Carbon Sequestration Newsletter

DECEMBER 2008

A Call for Papers
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WHAT'S INSIDE?

INTRODUCTION

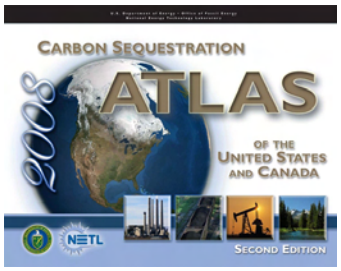
This Newsletter is created by the National Energy Technology Laboratory and represents a summary of carbon sequestration news covering the past month. Readers are referred to the actual article(s) for complete information. It is produced by the National Energy Technology Laboratory to provide information on recent activities and publications related to carbon sequestration. It covers domestic, international, public sector, and private sector news.

HIGHLIGHTS

***Fossil Energy Techline*, "DOE Completes Large-Scale Carbon Sequestration Project Awards."**

On November 17, the U.S. Department of Energy (DOE) awarded $66.9 million to the Big Sky Carbon Sequestration Partnership (BSCSP), the last of seven awards administered for the third phase of the Regional Carbon Sequestration Partnership (RCSP) Program's large-scale carbon sequestration projects. BSCSP, headed by Montana State University-Bozeman, plans to conduct a large-scale test in the Nugget Sandstone formation at the Riley Ridge Unit on the LaBarge Platform in Southwest Wyoming. The test will demonstrate the ability of a geological formation to safely, permanently, and economically store more than 2 million tons of carbon dioxide (CO_2); examine the entire CO_2 injection process from pre-injection characterization, injection process monitoring, and post-injection monitoring; and provide the groundwork for future carbon capture and storage (CCS) opportunities in the region. The eolian sandstone formations present throughout the region offer the opportunity to store more than 100 years of CO_2 emissions from regional point sources. BSCSP plans to drill a CO_2 injection well and inject up to 1 million tons of CO_2 per year into the Nugget Sandstone formation at an approximate depth of 11,000 feet. The CO_2 will be supplied by Cimarex Energy Company's planned helium and natural gas processing plant at Riley Ridge. Including the partnership's cost share, the project is estimated to cost $130.6 million (subject to annual appropriations from Congress). For more information about the National Energy Technology Laboratory- (NETL) managed BSCSP, visit: http://www.bigskyco2.org/. November 17, 2008, http://www.fossil.energy.gov/news/techlines/2008/08059-DOE_Makes_Sequestration_Award.html.

***Fossil Energy Techline*, "DOE Announces Release of Second Carbon Sequestration Atlas."**



DOE released its second Carbon Sequestration Atlas of the United States and Canada, documenting more than 3,500 billion metric tons of CO_2 storage potential in oil and gas reservoirs, coal seams, and saline formations. The second edition of the atlas updates the CO_2 storage portfolio, documents differences in CO_2 resource and CO_2 capacity, and provides updated information on the RCSPs' field activities. It provides updated information on the location of stationary CO_2 emission sources, the locations and storage potential of various geologic sequestration sites, and information about commercial opportunities for CCS technologies for each RCSP. NETL created the initial atlas and developed it with the RCSPs, as well as the National Carbon Sequestration Database and Geographical Information System (NATCARB). DOE has published both print and interactive editions of the atlas. The print version is available at: http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlasII/. The interactive version is available at: http://www.natcarb.org/Atlas/ims_map.html. November 17, 2008, http://www.fossil.energy.gov/news/techlines/2008/08060-DOE_Releases_Sequestration_Atlas.html.

