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The Basin Initiative

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The Basin Initiative
Shale Gas Assessment: A Regulatory Perspective

Topical Report

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Abstract

As part of a cooperative agreement with the U.S. Department of Energy National Energy Technology Laboratory, the IOGCC has been tasked with preparing a "regional/basin oriented examination of underdeveloped oil and natural gas resources." The project includes the identification of up to three multi-state basins to assess and the formation of work groups to assess resources and strategies to increase U.S. oil and gas supplies while accomplishing regional economic and environmental goals.

Preliminary analyses by the IOGCC determined that the most critical basins to examine were associated with shale gas development. In February 2009, The IOGCC formed the Shale Gas Directors' Task Force, comprised of the regulating officials from 17 shale-producing states, to assist with project research and analyses. This report is the result of the Task Force's efforts.

Included in this assessment are (1) the identification of challenges and opportunities to for states to support and encourage the efficient recovery of shale gas while protecting health, safety and the environment; and (2) the exploration of state initiatives and state-industry partnerships to address policy goals; and (3) outreach and educational materials prepared by the task force in response to the assessment.

The assessment incorporates input and information about shale-gas producing states across the nation. Regional activities and efforts focused around the three major shale gas plays – Barnett, Marcellus, and Fayetteville.

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Executive Summary

Advances in technology are unlocking the potential of shale gas in the United States. Horizontal drilling is leading to production in shale formations once thought to be inaccessible. Member states of the IOGCC understand the importance of shale gas for domestic production and continue to be good stewards of this new resource.

A key factor to the timely, environmentally sound production of oil and natural gas resources is the coordination of efforts among many different players. While many entities have sought to address individual factors affecting their industry segment through education and outreach, to date there have been no organized initiatives that address both inter- and intra-state barriers from a regulatory perspective.

As part of a cooperative agreement with the U.S. Department of Energy National Energy Technology Laboratory, the IOGCC has been tasked with preparing a "regional/basin oriented examination of underdeveloped oil and natural gas resources." The project includes the identification of up to three multi-state basins to assess and the formation of work groups to assess resources and strategies to increase U.S. oil and gas supplies while accomplishing regional economic and environmental goals.

Preliminary analyses by the IOGCC determined that the most critical basins to examine were associated with shale gas development. In February 2009, The IOGCC formed the Shale Gas Directors' Task Force, comprised of the regulating officials from 17 shale-producing states, to assist with project research and analyses.

Key challenges identified by the Shale Gas Directors' Task Force included the areas of market fluctuations, public perception, urban and frontier development, regulatory challenges, water management, inter- and intra-state cooperation and infrastructure.

The most influential and critical challenge facing regulators of shale gas development is public perception, particularly when it comes to the process of hydraulic fracturing. A majority of states expressed that public perception is a major barrier for future development. Identified areas include, but are not limited to, chemical composition of fracking fluid, development in previously unexplored areas, water use, storage and recycling issues, environmental footprints, and protection.

Regulatory processes are designed to protect health, safety and the environment. Communicating the effectiveness of these processes – to U.S. citizens, policy makers and lawmakers – is the greatest challenge and opportunity for the regulating community.

The answer is simple but not easy – the establishment of a proactive public outreach mechanism that objectively educates citizens about the effectiveness of state regulators. Once established, it will be important to maintain an ongoing informational resource for inquiries --from media, general interest, industry, etc. -- about up-to-date regulatory practices, rulings and monitoring activity.

The IOGCC, through its collaborative structure among oil and natural gas producing state regulators, is the catalyst for implementing such a communications system. Although state regulatory agencies operate independently, our collaborative compact is a foundational structure from which dissemination of shared disciplines, information and techniques - being effectively applied in various regulatory processes and procedures - can be expanded. Proactively employing this outreach -- while providing passive access to a centralized communications hub containing updated facts and findings -- leverages and enhances the credibility and authority of the state regulatory community.

Experimental Methods

The data for this study were gathered through informal surveys, letters, personal interviews, site visits, and published reports. Sources include government officials, regulatory agency employees, private oil and gas company owners and employees, oil and gas service-industry owners and employees, academics, trade publications, and government documents. Necessarily, much of the information is anecdotal and somewhat subjective. Statistics cited are identified by source. Estimates are based on published statistical evidence with the methodology and source identified.

In many instances, the actions of a particular state, or several states, are cited as examples of approaches to challenges faced by oil and gas development. It should be noted that in most of these cases, other oil- and gas-producing states are using similar approaches; the cited examples are deemed to be the most representative or inclusive.

The IOGCC Shale Gas Directors Task Force – comprised of the regulating officials in seventeen shale gas producing states – was formed and held its first meeting in February 2009. Directors identified challenges and opportunities facing shale gas states and discussed possible projects for development. This working group leads and directs research efforts of the Basin Initiative.

The task force includes regulating officials from existing, emergent and frontier shale basins across the U.S.

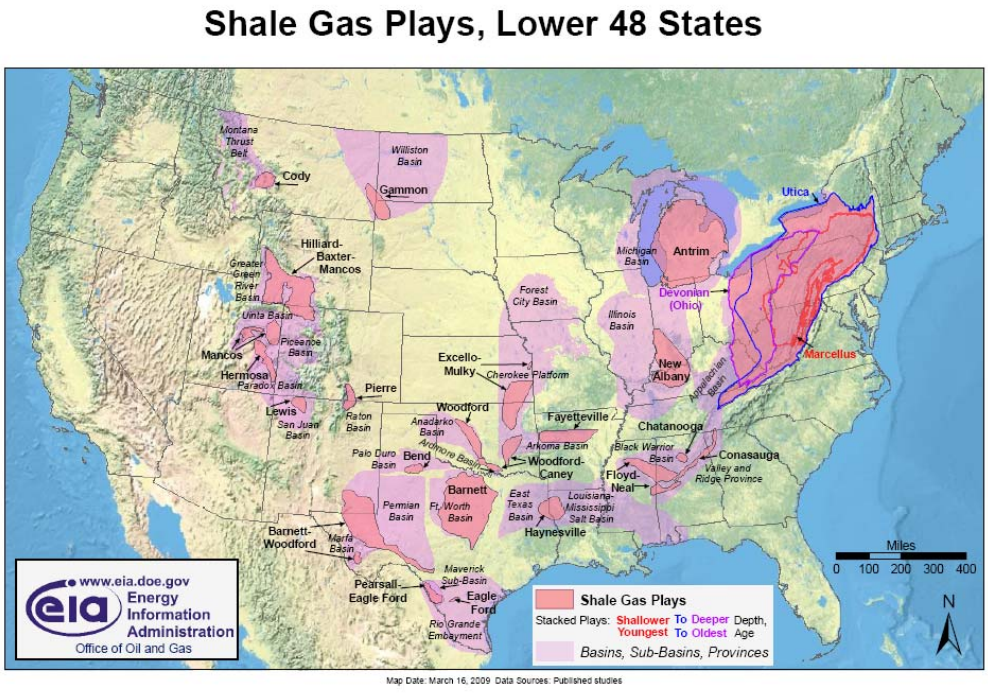

Figure 1. Shale Gas Plays, Energy Information Administration

Figure 2. Major Shale Gas Basins[1]

Existing	Ft. Worth – Barnett	Texas
	Michigan (Antrim)	Michigan
	Appalachian (Marcellus)	New York Ohio Pennsylvania West Virginia
Emerging	East Texas (Haynesville)	Louisiana Texas
	Permian	Texas
	Arkoma/Ardmore/Anadarko (Fayetteville and Woodford)	Arkansas Oklahoma Texas
	Illinois & Michigan	Illinois Indiana Kentucky Michigan
	Black Warrior	Alabama
	Williston	North Dakota
	Appalachian (Utica, Upper Devonian, Chattanooga)	New York Ohio Tennessee
	Palo Duro (Bend)	Texas
	Raton (Pierre)	Colorado New Mexico
Frontier	Permian – Woodford	Oklahoma Texas
	Green River	Colorado Utah Wyoming
	San Juan (Lewis)	Colorado New Mexico
	Denver (Niobrara)	Colorado Kansas Nebraska

[1] Identification of major basins based on EIA, USGS and CERA. Development categories are similar to RPSEA categories; shading denotes current RPSEA R&D priorities.

