com>. The April 2005 study, “Impacts of Modeled Recommendations of the National Commission on Energy Policy,” can be downloaded at [http://www.eia.doe.gov/oiaf/servicerpt/bingaman/pdf/sroiaf\(2005\)02.pdf](http://www.eia.doe.gov/oiaf/servicerpt/bingaman/pdf/sroiaf(2005)02.pdf)

“Duke Push For Carbon Tax May Signal Shift Toward Nuclear Power.” Duke Energy chief Paul Anderson’s surprising call on Congress to enact a carbon tax is being viewed as evidence of a company, and possibly an industry shift to nuclear power over coal, according to observers, who say such a tax would give emission-free nuclear power a significant competitive edge over coal. *Energy Washington*, April 12, 2005, <http://www.energywashington.com> (subscription required)

“States Seek Regulation Of Greenhouse Gases.” A coalition of 12 states and several cities asked a federal appeals court to make the Environmental Protection Agency reconsider its decision not to regulate heat-trapping greenhouse gases as air pollutants. *Washington Post*, April 10, 2005, <http://www.washingtonpost.com/wp-dyn/articles/A40500-2005Apr9.html> (registration required). For an in-depth discussion on the background of the case see, “Crazy on Carbon Dioxide,” *National Review*, April 8, 2005, <http://www.nationalreview.com/comment/lewis200504080955.asp>

“Green Goal.” The 2006 FIFA World Cup in Germany is to be the world’s first climate-neutral major sporting event. Germany plans to offset greenhouse gases that cannot be prevented by improving energy efficiency, or by replacing conventional energies with renewable ones. In order to prevent the major sporting event from causing any lasting damage to the atmosphere, an estimated 100,000 tonnes of GHG emissions will be prevented elsewhere through climate projects in South Africa and South East Asia. The costs of around one million euros will be borne by the World Cup Organizing Committee. *FIFA*, April 12, 2005, <http://fifaworldcup.yahoo.com/06/en/030331/4/az.html>

“U.S. senators urge climate action.” A joint resolution tabled by Democratic Senator Dianne Feinstein and co-sponsored by thirteen other Democrat and Republican senators urges the U.S. to demonstrate international leadership and responsibility in climate change issues. The resolution was tabled in February, and currently sits in the Foreign Relations Office of the U.S. Senate. The Senate resolution also asks the U.S. to support the long-term target of limiting the increase in global temperature to 2 degrees Celsius above pre-industrial levels, the same target the EU has set. *Point Carbon*, April 27, 2005, <http://www.pointcarbon.com/article.php?articleID=8022&categoryID=881> (subscription required)

June 2005

“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.enn.com/today.html?id=7667>

“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.chicagotribune.com>

“132 Mayors of U.S. cities Embrace GHG Emissions Reductions.” Seattle Mayor Greg Nickels says 131 other like-minded 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 equivalents 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 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.eenews.net/Greenwire.php> (subscription required)

“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-globalwarming-tax/2005/05/05/1115092623162.html?oneclick=true> (registration required)

“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.com>

July 2005

“The debate's over: Globe is warming.” Article cites recent events – GE’s Ecomagination campaign, Governor Schwarzenegger’s call for reduced GHG emissions in California, and pressure from religious groups – that have shifted the debate over whether the planet is heating, to what to do about it. *USA Today*, June 12, 2005, http://www.usatoday.com/news/world/2005-06-12-global-warming-cover_x.htm?POE=NEWSVA

“China to Watch Others on Climate Change Action.” China will watch how other countries meet their commitments under phase I of the Kyoto Protocol before deciding whether to sign up to its own mandatory cuts, said Xie Zhenhua, Chinese environment minister. *Reuters*, June 15, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsid/31247/story.htm>

“Scientists pile on pressure over climate change.” The Royal Society, the U.S. National Academies of Science, along with the science academies of France, Russia, Germany, Japan, Italy, Canada, Brazil, China, and India signed a joint statement calling on G8 nations to reduce greenhouse gas emissions. The statement says, “There is now strong evidence that significant global warming is occurring. It is likely that most of the warming in recent decades can be attributed to human activities...It is vital that all nations identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions.” *The Guardian*, June 8, 2005, <http://www.guardian.co.uk/climatechange/story/0,12374,1501659,00.html>. The statement can be downloaded at <http://nationalacademies.org/onpi/06072005.pdf>

U.S. is “doing more than people give them credit for.” In an interview with the Guardian ahead of the British-chaired G8 summit in July, which seeks to promote climate change and Africa as the great challenges of the decade, Tony Blair’s environment secretary says that the U.S. is “doing more than people give them credit for in terms of new technology investment such as carbon sequestration...But the question is, ‘is that enough?’ And the general feeling in the world community is that no, it is not doing enough.” In this article Margaret Beckett urges the Bush administration to accept that the “incontrovertible” weight of scientific evidence on the dangers of global warming is stimulating an urgent worldwide dialogue that the U.S. must seriously engage with - or risk being left out. *The Guardian*, May 28, 2005, <http://politics.guardian.co.uk/green/story/0,9061,1494310,00.html>

“Climate and energy: what the United States needs.” Article argues that America can meet the global warming challenge by modernizing its energy policy to catch up with and then lead the world. The author cites five paths to the future: cost-effective clean alternatives to gasoline (ethanol and hydrogen), modernization of the electric power grid, modernization of the U.S. auto industry, expanding renewable energy resources, and modernizing the coal industry. With regard to advanced combined cycle power plants with carbon sequestration the author says, “The Bush administration has a small program for this, but it is not nearly big enough.” *OpenDemocracy*, May 26, 2005, http://www.opendemocracy.net/globalization-climate_change_debate/USclimate_2547.jsp

Southern Company Chairman Addresses Energy Policy Issues. Southern Company Chairman, President and CEO David Ratcliffe said that the company is working hard to achieve a “delicate balance” of providing more affordable electricity to a growing region while continuing to lower emissions from its power plants. “As we look to the future, here’s what we know: There is a 250-year supply of coal in the United States, compared with about 50 years of a known supply of natural gas,” Ratcliffe explained. “Coal is here. It is not in a foreign land. As compared to the fact that more than 95 percent of the world’s known natural gas reserves lay outside the United States. We must continue to use coal, although we must use it more efficiently and cleanly.” Southern Company believes technology is the answer to address energy policy and energy demand, said Ratcliffe. “We must develop a smart, sensible energy policy, driven by technology that assures electricity is affordable and reliable for everyone.” *PRNewswire-FirstCall*, June 13, 2005, <http://newsinfo.southernco.com/article.asp?mnuType=sub&mnuItem=ni&id=1754&mnuOpco=soco&category=0>

August 2005

“Bush Administration Unveils Alternative Climate Pact.” The Bush administration, which is pushing alternatives to the Kyoto accord on global warming, unveiled a six-nation pact that promotes the use of technology to cut greenhouse gas emissions. The six nations, the United States, Japan, Australia, China, India, and South Korea, will build on existing bilateral agreements on technology sharing to control emissions, but will not set mandatory targets. The new group’s first summit will be held in Adelaide, Australia, in November. *New York Times*, July 28, 2005, <http://www.nytimes.com/2005/07/28/international/28climate.html>

The Group of Eight (G8) summit was held on July 6-8, 2005, in Gleneagles, Scotland. The following articles summarize the outcome of the meeting:

“Bush wants to shift global warming debate.” President Bush said he wanted to shift debate on global warming away from limits on greenhouse gas emissions to new technology that would reduce environmental harm without restricting energy use. In an interview with a British journalist Bush said, “My hope is – and I think the hope of Tony Blair is – to move beyond the Kyoto debate and to collaborate on new technologies that will enable the United States and other countries to diversify away from fossil fuels so that the air will be cleaner and that we have the economic and national security that comes from less dependence on foreign sources of oil.” *CNN*, July 5, 2005, <http://www.cnn.com>

“G8 climate plan ‘lacks bite’.” World leaders attending the G8 summit in Britain released their statement on climate change, agreeing that the issue is a “serious long-term challenge”. Their statement says that some US\$16 trillion of investment will be required over the coming 25 years, a period during which the world’s energy demands will increase by 60 percent, mostly in burgeoning economies such as India and China. Possible technologies that could be deployed to combat greenhouse-gas emissions include alternative power sources such as the sun, wind, water and nuclear fission or fusion. Perhaps the biggest challenge will be to equip developing nations with the technology to burn fossil fuels more cleanly, for example, by ‘scrubbing’ carbon dioxide from coal-fired power plants. *news@nature.com*, July 8, 2005, <http://www.nature.com/news/2005/050704/full/050704-15.html> (subscription required)

“G-8 Urges Action On Global Warming, With General Goals.” Leaders of the world’s eight major industrial nations agreed to take immediate steps to curb global warming, though they will not set concrete heat-trapping gas reductions or specify how much money they will spend. The leaders’ joint statement states that although some uncertainties about climate change remain, “we know enough to act now and to put ourselves on a path to slow, and, as science justifies, stop and then reverse the growth of greenhouse gases.” It also suggests that “human activities contribute in large part to increases in greenhouse gases associated with the warming of our earth surface.” *The Washington Post*, July 8, 2005, <http://www.washingtonpost.com/wp-dyn/content/article/2005/07/07/AR2005070702133.html>. For the full text of the G8 Climate Change, Clean Energy and Sustainable Development agreement and the Gleneagles plan of action, visit <http://www.wbcsd.org/includes/getTarget.asp?type=DocDet&id=15809>. Also read the Pew Center’s G8 summary at <http://ealert.pewclimate.org/ctt.asp?u=3445840&l=99178>

“Canada joins EPA’s international Methane to Markets Partnership.” Canada became the 16th member of the U.S. Environmental Protection Agency’s Methane to Markets Partnership. The partnership is an international initiative promoting the recovery and use of methane from landfills, coal mines, and natural gas and oil systems. Participants in the partnership hope to reduce annual methane emissions by 50 million metric tons, the equivalent of recovering 500 billion cubic feet of natural gas, enough energy to heat 7.2 million homes for one year. *Waste News*, July 15, 2005, <http://www.wastenews.com/headlines2.html?id=1121442010>

“Arizona to tackle climate change.” The state of Arizona will work on plans for cutting greenhouse gases, joining neighbors California and New Mexico. Arizona’s efforts will involve at least a year of study before any recommendations are made, culminating in a white paper. “Arizona and New Mexico are the first inland states to embrace climate change issues,” said Roger Clark, who works on air-quality issues for the Grand Canyon Trust. *The Arizona Republic*, July 10, 2005, <http://www.azcentral.com/arizonarepublic/local/articles/0710climatechange10.html#>

“World Bank to take lead in new climate change plan.” The World Bank wants to bring together nations split over the Kyoto Protocol to work out a new plan that would remain effective long beyond the 2012 expiration of the climate change treaty. Ian Johnson, the World Bank’s top environment official, said the bank will serve as a global mediator on climate change, bridging the huge differences in approach between the developed and emerging countries, including India and China. *Reuters*, July 20, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsid/31745/story.htm>

“EPA not required to limit emissions.” The Environmental Protection Agency does not have to regulate gases linked to climate change as air pollutants, a federal appeals court ruled, dealing a blow to a dozen states and three cities hoping to cut heat-trapping gases. In a divided 2-1 ruling, a panel of the U.S. Court of Appeals for the District of Columbia ruled that the EPA had solid policy reasons not to impose mandatory limits on carbon dioxide, methane, nitrous oxide and hydrofluorocarbons. *Chicago Tribune*, July 16, 2005, <http://www.chicagotribune.com>

Clinton Announces Global Initiative to Address Climate Change. Former President Bill Clinton has announced the Clinton Global Initiative (CGI) to address climate change, corruption, poverty, and religious and ethnic reconciliation. Mr. Clinton will host a meeting of private and public sector leaders from September 15-17, 2005 in New York to coincide with the United Nations’ General Assembly. Clinton says he is intent on finding ways the private sector can solve some of the world’s most pressing problems from poverty to terrorism. “It’s unrealistic to think all the world’s problems will be solved only by government actions,” Mr. Clinton said. He believes the most important statement on global warming in the past year came not from government but from a businessman, Jeff Immelt, General Electric’s CEO, who recently declared GE would spend \$1.5 billion in the next decade to make clean energy a profit leader at the company. *Associated Press*, July 13, 2005, <http://www.sanluisobispo.com/mld/sanluisobispo/news/world/12169991.htm>

Geology

September 2004

“Coal-Bed Methane Triggers Promise and Concern.” Discusses the potential of coal-bed methane as a domestic natural gas resource (currently CBM supplies 7.5% of domestic NG) and also brings to light concerns over the cost of CBM clean-up and the environmental issues associated with the large quantities of water that are produced with the gas. Discusses a cross-border dispute between Canada and the state of Montana over a Canadian plan to extract CBM from nearby British Columbia. The main concern is that the process, which uses significant amounts of fresh water, would pollute their combined water sources. *UtiliPoint International IssueAlert*, August 2, 2004, <http://www.utilipoint.com/issuealert/article.asp?id=2214>

October 2004

“CO₂ sequestration in Ontario, Canada. Part I: storage evaluation of potential reservoirs.” Two saline formations amenable to CO₂ storage are identified in Ontario, Canada. The first, located in the southern part of Lake Huron, has an estimated CO₂ storage capacity of 289 million tons. The second is located inside Lake Erie and could store 442 millions tons of CO₂. *Energy Conversion and Management*, Volume 45, Issue 17, October 2004, Pages 2645-2659, <http://www.sciencedirect.com/science/journal/01968904> (subscription required)

November 2004

“CO₂ sequestration in Ontario, Canada. Part II: cost estimation.” This paper evaluates the capital and operating cost for CO₂ sequestration in southwestern Ontario from a 500 megawatt coal fired power plant. The main focus is on the cost of sequestration (CO₂ transport and injection), and thus, the cost of capturing and pressurizing the CO₂ from the plant flue gas is not considered here. Many uncertainties are associated with cost estimation; several are identified and their impacts are considered in this paper. The estimated cost of sequestration of 14,000 ton/day of CO₂ at approximately 110 bar in southwestern Ontario is between 7.5 and 14 US\$/ton of CO₂ stored. *Energy Conversion and Management*, 45 (2004) 3207-3217, <http://www.sciencedirect.com/science/journal/01968904> (subscription required)

“Increasing CO₂ storage in oil recovery.” This paper contains examples which demonstrate and calculate the different mechanisms controlling the displacement behavior of CO₂ sequestration schemes, the interaction between flow and phase equilibrium, and how proper design of the injection gas composition and well completion are required to co-optimize oil production and CO₂ storage. *Energy Conversion and Management*, 46 (2005) 293-311, <http://www.sciencedirect.com/science/journal/01968904> (subscription required)

December 2004

“Methane and Carbon Dioxide Adsorption-Diffusion Experiments on Coal: Upscaling and Modeling.” A series of laboratory-scale experiments provide information on the kinetics of adsorption and desorption of CO₂ and CH₄ on coal. CO₂ sorption was consistently faster than CH₄ sorption under all experimental conditions. For moist coals, sorption rates of both gases were reduced by a factor of more than 2 with respect to dry coals, and the sorption rate was found to be positively correlated with temperature. Generally, adsorption rates decreased with increasing grain size for all experimental conditions. Based on the experimental results, simple bidisperse modeling approaches are proposed for the sorption kinetics of CO₂ and CH₄ that may be readily implemented into reservoir simulators. *International Journal of Coal Geology*, December 3, 2004, <http://www.sciencedirect.com/science/journal/01665162> (subscription required)

February 2005

“Interfacial Interactions between Reservoir Brine and CO₂ at High Pressures and Elevated Temperatures.” Investigators studied surface tension and its effects upon the transfer of CO₂ into brine and vice versa under conditions that simulate the injection of supercritical CO₂ into a geologic formation containing brine. Factors studied included interface disappearance, the swelling effect, the shrinking effect, and wettability alteration. Results indicate that a maximum CO₂ solubility is achieved in a depleted reservoir or saline aquifer as long as the operating pressure exceeds a threshold value. *Energy & Fuels*, January 19, 2005, pp 216-223, <http://pubs.acs.org/cgi-bin/sample.cgi/enfuem/2005/19/i01/pdf/ef049792z.pdf>

March 2005

“Feedbacks and the coevolution of plants and atmospheric CO₂.” This paper explores the complex network of geophysiological feedbacks associated with the coevolution of land plants, CO₂, and climate. The authors present a systems analysis of the physiological and geochemical processes involved, identifying new positive and negative feedbacks between plants and CO₂ on geological time scales. *Proceedings of the National Academy of Sciences*, February 1, 2005, <http://www.pnas.org/cgi/content/abstract/102/5/1302> (subscription required)

