Fossil Energy Today

A Newsletter About Innovative Technologies for Fossil Energy

Office of Fossil Energy, U.S. Department of Energy • Issue No. 2, Second Quarter, 2011

Carbon Capture Simulation Initiative Aims to Bring Technologies to Market Faster

The Office of Fossil Energy's National Energy Technology Laboratory (NETL) has begun research under the Carbon Capture Simulation Initiative (CCSI), partnering with other national laboratories, universities, and industry to develop a state-of-the-art computational modeling and simulation Toolset to accelerate commercialization of carbon capture and storage (CCS) technologies.

CCSI is one of three areas of research under the Carbon Capture and Storage Simulation Initiative announced late last year by Energy Secretary Steven Chu. The others involve developing validation data and experimental work, and developing methodology and simulation tools to assess risk. Work in all three areas will be aided by a new Simulation-Based Engineering User Center that NETL is creating in a separate but related effort.

There is an urgent need for accelerating the development of CCS technologies. DOE has the goal to support research and development, as well as pilot CCS projects so that barriers to the widespread, safe, and cost-effective deployment of CCS be overcome within 10 years. Currently, the fastest way to deploy carbon capture technology is to scale-up existing technologies, such as amine scrubbing, to the capacity required for use in a power plant, and to deploy the technology to the hundreds of existing power plants. However, estimates show that this could increase the cost of electricity by as much as 80 percent in new pulverized coal (PC) power plants while reducing the power plant's efficiency.

Taking promising new carbon capture technologies from concept to commercial scale could take 20–30 years because of the need to manage the overall risk of the scale-up process. Typically, several incremental steps are taken during scale-up, ensuring that the technical risk in each step is as small as possible. "The complementary CCSI approach, which is based on advanced modeling and simulation, has the potential to dramatically reduce this development time," said Dr. Madhava Syamlal, Director of CCSI and NETL Researcher. "Science-based models will be used in conjunction with pilot-scale data to enable reaching larger scales, earlier with greater confidence, thereby reducing the time and expense required for achieving commercial deployment of carbon capture technology."

"CCSI" continued on page 3

DOE's Early Investment In Shale Gas Technology Producing Results Today

More than 30 years ago, fears of dwindling domestic natural gas supplies pushed researchers to examine alternative sources of natural gas such as Devonian shales, coals, and low permeability or "tight" sands. Recognizing the need for research and development to quantify these unconventional reservoirs and to develop ways to produce them, DOE's Office of Fossil Energy invested in Devonian shale research from 1977 through 1992, matching technology to complex geology for various geologic settings.

"Shale Gas Technology" continued on page 4

Contents

Office of Clean Coal: Reorganization

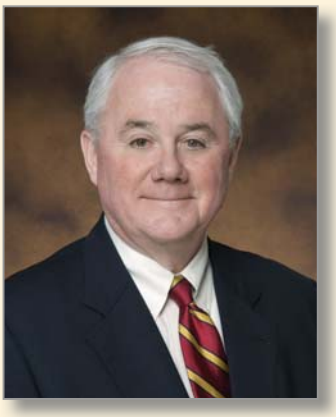
By James Wood

Over the past few years, the focus of the Office of Fossil Energy's (FE) Clean Coal Program has shifted to the current overriding objective of developing technically viable and economically competitive carbon capture and storage (CCS) systems. Late last year, the Office of Clean Coal was reorganized to help us operate more effectively and to better integrate related programs to meet this objective.

Today, the Office of Clean Coal comprises three sub-offices. The Office of Planning and Environmental Analysis continues to focus on intergovernmental activities and policies that impact the nation's coal fleet. The Office is also working to address carbon storage liability issues as part of the President's Intergovernmental Task Force on CCS.

The Office of Clean Energy Collaboration remains the lead on FE's international collaborative efforts on coal and CCS. In addition to spearheading key bilateral activities such as the India and China coal working groups, the Office of Clean Energy Collaboration also engages our international partners multilaterally. Notably, the Office acts as the Secretariat of the 25-member Carbon Sequestration Leadership Forum, which is committed to the global deployment of commercial CCS systems.

The major change resulting from the reorganization is that FE's coal R&D has been streamlined to focus on carbon capture and storage and is housed in the newly-christened Office of Clean Energy Systems, led by Dr. Darren Mollot.



James Wood is Deputy Assistant Secretary for Clean Coal in the Office of Fossil Energy.

