PENNSYLVANIA'S SHALE GAS BOOM:

How Policy Decisions Failed to Protect Public Health and What We Can Do to Correct It

EXECUTIVE SUMMARY

ENVIRONMENTAL HEALTH PROJECT
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Sources are cited in the main body of the white paper. For access to an electronic copy of the full paper, scan this QR code or visit:

https://www.environmentalhealthproject.org/white-paper

TABLE OF CONTENTS

EXECUTIVE SUMMARY

PURPOSE OF THIS PAPER

Any new technology brings with it an aura of excitement and possibility, fueled by innovation. Unfortunately, in some cases, that excitement can overshadow valid questions and concerns about public health and safety, to the detriment of many. This paper recounts the events that set the stage for the shale gas boom in Pennsylvania, with a particular focus on the actions (and, in many cases, inactions) of governmental bodies that negatively impacted public health across the Commonwealth. While this account is not exhaustive by any means, it does illustrate trends across three policymaking bodies of state government, specifically the General Assembly, the Office of the Governor, and the Pennsylvania Department of Health (DOH).

The various sections of this paper will illustrate how the stage was set for Pennsylvania's fracking boom and the resulting public health crisis. Actions taken by various governmental bodies demonstrate how the promise of economic benefits outweighed any sense of caution about potential health impacts from shale gas development, how the insistence on irrefutable evidence of health harms became the enemy of reasonable protective measures, and consequently how the burden of proof fell to the communities experiencing the health impacts. The paper closes with a view of what can be done differently to ensure that public health considerations are included in the decision-making process.

What "Shale Gas Development" Is

Shale gas development (also known as "unconventional gas development," "hydraulic fracturing," or "fracking") is a method of removing and processing fossil gas from shale formations. This relatively new technology introduces horizontal drilling to the process and features high-pressure water mixed with chemicals and fine sand to fracture the rock and unlock previously inaccessible gas (largely methane). Shale gas development comprises other operational stages, including flaring gases, eliminating wastewater,

NARRATIVE AND RESEARCH TIMELINE

NARRATIVE

JANUARY 2003
Ed Rendell assumes office as 45th Governor of Pennsylvania

AUGUST 2005
President Bush signs Energy Policy Act of 2005

JANUARY 2011
Tom Corbett assumes office as 46th Governor of Pennsylvania

MARCH 2011
Marcellus Shale Advisory Commission created

MARCH 2011
Pennsylvania Department of Health starts recording health impacts from shale gas development

RESEARCH

transporting gas through pipelines dotted with compressor stations, and separating out usable components at processing plants.

The Marcellus and Utica shale formations in Pennsylvania held the promise of vast economic impacts in the form of jobs and extraction revenue. State politicians, wanting to attract gas companies to the state, made conditions very favorable for operators, from enacting low drilling fees to protecting proprietary formulas in the fracking fluid.

This friendly environment for industry led to a quick escalation of shale gas operations across the state, with more than 13,000 unconventional wells drilled as of the writing of this paper. The ramp-up continued despite a growing body of research that pointed to a higher risk of adverse health outcomes for people living in proximity to shale gas infrastructure, including cardiac, respiratory, reproductive, and neurological disorders, as well as cancer. Research has continued during the years of the shale boom, much of it focused on Pennsylvania-based data because of the prevalence of shale gas wells in the state and the frequency of related symptoms in residents of shale gas communities. Confronted with this same body of evidence, other states and countries have placed an indefinite moratorium on shale gas drilling.

Peer-reviewed studies indicate a range of adverse health impacts that increase with proximity to shale gas facilities. The studied impacts include:

- Asthma and upper and lower respiratory complaints
- Hospitalizations for heart failure and mortality from heart attacks
- Low birth weights, intellectual and developmental disabilities, and infant mortality
- Congenital heart defects and neural tube defects
- Headaches, fatigue, and skin rashes
- Stress, anxiety, depression, and other mental health symptoms

Vulnerable populations—children, the elderly, pregnant individuals, those with chronic health conditions—are likely to experience increased symptoms.

NARRATIVE

JUNE 2011

Shale gas development health registry proposed but not funded

FEBRUARY 2012

Act 13, a landmark piece of legislation guiding Pennsylvania's approach to shale gas extraction, is passed.

MAY 2012

PA House Democrats introduce the Marcellus Compact, a set of six bills designed to revise Act 13

AUGUST 2012

EPA publishes regulations limiting VOC and methane emissions from newly fracked wells.

RESEARCH

JUNE 2012

Mental Health: Perry. Development, Land Use, and Collective Trauma: The Marcellus Shale Gas Boom in Rural Pennsylvania

APRIL 2013

Neurological, Dermal, Mental Health, Respiratory, Other-muscle: Steinzor et al. Investigating Links between Shale Gas Development and Health Impacts Through a Community Survey Project in Pennsylvania

Why Public Health Matters

The role of public health as a field is to promote and protect the health of individuals and communities, focusing first on prevention or mitigation over treatment. Public health agencies have seen wins over the years in areas like sanitation, nutrition, and the spread of disease. Likewise, when the adoption of new technologies raises the question of health impacts, it is incumbent upon public health institutions to gather information and mount a response based on the best information available at the time, modifying the approach as more information becomes available. This paper will demonstrate that, while the structures were in place for state agencies—such as the DOH—to respond effectively to other public health crises in the past, they did not, or could not, do so in the face of rising concerns about shale gas development.

The lack of such a comprehensive response on the part of the state led to the creation of the Environmental Health Project (EHP) in 2012. In the decade our team has examined this issue, we have consistently documented concerning symptoms in residents that may be explained by exposure to the various chemicals used and released in the shale gas process. Evidence now exists that the risk of exposures through air, water, and soil is higher as a result of both standard shale gas operations and accidental releases. Years of compiling findings from academic studies, data from individual residents and community science projects, and input from experts and advocacy groups alike have informed EHP's data-based approach in advocating for public health protections.

