EXECUTIVE SUMMARY

Pennsylvania is several years into unconventional oil and gas development—the early years of what some are calling a multi-decade shale energy boom. The regulatory environment is shifting, laws are being updated, and media and public attention are high. The issues related to accessing this resource have become politically and emotionally charged, with a significant amount of misinformation in the marketplace. While shale gas development presents a unique economic and energy opportunity for Pennsylvania and its surrounding states, development of these resources also presents substantial challenges for our region in the areas of water resources management, air quality, infrastructure maintenance, housing, and community quality of life, along with other environmental and public health impacts.

Shale formations such as the Marcellus, Utica, and Burket are referred to as unconventional resources due to the nontraditional methods utilized in producing oil and gas from them. Unlike conventional gas formations, shale gas is released from deep deposits using techniques that include multi-well pads, directional drilling, and hydraulic fracturing. In 2010, estimates of Pennsylvania's accessible natural gas reserves doubled as a result of the application of these technologies to the Marcellus Shale formation. The increase in Pennsylvania was a significant contributor to the rise in total U.S. accessible reserves, accounting for about 20 percent of the overall increase that year. Although hydraulic fracturing has been used since the middle of the last century, it was only a decade ago when its coupling with horizontal drilling and use in accessing deep shale deposits were piloted in Texas's Barnett Shale and more recently applied to the Marcellus Shale.

From 2002 through 2012, 6,283 unconventional oil and gas wells were drilled in Pennsylvania on more than 2,700 well pads. These wells produced a total of 3.7 trillion cubic feet of natural gas in that decade, with 85 percent of that total produced in 2011 and 2012. Approximately 35 percent of these wells are located in the 10-county Southwestern Pennsylvania region.

In 2012, 57 percent of all wells drilled in Pennsylvania and 90 percent of all wells drilled in Southwestern Pennsylvania were unconventional. At the end of 2012, 57 percent of all drilled unconventional wells in Pennsylvania were producing natural gas for market. Though unconventional wells represented only 5 percent of the total producing wells in the Commonwealth, they accounted for 90 percent of Pennsylvania's total gas production in 2012.

The Commonwealth's Department of Environmental Protection (DEP), through its Office of Oil and Gas Management, is the state agency primarily responsible for oversight of this sector. DEP issues permits; regulates water, air, and solid waste impacts; responds to complaints; and enforces compliance with relevant state laws and regulations. While DEP has the largest responsibility, the Pennsylvania Public Utility Commission, Pennsylvania Department of Conservation and Natural Resources, the U.S. Environmental Protection Agency, and several other state and federal agencies have roles in the management of various aspects of the oil and gas industry.

Over the last several years, Pennsylvania has made substantial efforts to improve the management of unconventional oil and gas development, including, but not limited to, updating water standards for total dissolved solids, increasing permit fees to support regulatory staffing needs, adopting the first comprehensive update of its Oil & Gas Act through Act 13 of 2012, and promulgating updated Chapter 78 environmental regulations to implement Act 13.

SHALE GAS ROUNDTABLE OVERVIEW

In response to the desire of regional, multi-sector leaders to elevate and inform the regional energy dialogue, the Shale Gas Roundtable was created in the fall of 2011 to fulfill a three-part mission related to unconventional oil and gas production, transport, and use:

- Building and sustaining relationships among relevant cross-sector stakeholders to better support diverse regional environmental protection, community quality of life, and economic development goals
- Identifying high-priority focus areas through consensus-building dialogue, extensive research, and shared goals for the region
- Assessing the focus areas and developing ideas and recommendations that promote the improved management of and outcomes from regional unconventional oil and gas development

The principles used to guide the Roundtable's deliberations and activities were as follows:

- Operating with integrity, inclusiveness, and accountability
- Seeking the best possible balance between environmental/community protection and shale gas development/economic growth
- Conducting a thorough and objective study of issues

- Seeking the best available data to guide fact-based dialogue
- Incorporating stakeholder input with the help of members
- Working closely with diverse decision makers to seek input and counsel

The Shale Gas Roundtable cochairs and staff worked thoughtfully and diligently to assemble a high-level, diverse membership of 26 individuals from relevant, interested constituencies. Roundtable members were recruited to serve because of the unique perspectives and contributions each could bring to the effort. The Roundtable's geographic scope included the 10 counties of Southwestern Pennsylvania—Allegheny, Armstrong, Beaver, Butler, Fayette, Greene, Indiana, Lawrence, Westmoreland, and Washington. These counties represent approximately one-third of the unconventional oil and gas permits issued, wells drilled, and gas produced in the Commonwealth over the last 10 years. The 10-county Roundtable focus does not imply that unconventional oil and gas development is only a regional issue. Rather, the region was selected to maintain a manageable geography for frequent in-person member interaction on these issues.

The Roundtable members collectively determined their direction, process, and recommendations. In this work, they were supported by the Institute of Politics at the University of Pittsburgh. The Institute staff team, through neutral facilitation and unbiased research, established a productive framework for members to develop, discuss, and evaluate policy ideas and options. The activities of the Shale Gas Roundtable and the services of the Institute of Politics were generously supported by the Pittsburgh Foundation, the Heinz Endowments, and the Richard King Mellon Foundation.