The Office of Clean Energy Systems will focus on four key priorities: 1) accelerating R&D on globally competitive carbon capture technologies for power plants and industrial sources; 2) establishing the basis for long-term geologic storage and CO_2 reuse; 3) improving the efficiency of both existing and new coal-fired power generation plants; and 4) implementing computer modeling and simulation to accelerate the R&D path from discovery to commercialization and reduce costs for new CCS technologies.

This reorganization more precisely reflects our current mission and will promote a more effective and efficient work environment. We are confident that streamlining our efforts to focus on mission-specific R&D will help us reach our goal of widespread deployment of commercial CCS systems within the next 10 years.

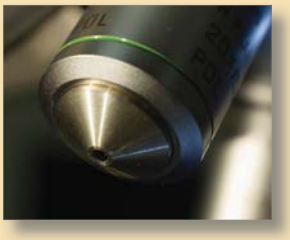
The Office of Clean Energy Systems Encompasses Four New Divisions

Advanced Energy Systems

This division oversees R&D on advanced combustion systems and gasification systems. It also manages research on hydrogen turbines, hydrogen from coal, and solid oxide fuel cells.

CCS Demonstrations

As its name indicates, this division manages FE's CCS demonstration programs, including the Clean Coal Power Initiative, the Industrial CCS program, and FutureGen 2.0.



Crosscutting Research

This division's mission is to develop and deploy state-of-the-art instrumentation, sensors, and controls to optimize the performance of advanced power systems. Research here will also focus on developing computer simulation tools to accelerate the CCS development-to-deployment cycle.

CCS Research

Research under this division includes post-combustion capture, pre-combustion capture, and industrial capture systems. It also heads up our Regional Carbon Sequestration Partnership program, as well as other R&D related to carbon storage.

"CCSI" continued from page 1

The Toolset will enable the use of integrated models for identifying promising concepts, for reducing the time for design and troubleshooting, for quantifying the technical risk during scale-up, and for stabilizing the cost during commercial deployment.

Meeting Industry Needs

The CCSI's industrial partners represent the power generation industry and power equipment manufacturers, and will be the initial customers of CCSI products. The initial industrial partners are ADA Environmental Solutions, Alstom Power, Ameren, Babcock Power, Babcock & Wilcox, Chevron, EPRI, Eastman, Fluor, General Electric, Ramgen Power Systems, and Southern Company.

CCSI's Industry Advisory Board will conduct semi-annual reviews to ensure that the development of tools and models within CCSI match the requirements of commercial decision-makers for improving confidence in capture deployment decisions. Industry partners will also provide guidance, data, and development support. Early releases of the CCSI Toolset will be made available to these participants during the project.

Opportunities for Students

The CCSI's academic participants — Carnegie Mellon University, University of Pittsburgh, Virginia Tech, Penn State University, Princeton University, and West Virginia University — bring unparalleled expertise in multiphase flow reactors, combustion, process synthesis and optimization, planning and scheduling, and process control techniques for energy processes.

Several graduate students and postdoctoral fellows will be involved in the development of CCSI technology. Other educational activities will include an active seminar series on CCSI that is broadcast to remote sites, archived on the web and widely available to graduate students. In addition, a summer school on CCSI will be organized at Carnegie Mellon University for engineers and graduate students from around the United States. This event will include lectures from industry and academia on frontier research and the state of the art relating to the science and technology of CCSI.

While the ultimate goal of the CCSI is to deliver a set of tools to industry that can simulate scale-up of a broad suite of new carbon capture technologies from laboratory to commercial scale, the first five years of the project will focus on developing capabilities applicable to post-combustion capture by solid sorbents and advanced solvents and to oxy-combustion. Among possible carbon capture technologies, these are expected to have the most immediate impact on U.S. pulverized coal power plants, which currently generate nearly half of the nation's electricity and are expected to emit 95 percent of U.S. coal-based CO_2 emissions between 2010 and 2030.

To learn more about the CCSI, visit its website at: www.acceleratecarboncapture.org.

The CCSI is led by the National Energy Technology Laboratory (NETL). The project brings together the best capabilities at NETL, Los Alamos National Laboratory, Pacific Northwest National Laboratory, Lawrence Berkeley National Laboratory, and Lawrence Livermore National Laboratory.

McConnell Joins FE Staff

Charles "Chuck" McConnell has joined the Office of Fossil Energy as Chief Operating Officer (COO).

