Fossil Energy Today

A Newsletter About Innovative Technologies for Fossil Energy

Office of Fossil Energy, U.S. Department of Energy • Issue No. 6, Second Quarter, 2012

NETL Shares Computing Speed, Efficiency to Tackle Barriers

New Supercomputer to Simulate Carbon Capture, Utilization and Storage Scenarios

One of the world's fastest supercomputers will be installed at the National Energy Technology Laboratory this summer to help develop solutions to carbon capture, utilization and storage (CCUS) technology barriers.

Housed at NETL's Simulation-Based Engineering User Center, a facility primarily devoted to advancing CCUS science and technology — the new supercomputer will be used to develop and deploy the advanced simulation tools needed to quickly and reliably overcome energy technology challenges.

Researchers from partnering organizations, such as the universities that are part of the NETL-Regional University Alliance, will be able to access the supercomputer via user centers at NETL's Albany, Ore.; Morgantown, W. Va.; and Pittsburgh, Pa. locations.

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NETL's new supercomputer, to be installed at the Simulation-Based Engineering User Center, is a powerful and energy-efficient modeling tool.

Dialog on Foreign Direct Investment in the U. S. Fossil Energy Industry

An FE-sponsored dialogue on Foreign Direct Investment (FDI) — investment by foreign entities — in the U.S. fossil energy sector was hosted by the U.S. Energy Association (USEA) on February 22. In an increasingly global marketplace, FDI has become vital to advancing US fossil energy technologies and to the companies that develop and market those technologies.

The purpose of this dialog was to engage DOE, other U.S. government agencies, the U.S. private sector, and foreign stakeholders in a discussion on how to advance this FDI. Over 40 participants attended. Among them were representatives of several major foreign companies with interests in the United States, including Alstom, GDF Suez, Sinopec and Statoil.

The meeting was keynoted by Charles McConnell, assistant secretary for Fossil Energy, who discussed the strengths of the United States as a hub for energy R&D and FDI, as well as DOE's approach to partnering with industry and its strong history of international partnerships.

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Highlights Inside

International Affairs: A Global Collaboration to Achieve Clean Fossil Energy

By Barbara McKee

Barbara McKee is Deputy Assistant Secretary for International Affairs in the Office of Fossil Energy.

The use of clean fossil energy is essential for the citizens of the world to achieve higher standards of living and levels of environmental quality. In this regard, International Affairs is responsible for the coordination of all international activities within the Office of Fossil Energy. Climate change, clean and efficient energy, and environmental protection are among the greatest challenges facing the world today. International Affairs strives to address these issues by leading various multilateral and bilateral relationships.

FE participates in several key multilateral activities, with International Affairs managing and coordinating all of the international activities in the FE Strategic Plan. FE's multilateral involvement includes the Office of Clean Coal and National Energy Technology Laboratory participating in the Carbon Sequestration Leadership Forum (CSLF); the Office of Oil & Natural Gas, Strategic Petroleum Reserve, and NETL participating in the International Energy Agency (IEA), and the Office of Clean Coal participating in the World Energy Council. NETL also participates in the Asia-Pacific Economic Cooperation, and the Office of Oil & Natural Gas will host the 12th US-China Oil and Gas Industry Forum in the United States this September and continue with their participation in the International Shale Gas and Offshore Technology Cooperation. The IEA Clean Coal Center (IEA CCC) includes FE and industry stakeholders, who recently came together to decide the 2012 Work Program for the IEA CCC.

The CSLF is a 25-member ministerial-level international climate change initiative that is focused on the development of carbon capture, utilization and storage (CCUS) technologies. International Affairs serves as the Secretariat for the CSLF, FE's Assistant Secretary Charles McConnell chairs the CSLF Policy Group, and FE and NETL are active members of the Technical Group. Upcoming CSLF events include the Technical Group Meeting in Bergen, Norway, in June; the Annual Meeting in Perth, Australia, in October; and a Risk and Liability Workshop in Paris in July. The CSLF's Capacity Building Program provides funding for over a dozen projects that help promote CCUS technology in Brazil, China, India, Mexico and South Africa.