May 2005

“Identification of early opportunities for CO₂ sequestration – worldwide screening for CO₂-EOR and CO₂-ECBM projects.” Using a Geographical Information System (GIS) to combine worldwide CO₂ point sources and oil and coal fields, this study highlights two potential enhanced oil recovery (EOR) projects and two potential enhanced coal bed methane recovery (ECBM) projects as potential early opportunities for CO₂ sequestration. Case 1 consists of a hydrogen plant in Saudi Arabia, which could sequester 0.26 Mt/year CO₂ in a depleted oil reservoir at a net saving of approximately 3 EUR/t CO₂. EOR case 2 is a hydrogen plant in California, which has to be retrofitted in order to generate a pure CO₂ stream. Approximately 0.28 Mt CO₂ could be stored annually. Mitigation costs were estimated at 9–19 EUR/t CO₂, depending on the availability of steam for CO₂ regeneration. In cases 3 and 4, circa 0.68 and 0.29 Mt CO₂ from ammonia plants in China and Canada could be sequestered annually in coal fields for ECBM production at approximately 5 and 6 EUR/t CO₂, respectively. *Energy*, Volume 30, Issue 10, July 2005, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

“Geologic storage of carbon dioxide and enhanced oil recovery I: Uncertainty quantification employing a streamline based proxy for reservoir flow simulation.” This paper proposes a work flow for co-optimization of oil recovery and geologic CO₂ storage. An analytic streamline based proxy for full reservoir simulation is proposed and tested. Streamline trajectories represent the three-dimensional velocity field during multiphase flow in porous media and so are useful for quantifying the similarity and differences among various reservoir models. The proxy allows rational selection of a representative subset of equi-probable reservoir models that encompass uncertainty with respect to true reservoir geology. The streamline approach is demonstrated to be thorough and rapid. *Energy Conversion & Management*, Volume 46, Issue 11-12, July 2005, <http://www.sciencedirect.com/science/journal/01968904> (subscription required)

“Geologic storage of carbon dioxide and enhanced oil recovery II: Co-optimization of storage and recovery.” In this study, several strategies are tested via compositional reservoir simulation to find injection and production procedures that “co-optimize” oil recovery and CO₂ storage. Flow simulations are conducted on a synthetic, three dimensional, heterogeneous reservoir model. The results show that traditional reservoir engineering techniques such as injecting CO₂ and water in sequential fashion, a so-called water-alternating-gas process, are not conducive to maximizing the CO₂ stored within the reservoir. A well control process that shuts in (i.e. closes) wells producing large volumes of gas and allows shut in wells to open as reservoir pressure increases is the most successful strategy for co-optimization. *Energy Conversion & Management*, Volume 46, Issue 11-12, July 2005, <http://www.sciencedirect.com/science/journal/01968904> (subscription required)

June 2005

“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> (subscription required)

“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 plants 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)

July 2005

“An experimental study on seismic monitoring of a CO₂ flooding in two sandstones.” Laboratory experiments indicated a 6 percent reduction in compressional wave velocities during CO₂ flooding. *Energy* 30 (August-September 2005) 2352-2359, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

“Effect of supercritical CO₂ on cap rock sealing performance.” Cap Rock samples from the Nagaoka CO₂ injection site in Japan were exposed to CO₂ and the effects measured. Porosity increased slightly. Permeability measurements were not taken but identified as important. *Energy* 30 (August-September 2005) 2344-2351, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

“Geology of coalbed methane reservoirs in the Southeast Qinshui Basin of China.” Article characterizes coal seams in the Southeast Qinshui Basin of China. Also discusses location of coalbed methane zones and permeability of the coalbed methane reservoir. *International Journal of Coal Geology* 62 (22 June 2005) 197-210, <http://www.sciencedirect.com/science/journal/01665162> (subscription required)

“Near-future perspective of CO₂ aquifer storage in Japan: Site selection and capacity.” Japan has started a 5-year national R&D project titled “Underground Storage of Carbon Dioxide” to reduce CO₂ emissions into the atmosphere. One of the targets of the project is to select a few preferred storage sites as candidates for large-scale demonstration tests and for commercial use in the near future. This paper ranks the sites in terms of capacity potential and CO₂ supply potential, both of which significantly affect the storage economics. In total, 69 sites on land and offshore and 113 fossil fuel fired power plants are being considered. *Energy* 30 (August-September 2005) 2023-2382, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

Technology

September 2004

“Coal gasification held back by cost.” A once-vibrant industry, coal mining in Illinois has lost thousands of jobs as in-state coal-fired power plants have switched to low-sulfur western coals. Gasification technology could be used to process Illinois coal and still comply with environmental regulations. “If you live in a carbon-constrained world, this [coal gasification] is your only alternative that offers the potential of carbon capture and sequestration,” said Jim Rogers, chief executive of Cinergy. “We have worked extremely hard to bring in [coal gasification] projects,” said Bill Hoback, bureau chief of the Illinois Office of Coal Development. So far they have not been successful. Illinois has as many as 10 coal-fueled power plants in the proposal stage. Of that, two are likely to come on line, but neither will use coal gasification. *Chicago Tribune*, August 24, 2004, <http://www.chicagotribune.com>

“IGCC leads clean technologies, but will it pass utility muster?” Discusses IGCC technology and highlights the Polk Power Station and the Wabash Generating Station as examples of commercial applications. The article explores some of the concerns the utility industry has with IGCC, which include: capital costs, reliability issues, and IGCC's ability to be used in large-scale baseload applications. *Greenwire*, August 11, 2004, <http://www.greenwire.com> (subscription required)

October 2004

Penn State Researchers Claim Breakthrough in CO₂ Mineralization. The researchers' method involves dissolving crushed serpentine in sulfuric acid. When serpentine dissolves in sulfuric acid, the silicon in the mineral becomes silicon dioxide, or sand, and falls to the bottom, while the magnesium becomes magnesium sulfate. Treating some of this magnesium sulfate with sodium hydroxide also creates some magnesium hydroxide. The researchers were able to convert large amounts of the serpentine's magnesium to these chemicals providing large surface areas for reactions to occur in solution at room temperature. "Researchers study natural mineral that locks up carbon dioxide," *Penn State Newswire*, September 7, 2004, http://www.environment.psu.edu/news/september_2004/mineral_bind_co2.asp

December 2004

"A study of methods of carbon dioxide capture and sequestration—the sustainability of a photosynthetic bioreactor approach." Discusses engineered photosynthesis as a line of research that may, in the future, help to reduce the greenhouse effect in a sustainable manner. The topic of photosynthetic reaction, which has long been known as a natural process that can produce useful by-products of biomass, oxygen, and hydrogen, and can fix carbon dioxide, has been examined. Paper describes the design of a laboratory scale reactor. *Energy Conversion & Management*, February 2005, <http://www.sciencedirect.com/science/journal/01968904> (subscription required)

"Simulation of CO₂ capture using MEA scrubbing: a flowsheet decomposition method." This paper presents a method of converging a process model and optimizing key process operating variables, in particular the amine loadings and temperature of MEA entering the stripper. This method was applied to three different CO₂ concentrations (molar fraction, wet basis): 3% (to simulate flue gas from a gas turbine), 14% (flue gas from a coal plant) and 25% (flue gas from a cement plant). A minimum reboiler duty was found at a lean MEA loading of 0.25 for all CO₂ concentrations studied. *Energy Conversion & Management*, February 2005, <http://www.sciencedirect.com/science/journal/01968904> (subscription required)

January 2005

"Carbon sequestration: a new road to Kyoto." Discusses the economics of carbon capture and sequestration. According to this article, at present, the only economically viable way of trapping CO₂ that would otherwise be released into the atmosphere is through its removal from freshly produced natural gas and injection back into depleted production fields. The article also states that while limiting CO₂ emissions remains the principal tool of achieving the Kyoto targets, trapping previously emitted CO₂ could also emerge as a viable alternative. *Datamonitor*, December 3, 2004, http://www.commentwire.com/commwire_story.asp?commentwire_ID=6182

"Using CaO- and MgO-rich industrial waste streams for carbon sequestration." This study examines a possible carbon capture and sequestration technology for the cement and steel industries. CaOH₂ and CaO from steel slag or concrete waste can be dissolved in water and reacted with CO₂ in ambient air to capture and store carbon safely and permanently in the form of stable carbonate minerals (CaCO₃). An example process scheme is presented. The operating cost is estimated to be US\$8/t-CO₂ sequestered. *Energy Conversion & Management*, 46 (March 2005) 687-699, <http://www.sciencedirect.com/science/journal/01968904> (subscription required)

"Carbon dioxide removal in power generation using membrane technology." Evaluates membranes for CO₂/H₂ separation in which CO₂ is contained in the permeate gas. Evaluates systems with CO₂/H₂ selectivities of 6.4 to 9. Modeling effort predicts significant H₂ loss and large membrane area requirements. Author concludes membranes only cost competitive with CO₂ concentrations in syngas greater than 10%. *Energy* 29 (Oct-Dec 2004) 2025-2043, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

February 2005

“From hydrocarbon to hydrogen–carbon to hydrogen economy.” The objective of this paper is to explore novel approaches to solving energy and environmental problems associated with the production of hydrogen from fossil fuels. The paper discusses the technological, environmental, and economical aspects of large-scale production of hydrogen and carbon by the catalytic dissociation of natural gas (NG). The authors propose a scenario of fossil-based “hydrogen-carbon” infrastructure, where the hydrogen component of NG is used as a clean energy carrier (e.g., in transportation) and the carbon component is used in several application areas: structural materials, power generation, soil amendment, and environmental remediation. *International Journal of Hydrogen Energy*, March 2005, <http://www.sciencedirect.com/science/journal/03603199> (subscription required)

March 2005

“New Technology Uses CO₂ to Make Plastic from Orange Peels.” Using just the oil from orange peel and CO₂, researchers at Cornell University have found a way to make a high quality, versatile plastic in an environmentally friendly way. Limonene is a carbon-based compound that makes up around 95% of the oil found in orange peel. Led by Professor Geoffrey Coates, the researchers discovered that a derivative of this substance, limonene oxide, could be made to react with CO₂ using a catalyst, producing an environmentally friendly polymer, polylimonene carbonate. The resulting polymer has many of the same characteristics as polystyrene, a petroleum-based polymer that is used to make many disposable plastic products. *Edie News*, January 31, 2005, http://www.climatebiz.com/sections/news_detail.cfm?NewsID=27630

“Scientists Looking at Ways to Trap Greenhouse Gases.” Article highlights research underway at Arizona State to neutralize CO₂ by combining it at high heat with serpentine or olivine - two common minerals - in a solution of water, sodium chloride, and sodium bicarbonate. The reaction produces magnesium carbonate, a stable substance that can be buried, turned into road pavement or stored in other ways. Said professor Michael McKelvy, “What we’re trying to do is take what nature does over 100,000 years and do it in less than an hour for 10 bucks a ton” of sequestered carbon. But right now, it costs about \$70 a ton. The researchers, who are working with more than a dozen other scientists in four other laboratories, are trying to make the reaction cheaper by breaking down a coating that forms over the minerals during the conversion process. *The Washington Post*, February 22, 2005, <http://www.washingtonpost.com/ac2/wp-dyn/A42365-2005Feb21>

April 2005

“The genome king seeks to produce a tiny CO₂ eater. Scientists at the J. Craig Venter Institute have spent three years hunting for microbes to munch carbon dioxide. While Venter’s ultimate goal is to synthesize a hydrogen bug – a designer organism that would churn out the clean-burning hydrogen fuel of tomorrow – at the very least, microbes might be adapted to scrub emissions from power plants. Or be engineered to bind CO₂ into carpets, nylon or pharmaceuticals, to keep the greenhouse gas out of the atmosphere. *The Star Ledger*, March 6, 2005, <http://www.nj.com/business/energy/ledger/index.ssf?/business/ledger/stories/0306genomeking.html>

Nanotechnology - Sequestration Link. According to a science policy study by Rice University, transmission lines built from carbon nanotubes that could conduct electricity across great distances without loss would radically change the economics of moving “energy” supply from distant natural gas sources, distant wind and solar farms, and coal sequestration sites. “Nanoscience Solutions for Energy Technologies Advocated,” *AZoNano.com*, March 9, 2005, <http://www.azonano.com/news.asp?newsID=589> The full report is available at <http://www.rice.edu/energy/publications/energynanotechnology.html>

“Benefits and drawbacks of clathrate hydrates: a review of their areas of interest.” Clathrate hydrates are well known structures that were considered for many years as harmful by the oil and gas industry because of their annoying tendency to plug pipelines. However, hydrates are now attracting renewed interest in many fields – gas hydrates naturally found in deep seas and permafrost may provide a large amount of methane. Other positive applications include carbon dioxide sequestration, separation and natural gas storage and transportation. Finally, the use of their dissociation energy can be applied in refrigeration processes and cold

storage. *Energy Conversion and Management*, June 2005, <http://www.sciencedirect.com/science/journal/01968904> (subscription required)

May 2005

“An assessment of mine methane mitigation and utilization technologies.” In this study the existing and developing technologies for coalmine methane mitigation and utilization are classified, with a discussion of the features of different technologies to identify potential technical issues for each technology when implemented at a mine site and to identify the best options for mine site applications. A technical assessment of these technologies for use at a Queensland coal mine is presented, with a preliminary economic assessment of some technologies that were determined to be technically feasible. *Progress in Energy and Combustion Science*, Volume 31, Issue 2 (2005), <http://www.sciencedirect.com/science/journal/03601285> (subscription required)

“Students Design System for Removing Carbon from Power Plant Emissions.” Students from Clarkson University have designed an innovative and efficient method for removing and storing carbon dioxide emitted in coal-fired power plant flue gas. “Their solution is a highly creative one,” said Stefan Grimberg, professor of Civil and Environmental Engineering and team advisor. “Their process uses steel slag, which is a byproduct of the steel manufacturing process and has very little market value, to extract the carbon dioxide. The result is the production of calcium carbonate (limestone) and hydrated slag, both of which can be sold and used by other industries. So the students have used a waste product to solve their problem and the resulting products have considerable market value.” *NewsWise*, April 15, 2005, <http://www.newswise.com/articles/view/511159/>

“Mallet gas processing facility uses membranes to efficiently separate CO₂.” The Cynara membrane system at Occidental Oil & Gas Corp.'s Mallet CO₂-removal facility in Sundown, Texas, has processed 100 MMscfd of gas with an online availability greater than 99% since 1994 and is being expanded to process an additional 100 MMscfd of gas. This article reviews the rationale for selecting membranes and the factors contributing to the successful 10-year operation of membranes at the facility. When properly applied, membranes have a long life and low operating cost. At the Mallet facility, membranes have proven to be a reliable, cost-effective solution during the 10+ years of operation. *Oil & Gas Journal*, April, 11, 2005, <http://ogj.pennnet.com> (subscription required)

“Sequestration of fermentation CO₂ from ethanol production.” This study shows that if the off-gases produced during the fermentation of sugars to fuel—ethanol were captured and, for example, injected deep underground to keep them from the atmosphere, then the production of ethanol could lead to the net removal of CO₂ from the atmosphere in addition to avoiding gasoline-related CO₂ emissions by using the ethanol as a transportation fuel. The authors give estimates of net CO₂ emissions for current systems for the production of fuel—ethanol, these systems modified to sequester fermentation CO₂, and gasoline-related CO₂ emission offsets. They also consider future developments that might affect the scope and economic feasibility of the sequestration of fermentation CO₂. *Energy*, Volume 30, Issue 10, July 2005, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

“High performance SOFC/GT combined power generation system with CO₂ recovery by oxygen combustion method.” The authors investigate carbon dioxide recovery from SOFC/GT combined power generation systems in which a gas turbine with carbon dioxide recycle or water vapor injection is adopted as the bottoming cycle. In these systems, fuel gas is first introduced to a SOFC, and its exhaust fuel gas is afterburned by pure oxygen. Carbon dioxide or water vapor is also injected into the combustor to reduce the combustion gas temperature. The obtained combustion gas, which is composed of only carbon dioxide and water vapor, is introduced to a gas turbine in the bottoming cycle. The overall efficiency of the system with carbon dioxide recycle reaches 63.87% (HHV) or 70.88% (LHV). *Energy Conversion & Management*, Volume 46, Issue 11-12, July 2005, <http://www.sciencedirect.com/science/journal/01968904> (subscription required)

June 2005

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/!ut/p/_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> (subscription required)

“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-mixmaster/2005/05/21/1116533577851.html?oneclick=true>