Figure 3. IOGCC Shale Gas Directors' Task Force, February 2009

STATE	SHALE	REPRESENTATIVE(S)
Alabama	Black Warrior	Berry "Nick" Tew, Oil and Gas Supervisor/Geologist, State Oil & Gas Board of Alabama
Arkansas	Arkoma/Ardmore/Anadarko	Lawrence E. Bengal, Director, Oil and Gas Commission
Colorado	Green River San Juan Denver	David Neslin, Director, Oil and Gas Conservation Commission
Illinois	Illinois & Michigan	Duane Pulliam, Acting Director, Office of Mines and Minerals, Division of Oil and Gas
Indiana	Illinois & Michigan	Brandon Seitz, Manager, Energy Division, Indiana Office of Energy and Defense Development
Kentucky	Appalachian Illinois & Michigan	Kim Collings, Director, Kentucky Department of Natural Resources, Division of Oil and Gas Conservation
Louisiana	East Texas	James Welsh, Commissioner of Conservation Jodee Bruyninckx, North Louisiana Director, Oil & Gas Association Jim Broussard, Shreveport District Manager
Michigan	Michigan	Harold R Fitch, Director, Office of Geological Survey Tom Godboldt, Supervisor, Field Operations Section Mike Bricker, Supervisor, Permitting & Technical Services Section
New York	Appalachian	Bradley J. Field, Director, Department of Environmental Conservation, Division of Mineral Resources
Ohio	Appalachian	Richard J. Simmers, North Region Manager, Division of Mineral Resources Management, Ohio Department of Natural Resources
Oklahoma	Arkoma/Ardmore/Anadarko Permian - Woodford	Lori Wrotenbery, Director, Oil and Gas Conservation Division, Oklahoma Corporation Commission
Pennsylvania	Appalachian	Ronald P. Gilius, Director, Bureau of Oil and Gas Management
Texas	Fort Worth East Texas Arkoma/Ardmore/Anadarko Permian	Tommie Seitz, Director, Oil and Gas Division, Railroad Commission of Texas

STATE	SHALE	REPRESENTATIVE(S)
	- Woodford	Charles Ross, Deputy Director, Field Operations, Oil and Gas Division, Railroad Commission of Texas Leslie Savage, Director, Planning and Administration Oil & Gas Division, Railroad Commission of Texas
Utah	Green River	John Baza, Director, Division of Oil, Gas and Mining, Utah Department of Natural Resources
West Virginia	Appalachian	James Martin, Chief, Department of Environmental Protection, Office of Oil and Gas
Wyoming	Green River	Tom Doll, State Oil and Gas Supervisor, Oil and Gas Conservation Commission

Results and Discussions

Shale Gas Potential

Advances in technology are unlocking the potential of shale gas in the United States. Horizontal drilling is leading to production in shale formations once thought to be inaccessible. Countless studies and reports have been published about the potential for domestic shale gas production. The IOGCC has identified several key studies which identify and demonstrate the impact of shale gas.

Figure 4. Economic Studies addressing Shale Gas Potential

CERA (2010) Fueling North America's Energy Future, 2010 HIS CERA Inc. Many NG shale statistics and perspectives

In the United States alone the new natural gas plays have increased the resource base by more than 1,100 Tcf. This is an order of magnitude larger than the proved reserves recognized by the US Energy Information Administration (EIA) only two years ago.

Environmental Resources Management Southwest, Inc. (June 2009.) Water Availability and Use in the Woodford Shale Play

This June 2009 report, produced by Environmental Resources Management Southwest, Inc. (ERM), is the result of a study of water resources in the Woodford shale play area in the Arkoma Basin of eastern Oklahoma. The study includes a survey of water availability, quality and use as well as regulations as they relate to water use and post-frac produced water disposal or reuse.

Loren C. Scott & Associates (April 2009). The Economic Impact of the Haynesville Shale on the Louisiana Economy in 2008

Prepared for the Louisiana Department of Natural Resources, this study captures and measures the direct and indirect effects on the Louisiana economy from the activities of extracting firms operating in the Haynesville Shale in 2008.

- During 2008, seven of seventeen firms generated approximately $2.4 billion in new business sales within the state of Louisiana.
- As a result of these activities, nearly $3.9 billion in household earnings was created in 2008.
- There was an increase of 32,742 new jobs within the state in 2008.
- State and local tax revenues increased by at least $153.3 million in 2008.

Navigant Consulting (2009). The Recognition of Natural Gas Abundance Continues to Grow

In an update to their July 2008 report prepared for the American Clean Skies foundation, Navigant Consulting continues to deliver the message that natural gas is an abundant resource and the most rapidly growing source is "unconventional" shale gas.

Navigant Consulting (July 4, 2008) North American Natural Gas Supply Assessment

Navigant Consulting prepared this assessment of North American natural gas production and recoverable reserves for the American Clean Skies Foundation. In their report they emphasize the rapid, ongoing development of unconventional gas resources. Of the unconventional resources in Navigant's review, shale gas is particularly important. The report tests the premise that most public sources of gas-supply information understate the contribution and potential of unconventional resources because their emergence has been too rapid for the underlying models to capture it accurately.

Pennsylvania State University (August 2009). An Emerging Giant: Prospects and Economic Impacts of Developing the Marcellus Shale Natural Gas Play

This recent study, sponsored by the Marcellus Shale Committee, and conducted by researchers at the Pennsylvania State University, is intended to educate the public about the current size, economic impacts, and future prospects of the Marcellus Shale gas industry in Pennsylvania.

Key findings of the report:

- In 2008, the Marcellus gas industry generated $2.3 billion in total value added, more than 29,000 jobs, and $240 million in state and local tax revenue. Economic output is estimated to top $3.8 billion in 2009, state and local tax revenues will be more than $400 million, and total job creation will exceed 48,000.
- Activity in the Marcellus will continue to expand, with natural gas production anticipated to rise to almost 4 billion cubic feet (BCF) per day by 2020, generating $13.5 billion in value added and almost 175,000 jobs.
- Drilling would decline by more than 30 percent, with an estimated $880 million net loss in the present value of tax revenue between now and 2020, should the recently proposed severance tax on natural gas production be passed.

The Perryman Group, (March 2009). An Enduring Resource: A Perspective on the Past, Present, and Future Contribution of the Barnett Shale to the Economy of Fort Worth and the Surrounding Area

This study by The Perryman Group (TPG), a Texas-based economic research and analysis firm, provides an overview of the economic impact of the Barnett Shale in the Fort Worth-area. TPG has been measuring the impact of activity within the Barnett Shale for several years and presents the results of this year's research in an easy-to-read format.

Key findings of the report:

- The Barnett Shale has continues to play a major role in the growth of the Fort Worth area economy. Although the pace has slowed in recent months, the field remains one of the most important deposits of natural gas in the US and a source of tens of thousands of jobs in the region.
- Exploration, drilling, and production in the Barnett Shale continue to serve as a key economic generator for Fort Worth and the surrounding area;
- The pace of activity in the Barnett Shale is expected to gain momentum with economic recovery efforts. Long-term energy needs will assure ongoing development of this important resource.

University of Arkansas Center for Business and Economic Research (March 2008). Projecting the Economic Impact of the Fayetteville Shale Play for 2008 – 2012

This study, prepared by the University of Arkansas Center for Business and Economic Research and sponsored by Arkansas Land and Exploration LLC, Chesapeake Energy Corporation, Petrohawk Energy Corporation, and Southwestern Energy Company, quantifies the potential economic impact of the Fayetteville Shale Play for the years 2008 through 2012.

- Over the next five year period, it is estimated that total economic activity of about $17.9 billion will be generated with annual direct employment of about 4,600 people.
- About $1.8 billion total in state tax revenues are estimated to result from direct, indirect, and induced effects of Fayetteville Shale activities.
- About $150 million total city and tax revenues are anticipated over the five-year period.
- The study cautions that projections are subject to two risks -- a decline in natural gas pricing and a significant increase in severance taxes.

Figure 5. Major Shale Plays Quick Facts

Marcellus Shale

The Marcellus shale formation is considered to be the largest shale formation in America. Geologists have known of this formation for years, but the prospect of large natural gas production was not considered until recently. Advances in drilling technology have the potential of solidifying the Marcellus as a major contributor of U.S. natural gas.

Estimated Production - More than 500 trillion cubic feet (Penn State University, 2008)

Well Depth - 1 mile or more below the surface

State Coverage - Ohio, West Virginia, Pennsylvania and New York. Small areas of Maryland, Kentucky, Tennessee and Virginia.

Barnett Shale

In just a few short years the Barnett Shale has become the largest producing play in the state of Texas. Located in the Fort Worth region, companies have successfully drilled and produced natural gas in what is considered a major population area.

Estimated Production - 26 trillion cubic feet (U.S. Geological Survey, 2003)

Well Depth - Less than 8,000 feet

State Coverage - North central Texas, covering 15 or more counties

Haynesville Shale

There is great potential surrounding this shale play in northwestern Louisiana. In fact, current indications suggest tens of thousands of jobs and billions of dollars will be pumped into the economy of Louisiana and surrounding states -mainly due to drilling and production activity in this shale play.

Estimated Production - 234 trillion cubic feet (LOGA, Shreveport Times, 2009)

Well Depth - Approximately 2 miles below the surface

State Coverage - Northwestern Louisiana, southwest Arkansas and eastern Texas.

Hydraulic Fracturing, Shale Gas and Regulations

An integral component of shale gas development is the process of hydraulic fracturing. Recognizing the importance of helping U.S. citizens, policy-makers, and lawmakers to understand the importance of shale gas to our economy and energy security, as well as the safeguards in place to prevent damage from shale gas exploration and production are all important aspects which need to be communicated.

