

FOSSIL ENERGY TODAY

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About Innovative
Technologies
for Fossil Energy



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CT SCANNERS GIVE ENERGY RESEARCHERS A CORE UNDERSTANDING OF MARCELLUS SHALE

Researchers at the National Energy Technology Laboratory (NETL) are employing conventional technology normally associated with medical procedures in a non-conventional way. Using several x-ray computer tomography (CT) scanners, researchers are imaging rock samples to obtain an in-depth understanding of how fluids move through various geologic media, such as shale or sandstone.

Geologic characterization studies tell researchers about the important features of rock formations. Although rock seems solid to the naked eye, it's made up of a network of solid particles (sometimes referred to as grains), and spaces called pores. Rock comprised of lots of spaces is considered "porous." The more porous channels in the rock, the easier fluids, including gases such as methane, can flow through. Shales, such as the Marcellus formation, are very dense with narrow pore channels.

Shale gas resides in natural cracks or fractures and in these tiny pores; however, in order to economically extract methane from these formations, the gas must have a pathway to escape.

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Photograph of a core sample from Marcellus shale showing natural, mineralized fractures.

LARGE-SCALE CO₂ INJECTION BEGINS

The Midwest Geological Sequestration Consortium (MGSC) recently began testing large-scale injection of carbon dioxide in Decatur, Illinois. The test, which will inject as much as one million metric tonnes of carbon dioxide (CO₂), is part of the development phase of the Office of Fossil Energy-led Regional Carbon Sequestration Partnerships program.

Long-term, environmentally safe and secure underground storage of CO₂ is a key component in achieving commercial deployment of carbon capture, utilization and storage, or CCUS, technology. Tests like those conducted by MGSC — led by the Illinois State

Geological Survey in partnership with Archer Daniels Midland Company and Schlumberger Carbon Services — and other regional partnerships are helping confirm the viability and enormous potential of permanent geologic storage as a critical climate change mitigation strategy. In fact, a recent report from the Midwest Regional Carbon Sequestration Partnership indicated that hundreds of years of permanent CO₂ storage capacity exist in nine states alone — from Indiana to New Jersey.

The MGSC project is capturing CO₂ from the Archer Daniels Midland Eth-

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THE STRATEGIC PETROLEUM RESERVE: ENERGY SECURITY FOR THE NATION

By David F. Johnson

Mission: Reduce U.S. vulnerability to the economic, national security, and foreign policy consequences of severe energy supply interruptions and carry out the obligations of the United States under the International Energy Program.

When an “oil event” somewhere in the world becomes a major news story, or sustained periods of high oil prices occur, the news media and Congress may direct their attention to the resources of the Strategic Petroleum Reserve (SPR). Often there are calls for the release of crude oil from the SPR in order to affect prices and bring relief to U.S. consumers. While it’s a tempting proposition from a consumer’s perspective, it’s a short-sighted solution that contradicts the purpose of the SPR.

When Congress created the SPR in 1975, the legislation was clear about its purpose, “Drawdown and sale of petroleum products from the Strategic Petroleum Reserve may not be made unless the President has found drawdown and sale are required by a severe energy supply interruption or by obligations of the United States under the international energy program.” While the legislation allows a limited release under certain other circumstances, the special circumstances must include a dislocation of petroleum supplies to the Nation. The only exceptions are the conduct of a “test sale” of no more than 5 million barrels and time exchanges for the purpose of acquiring more oil for the SPR.

The 1973-74 Arab oil embargoes served as the catalyst for the creation of the SPR. Although the concept of a strategic fuel reserve had been considered by previous administrations as early as the 1950s, the use of the political “oil weapon” by the Organization of the Petroleum Exporting Countries (OPEC) demonstrated with stunning clarity the Nation’s vulnerability to a cutoff of imports. The creation of a stockpile of petroleum that could be used to mitigate the impacts of such an event became imperative.