July 2005

“Behavior of supercritical CO₂ injected into porous media containing water.” Authors used a magnetic resonance imaging (MRI) technique to directly visualize the distribution of supercritical CO₂ injected into a packed bed of glass beads containing water. At high CO₂ saturations, a stable layer flow occurred. The effect of capillary contraction along the flow direction was also simulated. *Energy* 30 (August-September 2005) 2370–2382, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

“CO₂ separation during hydrocarbon gasification.” Hydrogen production by removal of carbon oxides during hydrocarbon gasification with CaO and other metal oxides was examined theoretically and experimentally. Because the chemical energy contained in CaO can be released during hydrocarbon gasification, H₂ production efficiency as high as 70–80 percent can be expected. *Energy* 30 (August-September 2005) 2186-2193, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

“Injection and boiling of liquid CO₂ with a hydrate coating.” Authors found that the hydrate film on a CO₂ droplet promotes the boiling of liquid CO₂ when the pressure decreases. Thus, when the drops rise above 500-m in the ocean, boiling due to decompression should occur. *Energy* 30 (August-September 2005) 2275-2283, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

August 2005

“Synthesis, Experimental Studies, and Analysis of a New Calcium-Based Carbon Dioxide Absorbent.” A new calcium-based solid CO₂ absorbent has a significantly improved CO₂ absorption capacity and cyclic reaction stability compared with other Ca-based CO₂ absorbents. *Energy & Fuels* 2005, 19, 1447-1452, <http://pubs.acs.org/cgi-bin/abstract.cgi/enfuem/2005/19/i04/abs/ef0496799.html> (subscription required)

Ocean

September 2004

“Controversy over new method to cut atmospheric CO₂ levels.” Article discusses work done at the University of Massachusetts where liquefied CO₂ was mixed with pulverized limestone in water to form an emulsion that researchers say could be suitable for release into the ocean where it would then become sequestered (D. Golomb et al, *Environ. Sci. Technol.*, 2004, 38, 4445). Environmental groups oppose the method saying: “Dumping our carbon waste into the ocean would be a dangerous experiment we can't afford to undertake.” Team leader Dan Golomb and colleagues are aware of the opposition they face and maintain their objective is to develop a more benign way to sequester CO₂ than alternative methods that acidify surrounding sea water. “Global warming debate heats up,” *Chemistry World*, Issue 9, September 2004, <http://www.rsc.org/chemistryworld/Issues/2004/September/globalwarming.asp>

Particular Algae May Help Corals Adapt to Warming Waters. Coral reefs, widely expected to be endangered by warming waters due to climate change, may be aided by a particular form of algae that can help corals adapt to warmer temperatures, scientists revealed. Corals teamed with the alga *Symbiodinium D* have significantly better survival rates in warming waters than those reefs under similar conditions that lack the algae. “*EESI – Climate Change News*, August 20, 2004, <http://www.eesi.org/publications/Newsletters/CCNews/8.20.04%20CCNews.htm>. For the original article see “Reefs get global warming lifeline,” *Nature*, August 11, 2004, <http://www.nature.com/news/2004/040809/full/040809-8.html> (subscription required)

October 2004

Experiments on Ecological Impacts of CO₂ Injection into Ocean Water. Researchers have conducted experiments using a natural plume of CO₂ that bubbles up from a subsea volcano called Loihi, near Hawaii. In one experiment, researchers set cages baited with mackerel close to the Loihi plume and at various distances from the CO₂. The bait away from the plume was eaten in less than 24 hours, whereas the bait over the vent remained untouched for more than a week. These initial results seem to indicate that fish can sense a CO₂ plume and avoid it. “Ocean fix for climate change finds tentative support,” *Nature*, September 9, 2004, <http://www.nature.com/news/2004/040906/full/431115b.html> (subscription required)

Researchers seek to study ocean acidity. Researchers met in Germany to discuss work to be done in studying the effects of increased ocean acidity. The increased acidity is caused by the increased uptake of CO₂, which is caused by the elevated concentrations of CO₂ in the atmosphere. “We're taking a huge risk,” says Ulf Riebesell, a marine biologist at the Leibniz Institute of Marine Sciences in Kiel, Germany. “Chemical ocean conditions 100 years from now will probably have no equivalent in the geological past, and key organisms may have no mechanisms to adapt to the change.” “Researchers seek to turn the tide on problem of acid seas,” *Nature*, August 19, 2004, <http://www.nature.com/news/2004/040816/full/430820b.html> (subscription required)

November 2004

More on acid oceans. Article provides a summary of ocean acidification and its effect on marine life. "Oceans to acid," *The Christian Science Monitor*, September 9, 2004, <http://www.csmonitor.com/2004/0909/p13s01-sten.html>

December 2004

"Pacific Dominance to Global Air-Sea CO₂ Flux Variability: A Novel Atmospheric Inversion Agrees with Ocean Models." Addresses an ongoing debate regarding the geographic distribution of interannual variability in ocean-atmosphere carbon exchange. Finds that, for 1983–1998, both novel high-resolution atmospheric inversion calculations and global ocean biogeochemical models place the primary source of global CO₂ air-sea flux variability in the Pacific Ocean. In the model considered here, this variability is clearly associated with the El Niño/Southern Oscillation cycle. Both methods also indicate that the Southern Ocean is the second-largest source of air-sea CO₂ flux variability, and that variability is small throughout the Atlantic, including the North Atlantic, in contrast to previous studies. *Geophysical Research Letters*, November 2004, <http://www.agu.org/pubs/crossref/2004/2004GL021069.shtml> (subscription required)

February 2005

"Scientists Discover Liquid Carbon Dioxide 'Champagne' Bubbles At Hydrothermal Vent." Article describes the findings of a NOAA expedition to the northern Mariana Arc of the Pacific Ocean in April 2004. Researchers found liquid carbon dioxide bubbles rising from a hydrothermal vent area, only the second location where the phenomenon has been identified. "In the Mariana Trench, we found a natural laboratory where the effects of carbon dioxide on marine organisms can be studied," said Steve Hammond, acting director of NOAA's Office of Ocean Exploration. *Science Daily*, January 5, 2005, <http://www.sciencedaily.com/releases/2005/01/050104114942.htm>

March 2005

"Greenhouse gas turning oceans acid, scientists warn." At a conference on climate change held in Exeter, England, a paper by a team of scientists from Britain's Plymouth Marine Laboratory concluded that ocean acidification is likely to affect the entire marine food chain. Although a growing number of studies about ocean acidification have been carried out in recent years, it is only very recently that the whole picture has been put together, and the truly stark nature of the threat appreciated. Another interesting finding disclosed at the conference was by the head of the British Antarctic Survey, Professor Chris Rapley, who said that the vast West Antarctic Ice Sheet, previously thought to be stable, may be beginning to disintegrate - an event that would cause a sea-level rise around the world of more than sixteen feet. *The New Zealand Herald*, February 4, 2005, http://www.nzherald.co.nz/index.cfm?c_id=5&ObjectID=10009477

April 2005

"Oceans extend effects of climate change." According to two studies in the March 18th issue of *Science*, even if the world stopped burning fossil fuels tomorrow, the emissions already in the atmosphere would cause global temperatures to climb for the next hundred years and the sea level to keep rising for even longer. "We're already committed to a significant amount of climate change, even if we could stabilize concentrations at some point," says Gerald Meehl of the National Center for Atmospheric Research in Boulder, Colorado. "And the longer we wait, the worse it gets." *Nature*, March 17, 2005, <http://www.nature.com/news/2005/050314/full/050314-13.html> (subscription required)

May 2005

“Proposal to Fight Global Warming May Threaten Oceans.” Focuses on research by MBARI scientists and researchers from LSU and FSU who have suggested capturing carbon dioxide gas from factory smokestacks and pumping it two miles under the ocean's surface. Freezing temperatures at that depth turn the CO₂ into a slushy solid, which sinks to the ocean floor. According to *Morning Edition*, the researchers found that freezing gas to combat global warming may significantly harm marine life. *NPR*, April 1, 2005, <http://www.npr.org/templates/story/story.php?storyId=4571038> [audio]

“Japan researchers look to seaweed in fight against global warming.” A group of private and academic research institutes is studying the viability of building a seaweed plantation in the Pacific Ocean to absorb carbon dioxide and produce biofuel. The plan is to place 100 floating fishing nets in the Pacific Ocean, each measuring 10 kilometers by 10 kilometers. Seaweed such as sea grape, which can reach 20 meters in length in a year, will grow from the nets. Seaweed discharges hydrogen and carbon monoxide gases when it is exposed to extremely heated water vapor. Methanol and other biofuels can be synthesized from the gases. Because the biofuel is made from carbon hydride, which is created from carbon dioxide through photosynthesis, no extra carbon dioxide is discharged into the atmosphere when the fuel is burned. In this sense the fuel holds a significant advantage over fossil fuels, says the article. *The Yomiuri Shimbun*, April 19, 2005, <http://www.sidsnet.org/latestarc/climate-newswire/msg00077.html>

“Role of Marine Biology in Glacial-Interglacial CO₂ Cycles.” It has been hypothesized that changes in the marine biological pump caused a major portion of the glacial reduction of atmospheric carbon dioxide (by 80 to 100 parts per million) through increased iron fertilization of marine plankton, increased ocean nutrient content or utilization, or shifts in dominant plankton types. This study analyzes sedimentary records of marine productivity at the peak and the middle of the last glacial cycle and shows that neither changes in nutrient utilization in the Southern Ocean nor shifts in plankton dominance explain the CO₂ drawdown. Iron fertilization and associated mechanisms can be responsible for no more than half the observed drawdown, the study states. *Science*, April 1, 2005, <http://www.sciencemag.org/content/vol308/issue5718/index.shtml> (subscription required)

June 2005

“Study of liquid CO₂ droplet formation under simulated middepth 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> (subscription required)

July 2005

"British Scientists Say Carbon Dioxide Is Turning the Oceans Acidic." A report by Britain's Royal Society says that carbon dioxide is turning the oceans acidic, and the growing acidity is very likely to harm coral reefs and other marine life by the end of the century. The burning of fossil fuels releases more than 25 billion metric tons of carbon dioxide into the air each year. Roughly a third of that is absorbed by the oceans, where the gas undergoes chemical reactions that produce carbonic acid, which is corrosive to shells. Depending on the rate of fossil fuel burning, the pH of ocean water near the surface is expected to drop to 7.7 to 7.9 by 2100, lower than any time in the last 420,000 years, the Royal Society report said. Ocean water today is somewhat alkaline, at 8.1. *New York Times*, July 1, 2005, <http://www.nytimes.com/2005/07/01/international/europe/01ocean.html?adxnnl=1&adxnnlx=1120224701-VL0ilgLJRI9wZ9E+Qm/WUA>. The report, "Ocean acidification due to increasing atmospheric carbon dioxide," can be downloaded at <http://www.royalsoc.ac.uk/document.asp?id=3249>

"Sea helps in global warming prevention." Japanese researchers have found that a subtropical area in the western Pacific absorbs about 60 million tons of carbon dioxide a year. Since 1981, Japan's Meteorological Agency has dispatched a marine meteorological observation vessel to the area around the Marshall Islands six times a year. After analyzing data in the subtropical area, researchers found interrelations between the temperature of the sea water and the amount of carbon dioxide the sea water absorbs and concluded that the sea in the area absorbs some 60 million tons of carbon dioxide a year. *ScienceDaily*, June 6, 2005, <http://www.sciencedaily.com/upi/index.php?feed=Science&article=UPI-1-20050606-06051400-bc-japan-carbondioxide.xml>

"Correlations among the design factors of the CO₂ ocean sequestration system, GLAD." An ocean sequestration method to dispose of a large amount of CO₂ gas has been developed to mitigate global warming. This system is called the gas lift advanced dissolution (GLAD) system. This paper describes a mathematical model of GLAD's internal flow, which was derived to optimize the system specifications, and the correlations among the design factors of GLAD system derived by using this mathematical model. *Energy* 30 (August-September 2005) 2308-2317, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

August 2005

"North Atlantic Ocean Temps Hit Record High." According to a report released by the federal Fisheries Department (Canada), ocean temperatures in the North Atlantic hit an all-time high last year. The ocean surface off St. John's averaged one degree Celsius above normal, the highest in the 59 years the department has been compiling records. Bottom temperatures were also one degree higher than normal, says the report. In addition, sea ice off the coast of Newfoundland and Labrador was below normal for the tenth consecutive year, and the water temperature outside St. John's Harbor was the highest on record in 2004. *Environmental News Network*, July 8, 2005, <http://www.enn.com/today.html?id=8186>

Terrestrial

September 2004

“Tracking Carbon from Sequestration in the Forest to Wood Products and Substitution.” Study shows that forest management and increased use of wood-based products lead to a significant reduction in atmospheric carbon by displacing more fossil fuel intensive products in housing construction. CORRIM: Phase I Final Report, March 25, 2004, http://www.corrim.org/reports/final_report_2004/Module%20N%20-%20Carbon_Final_July%201.pdf

“Life Cycle Environmental Performance of Renewable Building Materials.” Another report by the Consortium for Research on Renewable Industrial Materials (CORRIM) highlights the life cycle history of wood products, including a discussion of the carbon storage value of wood products. One of the conclusions is that environmental burdens, via carbon storage, could be lessened with increased forest management and wood substitution for materials that are more fossil fuel intensive - mainly concrete and steel. *Forest Products Journal*, June 2004, Vol. 54, No. 6, http://www.corrim.org/reports/pdfs/FPJ_Sept2004.pdf

Nitrogen Dynamics in the Duke Forest FACE Study Reference. Finzi et al. report “there were significant increases in canopy N and P contents under elevated CO₂” (26 and 50%, respectively), and that “canopy biomass was significantly higher under elevated CO₂ during the first 4 years of this experiment.” The authors concluded, “whole-canopy C assimilation is strongly stimulated by elevated CO₂ making this forest a larger net C sink under elevated CO₂ than under ambient CO₂.” “Canopy N and P dynamics of a southeastern U.S. pine forest under elevated CO₂,” *Biogeochemistry*, 69: 363-378 (2004), <http://www.springerlink.com/openurl.asp?genre=article&issn=0168-2563&volume=69&issue=3&spage=363>

“Bogs Watched for Warning Signs of Carbon Upset.” The August 25th edition of “All Things Considered” was dedicated to understanding the role of peat bogs in climate change. Globally, bogs contain more carbon than all the world's tropical rainforests. A decade ago, scientists started to worry that as the world warms, this vast store of carbon could vent out as carbon dioxide and speed up global warming. For the past eight years, researchers from McGill and Trent universities have set up a series of experiments at Mer Bleue bog to measure potential changes in carbon respiration. “Bogs Watched for Warning Signs of Carbon Upset: Wetlands a Global Warming Antidote, But for How Long?” *NPR – All Things Considered*, August 25, 2004, <http://www.npr.org/features/feature.php?wfid=3871344> [audio]

October 2004

Experiments Reverse Notion of Tundra Response to Warming Climate. A series of experiments in the Alaska tundra have debunked the theory that as temperatures rise, tundra ecosystems will flourish and store carbon underground, slowing the pace of global warming. Researchers have found that over the course of 20 years, deliberate fertilization led to a net loss of about 25 percent of the carbon in the tundra soil, or 4.4 pounds carbon for every 10.8 square feet. The researchers warned that high-latitude warming could accelerate carbon loss from soil, “causing a net loss of ecosystem carbon and a positive feedback to global warming.” “Ecosystem carbon storage in arctic tundra reduced by long-term nutrient fertilization,” *Nature*, September 23, 2004, http://www.nature.com/cgi-taf/DynaPage.taf?file=/nature/journal/v431/n7007/abs/nature02887_fs.html (subscription required). In an accompanying article, Wendy M. Loya, an ecologist at Michigan Technological University, said in an interview that carbon stored in the soil of northern Arctic and sub-Arctic ecosystems “equals two-thirds of the amount presently found in the atmosphere.” Given that these areas are most vulnerable to warming, she said, if they start releasing large amounts of carbon into the air in future decades, “it’s a huge deal.” “Global change: Carbon conundrum on the tundra,” *Nature*, September 23, 2004, <http://www.nature.com/nature/journal/v431/n7007/abs/431406a.html> (subscription required)