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Sequestration in the News

***University of Wyoming News Release*, "GE Energy and the University of Wyoming Reach Joint Agreement to Advance Cleaner Coal."**

GE Energy and the University of Wyoming (UW) reached an agreement for work to begin on a proposed development plan for the High Plains Gasification Advanced Technology Center. The center will enable researchers from both GE Energy and UW to develop advanced gasification and clean coal solutions for Powder River Basin and other coals. The agreement outlines the framework for the development, design, construction, engineering, and operation of the small-scale gasification facility. With the support of GE Energy, UW will perform a site selection and acquisition process that considers a number of factors, ranging from availability of land appropriate for the facility, availability of necessary utilities and waste disposal facilities, proximity to coal supply, and environmental permitting requirements. The cost of the center will be split by GE Energy and UW, with the state's contribution stemming from appropriations from the Federal Abandoned Mine Reclamation Fund. In 2008, Wyoming's initial state appropriation was $20 million; Governor Dave Freudenthal will seek an additional $30 million during the 2009 legislative session. While UW owns the facility and retains responsibility for its operation, the agreement calls for GE Energy to lease the facility from the university, with options to renew. For more detailed information about the High Plains Gasification Advanced Technology Center, click: http://www.uwyo.edu/ge/default.asp, or click: http://www.uwyo.edu/gesupport/docs/JDIA_Executive_Summary.pdf to view the Joint Development and Implementation Agreement. November 13, 2008, http://uwadmnweb.uwyo.edu/UW/research/showrelease.asp?id=26186.

***Reuters*, "Abu Dhabi $3 Bln Carbon Capture Project Set for 2013."**

The Abu Dhabi government-owned Masdar Initiative signed an agreement with Hydrogen Energy, a venture between BP Alternative Energy and Rio Tinto, to design a commercial-scale, hydrogen-fired power generation project with CCS technology. The $3 billion project, located in Abu Dhabi, will be operational by early 2013, allowing for enhanced oil recovery (EOR) and providing alternative energy and transport, according to officials. Work on the project has already begun and is currently in the front-end engineering and design (FEED) stage, which is being undertaken by the United States' company Foster Wheeler. Under this project, natural gas would be processed to create hydrogen, which would be used to generate low-carbon electricity and CO_2; the CO_2 would then be transferred via pipelines to aging oilfields for EOR. The CO_2 would replace the natural gas that is currently being injected into the fields to maintain pressure. Officials anticipate approximately 20 million tonnes of CO_2 will be captured during the project's 25-year lifespan. The design of the project is expected to be completed by the end of 2008. To view Hydrogen Energy's press release, go to: http://www.hydrogenenergy.com/MediaArticle.aspx?m=29&amid=41828. To view a video detailing the Abu Dhabi project, visit: http://www.hydrogenenergy.com/FullStory.aspx?m=51&amid=582. October 28, 2008, http://www.reuters.com/article/companyNews/idUKLS16612520081028?symbol=FWLT.O.

Sequestration in the News (Continued)

***Eni Press Release*, "Eni and Enel Sign Strategic Agreement on CO_2 Capture,"** and ***Reuters*, "Italy's Eni, Enel Agree CO_2 Capture Pilot Project."**

Enel, Italy's main electricity provider, and Eni, an Italian oil and gas company, signed an agreement to develop Italy's first carbon sequestration project, including technologies for the capture, transport, and geological sequestration of CO_2. Under the agreement, Enel will trap CO_2 from a coal-fired, thermal power station at Brindisi in Southern Italy and transport the CO_2 to the Eni-owned Stogit natural gas field at Cortemaggiore near Piacenza in northern Italy for injection. The project will also examine monitoring, verification, and accounting (MVA) techniques to observe the safety and stability of the injected CO_2. The pilot project stems from two independent projects launched by each company: Enel is currently completing Italy's first industrial CO_2 capture plant capable of removing 2.5 tonnes of gas per hour at the Brindisi power station, while Eni has initiated a project aimed at injecting about 8,000 tonnes of CO_2 per year at the Stogit field. Officials expect the pilot plant will be ready in Fall 2009 and underground injection is scheduled to begin sometime in Fall 2010; Enel and Eni will also build a pilot CO_2 pipeline at the Brindisi site. The agreement includes the preparation of a joint study to determine Italian CO_2 storage potential. In addition, Eni, Enel, and Italy's Environment Ministry signed a Memorandum of Understanding aimed at the verification of CO_2 capture techniques and the promotion of renewable sources. October 21, 2008, http://www.eni.it/en_IT/media/press-releases/2008/10/2008-10-21-accordo-Eni-Enel.shtml?menu2=media-archive&menu3=press-releases, and October 21, 2008, http://www.reuters.com/article/rbssEnergyNews/idUSLL51565620081021.