As COO, McConnell will manage the daily operations of Fossil Energy's programs in a leadership role that includes strategic planning, program direction, and evaluation. He will also oversee FE's administrative and budgetary operations.

McConnell brings a wealth of fossil energy and management experience to the new position. Most recently, he served as Vice President of Carbon Management at Battelle Energy, which included the business management and technology leadership of the Midwest Regional Carbon Sequestration Partnership. Prior to his work at Battelle, McConnell held a number of positions with Praxair, Inc., including Global Vice President of Energy, where he oversaw Oxy-Coal Technology and R&D development.

McConnell has also held a number of advisory positions, including chairmanships of the Gasification Technologies Council and the Clean Coal Technology Foundation of Texas. He also served on the FutureGen Advisory Board; the Gulf Coast Carbon Center; T&P Syngas Company; Pittsburgh Coal Conference; and the Coal Utilization Research Council.

"Shale Gas Technology" continued from page 1

Spurred by the technological advancements resulting from this $137 million research investment, U.S. shale gas production continues to grow, amounting to more than 13 billion cubic feet per day, or about 23 percent of the total volume of dry natural gas produced in the United States. The result: more U.S. jobs, increased energy security, and higher revenues for states and the Federal Government.

Through programs focused on Eastern gas shales, Western gas sands, and methane from coalbeds, DOE developed and stimulated the deployment of advanced exploration and production technologies. These technologies re-covered new gas supplies from unconventional gas resources by increasing per-well gas-recovery efficiencies and lowering unit development costs.

DOE's National Energy Technology Laboratory (NETL) employed a detailed resource characterization and technology development approach that geologically partitioned each natural gas resource and matched technology to geology to chart a path for resource development. More than 25,000 feet of oriented core and well log data from 35-cored shale wells provided the basic core and geologic data used to prepare the first publicly available estimates of technically recoverable gas for the Huron shales in West Virginia, Ohio, and Kentucky.

In 1986, DOE collaborated with industry to achieve a significant milestone: the first air-drilled 2,000-foot-long horizontal Devonian shale well in

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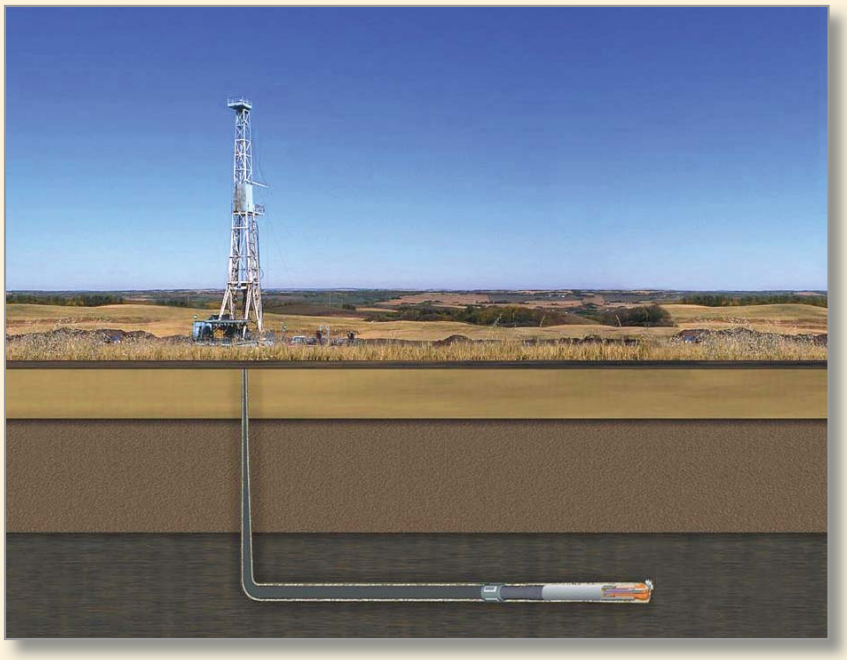
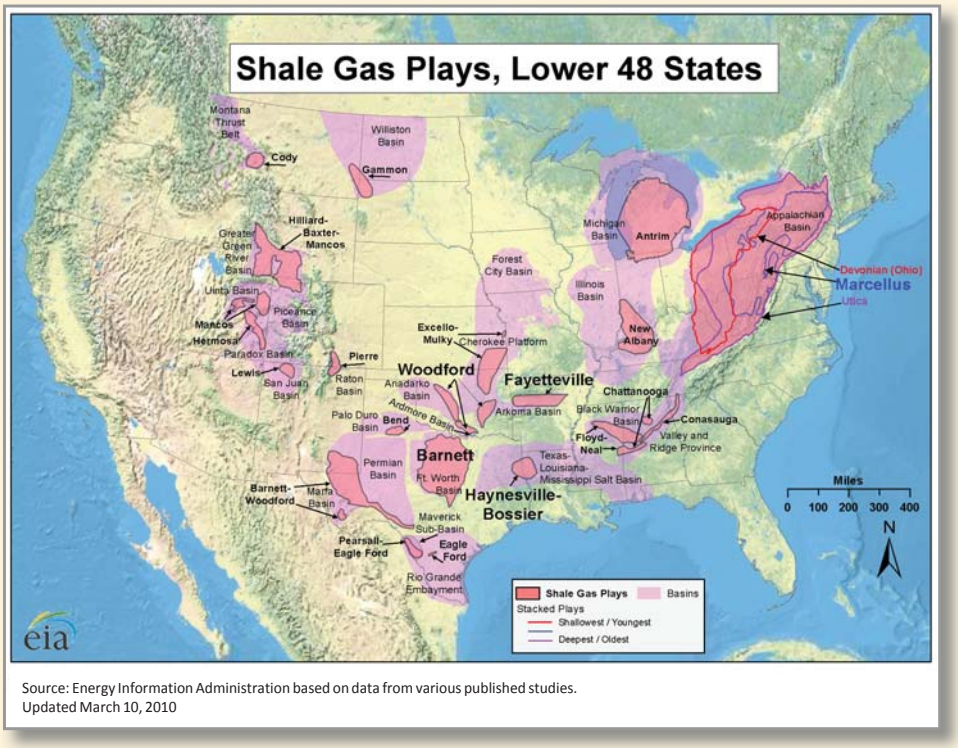


