PTTC Partners with ASME for Energy Forum

At 20, PTTC has looked to continue its history of collaboration with other professional groups to benefit the oil and gas industry. Recently PTTC was asked to participate in the launch of the pilot ASME Shale Development and Hydraulic Fracturing Conference. Held in San Diego earlier this month, the conference was specifically designed to focus on shale development and the application of hydraulic fracturing for the recovery of natural gas and oil.

A connection was made last year between ASME and PTTC thanks to PTTC’s Chairman and West Coast regional director, Jerry Anderson, CCCOGP Executive Director. With plans for a southern California event, Anderson was anxious for PTTC to join ASME’s plans, and PTTC leadership participated in several months of discussions and planning with ASME. Anderson and PTTC’s Co-Executive Director, Jeremy Viscomi, attended the workshops and the conference, representing PTTC at the event. Viscomi said of the conference, “PTTC was very proud to come together with ASME for their first ever Energy Forum on Hydraulic Fracturing. We believe that their work in providing technical content for surface operations, combined with our subsurface fundamental short courses, is a recipe for growth of this important conference.”

Key ASME themes of the conference included providing attendees a direct focus and perspective on the suppliers, the hardware and the systems for both surface and subsurface operations. While there are many conferences that discuss subsurface aspects of the hydraulic fracturing process, very few actually address the supporting infrastructure required by industry. As part of the conference PTTC put together three workshops aimed at providing the subsurface essentials for attendees to provide a foundation for the remaining days of the conference.

The first PTTC workshop, titled Petroleum Geology for the Non-Geologist, was led by Dr. Jan Gillespie. This was designed to help non-geologists understand just what all these geologists are talking about! The group discussed why oil is found in some areas and not in others, what kinds of tools geologists use to assess the petroleum potential and petroleum reserves in an area, and what factors they consider when deciding where to drill. Also during the class, participants worked as part of a team of “geologists” that came up with several “prospects” for drilling.

PTTC workshop number two was called Methodology and Approaches for Drilling, Evaluation, Fracturing, and Completions in Unconventional Shale Resources. Led by instructors Jack Wiener and Donald Kundert, this course covered methodology and approaches for Unconventional Shale reservoir exploitation for drilling, formation evaluation, fracturing, and completion considerations. Participants learned that the methodology and approach for a specific shale play may not be applicable to the entire shale play regionally. They explored how each regional shale has mineralogical, depositional, and maturity considerations that require considerations for successful exploitation.

Finally, workshop three entitled Rock Mechanics for Fracturing Applications led by Dr. Neil Nagel featured a discussion about critical geomechanical aspects of formation characterization and completion optimization for shale and other unconventional developments. The group learned that it is well-known that geomechanics plays a critical role in the understanding and development of many unconventional reservoirs—chiefly due to the complicated and variable impact of natural fractures on well stimulation and production.

Overall the short courses were well received and PTTC is looking forward to working with everyone at ASME once again as we begin planning next year’s conference. For information on upcoming PTTC events, take a look inside this edition of Network News, with a focus on Unconventional Resources.
horizontal drilling and hydraulic fracturing. The summary of a presentation given in January in Denver (see pages 4-5) provides some interesting statistics on the impact of unconventional resource plays. Modern Shale Gas Development in the United States: an Update by GWPC and DOE (see page 8) is reviewed.

Benefits from the rapidly expanded unconventional resource plays have directly affected many communities by providing jobs, local, state, and federal taxes and royalties. The speed of development has left some communities reeling from the physical impact; and the need for road and community service improvements and expansions, and concerns over protection of the environment. How individual communities and states have responded to the challenges reflects their willingness to accept change and embrace new developments. In North Dakota the Bakken play has generated whole new service industries built up around all the people needed to produce the oil. The enthusiasm in North Dakota is spontaneous and the positive impact on jobs and the economy is remarkable. State officials in North Dakota have acted in a responsible manner by encouraging drilling and hydraulic fracturing, but by maintaining control and advocating planning, state regulations and resource management.