The United States was not the only country to recognize the value of holding strategic stocks of petroleum. Led by then-Secretary of State Henry Kissinger, sixteen other petroleum import-dependent countries joined the United States to develop the framework for international cooperation among themselves and other countries that were dependent upon petroleum imports for their energy needs. The result was a 1975 treaty, *Agreement on an International Energy Program*, that obligates the participating countries to take certain actions to develop emergency self-sufficiency in oil supplies. Each participating country is required to hold petroleum stocks (crude oil or products) equal to 90 days of the country’s net imports for the previous year; to promote energy conservation; to develop alternative sources of energy; to promote demand restraint; to support allocation of energy supplies on an equitable basis; to promote cooperative relations with oil producing countries and other oil consuming countries through purposeful dialogue; and to develop a comprehensive international energy information system. These actions would be implemented through the International Energy Agency (IEA), created for this purpose in 1974 as a component of the Organisation for Economic Co-operation and Development. Today, the IEA has 28 member countries that are committed to cooperation in energy matters.

Here at the SPR, maintaining operational readiness is our top priority. Doing so ensures that we are ready to act should the need arise to protect our Nation’s economic and energy security.



David Johnson is the Deputy Assistant Secretary for Petroleum Reserves in the Office of Fossil Energy.

SPR COMPLETES DRAWDOWN OF 30 MILLION BARRELS

An Inside Look at How a Sale and Drawdown Is Conducted

In coordination with the International Energy Agency (IEA), the Department of Energy announced on June 23, 2011, that the Strategic Petroleum Reserve (SPR) would offer for sale 30 million barrels of light, sweet crude oil as its share of a 60 million barrel release of petroleum from IEA members.

The IEA's 28 member states had been monitoring the global impacts on petroleum supplies resulting from civil unrest in the Middle East and Northern Africa. In June, the IEA decided that a coordinated release was necessary to respond to elevated oil prices resulting from the ongoing disruption of supplies from Libya. IEA members agreed to release 2 million barrels per day over a 30-day period and to review the need for additional releases at the end of that time. This was the third coordinated release in IEA history.

Pursuant to section 161(d) of the Energy Policy and Conservation Act (42 USC 6241(d)), the Secretary of Energy may order a drawdown or sale of petroleum from the SPR if doing so is required by obligations of the United States under the International Energy Program implemented by the IEA. As part of that action, the President directed DOE to offer for sale 30 million barrels of crude oil from the Nation's stockpile in the SPR.



A technician inspects wellhead assembly at the Reserve's West Hackberry site near Lake Charles, LA.

Conducting the Sale

The SPR sells oil through an online auction system called the Crude Oil Sales Offer System. Potential bidders are encouraged to pre-register in the system. Pre-registration ensures that they will be notified when a sale is announced.

The sales are conducted in accordance with the Standard Sales Provisions (SSPs) and the Notice of Sale. The Notice of Sale provides sale specific requirements including the date offers are due, crude oil streams offered, delivery information and any necessary amendments to the SSPs. The Notice of Sale was sent electronically on June 23 to all who had registered.

The sale window was open for one week and bidders were required to submit their final bids by June 29. DOE held a pre-bid conference call to answer questions that potential bidders had pertaining to the sale. Following the call, the SPR posted questions and answers electronically so that all potential bidders would have access to the same information. The SPR offered 10 million barrels of light, sweet crude from three of its four sites – Big Hill in Freeport, Texas; Bryan Mound in Nederland, Texas; and West Hackberry in Sulphur, La. – for a total of 30.237 million barrels. Delivery was offered by marine vessel and pipeline.

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The Strategic Petroleum Reserve has four storage sites located near the Gulf of Mexico.

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The SPR received over 90 offers and the offering was substantially oversubscribed. The offers were evaluated for best price and value to the Government.

On June 30, the DOE released the list of Apparently Successful Offerors. The next several days were used to allow the awardees to submit financial guarantees for their purchases and for DOE to verify the validity of the submitted Letters of Credit. On July 11, DOE announced that 28 contracts were awarded to sell 30.64 million barrels of oil to 15 companies. In this drawdown, it was determined that the best value to the Government could be collected by awarding contracts for approximately 13 million barrels from Bryan Mound, 12 million barrels from West Hackberry and 5 million barrels from Big Hill.

Delivering the Oil

Once the contracts were awarded, the SPR began working to schedule deliveries of the crude oil. The contracts called for deliveries during the month of August, but the SPR accepted early delivery requests in order to get the crude oil to the market as soon as possible.