In the 1980s and early 1990s, NETL collaborated with industry to advance horizontal drilling techniques. The first air-drilled 2,000-foot horizontal Devonian shale well was completed by NETL and its partners in the Appalachian Basin.

According to Dr. Terry Engelder, Professor of Geosciences at Penn State University, DOE's Eastern Gas Shales Research Program ". . . helped expand the limits of gas shale production and increased understanding of production mechanisms . . . . It is one of the great examples of value-added work led by the DOE."

DOE's Energy Information Administration (EIA) projects that the shale gas share of U.S. natural gas production will reach 45 percent by 2035. The EIA also projects that 827 trillion cubic feet of natural gas is now recoverable from U.S. shales using currently available technology—an increase of nearly 500 trillion cubic feet over earlier estimates.



Source: Energy Information Administration based on data from various published studies.
Updated March 10, 2010

"Shale Gas Technology" continued from page 4

the Appalachian Basin. This also marked the first recovery of core from a horizontal air-drilled shale well and the first successful use of external casing packers in an air-filled wellbore. Through 1992, DOE also worked with industry to complete three additional 2,000-foot-long horizontal wells containing multiple hydraulically fractured zones and to develop more efficient downhole tools, such as electromagnetic measurement-while-drilling and directional air hammer technology, both of which are currently used by the oilfield service industry.

Another example of early DOE leadership in the development of technologies applicable to shale gas development is fracture mapping — techniques for using seismic responses to identify the orientation and extent of hydraulically created fractures. Today, a number of companies successfully map hydraulic fractures, including many in the major shale gas plays.

Developing domestic natural gas resources means additional jobs when wells are drilled, pipelines are constructed, and production facilities are built and operated. Larger volumes of domestic natural gas also translate into lower fuel or feedstock prices for industries that use natural gas to process or manufacture products. As a result, fewer jobs are lost to lower-cost overseas competitors and prices are lower for consumers. In addition, increased domestic natural gas production improves national energy security and results in higher tax revenues to states and the Federal Government.

DOE researchers gathering data from one of a series of cored shale wells in the Appalachian Basin in the early 1980s.

American ingenuity and steady research in the Office of Fossil Energy has helped natural gas production from shales increase fourteen-fold over the past decade. The energy supply promise of natural gas produced from shales, and the role of FE's National Energy Technology Laboratory in conducting R&D that helped make it happen, is featured in a new Department of Energy brochure, *Shale Gas: Applying Technology to Solve America's Energy Challenges*.