In the more populous eastern states the reaction of the public has been more divided, with some communities in Pennsylvania, West Virginia and Ohio thrilled with the economic benefits of the Marcellus and Utica shales and other communities in Pennsylvania and New York strongly opposed to drilling. Much of the protests in Pennsylvania and the moratorium on drilling in New York have resulted from often misguided efforts to show all drilling and hydraulic fracturing as harmful to the environment. Both state and federal agencies in West Virginia and Pennsylvania are addressing environmental concerns over development of the Marcellus, and a review of the newest regulations to protect water resources was presented in a recent PTTC workshop in West Virginia (summarized pages 6-7).

Mature basins, like the Illinois and Michigan Basins, are also experiencing renewed drilling interest in conventional and unconventional plays. PTTC workshops on the Mississippi lime play in Illinois and the Devonian Carbonate play in Michigan (see page 6) were held in early March in Evansville, Indiana and Mt. Pleasant, Michigan. In the Illinois Basin low porosities (3-4%) had discouraged exploration and development in the past. Audiences demonstrated a keen interest in evaluating these late Paleozoic carbonate reservoirs.\*
Is the oil and natural gas industry on the cusp of another step-change in resource development as unconventional oil and gas plays mature?

What’s the potential EUR for Bakken, Eagle Ford, and other shale wells?

What are the best EOR processes to deploy in the vast emerging shale and tight sands plays?

How will reservoirs subjected to huge multi-stage frac jobs respond to tertiary recovery methods?

What are the prospects for CO₂ EOR with carbon sequestration in unconventional plays?

How can water treating/handling best practices developed for EOR projects transfer to these new unconventional resource developments?

Get answers to these questions and learn even more about all the cutting-edge IOR and EOR technologies at the 19th Improved Oil Recovery Symposium, April 12-16, 2014, in Tulsa, Okla. Sponsored by the Mid-Continent Section of SPE since 1978, this biennial conference of the world’s leading experts in improved oil recovery and enhanced oil recovery is the largest gathering of its kind anywhere in the world.

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Join us at the 19th IOR Symposium in Tulsa on April 12–16, 2014, to learn about the latest advances and best practices and network with the top experts in IOR and EOR technology.

EXPLORE THE POSSIBILITIES AT IOR 2014:

Register Now at www.speior.org/registration.asp
March 2014

West Coast Region

The West Coast PTTC program has provided seven workshops year to date and coordinating nine additional workshops for 2014. The program is administered by Jerry Anderson, the West Coast PTTC director and Chairman of PTTC, and Dan Tuttle the training coordinator. Full day workshops are held throughout California in locations as Sacramento, Bakersfield, Ventura and Long Beach. The programs are well attended with individuals from oil and gas companies, regulatory agencies, consultants, and service providers.

FUNDAMENTALS OF WELL COMPLETIONS will be held on April 1 in Long Beach and April 3 in Bakersfield. In petroleum production, completion is the process of making a well ready for production. Understanding the completions process is important for many non-technical professionals working within the oil and gas industry. This course is intended for individuals with little to no prior completions knowledge who will benefit from learning more about the completions process. Different types of completion design will be covered, including open-hole, perforated, gravel packed, fractured, and more. Attendees will leave the course with a basic understanding of wellbore and completion equipment and methods. The course will also address topics such as completion fluids, stimulation, and testing methods.

WELLBORE INTEGRITY THROUGHOUT ITS LIFE CYCLE will be held on August 19 in Long Beach and August 20 in Bakersfield. This course will focus on two critical components of well integrity – CASING DESIGN and CEMENTING. Key aspects of casing design will be discussed so that the course attendees can gain a good understanding on why a good casing design is critical in ensuring that the well retains its structural integrity throughout its life cycle. The importance of obtaining a good primary cement job will also be covered including good cementing practices and evaluation including current cement bond logging techniques – ultra sonic imaging tool (USIT), circumferential acoustic scanning tool (CAST) and segmented bond tool (SBT) in addition to the conventional CBL/VDL techniques. Well integrity considerations for hydraulically fractured wells will also be covered in the course. NOTE: It is not a primary objective of this course to have the attendees become experts in Casing Design and Cementing, and in interpretation of cement bond logging techniques, but rather enable them to have a strong and clear understanding of these two critical well integrity components.

Other workshops being developed for 2014 include Wellbore Diagram Training (May), Designing and Operating Waterfloods (July), Drilling Engineering (September), Casing Design (October) and Thermal Operations.