Announcements

Call for Papers.

The 8th Annual Conference on Carbon Capture and Sequestration, scheduled for May 4-7, 2009, in Pittsburgh, Pennsylvania, is seeking abstracts addressing CCS systems evaluations, EOR utilization of CO_2 emissions from industrial facilities, electric utility proposals to use large-scale CCS, economics of CCS systems, and several other topics. The deadline for submission is January 19, 2009. For abstract information and guidelines, go to: http://www.carbonsq.com/pdf/2009/Call_for_papers.pdf.

DOE/NETL CO_2 Capture Technology Conference.

The CO_2 Capture Technology Conference, scheduled for March 24-26, 2009, in Pittsburgh, Pennsylvania, will address the state of technologies for capturing CO_2 emissions from existing coal-fired power plants. The conference will examine current progress from existing projects, as well as project details from recent award selections from DOE/NETL's CO_2 capture technology research conducted through NETL's Innovations for Existing Plants Program. For more information, visit: http://www.netl.doe.gov/events/09conferences/co2capture/index.html.

WRI Outlines Policy and Investment Guidelines for Carbon Transport and Storage.

E&E TV presented a video of an executive from the World Resources Institute (WRI) discussing the next Congress' role in developing CCS. The video also outlines guidelines for CCS policymakers, regulators, and project developers. The video can be found at: http://www.eenews.net/tv/video_guide/886. To view a transcript of the discussion, go to: http://www.eenews.net/tv/transcript/886.

Orbiting Carbon Observatory.

The National Aeronautics and Space Administration's (NASA) Earth System Science Pathfinder (ESSP) Program is sponsoring the Orbiting Carbon Observatory (OCO), a new Earth orbiting mission set to launch in 2009 that will collect precise global measurements of CO_2 in the atmosphere. Scientists will analyze the OCO data to improve understanding of the natural processes and human activities that impact the abundance and distribution of CO_2. To learn more, visit the OCO website at: http://oco.jpl.nasa.gov/.

United Nations Climate Change Conference in Poznań.

On December 1-12, 2008, the United Nations Climate Change Conference will take place in Poznań, Poland. The conference aims to arrive at an agreement for a course of action during the final year of the Kyoto Protocol, address ongoing issues surrounding the implementation of the United Nations Framework Convention on Climate Change (UNFCCC), and advance a shared vision for a new climate change regime. To learn more, visit the conference website at: http://unfccc.int/meetings/cop_14/items/4481.php.

Science

***Reuters*, "Lemmings in Norway Hit by Global Warming: Study,"** and ***Science News*, "Climate Change Stifling Lemmings."**

A recent study examining disruptions in snowfall caused by climate change and lemming populations revealed that the number of lemmings in Norway is falling, signifying a shift in the historic "boom-and-bust" cycle of the lemming population that has occurred over previous decades. Lemmings, which are famed for their population booms, typically undergo dramatic population booms every three to five years, as female lemmings can have litters of up to 12 as many as three times per year. Lemmings are about half the size of a guinea pig and live in nests beneath the snow during the winter months. However, warmer temperatures in recent years have resulted in wetter snow that melts and refreezes at ground level, making it difficult for lemmings to hide and reach food. When the snowpack is light and fluffy, warmth from the ground melts small spaces under the snow that the lemmings use to search for grass and moss without being exposed to predators. The study of lemmings since 1970 showed the last population boom was in 1994. The researchers noted that lemmings are still abundant and far from being labeled a threatened species, as temperatures in late winter and early spring in southeastern Norway in recent decades were the highest since recordkeeping began in 1756. To view the report, titled, "Linking climate change to lemming cycles," click: http://www.nature.com/nature/journal/v456/n7218/abs/nature07442.html.