In adopting this document, the Roundtable members endorse that the final report was built on constructive dialogue, was informed by sound research and information, and that the included recommendations merit consideration by policymakers at all levels as they seek to effectively and safely manage unconventional oil and gas development.

While the Roundtable has achieved general agreement on the report's value in informing decision makers, individual Roundtable members may not agree on the details of every recommendation. The final report reflects the careful deliberations and findings of the Shale Gas Roundtable; it does not necessarily reflect the views of the members' affiliated organizations or of the Institute of Politics.

BUILDING A COMMON UNDERSTANDING (2011–12)

At the inaugural meeting of the Shale Gas Roundtable in September 2011, members crafted a work plan to guide their collective efforts. That work plan was then implemented over the subsequent six months. It included the following components:

- Completing an extensive literature review of laws, policies, regulations, scientific studies, and advocacy materials related to unconventional oil and gas development in the region
- Conducting and summarizing more than 120 benchmarking interviews with environmental organizations, industry associations, landowner groups, researchers, and regulators and elected officials from the local, county, state, and federal levels. These interviews were completed through site visits to Colorado, New York, Ohio, Texas, and West Virginia. Interviews also were held with multi-sector leadership in Harrisburg and Washington, D.C.
- Continuing outreach to individual Roundtable members and to key stakeholders in Southwestern Pennsylvania to collect as much information as possible about regional unconventional oil and gas development
- Implementing a "Shale Gas University" to allow Roundtable members to participate in shared learning experiences. Educational modules featured expert guest speakers on topics ranging from water management to utility regulation to the full life cycle of natural gas production, transport, and use. Also included were field tours of a compressed natural gas fueling station, a centralized water treatment facility, a drilling site, and areas of the region most impacted by oil and gas development. The Shale Gas University sessions also provided opportunities for relationship building and education on critical issues and were held as needed throughout the entire course of the Roundtable's work.

The Roundtable met regularly to share the findings and results from the above activities.

"GETTING IT RIGHT" FRAMEWORK AND RECOMMENDATIONS DEVELOPMENT (2012–13)

The economic benefits of unconventional resource development are often described as worthwhile as long as that development is done right. Roundtable members agree, but "done right" often is not well-defined. Through extensive review and in-depth discussion of the data that resulted from the activities outlined above, the Roundtable concluded that the necessary ingredients for a "getting it right" framework are:

- a strong, adaptive legal and regulatory system with adequate implementation staff and resources;
- aggressive development and industry adoption of best management practices and other operational performance standards;
- investments in technological and operational innovation; and
- carefully targeted and balanced research to inform the continual improvement of statutes, regulations, best management practices, standards, and technology.

If Pennsylvania and its surrounding states pursue excellence in these four areas, the Appalachian Basin could serve as a national model for getting unconventional upstream, midstream, and downstream development right. Specifically, the Roundtable believes that Pennsylvania could best implement this framework by aiming progress at three interrelated goals:

- Minimizing the acute and cumulative impacts of oil and gas activity on the environment, public health, and local communities
- Minimizing surface disturbance from oil and gas activity and maximizing the efficiency of resource recovery and transport
- Enhancing the regional use of natural gas and supporting opportunities for regional economic growth based on the full natural gas value chain

In early 2012, the Roundtable agreed that its attentions would best be concentrated in the legislative, regulatory, and research aspects of this framework. This decision was based largely on the degree to which other organizations and efforts were already focused on creating best management practices and driving innovation.

With the above framework and goals in mind, the Roundtable decided to select a small number of areas for comprehensive exploration and focused recommendations. After considerable deliberation over 30 potential areas, the members prioritized four areas for targeted attention:

Policy-relevant research: increasing the amount and enhancing the perception of research on the impacts of unconventional oil and gas development and ensuring that the resulting knowledge is used for the improvement of regulations and best practices

Conservation and unitization: developing a balanced proposal for modernizing the 1961 Pennsylvania Oil and Gas Conservation Law to account for modern technologies and approaches, limit surface disturbance, avoid wasted oil and gas resources, and move toward uniform conservation rules for all unconventional shale formations

Water management: protecting water resources by identifying improvements in management and regulation in the areas of water sourcing, hydraulic fracturing chemical disclosure, erosion and sedimentation, impoundments, vehicle traffic for water transport, wastewater treatment and disposal, groundwater protection, water related violations, regional water management, and water monitoring

Midstream development (pipelines and related infrastructure): developing recommendations that minimize the environmental and surface footprints of midstream construction, improve pipeline safety, enhance coordination and planning of siting decisions, and provide increased opportunity for economic and community development

The Roundtable's full report contains extensive background information and recommendations for each of these four areas along with a set of core recommendations that emerged from the Roundtable's discussions. All of the recommendations were constructed using a thorough and deliberative process to prioritize and address critical issues for Southwestern Pennsylvania.

CORE RECOMMENDATIONS

Through examination of the four focus areas, the Roundtable also identified a set of broader, overarching recommendations that fit within its framework:

The Commonwealth of Pennsylvania should increase investments in improving the accuracy, functionality, and transparency of its oil and gas data infrastructure. DEP has made significant progress in its management of oil and gas data over the last several years, but additional investments in innovation and data transparency and utility are necessary. Increased investment in user-friendly, accurate, and real-time systems will improve the efficiency of DEP-industry interactions, enhance research and data analysis capabilities, facilitate public access to information, and build public trust.