On February 22, FE sponsored a dialogue to stimulate foreign direct investment (FDI) at the United States Energy Association in Washington, D.C. Attendees included U.S. private sector, foreign companies with an interest in the U.S., and other U.S. government agencies, including Commerce, State, and Treasury. By engaging foreign governments and companies, this FDI will help bring jobs to the U.S. By leading activities such as this, International Affairs helps by also serving as a catalyst to foster opportunities for U.S. firms competing in international energy markets; developing overseas deployment opportunities for U.S. fossil energy technologies; and developing and promoting international partnerships for the deployment of CCUS technologies to mitigate climate change.

International Affairs also leads key bilateral activities, including the U.S.-China Fossil Energy Protocol and the U.S.-India Coal Working Group. The U.S.-China Fossil Energy Protocol was signed in 2000 to promote scientific and technological cooperation between the United States and China in the field of fossil energy, particularly activities related to research, development, demonstration, and deployment.

Currently, I serve as Chairman of the World Energy Council's Committee on Cleaner Fossil Fuels Systems which has 35 member nations and six international organizations. I am also Vice Chairman of the International Energy Agency's Working Party on Fossil Fuels which functions in Paris and has 21 member nations; Vice Chairman of the United Nation's Economic Commission for Europe's Committee on Sustainable Energy which has 55 member states; and Vice Chairman of the International Energy Agency Clean Coal Center which is located in London.

Through these multilateral and bilateral relations, International Affairs is able to engage other countries to accelerate their commitment to greater energy efficiency and environmental stewardship. This is critical in helping populate the world with cleaner fossil energy technology. Additionally, our activities can help attract foreign investments. Our goal is to help secure both America's and the world's energy security, and a cleaner environment.

"Supercomputer" continued from page 1...

The three user centers will also provide advanced visualization hardware and software. This arrangement allows collaborators to simulate phenomena that are difficult or impossible to probe experimentally without the expense of building dedicated supercomputing facilities.

NETL's new supercomputer in brief:

- 22nd fastest supercomputer in the world.
- 43rd most energy efficient supercomputer in the world.
- Exceeds DOE goals for energy efficiency.
- Twice as large as any other DOE computer on the Green500 List of the world's most energy-efficient supercomputers.

Fittingly, the high-performance supercomputer, which can run simulations to improve power plant efficiency, is itself incredibly energy efficient. Supercomputer performance is usually associated with speed — as in the number of operations the machine can process per second — but equally important for the NETL is minimizing the amount of electrical power the computer consumes, as well as increasing metrics for reliability, availability and usability.

Exchanging Carbon Dioxide for Methane in Prudhoe Bay

Globally and for the United States, methane hydrates are a potential future source of natural gas. A recent U.S. Geological Survey study estimated technically recoverable gas resources from gas-hydrate-bearing sands on the North Slope of Alaska at more than 85 trillion cubic feet. Much larger gas hydrate resources are believed to occur in the Gulf of Mexico and off the Pacific and Atlantic coasts. Yet methane hydrates will remain untapped until a technically and economically viable means of producing methane from hydrates is demonstrated.

Laboratory experiments and computer modeling conducted by ConocoPhillips and the University of Bergen indicate potential for producing methane gas from hydrates through the injection of carbon dioxide (CO_2) into gas-hydrate-bearing sand reservoirs. This process could result in the exchange of CO_2 for methane in the solid hydrate structure, while theoretically offering the potential for simultaneous storage of CO_2 deep underground.

Methane hydrates are 3-D ice-lattice structures with natural gas locked inside. Methane hydrates are found under the Arctic and in ocean sediments along nearly every continental shelf in the world. The science and technology to find and produce gas from hydrates could boost U.S. and international economies and energy security by providing new supply options to address future energy demand.

An aerial view of Iġnik Sikumi # 1 gas hydrate test well. Iġnik Sikumi means "fire in the ice" in Inupiaq, a native language of the Alaska North Slope.

Now, ConocoPhillips, in partnership with the Office of Fossil Energy and the Japan Oil, Gas, and Metals National Corporation, is performing the first field trial of this promising methane hydrates production concept at a test site at Prudhoe Bay on the Alaska North Slope.