November 5, 2008, http://www.reuters.com/article/environmentNews/idUSTRE4A49MC20081105, and November 5, 2008, http://www.sciencenews.org/view/generic/id/38313/title/Climate_change_stifling_lemmings.

***Science Daily*, "Rocks Could Be Harnessed To Sponge Vast Amounts Of Carbon Dioxide From Air,"** and ***Reuters*, "Scientists Say a Rock Can Soak up Carbon Dioxide."**

The most common rock found in the Earth's mantle, peridotite, may be capable of slowing down potential climate change by storing large amounts of CO_2, according to a recent study. The rock naturally reacts at high rates with CO_2 to form solid minerals, and scientists claim the process could be enhanced up to 1 million times or more through drilling and injection methods. It is estimated that the process could grow underground minerals that can permanently store 2 billion or more of the 30 billion tons of CO_2 emitted by human activities every year. The scientists state they could initiate the carbon storage process by injecting peridotite with heated water containing pressurized CO_2. In addition to being found directly below the Earth's crust, peridotite also appears on the surface in areas like the Middle Eastern nation of Oman, where scientists say 4 to 5 billion tons of greenhouse gases (GHGs) could be stored per year. However, the rock is not found in GHG-emitting areas such as the United States, India, and China. The study, titled, "In situ carbonation of peridotite for CO_2 storage," can be found at: http://www.pnas.org/content/early/2008/10/31/0805794105. November 6, 2008, http://www.sciencedaily.com/releases/2008/11/081105180813.htm, and November 7, 2008, http://www.reuters.com/article/environmentNews/idUSTRE4A59IB20081107.

Policy

***Latrobe Valley Express*, "CCS Bill Gets the Nod,"** and ***Oil & Gas Journal*, "Aussie Bill Sets Up CO_2 Sequestration Framework."**

Two pieces of legislation were passed in Australia for the advancement of CCS technologies. Victoria became the first Australian state to pass CCS legislation with the State Government's "Greenhouse Gas Geological Sequestration Bill," which is expected to take effect on January 1, 2010. The bill will enable the onshore injection and permanent storage of CO_2 and other GHGs. The announcement of the bill follows the Australian Federal Treasury's release of detailed cost modeling and opportunities to meet the challenge of potential climate change. Australia's "Offshore Petroleum Amendment Bill," which was also recently approved by the Australian Petroleum Production and Exploration Association (APPEA), establishes the world's first regulatory framework for CCS. The bill ensures that after project completion, companies can transfer long-term liability to the government. The transfer of liability will not begin until a minimum of 20 years after CO_2 injection operations are complete. The new legislation also establishes access and property rights in Australia for geosequestration and forms the key component of the government's response to possible climate change. November 10, 2008, http://latrobevalley.yourguide.com.au/news/local/news/general/ccs-bill-gets-the-nod/1356258.aspx, and November 13, 2008, http://www.ogj.com/display_article/345336/7/ONART/none/DriPr/1/Aussie-bill-sets-up-CO-2--sequestration-framework/.

"The performance of the Norwegian carbon dioxide, capture and storage innovation system."