As we move forward in our planning for future workshops, we are utilizing suggestions to schedule workshops and providing quality instruction to the petroleum industry and related agencies.

Rocky Mountain Region

The Unconventional Oil & Gas Revolution: Another Look under the Hood by Mike Seal

This talk was presented at the monthly RMAG luncheon in January, 2014 by Pete Stark, IHS Senior Research Director and Advisor. Dr. Stark holds a BS degree in geology from the University of Oklahoma, and MS and PhD degrees in geology from the University of Wisconsin.

Discoveries of unconventional shale plays may be declining in the USA, but IHS has identified 134 plays worldwide outside the USA with the potential of 279 billion barrels of recoverable oil. US shale reservoirs could represent 47 billion barrels of recoverable oil. There has been a slump in conventional discoveries worldwide over the past three years, with no discoveries greater than one billion barrels of oil equivalent in 2013 and fewer than 400 total discoveries outside the USA. This situation is comparable to the 1970s. OPEC’s spare capacity is 2.19 million barrels per day, which is the lowest since 2007. Without shale oil in North America, the price for crude would be $140 per barrel.

The nature of drilling activity has changed significantly with the average number of rigs drilling for gas dropping from 1708 in 2008 to 274 in 2013 reflecting the decrease in gas prices triggered by excess production. Gas production in the USA was 26 Tcf in 2013, which is a new record. Gas production from the Marcellus Shale in the northeast US was expected to hit 12 Bcf/day in early 2014. Dr. Stark had mentioned in earlier talks that he thought that 600 gas rigs would be necessary to maintain production, but this might no longer be the case. Gas production associated with NGL’s from the Marcellus and other plays is propping up supply and operators’ increased efficiency is also helping. He said that gas production from the Marcellus could be profitable at less than $3/Mcf. Production from the Marcellus is displacing conventional production, notably production from the Rockies and Gulf Coast.

Regarding the demand growth that is necessary to use this 68-90 Bcf/day of gas supply, power generation has the most potential and unconventional gas has displaced 10 Bcf/day of imports and coal plants have been shut down. Petrochemicals could add $50 billion per year to the GDP in the future as the USA has a big price advantage. Natural gas vehicles offer some hope, but it will be difficult to scale up. Proposed LNG exports could use up to 8 Bcf/day by 2020.

With oil production, the production of tight oil could go beyond 4 million barrels per day by 2020. The Eagle Ford, Bakken – Three Forks, and the Permian are currently providing most of the growth in U.S. tight oil. The combination of Niobrara, Mississippi Lime, Granite Wash (and Oklahoma cousins), Wasatch, Tuscaloosa Marine, and Utica will allow the continuation of this growth. From IHS analysis, only 15% of the available economic
locations in the Eagle Ford have been drilled so far. In the past three years one million barrels per year production growth has been reached. Only Iraq and Saudi Arabia have achieved this yearly increase in the past. The current recovery levels of 3-5% of oil in place needs to rise to 15-20%.

A total of $125 billion and $90 billion have been invested in midstream and downstream infrastructure respectively. 47,000 thousand miles of new and refurbished pipeline has been built and 2.1 million jobs were generated in 2012, a number expected to rise to 4 million by 2025. The unconventional oil and gas revolution delivered $75 billion in federal and state taxes and $283 billion to US GDP during 2012 alone. In 2012 this industry produced $1,200 more disposable income to individuals in the USA due to reduced fuel costs. This number is expected to rise to $3,500 by 2025. $553 billion could be added to the US GDP by 2025.

Author’s note: There is a caveat to this increased energy supply. Although it has been helpful to the economy and consumers, energy production in general is becoming expensive and oil companies have not benefited correspondingly. The Financial Times reports that Exxon-Mobil and Chevron’s share prices have both increased by 11% over the past three years, while the S&P 500 Index rose more than 40%. Companies are coming under mounting pressure from shareholders to cut costs and increase efficiency. John Watson, the chief executive for Chevron, said at the recent IHS CERAWeek Conference in Houston that industry costs have doubled over the past ten years, and that break-even prices for new projects could be over $100 per barrel. Chevron provided a chart showing that US shale production needed $65-85 per barrel to break-even, while projects in the Canadian tar sands needed up to $100 and deepwater up to $110 per barrel.