EHP's efforts in the face of the shale gas boom represent only part of a vast, complex issue. Swift, protective action is the role of public health agencies in a public health crisis, but it is also the role of elected officials to act in the interest of their constituents. Communities hosting shale gas infrastructure often experience conflicting priorities, largely stemming from the promise of economic benefit weighed against the threat of health harms. The state legislature and governor's office have the power to support health protections for Pennsylvanians by supporting regulatory, investigative, and enforcement actions on the part of government agencies designed with that purpose.

JUNE 2013

Mental Health: Ferrar et al. Assessment and longitudinal analysis of health impacts and stressors perceived to result from unconventional shale gas development in the Marcellus Shale region

DECEMBER 2013

Cancer, Cardiology, Respiratory: Villeneuve et al. A cohort study of intra-urban variations in volatile organic compounds and mortality, Toronto, Canada

FEBRUARY 2013

Mental Health, Mortality: Adgate et al. Potential Public Health Hazards, Exposures and Health Effects from Unconventional Natural Gas Development

APRIL 2014

Maternal & Child Health: McKenzie et al. Birth outcomes and maternal residential proximity to natural gas development in rural Colorado

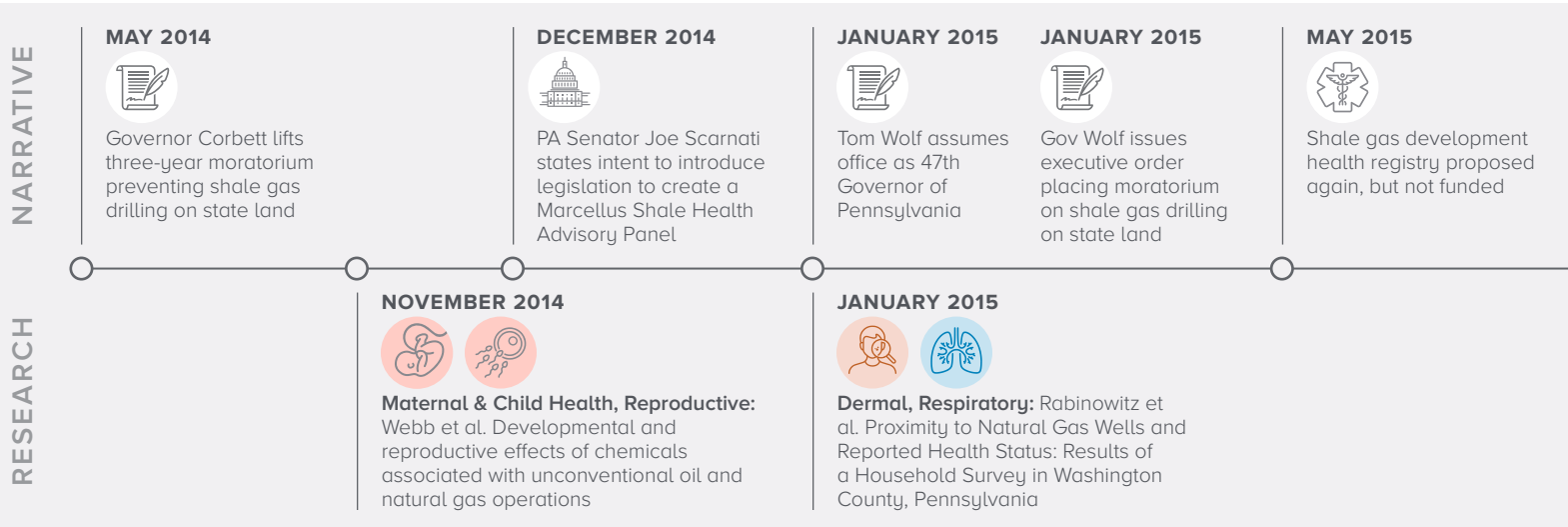
These governing bodies can also demand greater transparency from shale gas operators and can ensure more robust support mechanisms for communities that have traditionally been host to extractive industries. As this paper demonstrates, Pennsylvania's state government failed to take these protective actions.

INSIGHTS FROM EHP'S RESEARCH

While the research compiled for this paper is not exhaustive, the events and decisions examined in greater depth later are representative of broader trends within the Pennsylvania government. There are, no doubt, individuals throughout the General Assembly, the Governor's Office, and the Department of Health who are committed to serving the interests of their constituents. Similarly, there are some government actions that were no doubt undertaken with good intentions. Nonetheless, as this decade-plus survey of state-level decision-making shows, government officials demonstrated a lack of awareness of the available science, paid far more attention to accommodating the industry than to considering public health, and overestimated the protective nature of regulations. Major trends we identified are as follows:

1 *A chasm exists between the reliable public health research that has been conducted and the policies or initiatives that Pennsylvania's leading public health agency and other government policymakers have promoted. Public health actions are meant to be based on strong evidence, not irrefutable evidence. Yet, policymakers have consistently justified inaction by citing a lack of sufficient knowledge about health impacts.*

Epidemiological studies are at the core of public health research. They are based on observable trends in a given population and examine how those trends correlate with external factors, such as the presence of shale gas infrastructure. Epidemiological studies cannot establish a cause-and-effect relationship between two variables because, when dealing with humans, it is not possible to control all potential external variables (socioeconomic status, education, etc.), nor is it possible—or ethical—to



assign individuals to receive exposures or not receive them. Risks associated with large-scale environmental exposures can only be assessed by observing disease distribution across different times, populations, or exposure scenarios. Epidemiological studies can provide sound, actionable conclusions in their own right and must not be rejected out of hand, especially when multiple studies converge on the same findings.

An extensive and growing number of peer-reviewed studies demonstrate a statistically significant increase of health harms to people living or working in proximity to shale gas development. This research, occurring over the years of the shale gas boom, is characterized by the timeline that continues along the bottom of these pages.