Iġnik Sikumi

In 2011, ConocoPhillips drilled, logged, and instrumented Iġnik Sikumi #1, a gas hydrate field-

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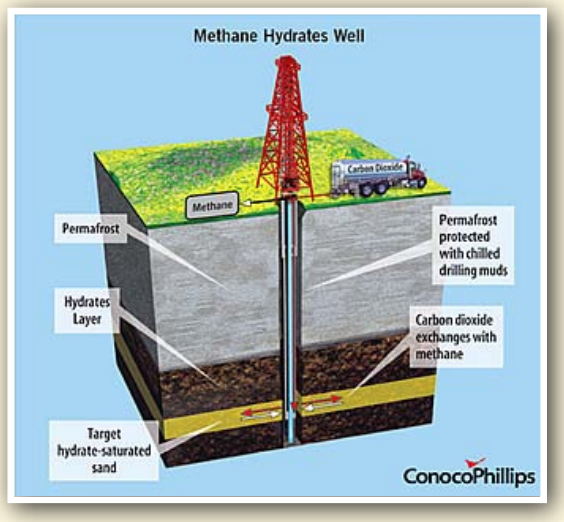
trial well in the Prudhoe Bay region. Using the well, ConocoPhillips and its partners are now conducting a short-duration trial of its CO_2-methane exchange concept in the hydrate-bearing sandstone formation into which the well is drilled.

In February, ConocoPhillips perforated its well and injected a mix of CO_2 and nitrogen into the formation. ConocoPhillips chose this specific gas mixture based on modeling efforts indicating that it provided the best opportunity to enable injection and promote the production of methane.

ConocoPhillips expects this mix to minimize CO_2 hydrate formation upon contact with free-formation water, which can form a barrier in the well and reduce the potential for the CO_2 to encounter the native methane hydrates. This design worked very effectively and 210,000 standard cubic feet of the gas mixture were injected at controlled pressures over 13 days.

Once injection was completed, ConocoPhillips shut the well in and reconfigured their surface equipment for flowback and drawdown testing. Post-injection flowback is now underway. Early results indicate that methane was produced back immediately and that CO_2 appears to be preferentially retained in the reservoir.



A conceptual rendering of ConocoPhillips' CO_2-methane exchange method for producing natural gas from hydrates. Computational modeling predicts that CO_2 injected into the well will enter the ice structure, swapping places with the methane and freeing it to flow into the wellbore for recovery. In a best case scenario, the CO_2 will be permanently trapped underground, giving producers the ability to both recover natural gas for energy production and sequester CO_2 that is recovered during traditional oil and natural gas operations.

Image courtesy of ConocoPhillips.

For more information on the Iġnik Sikumi field trial, visit the NETL website where photographs, project information, and weekly updates are posted.

http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/rd-program/ANSWell/co2_ch4exchange.html

McConnell Confirmed as Assistant Secretary for Fossil Energy

The U.S. Senate confirmed four nominees to key Department of Energy positions on March 29, including Charles McConnell to be the 12th Assistant Secretary for Fossil Energy. Also confirmed were David Danielson, Assistant Secretary for Energy Efficiency and Renewable Energy; Dot Harris, Director of the Office of Minority Economic Impact; and Gregory H. Woods, General Counsel.

Charles McConnell was most recently the Chief Operating Officer in the Office of Fossil Energy. Prior to joining DOE in 2011, Mr. McConnell served as Vice President of Carbon Management at Battelle Energy Technology from 2009-2011, with responsibility for business and technology management. He previously spent 31 years with Praxair, Inc., in various positions in the U.S. and Asia, including as Global Vice President.

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

Mr. McConnell holds a B.S. in Chemical Engineering from Carnegie-Mellon University and an M.B.A. in Finance from Cleveland State University.

"FDI" continued from page 1...

Darren Mollot, Director of Clean Energy Systems in FE's Office of Clean Coal, described CCUS opportunities for FDI, and Mike Smith, Executive Director of the Interstate Oil and Gas Compact Commission and former assistant secretary for Fossil Energy at DOE, described Shale Gas FDI opportunities.

Deputy Assistant Secretary for International Affairs Barbara McKee moderated a panel from the Departments of State, Treasury and Commerce that discussed the role of those agencies in facilitating FDI. The Obama Administration's new SelectUSA initiative to promote FDI was highlighted. A new brochure produced by the FE International Office listing specific FDI opportunities was also released at this dialog.