Midcontinent Region

The last quarter has been busy in the Midcontinent. In December KU TORP in conjunction with PTTC hosted a workshop entitled Mississippi Lime: Lessons learned & and what you need to know to make this play work for you. Day one featured speakers who have been working in this key area and discussed the overall impact of the play, making the Mississippian economical, production geology, and techniques aimed at staying in that complex pay zone. Day two focused on engineering, completions, and technology with applications in the region.

In February PTTC hosted a one-day course in Houston entitled Horizontal Completions Made Simple. Attendees from around the region listened as Jeff Chestnut from Tryton Tools delivered the essentials of horizontal completion technology.

Finally in early March KU TORP in conjunction with PTTC provided operators in Wichita with two days of courses discussing how to save power in old fields and artificial lift. During day one Mike Paik discussed common sense ways to reduce your power cost in the field. Techniques included having a basic understanding of your power bill, developing a relationship with your power provider, making changes in the office, making changes in the field, and finally technologies aimed at helping save power. Day two featured expert speakers Russell Stevens from Shores Lift Solutions and Allen Miller from Miller Pump systems. Stevens discussed rod lift systems, rod design, and optimization. Miller then spent the afternoon talking about progressive cavity pumps and how to evaluate where and when these pumps will work effectively.

Coming up on April 24-25, the Midcontinent will host Common Sense Economics for Oil and Gas in Houston, Texas and then in May KU TORP in conjunction with PTTC will be hosting a Mississippi lime outcrop field trip departing and returning from Rogers, Arkansas. For more information about these events please visit [www.pttc.org](http://www.pttc.org).
The Midwest PTTC workshop, “Everything Old is New Again: Middle Mississippian Opportunities in the Illinois Basin,” was held on March 5, 2014 in Evansville, Indiana. The March workshop annually precedes the Illinois Oil and Gas Association Annual Meeting, and is commonly a sold-out event. This year’s timely program, on the current hottest play in the basin, reached all-time high registration numbers with 193 registrants.

The Middle Mississippian play in the Illinois Basin has evolved rapidly, as companies have applied lessons learned in developing and re-evaluating carbonates in the St. Louis, Salem, Ullin/“Warsaw”/Harrodsburg and Fort Payne formations. Chasing lower porosity pays, once thought to be unproducible at porosities as low as 3 to 4%, and applying strategic hydraulic fracture treatments has unlocked new pay and along with deeper drilling, has led to new discoveries and extensions of production in the Illinois Basin in recent years.

Speakers from The Discovery Group (Bob Cluff, Daniel Hallau, and Ryan Sharma), from the Indiana Geological Survey (Brian Keith) and Illinois State Geological Survey (Zak Lasemi), and industry (Jeff Hoy, J LH Consulting and Jerry Robinson, Franklin Well Services) offered their experiences in defining the target through regional outcrop and subsurface studies, log assessment and newer treatment strategies. A wrap-up Round Table question and answer session led to lively discussions, sharing of experiences, and challenging new ideas. The popular Round Table wrap-up session included workshop speakers and local company participants (Scott Beatty of Citation, Tom Nichols, Petroleum Engineer and lead of Nichols Operating, and Tom Partin, exploration and consulting geologist.)

The distinctive Illinois Basin “Miss Lime” play is attractive on many levels, with re-evaluation of deeper or held-by-production acreage by existing companies, and new extension or exploration models that are attractive to newcomers to the Illinois Basin—representing rare opportunities in a mature basin such as ours. Thanks to our speakers for their generosity in creating an excellent program, and thanks to everyone for their support of Midwest PTTC; we drew on a local crowd as well as having a strong showing from out-of-state companies that heard about us on the national PTTC calendar. Watch your national PTTC calendar for upcoming information on materials and resources related to Illinois Basin “Miss Lime.” Questions? Contact Joan Crockett, Director, Midwest PTTC at the Illinois State Geological Survey, Prairie Research Institute, located on the campus of the University of Illinois, at crockett@illinois.edu or at (217) 333-6630.

The Michigan Basin Field Experiences and Devonian Carbonate Reservoir Core Workshop held March 20, 2014 had a record-breaking attendance of 228. The workshop was jointly sponsored by the Michigan PTTC Satellite at the Michigan Geological Repository for Research and Education, Geoscience Department, Western Michigan University and the Michigan Oil and Gas Association. The workshop was held in Mt. Pleasant, Michigan at the Soaring Eagle Casino & Resort.