State Regulatory Response to Hydraulic Fracturing

Contemporary state oil and gas regulations prohibit harm to the natural environment (State Oil and Natural Gas Regulations, 2009). At one time, however, regulations aimed at protection were not prevalent. From the first oil well in 1859 until the 1930s, there was little state regulation of the oil and gas industry (State Oil and Natural Gas Regulations, 2009). In fact, the majority of well construction operations were geared, not toward the protection of the environment, but to the protection of the asset – the oil and gas reservoir (State Oil and Natural Gas Regulations, 2009). Water was not something to protect, but was something to be protected from; water was the enemy (State Oil and Natural Gas Regulations, 2009). During this infancy of the oil and gas industry, operators thought that the royalties they paid landowners adequately compensated for any damage done to the ground water or the surface by oil and gas operations (State Oil and Natural Gas Regulations, 2009). The damage to the surface was considered to be a necessary evil inherent in the oil and gas production process (State Oil and Natural Gas Regulations, 2009).

As drilling and production increased through the first three quarters of the 20th century, landowners and regulators became increasingly aware of the environmental impact caused by the under-regulation of the of the oil and gas industry. Given states' interest in the protection of their respective natural environments and their historical familiarity with the production of oil and gas, states took up the effort to ensure the protection of the natural environment while not hindering the development of oil and natural gas. Oil producing states have since developed a legal infrastructure that ensures environmental protection in conjunction with the development of oil and natural gas. The state approach has been tailored to fit the situational needs of the various states. Because of this tailoring, added levels of federal oversight would be redundant to what states have already implemented. Further, by adding increased federal regulation, the states and the American taxpayer will have to foot the bill for the lost revenue. It is estimated that increased federal regulation proposed under the FRAC act would cost states $505 million in forgone state income taxes and will cost the federal government $1.2 billion in forgone federal income tax (New Regulations, 2009). Overregulation of the oil and gas industry proposed in the FRAC Act actually does more harm than good, especially where there has been no documented case of water contamination in over one million fractured wells.

Below is a summary of oil and gas production regulations in selected shale gas producing states. The summary addresses the issues of groundwater protection, casing procedures and requirements, and cementing.

Alabama

Alabama created the State Oil and Gas Board, vesting in the board the charge of preventing waste and promoting the conservation of oil and gas while ensuring the protection of the environment and the correlative rights of owners (Geological Survey of Alabama, 2009). The oil and gas board has broad statutory authority to promulgate and enforce rules and regulations to ensure the conservation and proper development of Alabama's oil and natural gas resources (Geological Survey of Alabama, 2009).

The majority of the hydraulic fracturing in Alabama occurs in coalbed methane. To address the issues that arise with the production of hydrocarbons from coal seams, the state has passed regulations specific to the production of coalbed methane. The state of Alabama's Oil and Natural Gas Board has the authority to shut down any drilling or production operation for failure to comply with any Board rule

(400-1-1-.11, 2000). In addition to that broad authority, any operator producing from coalbed methane shall conduct all oil and gas operations in a manner so as to prevent the pollution of all freshwater resources (400-3-4-.02, 2000); all freshwater that is of present or probable future value shall be confined to the water-bearing strata and the water shall be adequately protected (400-3-4-.02, 2000). Each coalbed shall be hydraulically fractured so as not to endanger any underground source of drinking water (400-3-8-.03(1), 2003). Operators shall certify that the proposed fracturing will not occur in an underground source of drinking water with evidence to support the certification (400-3-8-.03(3), 2003). For wells that are being fractured, before any fracturing operations may commence, the fracturing operation must be approved by the Supervisor of the Oil and Gas Board and each well shall be fractured in a way so as not to cause damage to water bearing strata (400-3-4-.07, 2000). Further, if the fracturing results in any irreparable damage to the well, the well shall be properly plugged and abandoned (400-3-4-.07, 2000). In addition to the fracturing requirements, the operator shall case and cement all wells with a sufficient number of casing strings necessary to prevent the contamination of freshwater bearing strata, support unconsolidated sediments, and to control formation pressure and fluid (400-3-4-.09(1), 2000). The casing used by the operator shall meet American Petroleum Institute standards and shall be reinforced with standard cement that is mixed with water of adequate quality so as not to degrade the setting properties of the cement (400-3-4-.09(2), 2000).

New York

The State of New York sits atop a large portion of the very productive Marcellus shale formation. The New York Department of Environmental Conservation (DEC) has had the exclusive authority to regulate the development of oil and gas since 1981 (Draft SGEIS, 2009). In 1992, New York commissioned the drafting of a generic environmental impact statement (GEIS) to address the DEC's regulations of oil, gas, underground gas storage and solution mining wells of any depth, brine disposal, and stratigraphic and geothermal wells deeper than 500 feet (New York DEC website, 2009). The 1992 GEIS concluded that the issuance of standard, individual oil or gas well drilling permits issued for anywhere in the state, when no other permits are involved, does not have a significant environmental impact (Draft SGEIS, 2009). However, the GEIS did find that the drilling of a oil or gas well within 1,000 feet of a municipal water supply well was always a significant event requiring a supplemental environmental impact statement addressing the ground water hydrology, potential environmental impacts, and mitigation measures (Final Generic EIS, 1992). The 1992 GEIS further found that the drilling of oil and gas wells between 1,000 and 2,000 feet of a municipal water supply well may be a significant event requiring a site specific environmental assessment and a state environmental quality determination (SEQR) (Final Generic EIS, 1992). The SEQR requires the state to consider the environmental factors associated with oil and gas drilling in the early planning stages of actions that are directly undertaken, funded, or approved by local and state agencies (Final Generic EIS, 1992).

On September 30, 2009 the DEC issued its draft supplemental generic environmental impact statement (DSGEIS) for the potential natural gas drilling activities in the Marcellus shale (Draft SGEIS, 2009). The DSGEIS outlines safety measures, protection standards, and mitigation strategies that operators would have to follow to obtain drilling permits (Draft SGEIS, 2009). The findings of the SGEIS will be applied to the reviewing and processing of permit applications in the deep, low-permeability formations of the Marcellus shale (Draft SGEIS, 2009).

The process envisioned in New York's EIS process emphasizes the importance of studying the potential impacts that drilling and hydraulic fracturing in the Marcellus shale could have. The draft SGEIS is indicative of a state effort to look at an issue that is unique to the state. The EIS process in New York is the product of robust state regulations aimed at the protection of the natural environment and the responsible development New York's natural gas resources. The EIS process is generally applicable to all oil and natural gas operations in the New York but is flexible to allow for exceptions to the general rules as dictated by the circumstances in the field.

Oklahoma

The State of Oklahoma began regulating the production of oil and gas in 1914 through the Oklahoma Corporation Commission (Ok. Corp. Commission, 2009). In 1915, the Oklahoma Legislature passed the Oil and Gas Conservation Act, expanding the role of the Commission to include the protection of the rights of all parties entitled to share in the benefits of oil and gas production (Ok. Corp. Commission, 2009). In addition to the protection of correlative rights, today's Corporation Commission is also responsible for ensuring environmental protection in oil and gas operations (Ok. Corp. Commission, 2009). To achieve adequate protection of the natural environment while encouraging development of oil and gas, the state of Oklahoma has enacted regulations affecting the drilling and completion of oil and natural gas wells. Oklahoma requires that surface casing be run and cemented from the bottom to the top of the casing with a minimum setting depth, which is the greater of either 90 feet below the surface or 50 feet below the base of treatable water (165:10-3-4(c)(1), 2009). The state further requires that an operator shall run and cement the surface casing string before drilling the well more than 250' below the base of the treatable water and the surface casing has to be steel casing (165:10-3-4(c)(5) & 165:10-3-4(c)(7)(D), 2009). When the casing has been run and cemented, the operator shall pressure test the installed casing for 30 minutes at a minimum pressure which is the lesser of the surface gauge pressure equal in psi to .2 of the length of the casing in feet or 1500 psig to ensure the integrity of the casing and cement (165:10-3-4(g), 2009).

Pennsylvania

Pennsylvania holds a special place in the history of the oil and gas industry. It was in Titusville, Pennsylvania that Edwin L. Drake discovered "rock oil" in 1859 (*The Prize*, 1990). Today, Pennsylvania remains important to the domestic oil and gas industry, but not for its rock oil. Instead, Pennsylvania is important because it holds a vast amount of natural gas locked in the state's portion of the Marcellus shale.