The following is the abstract of this article: "In order to take up Norway's twin challenge of reducing CO_2 emissions, while meeting its growing energy demand with domestic resources, the deployment of CCS plays an important role in Norwegian energy policies. This study uses the Functions of Innovation Systems approach to identify key policy issues that need to be addressed in order to prolong Norway's international leadership position in the development of CCS. The analysis shows that Norway has been successful in building an innovation system around CCS technology. The key determinants for this achievement are pinpointed in this article. However, the evolution of the innovation system seems to have entered a critical phase that is decisive for a further thriving development of CCS in Norway. The results provide a clear understanding of the current impediments in the CCS innovation system and stress the need to direct policy initiatives at the identified weak system functions – i.e. entrepreneurial activity and market formation – to improve the performance of the system. [The authors] discuss how policymakers can use these insights to develop a coherent set of

Policy (Continued)

policy instruments that would foster the deployment of CCS concepts related to power production and EOR in Norway." **Klaas van Alphen, Jochem van Ruijven, Sjur Kasa, Marko Hekkert, and Wim Turkenburg**, *Energy Policy*, Available online September 18, 2008, doi:10.1016/j.enpol.2008.07.029, http://www.sciencedirect.com/science/article/B6V2W-4TG8P50-2/2/6983d0e068693e162cb449e1f93b3db6. (Subscription may be required.)

"A climate protection strategy for Germany – 40 percent reduction of CO_2 emissions by 2020 compared to 1990."

The following is the abstract of this article: "This paper presents measures and instruments for Germany to achieve the goal of 40 [percent] CO_2-emission reduction until 2020 by reducing energy-related emissions by 224 million tonne (Mt). The most important measures in this regard are cuts in electricity generation (savings of 40 Mt), fuel switching and increased energy conversion efficiency (30 Mt) and an augmented 26 [percent] share of renewable energies in the provision of electrical energy (44 Mt). Average cost of the measures are at 50 euro per tonne avoided CO_2, which corresponds to an additional monthly expenditure per household of less than 25 euro." **Christoph Erdmenger, Harry Lehmann, Klaus Müschen, Jens Tambke, Sebastian Mayr, and Kai Kuhnhenn**, *Energy Policy*, Available online September 25, 2008, doi:10.1016/j.enpol.2008.07.031, http://www.sciencedirect.com/science/article/B6V2W-4THS3MT-1/2/61cbfa991facbfc4397f9188050a62d3. (Subscription may be required.)

Geology

"Coupled Flow and Geomechanical Processes during Enhanced Coal Seam Methane Recovery through CO_2 Sequestration."

The following is the abstract of this article: "The sensitivity of coal permeability to the effective stress means that changes in stress as well as pore pressure within a coal seam lead to changes in permeability. In addition coal swells with gas adsorption and shrinks with desorption; these sorption strains impact on the coal stress state and thus the permeability. Therefore the consideration of gas migration in coal requires an appreciation of the coupled geomechanical behavior. A number of approaches to representing coal permeability incorporate the geomechanical response and have found widespread use in reservoir simulation. However these approaches are based on two simplifying assumptions; uniaxial strain (i.e. zero strain in the horizontal plane) and constant vertical stress. This paper investigates the accuracy of these assumptions for reservoir simulation of enhanced coalbed methane through CO_2 sequestration. A coupled simulation approach is used where the coalbed methane simulator SIMED II is coupled with the geomechanical model FLAC3D. This model is applied to three simulation case studies assembled from information presented in the literature. Two of these are for 100 [percent] CO_2 injection, while the final example is where a flue gas (12.5 [percent] CO_2 and 87.5 [percent] N_2) is injected. It was found that the horizontal contrast in sorption strain within the coal seam caused by spatial differences in the total gas content leads to vertical stress variation. Thus the permeability calculated from the coupled simulation and that using an existing coal permeability model, the ShiDurucan model, are significantly different; for the region in the vicinity of the production well the coupled permeability is greater than the ShiDurucan model. In the vicinity of the injection well the permeability is less than that calculated using the ShiDurucan model. This response is a function of the magnitude of the strain contrast within the seam and dissipates as these contrasts diminish." **L.D. Connell**, *International Journal of Coal Geology*, Available online October 13, 2008, doi:10.1016/j.coal.2008.09.013, http://www.sciencedirect.com/science/article/B6V8C-4TNKH0M-1/2/9f62281ef0f61fa02341354924ecbd46. (Subscription may be required.)