Six industry members made presentations in the morning: Adam Wygant, Office of Oil, Gas and Minerals (MDEQ): Robert D. Lopiccolo, Peace River Group, LLC.; Dennis and Paul Schmude, Schmude Oil and Gary L. Jones HIS Kingdom Software; Timothy J. Brock, Brock Engineering, LLC.; Craig Donha and Chris Dennen, Merit Energy; and Bill Quinlan, Jordan Exploration Company, LLC. The afternoon program included the Devonian Carbonate Reservoir Core workshop by Dr. William Harrison (MGRRE), and Dr. Peter Voice (MGRRE). Six poster presentations about the cores, accompanied by a truckload of cores were presented. People really enjoyed the whole day.

Midwest PTTC’s upcoming event: RPSEA Onshore Production Conference: Illinois Basin and Surfactant Flooding will be held on April 30, 2014 in Evansville, Indiana. This event will feature presentations on current and recent RPSEA and DOE-sponsored research. We have solicited presentations with applications to mature basins such as the Illinois Basin, where improving recovery through technological advances is a key in tapping remaining resources. Watch the PTTC calendar for details, or contact Joan Crockett as detailed above.

The rapid development of the Marcellus Shale gas play in West Virginia (and Pennsylvania) led to many public concerns regarding the safety of drinking water and public health due to potential exposure to air-borne particles, noise and nighttime light. In response to these concerns, the West Virginia Legislature enacted the “Natural Gas Horizontal Well Control Act” on December 14, 2011. This act directed the West Virginia Department of Environmental Protection (WVDEP) to conduct several field-based studies to collect and analyze data and report their findings and recommendations to the Legislature. In particular, the following studies were directed by the new legislation:

**Well location restrictions:** The secretary shall, by December 31, 2012, report to the Legislature on the noise, light, dust and volatile organic compounds generated by the drilling of horizontal wells as they relate to the well location restrictions regarding occupied dwelling structures pursuant to this section. Upon finding, if any, by the secretary that the well location restrictions regarding occupied dwelling structures are inadequate or otherwise require alteration to address the items examined in the study required by this subsection, the secretary shall have the authority to propose...
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Disposal

Other upcoming Appalachian basin PTTC workshops will include the public.

Instead, a 625-foot setback is often a deterrent to development of the site and does not protect the public; good quality control and assurance protects the result of the study was that, again, poor quality control and quality assurance is the problem, and that a setback of any distance is not a key factor.

The study of air, light and noise was authorized to evaluate the validity of the 625-foot setback from the center of a well pad to an occupied dwelling.

near the pits and from surface streams, the team concluded that quality control of surface activities is the key – if problems occur, they will occur from that may occur will be from the formation, not from the chemistry of the frac fluid. Furthermore, following the study of water from monitoring wells that may occur are radioactive. The study of frac fluids, flowback water and produced water indicated that most of the contamination that may occur will be from the formation, not from the chemistry of the frac fluid. Furthermore, following the study of water from monitoring wells near the pits and from surface streams, the team concluded that quality control of surface activities is the key – if problems occur, they will occur from surface activities, not from what is being injected into the deep subsurface.

Most of the earlier public concerns were related to the safety of drinking water. More recently, concerns have been raised regarding solids and precipitates, especially those that may be radioactive. The study of frac fluids, flowback water and produced water indicated that most of the contamination that may occur will be from the formation, not from the chemistry of the frac fluid. Furthermore, following the study of water from monitoring wells near the pits and from surface streams, the team concluded that quality control of surface activities is the key – if problems occur, they will occur from surface activities, not from what is being injected into the deep subsurface.

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With regard to pits and impoundments, a key finding was that inspectors, both state and industry, were poorly trained and lacked the experience to properly inspect a site during and after pit/impoundment construction. The result was erosion of the slope, creating the potential for slips to develop, and uplift or tearing of the liner, creating the potential for leakage.

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The study of air, light and noise was authorized to evaluate the validity of the 625-foot setback from the center of a well pad to an occupied dwelling. The result was that, again, poor quality control and quality assurance is the problem, and that a setback of any distance is not a key factor. Instead, a 625-foot setback is often a deterrent to development of the site and does not protect the public; good quality control and assurance protects the public.