Despite the volume of studies demonstrating a relationship between the presence of shale gas infrastructure and adverse health outcomes—respiratory, cardiovascular, neurological, child development, and mental health issues, as well as increased cancer risk—Pennsylvania's public health policies have not caught up. Time and again in our review of decisions made at the state level, government officials used the lack of perfect knowledge on the subject as an excuse for delayed action. In other words, government officials have regularly called for irrefutable evidence of harm before taking decisive steps, indicating that the subject warrants further study and effectively pushing off any policy response indefinitely.

The standard public health approach, however, does not require perfect knowledge before action is warranted. Public health protections require a swift response based on reliable (not complete) information, with the understanding that protective actions will be modified as more information becomes available. A good example of this approach is what would happen in the case of a suspected disease outbreak in a restaurant: the restaurant would be shut down while the situation could be investigated further. The issue that emerges in this paper is that government officials regularly used the lack of irrefutable evidence of health harms as an argument to say that shale gas development posed no risk at all. We now know that lead and tobacco are hazardous to human health, but for years these substances were treated with a presumption of

JANUARY 2016

Agency for Toxic Substances and Disease Registry releases Brigich report

JUNE 2015

Maternal & Child Health: Stacy et al. Perinatal Outcomes and Unconventional Natural Gas Operations in Southwest Pennsylvania

JULY 2015

Dermal, Neurological, Cancer, Cardiology, Reproductive: Jemielita et al. Unconventional Gas and Oil Drilling Is Associated with Increased Hospital Utilization Rates

JANUARY 2016

Mortality, Cardiology: Harrison et al. Sudden Deaths Among Oil and Gas Extraction Workers Resulting from Oxygen Deficiency and Inhalation of Hydrocarbon Gases and Vapors - United States, January 2010 - March 2015

safety that allowed industries to continue selling products without regard to health impacts. The shale gas industry currently operates under a similar presumption.

2 *Regulations provide a degree of safety, but there is a common misconception that they are data-based, health-protective standards; they are not. The widespread presumption of safety means that the burden of proof that emissions are causing harm often falls to the affected individuals and communities.*

The skeptical call for irrefutable proof has been detrimental to efforts of those trying to raise awareness of safety concerns about industry operations, as though lack of such evidence implies lack of harm. This unfounded argument is compounded by a common misconception that regulations governing the shale gas industry represent safety levels of exposure and that, as long as shale gas operators adhere to regulations, their operations pose no risk. While the presence and enforcement of existing regulations do help to protect the health of those who may be exposed to emissions, regulations do not represent a threshold of safety regarding the various compounds with which humans may interact. These levels are instead based on something called "acceptable risk."

Regulations frequently incorporate the concept of acceptable risk into the final decision-making process. Acceptable risk recognizes that the regulated activities are not completely safe but balances that recognition with an understanding that the known risks are small or unlikely. In the case of shale gas development, Pennsylvania's regulations do assume a level of acceptable risk. It is clear, however, that in deciding what level of risk the state was willing to accept, the industry understated the risks and government officials failed to investigate unknown risks, of which there are many whenever a new technology is introduced.

When public health policies are ineffective at preventing public health harms, those feeling the effects often turn to their elected officials to take action. It is rare that a

NARRATIVE

RESEARCH

FEBRUARY 2016

Hospitalizations: Werner et al. All-age hospitalization rates in coal seam gas areas in Queensland, Australia, 1995-2011

FEBRUARY 2016

Mental Health: Sangaramoorthy et al. Place-based perceptions of the impacts of fracking along the Marcellus Shale

APRIL 2016

Maternal & Child Health: Casey et al. Unconventional natural gas development and birth outcomes in Pennsylvania, USA

MAY 2016

Cancer, Other-immune: Rich & Orimoloye. Elevated Atmospheric Levels of Benzene and Benzene-Related Compounds from Unconventional Shale Extraction and Processing: Human Health Concern for Residential Communities

community has the clout to push back effectively against a well-financed industry or corporation. Successful advocacy requires time, education, and money, and many residents of communities that have historically been host to extractive industries are lacking in one or more of those resources. This situation represents an equity issue: the burden of proof often falls to individuals or communities being impacted, and they are commonly the least equipped to advocate for themselves.

3 *With respect to shale gas development in Pennsylvania, the promise of economic benefits overshadowed the caution over health impacts. In an attempt to attract more economic benefits, policies were created to be exceptionally accommodating to the industry.*

In addition to government bodies not effectively enforcing regulations, the policies governing these regulations were largely ineffective in the first place. Based on comments and actions by elected officials in the early years of the shale boom, it is clear that the state hoped to attract shale gas corporations through the promise of wide latitude to operate. Examples of these benefits included the institution of a small impact fee, rather than a healthy severance tax, and intellectual property protections that enabled companies to keep confidential any information about chemical compounds they deemed to be a trade secret.

Leaders in government failed to take health concerns into account in any significant way when constructing the policies that would govern the actions of shale gas operators in Pennsylvania. Lawmakers committed insufficient dollars to support investigations of resident complaints or enforcement of regulations. Further, the move to allow the industry to keep proprietary compounds confidential has hampered the efforts of health care providers to respond to patients' needs and of researchers to know what chemicals to study.

Economic research in recent years has examined counties across the state that have hosted shale gas development. Overall, the resulting economic benefit has been small,

AUGUST 2016

Reproductive, Maternal & Child Health: Balise et al. Systematic review of the association between oil and natural gas extraction processes and human reproduction

SEPTEMBER 2016

Preemption section of Act 13 overruled in state court in Robinson Township v. Commonwealth

SEPTEMBER 2016

Respiratory: Rasmussen et al. Association Between Unconventional Natural Gas Development in the Marcellus Shale and Asthma Exacerbations

OCTOBER 2016

Pennsylvania Medical Society recommends moratorium on shale gas development

OCTOBER 2016

Cancer: Elliott et al. Unconventional oil and gas development and risk of childhood leukemia: Assessing the evidence

OCTOBER 2016

Chapter 78A rulemaking updates environmental protections in PA regulations

NOVEMBER 2016

Mental Health: McDermott-Levy & Garcia. Health Concerns of Northeastern Pennsylvania Residents Living in an Unconventional Oil and Gas Development County

with few local jobs created and much of the work going to out-of-state laborers who move with the industry. Meanwhile, a significant amount of the health research on the subject is based in Pennsylvania, as there are so many communities in proximity to shale gas development experiencing adverse health impacts. Some of the specific actions of the various government bodies that contributed to the current situation are described in more detail in the next section.