The Commonwealth should develop regulatory staffing parameters and oil and gas annual reports. DEP also should report annually—and publicly—on its oil and gas activities, including information about the prior year's progress and priorities for the upcoming year. The inclusion of transparent staffing parameters (possibly including minimum inspector-to-well ratios, frequency and number of well inspections, time frame required for permit review and action, expectations for timely responses to public and stakeholder complaints and inquiries, and other critical metrics) in this annual report would provide a clearer picture of DEP's additional staffing needs, if any, and demonstrate its continued ability to fully implement the state's oil and gas regulations.

The Commonwealth should restructure the Oil and Gas Technical Advisory Board. While most DEP advisory committees are diverse and provide opportunities for cross-sector dialogue on policy and technical issues, the existing Oil and Gas Technical Advisory Board (TAB) has five members, all with geologic and petrochemical backgrounds and most with industry ties (this structure is statutorily mandated in the current Pennsylvania Oil & Gas Act). The administration and the legislature should expand the Advisory Board's scope beyond technical issues and diversify the membership at the earliest possible time.

The Commonwealth should continue to regularly evaluate the ability of existing budget support and permit fees to support oil and gas regulation. As the administration and legislature consider future DEP budgets, they should regularly evaluate the ability of budget support and permit fees to adequately support DEP oil and gas operations. Currently, the oil and gas program is entirely funded by a combination of new permit fees, impact fee revenue, fines, and civil penalties. With current low natural gas prices and slowed drilling, it is unclear if new permit fees will be able to sustain the necessary oil and gas regulatory staffing level.

The Commonwealth should participate in regular, comprehensive STRONGER reviews. DEP should regularly participate in State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER) reviews in order to benefit from independent assessments of the state's oil and gas regulations and to identify opportunities for additional improvement. A STRONGER review already is underway in 2013–14, and it may take into account proposed regulations based on Act 13.

The federal government, state government, and stakeholder groups should support efforts to increase balanced research on and rigorous monitoring of the possible impacts of unconventional oil and gas development. The Roundtable's recommendation for an independent research fund, described below, represents a particularly compelling opportunity for progress in the understanding of oil and gas development impacts.

Government, industry, and regional universities should support NETL as the premier national unconventional oil and gas technology research hub and, through NETL, continue to advance technology and operational innovations. The Appalachian Basin states are well-positioned to lead on oil and gas technology and operational innovations with the excellent capabilities of local research universities and with the U.S. Department of Energy's National Energy Technology Laboratory (NETL) headquartered in Southwestern Pennsylvania. The federal and state governments, along with diverse stakeholders throughout the basin, should seek stronger relationships with NETL in order to continue developing innovations that can diminish the environmental risks of unconventional resource extraction, transport, and use.

DEP should strengthen engagement with and support of various cross-sector and industry efforts to develop Best Management Practices. DEP should continue its engagement with and support of various multi-stakeholder and industry efforts to develop best management practices (BMPs) and high-level performance standards. As appropriate, these practices/standards should be considered for incorporation into future revisions of relevant regulations and guidance documents to ensure continual improvement of industry operations.

UNCONVENTIONAL OIL AND GAS RESEARCH FUND PROPOSAL

Shale gas development is complex and multi-faceted, with economic, environmental, public health, social, and technological components. Robust and trustworthy research should be one of the critical ingredients in decision making by the state and federal governments and other important stakeholders.

The Roundtable used various tools and approaches to explore the research focus area, including a higher education survey, interviews with key government policymakers, outreach to relevant stakeholders, and media/literature reviews. The findings indicated that:

1. While substantial research has been completed or is under way, the amount of research activity on shale gas is lacking relative to the knowledge needs of policymakers and the public. Further, this mismatch between needs and actual research often is due to a dearth of funding.

2. Research that has been completed or is underway often is perceived as biased due to the funding source or review processes used.
3. Research has not been well aligned with the information or timing needs of regulatory staff, elected decision makers, or other civic leaders.

The Roundtable also investigated possible models to address the identified research deficiencies. Most potential models proved inadequate to overcoming the particular barriers of enhanced shale gas research. The one exception, however, was the Health Effects Institute (HEI), based in Boston. To a significant degree, HEI's nonpartisan approach, independent structure, history, and activities informed the Roundtable members' thinking on unconventional oil and gas research issues and aided in the development of the proposal below.

Based on the demonstrated need for additional balanced research, the investigation of models, stakeholder input, and the other information gathered, the Roundtable recommends that a fund be created to support rigorous and enhanced research to guide unconventional oil and gas development. The fund would have the following characteristics:

- diverse funding streams (state and federal governments, industry, and private philanthropy)
- regularly updated multi-year strategic research plan
- scientifically rigorous (competitive funding awards and peer review)
- transparency of funding and of research outcomes
- strong government and stakeholder relationships
- supportive of informed policy and practice based on state-of-the-art science
- able to synthesize existing research for shorter-term consumption by decision makers
- adequacy of funding support and staffing to implement a multi-year strategic research plan

In combination, these characteristics will help the research fund to maintain its ability to be nimble and responsive while being deliberative, strategic, and scientifically rigorous.