Other upcoming Appalachian basin PTTC workshops will include NORM and TNORM: Occurrence, Analysis Methods, Monitoring, Handling and Disposal workshop on May 11, in Columbus, Ohio and Geochemistry of Shale Gas workshop on June 5 in Pittsburg, Pennsylvania. Watch for announcements from your local AAPG-affiliated geological society, SPE chapter, IOGA, university or government agency, all of whom are members of our e-mail distribution network.

Network News March 2014
Shale Gas Development in the U.S.

In September 2013, NETL released a 79-page document, Modern Shale Gas Development in the United States: an Update. The publication was prepared by the Ground Water Protection Council (GWPC) with ALL Consulting serving as lead researcher. Additional information was provided by NETL’s Strategic Center for Natural Gas and Oil with assistance from Leonardo Technologies Inc. Funding was provided by the U.S. Department of Energy, Office of Fossil Energy, National Energy Technology Laboratory (NETL) for the update of the previous Primer on Modern Shale Development in the United States published by GWPC.

Statistics by DOE’s Energy Information Agency show that fossil fuels supply about 84% of the nation’s energy, with natural gas supplying about 27% of the total energy consumed. EIA estimates that the U.S. contains over “1,864 trillion cubic feet (tcf) of technically recoverable natural gas (wet gas volume, including natural gas liquids), including 318 tcf of proved reserves (the discovered, economically recoverable fraction of the original gas-in-place).” Based on data collected through the end of 2012, the future recovery of natural gas is estimated at 2,689 tcf. Shale gas represents 1,073 tcf of the future recovery potential. The EIA estimates that gas supply will continue to increase at 1.3% per year and supply will pass demand by 2019, making the U.S. a net exporter of natural gas. IHS Global Insight report for 2012 is even more optimistic than EIS’s statistics, predicting the growth in natural gas production will reach 60 Bcf/d by 2015, compared to EIA’s 2013 projection of 42 Bcf/d.

The dramatic increase in shale gas production in the past decade has been the result of improved technologies in drilling and hydraulic fracturing that have allowed new shale plays to be discovered. Unconventional plays including shale gas and oil and tight sands have been impacted by these technologies to the extent that “The unconventional has become the conventional.” A map overlying the shale plays on U.S. basins reveals the broad extent of shale gas development. From the original discovery of the Barnett Shale in north Texas to the enormous extent of the Marcellus Shale in the Appalachian Basin, shale plays have been found in most U.S. basins including the Michigan Basin, Williston Basin, Green River Basin, Denver Basin, Permian Basin, South Texas, the Texas-Louisiana-Mississippi Salt Basin and the Midcontinent Oklahoma, Arkansas and Kansas region, and many smaller, but equally important basins across the country. Play names including Barnett, Marcellus, Antrim, Bakken, Niobrara, Fayetteville, Woodford, Eagle Ford, Haynesville-Bossier, Bone Spring and Monterey are becoming well known to the public as a source of new jobs, and local and regional growth and economic recovery. Shale plays are developing so rapidly that new plays like the Utica Shale in Ohio barely appear on EIS’s 2012 map.

The history of shale gas discoveries is reviewed starting with Mitchell Energy’s first attempts to develop the Barnett Shale in the 1980’s and the expansion of the Barnett in the 1990’s. Horizontal drilling and later advances in hydraulic fracturing were the key to success in shale plays. Geologically the clay sized particles that compose shales were deposited in quiet water energy environments including tidal flats and deep water basins both marine and lacustrine. These extensive shales had been known as the source of conventional oil and gas exploration, but it took a revolution in technology to turn source rocks into reservoirs.

The varied nature of the depositional environment (continental to deep marine) in basins across the U.S. and the wide range in age from lower Paleozoic to Cenozoic results in shale plays that each have unique characteristics and challenges for production. Water availability and regional and local topography and environmental conditions have played a major part in the development of the shale gas plays from South Texas to the Appalachian Basin and from the northern Rockies to southern California.

The report provides numerous statistics and descriptions from all the U.S. shale gas plays, and well distribution maps and geographic maps of the geologic facies for twelve of the major plays. Regional analysis covers economic factors and environmental impacts for individual plays. The report reviews drilling and completion practices and discusses how they vary from play to play and impact ultimate success for shale gas recovery.