The SPR Program Management Office in New Orleans worked with the sites, purchasers, terminals, pipelines, and marine vessels to schedule and facilitate the physical deliveries. The Headquarters office in Washington, D.C., worked with the purchasers, the Maritime Administration, the Department of Homeland Security, and the Department of Defense to coordinate policy decisions and Jones Act Waivers, which allows foreign-flagged vessels to be used to move the oil.

All of the deliveries were scheduled and successfully completed between July and September. The SPR was able to accommodate requests for 16 early deliveries totaling 8.3 million barrels in July. The remainder was delivered by September 1.

SPR sites moved the crude oil by pipeline from the caverns to the terminals specified by the purchasers. The vast majority (80 percent) was delivered to marine terminals, where 48 separate tankers were loaded to carry the oil to U.S. destinations.

Pricing and Payments

The final price isn't determined until delivery has been completed. The price is calculated from a formula using the offered price, average daily prices surrounding the NS release, and prices surrounding the delivery dates for each cargo. The reference crude price for SPR light, sweet, crude is Louisiana Light Sweet because the crude streams have similar characteristics.

Invoicing and payments were completed by mid-September and DOE collected more than \$3 billion for the Government. In accordance with provisions of the Energy Policy and Conservation Act, receipts from the sale went into the SPR Petroleum Account, which is held by the U.S. Department of the Treasury and is specifically designated for funds from SPR sales. The drawdown was considered a success and the SPR has returned to readiness mode.

More information on the Strategic Petroleum Reserve can be found on the Office of Fossil Energy Web site at

<http://www.fossil.energy.gov/programs/reserves/spr/index.html>.

Quick Facts on the SPR

Storage Capacity – 727 million barrels

Current Inventory – 695.9 million barrels of crude oil

Market Value of Crude Oil - \$75 billion

Average cost per barrel - \$29.70

Maximum Drawdown Rate – 4.4 million barrels per day for the first 90 days

Building the Reserve

Acquisition of storage sites and development of the deep underground salt caverns began in 1977 and completed in 1985. The sites contain 62 caverns.

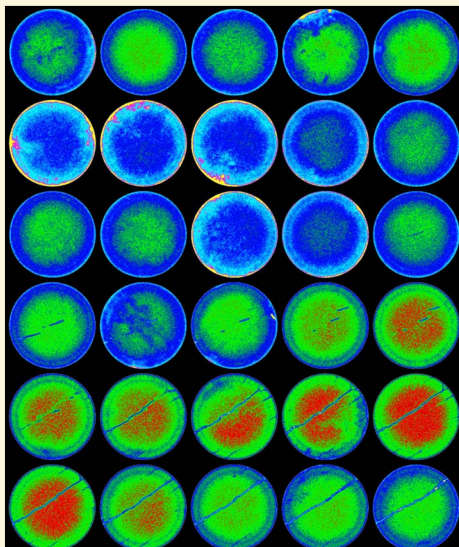
Drawdowns

- The first was in 1991 at the beginning of Operation Desert Storm in the Persian Gulf region when the United States joined its allies in assuring the adequacy of global oil supplies. The SPR offered for sale 30 million barrels of crude oil and accepted competitive offers to purchase 17.3 million barrels.
- The second emergency sale was in September 2005 after Hurricane Katrina. The SPR first responded by quickly approving emergency exchanges (loans) of 9.8 million barrels of crude oil that were requested by industry. Concurrent with the emergency exchanges, the SPR conducted a drawdown and sale process that offered 30 million barrels for delivery to U.S. markets. Contracts were awarded to successful bidders for 11 million barrels.
- The third drawdown and sale was conducted the summer of 2011 when the United States participated in a general release called by the IEA to offset the continued disruption in global oil supplies caused by unrest in Libya. The United States' obligation under the International Energy Program was for 30 million barrels of petroleum.

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Hydraulic fracturing, or “fracking,” creates such pathways, enabling gas to flow into a horizontal well pipe.

NETL’s x-ray CT scanners allow researchers to see inside rocks and study how fluids move and interact under varying temperatures and pressures. With these scanners, NETL researchers can do extensive characterization studies on a variety of geologic materials, from dense shales to sponge-like sandstones. The three machines provide information at the sub-millimeter scale on samples of core, which are cylindrical rocks obtained from drilling operations. Because they are non-destructive, the CT scanners leave the samples intact, so researchers can run the same core through multiple, complementary tests that inform big picture “core studies.” This offers a greater return on investment for industry, since core samples can be reused and analyzed in several ways. Additionally, the scanners can mimic conditions that exist in the well in terms of pressure and temperature, so researchers can observe the actual progression of fluids inside the rocks, in real-time, as the fluids would behave downhole.