Coal-Cleaning Technology Succeeds In Commercial Demonstration

Novel Centrifuge Paves Way to Recover Tons of Waste Coal for Energy Use

Every year, U.S. coal producers discard large amounts of coarse, moisture-laden coal particles (known as fines) that are typically deposited in containment ponds or impoundments as a slurry, a mixture of waste coal fines and water. In some cases the water is evaporated to stabilize the deposits before they are recovered in surface reclamation; in others, and for a variety of reasons, the waste coal — which represents a potentially useful energy resource — is not recovered.

Recently, a DOE-supported project successfully demonstrated a novel technology that could help release some of the currently unusable energy in an estimated 2 billion tons of U.S. coal. The unique hyperbaric centrifuge technology is aimed at separating the fine coal particles from water, allowing their recovery for energy while simultaneously cleaning up the environment and providing jobs in the coal-cleaning industry. The technology represents a major step forward in coal-cleaning separation and could pave the way for the use of billions of tons of waste and fine coal refuse added to slurry impoundments by the U.S. coal industry each year.

The full-scale test of the advanced hyperbaric centrifuge technology at a Jim Walter Resources Inc. coal-cleaning plant in Alabama resulted in the successful reduction of moisture from the ultrafine coal waste. The test builds on an eight-year cooperative effort between FE's National Energy Technology Laboratory (NETL) and Virginia Tech.

In the past, removing moisture from very fine coal particles had been difficult. Methods typically used, such as thermal dryers or mechanical dewatering, had either proven too costly or had been unable to remove the moisture from ultrafine coal particles of 0.1 millimeters or less.

"Coal-Cleaning Technology" continued on page 6

"Coal-Cleaning Technology" continued from page 5

Researchers at Virginia Tech developed and patented the hyperbaric centrifuge and other related technologies. Virginia Tech's Center for Advanced Separation Technologies successfully tested its prototype technology at a variety of coal-cleaning plants. Virginia Tech subsequently sublicensed the technology to Decanter Machine Inc., of Johnson City, Tenn., which built the initial prototype unit that successfully reduced the moisture in fine coal to a level of 13–19 percent at a rate of 30 gallons per minute. Coal recovery from the sludge was greater than 97 percent.

Decanter Machine then constructed a full-scale commercial unit capable of handling 600 gallons of slurry per minute. Jim Walter Resources successfully tested the full-scale commercial unit at the greater rate, applying a combination of air pressure and centrifugal force. This process reduced moisture in the ultrafine coal to less than 20 percent. Through the cooperative agreement with NETL, Virginia Tech's development of the hyperbaric centrifuge, in combination with its related developments such as a coal-cleaning technology called Microcel™, has been able to remove both water and ash from fine coal discarded at impoundments. The Microcel technology uses microbubbles to separate fine coal mineral matter that subsequently becomes ash during coal combustion. As a successful example of technology transfer, the Microcel process has been widely used in Australian clean coal plants.

Decanter Machine, Inc. constructed a full-scale commercial unit capable of handling 600 gallons of slurry per minute. Jim Walter Resources successfully tested the commercial unit at the greater rate, applying a combination of air pressure and centrifugal force. This process reduced moisture in the ultrafine coal to less than 20 percent. (Image courtesy of Decanter Machine, Inc.)

Sonar Survey Program Monitors Underground Storage Caverns

The Strategic Petroleum Reserve (SPR), filled to capacity at 727 million barrels, is the world's largest supply of emergency crude oil. The federally owned oil stocks — managed by the Office of Fossil Energy — are stored in underground salt caverns along the coastline of the Gulf of Mexico. To assure the long-term integrity of the 62 oil storage caverns in the SPR, the Sonar Survey Program was developed as part of an overall cavern monitoring program. A sonar survey is a tool used to determine the volume of a storage cavern by transmitting and receiving sound waves through a device run on an electric wire-line down into the cavern. The signals are received and recorded at the surface. The sound waves move through the oil and/or brine stored in the cavern and bounce off the cavern walls. From this information, the internal geometry of the cavern is defined and a 3-D cavern image is generated.