FUND GEOGRAPHY

While the fund could grow into a national effort, the best interim start-up strategy is to focus specifically on geologic formations found in the Appalachian Basin. Exact geographic dimensions of the basin vary, but the most commonly included states are New York, Pennsylvania, Ohio, and West Virginia.

These states share unconventional resources in the Marcellus, Utica, and other shale formations. They have a shared historical experience with resource extraction and, in many ways, similar regulatory regimes.

At the end of 2011, the U.S. Secretary of Energy Advisory Board's Natural Gas Subcommittee endorsed the creation of Regional Centers of Excellence that would involve public interest groups, state and local agencies, colleges and universities, and industry in basin-specific best practice development. While this research fund would have a slightly different mission, an Appalachian Basin scale would be consistent with the U.S. Department of Energy's emphasis on regional, shale-basin defined, and cross-sector approaches.

FOCUS OF RESEARCH ACTIVITIES

A multi-sector fund appears particularly well suited to support research on the acute and cumulative environmental, ecological, public health, social, and community impacts of unconventional oil and gas extraction, production, transport, and use. These are the most contentious areas that require increased attention and skilled, impartial investigation.

FUND IMPLEMENTATION STRATEGY

In order to begin the implementation of the research fund proposal, planning already is under way for a process to establish a multi-year unconventional oil and gas research agenda that will include targeted, carefully timed, and policy-relevant research questions. This initial process and resulting agenda will, to the highest degree possible, conform to the characteristics of the fund itself.

It will be essential for diverse stakeholders to be able to trust the rigor and independence of the process and the resulting agenda. The agenda cannot be viewed as being driven by one sector or one institution. Expert scientific staff with experience in collaboratively identifying research questions, setting priorities, and establishing strategic research plans will be essential ingredients in the process. A scientifically credible, impartial facilitator with a track record in this type of work and with experienced staff would heighten the chances of successfully crafting an agenda that can attract implementation funding.

In parallel with the agenda-setting process, a detailed plan for the implementation of the agenda through a multi-year, cross-sector fund will be constructed. Longer-term emphasis will be on securing stability and predictability for the research fund through multi-year funding commitments, regular stakeholder communications, hiring full-time staff, establishing research and review committees, and eventually drafting requests for proposals based on the strategic research agenda.

MODERNIZATION OF THE OIL AND GAS CONSERVATION LAW

In long-standing Pennsylvania law, the "rule of capture" provides that ownership of a natural resource is determined by who "captures" the resource first. This legal paradigm resulted in the early, inefficient extraction of Pennsylvania's oil reserves. Through over-drilling to capture the oil resource, well operators depressurized oil reservoirs, stranded numerous barrels of oil, and littered the landscape with wells. The Oil & Gas Conservation Law, which was originally adopted to satisfy Pennsylvania's membership requirements for the Interstate Oil & Gas Compact Commission, was designed to more effectively and efficiently manage oil and gas reservoirs.

However, the Conservation Law has not been updated since 1961. It is the last portion of a three-part Pennsylvania oil and gas legal structure to be updated—both the Oil & Gas Act (Act 13) and the Coal & Gas Resource Coordination Act have been revised within the last several years. The 1961 Pennsylvania Conservation Law uses outdated depth restrictions, which in turn generate distinct regulatory systems for the Utica, Marcellus, and other shale formations.

The Shale Gas Roundtable has developed a balanced proposal for modernizing the Conservation Law and ensuring a standardized regulatory structure through all unconventional formations. This framework can be used to inform a comprehensive update of the Conservation Law or, in the interim, components of the framework could be legislated separately.

The Roundtable's considerations in crafting this proposal included the following:

- The Commonwealth should not have different conservation rules for different shale layers.
- The 1961 law did not anticipate horizontal drilling, multi-well pads, or large-volume hydraulic fracturing, and any update should take these advances into account.
- It is in the best interest of the Commonwealth to limit the density of well pad development. Fewer pads equal fewer acres of surface disturbance, less infrastructure build out including gathering pipelines, and likely fewer potential environmental impacts.
- Land and mineral rights owners have complicated relationships with each other and with the natural gas resource. The Commonwealth should approach any update with careful attention paid to the ability of all stakeholders to constructively participate in the unitization process.
- Natural gas is an important economic asset of the Commonwealth. With substantial extraction already under way, the Commonwealth should make every effort to increase the efficiency of resource recovery and to prevent waste through stranded gas/acreage.

The framework below aims to provide uniform conservation rules that account for modern oil and gas development approaches and that prevent unnecessary environmental impacts and wasted resources.

APPLICABILITY AND ADMINISTRATION OF THE CONSERVATION LAW

Modernized provisions in the Conservation Law should apply to all unconventional reservoirs as defined by Act 13. Given that the original act will likely be amended instead of replaced, 1961 provisions that remain relevant to either conventional or unconventional gas development should be retained.

The Department of Environmental Protection (DEP) would carry out the functions outlined in these recommendations, including the review of proposed units and integration requests. Operators are accustomed to state unit review and approval processes in many other oil and gas-producing states. The aim is not to create new bureaucracy but to enable DEP to ably manage the additional Conservation Law responsibilities in strong alignment with existing environmental regulations. DEP would be required to design a unit filing process that enables operators to clearly demonstrate their fulfillment of the established requirements and facilitates timely decisions. Recently instituted state permit review and decision guarantees (assuming accurate/complete applications) would apply to DEP unit reviews. In order to pay for the additional staff necessary to conduct unit and integration reviews, DEP would be enabled to charge fees for integration requests and unit proposal filings.