Pennsylvania's Department of Environmental Protection established the Bureau of Oil and Gas Management to oversee statewide oil and gas conservation and environmental programs designed to facilitate the safe exploration, development and recovery of Pennsylvania's oil and gas reservoirs in a manner that will protect Pennsylvania's natural resources and the environment (Pa. DEP, 2009). To help meet these goals, Pennsylvania has enacted regulations aimed at achieving the complementary goals of effective production and environmental protection. When drilling a well, the operator shall install casing that can withstand the effects of pressure, tension, and prevent the burst and collapse of the hole during the installation of the casing, cementing and subsequent drilling and producing operations (25 Pa. Code § 78.84(a), 1989). The operator shall equip the casing string with appropriate equipment to center the casing through the hole in fresh groundwater zones (25 Pa. Code § 78.84(b), 1989). When cementing the casing in place, the operator shall use cement that will resist degradation by the chemical and physical conditions in the well (25 Pa. Code § 78.85(a), 1989). The goal of the casing and cementing operations is to accomplish effective well control at all times, prevent the migration of gas or other fluids into sources of fresh groundwater, prevent pollution or diminution of fresh groundwater, and to prevent the migration of gas or other fluids into coal seams (25 Pa. Code § 78.81(a), 2001). Further, when an operator is drilling through fresh groundwater zones, the operator shall do so with diligence and as efficiently as practical in order to minimize drilling disturbance and commingling of groundwater zones (25 Pa. Code § 78.81(b), 2001).

Texas

The State of Texas has been regulating the oil and gas industry through its Railroad Commission of Texas since the 1910s (State Oil and Natural Gas Regulations, 2009). The Railroad Commission considers the protection of the environment and the preservation of individual property rights to be its two main objectives (History of the Railroad Commission, 2009). To that end, the State of Texas has passed regulations aimed and protecting groundwater in the development of oil and natural gas. Texas requires

that upon the abandonment of an oil or gas well, the surface casing is to be left in place in order to protect freshwater sands (16 Tex. Admin. Code § 3.15, 2009). Further, whenever hydrocarbons are encountered in any well drilled for oil or gas, the fluid shall be confined to its original stratum until it can be produced and utilized without waste (16 Tex. Admin. Code § 3.7, 2009). Each stratum shall be protected from water infiltration and wells may be drilled deeper after encountering the hydrocarbon fluids if drilling is done with diligence and any encountered fluids are confined to their original strata and protected upon the completion of the well (16 Tex. Admin. Code § 3.7, 2009). Texas also requires the use of steel casing that is cemented and hydrostatically tested (16 Tex. Admin. Code § 3.13, 2009).

Wyoming

In July of 2009, the state of Wyoming enacted drilling and production rules specifically for hydraulic fracturing (Wyoming Hydraulic Fracturing Rules and Regulations, 2009). The rules require that information be given to the Supervisor of the Oil and Gas Conservation Commission pertaining to a drilling plan, including any other information that may be required by the Supervisor (Wyo. Admin. Code Ch. 3 § 8(c), 2009). Operators have been informed by Oil and Gas Conservation Commission staff to include detailed information regarding hydraulic fracturing in the application for the permit to drill (Wyoming Hydraulic Fracturing Rules and Regulations, 2009). The rules also set out that approval of the Supervisor must be sought prior to the fracturing of a well (Wyo. Admin. Code Ch. 3 § 1(a), 2009). The notice must include the depth of the perforations, the source of water and/or the trade name of fluids used in fracturing, the types of proppants used, and the estimated pump pressure (Wyo. Admin. Code Ch. 3 § 1(a), 2009). Upon the completion of the fracturing, a report on the operation shall be filed with the Supervisor of the Oil and Gas Conservation Commissioner (Wyo. Admin. Code Ch. 3 § 12, 2009). The report shall be a detailed accounting of the work performed (Wyo. Admin. Code Ch. 3 § 12, 2009). Further, all surface casing shall be run to reach a depth below all known or reasonably estimated utilizable domestic fresh water supplies (Wyo. Admin. Code Ch. 3 § 22(a)(i), 2009).

Shale Gas Rules and Regulations

Alabama and Oklahoma have specific laws and regulations to address shale-gas production.

Figure 6. State Specific Shale Gas Rules and Regulations

State	**Alabama**
Citation	**Ala. Code §§ 9-17-1, 9-17-6, 9-17-12**
Title	*Drainage or Production Units*
Discussion	Allows more than one well to be drilled and produced within the drainage or production units in shale gas fields.
State	**Oklahoma**
Citation	**Okla. Admin. Code § 165:10-17**
Title	*Well Tests*
Discussion	Upon written request, the rulemaking provided for more time to perform the state test than the 30-day period specified in the rule. This change was implemented primarily to accommodate the longer time required to recover frac fluids and "fines" created in certain stimulation techniques used in the completion of Woodford Shale gas wells. Shutting in the well too early to perform the state test posed a higher risk of damaging the well or even losing it.

Shale Gas Regulatory Challenges and Opportunities

In February 2009, the IOGCC conducted a survey of the regulatory officials in 17 shale-gas producing states crossing fifteen existing, emerging, and frontier shale plays. The survey, and ensuing discussions identified regulatory challenges and opportunities.

Regulatory Challenges

Of the six identified challenges, three emerged as the most cross-cutting and influential – public perception, infrastructure, and water issues. While market fluctuations were identified as a challenge for many shale producing states, for the purposes of the report they are viewed as an external factor to take into consideration but not necessarily address in outreach activities.

Figure 7. Shale Gas Challenges

Market fluctuations: Fluctuations in market prices continue to challenge regulators and operators alike. Currently, natural gas prices are depressed, making development of shale gas a losing proposition in some areas. Market fluctuations have a direct impact on workforce.
Public Perception: A majority of states expressed that public perception is a major barrier for future development. Identified areas include, but are not limited to, chemical composition of fracking fluid, development in previously unexplored areas, water use, storage and recycling issues, environmental footprints, and protection. Many states identified incorrect or skewed media reports as a large factor affecting public perception.
Urban and Frontier Development: Exploration and production in urban areas or in areas that have not been drilled previously and eminent domain issues have come into play for some. Identified issues include public perception, concerns related to the rate of development and the cumulative effect that this will have on the environment.
Regulatory Challenges: Some states are trying to apply regulations designed for vertical drilling to new technological practices for horizontal drilling. Issues include well spacing, integration issues, correlative rights, and field rules.
Inter- and Intra-state Cooperation: An increased interest in working with local regulatory authorities was expressed as well as an ongoing need for inter-agency cooperation. In western states, most shale gas is on public lands and requires cooperation with applicable federal agencies, such as the Bureau of Land Management and the Environmental Protection Agency.
Infrastructure Expansion: Pipeline infrastructure to transport shale gas.

Figure 8. Regulatory Challenges by state -- Shale Gas

	AL	AR	KY	LA	MI	NY	OK	PA	TX	UT	WV	WY
MARKET FLUCTUATIONS	X	X		X		X	X	X			X	X
PUBLIC PERCEPTION	X	X		X	X	X*	X	X	X		X	
PREVIOUSLY UNEXPLORED AREAS	X	X										
REGULATORY CHALLENGES			X	X*								
INFRASTRUCTURE ISSUES		X	X	X		X	X	X	X		X	X
WATER ISSUES				X	X	X	X	X	X	X	X	X
URBANIZATION				X		X*			X*			
WORKFORCE				X								
CUMULATIVE IMPACT	X							X				
INTER-STATE BOUNDRIES									X			
PUBLIC LANDS										X		X
INTER-AGENCY COOPERATION									X	X*		X

*LA – New regulatory guidelines pending.

*NY – Public perception as well as urbanization issues stem from developing areas in well-to-do vacation spots for city dwellers.

*TX - Urbanization issue developing in Fort Worth area.

*UT – Federal vs. state government interaction.

**All states indicated, at varying degrees, that market fluctuations, public perception and water issues were important obstacles that needed to be discussed further. A couple of states, such as Utah and Wyoming are new to shale gas recovery and were not experiencing the listed issues on the same scale as the other, more established markets.

Regulatory Opportunities

The IOGCC and the Shale Gas Directors' Task Force identified several potential means for addressing identified barriers and using its leverage as a multi-state government agency to overcome them. The IOGCC has long-standing relationships with state agencies, governors, industry associations, oil and gas legal experts, industry, federal government agencies, and the environmental community.

Figure 9. Regulatory Opportunities -- Shale Gas

Petroleum geologic regional framework: Work with local geological surveys and academic institutions to identify geographic areas of potential, address water requirements, and quantify the potential of individual regions.
Regulatory clearinghouse: Develop a user-friendly Web site with links to state and regulatory rules, views, and responses that can be used to increase public awareness and share best practices among the states. The clearinghouse could include regulatory items --- such as horizontal shale rules, spacing, cross unit wells, and water analysis --- as well as scientific studies and other resources.
Inter- and Intra-Agency Forums: Continue communications both at the inter- and intra-state level to include federal, state, and local parties as well as geological survey information.
Public Education: Provide the facts, such as "Fracturing 101" in a user-friendly fashion in a variety of mediums such as town hall meetings, local seminars, and Web sites with open lines of communication.