Carbon Sequestration in Iran. A terrestrial carbon sequestration project is being carried out in a village in the eastern Khorasan Province of Iran. Underway since April 2003, the projects is a collaboration between the Iranian Forest and Range Organization (FRO) and the United Nations Development Program (UNDP). Local

villagers are planting crops on 9,000 hectares of abandoned rangelands. "The project also aims to establish a local credit fund – like what the UNDP did in southeast Asia – which is an efficient way to reduce poverty in the region and establish self-organized groups centralized by women and low-income people," the project manager said. "Carbon sequestration under progress in Iran," *IranMania*, September 21, 2004, <http://www.iranmania.com/News/ArticleView/Default.asp?NewsCode=25423&NewsKind=Business%20%26%20Economy>

Entergy sponsors carbon sequestration program. Entergy Corp. announced that it will contribute more than \$1 million to help finance the expansion of the Tensas River National Wildlife Refuge in Tallulah, Louisiana. The donation, described as part of a unique partnership between the Trust for Public Land and the U.S. Fish and Wildlife Service, will help pay for the planting of native bottomland hardwood trees in an attempt to reduce carbon dioxide emissions associated with global warming. Under the agreement, the Fish and Wildlife Service will buy the 2,209 acres of land from the Trust for Public Land. Entergy will provide more than \$1 million for the purchase, replanting, and maintenance of the forest land. "Entergy pays to enlarge refuge," *The Times-Picayune*, September 29, 2004, <http://www.nola.com>

"Senate Committee Approves \$2 Million for Tensas National Wildlife Refuge." The Senate Appropriations Committee provided \$2 million in funding from the Land and Water Conservation Fund (LWCF) for the Tensas National Wildlife Refuge. The LWCF funds will allow the refuge to acquire the second phase, 2727 acres, of the Chicago Mill property in Madison County. At present, the Tensas NWR exists as two separate units. With the acquisition of the Chicago Mill property, these two units will be bridged, thus providing a protected wildlife corridor for the refuge species, most notably the Louisiana black bear. This acquisition will be leveraged by private carbon sequestration dollars, which will also be used to reforest nearly 2000 acres of the phase II lands. *U.S. Newswire*, September 16, 2004, <http://releases.usnewswire.com/GetRelease.asp?id=36380>

November 2004

"Forest CO₂ finding surprises soil scientists." Elizabeth Sulzman, a soil scientist at Oregon State University, discovered that adding additional organic matter to Oregon's forest soils may actually increase rather than hinder the release of carbon dioxide into the atmosphere. Sulzman has shown that exposing forest soils to twice the normal amount of organic matter increased soil carbon releases by 34 percent more than expected. *Bend.com*, October 6, 2004, http://www.bend.com/news/ar_view%5E3Far_id%5E3D18448.htm#no-hash

"Enhancement of Carbon Sequestration in U.S. Soils." In the October 2004 issue of *BioScience*, a group of researchers led by Wilfred M. Post of the Oak Ridge National Laboratory described an approach to assessing "promising" techniques for mitigating global warming caused by the greenhouse effect. "Potential for enhanced sequestration of carbon in soils supports evaluations," *EurekaAlert*, September 30, 2004, http://www.eurekaalert.org/pub_releases/2004-09/aioB-pfe093004.php

December 2004

"Fine-Root Production Dominates Response of a Deciduous Forest to Atmospheric CO₂ Enrichment." Article presents a nearly continuous 6-year record of fine-root production and mortality from minirhizotron analysis of a closed-canopy, deciduous sweetgum forest in a free-air CO₂ enrichment experiment. Annual production of fine roots was more than doubled in plots with 550 ppm CO₂ compared with plots in ambient air. The preferential allocation of additional carbon to fine roots rather than to stemwood reduces the potential of long-term enhancement by elevated CO₂ of carbon sequestration in biomass. However, sequestration of some of the fine-root carbon in soil pools is not precluded, and there may be other benefits to the tree from a seasonally larger and deeper fine-root system. *Proceedings of the National Academy of Sciences*, June 29, 2004, <http://www.pnas.org/cgi/content/abstract/101/26/9689> (subscription required)

"Managed Grasslands: A Greenhouse Gas Sink or Source?" Paper describes a one year investigation of CO₂ and N₂O fluxes over a fertilized grassland in Ireland using two eddy covariance systems. Authors observed a net annual uptake of 9.45 T CO₂/ha. N₂O emissions equivalent to 5.42 T/ha CO₂ GWP counteracted 57% of the effect of the CO₂ uptake. Estimated methane emissions from ruminants (3.74 T/ha CO₂ GWP) further counteract the CO₂ uptake, making the overall GWP nearly neutral. This delicate balance of the greenhouse gas

fluxes underscores the significance of fertilizer application strategies in determining whether a managed grassland is a net GWP source or sink. *Geophysical Research Letters*, October 2004, <http://www.agu.org/pubs/crossref/2004/2004GL021161.shtml> (subscription required)

“Nitrogen Deposition and Plant Species Interact to Influence Soil Carbon Stabilization.” Study provides evidence from a 5-year grassland field experiment in Minnesota that under elevated atmospheric CO₂ concentration (560 ppm), plant species determine whether N deposition inhibits the decomposition of soil organic matter via interspecific variation in root lignin concentration. Plant species producing lignin-rich litter increased stabilization of soil C older than 5 years, but only in combination with elevated N inputs. The results suggest that N deposition will increase soil C sequestration in those ecosystems where vegetation composition and/or elevated atmospheric CO₂ cause high litter lignin inputs to soils. *Ecology Letters*, December 2004, <http://www.blackwell-synergy.com/links/doi/10.1111/j.1461-0248.2004.00679.x/abs/>

“Scientist’s Plan Could Bury Global Warming.” A New Zealand economist, Dr. Peter Read, is promoting a massive worldwide plan to plant crops and bury charcoal to avoid global warming. Read advocates the use of fast-growing crops to produce ethanol or biodiesel. He says a massive global program of planting crops and plowing organic matter back into the soil could cut carbon dioxide back to pre-1800 levels – and feed poor countries at the same time. *New Zealand Herald*, November 22, 2004, <http://www.nzherald.co.nz/storydisplay.cfm?storyID=3612471&thesection=news&thesubsection=general>

January 2005

“Trees Could Cut Global Warming.” A team of researchers from CSU-Monterey Bay and NASA Ames Research Center in Menlo Park estimates that a fifth of the carbon dioxide released annually from fossil-fuel emissions could be sequestered by planting groves of trees on marginal agricultural and rangeland areas. Controlling infestations of insects that kill trees is key. “The dead trees not only are no longer trapping carbon dioxide,” says Christopher Potter of NASA, “but the decaying process emits even more.” *Monterey County Herald*, December 17, 2004, <http://www.montereyherald.com>

February 2005

“Economics, technology help no-till farming gain converts.” The 2004 National Crop Residue Management Survey found that 41 percent of all cropland in the United States is farmed under a conservation tillage system. That means that the residue or stubble from the previous crop covers at least one-third of the soil's surface. No-till - the leading form of conservation tillage - increased by 7.1 million acres in 2003. The 7-million-acre increase in no-till acres is the highest two-year increase in the last decade. High fuel costs and improved practices are attributed to the jump in no-till. *FarmWeek*, January 5, 2005, <http://farmweek.ilfb.org/viewdocument.asp?did=7458&r=0.9083216>

“Researchers challenge carbon absorption effects of managed forests.” Researchers from the University of Edinburgh in Scotland placed sensors above treetops at a privately owned forest and found that while the forest initially absorbed carbon, it started emitting carbon dioxide after forest workers trimmed the trees to increase their suitability for sale as lumber. The researchers discovered that bacteria consumed the dead plant material on the forest floor and emitted carbon dioxide as a byproduct of the digestion process. *Greenwire*, January 5, 2005, <http://www.eenews.net/Greenwire.php>

“Long-term sensitivity of soil carbon turnover to warming.” Study claims that rising temperatures brought about by climate change will cause microorganisms in the world's soils to decompose organic matter more rapidly, releasing extra carbon dioxide and accelerating climate change. *Nature*, January 20, 2005, http://www.nature.com/cgi-taf/DynaPage.taf?file=/nature/journal/v433/n7023/abs/nature03226_fs.html (subscription required)

April 2005

“Soil carbon sequestration in Phytoliths.” This paper highlights a unique technology for quantification and long term sequestration of carbon in soil. The process is based on enhancing silica mineralization within crops and forests. The authors believe this technology has the potential to economically sequester hundreds of millions of tones of carbon per year. In the long term, the authors hope the technology will allow struggling land holders and grain producers to offset their incomes by selling carbon credits to the coal industry to offset their emissions. *Soil Biology and Biochemistry*, January 2005, <http://www.sciencedirect.com/science/journal/00380717> (subscription required)

New imaging tool can track carbon sequestration in plants. Scientists at the U.S. Department of Energy's Brookhaven National Laboratory have applied radiotracer imaging to track the distribution of nutrients in poplar trees in response to a simulated insect attack. Richard Ferrieri, who leads Brookhaven's role in the research, says scientists trying to improve plants' resistance to environmental challenges – or their ability to perform useful tasks such as carbon sequestration, phytoremediation, or the production of biofuels could also use functional imaging to help track their progress.” Poplar Trees Redirect Resources in Response to Simulated Attack; Use of 'Functional Imaging' to Track Plant Nutrients Has Many Potential Applications,” *AScribe*, March 28, 2005, <http://newswire.ascribe.org/cgi-bin/behold.pl?ascribeid=20050328.052546&time=07%2038%20PST&year=2005&public=0>

“Secondary forests as temporary carbon sinks?” In this study the authors applied the accounting rules for temporary and long-term Certified Emission Reductions (CER) to two reforestation projects: forest plantation and natural regrowth of secondary forest. A comparison of these alternatives showed that secondary forest is an attractive alternative because of its low establishment costs and relative early timber revenues. *Ecological Economics*, available online February 9, 2005, <http://www.sciencedirect.com/science/journal/09218009> (subscription required)

“Innovative Study Will Measure Residential Carbon Sequestration.” Article highlights a \$660,000, three-year National Science Foundation project led by Jennifer Jenkins, a research assistant professor at the Gund Institute of Ecological Economics, that seeks to quantify carbon cycles in three Baltimore-area neighborhoods and determine how different factors influence them. One facet of the project will use neighborhood-level commercial marketing-research to relate an area's per-capita fertilizer and lawn products spending to the carbon-sequestering vigor of its sweeping green lawns, perhaps yielding a model with predictive power nationwide. *Science Daily*, March 22, 2005, <http://www.sciencedaily.com/releases/2005/03/050321090451.htm>

Pennsylvania Awards Grant to Rodale Institute. Environmental Protection Secretary Kathleen A. McGinty awarded a \$138,531 Growing Greener grant to the Rodale Institute to develop advanced soil management methods that lock up nutrients before they pollute local waterways. In addition to locking-up nutrients to improve water quality, the institute will use its grant to determine the ability of organic management methods to sequester carbon in soil, said a press release. “Rendell Administration Awards \$138,531 Grant to Rodale Institute for Soil Management Study; Advanced Methods Enhance Water Quality by Locking up Nutrients in Soils,” *AScribe*, March 25, 2005, <http://newswire.ascribe.org/cgi-bin/behold.pl?ascribeid=20050325.113358&time=11%2041%20PST&year=2005&public=0>

May 2005

“Canadian Farmers to receive cash to fight global warming.” After eight years of negotiations, the Canadian federal government signed a \$1-million agreement that will pay farmers to keep carbon dioxide in their land by not tilling. The three-year pilot project covers 210 farmers across the country, with 100 of them in Saskatchewan. Zero-till farming has been a common practice on the prairies as a means to prevent soil erosion. More recently, it's been promoted as a way to help Canada meet its international commitment to reduce greenhouse gas emissions. John Bennett, a spokesman for the Saskatchewan Soil Conservation Association, said agriculture could reduce Canada's cost of compliance for its Kyoto targets by between 40 and 60 percent. *CBC News*, April 8, 2005, <http://www.cbc.ca/sask/story/carbon-farming050408.html>

“Alarm bells over plantations.” In 1996 the Australian Federal Government announced its 2020 forestry vision, which sparked a tax advantages and other incentives to encourage plantations that would serve as carbon sinks. In response to massive forest fires in Indonesia in 1998, CSIRO scientists began to question whether production forests could actually be a source of carbon dioxide pollution. This article highlights research on the consequences of controlled regeneration burning when calculating carbon sequestration for Australian forests. *The Mercury*, April 3, 2005, <http://forests.org/articles/reader.asp?linkid=40495>

“Protection of soil carbon by microaggregates within earthworm casts.” Study finds direct involvement of earthworms in providing protection of soil carbon in microaggregates within large macroaggregates leading to a possible long-term stabilization of soil carbon. *Soil Biology and Biochemistry*, Volume 37, Issue 2, February 2005, <http://www.sciencedirect.com/science/journal/00380717> (subscription required)

June 2005

“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 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://www.knoe.com/fullstory.php?id=429>

“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 metaregression 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)

July 2005

“Researchers unlocking switchgrass secrets.” Article highlights the potential for switchgrass to store carbon and produce ethanol. Besides its significant above-ground biomass for bioenergy production, the crop has an abundant and deep root system. The roots can extend more than 8 feet into the soil and account for more than 80 percent of the plant's biomass, says Mark Liebig, a soil scientist at USDA's Agricultural Research Service laboratory in Mandan, North Dakota. At 1 to 2 feet deep, the soil organic carbon difference between switchgrass and other crops – such as wheat and corn – could be 3.5 tons per acre. At 2- to 3- foot depths, the difference could be 2 tons per acre. Over a 4-foot depth, it then averaged 6.9 tons per acre more soil organic carbon than a cultivated crop. *Grand Forks Herald*, May 30, 2005, <http://www.grandforks.com/mld/grandforks/business/11772006.htm>

“Range That's a Home to Forage Research” Article highlights the USDA Agricultural Research Service's (ARS) Southern Plains Range Research Station (SPRRS) in Woodward, Oklahoma. According to the article, current Southern Plains Experimental Range (SPER) projects have potential to affect the Southern Plains – and the world – far into the future, and even beyond agriculture. “We're examining ways for growers to sequester carbon and, perhaps, one day earn money from doing so. We're also evaluating systems that complement both forage and livestock, improving cropland and pasture restoration techniques, and examining the importance of plant diversity for sustainable management of restored grasslands,” says research leader Phillip Sims. ARS is working to develop a national estimate of how much carbon U.S. farm and grazing land soils are currently storing in what is, in effect, a net carbon bank. *Agricultural Research* magazine, June 2005, <http://www.ars.usda.gov/is/AR/archive/jun05/range0605.htm>

“The Relationship between Carbon Input, Aggregation, and Soil Organic Carbon Stabilization in Sustainable Cropping Systems.” The objectives of this study were to evaluate the long-term role of C input in soil organic carbon (SOC) sequestration and to identify underlying mechanisms of C stabilization in soils. Ten Mediterranean cropping systems were studied, with annual soil C sequestration rates ranging from –0.35 to 0.56 Mg C/ha/yr. The authors found a strong linear relationship between SOC sequestration and cumulative C input, with a residue-C conversion to SOC rate of 7.6 percent. This linear relationship suggests that these soils have not reached an upper limit of C sequestration (i.e., not C saturated). *Soil Science Society of America Journal*, 69:1078-1085 (2005), published online: June 2, 2005, <http://soil.scijournals.org/cgi/content/abstract/69/4/1078> (subscription required)

“C-Lock: A System for Estimating and Certifying Carbon Emission Reduction Credits for the Sequestration of Soil Carbon on Agricultural Land.” The C-Lock system was developed to address the need for an improved method of quantifying and certifying project-level carbon emission reduction credits (CERC). It was designed to enable individual landowners to efficiently quantify, certify, pool, market, and trade CERCs generated by agricultural management practices. This article provides a general overview of the C-Lock system as it has been implemented for the USA State of South Dakota. *Mitigation and Adaptation Strategies for Global Change* (2005) 10: 307–331, <http://www.ingentaconnect.com/content/klu/miti/2005/00000010/00000002/00000643> (subscription required)

“The Ecological and Economic Potential of Carbon Sequestration in Forests: Examples from South America.” This study quantifies carbon sequestration in above-ground biomass and soils of plantation forests and secondary forests in two countries in South America – Ecuador and Argentina – and calculates the cost of temporary carbon sequestration. Costs per temporary certified emission reduction unit vary between 0.1 and 2.7 USD per Mg CO₂ (1 Mg = 1 tonne) and mainly depend on opportunity costs, site suitability, discount rates, and certification costs. In Ecuador, secondary forests are a feasible and cost-efficient alternative, whereas in Argentina reforestation on highly suitable land is relatively cheap. The results can be used to design cost-effective sink projects and to negotiate fair carbon prices for landowners. *Ambio*, Vol. 34, No. 3, May 2005, http://www.ambio.kva.se/2005/Nr%203_05/May05_8.shtml (subscription required)