A storage cavern is developed by drilling a well and cementing a pipe string into the salt dome, typically at a depth of about 1,500 to 2,000 feet below the surface. This is followed by a leaching operation in which fresh water is circulated down a pipe string below the cemented pipe. The water dissolves the salt, and the brine generated is removed and disposed. The DOE caverns typically have a volume of about 11 to 13 million barrels. They are cylindrical in shape with the top and bottom at 2,000 feet

"Sonar Survey" continued on page 7

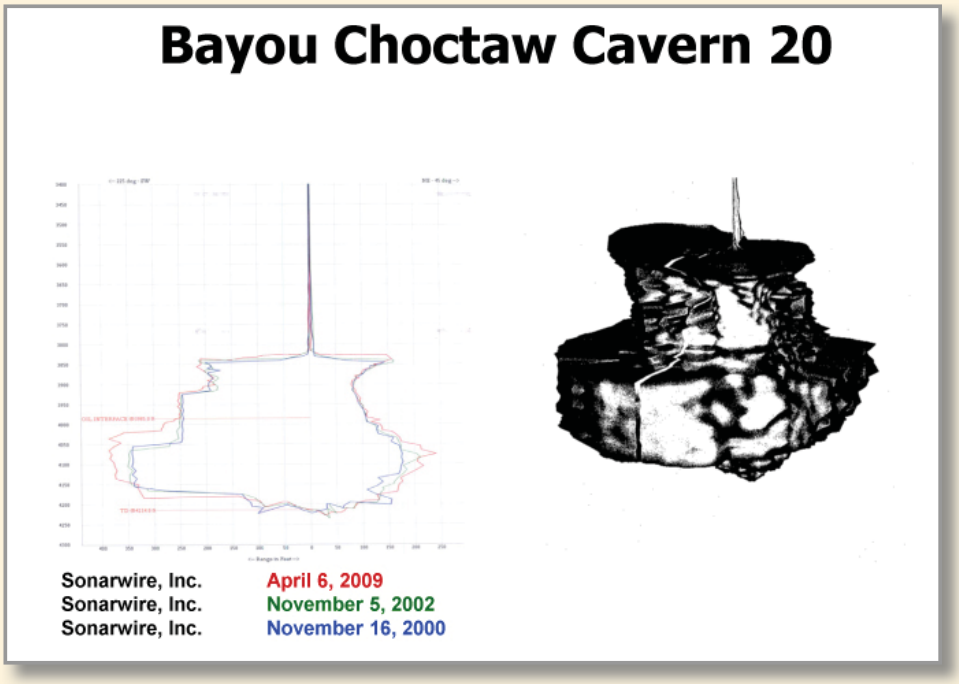
The Strategic Petroleum Reserves includes 62 underground oil storage caverns at four locations along the coastline of the Gulf of Mexico.

"Sonar Survey" continued from page 6

and 4,000 feet below the surface, respectively. Typical diameter of these caverns is about 210 feet, or about two-thirds the length of a football field. Following initial leaching of the cavern, a sonar survey is run to determine the initial cavern geometry and volume. This will determine how much oil can be stored in the cavern. Due to changes in cavern volume with time, sonar surveys are required at least every 10 years, or more frequently if required by operational conditions.

Interpretation of sonar surveys includes the following:

- Dimensions and configuration of the cavern.
- Relationship of the cavern to adjacent caverns.
- Relationship of the cavern to the edge of the salt dome.
- Description and explanation of any anomalies.
- Description of any changes in operation necessary to obtain desirable cavern dimensions and configurations.



DOE to Convert Heating Oil Reserve to Ultra Low-Sulfur Distillate

In response to new, more stringent fuel standards in several Northeastern states, the Department of Energy recently began the task of converting its heating oil reserve to a cleaner fuel known as ultra low-sulfur distillate.

New York, New Jersey and Maine are among the states that have recently passed legislation requiring all heating oil sold be ultra low-sulfur fuel, with sulfur content being decreased over the next few years to a final limit of 15 parts per million (ppm).

Until recently, the nearly 2-million-barrel Northeast Home Heating Oil Reserve held stocks of heating oil with up to 2,000 ppm. To meet the new requirements, DOE sold the heating oil from the reserve and will use the funds from the sale to purchase ultra low-sulfur distillate.

The sale of the heating oil stocks took place via two separate online sales and concluded on February 10, 2011, with contracts awarded to five different companies: Morgan Stanley (950,000 barrels), Shell Trading U.S. Company (400,000 barrels), Hess Corporation (300,000 barrels), George E. Warren Corporation (234,253 barrels), and Sprague Energy Corporation (100,000 barrels).