RATIONALIZATION OF DRILLING UNITS

The Conservation Law should govern the logical organization of drilling units in order to minimize surface disturbance and maximize the efficiency of extraction and transport of oil and natural gas.

The Commonwealth should not legislatively define minimum and maximum unit sizes, number of pads per unit, or number of wells per unit. Instead, DEP would be charged with developing a maximum ratio of surface disturbance to unit size and requirements that the unit be effectively drained. For example, if the legislation required exactly 400-acre units with one pad per unit, the operator would need three pads to drain 1,200 acres. What if, instead, the operator could design a 1,200-acre unit and drain it with two pads? Or, what if the operator could drain an

800-acre unit with one pad and drain the adjacent 400-acre unit from a pad on the 800 acres? A ratio tool and requirements for effective drainage would allow flexibility to DEP and operators in effectively managing the gas reservoir, avoiding stranded gas, adapting to technological and best practice advances, rationalizing units, and limiting surface disturbance. These unit parameters should be evaluated for revisions every three years to account for advancing technology and operational practices.

Operators would be encouraged to propose multiple units to DEP in one filing. Such an approach would allow for more comprehensive conservation by allowing industry and the Commonwealth to work toward development that limits surface impact and improves efficiency over multiple units covering a larger geographic area.

Based on fracture propagation data and area geology, operators should be required to propose setback distances between the unit boundary (boundary with leases/land not included in that unit) and any well laterals. This approach prevents subsurface trespass and protects adjacent mineral rights owners. It also protects operators from cross-fracturing each other's laterals.

INTEGRATION OF UNITS

In most cases, operators would control all leases in a proposed unit. DEP would not have jurisdiction over which leases or acreage are included in the proposed unit, only over whether the operators are meeting surface disturbance and effective drainage requirements.

In many other oil and gas-producing states, when operators are not able to secure leases for all of the acreage in a proposed unit, compulsory integration of non-consenting rights owners is an important component of conservation law. In Pennsylvania, full compulsory integration is currently available below the Onondaga Limestone via the 1961 Oil & Gas Conservation Law. Given the aim of minimizing surface impacts and avoiding waste, such compulsory integration does efficiently and effectively serve these goals. At a minimum, Pennsylvania should consider enabling company integration and existing lease integration:

- Company-on-company compulsory integration: The capability to request integration should be available to "persons" defined as operators. This will provide a remediation tool in the event that operators are effectively blocking the integration of efficient units.
- Existing lease integration: If an operator has the right to develop multiple, contiguous, held-by-production leases separately, the operator should be able to request integration of those leases into a unit for the purposes of oil and gas development via horizontal drilling (unless expressly prohibited by an existing lease). A similar provision is found within Pennsylvania Senate Bill 259, which passed the Senate and the House of Representatives in June 2013.

Seventy percent of the acreage in a proposed unit should be under the control of the operator before any type of integration request can be filed. The operator should demonstrate and document its attempts at good faith negotiation before a request can be considered. A fee would be associated with filing any type of integration request, which would serve to discourage such requests and provide additional revenue to support DEP's unit review functions.

AVAILABILITY OF UNIT INFORMATION

DEP should develop requirements for formatting and data inclusions in unit proposal and final unit filings. A statewide electronic filing system for unit proposals and declarations should be designed and implemented. The resulting maps and data should be publicly accessible via an online portal. There would be a need to ensure that the new filing system integrates with other DEP, Department of Conservation and Natural Resources, Pennsylvania Natural Diversity Inventory (PNDI), and Pennsylvania Spatial Data Access (PASDA) data systems. The current county-level paper filing system for final unit declarations should be retained to remain consistent with Pennsylvania title practices.

OIL AND GAS LEASE RELEASE REQUIREMENT

Upon the expiration of an oil and gas lease, the operator should, within 30 days after a request by the rights owner, execute, acknowledge, and deliver or cause to be recorded, a quitclaim of all interest in and to the resources covered by the oil and gas lease. Such a request can only be filed and only requires a response if the lease is no longer in the primary term and the lease is not held by production. This requirement facilitates the cleaning of title upon lease expiration and improves the marketplace for acreage then available to be included in future units.

TEMPORARY REGULATIONS

DEP should be allowed to issue temporary regulations to speed implementation of the modernized Conservation Law until permanent regulations can be promulgated and approved. Temporary regulations should be in place a maximum of two years.

WATER AND UNCONVENTIONAL OIL AND GAS RECOMMENDATIONS

In the spring of 2012, the Shale Gas Roundtable began to collect and analyze data for a regional scan of water-related issues relevant to shale gas extraction, transport, and use. Based on the information gathering and stakeholder dialogue processes, the Roundtable also was able to construct a set of recommendations focused on preventing potential water-related impacts of unconventional oil and gas development. The Roundtable developed recommendations in the categories provided below, with a risk-based life-cycle approach to managing water impacts.