CT scan images of shale sample enhanced with color. Blue lines show mineralized fractures. Denser portions are represented by darker colors, in this case blue.

From lowest to highest resolution, NETL’s lineup of CT scanners is —

- **Universal Systems medical CT scanner** — Working at the largest scale, or “core scale” is NETL’s upgraded medical CT scanner. This machine evaluates how fluids flow through the core itself. The scanner allows researchers to collect 4-second image “slices,” which are mathematically combined into a three-dimensional image of the sample. Equipment on this machine also recreates pressures and temperatures similar to downhole conditions and can inject fluids during the scanning process to capture motion through the sample.
- **North Star Imaging industrial-scale CT scanner** — NETL’s industrial scanner shows researchers what goes on at the pore level, offering a view of the individual spaces and particles within a core. This machine relays detailed information about a core sample’s pore structure and how fluids navigate through this network. Unique to this scanner is the capability to tilt the sample to study how gravity affects movement through porous rock with controlled pressure and scan times from minutes to hours. Compared to the medical scanner, the industrial scanner works at a finer resolution and provides detailed information rather than the bulk characteristics obtained from the lower resolution machine.
- **Xradia MicroXCT-400 micro-CT scanner** — The micron-scale scanner is NETL’s finest resolution CT scanner. With scan times of hours to days, researchers can see below the pore level to examine details on the pore surface. For example, minerals from fluids may deposit on the grains and clog pore space, which would inhibit the movement of fluids through the surrounding space. Conversely, minerals can be dissolved from surfaces and open up the pore structure, enabling fluids to travel through more freely.

The fluid flow and characterization studies performed in this lab are



Marcellus shale core sample in medical scanner.

helping researchers more accurately predict how much gas is available and recoverable from Marcellus shale. Analysis is also revealing information on fracking and how gas will move through fractures. NETL’s research is answering questions such as how easily the shale will fracture and whether or not natural fractures already exist, which could affect fracking in terms of form and direction. Data from industrial partners’ core samples can yield information on specific wells, such as identifying the best depths for fracking and whether a fracture may be more likely to deviate in a certain direction. Beyond the laboratory, this information can help domestic energy producers capitalize on shale resources by helping identify the best locations for drill sites.

NETL’s CT scanner studies are providing a thorough, multi-scale understanding of shales’ underlying properties. The geologic analysis made possible with these machines is informing industry decisions, helping ensure that this resource is tapped wisely and efficiently.

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anol Production Facility. A processing plant built for this project removes water from the CO₂ stream and then compresses the dry CO₂ to a dense liquid-like “supercritical” state. The compressed CO₂ then travels through a mile-long pipeline and is injected more than a mile underground into the Mt. Simon Sandstone, which has an estimated CO₂ storage capacity of 11 to 151 billion metric tonnes.

After undergoing a rigorous environmental analysis, the MGSC project was the first large-scale CO₂ injection test in a saline formation to be approved in the United States. During and following injection, a comprehensive monitoring program will ensure that the injected CO₂ is safely and permanently stored. The position of the underground CO₂ plume will be tracked, and deep subsurface water, groundwater, and surface water will continually be monitored around the injection site. The monitoring program will be evaluated yearly and modified as needed.

In addition to the Decatur project, the MGSC is investigating options for the 60,000 square mile Illinois Basin, which underlies most of Illinois, southwestern Indiana, and western Kentucky. Annual CO₂ emissions in this area exceed 265 million metric tonnes, attributed mostly to the region’s 126 coal-fired power plants.

INTERNATIONAL EFFORTS IN CLEAN ENERGY

Office of Fossil Energy Staff Participate in International Forum

APEC, the Asia-Pacific Economic Cooperation, is a regional economic forum set up in 1989, which now has 21 member economies that border on the Pacific Ocean. Its primary goal is to support sustainable economic growth and prosperity in the Asia-Pacific region, via activities aimed at trade and investment liberalization, business facilitation, and economic and technical cooperation.