"CO_2 Injection in Geological Formations: Determining Macroscale Coefficients from Pore Scale Processes."

The following is the abstract of this article: "CO_2 injections in geological formations are usually performed for enhanced hydrocarbon recovery in oil and gas reservoirs and storage and sequestration in saline aquifers. Once CO_2 is injected into the formation, it propagates in the porous rock by dispersion and convection. Chemical reactions between brine ions and CO_2 molecules and consequent reactions with mineral grains are also important processes. The dynamics of CO_2 molecules in random porous media are modeled with a set of differential equations corresponding to pore scale and continuum macroscale. On the pore scale, convective-dispersive equation is solved considering reactions on the inner boundaries in a unit cell. A unit cell is the smallest portion of a porous media that can reproduce the porous media by repetition. Inner boundaries in a unit cell are the surfaces of the mineral grains. Dispersion process at the pore scale is transformed into continuum macroscale by adopting periodic boundary conditions for contiguous unit cells and applying Taylor-Aris dispersion theory known as macrotransport theory. Using this theory, the discrete porous system changes into a continuum system within which the propagation and interaction of CO_2 molecules with fluid and solid matrix of the porous media are characterized by three position-independent macroscopic coefficients: the mean velocity vector, dispersivity dyadic, and mean volumetric CO_2 depletion coefficient." **F. Javadpour**, *Transport in Porous Media*, Available online October 4, 2008, doi: 10.1007/s11242-008-9289-6, http://www.springerlink.com/content/m927615304048728/?p=cfef5a9335004d63b2ebebab4c8e6145&pi=11. (Subscription required.)

Technology

"Application of crosswell seismic tomography using difference analysis with data normalization to monitor CO_2 flooding in an aquifer."

The following is the abstract of this article: "A pilot-scale experiment for CO_2 sequestration was undertaken at the Nagaoka test field in Japan. Time-lapse crosswell seismic tomography was conducted to detect and monitor the movement of CO_2 injected into an aquifer. [The authors] applied difference analysis with data normalization (DADN) to the time-lapse data to eliminate false images that were apparent in a conventionally processed difference section. Conventional difference analysis calculates travel-time delays after inversion, whereas the DADN method calculates them from raw travel-time records

Technology (Continued)

before inversion. Thus, fewer errors are generated with the DADN method compared to a conventional inversion analysis. [The authors] applied the DADN method to time-lapse tomography data recorded before and after the injection of CO_2 and computed the velocity variation in a subsurface section, which clearly showed the distribution of CO_2 flooding within a high permeability zone in the aquifer and showed no CO_2 leakage into the caprock. Our results also show the maximum velocity decrease as a result of CO_2 injection was about 9 [percent], which is close to the results obtained in laboratory experiments. Finally, numerical simulations were inverted to test the effectiveness of the conventional and DADN methods in dealing with noise. These tests showed that the DADN method effectively reduces unique coherent noise for particular receiver and source combinations. [The authors] concluded that the DADN method provides useful data for monitoring the flow of CO_2 sequestered in underground aquifers." **Kyosuke Onishi, Tetsuyuki Ueyama, Toshifumi Matsuoka, Dai Nobuoka, Hideki Saito, Hiroyuki Azuma, and Ziqiu Xue**, *International Journal of Greenhouse Gas Control*, Available online October 9, 2008, doi:10.1016/j.ijggc.2008.08.003, http://www.sciencedirect.com/science/article/B83WP-4TMRK76-2/2/536f901e050d3fb89315c099f863e394. (Subscription may be required.)

"Numerical Modeling of Pressure and Temperature Profiles Including Phase Transitions in Carbon Dioxide Wells."