GOVERNMENT ACTIONS (OR LACK THEREOF)

The federal Energy Policy Act of 2005 opened the door for swift shale gas investment in states that could capitalize on it, such as Pennsylvania. This act offered federal subsidies, tax benefits, and regulatory preferences for many energy sources, with particular emphasis on the oil and gas sectors, and it effectively removed the Environmental Protection Agency (EPA) from meaningful rulemaking over shale gas development and related operations. Further, the Energy Policy Act of 2005 excluded fracking wastewater from the "hazardous" waste category, regardless of its harmful components, allowing for the disposal of hazardous wastewater in regular sanitary landfills. From this point forward, states were given wide latitude in determining their own approaches to managing this new technology. Pennsylvania's approach indicated a preference for supporting industry growth over evaluating and responding to mounting concerns over health impacts.

The Pennsylvania General Assembly, the Governor's Office, and the Department of Health (DOH) all failed to respond meaningfully to this health crisis in the making. The failings of the Pennsylvania Department of Environmental Protection (DEP), which contributed significantly to this public health crisis, were well-documented in the findings of the Pennsylvania Grand Jury report investigating the state's oversight of shale gas development. For that reason, this paper does not address the DEP in depth.

General Assembly

Legislators are elected to represent the interests of their constituents. Many members of Pennsylvania's General Assembly serve on behalf of districts that host shale gas

DECEMBER 2016

Cancer: Finkel. Shale gas development and cancer incidence in southwest Pennsylvania

JANUARY 2017

Respiratory, Maternal & Child Health: Stacy. A Review of the Human Health Impacts of Unconventional Natural Gas Development

FEBRUARY 2017

Neurological, Respiratory: Tustin et al. Associations between Unconventional Natural Gas Development and Nasal and Sinus, Migraine Headache, and Fatigue Symptoms in Pennsylvania

FEBRUARY 2017

Cancer: McKenzie et al. Childhood hematologic cancer and residential proximity to oil and gas development

infrastructure and therefore should especially understand the complexity of this issue. However, the General Assembly's actions (and inactions) have typically favored the shale gas industry over public health protections. Most notably, the General Assembly demonstrated support for industry-friendly legislation, failed to provide sufficient funding for health-protective research and initiatives, and exhibited a preference for symbolic, over meaningful, action.

Act 13, Pennsylvania's landmark oil and gas law enacted in 2012, was the cornerstone of shale gas policy in the state. It generated a relatively small amount of revenue for the state through an impact fee rather than a severance tax, and we could find no evidence that any of this revenue was allocated to support the DOH in evaluating residents' complaints or concerns about local shale gas infrastructure. Act 13 also allowed the state to preempt local ordinances and overrule limitations local municipalities placed on shale gas activities. Finally, it permitted companies to designate certain chemicals used in their operations a "trade secret," preventing public disclosure of compounds that would help healthcare providers better treat their patients and researchers better examine impacts on human health. Pennsylvania's courts eventually declared some aspects of this legislation to be unconstitutional, but the foundation of Act 13 remains.

Budget authority in the General Assembly determines the resources—and therefore the bandwidth—of agencies tasked with protecting public health. Over the years examined in this paper, the General Assembly consistently underfunded efforts that could have shed light on public health risk. As early as 2011, Tom Corbett's Marcellus Shale Advisory Commission recommended $2 million to fund a health registry for monitoring public health in drilling areas. The General Assembly continually refused to fund such an effort until 2017, when the DOH received a fraction of the money necessary to create an effective registry. Agencies tasked with protecting public health and the environment, such as the DOH and the DEP, have pointed to the lack of adequate resources to evaluate complaints residents have logged and, in the case of the DEP, exercise enforcement powers over regulatory violations.

MARCH 2017

Pennsylvania Department of Health creates shale gas health registry

MARCH 2017

Mental Health: Maguire & Winters. Energy Boom and Gloom? Local Effects of Oil and Natural Gas Drilling on Subjective Well-Being

APRIL 2017

Maternal & Child Health, Mortality: Busby & Mangano. There's a World Going on Underground—Infant Mortality and Fracking in Pennsylvania

APRIL 2017

Mental Health: Boyle et al. A pilot study to assess residential noise exposure near natural gas compressor stations

MAY 2017

Hospitalizations: Werner et al. Is Increasing Coal Seam Gas Well Development Activity Associated with Increasing Hospitalization Rates in Queensland, Australia? An Exploratory Analysis 1995-2011

Political theater is made up of largely symbolic action that results in little impact and is sometimes used as a stalling tactic. At face value, investigative initiatives like advisory bodies seem like positive steps, but even when created with good intentions, they are not always set up for success or action. The Marcellus Shale Advisory Commission, formed in 2011, was considered by many to be political theater: the 30-person panel contained no public health agency representatives and was imbalanced in favor of shale gas industry supporters. Even though the commission did make some reasonable health recommendations, the General Assembly did not enact any significant health-protective steps.

The General Assembly had the opportunity to take a number of positive actions to ensure public health was protected from the harms posed by shale gas development. The General Assembly could have:

- Permitted all municipalities the power to enact ordinances and zoning that protect public health and allowed them to decide whether or not to host shale gas development at all.
- Required industry transparency of chemical information so doctors and patients could have had productive conversations about exposure, risk, and health outcomes.
- Allocated sufficient funding and clear directives to state agencies tasked with protecting public health.
- Discontinued the creation of unproductive committees or commissions used primarily as a stalling tactic and instead acted immediately on the available science.