State Initiatives and Partnerships

In response to identified regulatory challenges and opportunities, the IOGCC and the Shale Gas Directors' Task Force have begun initiatives at regional, state, and national levels. These initiatives address the key challenges of public perception, water challenges, and infrastructure development and the key opportunities of providing a regulatory clearinghouse, inter- and intra-agency forums and public education.

Groundwork

Perhaps the most compelling opportunity identified by the Task Force was the development of a regulatory clearinghouse that would provide regulatory information about shale gas in an easy-to-access medium.

Leveraging the already established IOGCC regulatory Web site, which launched in October 2009, the Shale Gas Directors' Task Force developed fact sheets and other regulatory information for a micro-site dedicated to Shale Gas. http://groundwork.iogcc.org/topics-index/shale-gas

This ongoing project provides regulatory information about shale gas production in an easy-to-understand media. Targeted toward the key audiences identified in Resolution 09.106, the clearinghouse concept communicates with multiple audiences.

Fact Sheets

The Shale Gas Directors' Task Force authored several fact sheets to address the identified challenges and opportunities. *Fact sheets are available as appendices to the report*

Shale Gas in the U.S.
Jobs and Shale Gas
Basin-Specific Fact Sheets: Barnett, Haynesville, Marcellus

Community and the Environment
Hydraulic Fracturing
Infrastructure

Presentations

Planning for Progress: Infrastructure and Water in the Marcellus Shale. The IOGCC planned and developed a Pennsylvania Natural Gas Summit in partnership with Penn State University. Planning for Progress: Infrastructure and Water in the Marcellus Shale, in partnership with Penn State University was held on November 16 – 18, 2009. With over 440 participants, the summit was deemed a success by all and the partnership anticipates a follow-on summit in 2010.

Washington Briefings. In an effort to show the importance of shale gas development in the U.S., the Interstate Oil and Gas Compact Commission (IOGCC) held two congressional briefings, one for the U.S. Senate, and one for the U.S. House of Representatives on March 5, 2010.

The IOGCC enlisted three of the commission's official representatives who, because of their states development of shale gas, could easily explain the importance of shale gas development.

Oklahoma Energy Secretary Robert Wegener; Railroad Commission of Texas Chairman Victor Carrillo; and Department of Environmental Protection of Pennsylvania Deputy Secretary Scott Roberts, gave presentations in both congressional briefings covering the topics of:

- American jobs/economic potential
- Domestic energy/national security
- Personal perspective as a state regulator on development of shale gas in the U.S. and to the outstanding job that states are doing regulating the development of this most important national resource.
- Competency and commitment of state oil and gas regulators to protect our states' drinking water resources in the development of the country's shale gas energy resources.

With over 60 staffers attending the two briefings, the IOGCC's message for the need to continue to develop the nation's shale gas was made, and the IOGCC will continue to be a leading voice for the organization's member states on not only shale gas development, but also oil and natural gas related topics that may arise.

Conclusions

Of the key challenges and opportunities identified by shale gas states, the most compelling is public perception of regulatory processes associated with shale gas development and the hydraulic fracturing process.

Public Perception Holds the Key

The most influential and critical challenge facing regulators of shale gas development is public perception, particularly when it comes to the process of hydraulic fracturing. A majority of states expressed that public perception is a major barrier for future development. Identified areas include, but are not limited to, chemical composition of fracking fluid, development in previously unexplored areas, water use, storage and recycling issues, environmental footprints, and protection.

In October 2009, IOGCC member states passed Resolution 09.106 that resolves that shale gas should be encouraged under conditions that protect the environment and public health and safety. Excerpts from the resolution states the concept succinctly:

It is crucial for U.S. citizens, policy-makers, and lawmakers to understand the importance of shale gas to our economy and energy security as well as the safeguards in place to minimize impacts from shale gas exploration and production.

Domestic sources of natural gas are expected to increase as a share of U.S. supply from 84 percent in 2007 to 97 percent in 2030.

Member states of the IOGCC have proven to have effective regulatory systems that protect water, air, soils, and other resources as well as public health and safety.

Regulatory processes are designed to protect health, safety and the environment. Communicating the effectiveness of these processes – to U.S. citizens, policy makers and lawmakers – is the greatest challenge and opportunity for the regulating community.

The answer is simple but not easy – the establishment of a proactive public outreach mechanism that objectively educates citizens about the effectiveness of state regulators. Once established, it will be important to maintain an ongoing informational resource for inquiries (from media, general interest, industry, etc.) about up-to-date regulatory practices, rulings and monitoring activity.

The IOGCC, through its collaborative structure among oil and natural gas producing state regulators, is the catalyst for implementing such a communications system. Although state regulatory agencies operate independently, our collaborative compact is a foundational structure from which dissemination of shared disciplines, information and techniques - being effectively applied in various regulatory processes and procedures - can be expanded. Proactively employing this outreach -- while providing passive access to a centralized communications hub containing updated facts and findings -- leverages and enhances the credibility and authority of the state regulatory community.

Recommendations

In Spring 2010, the IOGCC submitted the following recommendations in its report to the U.S. Department of Energy, *New Energy Technologies, Regulating Change*.

Support the Safe, Responsible Development of Domestic Unconventional Resources

Unconventional resources production should be encouraged under conditions that protect the environment, public health, and safety. It is important that all parties involved understand the importance of unconventional gas to our economy and energy security as well as the safeguards in place to minimize impacts from natural gas exploration and production.

FEDERAL STAKEHOLDERS

- Recognize the exemplary job by state agencies in regulating the decades-old practice of hydraulic fracturing. States and the U.S. Environmental Protection Agency agree that there has never been a single instance of drinking water contamination as a direct result of hydraulic fracturing. The federal government should support state regulation of hydraulic fracturing and avoid the application of unnecessary provisions of the Safe Drinking Water Act. Further, the Congress of the United States should oppose legislation that removes the exemption for hydraulic fracturing as unnecessary, duplicitous, and an infringement on state authority and regulatory procedures that have been in place for decades.
- Allow the states to participate as a partner should any new studies be undertaken on the impacts of oil and natural gas resource development, including any studies targeting shale oil and gas plays
- Encourage efforts by agencies such as the U.S. Departments of Energy and Environment to strengthen existing relationships with the IOGCC and member states for the purposes of providing financial and technical support, improving efficiency in the use of limited resources, minimizing or eliminating duplication of effort, supporting the national goals of energy production, environmental protection and economic development and improving public understanding of energy-related issues. Seek out additional opportunities for agencies to partner with states on issues of joint concern or interest.

STATE STAKEHOLDERS

- Foster the development of a regulatory environment that permits the development and utilization of technological advances to improve the effectiveness and efficiency of recovering oil and natural gas while at all times maintaining the highest levels of environmental protection.
- Seek opportunities to partner with stakeholders to create a greater public understanding about the role of unconventional fuels in the country's energy mix.
- Spearhead research and information transfer on under-explored and emerging resource plays.
- Recognize the need for long-term transportation and storage contracts that attract long-term, preferred financing of additional gas transportation and storage infrastructure to accommodate future gas demand, while moderating natural gas prices.
- Seek solutions to existing field-to-market bottlenecks, such as the Bakken, and proactively work to head off such barriers in emerging, unconventional plays such as the Marcellus.

- Continually seek to improve regulatory programs for the dual goals of environmental protection and full resource development. Especially in emerging play, seek to inform and involve stakeholders as issues are anticipated or arise. Possible approaches include structured public information systems and a presence in affected communities.
- Participate with the IOGCC on a regional basis to promote the potential for shale gas in the United States' energy future.

INDUSTRY

- Continue to invest in environmentally sound methodologies for responsible unconventional production.
- Go "above-and-beyond" regulatory compliance to ensure that environmental safeguards are in place.
- Recognize the need for long-term transportation and storage contracts that attract long-term, preferred financing of additional gas transportation and storage infrastructure to accommodate future gas demand, while moderating natural gas prices.
- Reach out to the general public to understand and head off confrontations regarding development in previously undeveloped areas.
- Join with states and the IOGCC in seeking streamlined yet effective regulatory structures that achieve compliance while permitting resource development.

CIVIC AND COMMUNITY

- Take advantage of educational opportunities to become knowledgeable about regulatory processes and procedures in place in individual communities.
- Participate in town hall meetings, public commentaries, and other means of community participation for rule development.