From L-R: Charles McConnell, Barbara McKee and Darren Mollot at the FE-sponsored dialogue on Foreign Direct Investment in the U.S. fossil energy sector, hosted by the U.S. Energy Association on February 22.

An industry roundtable chaired by GE discussed industries needs and perspectives on FDI and the potential role of government. The need of foreign companies to understand the US energy industry, especially regulatory issues was a particular focus of the discussion.

New Catalyst Technology will Reduce Diesel Engine Idling Through the use of Hydrogen-Based Fuel Cells

Many of us have observed tractor trailers idling away at a rest area and probably regarded it as a waste of fuel not to mention the negative effects that engine idling has on the environment. The reality of the situation is that professional truck drivers are mandated by the Department of Transportation to rest for 10 hours after every 11 hours of driving. During this rest period, they must leave their engines running to provide HVAC to the cabin where they sleep and to power other electrical devices onboard the truck.

The 2.2 million diesel trucks that haul goods across the United States every day produce an enormous amount of emissions, including an estimated 11-million tons of carbon dioxide; 200,000 tons of nitric oxide; and 5,000 tons of particulate matter while wasting over 1 billion gallons of fuel annually. This situation has prompted anti-idling regulations to be adopted, which has created the necessity and perfect commercial opportunity for deployment of diesel "auxiliary power units" (APUs) based on solid oxide fuel cells (SOFCs). APUs would allow the truck driver to turn the engine off and obtain power from a cleaner, more efficient power source — a fuel cell. If the efficacy of APUs based on SOFCs can be demonstrated in the niche market of trucking, then the doors will be open for their use in large-scale, commercial power plants.

Research conducted at NETL has focused on addressing this problem. Methods for generating synthesis gas from simple hydrocarbons (also known as reforming), such as methane, have been available for many years. These processes routinely involve the use of a catalyst — a material that speeds up the reaction but is not consumed — to make the process economically feasible. However, the high sulfur and aromatic content of fuels such as diesel poses a major technical challenge, since these components can deactivate traditional reforming catalysts. No economically feasible reforming catalyst is available for converting heavy hydrocarbons, such as diesel and coal-based fuels, into hydrogen-rich synthesis gas for use in SOFC.

Technology developed at NETL has resulted in inventions, one for the use of pyrochlore catalysts in hydrocarbon reforming, which was patented this March, and the other for a method of optimizing the performance of pyrochlore catalysts for a given set of hydrocarbon reforming conditions (patent-

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pending). Together these inventions help overcome the limitations of current catalysts by efficiently reforming diesel fuel while maintaining thermal stability and resistance to sulfur, aromatics, and carbon formation. Pyrochlore catalysts are less expensive and longer-lasting compared to currently available heavy hydrocarbon reforming catalysts. Additionally, converting liquid fuels to hydrogen by using air as an oxidant rather than water (as do most commercially available catalysts) will benefit mobile fuel cells by decreasing weight, reducing operating size, and simplifying operation. The pyrochlore also has the ability to use varying amounts of both air and water, making them extremely flexible to system design and customer requirements.

The commercial potential of these inventions have recently been recognized through the execution of an exclusive licensing agreement with the newly formed Pyrochem Catalyst Corporation. This agreement marks the first time that an NETL-licensed technology has been used as a basis for the creation of a start-up company. Established with financial support from Pittsburgh-based Innovation Works, Pyrochem Catalyst's research and development activities will be headquartered in southwestern Pennsylvania. The successful commercialization of pyrochlore-type catalysts for reforming hydrocarbon fuels may lead to the creation of high-technology jobs in the region. Work at Pyrochem Catalyst will initially focus on further developing pyrochlore catalysts for use in fuel cell APUs to provide non-propulsion power for vehicles, including long-haul truck transport, and to supply power in several military power applications.

A "monolith" reactor for reforming hydrocarbon-based fuels. The reactor is created by depositing NETL's novel pyrochlore catalyst on a honeycombed alumina structure. The catalyst converts heavy hydrocarbons, such as diesel and coal-based fuels, into hydrogen-rich synthesis gas for use in fuel cells and other applications.