APEC’s senior officials are advised by a number of Working Groups covering the principal facets of economic activity. The Energy Working Group (EWG), launched in 1990, seeks to maximize the energy sector’s contribution to the regional economy, while mitigating the environmental effects of energy supply and use. The EWG is assisted by four Expert Groups on

different energy areas, including an Expert Group on Clean Fossil Energy (EGCFE).

The EGCFE has been chaired by senior staff members of the Office of Fossil Energy since its establishment in the early 1990s, including Scott Smouse of the National Energy Technology Laboratory since 2001.

Promoting Clean and Efficient Fossil Energy

The EGCFE’s mission is to encourage the use of clean fuels and energy technologies that will contribute to sound economic and environmental performance, with emphasis on increasing the efficiency of fossil energy production and use, and mitigating local, regional, and global environmental impacts. The Group promotes clean fossil energy options through a variety of activities.

Rapid economic and energy demand growth in a number of developing APEC economies is necessitating major expansions in energy infrastructure, especially power generation. Coal is expected to account for more than a quarter of new generating capacity in the APEC region during the next two decades. With growing concern about global climate change, the growth of CO₂ emissions from the region’s rapidly expanding coal-fired power generation sector provides an additional motivation for the EGCFE’s primary energy efficiency and emission reduction thrust.

To minimize coal’s environmental impacts it is important to employ technologies that increase the efficiency of generation from coal to the maximum extent consistent with cost and reliability/operability goals. A number of clean coal technologies (CCTs) have been developed and demonstrated that offer significantly higher efficiencies and lower emissions than conventional technologies that are widely used throughout the region. Others are under development.

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Asia-Pacific Economic Cooperation

The Asia-Pacific Economic Cooperation’s mission is to support sustainable economic growth and prosperity in the Asia-Pacific region. Member economies include: Australia; Brunei Darussalam; Canada; Chile; People’s Republic of China; Hong Kong, China; Indonesia; Japan; Republic of Korea; Malaysia; Mexico; New Zealand; Papua New Guinea; Peru; The Republic of the Philippines; The Russian Federation; Singapore; Chinese Taipei; Thailand; United States of America; and Viet Nam. Learn more at <http://www.apec.org/>.

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Information Transfer and Capacity Building

The primary objective of the EGCFE's vibrant multi-year program is to accelerate the uptake of clean coal technologies for new plants, particularly in developing APEC economies where coal use is on a rapid growth path, and to improve the performance of existing plants, including reduced emissions, through power plant upgrading and refurbishment and better environmental monitoring. EGCFE projects aimed at information transfer and capacity building in these economies have covered:

- Regulatory and permitting issues related to CCT implementation,
- Technology status and project development risks for new CCT plants,
- Reducing trade, regulatory, and financing barriers to implementation, and
- Incentives to promote early deployment of commercial CCTs.

The EGCFE has conducted a number of projects in the area of carbon capture, utilization, and storage (CCUS). Though implementation of CCUS technologies is still at an early stage even in developed economies, the projected growth of CO₂ emissions in developing APEC economies warrants an early effort to equip these economies with the information needed to build their capacities for the time when CCUS may become necessary and possibly urgent. CCUS projects supported by APEC through the EGCFE have included:

- Planning and cost assessment guidelines for making new plants in developing APEC economies CO₂ capture ready,
- Permitting issues related to CCS in new coal-based power plants, and
- A series of CCS capacity building workshops in developing APEC economies, including development training materials aimed at policymakers and their experts in these economies. Workshops have been held in Korea, China, Mexico, and Vietnam, with two more in planning.

At present, without specific regulatory requirements and/or some form of carbon pricing, the economics of CCS do not favor deployment unless a project receives financial support. There are, however, situations where the disposition of the captured CO₂ can serve a purpose, rendering the project economics attractive. The most short-term practicable example of CCUS is in enhanced oil recovery (EOR). CO₂ reuse can be a key to large-scale CCS demonstration projects, and CO₂-EOR is best placed to accelerate conventional CCS deployment. A new 2012 EGCFE project is focusing on CO₂ reuse prospects in developing APEC economies with rapidly growing CO₂ emissions and practical possibilities for CO₂ reuse, and explore the near-term opportunities for CCUS in these economies, in particular for EOR. This project will be conducted in cooperation with the Carbon Sequestration Leadership Forum (CSLF), whose focus has recently been broadened to include CCUS.