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List of Acronyms and Abbreviations

BCF	Billion cubic feet
CERA	Cambridge Energy Research Associates
EIA	Energy Information Administration
EIS	Environmental Impact Statement
ERM	Environmental Resources Management Southwest, Inc
GEIS	Generic Environmental Impact Statement
IOGCC	Interstate Oil and Gas Compact Commission
SEQR	State Environmental Quality Determination
TCF	Trillion cubic feet
TPG	The Perryman Group
USGS	United States Geological Survey

Appendices

INTERSTATE
Oil & Gas
COMPACT COMMISSION

RESOLUTION 09.106
SHALE GAS

OCTOBER, 2009

RESOLUTION 09.106

SUPPORTING CONTINUED ENVIRONMENTALLY RESPONSIBLE DEVELOPMENT OF SHALE GAS IN THE UNITED STATES

WHEREAS, the United States relies on natural gas for 23 percent of its energy supply, and demand for natural gas as a clean-burning energy source is expected to increase in the upcoming decades; and,

WHEREAS, natural gas, in addition to being a significant component of our energy supply, is a critical raw material used in many commercial, industrial, and agricultural applications, including chemicals, plastics, fertilizers, pharmaceuticals, and others; and

WHEREAS, domestic sources of natural gas are expected to increase as a share of U.S. supply from 84 percent in 2007 to 97 percent in 2030; and

WHEREAS, gas from shale formations is expected to be the fastest growing source of domestic natural gas supplies; and

WHEREAS, concerns have been expressed over potential impacts of shale gas development associated with hydraulic fracturing, infrastructure, development in urban areas, and related issues; and

WHEREAS, the member states of the Interstate Oil and Gas Compact Commission (IOGCC) have proven to have effective regulatory systems that protect water, air, soils, and other resources as well as public health and safety; and

WHEREAS, it is crucial for U.S. citizens, policy-makers, and lawmakers to understand the importance of shale gas to our economy and energy security, as well as the safeguards in place to minimize impacts from shale gas exploration and production**;**

NOW, THEREFORE, BE IT RESOLVED, by the IOGCC, that shale gas development should be encouraged under conditions that protect the environment and public health and safety; and.

BE IT FURTHER RESOLVED, that the IOGCC urges the EPA to provide for the states to participate as a partner in any new studies to be undertaken on the impacts of hydraulic fracturing; and

BE IT FURTHER RESOLVED, that the IOGCC urges the U.S. Department of Energy to continue to provide financial and technical support for the IOGCC to maintain and enhance initiatives supporting the safe and environmentally sound development of shale gas.

Submitted by James Welsh, Official Representative, Louisiana, October 1, 2009. Approved October 2009

Fact Sheets

BARNETT SHALE

Fact Sheet

First Shale Play in the U.S.

Can Provide Three Years Worth of Natural Gas

Created Over 111,000 Permanent Jobs

LOCATION OF BARNETT SHALE

- The Barnett Shale lies in the heart of north-central Texas. The Barnett Shale covers 20 counties, including Tarrant, Dallas, and Denton. Much of the production in the Barnett Shale comes from Tarrant, Dallas, and Johnson counties[1]

THE IMPORTANCE

- The Barnett Shale holds an estimated 26 trillion to 45 trillion cubic feet of natural gas reserves. The Barnett Shale holds enough gas to meet U.S. demand at 2008 consumption levels for approximately two to three years.[2]
- In 2007, 1.4 trillion cubic feet of natural gas were produced from the Barnett Shale.[3]
- The Barnett Shale is the first shale play in the United States to utilize horizontal drilling and hydraulic fracturing – two processes vital to the development of shale gas.

THE ECONOMIC IMPACT

- From 2007 to 2008, the number of permanent jobs associated with the Barnett Shale expanded from 83,823 to 111,131. Employment levels declined in 2009 but are expected to rebound in the near future.[4]
- In total, 2008 saw the Barnett Shale generate an estimated $13.7 billion in economic output and 132,497 jobs.[5]
- From 2001 to 2015, the Barnett Shale is projected to generate in excess of $100 billion and 1 million person-years of employment.[6]

REGULATIONS AFFECTING THE BARNETT SHALE

- The Railroad Commission of Texas regulates the exploration and production of oil and natural gas in Texas, including the protection of surface and subsurface waters.
- The Railroad Commission of Texas has approved several pilot projects in the shale formation to reduce the amount of fresh water used in the Barnett Shale

1 AskChesapeak.com, available at: http://www.askchesapeake.com/Barnett-Shale/Pages/information.aspx.

2 Id.

3 An Enduring Resource: A Perspective on the Past, Present, and Future Contribution of the Barnett Shale to the Economy of Fort Worth and the

4 Surrounding Area, The Perryman Group, The Barnett Shale Expo – March 2009.

5 Id.

6 Id.

INTERSTATE Oil & Gas COMPACT COMMISSION

groundwork

COMMUNITY AND THE ENVIRONMENT

Fact Sheet

Potential Environmental Impacts

Regulations and Safeguards in Place to Protect the Environment and Communities

WHAT ACTIVITIES TAKE PLACE AT A SHALE GAS WELL SITE?

- Well site preparations include construction of well pads, access roads, drilling pits and erosion control measures.
- Drilling of the well includes installing casing and cement to protect ground water and other natural resources, such as mineable coal seams, and confining drilling fluids and rock cuttings to storage tanks or pits for later disposal. Hydraulic fracturing is then used to break up the gas-bearing rock, allowing natural gas to flow to the well.
- Stimulation of the well includes foam, cross-link or nitrogen fracing.
- For a producing well, flow lines and gathering lines and storage tanks are installed. Well site stabilization techniques are employed as needed, and eventually the well site is reclaimed with native vegetation.

WHAT ARE THE POTENTIAL ENVIRONMENTAL IMPACTS OF THIS DEVELOPMENT?

- Many of the potential environmental effects from shale gas are similar to those from other types of oil and gas development. For example, the construction of well pads, roads, and pipelines disturbs the landscape. Although improper well drilling and completion techniques can lead to potentially adverse impacts on ground water resources, regulatory requirements are designed to prevent this occurrence. Other impacts may involve surface water, air emissions, noise and dust.
- Shale gas development raises concerns because it often occurs in areas that previously experienced little or no oil and gas activity. In addition, the intensity of such development can result in the rapid proliferation of well sites and drilling activity.

HOW MIGHT THE COMMUNITY BE AFFECTED BY DEVELOPMENT?

- Like other types of development, shale gas development can increase traffic, potentially causing congestion and road damage. It can also raise concerns about safety, noise, and aesthetics.
- Shale gas development has raised special concerns about water availability because many wells require large volumes of water for hydraulic fracturing. These water demands may challenge existing supplies and infrastructure, but they generally represent less than one percent of the total water use in a basin.
- Shale gas development creates additional direct and indirect employment opportunities, while also providing tax revenues to state and local governments and royalties and fees to property owners. These employment and economic benefits can assist communities in responding to population increases and service and infrastructure demands.

INTERSTATE Oil & Gas COMPACT COMMISSION
groundwork

COMMUNITY AND THE ENVIRONMENT

WHAT SAFEGUARDS EXIST FOR THE ENVIRONMENT AND COMMUNITIES?

- Like other types of oil and gas development, shale gas wells are subject to various environmental and community safeguards through rigorous regulatory programs administered by the states. These programs require:
    - Installation of multiple layers of protective steel casing and cement in the well bore to protect fresh water aquifers and isolate the producing zone;
    - Technological controls and practices to reduce air emissions and noise;
    - Recycling and storage of wastes in specially designed pits and tanks;
    - Revegetation and storm water controls to limit erosion and runoff;
    - Special safety equipment, setbacks, and best management practices to address community concerns; and
    - Monitoring programs to determine whether impacts to water, air, and other resources are occurring so that proper and appropriate mitigation measures can be implemented.
- Shale gas development typically makes extensive use of horizontal wells and, often, multiple wells are drilled from a single pad, thereby consolidating facilities. Thus, sensitive areas can be avoided, surface disturbance is reduced, and environmental and community effects are decreased.

WHAT IS THE ROLE OF STATE REGULATORY PROGRAMS?

- States review drilling permit applications for compliance with applicable regulations before drilling may commence.
- State inspectors monitor the construction of access roads and well sites and the drilling, completion, production, and plugging and abandonment of wells to ensure regulatory compliance, responsible resource development, protection of environment, and public safety.
- States require the filing of well records and production data, which are archived and available for public inspection along with inspection reports.

INTERSTATE Oil & Gas COMPACT COMMISSION
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HAYNESVILLE SHALE

Fact Sheet

Can Provide 10 Years Worth of Natural Gas

Created over 32,000 New Jobs

Increased State and Local Tax Revenues

LOCATION OF HAYNESVILLE SHALE

- The Haynesville Shale formation is located approximately 10,500 to 13,000 feet below of the subsurface of Northwest Louisiana and East Texas. The most productive portions of the shale play lie in the Louisiana parishes of Caddo, Bossier, DeSoto, Bienville, Webster and Red River.[1]

THE IMPORTANCE

- The Haynesville Shale is estimated to contain as much as 251 trillion cubic feet of gas meaning the Haynesville Shale contains enough natural gas to meet U.S. demand for approximately 10 years at 2008 consumption levels.[2]

THE ECONOMIC IMPACT

- Economists project that in 2008 the Haynesville Shale generated nearly $3.9 billion dollars in household earnings.[3]
- The activity of the Haynesville Shale created 32,742 new jobs in 2008.[4]
- State and local tax revenues were increased by at least $153.3 million dollars in 2008.[5]

STATE REGULATIONS

- The Louisiana Department of Natural Resources has proposed an order regulating the urban development of the Haynesville Shale. The order applies to wells drilled and completed in the Haynesville Shale within 750 feet of a residence, religious institution, public building or public park in an urban area.[6]
- Louisiana Commissioner of Conservation Jim Welsh has recommended the use of ground water from the Red River Alluvial aquifer system because of its high yield and coarse nature making unsuitable for domestic consumption, preserving the Carrizo-Wilcox Aquifer for domestic use.[7]
- Louisiana requires all drilling operators to give proper legal notice of the well location to the Office of Conservation prior to fracturing operations, giving the Office of Conservation time and opportunity to determine whether the well location might pose a risk to ground water resources.[8]

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1 http://myhaynesvilleshale.com/

2 http://www.askchesapeake.com/Haynesville-Shale/LA/NaturalGas/Pages/About-Haynesville-Shale.aspx

3 Loren Scott & Assoc., The Economic Impact of the Haynesville Shale on the Louisiana Economy in 2008, available at: http://dnr.louisiana.gov/haynesvilleshale/loren-scott-impact2008.pdf.