The technology will also be developed for use in distributed or onsite electricity generation, which is inherently efficient since the electricity is generated near the point of use, reducing energy loss due to transmission. Collaborative efforts between Pyrochem Catalyst, NETL and multiple catalyst manufacturers are ongoing for catalyst evaluation and market application studies. Delphi, a fuel cell manufacturer, is in the testing stage for assessing suitability of the catalyst for ultimate incorporation into their near-commercial APU fuel cell systems. Other fuel cell manufacturers are also evaluating the catalyst technology.

Developing stable catalysts to convert diesel fuel to hydrogen is an important advancement in the implementation of fuel cells in areas such as stationary power generation and transportation. The ability to produce hydrogen at the diesel source point will allow for more efficient and economical generation of hydrogen and lead to greater adoption of fuel cell technology. The use of pyrochlore catalysts in conjunction with hydrogen-based fuel cell APUs will reduce the economic and environmental costs of diesel engine idling. Significant monetary savings will be realized through decreased fuel consumption and extended engine life. Environmentally, reduced diesel usage will result in lower emissions of oxides and particulate matter, which has now become more important with the advent of new anti-idling regulations.

RECS Training Program Now Accepting Applications

The Research Experience in Carbon Sequestration (RECS) initiative, supported by the Office of Fossil Energy and NETL, is currently accepting applications for its 2012 program. RECS is a collaboration between EnTech Strategies, Southern Company and SECARB-Ed, and is scheduled for June 3-13, in Birmingham, Alabama.

An intensive science and field-based program, RECS 2012 will combine background briefings with group exercises and field activities at an integrated CCUS project, and visits to a power plant, core laboratory and the National Carbon Capture Center. RECS faculty is comprised of globally recognized scientists and industry leaders, including Dr. Howard Herzog of the Massachusetts Institute of Technology (MIT) as the keynote speaker.

To learn more about the program and to apply, visit http://www.recsco2.org/. The deadline to apply is April 15, 2012.

SPR Degas Plant Provides Safe Oil Deliveries

The mission of the Strategic Petroleum Reserve (SPR) is to store petroleum to reduce the adverse impact of a major petroleum supply interruption to the United States and to carry out obligations under the International Energy Program. Storing crude oil in man-made underground, solution-mined salt caverns 2,000 to 4,000 feet deep requires careful planning and close monitoring of the properties of the crude oil.

Long-term storage of crude oil in salt caverns results in gradual geothermal heating that raises the temperature of the oil from approximately 80°F when it is delivered to the cavern, to a range between 110°F and 130°F over time. In addition, because of operational activities that include occasional injection of raw water into the cavern, gasses encapsulated in the salt are released and absorbed into the oil while stored. Naturally occurring methane gas may also migrate into the cavern through the salt matrix or through discontinuities.

As long as the crude oil stock is drawn down in five year cycles, as was the assumption when originally designed, the concern over crude oil vapor pressure risk is significantly mitigated. However, historically the drawdowns of stocked crude oil have been less frequent than envisioned, which creates a concern about the volatility of the stored oil when removed from the caverns.

The SPR's gaseous oil problem was first identified in 1992 during routine cavern oil sampling. When oil is removed from the caverns and delivered to atmospheric conditions, such as an above ground storage tank, those new conditions initiate the release of noxious gasses (also known as flashing off) into the atmosphere at potentially unacceptable quantities and concentrations. These flashes could produce clouds of gasses that would pose environmental, safety and health risks when the oil is delivered to above ground commercial storage terminals. In order to ensure safe delivery of the crude oil, the SPR monitors gas content in the crude oil.

The SPR has received several awards for pollution prevention by using the degas plant to reduce emissions. In 2009, the SPR received the National Pollution Prevention Roundtable Most Valuable Pollution Prevention Award and the National Registry of Environmental Professionals Significant Contribution to Environmental Knowledge. In 2005, the SPR received the White House Closing the Circle Environmental Honorable Mention Award for Preventing Downstream Emissions through Sustainable Product Stewardship and the DOE Pollution Prevention Star Award.

The SPR's first degas program, Degas I, operated from 1995 to 1997.