August 2005

Constellation Energy to Reduce Chesapeake Bay Pollution and Offset Greenhouse Gas Emissions. The State of Maryland, Constellation Energy, and The Alliance for the Chesapeake Bay signed a Memorandum of Agreement that provides \$300,000, funded through Constellation Energy, to the Alliance for planting riparian forest buffers. The reforestation program will span 75 acres over three years and will include trees appropriate for each site. It is estimated that these trees will capture between 4 and 4.5 tons of carbon dioxide per acre, per year. Constellation Energy will be claiming the carbon offsets through the 1605(b) registry. *Maryland DRN Press Release*, May 2, 2005, <http://www.dnr.state.md.us/dnrnews/pressrelease2005/050205.html>

“The Potential of Soil Carbon Sequestration Through Improved Management Practices in Norway.” This study assesses the potential of Norwegian agricultural ecosystems to sequester carbon based on data from long-term agronomic and land use experiments. The overall potential for soil organic carbon (SOC) sequestration ranges from 0.6 to 1.0 MMTC/yr. Of the total potential, 59 percent is due to adoption of erosion control measures, 5.8 percent to restoration of peat lands, 21 percent to conversion to conservation tillage and residue management, and 14 percent to adoption of improved cropping systems. *Environment, Development and Sustainability* (2005) 7:161– 184, <http://www.springerlink.com/openurl.asp?genre=article&id=doi:10.1007/s10668-003-6372-6> (subscription required)

“Topsoil organic carbon storage of China and its loss by cultivation.” The study found that the mean topsoil soil organic carbon (SOC) density of China was lower than the world average value. Therefore, China may be considered as a country with low SOC density and may have great potential for C sequestration under well defined management. *Biogeochemistry* (2005) 74: 47–62, <http://www.springerlink.com/openurl.asp?genre=article&id=doi:10.1007/s10533-004-2222-3> (subscription required)

“Outsourcing forests to India.” Article discusses how farmers in Maharashtra, India will benefit from carbon credit trading following the signing of the Kyoto Protocol. A nongovernmental organization, Friends of Carbon (FoC), has brought together 5,000 farmers to exploit the option, which permits a developed country to meet part of its targeted emission cuts by funding tree plantations in developing countries like India, for carbon sequestration. Says Shekhar Kadam, who is in charge of the financial and commercial aspects of FoC, “Plantations are one of the best solutions to curbing damage from GHG emission.” Kadam claims that the mango tree is one of the best varieties. The current average rate for a tonne of carbon is around \$4. *The Times of India*, July 25, 2005, <http://timesofindia.indiatimes.com/articleshow/1182451.cms>

Trading

September 2004

Digging for Gold in the Carbon Market. Australian gold miner and explorer Revesco Group Ltd. plans to pull out of the minerals sector to reinvent itself as an environmental services business, selling carbon credits to clients. Revesco company secretary Harley Whitcombe said the former miner would establish large scale, long-term, mallee eucalypt plantations under the brand name CO₂ Australia, with the aim of supplying the emerging carbon economy. “Revesco eyes tree planting business,” August 3, 2004, *The Age*, <http://www.theage.com.au/articles/2004/08/03/1091476462547.html?oneclick=true#> (registration required)

TECO Energy Joins Chicago Climate Exchange. TECO Energy Inc. has joined the Chicago Climate Exchange (CCX). The company has committed to voluntarily reduce greenhouse gas emissions by 4 percent below the average of its 1998-2001 baseline by 2006. *TECO Energy Press Release*, August 5, 2004, http://www.tecoenergy.com/ENNws08_05_04.html

Companies make carbon credit trade. TransAlta Corp. announced a deal to spend about \$9-million for credits worth 1.75 million tonnes of greenhouse gas emissions from hog farmer Agricola Super Ltd. of Chile. TransAlta generates about 30 million tonnes of greenhouse gases in Canada each year and hopes to use the credits in the period from 2008-12, during which Kyoto targets are to be met. Like most hog businesses, Agricola stores manure in open lagoons, which are major emitters of methane, a greenhouse gas. Agricola is using technology that reduces methane emissions and physical structures to capture gas emitted. "TransAlta, Chilean firm strike emissions swap deal," *The Globe and Mail*, August 25, 2004, <http://www.ieta.org/ieta/www/pages/index.php?IdSitePage=487>

"Greenhouse Gases Heat Up as a Commodity." According to CCX vice president Rafael Marques, more than one million tons of carbon dioxide have been traded on the exchange since its inception. Although the number of emissions permits traded per month on the exchange is growing, the price per ton is hovering just below \$1, according to CCX. Bruce Braine, vice president of strategic policy analysis for American Electric Power (AEP), expects more power companies to join once overall membership reaches critical mass. *AlertNet*, August 26, 2004, <http://www.alternet.org/story/19683/>

October 2004

Creation of European Climate Exchange, for trading of emissions credits. The European Climate Exchange (ECX), in an agreement between the Chicago Climate Exchange (CCX) and London's International Petroleum Exchange (IPE), will offer European companies a place to trade emissions credits for greenhouse gases. "A green future; Carbon emissions trading," *The Economist* (print edition), September 11, 2004, <http://www.economist.com>

Assessment of an Emissions Trading Scheme for Japan. A WWF report evaluates options for an emissions trading scheme that would help Japan reach its commitment under the Kyoto Protocol. "Japan should adopt emission trading scheme says WWF," September 28, 2004, http://www.panda.org/downloads/climate_change/final0926.pdf

November 2004

"Carbon trading in Europe triples since Russian move on Kyoto." The amount of carbon dioxide being traded in Europe has almost tripled since Russia said it would ratify the Kyoto protocol. About 670,000 tons of carbon emissions were traded in the first week of October, compared with the record one million tons in September. Early this year, fewer than 50,000 tons were traded a month. *Financial Times*, October 12, 2004, <http://www.ieta.org/ieta/www/pages/index.php?IdSitePage=523>

First Public Transaction of CERs in EU. CO2e.com facilitated the first legally binding purchase of Clean Development Mechanism (CDM) Certified Emission Reductions (CERs) by a European company. The CERs have been bought from Brazil for use within the European Union Emission Trading Scheme (EU ETS). The CERs will be generated from renewable energy, using sugarcane waste residue as a fuel for electricity cogeneration. *CO2e.com Press Release*, October 11, 2004, <http://www.co2e.com>

"Green Mountain Power Joins Chicago Climate Exchange." Green Mountain Power became the first electric utility in the northeast to join the CCX. Green Mountain Power is committed to voluntarily reduce greenhouse gas emissions by four percent below its 1998-2001 baseline average by 2006. *Press Release*, October 7, 2004, <http://www.chicagoclimatex.com/news/articles/archive/2004/newsScroller2005021601161357.html>

"Money to Be Made In Carbon Trading." This article discusses carbon emissions trading and claims it is "the new way to make money from environmental restrictions." Capital markets can save the planet from global warming and earn billions for financial institutions at the same time. *The Hindu*, October 17, 2004, <http://www.hinduonnet.com>

December 2004

“CCX Opens to Californian Forest Credits.” The Chicago Climate Exchange (CCX) announced that it will recognize the California Climate Action Registry rules on accounting for carbon dioxide sequestration through forestry management. The decision by the CCX to recognize those credits will open the door for California’s forest owners to sell them into Chicago’s climate marketplace, providing a new source of revenue. *Point Carbon*, November 4, 2004, <http://www.pointcarbon.com/article.php?articleID=5182&categoryID=147>

“Japanese Firms Pick China for CDM.” Sumitomo Corp., Chugoku Electric Power Co. and Niigata Power Systems Co., a subsidiary of Ishikawajima-Harima Heavy Industries Co., are planning to invest in a project that will collect methane gas generated at Chinese coal mines and use it to produce electricity. The companies plan to install a gas engine with an output capacity of 2,000 kW that will use methane gas produced at a coal mine in China's Heilongjiang Province to generate power. *Point Carbon*, November 15, 2004, <http://www.pointcarbon.com/article.php?articleID=5294&categoryID=147>

“The Carbon Game.” Article provides an excellent overview of carbon trading. Focuses on the European Trading Scheme (ETS), National Allocation Plans (NAP), and the Clean Development Mechanism (CDM). Also highlights the Acid Rain Program and the voluntary Chicago trading scheme in the U.S. *Nature*, November 18, 2004, <http://www.nature.com/cgi-taf/DynaPage.taf?file=/nature/journal/v432/n7015/index.html>

January 2005

“Entergy to Purchase One Million CO₂ Credits Through Blue Source.” Entergy is exercising an option to purchase one million CO₂ emission reduction credits, representing the largest geologic CO₂ sequestration purchase within the United States. This purchase is an extension of the initial transaction between Entergy and Blue Source, which was completed in December of 2003. This project, however, directly deposits the carbon emissions back into dormant oil wells to recover oil deposits currently untapped by conventional extraction techniques. *PR Newswire*, December 20, 2004, <http://www.prnewswire.com/cgi-bin/stories.pl?ACCT=109&STORY=/www/story/12-20-2004/0002669420&EDATE>

“Industry fears CO₂ trading will lead to surge in electricity prices.” A coalition of power intensive industries – including iron & steel, glass, non-ferrous metals, alloys, cement, ceramics, paper, and lime - have warned against a surge in electricity prices due to the entry into force of the EU carbon emissions trading scheme in January 2005. The coalition blames the lack of competition in the European power market, which will result in power companies passing on the costs of allowances to energy intensive industries. *EurActiv.com*, December 14, 2004, <http://www.wbcso.org/plugins/DocSearch/details.asp?type=DocDet&ObjectId=12306>

EU CO₂ trading “will force firms out of Europe.” Two French business leaders have predicted that industry will be forced out of Europe by the EU greenhouse gas limits and carbon dioxide emission trading. In a front page article in *Le Monde* newspaper on December 11, Bertrand Collomb of cement producer Lafarge and Guy Dollé of steelmaker Arcelor allege that the European Commission has failed to harmonize national plans for the scheme. They criticize the exclusion of transport and households - both big CO₂ emitters - and the fact many industrial companies are also not covered, producing discrimination. *Environment Daily*, December 16, 2004, <http://www.environmentdaily.com/articles/index.cfm?action=issue&no=1791> (subscription required)

February 2005

“World Bank expresses interest to purchase Carbon Sequestration from Precious Woods project in Nicaragua.” The World Bank, as trustee of the Bio Carbon Fund expressed its interest to buy the future carbon sequestration from a project developed by Precious Woods in Nicaragua. The project would reforest 600 hectares of degraded pasture land with plantations of teak and native species. Precious Woods plans to expand the total reforestation area in Nicaragua to at least 4000 hectares in the coming years leading to a potential carbon sequestration of over two million tons. *Vereinigte Wirtschaftsdienste* (Germany), January 18, 2005, <http://www.vwd.de/vwd/news.htm?id=23444587&navi=home&sektion=adhoc>

“Energy paying oil firm to secure its emissions.” Article discusses Energy’s purchase of CO₂ emission reduction credits from Denbury Resources, as reported in the January 2005 Carbon Sequestration Newsletter. The investment in the Mississippi oil project represents a 2 million ton reduction in carbon dioxide emissions, the largest carbon sequestration credit investment ever made in the United States. The project increases the amount of credits Energy holds to 2.8 million tons. *The Times-Picayune*, January 26, 2005, <http://www.nola.com>

“EU Carbon Trading in Political Trouble.” According to this article, the CO₂ emissions trading system of the European Union is threatened with the prospect of lawsuits by Britain, Germany, and other countries which seek more generous emission allowances for their industries which are forced to reduce CO₂ emissions. *The Electricity Daily*, January 19, 2005, <http://www.electricity-online.com> (subscription required)

“Russian companies cannot trade in emission quotas at exchange.” In theory, Russian companies could make good money by selling their emission quotas. However, Russian companies have so far been denied access to the EU quota exchange. Only EU companies, certified by the EU for the permissible emission volumes, are allowed to buy and sell, according to Alexei Kokorin, the World Wildlife Fund’s climatic program director. EU members can only buy Russian quotas in direct deals, paying with investments in Russian energy efficient technology projects, rather than in cash, adds Mikhail Rogankov who represents the Energy Carbon Fund. For Russia to trade in its quotas, the country has to set up an exchange similar to the EU one, and convert its quotas to certificates for specific companies, as the EU has done. *RIA Novosti*, January 13, 2005, <http://en.rian.ru>

“Landmark transaction paves way for increased activity within greenhouse gas market.” CO₂e.com, a global broker of greenhouse gas credits, announced the facilitation of the largest-ever known brokered deal in European Emissions Allowances (EUAs) in December 2004. The deal is unique because it involves the purchase of a large volume of EUAs, and the pioneering linked sale of “secondary market” Certified Emission Reductions (CERs), paving the way for larger structured deals incorporating both compliance instruments. CERs are usually purchased directly from project developers in developing countries, which often raises questions about credit-worthiness and project delivery risk. The sale of secondary market CERs directly from a European company is highly unusual, and could lead to increased liquidity and price discovery in an emerging secondary CER market. *CO₂e.com Press Release*, January 11, 2005, <http://www.co2e.com>

“Climate trading’s accounting impacts explored.” The EU’s greenhouse gas trading scheme could disrupt companies’ annual financial reporting, according to the European federation of accountants (Fee). Participating firms “may face difficulties in measuring assets and liabilities and the effects on the profit and loss account,” Fee says in a review of climate trading’s likely impacts on accounting and auditing practices. *Point Carbon*, January 26, 2005, <http://www.pointcarbon.com/article.php?articleID=6211&categoryID=147>

March 2005

“Climate Trust to Stimulate U.S. Carbon Market with \$4.3 Million for Offsets.” The Climate Trust received \$4.3 million to reduce global warming emissions under Oregon’s innovative climate change regulation. The funds, provided by Portland General Electric, are required to offset carbon dioxide emissions from the new Port Westward power plant. To date, The Climate Trust has funded a diverse \$4 million portfolio to offset 1.6 million metric tons of carbon dioxide. *Climate Trust Press Release*, February 2, 2005, http://www.ewire.com/display.cfm/Wire_ID/2462

Natsource launches buyers pool. Natsource launched a private-sector buyers’ pool, the Greenhouse Gas Credit Aggregation Pool (GG-CAP). GG-CAP will purchase and manage the delivery of a large pool of GHG emission reduction that its buyer members can use to comply with EU emissions trading scheme and Kyoto Protocol emission reduction requirements. At first close, Natsource had approximately US\$95 million committed to acquire GHG emission reductions. This amount will increase to approximately US\$130 million within 30 days, the firm said in a press release. *Natsource Press Release*, February 28, 2005, http://www.natsource.com/uploads/features/Press%20release_Feb%2028%2005_FINAL.pdf

April 2005

“World class.” Article discusses the European Union Emissions Trading Scheme (ETS), with emphasis on what will happen after 2012. Markets are already jittery about lack of information on the regulatory drivers for the carbon market post-2012, and their nervousness will increase exponentially as time passes without the issue being resolved. This uncertainty is not only an issue for traders and those with positions in carbon markets, it is also key to the industry, which needs some level of regulatory certainty to support planning and risk management in the future, the article states. *Utility Week*, March 18, 2005, <http://www.pointcarbon.com/About+us/Press+room/Point+Carbon+in+the+media/article7323-145.html>

“ADB Opens First CDM Facility Project to Buyers.” An ADB-backed Coal Mine Methane/Coal Bed Methane Utilization Project in Fuxin, China, is the first project under its Clean Development Mechanism (CDM) Facility to be presented to carbon buyers. Between 2006 and 2012, more than 5 million carbon credits are expected to be generated from the Fuxin project, which is part of an Environmental Improvement Project in Liaoning, backed by an ADB loan of \$70 million approved in November 2004. ADB will help the project find a buyer for the credits and facilitate the transaction process during 2005. See <http://www.adb.org/cdmf> for details. *Lyrus*, March 16, 2005, <http://lists.iisd.ca:81/read/messages?id=24924>

“Northeast States Lead Regional Global Warming Initiative.” Highlights the “Regional Greenhouse Gas Initiative” to establish limits on carbon dioxide emissions and create a trading system in the Northeastern U.S. The program would allow states outside of the Northeast to participate as well, and could be extended to cover not just power plants but all stationary global warming pollution sources, and additional greenhouse gases such as methane and sulfur dioxide. The states involved in the initiative expect to jointly develop a “model rule” by June 2005, which could then be implemented by each state, says a press release. *iNRDC Press Release*, March 28, 2005, <http://www.nrdc.org/media/pressreleases/050328.asp>