4 Id.

5 Id.

6 http://dnr.louisiana.gov/cons/notices/20090501-haynesville.pdf

7 http://dnr.louisiana.gov/sec/execdiv/pubinfo/newsr/2008/1016con-gwater-advisory.ssi

8 http://dnr.louisiana.gov/sec/execdiv/pubinfo/newsr/2008/0813con-well-notification-rules.ssi

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HYDRAULIC FRACTURING

Fact Sheet

Since the 1940s Hydraulic Fracturing Has Been Used in the U.S.

Hydraulic Fracturing is Necessary for Shale Gas Development

Hydraulic Fracturing Makes Shale Gas Development Economical

WHAT IS HYDRAULIC FRACTURING?

- Hydraulic fracturing is a process that uses high pressures and "fracturing fluids" to break open natural gas-bearing rocks and create pathways for gas flow that allow production of these valuable resources.
- Fracturing fluids consist primarily of water, sand, and some chemical additives.
- Induced fractures are kept open with sand, or proppant, to ensure the continued flow of natural gas.
- Hydraulic fracturing has been used safely since the 1940s in more than one million wells in the United States.[1]

WHAT ARE THE BENEFITS OF HYDRAULICALLY FRACTURING SHALE GAS?

- Gas-bearing shales are classified as "unconventional" reservoirs, meaning that although they may contain significant quantities of natural gas, this gas cannot be produced without fracturing the rock to liberate gas and allow it to flow to production wells in commercial quantities.
- The combination of high-volume hydraulic fracturing and long-reach horizontal well drilling have proven to be necessary to establish conditions that allow sufficient gas to be produced to make these wells commercially viable. In general, without these technologies, production of gas from shales would not be economically feasible.[2]
- The lower 48 states have a wide distribution of shales that contain vast resources of natural gas. The Potential Gas Committee concludes that the growing importance of shale gas is substantiated by the fact that shale gas accounts for 616 Tcf or approximately 33% of the United States total potential gas resources.[3]
- Production of shale gas is expected to increase from a 2007 US total of 1.4 Tcf to 4.8 Tcf in 2020.[4]

WHAT ARE THE RISKS AND POSSIBLE IMPACTS?

- There are concerns that the chemicals added to the hydraulic fracturing fluid to enhance the performance and effectiveness of the treatment may impact surface water and ground water resources and may pose a risk to public health.
- There are concerns that injecting fluids into a well with sufficient force to break or fracture the gas-bearing rocks poses a risk from uncontrolled movement of the fracturing fluid into fresh water aquifers or other formations underground.
- The water necessary for hydraulic fracturing may be withdrawn from surface or ground water sources and either trucked or piped to the area of operations and stored in impoundments. Acquiring, transporting, and storing large volumes of water poses potential impacts to surface water and ground water resources, local roads and infrastructure, and typically requires more surface area to be cleared at well locations.

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HYDRAULIC FRACTURING

- Collecting, transporting, and disposing of the fluids that flow back out of wells after hydraulic fracturing operations poses risks to surface waters, local roads, and infrastructure.

HOW ARE THE RISKS AND IMPACTS MANAGED AND REDUCED?

- State oil and gas regulatory programs are charged with mitigating the risks and potential impacts from oil and gas operations, including hydraulic fracturing. State regulators are best situated to do this because they are empowered with the necessary statutory authority and are attuned to the unique geological and geographic characteristics of their state and the needs of its citizens.
- Risks and impacts from hydraulic fracturing of shale wells are managed and reduced through rigorous state regulatory programs. For example, these include:
    - Technical review of well drilling permit applications, including hydraulic fracturing plans, by professional staff with experience in oil and gas well drilling, production, and geology.
    - Installation of multiple layers of protective steel casing and cement in the well bore to protect fresh water aquifers and to isolate other hydrocarbon zones and the producing zone.
    - Operational controls and construction standards for fluid handling at the well site, including hydraulic fracturing chemicals and additives.
    - Requirements for disclosure of the chemical additives used in hydraulic fracturing.
    - Water source review and limits and/or controls on water withdrawal activities.
    - Review and approval of fluid disposal plans.
    - Well site monitoring and inspections by state regulators during well drilling and hydraulic fracturing to ensure compliance with statutes, regulations, and standards.
    - Requiring operators to submit records and reports describing the completion of the well, including hydraulic fracturing operations.

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1 American Petroleum Inst., Hydraulic Fracturing, available at http://www.api.org/policy/exploration/hydraulicfracturing/index.cfm; see also Interstate Oil and Gas Compact Comm'n, Testimony Submitted to the House Committee on Natural Resources Subcommittee on Energy and Natural Resources (Washington, D.C. June 18, 2009), available at http://www.iogcc.state.ok.us/Websites/iogcc/Images/Additional-IOGCC-Testimony-June2009.pdf.

2 U.S. Dep't of Energy and Nat'l Energy Tech. Lab., Modern Shale Gas Development in the United States, at ES-1 (2009).

3 Potential Gas Committee, Potential Gas Committee Reports Unprecedented Increase in Magnitute of U.S. Natural Gas Resource Base (2009), available at: http://www.energyindepth.org/wp-content/uploads/2009/03/potential-gas-committee-reports-unprecedented-increase-in.pdf.

4 Supra, n. 1.

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SHALE GAS INFRASTRUCTURE

Fact Sheet

Infrastructure Associated With Shale Gas Development

Potential Impacts of Infrastructure Development

Regulations and Safeguards in Place

INFRASTRUCTURE

- Infrastructure issues associated with shale gas development may include new roads and electric transmission lines; compressors and pipelines; water storage and disposal facilities; and associated equipment.
- Water is used both for drilling operations and for hydraulic fracturing of wells (see Hydraulic Fracturing Fact Sheet).
- Water, often containing additives, is typically pumped out of a well after fracturing and may also be produced along with natural gas. "Produced water" often contains salts and other substances that originated in the shale.

IMPACTS

- Infrastructure development often raises concerns over changes in land use, particularly in areas with little or no historic oil or gas activity.
- The construction phase in particular can involve temporary disturbance of the land and use of heavy equipment, along with noise, dust, and traffic.
- Improper construction and use of infrastructure can result in environmental impacts such as leaks, spills, and soil erosion.
- Water use, particularly when volumes are large relative to the supply, can compete with other water demands.

REGULATIONS AND SAFEGUARDS

- Federal, state, and local governmental entities regulate various aspects of infrastructure development.
- Effective regulations are in place to protect against environmental damage from spills, leaks, and soil erosion.
- Either a state agency or the US Environmental Protection Agency, or both, regulate water disposal wells.
- States also regulate discharges to groundwater and surface water to assure that water quality is protected.
- Depending on the volumes of water used and the availability of water sources, a state agency may regulate the withdrawal of water to conserve and protect water resources.
- Many states encourage reuse or recycling of water used in oil and gas operations. Some states prefer disposal of fracturing and produced waters and all regulate disposal activities.
- Conflicts over land use usually involve property rights issues that must be resolved between the parties. However, states set well spacing and location criteria that limit impacts by addressing the number of wells that can be drilled and requiring wells and associated infrastructure to be located so as to reduce conflicts with alternative land uses.

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SHALE GAS: CREATING AMERICAN JOBS

Fact Sheet

Development of American Shale Gas Creates Thousands of Jobs

Shale Gas Will Boost U.S. Energy Independence

SHALE GAS: THE BRIDGE TO A CLEANER, MORE INDEPENDENT AND PROSPEROUS AMERICA

- ***"The brightening outlook for natural gas supplies changes the backdrop against which we consider energy policy here in America."*** Rep. Edward Markey, Chairman, House Subcommittee on Energy and Environment, January 20, 2010

JOBS, JOBS, AND MORE JOBS

- A stable and adequately trained work force is critical to the continued environmentally sound development of the nation's oil and natural gas resources. As domestic production attention shifts toward utilizing the nation's vast shale resources, there will be a growing demand for personnel to staff shale development projects. Shale gas development represents a key opportunity for policy makers to take proactive steps that ensure a strong, well-trained workforce that can harness the vast amounts of energy that remain trapped in rock formations deep below the surface of the earth.