Governor's Office

All three governors who held office during Pennsylvania's shale boom have demonstrated strong commitments to the shale gas industry, hailing it as an economic opportunity for the state. Governors have unique power in setting priorities for executive agencies, which have significant regulatory or programmatic impacts. Even if their party does not hold power in the legislature, they can still work to steer policy conversations

NARRATIVE

SEPTEMBER 2017

Pennsylvania Department of Health conducts Elk Lake assessment

RESEARCH

JULY 2017

Maternal & Child Health, Mortality: Whitworth et al. Maternal residential proximity to unconventional gas development and perinatal outcomes among a diverse urban population in Texas

JULY 2017

Mental Health: Davidson. Evaluating the effects of living with contamination from the lens of trauma: a case study of fracking development in Alberta, Canada

SEPTEMBER 2017

Neurological, Respiratory, Mental Health, Other-gastrointestinal: Weinberger et al. Health symptoms in residents living near shale gas activity: A retrospective record review from the Environmental Health Project

and impact public opinion. Pennsylvania's governors had the chance to support a moderated approach to shale gas development and largely chose not to.

Ed Rendell ushered in the beginning of the shale boom when the first unconventional well was drilled in Washington County in 2004, followed by the first surge of drilling in 2008. It was during his time in office that industry watchdogs identified instances of well water contamination, toxic chemical spills, air pollution, and explosions, for which industry operators were responsible. Governor Rendell and the DEP did issue a fine to at least one operator in regulatory violation, barred it from drilling in the affected county, and demanded that it provide clean water to the impacted residents, but penalties for violations have been arguably light across the board.

Tom Corbett campaigned on aggressive pursuit of shale gas development and fulfilled that promise during his time in office (2011 to 2015). He worked to minimize governmental interference in the industry and adamantly opposed severance taxation, despite its use in every other shale gas-producing state. He established the 30-member Marcellus Shale Advisory Commission, which was heavy on representatives from industry (11 members) and devoid of medical or public health professionals or researchers. Ultimately the commission developed some proactive, health-protective recommendations, but the large majority of them were not executed. Also, during his time in office, Governor Corbett signed into law industry-friendly Act 13 of 2012 and lifted Governor Rendell's three-year moratorium for unconventional drilling on state land.

Tom Wolf entered office with a stated optimism that shale gas development could be done safely and provide revenue to support social programs. He opposed a statewide ban but did support a moratorium on shale gas drilling in the Delaware River Basin and on new gas leasing in state parks and forests. He also supported the public health registry, which had yet to find sufficient funding, and authorized funding for two health studies in communities in Southwestern Pennsylvania concerned with health impacts from shale gas development and a rise of rare cancers. Despite these promising steps,

OCTOBER 2017

Neurological, Maternal & Child Health: Webb et al. Neurodevelopmental and neurological effects of chemicals associated with unconventional oil and natural gas operations and their potential effects on infants and children

NOVEMBER 2017

Reproductive: Komarek & Cseh. Fracking and public health: Evidence from gonorrhea incidence in the Marcellus Shale region

DECEMBER 2017

Maternal & Child Health: Currie et al. Hydraulic fracturing and infant health: New evidence from Pennsylvania

DECEMBER 2017

Mental Health, Neurological, Respiratory, Dermal: Fisher et al. Psychosocial implications of unconventional natural gas development: Quality of life in Ohio's Guernsey and Noble Counties

Governor Wolf's actions were still insufficient to make public health central to the conversation. The severance tax has not become a reality, the health registry is too underfunded to be effective, and there are already concerns that the approach and focus of the health studies may be insufficient to provide any new information.

The shale gas development narrative could have played out differently if Pennsylvania's governors had taken more decisive steps toward protecting public health. Governors could have:

- Taken more direct action in demanding health protections for Pennsylvania residents, relying on the constitutional guarantee of clean air and pure water.
- Worked with the General Assembly to pass legislation that would have halted or slowed the growth of shale gas development until health impacts were more fully researched.
- Directed the agencies they oversee to include health protections in policies regulating the industry.
- Successfully lobbied for more funding from the General Assembly to support the specific shale gas-related work of these agencies.
- Used their bully pulpits to advocate for health-protective legislation and to inform the public about associated health risks.

Department of Health

Pennsylvania's chief public health agency bears much of the responsibility for protecting frontline residents and, consequently, much of the public's ire when it fails to do so. While the other governmental bodies examined here must weigh various concerns that impact their constituents, such as economic and environmental factors, the DOH's concern is solitary: public health. Nevertheless, it is also important to highlight the limitations of the DOH's own ability to act, much of which has been determined by the General Assembly and Governor's Office during the time period in question.

NARRATIVE

RESEARCH

JANUARY 2018

Maternal & Child Health: Caron-Beaudoin et al. Gestational exposure to volatile organic compounds (VOCs) in Northeastern British Columbia, Canada: A pilot study

FEBRUARY 2018

Mental Health: Hirsh et al. Psychosocial Impact of Fracking: A Review of the Literature on the Mental Health Consequences of Hydraulic Fracturing

MARCH 2018

Endocrine: Bolden et al. Exploring the endocrine activity of air pollutants associated with unconventional oil and gas extraction

MARCH 2018

Respiratory, Maternal & Child Health, Neurological: McKenzie et al. Ambient Nonmethane Hydrocarbon Levels Along Colorado's Northern Front Range: Acute and Chronic Health Risks

The DOH's role and authority are fairly limited in the state of Pennsylvania. The DOH secretary is appointed by the governor, and the agency takes the governor's lead in setting its agenda. The DOH does not have regulatory authority or enforcement capacity related to oil and gas but, rather, serves in an advisory capacity. Like most state health departments, the DOH can provide public health information and guidance, conduct health surveillance, and evaluate public health outbreaks or threats. The DOH does operate a division of epidemiology where residents can report their environmental health concerns, and DOH can provide guidance to those residents. While largely absent in the past, there now appears to be a nascent effort to communicate more directly and frequently with the DEP regarding complaints and health concerns around shale gas development.