May 2005

“Australian states agree to cap and trade GHG emissions.” State and territory governments in Australia have made the decision to develop a nationwide emissions trading scheme, despite lack of support from the federal government. Victoria and New South Wales have been the main drivers behind the agreement, which states that greenhouse gas emissions should be capped and permits traded. The final design of the scheme has not yet been worked out. *Point Carbon*, March 31, 2005, <http://www.wbcsd.org/plugins/DocSearch/details.asp?type=DocDet&ObjectId=14042>

“IPE/ECX Muscle in on Carbon Market with Low Fees.” London's International Petroleum Exchange (IPE) and Dutch-based European Climate Exchange have raised the stakes in the battle for Europe's carbon dioxide market by charging ultra low trading fees. In a bid to become the central pool of liquidity in the carbon market, the two exchanges launched CO₂ futures trading on the IPE's electronic platform, charging fees that dealers say will undercut most rival bourses and brokers. *Planet Ark*, April 21, 2005, <http://www.planetark.com/dailynewsstory.cfm/newsid/30482/story.htm>

“California eyes cap-and-trade plan to trim greenhouse gases.” The California Energy Commission's Climate Change Advisory Committee is eying “cap-and-trade” proposals, similar to what has worked to limit smog and acid rain, to reduce greenhouse gases that contribute to global warming. The article discusses the benefits and potential drawbacks to implementing such a plan in California when neither GHG emissions nor electricity stop at state borders. *Associated Press*, April 7, 2005, <http://www.ieta.org/ieta/www/pages/index.php?IdSitePage=642>

“Cap and trade system gaining support.” At a congressional briefing, Robert Donkers, an environmental counselor to the European Commission, said that American companies based in Europe are looking for a nod from the administration that would open the door for their partners and other corporations within U.S. borders to participate in the European Union's “cap-and-trade” trading system. Donkers said American companies overseas are having “positive” experiences with the trading system, which has been in effect since January. He also said the EU's carbon dioxide trading so far has yielded prices between euro 7 to 16.45 (\$9.00 to \$21.32)

since the beginning of the year. The trading price for April rests around euro 13 (\$16.85), he said. *U.P.I.*, April 27, 2005, <http://www.washingtontimes.com/upi-breaking/20050427-111013-7988r.htm>

“A tangle of assets and liabilities.” Article discusses a new challenge faced by accountants in the post-EU-ETS world – how to treat emissions allowances in financial statements. According to the article, treatment of these new assets and liabilities was set out in the International Financial Reporting Interpretations Committee guidance on emissions trading, or IFRIC 3, issued in December last year. However, the interpretation has created an accounting headache for companies. The article discusses the heart of the issue, an accounting mismatch between assets and liabilities. *Financial Times*, April 28, 2005, <http://www.ieta.org/ieta/www/pages/index.php?IdSiteTree=1243>

“Green Mountain Energy Company Goes Carbon Neutral.” As part of its corporate commitment to sustainable business practices and focus on improving the community in which it does business, Green Mountain Energy Company announced its participation in the Environmental Protection Agency's “Climate Leaders Program.” Starting in 2005, Green Mountain Energy Company plans to offset a full 100 percent of its carbon dioxide emissions, according to the press release. *Business Wire*, April 20, 2005, <http://www.epa.gov/climateleaders/docs/GreenMountainPressRelease.pdf>

“Montana Power Plant will meet the Oregon Standard for CO₂ Emissions.” The Climate Trust announced that it will receive \$500,000 to purchase greenhouse gas offsets on behalf of Montana-based Basin Creek Power and the Montana Environmental Information Center. The purchase will be the first offset transaction emanating from the Big Sky state. The offset funds will be used to acquire CO₂ offsets according to The Climate Trust's application of the Oregon Standard for CO₂ emissions, one of the most stringent GHG standards for power plants in the country. The offsets will count against the CO₂ emissions of Basin Creek Power's 55 MW natural gas facility in Butte, Montana. *Climate Trust Press Release*, April 18, 2005, <http://www.climatetrust.org/pdfs/PR/Basin%20Creek%20Press%20Release.pdf>

June 2005

“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.planetark.com/dailynewsstory.cfm/newsid/30772/story.htm>

“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 U.S.,” 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 U.S.,” he said. He would be surprised if major U.S. 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>

July 2005

“Optimal intensity targets for emissions trading under uncertainty.” This study assess how well intensity targets – where countries' permit allocations are indexed to future realized GDP – can cope with uncertainties in a post-Kyoto international greenhouse emissions trading scheme. The authors present some empirical foundations for intensity targets and derive a simple rule for the optimal degree of indexation to GDP. Using an 18-region simulation model of a 2020 global cap-and-trade treaty under multiple uncertainties and endogenous commitments, optimal intensity targets could achieve global abatement as much as 20 percent higher than under absolute targets. *The Australian National University, Economics and Environment Network Working Paper EEN0504*, June 21, 2005, http://een.anu.edu.au/download_files/een0504.pdf

“The dynamics of carbon sequestration and alternative carbon accounting, with an application to the upper Mississippi River Basin.” Carbon sequestration is a temporal process in which carbon is continuously being stored/released over a period of time. Different methods of carbon accounting can be used to account for this temporal nature including annual average carbon, annualized carbon, and ton-year carbon. In this paper, starting by exposing the underlying connections among these methods, the authors examine how the comparisons of sequestration projects in the Upper Mississippi River Basin are affected by these methods and the major factors affecting them. *Ecological Economics* 54 (2005) 23– 35, <http://www.sciencedirect.com/science/journal/09218009> (subscription required)

August 2005

“The Market in Carbon.” Article discusses the carbon trading industry, particularly how emissions trading markets are “springing up all over the place.” Three have come on line in Europe since the beginning of 2005, and another three will start up in the next few months. According to the article, volumes traded on the European emissions trading scheme (EU ETS) are small – around 500,000 tonnes a day – but the totals are increasing fast. Today's daily totals are the equivalent of a month's trades in the pre-market phases last year. At around 20 euros, double the price at the beginning of the year, the carbon price is certain to tempt more sellers. Banks and other financial institutions are gearing up to start trading, both as aggregators for small companies and as speculators in their own right. In the longer term, other countries, such as Norway, Switzerland, Canada, and Japan, are thinking of linking with the European system. *The Observer*, June 26, 2005, <http://observer.guardian.co.uk/carbontrust/story/0,16099,1515610,00.html>

“First-mover disadvantage.” Europe has signed up to Kyoto, and its companies face fines if they exceed their emissions caps, while America has not. China, the second biggest polluter, and India, which is rapidly increasing emissions, are exempt from its provisions as well. This article argues that Europe's companies are at a competitive disadvantage as they shoulder the cost of something that should benefit the whole world. And now, because of the high price of oil and gas, that disadvantage is looking a lot bigger than it did. *The Economist*, July 5, 2005, http://www.economist.com/research/articlesBySubject/displayStory.cfm?subjectid=2512631&story_id=4146710 (subscription required)

Special Edition of *Climate Policy* includes eleven articles looking at the EU emissions trading scheme. Some of the titles are as follows: The European Union Emissions Trading Scheme (EU ETS); Price determinants in the EU emissions trading scheme; Allocation of carbon emission certificates in the power sector: how generators profit from grandfathered rights; The interaction between the EU emissions trading scheme and national energy policies; Value and risks of expiring carbon credits from afforestation and reforestation projects under the CDM; and Allowance allocation in the European emissions trading system: a commentary. *Climate Policy*, Volume 5 No. 1, July 5, 2005, http://www.earthscan.co.uk/defaultCLIMATE_POLICY.asp?sp=&v=6 (abstracts available)

Publications

September 2004

The "Hydrogen Economy" was mentioned in numerous sources this month. Some of the articles are as follows:

A Special Issue of *Science*, "Toward a Hydrogen Economy," is now available. Articles include: "The Carbon Conundrum" and "Choosing a CO₂ Separation Technology." *Science*, Volume 305, Issue 5686, Toward a Hydrogen Economy dated August 13 2004, <http://www.sciencemag.org/content/vol305/issue5686/index.shtml?etoc> (subscription required)

"The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs." A report by the National Research Council Committee on Alternatives and Strategies for Future Hydrogen Production and Use provides an assessment of hydrogen as a fuel in the nation's future energy economy and describes a number of important challenges that must be overcome if it is to make a major energy contribution. There is a chapter dedicated to carbon capture and storage. The book is available online at <http://www.nap.edu/catalog/10922.html>

NPR, "Building a Hydrogen Economy." The August 13th edition of "Talk of the Nation" was dedicated to a discussion on moving toward a hydrogen economy - the technological developments necessary to make it a reality, how long such a shift would take, and whether a move to hydrogen would truly free us from a dependence on fossil fuels. Guests included: Stephen Pacala, director of Carbon Mitigation Initiative at Princeton; John Turner, principal scientist, National Renewable Energy Laboratory in Golden, Colorado; and Amy Jaffe, associate director, Rice Energy Program at Rice University in Houston. Carbon sequestration, EOR, FutureGen, and Slepner were all mentioned. Audio of the program is available at <http://www.npr.org/features/feature.php?wfid=3850465> [audio]

"Hydrogen: savior or fatal distraction." Should developing a "hydrogen economy" be the number one priority, or should we be investing in more immediate ways to cut emissions, such as burying the carbon dioxide produced by fossil fuels? The article tackles this issue from both perspectives. John Turner of NREL, a leading advocate of hydrogen, argues in the journal *Science* that using renewable energy to generate hydrogen is the only "green" way to produce the energy to run our cars and trucks. On the other hand, Joseph Romm, an official responsible for renewable energy during the Clinton administration, says making hydrogen from renewables is far from being economically feasible. *Reed Business Information*, August 24, 2004, <http://www.fuelcellworks.com/Supppage1047.html>. See also, "Sustainable Hydrogen Production," Turner's article in *Science*, Vol. 305, August 13, 2004.

Energy Policy. The December 2004 issue contains articles on the Bush Administration's climate policy, CO₂ emissions in international trade, OPEC and the Kyoto Protocol, the Greek energy system and its Kyoto target, and more. For further information, see *Energy Policy*, Volume 32, Issue 18, Pages 1993-2088 (December 2004), <http://www.sciencedirect.com/science/issue/5713-2004-999679981-512875> (subscription required)

Special Edition on Climate Policy. The October 2004 edition of *Global Environmental Change Part A* is dedicated to the benefits of climate policy. Topics include: estimating global impacts from climate change, regional and global impacts, abrupt climate change, and adaptation benefits and costs. *Global Environmental Change Part A*, Volume 14, Issue 3, Pages 195-297 (October 2004), The Benefits of Climate Policy Edited by Jan Corfee-Morlot and Shardul Agrawala, <http://www.sciencedirect.com/science/issue/6020-2004-999859996-514274> (subscription required)

California Warned of Global Warming Impact. California was warned in a study published in the *Proceedings of the National Academy of Sciences* that global warming could cause dramatically hotter summers and a depleted snow pack in the state. According to the study, under the most optimistic computer model, periods of extreme heat would quadruple in Los Angeles by the end of the century, the Sierra Nevada snow pack would decline, and alpine forests would shrink. The most pessimistic model projects six to eight times as many heat waves and even more reduction in snow pack and high altitude forests. "Emissions pathways, climate change,

and impacts on California,” the *Proceedings of the National Academy of Sciences*, August 24, 2004; 101 (34), <http://www.pnas.org/cgi/content/full/101/34/12422> (subscription required)

Report Warns Europe Particularly Vulnerable to Climate Change. Europe will suffer worse, and sooner, than other parts of the world from climate change, according to a report from the European Environment Agency. The continent can expect more severe heat waves and more frequent and violent storms. Northern Europe can expect more precipitation, while southern regions are likely to experience drought. By 2080, cold winters could almost entirely disappear. The report urged a worldwide effort to reduce greenhouse gas emissions. See “Europe 'must adapt on climate',” *BBC News*, August 18, 2004, <http://news.bbc.co.uk/1/hi/sci/tech/3570602.stm>; “Europe facing ever-more weather extremes, warns a report,” *TerraWire*, August 18, 2004, <http://www.terradaily.com/2004/040818114036.xd3pyn83.html>; and “A flash flood in the pan or a rainstorm caused by global warming?” *Independent News*, August 18, 2004, <http://climateark.org/articles/reader.asp?linkid=34410>

Online Book. “Implementing Climate and Global Change Research: A Review of the Final U.S. Climate Change Science Program Strategic Plan,” is available on the National Academies Press web site. The report reviews a draft strategic plan from the U.S. Climate Change Science Program, a program formed in 2002 to coordinate and direct U.S. efforts in climate change and global change research. *National Research Council* 2004, <http://www.nap.edu/catalog/10635.html>

Legal merits of tort-based climate change litigation. In a follow-up to the July 21 filing of a lawsuit against the top five U.S. carbon dioxide emitters, this article explores the legal merits of the case, which cites federal common law on public nuisance. “Climate Change a Nuisance? Nine State and City Attorneys General Bet a Lawsuit On It,” *CSRwire*, August 8, 2004, <http://www.csrwire.com/sfarticle.cgi?id=1487>

October 2004

Energy Economics, Special Edition. This special edition, “EMF 19 Alternative technology strategies for climate change policy,” includes 13 articles. Three are summarized below:

“Stabilization of CO₂ in a B2 world: insights on the roles of carbon capture and disposal, hydrogen, and transportation technologies.” Performs a MiniCAM analysis of the B-2 scenario developed by SRES and uses a revamped transportation sector model. Predicts continued expansion of fossil fuels through 2095. Authors find that “the existence of advanced technologies, including high efficiency vehicles, does not significantly lower emissions in the absence of policies that limit CO₂ emissions.” Carbon taxes are found to have little effect on the behavior/emissions in the transportation sector because fuel costs are only 10% of the total cost of transportation service. *Energy Economics*, Volume 26, Issue 4, July 2004, Pages 517-537, <http://www.sciencedirect.com/science/journal/01409883> (subscription required)

“Technological learning for carbon capture and sequestration technologies.” Applies reductions in cost achieved with SO_x control technologies to CO₂ capture and storage. Shows a reduction in avoided cost of emissions for CO₂ capture from \$100-110 \$/tC today to 30-50 \$/tC after 1,000 GW of power plant capacity with capture has been deployed. *Energy Economics*, Volume 26, Issue 4, July 2004, Pages 539-564, <http://www.sciencedirect.com/science/journal/01409883> (subscription required)

“The impact of learning-by-doing on the timing and costs of CO₂ abatement.” Authors find that the benefits of learning-by-doing do not necessarily mean that stringent near-term limitations on carbon emissions reduce the cost of emissions abatement. *Energy Economics*, Volume 26, Issue 4, July 2004, Pages 603-619, <http://www.sciencedirect.com/science/journal/01409883> (subscription required)

UCS Report. The Union of Concerned Scientists (UCS) released a report entitled, “Choosing Our Future: Climate Change in California.” The UCS report and accompanying products include a summary of projected impacts on: temperature, precipitation, sea level, extreme heat, human health, water resources, agriculture, and vegetation distribution; a summary of climate change solution options available for California; and expanded pieces on heat and risks to human health, and declining snowpack and risks to water supplies. All of these materials are available online at <http://www.climatechoices.org>

Return To Coal: Why Utilities Must Reconsider This Cheap, Plentiful Fuel. Thinking Energy has developed a 258-page technical and economic study setting forth the benefits of coal utilization by the power industry. Report is available for \$250. *Research and Markets*, September 16, 2004, http://www.researchandmarkets.com/reportinfo.asp?report_id=307833

“New Study Examines Business Impacts of Energy and Climate Choices.” Energy demand could double or triple by 2050, as population rises and developing countries expand their economies and overcome poverty, according to a study. The study, by the World Business Council for Sustainable Development, explores challenges in achieving a sustainable energy situation globally, and future energy options and infrastructures. *GreenBiz.com*, September 7, 2004. The study can be downloaded at <http://www.wbcsd.ch/plugins/DocSearch/details.asp?MenuId=1&ClickMenu=&doOpen=1&type=DocDet&ObjectId=NzE1OQ>

November 2004

Paper Posted on NETL website. A paper entitled “GEO-SEQ Best Practices Manual Geologic Carbon Dioxide Sequestration: Site Evaluation to Implementation” has been posted in the Resources area under Accounting Protocols, available at http://www.netl.doe.gov/coal/Carbon%20Sequestration/pubs/GEO-SEQ_BestPract_Rev1-1.pdf