ENERGY INDEPENDENCE AND JOB CREATION – SHALE GAS IS A REMEDY

- Domestic natural gas and the development of the United State's shale resources provide much needed relief from foreign energy sources while creating high-paying, high-skilled, quality jobs for Americans. The development of America's shale gas resources will create more jobs, and the investment in the production of clean-burning natural gas and will boost U.S. energy independence.

DOMESTIC JOB CREATION THROUGH DEVELOPMENT OF A CLEAN-BURNING RESOURCE

- In 2008, natural gas production contributed $385 billion to the national economy and helped support more than 2.8 million jobs.[1]
- More than 700,000 jobs are indirectly involved with the natural gas industry.[2]
- More than 600,000 jobs are directly involved in exploring, producing, transporting and delivering natural gas or providing critical supplies or services to the industry.[3]
- In 2008, 33 states had at least 2,000 workers directly involved in natural gas activities, with 21 of the 33 having at least 4,000 people directly involved in natural gas activities.[4]
- Activity in the Marcellus, Haynesville, and Fayetteville shales has created an estimated 80,000 jobs.[5]
- Over the next two decades, shale gas production is expected to create 300,000 new jobs.[6]

1 America's Natural Gas Alliance, The Contributions of the Natural Gas Industry to the U.S. National and State Economies 1 (2009).
2 Id.
3 Id.
4 Id. at 2
5 America's Natural Gas Alliance, The Contributions of the Natural Gas Industry to the U.S. National and State Economies (2009).
6 The ExxonMobil-XTO Merger: Impact on U.S. Energy Markets, Subcommittee on Energy and Environment, Committee on Energy and Commerce, 111th Cong., 101 (2010) (statement of Rex W. Tillerson, Chairman and CEO, ExxonMobil Corp.).

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MARCELLUS SHALE

Fact Sheet

Can Provide Three Years of Natural Gas

Over $2 Billion to the Local Economy

Almost 30,000 Jobs Have Been Created

LOCATION OF MARCELLUS SHALE

- The Marcellus Shale is named after a distinctive outcrop of rock near the town of Marcellus, New York.[1]
- The Marcellus Shale is found throughout the Allegheny Plateau region of the Appalachian Basin.[2]
- The Marcellus Shale runs from southern New York, into Pennsylvania, Ohio, Maryland, West Virginia, and portions of Virginia.[3]

THE IMPORTANCE

- The U.S. Geological Survey originally thought that the Marcellus Shale contained a marginal amount of gas in the range of 1.9 trillion cubic feet.[4]
- In April 2009, the U.S. Department of Energy changed that estimate, concluding that the Marcellus Shale contained 262 trillion cubic feet of gas.[5]
- Some geologists believe that the Marcellus Shale could hold as much as 500 trillion cubic feet of gas.[6]
- Modest estimates of total production potential show that the Marcellus Shale, by itself, is capable of producing enough natural gas to meet U.S. natural gas demand for the next two years.

ECONOMIC IMPACT

- The development of the Marcellus Shale will have a tremendous impact on Pennsylvania's economy.
- In 2008, operators in the Marcellus Shale spent $2.95 billion in Pennsylvania.[7]
- From 2005 to 2009, operators in the Marcellus Shale spent close to $4.7 billion in Pennsylvania - $2.5 billion on lease, bonus and other land payments and $2.2 billion on equipment and supplies.[8]
- For every $1 that Marcellus operators spend in Pennsylvania, $1.94 of total economic output is generated.[9]
- In 2008, Marcellus Shale production added $2.3 billion to the Pennsylvania economy.[10]
- The development of the Marcellus Shale led to the creation of 29,284 jobs.[11]

REGULATIONS

- Strategies and policies that encourage growth of the Marcellus gas industry will generate significant economic and environmental benefits for Pennsylvania.[12]
- The Pennsylvania Department of Environmental Protection Bureau of Oil and Gas Management is responsible for the regulation of the oil and gas industry statewide.
- Pennsylvania has developed the Marcellus Shale Wastewater Partnership to address the water disposal issues that arise with natural gas production in the Marcellus Shale.[13]

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1 "Marcellus Formation," from Wikipedia, available at: http://en.wikipedia.org/wiki/Marcellus_Shale#cite_note-MGS1918-2.
2 Id.
3 Id.
4 Id.
5 Modern shale gas development in the United States: a primer, U.S. Dept. of Energy, at 17(2009).
6 "Researchers: Shale holds vast supply of natural gas". Business First of Buffalo. David Bertola, available at: http://buffalo.bizjournals.com/buffalo/stories/2008/02/11/story2.html?b=1202706000%5E1587557.
7 An Emerging Giant: Prospects and Economic Impacts of Developing the Marcellus Shale Natural Gas Play, Penn State Univ., Timothy Considine, et al. (2009).
8 Id.
9 Id.
10 Id.
11 Id.
12 Id.
13 Available at: http://www.portal.state.pa.us/portal/server.pt/community/marcellus_shale_wastewater_partnership/18683.

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SHALE GAS IN THE U.S.

Fact Sheet

Shale Gas Development Creates New Jobs

Lower Emissions into the Environment

U.S. is the Largest Natural Gas Producer

WHAT IS SHALE GAS?

- Shale is a type of rock created millions of years ago, usually in a deep ocean or lake environment. Over geologic time, mud, silt, and organic life forms are compressed and subjected to intense heat and pressure, creating oil and natural gas. Shale formations are "tight" formations meaning that they have low permeability and low porosity, prohibiting the free migration of oil and natural gas.

WHERE CAN SHALE GAS BE FOUND?

- Hydrocarbon-bearing shale formations can be found throughout the United States. Some of the prolific "shale plays" are the Marcellus Shale in the northeastern United States, the Barnett Shale in north-central Texas, the Haynesville Shale in northwestern Louisiana and eastern Texas and the Bakken Shale in North Dakota and parts of South Dakota.[1]
- Productive shale formations are found deep within the surface of the earth. The depth of productive shale formations ranges anywhere from 1000 feet below the earth's surface to as much as 13,500 feet below the surface.[2]

WHY IS SHALE GAS IMPORTANT

- Shale gas formations in the United States hold approximately 649.2 trillion cubic feet of technically recoverable natural gas.[3]
- The United States has overtaken Russia, becoming the world's largest producer and consumer of natural gas.[4]
- In 2009, the United States produced more than 22 trillion cubic feet of natural gas compared to Russia's production of 20.5 trillion cubic feet.[5]
- Because of the low emissions of natural gas, it will play an important role in promoting environmental well-being. Further, as the Environmental Protection Agency and other federal and state regulatory agencies take a harder look at emissions, natural gas will be an important fuel alternative for electric power generation.
- The abundance of natural gas contained in shale plays represents a viable alternative to the United States' dependence on foreign sources of energy. Natural gas in shale plays also will serve as a bridge fuel to a cleaner energy economy. Without natural gas, the transition to a "green" energy economy would be impossible.

HOW IS SHALE GAS PRODUCED?

- Shale gas was once thought to be too costly to produce.
- The gas trapped in shale formations are by nature subject to low porosity and low permeability. Technology has overcome these barriers to recovery.

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SHALE GAS IN THE U.S.

- Advances in drilling technique and technology now make the recovery of these vast resources possible. Horizontal drilling is opening up vast reserves that were once thought untouchable. Horizontal drilling also has decreased the average footprint of drilling operations by allowing recovery from one well-bore what typically would have taken dozens of well-bores to recover. Hydraulic fracturing is allowing operators to create channels for oil and gas to flow through, allowing for the recovery of resources contained shale formations. Hydraulic fracturing occurs at depths and in controlled environments that ensure the protection of groundwater resources.

STATE REGULATIONS AFFECTING THE DEVELOPMENT OF SHALE GAS

- All states have regulations addressing casing and cementing requirements. Proper casing and cementing ensures that fracture fluids injected into the formation being fractured remain in that formation.
- Oil and gas conservation experts review the geologic information to ensure there is an impervious stratum above the formation fractured.
- All states utilize inspectors, who observe the actual hydraulic fracturing operation to ensure that the operation is conducted properly so that no harm is caused.
- All states have enforcement authority to ensure compliance with applicable statutes and regulations.

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[1]U.S. Energy Information Administration, United States Shale Gas Plays.

[2]U.S. Dept. of Energy, ***Modern Shale Gas Development in the United States: A Primer,*** at 17 (2009).

[3] ***Id.***

[4]***World's largest producer of natural gas?:*** Now it's U.S., available at http://seekingalpha.com/article/182347-worlds-largest-producer-of-natural-gas-now-it-s-u-s.

[5]Id.

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