EGCFE projects have resulted in a number of publications on more efficient clean fossil energy technologies. These publications are available for downloading from the EGCFE Project Reports web page at <http://www.egcfe.ewg.apec.org/projects.htm>.

METHANE HYDRATE PRODUCTION TECHNOLOGIES TO BE TESTED ON ALASKA'S NORTH SLOPE

NETL and ConocoPhillips are working together with the Japan Oil, Gas and Metals National Corporation to test innovative technologies for producing methane gas from hydrate deposits on the Alaska North Slope.

The collaborative testing is consistent with a Statement of Intent for Cooperation in Methane Hydrates signed in 2008 and extended in 2011 by DOE and Japan's Ministry of Economy, Trade, and Industry. The production tests are the next step in both U.S. and Japanese national efforts to evaluate the response of gas hydrate reservoirs to alternative gas hydrate production concepts. The tests will provide critical information to inform potential future extended-duration tests.

The tests will utilize the "Iñnik Si-kumi" (Iñupiaq for "fire in the ice") gas hydrate field trial well, a fully instrumented borehole that was installed in the Prudhoe Bay region by ConocoPhillips and NETL earlier this year.

Methane hydrate consists of molecules of natural gas trapped in an open rigid framework of water molecules. It occurs in sediments within and below thick permafrost in Arctic regions, and in the subsurface of most continental waters with a depth of ~1,500 feet or greater. Many experts believe it represents a potentially vast source of global energy, and DOE scientists have studied methane hydrate resource potential and production technologies for more than two decades.

Visit http://www.fossil.energy.gov/news/techlines/2011/11055-Hydrate_Production_Technologies_to.html for more information.

NETL TEAMS EARN ACHIEVEMENT AWARDS

Lab Recognized for Response to Deepwater Horizon Oil Spill, Contributions to Hanford Site Clean-Up

Secretary of Energy Steven Chu honored the National Energy Technology Laboratory and several partner agencies with Secretary of Energy Achievement Awards for contributions to two significant environmental efforts in 2010.

The Office of Fossil Energy's Chief Operating Officer Chuck McConnell lauded the NETL teams for their contributions. "These awards recognize what has long been the tradition at NETL: commitment, perseverance, innovation, and presenting practical solutions to problems facing the American people. All of us are proud that NETL's work is making substantial and beneficial contributions to our nation. I am proud to work with exceptional colleagues who invest themselves in addressing the energy needs of the nation and the world."

Deepwater Horizon Flow Estimation Group/Nodal Analysis Team

NETL is recognized for its swift and effective response to the Deepwater Horizon oil spill. The Incident Command's Flow Rate Technical Group/Nodal Analysis Team was led by NETL's Dr. George Guthrie and staffed by researchers from NETL, Los Alamos National Laboratory, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Pacific Northwest National Laboratory, Oak Ridge National Laboratory, and the National Institute of Standards and Technology. The team put forth a multi-agency effort critical to estimating the rate of oil flowing into the Gulf and, in turn, to developing options to cap the well.

The team operated efficiently and worked tirelessly to assemble, reduce, and analyze data and vet the results. Their analyses guided key decisions, helping speed the ultimate solution and reduce the environmental cost of the disaster. For their efforts, three NETL staff members received Director's Awards for Exemplary Service to the Nation from the U.S. Geological Survey (USGS). In presenting the awards, USGS Director Dr. Marcia McNutt said, "The nation was privileged to have a cadre of dedicated and capable government, academic, and independent scientists to call upon during this disaster."



Hanford Site Validation and Verification Evaluation

At the Hanford Site in the state of Washington, nine nuclear reactors and their associated facilities produced plutonium for our nation's defense during World War II and throughout the Cold War. Today, the site is home to one of the most complex and challenging environmental clean-up projects in our nation's history.