“Consumer lifestyle approach to U.S. energy use and the related CO₂ emissions.” Historically, a sectoral approach has shaped the way we frame and analyze issues of energy conservation and CO₂ mitigation. This paper proposes an alternative paradigm, called the Consumer Lifestyle Approach (CLA), to explore the relationship between consumer activities and environmental impacts in the US. The study shows that more than 80% of the energy used and the CO₂ emitted in the U.S. are a consequence of consumer demands and the economic activities to support these demands. Direct influences due to consumer activities (home energy use and personal travel) are 4% of the U.S. GDP, but account for 28% and 41% of U.S. energy use and CO₂ emissions, respectively. *Energy Policy* 33 (2005) 197-208, <http://www.sciencedirect.com/science/journal/03014215> (subscription required)

“An Effective Approach to Climate Change.” Eileen Claussen, president of the Pew Center on Global Change, wrote in *Science’s* October 29th Policy Forum, “We need far more vigorous effort to promote energy efficient technologies; to prepare for the hydrogen economy; to develop affordable carbon capture and sequestration technologies; and to spur growth of renewable energy, biofuels, and coal-bed methane projects.” *Science*, October 29, 2004, <http://www.sciencemag.org/content/vol306/issue5697/index.shtml> (subscription required)

“A healthy reduction in oil consumption and carbon emissions.” Article concludes that gasoline demand and CO₂ emissions in the U.S. could be reduced by 35% and 11%, respectively, if obese and overweight conditions were eliminated from the adult population through the use of walking or biking for transportation. *Energy Policy* 33 (January 2005): 1-4, <http://www.sciencedirect.com/science/journal/03014215> (subscription required)

Cutting Greenhouse Gases Makes Financial Sense Says Report. A report, released by The Climate Group, shows that public and private sector organizations have managed to achieve significant reductions of greenhouse gases and increase profits as a result. The report, “Carbon Down, Profits Up,” is available for download at <http://www.theclimategroup.org/index.php?pid=370>

“A Climate of Innovation: Northeast business action to reduce greenhouse gases.” This report reviews corporate greenhouse-gas emissions management based on the experiences of nine large corporations from various economic sectors. The study concludes that “proactive work” by companies to measure emissions and minimize the costs of coming rules could be much less expensive than “reacting to events at a later date.” The report can be downloaded at http://climate.wri.org/pubs_description.cfm?PubID=4031

“Exergy analysis of a gas-turbine combined-cycle power plant with precombustion CO₂ capture.” Natural gas was reformed in an auto-thermal reformer, and the CO₂ was separated before the hydrogen-rich fuel was used in a conventional combined-cycle process. The main purpose of the study was to investigate the integration of the reforming process and the combined cycle. *Energy*, Volume 30, Issue 1, January 2005, Pages 5-39, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

December 2004

“Regulation Geosequestration.” The October/November edition of *AETF Review* contains an article on draft regulatory guiding principles for carbon dioxide geosequestration as developed by the Australian Ministerial Council for Minerals and Petroleum Resources (MCMPR). The draft regulatory framework addresses seven fundamental issues: access and property rights, long-term responsibilities, environmental issues, authorization and compliance, monitoring and verification, transportation issues, and financial issues. The article can be downloaded at <http://aetf.emcc.net.au/ContentStore/pdf/ReviewOctNov2004.pdf>

Arctic climate report released. The Arctic Climate Impact Assessment has been released and a summary of the report is available for download at <http://www.acia.uaf.edu/>. Also see: “Study: Arctic warming at twice the global rate,” *New Scientist*, November 2, 2004, <http://www.newscientist.com/article.ns?id=dn6615>, and “Study Reveals Global Warming Effects in Arctic,” *NPR, All Things Considered*, November 8, 2004, <http://www.npr.org/templates/story/story.php?storyId=4159482> [audio]

“Climate Change Impacts are Sensitive to the Concentration Stabilization Path.” Article derives pathways leading to stabilization of equivalent CO₂ concentration (including radiative forcing effects of all significant trace gases and aerosols) with a range of transient behavior before stabilization, including temporary overshoot of the final value. Compares resulting climate changes to the sensitivity of representative geophysical and ecological systems. Based on the limited available information, some physical and ecological systems appear to be quite sensitive to the details of the approach to stabilization. The likelihood of occurrence of impacts that might be considered dangerous increases under trajectories that delay emissions reduction or overshoot the final concentration. *Proceedings of the National Academy of Sciences*, November 23, 2004, <http://www.pnas.org/cgi/content/abstract/101/47/16411> (subscription required)

January 2005

National Commission on Energy Policy Report Released. The report contains detailed policy recommendations for addressing oil security, climate change, natural gas supply, the future of nuclear energy, and other long-term challenges. The Commission’s recommendations for coal included: Providing \$4 billion over ten years in early deployment incentives for IGCC coal technology; Providing \$3 billion over ten years in public incentives to demonstrate commercial-scale carbon capture and geologic sequestration at a variety of sites. Said William K. Reilly, former EPA Administrator, “Coal’s abundance in the United States, and in major developing countries like China and India, makes finding clean ways to use it among our highest priorities. Coal gasification, when combined with carbon sequestration, has the potential to revolutionize energy production.” “Bipartisan Commission Issues Strategy to Address Long-Term U.S. Energy Challenges,” *PR Newswire*, December 8, 2004. <http://www.prnewswire.com/cgi-bin/stories.pl?ACCT=109&STORY=/www/story/12-08-2004/0002590358&EDATE>. The report entitled, “Ending the Energy Stalemate: A Bipartisan Strategy to Meet America’s Energy Challenges,” is available for download at <http://www.energycommission.org>

“The costs of mitigating carbon emissions in China: findings from China MARKAL-MACRO modeling.” In this paper an integrated energy-environment-economy model is used to generate China’s reference scenario for future energy development and carbon emissions through the year 2050. The results show that China’s primary energy consumption is expected to be 4818 MtCe with carbon emissions of 2394 MtC by 2050. Carbon intensity per GDP is expected to decrease at an annual rate of 3% during the period 2000–2050. Marginal abatement cost curves of carbon for the year 2010, 2020, and 2030 are also derived from the model. *Energy Policy*, 33 (May 2005) 885-896, <http://www.sciencedirect.com/science/journal/03014215> (subscription required)

“On the Integration of Carbon Capture and Storage into the International Climate Regime.” This article analyzes the potential integration of Carbon Capture and Storage (CCS) in the international climate regime. Utilizes experiences from the Land use, Land-use change and Forestry (LULUCF) sector to argue that CCS can only be accounted for in a transparent and comprehensive way. Discusses accounting problems associated with cross-border projects, which arise due to the geographical separation of the capture and storage site. An economic analysis is conducted considering the consequences of non-permanent storage. The study suggests that CCS is not as attractive as widely claimed. *Hamburg Institute of International Economics*, Discussion Paper 303, 2004, available for download at http://www.hwwa.de/Publikationen/Discussion_Paper/2004/303.pdf

“Bottom-up approaches for defining future climate mitigation commitments.” This report analyses a number of alternative, bottom-up approaches, i.e. technology and performance standards; technology research and development agreements, sectoral targets, etc. While bottom-up approaches are concluded as being valuable components of a future climate regime, they do not seem to offer a real alternative to emission reduction and limitation targets, as they provide little certainty about the overall environmental effectiveness of climate policies. RIVM report 728001029/2004. The report can be downloaded at <http://www.rivm.nl/bibliotheek/rapporten/728001029.html>

Cinergy Releases Report On Potential Impact Of Greenhouse Gas Regulation. Cinergy Corp. released its report entitled, “The Air Issues Report to Stakeholders,” on the potential impact of regulation of greenhouse gas emissions on the operation of its electric generating system. The full report can be downloaded at http://www.cinergy.com/pdfs/AIRS_12012004_final.pdf

February 2005

NETL Report Posted to Analysis/Policy Page. The report entitled, “Carbon Sequestration Role in State and Local Actions,” summarizes existing carbon sequestration activities at the state level, to inform decision makers, planners, and others who may be interested in the progress of carbon sequestration development in the United States. The report can be downloaded at http://www.netl.doe.gov/otiic/pubs/sfinal_1.pdf

Pew Center study finds terrestrial sequestration becomes expensive at large aggregate scale. To offset one-fifth of U.S. emissions would require about 300 million acres, roughly the size of Texas. “There is little doubt that the most important factor affecting the cost of forest-based carbon sequestration in the United States is the cost of land,” write Robert Stavins and Kenneth Richards, the report's lead authors. The full text of the report, “The Cost of U.S. Forest-based Carbon Sequestration,” is available at http://www.pewclimate.org/docUploads/Sequest_Final.pdf

“Essays on the Economics of Forestry-Based Carbon Mitigation.” This book is a collection of articles that deal with the following: the impact of risk on the supply of carbon sequestration and forest ecosystem services, the identification of least-cost sites for carbon sequestration worldwide, the evaluation of the aggregated carbon supply curve at a global level, the cost-effectiveness of carbon sequestration through the natural regeneration of secondary forests, and the impact of recent decisions for carbon accounting under the CDM. Copies of the book can be obtained from the author, Pablo C. Benitez: pablo.benitezponce@wur.nl

“United States participation in future climate agreements: An assessment.” A CICERO report identifies the major obstacles to U.S. participation in an international treaty to control greenhouse gas emissions, and suggests some possible strategies for re-engaging the United States. For details and to download the report visit http://www.cicero.uio.no/publications/detail.asp?publication_id=3312&lang=en

“Beyond Climate: Options for broadening climate policy.” This report assesses the potential, synergies, and trade-offs of linking climate to other relevant policy areas, including poverty reduction, land-use, security of energy supply, trade and finance, and air quality and health. The study also explores the possibility of climate becoming a mainstream issue in those policy areas. The report can be downloaded from: http://www.climnet.org/pubs/200501_adpt_paper.pdf

March 2005

Report Posted on NETL Policy/Analysis Page. The report, entitled “A Primer on Perceptions of Risk, Risk Communication and Building Trust” can be downloaded at <http://www.netl.doe.gov/coal/Carbon%20Sequestration/pubs/regissues/TKC%20Risk%20Paper.fin.pdf>

Brookings Transcript Now Available. A transcript from a February 9, 2005 Brookings event, “Climate Change Policy: Next Steps,” is now available. During the event, Senator Hagel described his then upcoming legislation, where sequestration was mentioned specifically as “the kind of technology that must be employed around the world to achieve results in reducing greenhouse gas emissions.” To view the transcript visit

<http://www.brookings.edu/comm/events/20050209climate.pdf>. For more information about Senator Hagel's proposal, see the Legislative section of this newsletter index.

“Assessing carbon stocks and modeling win-win scenarios of carbon sequestration through land-use changes.” A publication by the Land and Water Development Division of the Food and Agriculture Organization of the UN focuses on inventory of carbon stocks in above- and below-ground biomass and on modeling of scenarios of carbon sequestration through land use changes. The publication can be downloaded at <ftp://ftp.fao.org/agl/agll/docs/carbonstocks.pdf>

“Global Warming Bill Means Thousands of New Jobs.” According to a study, major global warming legislation would add more than 800,000 new jobs in America by 2025. The bi-partisan bill, the Climate Stewardship Act, would trigger new development and investment in clean energy technologies, bringing much-needed employment to states and diverse job sectors across the country. The analysis predicts some job losses in the coal industry, but those effects could be mitigated through policies to promote deployment of advanced coal technologies, as well as through transition assistance to displaced workers. *NRDC Press Release*, February 10, 2005, <http://www.nrdc.org/media/pressreleases/050210a.asp>. The report, “Jobs and the Climate Stewardship Act,” can be downloaded at <http://www.nrdc.org/globalWarming/csa/CSAjobs.pdf>

April 2005

“Modelling the Potential of Geosequestration.” Highlights a CO2CRC-supported study where a mathematical model was developed to assess the potential of geosequestration for mitigating global and local CO₂ emission levels and atmospheric CO₂ concentrations. A secondary objective was to assess the extent to which leakage needs to be taken into account when globally modeling carbon capture and storage. *AETF Review*, February/March 2005, <http://aetf.emcc.net.au/ContentStore/pdf/ReviewFebMar2005.pdf>

“Carbon Capture and Storage (CCS).” In this four page POSTnote, the UK government's global strategy to address climate change is discussed. The POSTnote discusses the potential of carbon capture and storage (CCS) to reduce UK and global emissions, and also the costs, environmental impacts and public perceptions of CCS. *POSTnote*, March 2005, <http://www.parliament.uk/documents/upload/POSTpn238.pdf>

“Agriculture could help solve global warming, says report.” A report shows that by 2030, the Illinois summer climate will generally resemble that of current east Texas. University of Illinois professor Michelle Wander and co-author Steve Clemmer of UCS say that agriculture can be an important part of the solution to global warming and they recommend incentives to sequester carbon on marginal lands. *University of Illinois Press Release*, February 28, 2005. Read the full report, “Confronting Climate Change in the Great Lakes Region: Impacts on Our Communities and Ecosystems,” at <http://www.ucsusa.org/greatlakes>

“Companies and Regulators in Emissions Trading Programs.” Much has been written about the economic and environmental performance of U.S. emissions trading programs for sulfur dioxide and nitrogen oxides. Less explored have been the unique roles and interactions of environmental regulators and the companies they regulate in these programs. The paper uses examples from U.S. trading programs to illustrate the design and administrative features that allow program administrators and companies to best fulfill their respective roles. The paper also examines whether these features are present in the EU Emissions Trading System and analyzes the implications for its effectiveness. *Resources for the Future*, February 2005, available at <http://www.rff.org/rff/Documents/RFF-DP-05-03.pdf>

May 2005

“International Initiatives.” The Spring 2005 edition of *Clean Coal Today* contains an article that highlights the Australian Cooperative Research Center on CO₂ (CO2CRC). The newsletter can be found at <http://www.netl.doe.gov/cctc/newsletter/newsletter.html>

“Isolation and determination of cultural characteristics of a new highly CO₂ tolerant fresh water microalgae.” Fresh water microalgae, which has high CO₂ tolerance, were isolated and its cultural characteristics were investigated. The microalgae showed maximum growth at 10% CO₂ enriched air flowing condition, and a good growth rate in a broad range of physically controllable conditions, including CO₂ concentrations up to 70%, CO₂ enriched air flow rate, temperature and pH value. The results indicated the feasibility for fixing CO₂ from stack gases. *Energy Conversion & Management*, Volume 46, Issue 11-12, July 2005, <http://www.sciencedirect.com/science/journal/01968904> (subscription required)

“Co-production of hydrogen, electricity and CO₂ from coal with commercially ready technology.” This two-part paper investigates performances, costs and prospects of using commercially-ready technology to convert coal to H₂ and electricity, with CO₂ capture and storage. Part A, “Performance and emissions,” focuses on plant configuration, performance, and CO₂ emissions. Part B, “Economic analysis,” focuses on the cost of producing H₂ and electricity, with and without reduced CO₂ emissions. *International Journal of Hydrogen Energy*, Volume 30, Issue 7, July 2005, <http://www.sciencedirect.com/science/journal/03603199> (subscription required)

“The Role of Technology Development in Accelerating U.S. Mercury and Carbon Dioxide Emission Reductions.” As part of a panel on Power Sector Emission Issues, Ned Helme, President of the Center for Clean Air Policy, addressed the role of technology development in hastening reductions in mercury and carbon dioxide before an audience at the 13th annual EIA Annual Energy Outlook and Modeling conference in Washington, DC on April 12. At the presentation Helm recommended that legislative approaches include incentives for IGCC with carbon capture and sequestration, whether with or without a cap. Such incentives can help reduce carbon dioxide emissions while preserving coal-fired power generation, he said. To view the presentation slides, visit http://www.ccap.org/pdf/EIA%20presentation_Apr_12_05.pdf

June 2005

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, “The Climate of Man-II,” May 2, 2005, and “The Climate of Man-III,” May 9, 2005, <http://www.newyorker.com>

“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. 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.iea.org/bookshop/add.aspx?id=196>

“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)

“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://newsinfo.southernco.com/article.asp?mnuType=sub&mnultem=ni&id=1735&mnuOpco=soco&category=0>. 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)

July 2005

“CMU study: New coal technology could help reduce emissions.” Increased investment in coal gasification technology by electric utilities could dramatically reduce carbon dioxide emissions without damaging the economy, according to a Carnegie Mellon University study. The 75-page report, commissioned by the Pew Center on Global Climate Change, says such technology combined with carbon capture and sequestration could all but eliminate carbon dioxide emissions in 50 years as new power plants are phased in. Granger Morgan, a co-author of the report and head of CMU’s Department of Engineering and Public Policy and co-director of the Electric Industry Center, said that the \$250 billion electric utility industry should be required to invest 1 percent of its revenues – more than triple what they do now – to further develop such advanced technologies. *Pittsburgh Post-Gazette*, June 16, 2005, <http://www.post-gazette.com/pg/05167/522393.stm>. The report, “U.S. Electric Power Sector and Climate Change Mitigation,” is available at http://www.pewclimate.org/global-warming-in-depth/all_reports/electricity/index.cfm