The DOH's shale gas health registry has been problematic. It was not funded until 2017, and the funding the DOH received for it was not sufficient to build a robust tool or market it effectively. The DOH has taken the complaints logged from 2011 up to the creation of the registry and combined those records with the data gathered through the registry. Taken together, this data shows that residents are experiencing a range of respiratory, neurological, dermatological, gastro-intestinal, and psychological impacts, not to mention other issues. However, the total number of records still represents a relatively small number of concerned residents. Anecdotal evidence from EHP's work with frontline communities indicates that residents lack awareness that the registry exists, that those who try to use it have difficulties with finding or accessing it, and that impacted individuals exhibit a widespread reluctance to reach out at all based on a common perception that the DOH does not care or will not act.

The DOH's response to concerned residents was insufficient, according to reports in some media outlets as well as information gathered in the 2020 Grand Jury's investigation into the state's oversight of shale gas development. Particularly of note were assertions that the DOH had mishandled conversations with residents specific to shale gas development and had purposely limited staff knowledge of the issue. While the DOH has occasionally collaborated with the U.S. Agency of Toxic Substances

MARCH 2018

Hospitalizations, Respiratory: Peng et al. The health implications of unconventional natural gas development in Pennsylvania

MARCH 2018

Reproductive: Deziel et al. Shale gas activity and increased rates of sexually transmitted infections in Ohio, 2000-2016

MARCH 2018

Maternal & Child Health: Whitworth et al. Drilling and Production Activity Related to Unconventional Gas Development and Severity of Preterm Birth

JUNE 2018

Respiratory, Hospitalizations: Willis et al. Unconventional natural gas development and pediatric asthma hospitalizations in Pennsylvania

and Disease Registry (ATSDR) to investigate community level environmental health concerns, funding for these efforts is limited, and neither agency has any enforcement power when it comes to shale gas operations. Consequently, when the DOH and ATSDR do conduct community investigations and find clear health dangers, there is little they can do outside of making recommendations. More commonly, when the DOH calls for additional data collection in impacted communities as opposed to taking direct action, they are continuing to foster the flawed position that lack of incontrovertible evidence demonstrates lack of harm.

Research and education on factors that impact public health are areas where the DOH has an opportunity to shine, even in the absence of budgetary support. Under past DOH secretaries, the agency was reluctant to recognize and articulate to the public the risks posed by shale gas development. Most notably, in 2019, the state health departments of Pennsylvania and Colorado jointly released a literature review of existing epidemiological studies of populations living near shale gas development. In this paper, the joint departments of health called for research that showed direct causal links between shale gas emissions and health symptoms, referencing standards that are inconsistent with environmental health research and limiting the value of the preponderance of existing observational research. This stance, taken by DOH Secretary Dr. Rachel Levine under Governor Wolf's administration, was counter to generally accepted public health principles. It set the stage for the DOH and other government officials to further deny health impacts or—at best—to fail to comment on the subject at all. Frontline communities and the health care providers that treat them still wait for the DOH to issue formal guidance on how to best protect residents' health from shale gas exposures.

The DOH, with the right leadership and funding, could provide an invaluable service to the residents of Pennsylvania. Even without support from above, the DOH could have:

- Assumed a more important presence in the wider shale gas and health discussion, proactively seeking out information and advice from a broad spectrum of experts, researchers, community leaders, and others.

NARRATIVE

JULY 2018

Pennsylvania Department of Health performs public health evaluation on long-term air sampling

RESEARCH

JULY 2018

Mental Health: Casey et al. Associations of unconventional natural gas development with depression symptoms and disordered sleep in Pennsylvania

AUGUST 2018

Maternal & Child Health: Hill. Shale Gas Development and Infant Health: Evidence from Pennsylvania

SEPTEMBER 2018

Reproductive: Beleche & Cintina. Fracking and risky behaviors: Evidence from Pennsylvania

OCTOBER 2018

Maternal & Child Health: Konkel. Drilling into Critical Windows of Exposure: Trimester-Specific Associations between Gas Development and Preterm Birth

- Provided communities with more guidance and information to help them protect themselves and their families from harmful shale gas emissions. If funding was an issue, the DOH could have distributed guidance and information developed by other agencies or non-governmental organizations (NGOs) who had studied the issue.
- Lobbied the governor or regulatory agencies for more caution in the face of existing research, promoting health-protective policies and raising a warning flag that shale gas development might not be as safe as the industry led the public to believe. It is unclear whether this ever happened behind closed doors.

FRAMEWORK FOR A BETTER APPROACH

Recognizing that past actions do not dictate future decisions, this paper concludes with a framework that can support a more health-protective approach for Pennsylvania. Applying *good governance* principles, which support individual human rights, EHP has identified the following opportunities to correct the chosen course of the past, one that has contributed to health harms for over a decade of the shale gas boom (and over generations of extractive industry operations) across the state.

Four key areas represent opportunities to close the gap between the status quo and a more health-protective approach to shale gas development:

Equity:
Protect people in areas that bear the burden of all aspects of this extractive industry; create more meaningful approaches to ensuring equity

It must be recognized that there is no strong evidence that demonstrates shale gas development can be conducted in a way that keeps people safe. However, for as long as shale gas extraction is going to continue in Pennsylvania, community groups and local or county governments must have a say in what happens in their own regions.

NOVEMBER 2018

Mental Health: Blair et al. Residential Noise from Nearby Oil and Gas Well Construction and Drilling

JANUARY 2019

Mental Health: Richburg & Slagley. Noise concerns of residents living in close proximity to hydraulic fracturing sites in Southwest Pennsylvania

JANUARY 2019

Maternal & Child Health: Janitz et al. The associations between natural gas well activity and specific congenital anomalies in Oklahoma, 1997-2009

FEBRUARY 2019

Mental Health, Respiratory, Cardiology, Maternal & Child Health, Cancer: Gorski & Schwartz. Environmental Health Concerns from Unconventional Natural Gas Development

There must also be a meaningful mechanism to incorporate the feedback of frontline communities into the decision-making process.