An NETL team of recognized experts in computational fluid dynamics evaluated Bechtel National Inc.'s (BNI's) pulse-jet mixing vessel design, developed for the waste treatment and immobilization plant that BNI is designing and building at the site. The plant will be the world's first chemical processing facility capable of turning radioactive liquid waste into a stable glass form suitable for safe, permanent disposal. The pulse-jet mixing system must be designed to safely process the 53 million gallons of liquid nuclear waste stored in aging tanks at the site today.



The NETL team analyzed BNI's computer modeling process and made technical recommendations for improving the company's verification and validation process and, beyond the original scope of work, addressing potential issues with the pulse-jet mixer design. The methodical, precautionary efforts of NETL and BNI, in close association with Hanford's Office of River Protection and the Defense Nuclear Facilities Safety Board, will help ensure that the pulse-jet mixing system is safe, secure, and sound in design. It also lays the groundwork for future applications in the nuclear industry and across the energy sector.

MIDWEST HAS POTENTIAL TO STORE HUNDREDS OF YEARS OF CO₂ EMISSIONS

Regional Partnership's Phase II Field Tests Validate Earlier Research Results

Geologic capacity exists to permanently store hundreds of years of regional carbon dioxide (CO₂) emissions in nine states stretching from Indiana to New Jersey, according to injection field tests conducted by the Midwest Regional Carbon Sequestration Partnership (MRCSP).

MRCSP's just-released Phase II final report indicates the region has likely total storage of 245.5 billion metric tons of CO₂, mostly in deep saline rock formations, a large capacity compared to present day emissions. While distributed sources such as agriculture, transportation, and home heating account for a significant amount of CO₂ emissions in the MRCSP area, over half of the emissions come from large, stationary sources such as power and industrial plants. These units account for nearly 700 million metric tons annually.

MRCSP's Phase II small-scale geologic field tests used less than 60,000 metric tons of CO₂ injection into selected deep saline formations to validate data from earlier Phase I, or characterization, research. Deep saline formation injection is a storage type that represents the most significant geologic storage potential for the United States. These latest results turn earlier information into practical, real-world knowledge for the most promising carbon storage technologies.

Phase I projects characterized large point sources of CO₂ and potential geological and terrestrial storage options for the region, which comprises Indiana, Kentucky, Maryland, Michigan, New Jersey, New York, Ohio, Pennsylvania, and West Virginia.

In all, seven small-scale field validation tests were conducted in Phase II:

- Three geologic injection tests, one in each of the three major geologic provinces of the region: the Michigan Basin, Appalachian Basin, and Cincinnati Arch, and hosted by major power companies in the region.
- Four terrestrial field tests in land types characteristic of the region's diversity: croplands, reclaimed minelands, reclaimed marshlands, and forested wetlands.

Phase II terrestrial field tests showed that the MRCSP region can potentially store about 15 percent of the region's annual CO₂ emissions from large point sources, such as power plants. In particular, Phase II confirmed that no-till agriculture is a valuable carbon storage strategy with the added benefit of improved soil quality and agronomic productivity.

MRCSP Phase II field tests also determined that oil-and-gas fields have a high potential for enhanced oil and gas production associated with CO₂ storage. In addition, using CO₂ for enhanced coalbed methane recovery also shows potential for storing CO₂. The MRCSP estimates that by utilizing CO₂ for EOR, approximately 1.2 billion barrels of oil could be recovered from existing oil fields in their region helping to offset the cost of deploying carbon capture and storage technologies.

Read the final report at http://216.109.210.162/userdata/phase_ii_reports/phase_ii_final_report_MRCSP.pdf.

SEAB FINAL REPORT ON SHALE GAS PRODUCTION RELEASED

The Shale Gas Subcommittee of the Secretary of Energy Advisory Board (SEAB) released its final subcommittee report on Shale Gas Regulation in November. The final report developed a list of 20 recommendations that could help reduce the environmental impact of shale gas production and to assure its safety.

According to the SEAB, implementing the recommendations would “require a great deal of effort and regulators, public officials, and companies need to decide how to allocate scarce human and financial resources to each recommendation, potentially shifting effort from other valuable existing activities.”

Read the report and the recommendations at <http://shalegas.energy.gov/>.