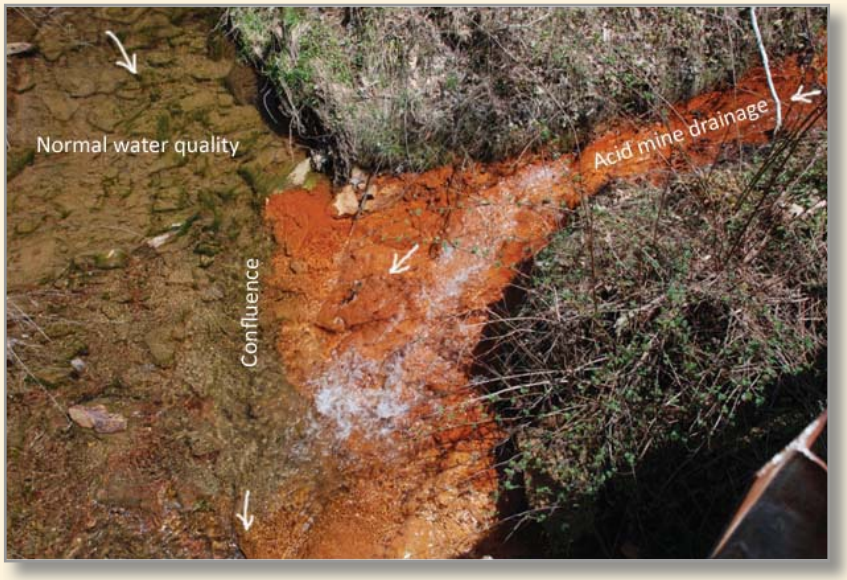
DOE will purchase the new, ultra low-sulfur heating oil prior to the 2011–2012 heating oil season.

The Northeast Home Heating Oil Reserve was established by the Energy Policy Act of 2000 to provide an emergency petroleum stockpile to supplement commercial fuel supplies in the event of an actual or imminent severe supply disruption. The Reserve can provide supplies for up to 10 days, the time required for ships to carry heating oil from the Gulf of Mexico to New York Harbor.

Marcellus Water Management Project to Test Use for Mine Drainage Water

A team of researchers from the University of Pittsburgh and Carnegie Mellon University, supported by FE's National Energy Technology Laboratory, is developing a novel approach for the re-use of fracturing flowback water in the Marcellus Shale play, one of the nation's largest sources of potentially recoverable natural gas. Initiated last October, and scheduled to run through September 2012, the project will examine acid mine drainage (AMD) water as a possible way to treat flowback water, which results from drilling, so that it can be re-used in the hydraulic fracturing process. The team believes that the sulfate in the mine water will react with the barium and strontium in the flowback water, eliminating one of the barriers to simply reusing the water to hydraulically fracture the shale elsewhere. The project will also develop new viscosity modifiers that are stable at the high levels of salinity observed in some Marcellus flowback water.

The project responds to growing concerns over flowback water management in the Marcellus shale, particularly in Pennsylvania where drilling has expanded dramatically in the last year. At least 710 Marcellus wells were drilled in the state in 2009, while 821 shale wells were drilled in the first four months of 2010 alone. Increasingly large fracturing projects have resulted in higher amounts of fracturing flowback water in Pennsylvania. At one point, more than 1,000 tank trucks a day were estimated to leave the state with loads of produced flowback water headed for disposal in injection wells, primarily in Ohio.



This image shows acid mine drainage (AMD) water, a possible supplement to flowback water, which results from drilling and can be re-used in the hydraulic fracturing process. (Image courtesy of Callan Bentley, Assistant Professor, Northern Virginia Community College.)

A technically and economically feasible approach for the reuse of flowback water could reduce the amount of freshwater needed for Marcellus Shale development, minimize disposal liability and costs, and find a practical use for an existing wastewater product from past mining activity in the Appalachian Basin.

Fossil Energy Spotlight

A Look at Notable News, Projects and Research

Licensing Agreement Moves Two NETL-Patented Carbon Capture Sorbents Closer to Commercialization

Two new patented sorbents used for carbon dioxide capture from coal-based power plants have moved closer to commercialization as a result of a licensing agreement between the National Energy Technology Laboratory and ADA Environmental Solutions.

The nonexclusive agreement facilitates negotiations on intellectual property rights, protects proprietary information, and grants non-exclusive licensing of the new technology. Under federal regulations, NETL is authorized to obtain, maintain, and own patent protection for its inventions, including those funded through collaborative agreements. By granting a commercial license for these sorbents, NETL can now convey and control the right to make, use, and sell the products and services claimed in the patent, thereby assuring strategic commercialization throughout the coal-fired power plant industry.