WATER SOURCING

- Pennsylvania should sign the pending memorandum of understanding that supports the Ohio River Valley Water Sanitation Commission's (ORSANCO) study of water quantity regulation in the Ohio River Basin and also actively engage in the Commission's forthcoming studies.
- DEP should incorporate the recommendations in the Upper Ohio Basin flow study into its water management programs and update its policy to reflect this recent research. The Susquehanna River Basin Commission's new policy, based on a similar study, creates classes of streams based on their sensitivity to water withdrawals and limits withdrawals when they are likely to have ecological impacts. DEP should consider similar factors when managing water in the Upper Ohio Basin.
- The potential benefits of using abandoned mine water for hydraulic fracturing operations are well documented. The technology necessary to use this water largely exists, and the most significant barrier remains potential liability. As such, the General Assembly should adopt Pennsylvania Senate Bill 411, or similar legislation, to encourage the use of abandoned mine water in well development. The U.S. Environmental Protection Agency (EPA) and possibly the U.S. Congress should consider also addressing operator liability concerns under federal law.
- A water quantity life-cycle analysis for shale gas development should be supported and conducted at the earliest possible time to inform the public and future water quantity regulation.
- The draft Chapter 78 Water Management Plan (WMP) provisions should be enacted, including the extension of certain existing Susquehanna River Basin Commission water withdrawal rules to the Ohio River Basin. DEP should fully leverage the expertise of department water staff in WMP reviews, compliance monitoring, and enforcement (in collaboration with oil and gas staff).

HYDRAULIC FRACTURING CHEMICALS

- The Roundtable recognizes DEP for its strong efforts at facilitating public transparency of fracturing chemicals and its pressure to update the FracFocus.org platform to more adequately communicate needed information. DEP should continue to evaluate methods for improving the accessibility and utility of collected chemical information, with commensurate pressure on FracFocus.org to improve and innovate in order to meet Pennsylvania's needs in this regard.
- Industry, federal and state governments, and academia should prioritize the development of biodegradable "green" fracturing fluids. A green fracturing fluid would minimize the potential harm to natural gas workers and the potential environmental damage that could result from surface spills or underground migration of fracturing chemicals or flow back water. In the interim, the use of DNA or isotopic tracers in the fracturing fluid mixture may improve the ability to monitor underground fluid migration.

EROSION AND SEDIMENTATION

- In the design and review of oil and gas Post-Construction Stormwater Management Plans, DEP should require "whole-site" plans that take into account not only the well pads but the access roads and pipelines that service a particular development location.

IMPOUNDMENTS AND CONTAINERS

- DEP should evaluate various natural gas wastewater storage techniques, including mobile containers and centralized impoundments, to determine best practices for management of these fluids. This evaluation should use a life-cycle approach that estimates potential environmental and safety risks associated with each of the available storage technologies. In particular, DEP should continue to monitor potential acute emissions problems with open impoundments.

VEHICLE TRAFFIC/WATER TRANSPORT

- In addition to the new uniform rules in the draft Chapter 78 revisions, DEP should continue to seek methods that facilitate and incentivize the use of fresh water pipelines for water transport (possibly including a requirement that water transportation plans be included in the Water Management Plan).
- While Excess Maintenance Agreements (EMA) typically have been sufficient tools to ensure infrastructure repairs, the Commonwealth should evaluate whether the 30-year-old bonding rates should be increased to better protect local municipalities from EMA default.

WASTEWATER TREATMENT AND DISPOSAL

- The Commonwealth should transparently define and codify the categories of waste produced by unconventional oil and gas development and the differences among drilling, flow back, and produced waters. The lack of formal definitions adds unneeded complexity and uncertainty to disposal data and should be remedied through future legislation and regulation.
- DEP should consider requesting that operators include their water manifest tracking data in their biannual waste reporting and that the resulting data be made available for public consumption. The ability to follow all wastewater from well site to disposal location could improve public faith in the handling of these materials.
- Many wastewater treatment technologies leave residual by-products after the water is reclaimed. Additional government attention and industry/academic research should be aimed at the appropriate disposal and/or beneficial reuse of these by-products.
- DEP should evaluate current and future wastewater regulations by their ability to move toward zero discharge of natural gas-related wastewater in favor of recycling, reuse, and underground injection.
- DEP should proactively engage with U.S. EPA in a dialogue about the effectiveness and management of the Underground Injection Control and Wastewater Pre-Treatment programs, which are currently administered by EPA. Also, EPA recently completed a comprehensive risk analysis for Class 1 hazardous materials injection wells. EPA and/or the Commonwealth should consider conducting a similar analysis for Class 2 oil and gas brine disposal injection wells.

GROUNDWATER PROTECTION

- Enhanced research and monitoring are needed to establish baseline groundwater conditions and gauge possible cumulative impacts of unconventional oil and gas development on groundwater. Act 13 provided impact fee monies to the Commonwealth Financing Authority in order to fund statewide initiatives that can help to collect baseline water quality data on private water supplies. This program and others should be supported and expanded.
- The Pennsylvania General Assembly should pass House Bill 343, or similar legislation, which would establish construction standards for new private water wells. Legislators also should consider adding technical and financial assistance provisions that aid homeowners in the evaluation, maintenance, and refurbishment/replacement of existing private water wells.
- DEP should undertake efforts to standardize rigorous pre-drilling water testing parameters, methodologies, land owner notification procedures, and reporting requirements. Consistent parameters for post-drilling monitoring and sampling processes also should be developed.
- Regular inspection of sites is necessary to ensure industry compliance with DEP cementing and casing standards. In anticipation of future well re-stimulation activities, the Commonwealth should develop requirements for checking the continued strength and stability of the original cementing and casing. As noted in the Core Recommendations, it will be essential that DEP sets transparent goals and possesses the resources and staff to meet its inspection obligations.
- Due to groundwater infiltration concerns, Chapter 78 should be amended to prohibit on-site disposal of drill cuttings from the horizontal phase of drilling operations or solid wastes from hydraulic fracturing of unconventional wells.