“The public perception of carbon dioxide capture and storage in the UK: results from focus groups and a survey.” A series of meetings of two “Citizen Panels” were held to explore public perceptions of off-shore carbon dioxide capture and storage (CCS). In addition, a face-to-face survey of 212 randomly selected individuals was conducted. The study found that, on the first hearing about CCS in the absence of any information on its purpose, the majority of people either do not have an opinion at all or have a somewhat negative perspective. However, when (even limited) information is provided on the role of CO₂ storage in reducing CO₂ emissions to the atmosphere, opinion shifts towards expressing slight support for the concept. *Climate policy* 4 (4, 2005): 377-398, <http://www.earthscan.co.uk/news/article/mps/uan/382/v/6/sp/> (subscription required)

“Sequestration rental policies and price path of carbon.” Carbon rental has been suggested as a way of providing incentives to sequester carbon in biomass in the context of emissions trading systems for GHG emissions. A rental system works by issuing a credit for sequestered carbon that must be repaid after some fixed term. Rental systems avoid many of the difficulties of ensuring the permanence of sequestered carbon that exist in other institutional arrangements. This article adapts the results of Herzog et al. (2003) to argue that a

rental system requires that carbon prices rise more slowly than the value of alternative investments in order to provide adequate incentives, and that there are good reasons to believe that this may not happen. *Climate policy* 4 (4, 2005): 419- 425, <http://www.earthscan.co.uk/news/article/mps/uan/382/v/6/sp/> (subscription required)

“Can geological carbon storage be competitive?” A working paper from CICERO reviews the literature on the costs and benefits of geological carbon storage and finds that in the near-term Carbon Capture and Storage (CCS) is likely to be an economically viable option only in a small set of circumstances, particularly enhanced oil recovery. In the medium and longer term, with improvements in CCS technology and the likelihood of increased greenhouse gas permit prices, CCS is likely to become an economically viable option under a wider range of circumstances. The paper can be downloaded at http://www.cicero.uio.no/publications/detail.asp?publication_id=2735&lang=en

Case studies on International Energy Technology Collaboration and Climate Change Mitigation. The case study, “Clean Coal Technologies,” reviews experience and identifies lessons in international collaboration with regard to clean coal technologies. It presents information on efficient coal technologies, with a focus on fuel combustion and power generation, and on clean coal technology and equipment transfer to China. The paper can be downloaded from <http://www.oecd.org/dataoecd/22/38/34878689.pdf>

“Top 100 U.K. Carbon Emitters Named as Warning to Investors.” A report, “The Carbon 100,” evaluates the total carbon emissions of the FTSE 100. It shows that just five sectors – oil and gas, electricity, mining, steel, and leisure – generate 85 percent of direct carbon emissions despite accounting for only 29 percent of market capitalization. Shell has been named as the biggest emitter of greenhouse gases in the U.K. The oil company is responsible for 23 percent of all emissions from FTSE 100 companies, closely followed by BP and Scottish Power who account for 17 percent each. The report calls for improved disclosure from companies about their emissions so that investors can make more informed decisions. At present less than half of the FTSE 100 disclose their carbon emissions. *Edie News*, June 20, 2005, http://www.greenbiz.com/news/news_third.cfm?NewsID=28272. The report can be downloaded in PDF format online at http://www.trucost.com/Trucost_The_Carbon_100.pdf

“Emission and Atmospheric CO₂ Stabilization: Long Term Limits and Paths.” The objective of stabilization of greenhouse gas concentrations is often envisioned as a monotonic approach to higher constant concentrations. For CO₂ to approach a constant concentration over a finite time, CO₂ emissions must peak and then gradually approach zero over 1,000+ years, regardless of the concentration level. While this intellectual architecture has proved useful, the authors suggest consideration of a broader range of scenarios, including ones in which net emissions decline to zero over a finite period of time resulting in a maximum CO₂ concentration followed by a long-term decline to a lower level. Carbon cycle model results illustrate these scenarios. *Mitigation and Adaptation Strategies for Global Change* (2005) 10: 213–220, <http://www.ingentaconnect.com/content/klu/miti/2005/00000010/00000002/00003783> (subscription required)

August 2005

“Energyplexes for the 21st century: Coal gasification for co-producing hydrogen, electricity and liquid fuels.” This paper illustrates the role that integrated energy systems, also known as ‘energyplexes’, could play in supplying energy demands in the long term. Their potential is highlighted here using the case of coal-fired, synthesis gas-based gasification systems that allow co-producing hydrogen, electricity and liquid fuels, i.e. Fischer–Tropsch liquids and methanol, and could be a key building block in a clean-coal technology strategy. Co-production, also known as poly-generation, strategies may contribute to improve the economics of the system and exploit potential synergies between the constituent processes. However, the technical feasibility and economic viability of poly-generation schemes have to be examined carefully on a case-by-case basis. *Energy* 30 (2005) 2453–2473, <http://www.sciencedirect.com/science/journal/03605442> (subscription required)

“Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2002 Update.” This paper updates California’s statewide inventory of GHG emissions, using 2002 data, the most recent data available from the DOE’s EIA. It also extends the period of the California GHG inventory from 1999 to 2002. This inventory – for the first time ever – reports GHG emissions from out-of-state electricity along with in-state GHG emissions and projects future emissions trends. *California Energy Commission*, June 2005, Publication CEC-600-2005-025, available at <http://www.energy.ca.gov/2005publications/CEC-600-2005-025/CEC-600-2005-025.PDF>

“Prospective Evaluation of Applied Energy Research and Development at DOE (Phase One): A First Look Forward.” In 2001, the National Research Council (NRC) completed a congressionally mandated assessment of the benefits and costs of DOE’s fossil energy and energy efficiency R&D programs. The Congress followed this retrospective study by directing DOE to request the NRC to develop a methodology for assessing prospective benefits. This report presents the results of phase one, which focuses on development of the methodology. Phase two will make the methodology more robust and explore related issues, and subsequent phases will apply the methodology to review the prospective benefits of different DOE fossil energy and energy efficiency R&D programs. To view the full report – including Appendix G: Report of the Panel of Sequestration R&D – visit http://www.nap.edu/catalog/11277.html?ee_26

“The Cutting Edge; Climate Science to April 05.” This report summarizes climate research from the Hadley Centre, UK, on carbon cycle feedbacks, and the Potsdam Institute, Germany, on the stabilization levels necessary to avoid exceeding a 2 degree temperature rise. The report suggests that a reduction in global greenhouse gases of 60 percent will be required by 2030, and under the contract and converge principles, the UK (and similar developed countries) will need to achieve around 90 percent reductions by 2030. The report is available to download from http://www.climate-crisis.net/downloads/THE_CUTTING_EDGE_CLIMATE_SCIENCE_TO_APRIL_05.pdf

Legislation

October 2004

“California OKs Toughest Auto Emissions Rules.” California adopted the world’s first rules to reduce greenhouse emissions for automobiles. Under the regulations the auto industry must cut exhaust from California’s cars and light trucks by 25 percent and from larger trucks and sport utility vehicles by 18 percent. The industry will have until 2009 to begin introducing cleaner technology, and will have until 2016 to meet the new exhaust standards. The proposals would require automakers to reduce emissions by using such technological innovations as better air conditioners, more efficient transmissions, and smaller engines. *Associated Press*, September 25, 2004, <http://enn.com/today.html?id=93>

January 2005

Congress approved the \$388 billion omnibus spending bill. The President’s Coal Research Initiative received \$273 million, of which \$45 million is devoted to Sequestration R&D. The overall 2005 budget for DOE’s Fossil Energy program is \$640.2 million, which is a reduction from the 2004 appropriation of \$804.8 million. To view a summary table of DOE’s Fossil Energy budget for fiscal year 2005 visit http://fossil.energy.gov/aboutus/budget/05/Budget_Table_-_FY2005.html

Rhode Island Adopts California Emission Standards. Governor Donald L. Carcieri announced that the Department of Environmental Management filed regulations that adopt the latest California Low Emission Vehicle II (LEV II) vehicle emission standards for new vehicles sold in Rhode Island beginning with model year 2008. The standards require that 10 percent of the autos and light trucks be so-called zero-emission vehicles. Rhode Island joins Connecticut, Massachusetts, Vermont, Maine, and New York in adopting the California program. New Jersey is in the process of adopting the California standards. “Governor Carcieri Announces Adoption of California Emissions Standards for Rhode Island,” *RI Department of Environmental Management Press Release*, December 21, 2004, <http://www.state.ri.us/dem/news/2004/pr/1221042.htm>

March 2005

FY2006 Budget Request to Congress. The proposed U.S. 2006 Energy budget provides \$286 million, an increase of \$13 million over 2005 enacted levels, for the President's Coal Research Initiative. Specifically, \$67 million was allocated for Sequestration R&D. The overall 2006 budget request for DOE's Fossil Energy Research and Development was \$491 million, which is a reduction from the 2005 appropriation of \$572 million. To view a statistical table of DOE's FY 2006 Budget Request to Congress visit http://www.mbe.doe.gov/budget/06budget/Content/appstat_cd.pdf

Climate Stewardship Act reintroduced. Senators John McCain and Joe Lieberman reintroduced their plan for a nationwide plan to regulate carbon dioxide emissions, with McCain pledging to go after a vote on the measure within the first legislative vehicle he can find. "Senator Lieberman and I will not give up on this issue," said McCain, noting that many of his Senate colleagues are taking a fresh look at global warming as the topic becomes more mainstream. "We can no longer afford to simply gather data and publish reports," he said. "Senators McCain and Lieberman Actively Seeking Vehicle for Climate Vote," *Environment & Energy Daily*, February 14, 2005, <http://www.eenews.net/EEDaily.php> (subscription required). Support from some senators who previously opposed the bill is summarized in, "Senators Warm Up to Emissions Curbs," *Wall Street Journal*, February 23, 2005, <http://online.wsj.com> (subscription required)

"Hagel Introduces Comprehensive Climate Change Legislation." U.S. Senator Chuck Hagel (R-NE) introduced legislation to provide a comprehensive approach to dealing with the issue of climate change. The legislative package consists of three bills (S. 386,387,388) which address domestic policy, international policy, and tax policy. They focus on the role of private-public partnerships, technology, and developing countries in reducing greenhouse gas emissions. For bill summaries and the complete text of Hagel's floor statement visit <http://www.swnebr.net/newspaper/cgi-bin/articles/articlearchiver.pl?157008>. *Southwest Nebraska News*, February 16, 2005.

April 2005

"Coal: Clean King?" In this interview with Peabody Energy CEO Irl Engelhardt and Duke Power CEO Ruth Shaw the following topics are discussed: The Clear Skies bill and the incorporation of limits on CO₂, Senator Hagel's proposed incentives for clean coal and IGCC, with in-depth discussion of how to encourage the construction of more IGCC plants, and FutureGen status. *E&ETV*, March 10, 2005, transcript available at <http://www.eande.tv/showAssets/related/031005/031005transcript.html>

May 2005

"Senator Byrd Calls for Mandatory Carbon Policy." On Monday April 11, Senator Byrd (D-WV) introduced the International Clean Energy Deployment and Global Energy Markets Investment Act of 2005 (S.745) along with cosponsors Senators Bingaman (D-NM), Jeffords (I-VT), and Kerry (D-MA). The Act aims, among other things, to strengthen U.S. cooperation with developing countries in addressing critical energy needs and global climate change; to promote sustainable economic development; increase access to modern energy services; reduce greenhouse gas emissions; and strengthen energy security and independence in developing countries through the deployment of clean energy technologies. More information via *Congressional Record* (S3416-S3417) at http://frwebgate.access.gpo.gov/cgi-bin/getpage.cgi?dbname=2005_record&page=S3416&position=all and *Thomas* at <http://thomas.loc.gov/cgi-bin/bdquery/z?d109:SN00745:@@P>

June 2005

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>

"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>

July 2005

"Senators address global warming." Ten senators, half of them Republicans, for the first time supported a resolution calling for mandatory limits on greenhouse gas emissions that cause global warming. The resolution came on the heels of the 60-38 defeat of the McCain-Lieberman Climate Stewardship and Innovation Act. The "Sense of the Senate on Climate Change" resolution says, "It is the sense of the Senate that, before the end of the first session of the 109th Congress, Congress should enact a comprehensive and effective national program of mandatory, market-based limits on emissions of greenhouse gases that slow, stop, and reverse the growth of such emissions at a rate and in a manner that will not significantly harm the United States economy; and will encourage comparable action by other nations that are major trading partners and key contributors to global emissions." *Lynchburg News and Advance*, June 25, 2005, http://www.newsadvance.com/servlet/Satellite?pagename=LNA%2FMGArticle%2FLNA_BasicArticle&c=MGArticle&cid=1031783495103&path=/news/archive

"Senate Rejects Greenhouse Gas Limits." Voting 60 to 38, lawmakers rejected an amendment sponsored by Sens. John McCain and Joseph I. Lieberman, calling for mandatory limits on emissions linked to global warming. *Washington Post*, June 23, 2005, <http://www.washingtonpost.com/wp-dyn/content/article/2005/06/22/AR2005062200465.html>

"Global Warming Gains Higher Profile in Senate." Discusses the three plans proposed in June 2005 to address global warming. Sponsors included Sen. Jeff Bingaman, Sens. John McCain and Joe Lieberman, and Sen. Chuck Hagel. *LA Times*, June 19, 2005, <http://www.centredaily.com/mld/dailytimes/2005/06/21/news/nation/11936987.htm>

"GOP Warms Up to Emissions Cuts." Highlights shifting views of Republican Senators who have historically dismissed calls for federal action on global warming and are now seeing a political benefit to embracing curbs on GHGs. *Washington Post*, June 12, 2005, <http://www.washingtonpost.com/wp-dyn/content/article/2005/06/11/AR2005061100557.html>

"U.S. House Approves Funding For FutureGen." U.S. Congressman Jerry Costello (D-IL) announced that the FutureGen clean coal power plant project will receive \$18 million in the House Energy & Water Development Appropriations bill for fiscal year 2006. In addition, another \$257 million in clean coal funds will be set aside exclusively for FutureGen in following years. "This is an important step that gives FutureGen increased momentum," said Costello. "Having the full House of Representatives make the commitment to set aside this

substantial amount of money in future years is a significant step forward for the program.” *Press Release*, May 26, 2005, <http://www.house.gov/costello/press/2005/may25.htm>

“State panel debates climate change.” According to this article, for the first time a Pennsylvania state committee has debated global warming, with an eye toward implementing a plan to reduce greenhouse gas emissions. Montgomery County became the first in Pennsylvania to take action by agreeing to create an inventory of greenhouse gas emissions. That inventory would let county officials know where local sources of greenhouse gases are coming from, such as farms and traffic pollution, to help inform open space and smart growth policies, said Montgomery County Commissioner Thomas Jay Ellis. “We can set an example. We can be the laboratory for the nation,” Ellis said. According to some estimates, Pennsylvania produces 1 percent of the world’s greenhouse gas emissions. *The Intelligencer*, June 22, 2005, <http://www.phillyburbs.com/pb-dyn/news/113-06222005-505695.html>

August 2005

“Senators Struggle to Act on Global Warming.” After listening to some of the world’s preeminent climate researchers, a bipartisan group of senators said they saw the need to take quick action on global warming but were struggling to reach consensus on what policy to adopt. Several Republicans on the Senate Energy and Natural Resources Committee said they would consider adopting mandatory limits on emissions of heat-trapping gases but that they prefer the approach of promoting new technologies that do not contribute to the problem. “I have come to believe, along with many of my colleagues, that there is a substantial human effect on the environment,” said Sen. Larry E. Craig (R-Idaho), who has opposed mandatory curbs on greenhouse gas emissions and voted against last month’s “sense of the Senate” resolution on climate change. *Washington Post*, July 22, 2005, <http://www.washingtonpost.com/wp-dyn/content/article/2005/07/21/AR2005072102235.html>. Also see, “Scientist Testifies on Global Warming,” *Associated Press*, July 20, 2005, <http://www.enn.com/today.html?id=8296>

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***For more information on the Carbon Sequestration Program
please visit our web site:***

NETL Carbon Sequestration Page at:
<http://www.netl.doe.gov/sequestration>

November 2005