Such a shift to a more equitable approach would require the government to balance, on the one hand, the benefits and costs of shale gas extraction for industry and landowners who benefit financially and, on the other, the costs for people who bear the burdens of health impacts, including the premature mortality for which industry-generated pollution is responsible. Further, because pollution does not follow political boundaries, a state-level approach with broad protections would be more effective and safeguard more people than steps enacted by individual counties or municipalities.

Because its first commitment is to its own residents, a responsive government is generally obligated to assume the side of a community over that of a well-resourced company. As it has played out in Pennsylvania, a municipality might restrict industry from developing shale gas sites in certain zones, but the industry operator can, and sometimes does, threaten to sue the municipality if any restrictive action is taken to limit extraction. Defending against that threat is nearly always beyond the municipality's financial capabilities, and so the municipality must usually acquiesce—that is, unless the state seeks remedies to equitably protect the health and welfare of the residents. At the very least, Pennsylvania state government must work to establish a more level playing field, one that recognizes historically disadvantaged communities.

Transparency:
Allow individuals, community groups, and other organizations access to important health information that they can understand and act on; compel the industry to make public all chemicals it uses

Over the past ten-plus years, government efforts to look at problems posed by shale gas development have not always been transparent. While it ought not be the responsibility of frontline residents to defend their own health, it is essential that they be given the tools to understand the exposures and potential health impacts they could be facing.

NARRATIVE

RESEARCH

MARCH 2019

Hospitalizations: Denham et al. Unconventional natural gas development and hospitalizations: evidence from Pennsylvania, United States, 2003-2014

MARCH 2019

Cardiology: McKenzie et al. Relationships between indicators of cardiovascular disease and intensity of oil and natural gas activity in Northeastern Colorado

MAY 2019

Maternal & Child Health: Caron-Beaudoin et al. Urinary and hair concentrations of trace metals in pregnant women from Northeastern British Columbia, Canada: a pilot study

AUGUST 2019

Maternal & Child Health: Stacy et al. Maternal Obesity, Birth Size, and Risk of Childhood Cancer Development

Regional air quality monitors now cast a loose net, often missing emission peaks from localized sources. If monitoring is conducted, it must be done with an eye toward understanding human exposures and their potential impact on health at the local and hyper-local levels. Monitoring data must then be shared with the public, and residents must be provided information to help them understand how emissions impact their health. Allowing impartial, third-party evaluators access to emissions and health data will provide a clearer picture of exactly what is happening in local air and watersheds.

The industry must be compelled to make public the complete range of chemicals used in shale gas operations. Drilling waste streams must be monitored and tested for toxic and carcinogenic substances, and communities must be informed when dangerous levels of contaminants enter the environment. Ultimately, industry can be compelled to manage a public warning system when excessive releases of contaminants occur, as has been adopted in at least one other state.

Transparency on the side of state government includes access to the political decision-making process, particularly as it relates to how public sector decisions are made and what the alternatives to those decisions are. Pennsylvanians need to understand what factors influenced the decisions that affect them at home, at work, and at school.

Authority:
Provide funding for government agencies to do their jobs effectively; authorize them to take action through a strong mandate to protect public health

Appropriate government officials, starting at the top, need to provide a clear mandate that government agencies are tasked with protecting the health of the environment and the people in it. When examining the existing body of knowledge on the subject, as well as the myriad complaints from Pennsylvania residents, it is clear that, to date, many members of the General Assembly, the Governor's Office, and the DOH have failed to make a good faith effort to understand and address the health risks and resulting health impacts of shale gas development. The current approach is not

OCTOBER 2019

Pennsylvania Department of Health holds community meeting to discuss cancer concerns

NOVEMBER 2019

Governor Wolf announces $3 million shale gas development health study

OCTOBER 2019

Maternal & Child Health, Mental Health: Casey et al. Unconventional natural gas development and adverse birth outcomes in Pennsylvania: the potential mediating role of antenatal anxiety and depression

OCTOBER 2019

Cancer: Holder et al. Evaluating potential human health risks from modeled inhalation exposures to volatile organic compounds emitted from oil and gas operations

OCTOBER 2019

Maternal & Child Health: Apergis et al. Fracking and infant mortality: fresh evidence from Oklahoma

NOVEMBER 2019

Maternal & Child Health, Cardiology: McKenzie et al. Congenital heart defects and intensity of oil and gas well site activities in early pregnancy

sufficient. The Pennsylvania government, at all levels, can use its authority to fulfill its commitment to public safety and wellbeing, setting more health-protective priorities for the future.

Government agencies, such as the DOH, could be far better equipped to fulfill their missions if they were allocated sufficient funding. Given adequate resources, agency field staff could analyze air and water samples where people live and at emission sources, and they could collect health data to get a better picture of the risks of living in proximity to shale gas development. Additionally, government agencies could better engage with individuals and communities to more fully understand their circumstances, experiences, and concerns. Armed with this knowledge, agencies could then provide better education and guidance on what impacted residents need to know and how they can take action to mitigate exposures. They could also provide information to health care providers on the front lines of this public health threat, who need to know how to respond.

