The Effects of Drilling the Marcellus Shale in Pennsylvania
Addressed to: The General Assembly of Pennsylvania

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Executive Summary: The extraction of natural gas from the Marcellus Shale Formation in Pennsylvania has significantly improved the state economy, but it is not a sustainable path forward. Extraction from the Marcellus shale is expected to last at most 92 years, not accounting for diminishing returns as gas is continuously extracted. Hydraulic fracturing of the Marcellus shale has also contaminated private water sources and caused localized air pollution. Transparent regulations and government oversight, coupled with the implementation of a state tax, can promote economic development and preserve the health of Pennsylvania citizens and their environment. This memorandum summarizes the current regulations surrounding drilling in the Marcellus Shale Formation in Pennsylvania and policy recommendations to utilize extraction as an excellent transition into the future of the state.

I. The natural gas boom of Pennsylvania

The Marcellus Shale is a source of natural gas composed of a sedimentary rock formation thousands of feet underground that stretches through the states of New York, Pennsylvania, West Virginia, and Ohio[1]. In 2008, the development of hydraulic fracturing, a drilling technique in which liquids are injected underground at high pressure to create cracks and release gas, allowed a surge in natural gas extraction in Pennsylvania, particularly from the Marcellus shale[2]. While hydraulic fracturing, or fracking, has generated economic benefits for Pennsylvania in the short-term, such as employment growth and a revived role in the nation's oil and natural gas industry[3], the non-renewable nature of shale gas necessitates thoughtful investment in the state economy's future. Further, its success has come at the cost of environmental and health impacts.

II. Current policy and challenges

Current estimates indicate that the 489 trillion cubic feet of natural gas stored in the Marcellus Shale Formation has a gross value of 1.46 trillion U.S. dollars, about three times the Pennsylvania economy in 2008 as defined by the total income of all Pennsylvania residents[4]. Pennsylvania counties situated along the formation contribute disproportionately less to the gross state product due to their economic focus on agricultural production. As a result, they are positioned to gain the most from natural gas extraction through hydraulic fracturing. Pennsylvania law requires that owners of natural gas resources be paid at least one-eighth of the value of natural gas extracted from gas wells[5], and the Oil and Gas Act of 2012 (Act 13) imposes an impact fee, which requires gas companies to pay for each fracking well they operate to cover local impacts from fracking[6]. As fracking has expanded in the counties in the region, economic activity has increased, including growth in employment and an increase in state sales tax collections, indicating increased expendable income for citizens in this region[4].

While fracking has generated economic benefits for Pennsylvania in the short-term, the non-renewable nature of shale gas necessitates thoughtful investment in the future of the state economy. As of 2017, Pennsylvania had 10,586 active fracking wells[7], where each well site takes up several acres of land and requires miles of pipelines and new roads[8], all of which lead to property devaluation[9] and become unusable infrastructure in the long-term. As of 2016, the number of state residents working in the industry was approximately 250,000[10], representing a large community that will be unemployed when the Marcellus shale is spent. As the number of active well sites decreases and the number of wells with short production lives increases[7], the Marcellus shale's lifetime expectancy is projected to be only 11 to 92 years[11]. From 2015 through 2018, Governor Tom Wolf has repeatedly proposed a severance tax, requiring gas companies to pay based on the volume of gas produced at each well to improve the resiliency of state infrastructure, but it has never passed[12,13].

Further, the success of fracking comes at the cost of health and environmental wellbeing. One specific concern is increased drinking water pollution in Pennsylvania as a result of fracking, as the chemicals involved in fracking[17], such as methane, can contaminate local drinking water sources as the chemicals are released from the shale[20,21]. Based on a report released to Congress in 2016 by the Environmental Protection Agency (EPA), poorly constructed wells and incorrect wastewater management can contaminate drinking water, particularly near drilling sites[18]. Such construction faults were observed in 3.4% of wells in Pennsylvania constructed between 2008 and 2013[19]. In 2012, contaminated samples were collected from three drinking water wells in Branford County, PA, and since the state did not need to notify private well owners of water contamination between 2012-2016, it is possible that other contaminated drinking wells were not reported during this time[24]. Additional health and environmental dangers of fracking have been observed, including correlations with increases in asthma, sleep disruption, headaches, and other health irritations[14-16].

Current regulations constrain attempts to address fracking-related water quality issues in Pennsylvania. The wastewater from drilling is exempt from regulations imposed by the Safe Drinking Water Act; therefore, possible contaminants entering public water systems are not held to a uniform federal standard[22]. The Fracturing Responsibility and Awareness of Chemicals (FRAC) Act has been proposed to remove this exemption. Despite modifications and multiple reintroductions to the U.S. Congress as recent as 2017[23], the FRAC Act has yet to pass. Likewise, to address health concerns, well operators are required to disclose chemicals used in fracking to the Department of Environmental Protection and the FracFocus database[26,27]. However, chemicals that are reported as trade secrets are exempt from disclosure except to medical professionals and emergency personnel who make a written request based on a reported possible direct exposure[25]. Furthermore, disclosure of chemicals is not required of chemical manufacturers, and operators are not responsible for reporting chemicals that manufacturers have not reported to them[25]. When chemicals are reported, the exact chemical composition may remain opaque due to incomplete Safety Data Sheets used[27]. These policies handicap both public health responses and individual treatments.