WATER-RELATED VIOLATIONS

- DEP should invest in improvements to the violation database systems. Violations should be better categorized to improve understanding of the nature of the violation, its actual or potential severity of impact, DEP's enforcement actions, and the operator's response to the violation (as required by Act 13). DEP should consider annually summarizing and reporting on violation activity—and progress in remedying violations and preventing future incidents.
- DEP also should remove redundant violation records for single incidents so that the public and policymakers can more clearly evaluate violations activity.

REGIONAL WATER MANAGEMENT

- As delineated in the water sourcing section, the Commonwealth should support and actively engage in the ongoing ORSANCO water quantity studies.
- In 2009, a regional effort led by the Regional Water Management Task Force endorsed the creation of a water planning division at the Southwestern Pennsylvania Commission (SPC). That effort, which is under way, is designed to improve the cohesion of water monitoring, planning, investment, and technical assistance within a 10-county Ohio River Basin area. While SPC plans to initially focus its primary attention on stormwater, shale gas water management issues provide further impetus for this work. The region should support the growing role of SPC in planning for the future of Southwestern Pennsylvania's water resources.

- The Chapter 78 draft rulemaking states that DEP will collaborate with the Susquehanna River Basin Commission, the Delaware River Basin Commission, and the Great Lakes Commission on water monitoring and regulation of oil and gas activities. While Southwestern Pennsylvania does not have a direct corollary agency, DEP should consider outreach to and partnership with both ORSANCO and SPC on Ohio River Basin water resources management. Such collaborations would allow DEP to have natural water partners within this region of a similar type to those that already exist in Central and Eastern Pennsylvania.
- Local communities should consider the potential benefits of developing and maintaining a Source Water Protection Plan for drinking water sources. DEP should continue to encourage local jurisdictions to complete such plans and provide technical assistance to support the planning processes.

MIDSTREAM DEVELOPMENT RECOMMENDATIONS

Midstream infrastructure includes pipelines, processing facilities, compressor stations, and related infrastructure for transporting natural gas from well sites and preparing that gas for market. As of December 2012, 57 percent of Pennsylvania's spud unconventional wells were producing gas, a number that at least partially reflects the lack of adequate pipeline infrastructure to bring these wells into production. In the last six months of 2012, 683 wells were producing that had not been in the previous six-month period, possibly indicating the scale of recent midstream investment.

This ongoing development of a gathering and transmission network for Pennsylvania's unconventional wells caught the Roundtable's attention for multiple reasons:

- Building pipelines includes both substantial surface disturbance (both temporary and permanent) and construction activities that have environmental risks such as erosion and sedimentation, invasive species introduction, forest fragmentation, and stream crossings and encroachments.
- While incidents have been rare, the safety of pipeline systems will continue to be a public concern.
- Air quality and climate change impacts from compressor stations and methane leakage are possible.
- The pipeline system is a delivery mechanism to get shale resources from production to end users. As the markets for these resources continue to develop within the Commonwealth, the locations of midstream infrastructure can, at times, be either a help or a hindrance to users' cost-effective access.
- Pipeline rights of way become fairly permanent aspects of the landscape, and midstream planning will continue to interact with other local economic and community development planning.
- Any development inefficiencies that add to the costs of the overall system could possibly be passed on to consumers/ratepayers.

The natural gas midstream system has a wide range of potential impacts on landowners, the environment, public health, the local and state economy, and the individual consumer. As midstream infrastructure in Pennsylvania continues to expand to serve new producing wells, the short-term and long-term consequences of this development will require careful monitoring and management with the best interests of the public in mind.

In order to promote midstream development, which is environmentally protective and economically beneficial, the Roundtable recommends that the Commonwealth and interested stakeholders pursue a suite of important goals, including the following:

Crafting legislative and regulatory provisions that, in the public interest, encourage the efficient development of intrastate midstream infrastructure

The Commonwealth should actively seek opportunities to improve the efficiency of intrastate midstream infrastructure development, possibly including the sharing of pipeline capacity to transport produced gas. In addition to sharing infrastructure, such coordinated systems could jointly take advantage of existing rights of way that may be available and even co-locate with other utilities or natural gas-related infrastructure.

While joint efforts could be challenging because the new transmission would have to account for the diverse needs and lease-holdings of multiple operators, approaches such as these could serve the public interest by limiting surface disturbance and preventing the construction of unnecessary or duplicative lines. Identifying opportunities for increased efficiency also could decrease the total costs of infrastructure development, in turn positively influencing consumer rates.