Since this discovery, the SPR has employed three basic strategies to reduce risks by limiting the release of these gasses during oil deliveries. These processes are referred to as cooling, degassing and blending. For example, the cooling process utilizes heat exchangers to lower the temperature of the heated oil between 90°F to 95°F. That partially mitigates the problem, but to avoid flash offs, a portable, modular degasification unit (degas plant) is also used to reduce the vapor pressure of the oil prior to exposing it to atmospheric conditions.

After installing the degas plant at a site, the plant processes crude oil to extract unwanted gasses and returns the oil to storage. A defined amount of oil is treated to ensure that when an entire crude oil stream is delivered, the treated oil and untreated oil have been blended together in a combined stream that can be delivered safely.

The SPR's first degas program, Degas I, used two leased, transportable plants to degas approximately 172 million barrels of oil stored in 22 caverns spread across the SPR's four storage facilities. Degas I processing occurred between July 1995 and December 1997. The SPR inventory at that time was 591 million barrels and the oil was conditioned for safe delivery. With continuous operations and an increase in inventory of 79 million barrels since the conclusion of Degas I, it became evident in 2004 that the degas program would need to resume. The SPR's total inventory had reached 670 million barrels.

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Recognizing that degassing would become a continuous operation, the SPR determined that long-term cost savings could be realized by owning, rather than leasing, a portable degas plant that could be rotated among all four SPR sites every three to four years. After comprehensive analysis, planning, design, and construction, Degas II was placed into service at the Big Hill storage facility in Winnie, Texas. Degas II is capable of processing up to 150,000 Standard Barrels Per Day.

Degas operations at Big Hill were completed in October 2006. The plant had processed approximately 110 million barrels of crude oil from nine storage caverns and effectively lowered the vapor pressure to acceptable limits. Once the degas operations were completed at Big Hill, the plant was purged, dismantled, refurbished, and finally transported to the Bryan Mound storage facility in Freeport, Texas, where it was re-assembled.

In August 2007, crude oil was introduced into the Degas II plant at Bryan Mound. After processing approximately 150 million barrels from 11 caverns, degas operations were completed in February 2011 and the plant was decommissioned. The next planned degas operations will be at the West Hackberry, Louisiana site.

To date, the SPR has incurred approximately $20.5 million in capital cost associated with the degas plant, and approximately $0.10 per barrel in operating cost. As a result of the plant's performance, sweet crude oil bubble point pressures have been reduced from an average of 19.9 psia pre-degas to an average of 13.2 psia post degas, and sour crude oil bubble point pressures have been reduced on average from 19.5 psia to 12.0 psia.

The Degas II plant being disassembled for movement to another SPR location.

Since the Degas II plant became operational, an additional 56 million barrels have been added to the SPR inventory, which filled the reserve to its authorized capacity of 726.5 million barrels in December 2009. The sale of 30 million barrels during July-August 2011, directed by the President as part of the International Energy Agency collective action, has reduced the inventory, but continued treatment of SPR crude oil remains a critical component to safe deliveries during future drawdowns.

Remote Gas Well Monitoring Technology Applied to Marcellus Shale Site

System to Monitor Environmental Conditions Developed with Department of Energy Funding

A technology to remotely monitor conditions at energy-rich Marcellus Shale gas wells to help insure compliance with environmental requirements has been developed through a research partnership funded by the Department of Energy.

The technology – which involves three wireless monitoring modules to measure volatile organic compounds, dust, light and sound – is currently being tested at a Marcellus Shale drilling site in Washington County, Pennsylvania. It was developed by Dr. Michael McCawley, a research associate professor in West Virginia University's Department of Community Medicine, as part of the National Energy Technology Laboratory's Regional University Alliance for Energy Technology Innovation (NETL-RUA).

Shale gas is natural gas trapped inside formations of shale, fine-grained sedimentary rocks that can be rich sources of petroleum and natural gas. Shale gas production, which has increased twelve-fold over the past decade according to the U.S. Energy Information Administration, is contributing to a rejuvenation of domestic natural gas supply.

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The Marcellus formation is a large shale deposit (estimated to be a third of the nation's recoverable resource) located in the subsurface beneath much of Ohio, West Virginia, Pennsylvania and New York, and smaller areas of Maryland, Kentucky, Tennessee and Virginia.