For more information, visit: www.fossil.energy.gov/news/techlines/2011/11019-CO2_Capture_Sorbents_Move_Closer_t.html

DOE Leverages Fossil Energy Expertise to Develop and Explore Geothermal Energy Resources

Focusing on reducing the upfront costs of geothermal development as well as improve its effectiveness, the U.S. Department of Energy has announced plans to leverage oil and gas expertise to test the reliability and efficiency of geothermal power generation at oil and gas fields. DOE's Office of Fossil Energy and Office of Energy Efficiency and Renewable Energy will combine efforts to have experts test and validate low temperature geothermal power generation technologies at the Rocky Mountain Oilfield Testing Center (RMOTC) near Casper, Wyoming.

The goal of this project is to leverage the resources of both program offices to support state-of-the-art research and development into geothermal power generation technology using co-produced fluids from older oil and gas operations. This hybridization combines traditional fossil energy operations with emerging renewable technologies to evaluate low temperature geothermal power production from oil fields. Leveraging existing oil and gas infrastructure reduces the upfront costs of geothermal development. The potential to produce renewable energy from existing sites extends beyond the work with RMOTC to oil and gas fields worldwide.

For more information, visit: www.fossil.energy.gov/news/techlines/2011/11012-DOE_Leverages_FE_Expertise.html

Process for Capturing CO_2 Emissions Wins National Award for Excellence in Technology Transfer

A process developed by researchers at the Office of Fossil Energy's National Energy Technology Laboratory (NETL) that improves the capture of carbon dioxide (CO_2) emissions from power plants while reducing the cost has been selected to receive a 2011 Award for Excellence in Technology Transfer.

The Basic Immobilized Amine Sorbent Process separates CO_2 from the flue or stack gas of power plants, preventing its release into the air. The captured CO_2 can then be permanently stored in a carbon sequestration scenario. Application of this technology reduces the costs and energy associated with more conventional scrubbing processes to capture CO_2 in large-scale power generation facilities; consequently, its transfer from the laboratory to the marketplace is another important step in moving forward the commercialization and deployment of innovations that help decrease atmospheric emissions of greenhouse gases.

This national award is presented annually by the Federal Laboratory Consortium for Technology Transfer in recognition of outstanding work by researchers in the transfer of technology from federal laboratory to the commercial marketplace. NETL's McMahan Gray and Henry Pennline received the award for their effort on this project.

For more information, visit: www.fossil.energy.gov/news/techlines/2011/11009-NETL_Process_Wins_Award.html

State Regulatory Framework Will Most Likely Result in Robust CO_2 Pipeline System, New Study Says

A private sector model with a state rather than Federal-based regulatory framework is the approach that will "most likely result in a robust CO_2 [carbon dioxide] pipeline system" in the United States, according to a new report developed with funding from the U.S. Department of Energy's National Energy Technology Laboratory.

However, a Federal role that "includes incentives to encourage the private construction of CO_2 pipelines" would be an important factor in moving the concept forward, the study says.

The report, *A Policy, Legal, and Regulatory Evaluation of the Feasibility of a National Pipeline Infrastructure for the Transport and Storage of Carbon Dioxide*, analyzes a potential pipeline infrastructure that would transport CO_2 from large point sources, such as power plants, to designated underground storage locations. Constructing a viable pipeline network is a key component for commercializing and deploying carbon capture and storage technology, considered by many experts to be a promising option for helping to reduce the buildup of atmospheric CO_2 due to human activity.

For more information, visit: www.fossil.energy.gov/news/techlines/2011/11007-New_Report_Analyzes_CO2_Pipeline_S.html

Upcoming Events

www.fossil.energy.gov/news/events

May 2 – 5
2011 Offshore Technology Conference
Houston, Texas
DOE Contact: Debbie Turner, 304-285-0238
www.otcnet.org/2011/

May 10 – 12
Department of Energy's 12th Small Business Conference & Expo
Kansas City, Missouri
http://smallbusinessconference.energy.gov/

June 5 – 9
36th International Technical Conference on Clean Coal & Fuel Systems
Clearwater, Florida
DOE Contact: Gene Kight, 301-903-2624
www.coaltechnologies.com

August 16 – 18
Coal-Gen 2011
Columbus, Ohio
DOE Contact: Gene Kight, 301-903-2624
www.coal-gen.com

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Comments are welcome and may be submitted.