Accountability:
Strengthen health assessment programs at the state level to be more responsive to residents' needs; follow up on reports of adverse health outcomes and risk near shale gas sites

Pennsylvania state government must establish and maintain a structured process to hold shale gas industry actors accountable for their actions or inactions. There also must be a robust mechanism in place for residents to log their health concerns or flag violations committed by industrial operators and for state agencies, such as the DOH, to respond meaningfully and in a timely manner to community members. In the shale gas arena, the federal government has stepped back from its commitments to protect environment and health. Taking its cue from U.S. presidents and Congress, Pennsylvania's governors and legislators eschewed their responsibility to protect the health of the Commonwealth's residents. Meanwhile, those same residents have no way to hold their government responsible except through the occasional court case or,

NARRATIVE

JUNE 2020

Pennsylvania's 43rd Statewide Investigating Grand Jury report on the unconventional oil and gas industry released

RESEARCH

MARCH 2020

Endocrine: Nagel et al. Developmental exposure to a mixture of unconventional oil and gas chemicals: A review of experimental effects on adult health, behavior, and disease

MARCH 2020

Mental Health: Mayer et al. Understanding Self-Rated Health and Unconventional Oil and Gas Development in Three Colorado Communities

APRIL 2020

Reproductive: Johnson et al. A Multiregion Analysis of Shale Drilling Activity and Rates of Sexually Transmitted Infections in the United States

JUNE 2020

Maternal & Child Health: Tran et al. Residential Proximity to Oil and Gas Development and Birth Outcomes in California: A Retrospective Cohort Study of 2006-2015 Births

in very dilute fashion, at the ballot box. Both of these remedies are slow, unpredictable, and lack meaningful resolution for residents being harmed.

Armed with the proper resources and a firm mandate, the DOH could fulfill its mission to help ensure that the health of Pennsylvanians is sufficiently protected. Over the years, the DOH has cultivated a working relationship with ATSDR, including joint investigations of community concerns related to shale gas sites. While the agencies have completed few investigations overall, the collaboration between state and federal agencies is promising. And while neither agency has any enforcement power, the framework is in place for a more effective approach to investigating environmental health concerns, including one where findings are not downplayed or diminished. While Pennsylvania has no control over the bandwidth or latitude federal regulators afford ATSDR, the state could enable its own public health agency to be more responsive to the needs of residents while providing the necessary resources for the agency to follow up on its own recommendations.

NEXT STEPS

When looking at the first decade or so of shale gas development and political decisions in Pennsylvania, it is clear that the government's response regularly favored creating an accommodating environment for the shale gas industry rather than establishing a cautious approach that would protect the health of Pennsylvanians. Leaders at multiple levels of government frequently justified a lack of caution by arguing that there was a lack of incontrovertible evidence, something an effective public health response does not require.

Those who debate the merits of shale gas development argue that pursuing economic benefits is at odds with promoting caution in the face of health risks, but economics and health are not opposed. The reality is that Pennsylvania's leaders could have better addressed both of these priorities in reaching reasonable, health-protective policy decisions.

JULY 2020

Maternal & Child Health: Cushing et al. Flaring from Unconventional Oil and Gas Development and Birth Outcomes in the Eagle Ford Shale in South Texas

JULY 2020

Mortality: Hendryx & Luo. Natural gas pipeline compressor stations: VOC emissions and mortality rates

AUGUST 2020

Endocrine: Nagel et al. Developmental exposure to a mixture of unconventional oil and gas chemicals: A review of experimental effects on adult health, behavior, and disease

AUGUST 2020

Maternal & Child Health: Gonzalez et al. Oil and gas production and spontaneous preterm birth in the San Joaquin Valley, CA

This paper has provided insights into decisions made by the Commonwealth's legislators, governors, and DOH leadership. The path to a healthier Pennsylvania rests on government equity, transparency, authority, and accountability. Government actions that could move us closer to that goal include the following:

- **Legislators** are in a position to craft and enact legislation that addresses the oversights of earlier actions. In addition to pushing forward more health-protective laws, they can also choose to allocate funding to the DOH and other agencies so these health protectors can fulfill their missions more effectively.
- **Governors** have the opportunity to set the tone from the top to ensure more robust regulations and enforcement by providing clear mandates and resources to agencies under their control.
- **The Department of Health**, while limited by resources granted by governors and the General Assembly, has the opportunity to be a more vocal advocate of public health protections, based on what is known from the existing science.
- **All public officials** have the opportunity—and the obligation—to listen and respond to the communities they represent, particularly the ones experiencing adverse health impacts from the shale gas industry.

From the beginning, Pennsylvania's public officials did not have the foresight, or perhaps the discipline, to approach the shale gas boom in a health-protective way. Meanwhile, the next energy revolution—away from fossil fuels—is already occurring. As this transition happens, we believe it is imperative that leaders in Pennsylvania government recognize the legions of research findings and testimonies from constituents demonstrating health harms related to shale gas development. Further, we call on these leaders to introduce policy and support decisions that protect the public's health in the face of this emission-intensive extractive industry. There is much to be done.

NOVEMBER 2020

Endocrine: Singam et al. Structure-based virtual screening of perfluoroalkyl and polyfluoroalkyl substances (PFASs) as endocrine disruptors of androgen receptor activity using molecular docking and machine learning

DECEMBER 2020

Mental Health: Soyer et al. Socio-Psychological Impacts of Hydraulic Fracturing on Community Health and Well-Being

DECEMBER 2020

Cardiology, Hospitalizations: McAlexander et al. Unconventional Natural Gas Development and Hospitalization for Heart Failure in Pennsylvania

APRIL 2021

Cardiology, Hospitalizations, Mortality: Denham et al. Acute myocardial infarction associated with unconventional natural gas development: A natural experiment

JULY 2021

Maternal & Child Health: Willis et al. Associations between Residential Proximity to Oil and Gas Drilling and Term Birth Weight and Small-for-Gestational-Age Infants in Texas: A Difference-in-Difference Analysis

AUGUST 2021

Endocrine: Gonzalez et al. Iodoacetic Acid, a Water Disinfection Byproduct, Disrupts Hypothalamic, and Pituitary Reproductive Regulatory Factors and Induces Toxicity in the Female Pituitary

DECEMBER 2021

Maternal & Child Health: Willis et al. Associations between residential proximity to oil and gas extraction and hypertensive conditions during pregnancy: a difference-in-differences analysis in Texas, 1996-2009

JANUARY 2022

Mortality: Li et al. Exposure to unconventional oil and gas development and all-cause mortality in Medicare beneficiaries

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