The project is significant because it streamlines a process to remotely monitor shale gas well drilling sites in areas where the terrain typically hinders monitoring and the lack of nearby power and phone lines makes traditional monitoring difficult. Having remote monitoring available becomes even more significant as the number of Marcellus Shale gas wells in West Virginia proliferate.

Learn more about this project online at: http://www.fossil.energy.gov/news/techlines/2012/12006-Well_Monitoring_Technology_Applied.html.

Utility to Purchase Electricity from Innovative DOE-Supported Clean Coal Project

An innovative clean coal technology project in Texas will supply electricity to the largest municipally owned utility in the United States under a recently signed Power Purchase Agreement. Under the agreement – the first U.S. purchase by a utility of low-carbon power from a commercial-scale, coal-based power plant with carbon capture – CPS Energy of San Antonio will purchase approximately 200 megawatts (MW) of power from the Texas Clean Energy Project (TCEP).

The 400-MW TCEP plant is a first-of-its-kind Integrated Gasification Combined Cycle poly-generation facility believed to be the cleanest coal-fueled power plant operating anywhere in the world. The facility is capable of capturing 90 percent of the carbon dioxide (CO_2) it produces, as well as 99 percent of sulfur dioxide, 90 percent of nitrogen oxide, and 99 percent of mercury.

Gasification uses oxygen and steam at high pressures to convert coal into synthesis gas, also known as syngas, which is mainly a mixture of hydrogen and carbon monoxide. In a non-carbon-capture plant, the syngas is cleaned to remove impurities and sent to a gas turbine where it undergoes combustion to produce electricity. The hot flue gas from the gas turbine, containing CO_2, is used to generate steam, which is fed to a steam turbine to produce additional electricity and then vented to the atmosphere. This process is known as integrated gasification combined cycle (IGCC) because coal-fired gasification is integrated into a combined-cycle system that produces electricity from both the gas turbine and the steam turbine.

Compared to traditional power plants, IGCC offers many advantages, including increased power plant efficiency and resulting lower-cost electricity. Unlike conventional power plants that remove environmental contaminants from the large-volume nitrogen-containing flue gas after combustion, IGCC power plants remove contaminants before combustion. Because gasification plants operate at high pressure with oxygen instead of air, the volume of gas that has to be treated is nearly two orders of magnitude lower, making the removal of environmental contaminants much easier. In addition, CO_2 is much easier to capture and is produced at higher pressures than that from conventional power plants.

In the TCEP carbon capture plant, the carbon monoxide in the syngas will first be "shifted" to produce additional hydrogen and CO_2, cleaned of impurities, and then separated into pure streams of hydrogen and CO_2. The hydrogen will be combusted in an advanced combustion turbine, producing a carbon-free flue gas. Of the nearly 2.9 million metric tons of CO_2 that will be captured annually at the TCEP plant, approximately 83 percent will be used for enhanced oil recovery in the West Texas Permian Basin, a process that both prevents the greenhouse gas from entering the atmosphere and enables more oil to be produced from regional oilfields; the remainder will be to produce urea, a high value product. The production of a co-product in addition to electricity significantly improves the overall economics of the process.

TCEP was a third round selection under DOE's Clean Coal Power Initiative, a cost-shared collaboration between the Federal government and private industry aimed at stimulating investment in low-emission coal-based power generation technologies through successful commercial demonstrations. The $2.4 billion plant will receive $450 million in funding from the Clean Coal Power Initiative; of this, $211 million comes from the American Recovery and Reinvestment Act of 2009. The facility is expected to be fully operational in 2015.

Upcoming Events

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

May 15-17
Electric Power 2012
Baltimore, MD
FE Contact: Gene Kight, 301-903-2624

May 21-22
Eastern Coal Council 33rd Annual Conference
Kingsport, TN
FE Contact: Gene Kight, 301-903-2624

June 4-7
International Technical Conference on Clean Coal & Fuel Systems
Clearwater, FL
FE Contact: Gene Kight, 301-903-2624

June 30 - July 2
National Education Association's Annual Meeting
Washington, DC
FE Contact: Jenny Hakun, 202-586-5616

August 15-17
Coal-Gen 2012
Louisville, KY
FE Contact: Gene Kight, 301-903-2624

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Comments are welcome and may be submitted to the editor.