The following is the abstract of this article: "Geological storage of CO_2 will usually be at condition above the critical temperature and pressure, so the CO_2 will exist as a single dense phase. However, conditions in the upper part of the CO_2 well with surface temperatures below the critical point of 31 degrees Celsius can lead to boiling and condensation in the well. The consequences of this are most apparent when flow rate changes, for example when a well is hut-in or if there is a well blowout. [The authors] have calculated density profiles for wells experiencing different thermal conditions to determine how bottom-hole pressures are related to wellhead pressures. There are two limiting cases, one when the fluid is in thermal equilibrium with the rock at the same horizon, there other when there is no heat exchange with the casing or the rock. [The authors] find that in deeper will static columns can exist in a stable state with liquid to the surface, but for shallower wells or wells in depleted reservoirs that a static column can be initially unstable with two-phase conditions near the surface. In producing wells, as the flow rate increases from static conditions, the pressure and temperature at the wellhead increases until high production rates are reached when the wellhead temperature then decreases, which can be to very low values. For injection wells, bottom-hole conditions are confined between the wellhead and the reservoir temperature. In general, phase change does not prevent CO_2 injection. Nevertheless care is needed in shallower or depleted reservoirs for the interpretation of reservoir pressure, the use of pressure for monitoring, and in all reservoirs for the management of blowouts." **L. Paterson, M. Lu, L. Connell, and J. Ennis-King**, *In: Proceedings of the 2008 SPE Annual Technical Conference and Exhibition, Denver, Colorado, USA*, September 21-24, 2008, Available online September 21, 2008, https://extra.co2crc.com.au/modules/pts2/download.php?file_id=2624&rec_id=1058.

Terrestrial/Ocean

"Carbon sequestration by forests and soils on mined land in the Midwestern and Appalachian coalfields of the U.S."

The following is the abstract of this article: "Carbon accreditation of forest development projects is one approach for sequestering atmospheric CO_2, under the provisions of the Kyoto protocol. The [carbon] sequestration potential of reforested mined land is not well known. The purpose of this work was to estimate and compare the ecosystem [carbon] content in forests established on surface, coal-mined and non-mined land. [The authors] used existing tree, litter, and soil [carbon] data for [14] mined and eight adjacent, non-mined forests in the Midwestern and Appalachian coalfields to determine the [carbon] sequestration potential of mined land reclaimed prior to the passage of the Surface Mining Control and Reclamation Act (1977). [The authors] developed statistically significant and biologically reasonable models for ecosystem [carbon] across the spectrum of site quality and stand age. On average, the highest amount of ecosystem [carbon] on mined land was sequestered in pine stands (148 Mg ha^{-1}), followed by hardwood (130 Mg ha^{-1}) and mixed stands (118 Mg ha^{-1}). Non-mined hardwood stands sequestered 210 Mg [carbon] ha^{-1}, which was about 62 [percent] higher than the average of all mined stands. [The] mined land response surface models of [carbon] sequestration as a function of site quality and age explained 59, 39, and 36 [percent] of the variation of ecosystem [carbon] in mixed, pine, and hardwood stands, respectively. In pine and mixed stands, ecosystem [carbon] increased exponentially with the increase of site quality, but decreased with age. In mined hardwood stands, ecosystem [carbon] increased asymptotically with age, but it was not affected by site quality. At rotation age (60 yr), ecosystem [carbon] in mined hardwood stands was less on high quality sites, but similar for low quality sites compared to non-mined hardwood stands. The overall results indicated that the higher the original forest site quality, the less likely [carbon] sequestration potential was restored, and the greater the disparity between pre- and post-mining [carbon] sequestration stocks." **Beyhan Y. Amichev, James A. Burger, and Jason A. Rodrigue**, *Forest Ecology and Management*, Available online August 26, 2008, doi:10.1016/j.foreco.2008.07.020, http://www.sciencedirect.com/science/article/B6T6X-4T9BXHY-2/2/a55c3b6e1fecdf8258ebb8a7e7684159. (Subscription may be required.)