The report ends with a review of regulatory practices, which vary greatly from state to state. Federal and State efforts to regulate water usage and protect the environment have encouraged industry to develop technologies and strategies to meet the challenges of responsible development. “Regulation of shale gas development is complicated and evolving.” The speed of discovery and development of shale gas has resulted in some problems and difficulties for local communities and local, state and federal agencies, which are being addressed. Public perception of how development and regulation are managed and controlled continues to be a hot topic in some states. In general states that had extensive conventional oil and gas development have been more receptive to the expansion of unconventional resources and shale plays than states where petroleum was not previously an important contribution to the state’s economy. The report provides a wealth of information in a concise manner and is excellently illustrated. To download the report, go to www.netl.doe.gov/File%20Library/Research/Oil-Gas/shale-gas-primer-update-2013.pdf.
NETL Receives 15 Patents in 2013

Researchers at DOE’s National Energy Technology Laboratory received 15 patents in 2013 for innovative technologies ranging from membrane separation of hydrogen from gas mixtures to a process for the rapid formation of gas hydrates.

• **Cu-Pd-M Hydrogen Separation Membranes** (U.S. patent 8,608,829) - a process to separate hydrogen from gas mixtures to facilitate the use of hydrogen as a chemical feedstock and fuel.

• **Fabrication of Fiber Supported Ionic Liquids and Methods of Use** (U.S. patent 8,383,026) — a method for polymer separation based on a dry-wet spinning process for producing a fabricated fiber composed of a porous polymer network and an immobilized liquid within the pores.

• **Active Combustion Flow Modulation Valve** (U.S. patent 8,540,209) — development of throttle valves to control the flow of fluids, designed to modulate fluid flow at high speeds in response to an externally supplied control signal.

• **Method of Particle Trajectory Recognition in Particle Flows of High Particle Concentration Using a Candidate Trajectory Tree Process with Variable Search Areas** (U.S. patent 8,391,552)

• **Process for CO₂ Capture Using a Regenerable Magnesium Hydroxide Sorbent** (U.S. patent 8,470,276) — the process uses a magnesium hydroxide sorbent to separate CO₂ from a gas stream.

• **Regenerable Sorbent Technique for Capturing CO₂ Using Immobilized Amine Sorbents** (U.S. patent 8,500,854) — this technology provides an absorption method that uses an amine-based solid sorbent to remove CO₂ from a gas stream.

• **Regenerable Solid Imine Sorbents** (U.S. patent 8,530,375) — this patent describes two new classes of amine-based sorbents—polymers-immobilized tertiary amines and polymer-bound tertiary amines—that can serve as sorbents for the removal of CO₂ and other acid anhydrides from any effluent stream.

• **Minimization of Steam Requirements and Enhancement of Water-Gas Shift Reaction with Warm Gas Temperature CO₂ Removal** (U.S. patent 8,617,499) — This process uses a hydroxide sorbent to treat a gas stream composed of carbon monoxide and CO₂ before it enters a water-gas-shift reactor.

• **Method of Producing an Oxide Dispersion Strengthened Coating and Micro-channels** (U.S. patent 8,609,187) — provides mechanical alloying used to synthesize a variety of alloys starting from blended powders.


• **Method of Preparing and Utilizing a Catalyst System for an Oxidation Process on a Gaseous Hydrocarbon Stream** (U.S. patent 8,486,301) — preparation of catalysts for lean combustion.

• **Transpiration Purging Access Probe for Particulate Laden or Hazardous Environments** (U.S. patent 8,596,798) — provides an effective means to control particulate-laden flows or other hazardous environments.

• **Fly Ash Carbon Passivation** (U.S. patent 8,440,015) — for efficient combustion of fly ash in coal-fired boilers.

• **Radial Flow Pulse Jet Mixer** (U.S. patent 8,469,583) — developed mixing processes to make heterogeneous physical systems more homogenous.

• **Nanocomposite Thin Films for High Temperature Optical Gas Sensing of Hydrogen** (U.S. patent 8,411,275) — a method for sensing hydrogen in a gas stream at temperatures greater than 500 degrees Celsius.