Creating and leveraging opportunities for enhanced communication between midstream operators and other key stakeholders

In the near future, the Public Utility Commission (PUC) and DEP should consider partnering to convene three in-depth workshops to guide thinking on midstream issues in the Commonwealth:

1. Environmental and community impacts: A targeted discussion on present and future potential issues of concern regarding pipeline infrastructure. Industry; landowners; municipal and county officials; and environmental, conservation, and sportsmen's groups would be natural participants. What are the high-priority concern areas? How are companies proactively

addressing them? Are the appropriate state regulatory tools available to manage those areas of concern?

2. Economic and regulatory efficiency: A multi-part dialogue with an initial focus on supporting increased efficiency of infrastructure development. The multiple state and federal agencies that regulate aspects of midstream development should participate to discuss their own efforts at collaborative oversight and at improving the efficiency of interactions with industry.

3. Building midstream and downstream connections: A unique effort to create a dialogue among those who produce, transport, and use natural gas and related products in Pennsylvania. An initial conversation could include participants such as exploration and production companies, midstream operators, local distribution utilities, power generation companies, transportation sector representatives, and manufacturing companies. The goal would be to identify points of agreement and disagreement that have implications for Pennsylvania's management of its energy portfolio.

These conversations would be aimed at cross-sector relationship building and the identification of critical opportunities and challenges in the improvement of midstream policy and regulation. Due to the diverse interests and aspirations of the participants, the Commonwealth agencies are particularly well suited to serve as neutral conveners. If any or all of the discussions prove useful, additional follow-up sessions focused on more specific issues are possible.

Ensuring the availability of the necessary expertise and resources for state midstream permitting, planning, and inspection agencies

Staffing and resource issues for DEP are addressed at length in the Core Recommendations. As midstream activity increases, the PUC also should regularly monitor and report on the sufficiency of its resources, staff, and technical capabilities to meet federal and Pennsylvania public safety regulation and inspection requirements for midstream development.

Maintaining the protective adequacy of pipeline safety regulations, especially as larger volume, higher pressure gathering and transmission systems are being constructed

Current Pennsylvania law incorporates federal pipeline safety regulations by reference and enables the PUC to implement them. Any changes to those federal regulations, then, will automatically transfer to Pennsylvania as well. Given this arrangement, Pennsylvania should continue to proactively engage with other states and with the federal government to aid in shaping and strengthening any potential safety updates.

Minimizing and avoiding surface disturbance, forest fragmentation, and other impacts on sensitive ecological areas

Most states, including Pennsylvania, lack regulatory power for the review of intrastate pipeline siting determinations. However, since intrastate lines cannot be sited using eminent domain power, individual property owners can impact siting decisions through easement negotiations with midstream operators. In the absence of state review, multiple avenues are available to the Commonwealth and to operators in minimizing the environmental footprint of midstream infrastructure:

- The Roundtable's proposed modernization of the Oil & Gas Conservation Law could be one of the strongest tools available to the Commonwealth in avoiding surface disturbance and forest fragmentation. The Conservation Law framework is designed to rationalize units and prevent the construction of unnecessary well pads to extract the resource. Fewer pads should translate to less pad-related infrastructure, including gathering lines and access roads.
- DEP and other relevant state and federal regulatory agencies should consider creating a voluntary pre-construction consultation process, wherein developers would have the ability to discuss the proposed placement of new midstream infrastructure, particularly large transmission pipelines, and plans to minimize the impacts of that development. The utility and mechanics of such a process could be one of the discussion points for the second workshop outlined above.
- Ecological impacts also can be reduced through the increased use of siting decision support tools, which some operators already employ to great effect. These tools include mitigation banking and the identification and use of low-impact utility corridors where infrastructure can be clustered to avoid other more sensitive areas.
- The first recommendation in this section, regarding improved efficiency to avoid unnecessary infrastructure, also could be an important method for minimizing the surface footprint of the pipeline system.

Monitoring and responding to the implications of cumulative pipeline placement decisions on the needs of communities and citizens, on the potential for Pennsylvania consumers to use gas produced within the state's borders, and on the future use and value of land

County commissioners and other local government officials, while having limited midstream regulatory power, should be consulted throughout the midstream development process as important partners in protecting public safety and ensuring that operators are aware of and can adapt to local economic, land use, and community plans.

During these consultations, operators and local officials also should review economic development considerations related to pipeline placement. Opportunities may exist for innovative supply approaches along pipeline paths to feed various downstream users of natural gas, oil, and natural gas liquids. In a related vein, midstream operators could have an important role in supporting the expansion of consumer access to affordable natural gas service, particularly in rural and underserved areas.

CONCLUSION

The Roundtable recognizes that enacting these core and focus area (research, conservation and unitization, water, and midstream) recommendations will require serious consideration and action by a broad group of decision makers. Some recommendations will need legislative action for full implementation; others can be addressed through policy or regulatory actions by federal, state, and local agencies; and some can even be voluntarily pursued by regional stakeholders. In most cases, specific Roundtable recommendations identify which actors can pursue implementation.

A primary goal of this report is to inform the ongoing public policy discussion in this region and in the Commonwealth. As such, the Roundtable will continue to share its recommendations with state and federal officials, local civic leaders, and other relevant regional stakeholders to spread awareness of the report's contents and key findings—findings that can assist Pennsylvania in improving environmental, public health, and economic outcomes for local communities impacted by unconventional oil and gas development. ■