Secretary of Energy Advisory Board



**Shale Gas Production
Subcommittee
Second Ninety Day Report
November 18, 2011**

COMMUNITY OUTREACH AND CCUS

An Overview of How One Project is Helping to Educate the Public

Outreach activities in carbon capture, utilization, and storage (CCUS) are an integral part of any project. *Fossil Energy Today* takes a look at the Illinois Industrial Carbon Capture and Storage project, led by Archer Daniels Midland Company (ADM), and how it is reaching out to the community to explain this technology.

The Illinois Industrial Carbon Capture and Storage (Illinois ICCS) project team developed and conducted an integrated communication, outreach, training, and education initiative to engage stakeholders in understanding CCUS and the Illinois ICCS project. The project team included ADM, Illinois State Geological Survey (ISGS), Schlumberger Carbon Services, and Richland Community College (RCC). Richland Community College has a strong relationship with the Decatur community through its educational programs and outreach activities. RCC, located in Decatur, Illinois, features a main campus and four major extension sites and offers over 150 degrees and certificates. Because of its close proximity to the ADM sequestration site, a National Sequestration Education Center (NSEC) is being established at RCC as part of the Illinois ICCS project implementation. This 15,000 square foot building will house classrooms, training and laboratory facilities, and offices for the Illinois ICCS project partners to conduct educational, training, and outreach activities.

Recent outreach activities:

■ Richland Summer Excursion

As part of Richland's Decatur community CCUS educational outreach activities, Dr. David Larrick, Director of the Sequestration program at RCC, integrated CCUS concepts into the Richland Summer Excursion, a six-week program for elementary school students that was completed on July 15, 2011. Approximately 500 first through fourth grade students were enrolled in the program. Students were engaged in experiments and other hands-on activities, while learning about carbon storage, biofuels, global warming, solar energy, wind energy, recycling, and sustainable agriculture.



At Richland Community College, students conducted an ethanol experiment, in which their balloons were filled with CO₂. This experiment led to a discussion of global warming and CCUS as a way to reduce atmospheric CO₂ levels. Photo by Richland Community College.

■ Illinois State Fair

RCC College was an exhibitor at the Illinois State Fair in August. Dr. Larrick disseminated Illinois ICCS project information to visitors of the Illinois Department of Agriculture tent. The participation of RCC at the State Fair has successfully provided visitors with general information regarding the Illinois ICCS project and CCUS technology, the NSEC, and Richland's planned degree in CCUS. The most frequently asked question was "what is CCUS?" Dr. Larrick's response was that CCUS is a way to reduce CO₂ emissions into the atmosphere (and CO₂ is a greenhouse gas leading to global warming) by capturing CO₂ from a power plant or biofuels plant and storing it deep underground in a porous rock formation, like sandstone or use it for enhanced oil recovery.

■ Farm Progress Show



From left to right: Dr. Douglas Brauer (Vice President, Economic Development and Innovative Workforce Solutions, Richland Community College), Dr. Gayle Saunders (College President, Richland Community College), Governor Quinn, Amy Bliefnick (Illinois State Fair Show Manager), and Richard Guebert (Vice President, Illinois Farm Bureau)

Richland Community College was the host institute for the 2011 Farm Progress Show (FPS), the nation's largest outdoor farm show, bringing the best of American agriculture to Decatur. Visitors from North America and around the world came to see the latest farming equipment, seed varieties, crop chemicals, and field demonstrations, along with arts, and crafts.

From August 30 to September 1, the 380-acre FPS site attracted an estimated 250,000 visitors, with \$1 billion of farm equipment at the show. On August 30, Governor Pat Quinn visited the Richland tent. He was impressed with the mobile biofuels laboratory and the CCS project hosted in Decatur.

Upcoming Events

<http://www.fossil.energy.gov/news/events/index.html>

January 30- Feb.1

[Energy, Utility & Environment Conference](#)

Phoenix, AZ

FE Contact: Gene Kight, 301-903-2624

March 29- Apr.1

[National Science Teachers Association Conference](#)

Indianapolis, IN

FE Contact: Eileen Division, 202-586-3474

April 14-19

[National Association of Broadcasters](#)

Las Vegas, NV

FE Contact: Jenny Hakun, 202-586-5616



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Contact: Jenny Hakun, Editor
Phone: 202-586-5616
E-mail: energytoday@hq.doe.gov

Web site: <http://www.fossil.energy.gov/news/energytoday.html>

Comments are welcome and may be submitted to the editor.