In addition to potentially contaminating water resources, wastewater cannot be treated at most treatment centers in Pennsylvania[28], and so a portion is transported to other states, resulting in vehicular emissions and increased air pollution[29]. Leaks of methane (a greenhouse gas) also occur at multiple points throughout the fracking process, causing natural gas production to be the largest contributor of U.S. methane emissions[30]. Although the air pollution from fracking is lower than that emitted from coal-generated energy[3], the air near wells may still have elevated levels of harmful chemicals, including ozone, particulates, and nitrogen oxide[31]. Overall, fracking was estimated to have cost Pennsylvania $7.2 - $32 million in 2011 due to air pollution[32].

In light of health and environmental risks, the EPA has set standards for air pollution from fracking

operations. The New Source Pollution Standards were updated in 2016 seeking to reduce emissions of methane and other toxic air pollutants[33]. However, a possible modification of these standards was first proposed in 2017 to reduce the required monitoring of leaks from semiannual to annual surveys[34]. Less frequent monitoring may increase the risk of leaks by potentially increasing time to response and thus cumulative exposure, but the modification has not been approved yet.

It is concerning to note that the Pennsylvania state advisory commission formed in 2011 for studying the effects of Marcellus shale drilling did not include experts or professionals in environmental health or any health field[37], limiting the commission's ability to adequately consider and respond to potential health risks. These health exposures will be borne disproportionately by poor communities, who are more likely to live in close proximity to hydraulic fracturing wells[38].

III. Policy Recommendations

i. Increase transparency and consultation of health experts

Improved monitoring, response, and planning regarding environmental and public health effects in the Marcellus Shale region require appropriate guidance from economic and environmental policy advisors and researchers, as well as more information provided from appropriate scientific studies. Public health must be safeguarded through the disclosure of fracking chemical exposures to patients and public health officials via physical and digital records, a measure endorsed by the American Academy of Family Physicians and partially addressed in the FRAC Act. Concurrently, closing loopholes that allow chemical manufacturers to treat chemicals as trade secrets will help clarify exposure risks. Knowledge of potential pollutants and better monitoring may protect local communities from negative health outcomes that arise due to acute or prolonged exposure. Oversight will be conducted by the state advisory committee, which should include experts in environmental health. These actions will likely not have a large economic impact on the natural gas sector in Pennsylvania but will enable policy makers and public health officials to better ascertain the risks to Pennsylvania's citizens and natural environment and to act appropriately.

ii. Pass the FRAC Act and tighten emission regulation

Preemptively strengthen protections for Pennsylvania's citizens and natural environment by passing the FRAC Act, closing the exemption for manufacturers of fracking chemicals in reporting chemical composition, and maintaining semi-annual monitoring of pollution emissions. Current treatment options are insufficient for releasing wastewater into the environment. The state must invest research towards processes for treatment of water that is resurfaced after fracking and hold businesses to similar treatment standards as other regulated industries. Passing the FRAC Act will allow EPA oversight over and standardization of state-level regulations. Increased transparency in chemical reporting and more regular monitoring for leaks will increase the effectiveness of responding to contamination and exposure. Since state-level regulation already exists, businesses may not see large increases in cost to meet federal standards. However, compliance may cost businesses through additional treatment and disposal considerations.

iii. Use proceeds from a Severance Tax to invest in sustainable economic development Pennsylvania is currently the only natural gas producing state without a severance tax, a state tax on the extraction of non-renewable natural resources that will be used in other states[39]. An effective severance tax will scale with natural gas prices to appropriately benefit state residents. An initiative similar to the Restore Pennsylvania initiative, introduced by Governor Wolf in 2019, would provide a significant boost in funding for crucial investment in state infrastructure. Although it is possible increases in taxes may lead to drilling companies operating in other states, economic incentives that lower the tax rate can be applied to specific wells in return for a complete disclosure of the chemicals that have been leached into local wastewater. Further tax benefits may be earned through coordination with local and regional committees to eliminate construction faults in

established wells, provide proper construction of future wells, and remediate wastewater near residential areas.

States, such as Texas and Louisiana, effectively impose severance taxes on the extraction of their non-renewable energy resources and invest the tax money in education, infrastructure, and other renewable energy resources[40]. Once a severance tax is implemented, Pennsylvania can utilize the revenue similarly, including investing in job training in the renewable energy sector. Specifically, Pennsylvania is well suited to harness wind energy across the state. As of 2017, the state generates 1.7% of in-state electricity from wind power, and it can supply up to 6.4% of the state's electricity consumption. Providing job programs to train and move workers from the natural gas industry to the wind power industry will also promote employment in lower-income regions[41].

IV. Conclusion

The short-term economic benefits of extracting natural gas from the Marcellus Shale Formation are beneficial to Pennsylvania, but with limited extraction lifespan and documented health and environmental hazards, continued drilling is not a long-term energy source. Citizens' health should be protected through transparent policies, and profits from drilling should be used to improve state infrastructure and prepare the state employees for the future job market with an appropriate training program to gain employment in the renewable energy sector. With these recommendations, Pennsylvania will leverage an economic boon to improve the wellbeing of its citizens and ensure its future.

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