Mitigating the Invasive Method of Hydraulic Fracturing Through a Phase Out Policy Plan

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Executive Summary: Hydraulic fracturing, or fracking, is a process used to extract natural gas from shale deposits deep below the surface. Fracking is heralded as a "clean" energy source compared to other extraction methods due to comparatively low carbon emissions. The fracking industry decreases the U.S.'s dependence on foreign nations for energy and brings valuable job opportunities when sites are first established; however, affected communities do not experience the benefits of these economic "booms" for long. Concerns like increased cancer risk from air and water contamination are linked to fracking activity. Fracking operators are not required to disclose the contents of 'proprietary' fracking fluids used in extraction, which are known to contain chemicals that threaten public and environmental health. Fracking has detrimental effects on national public health and contributes to climate change through elevated methane emissions. Therefore, to help mitigate these challenges, we recommend a phase out plan including 1) increasing setback requirements and eliminating any exemptions, 2) managing methane (CH_4) leakages and improving monitoring systems on all sites, 3) mandating disclosure reports, and 4) mandating the collection of preliminary data to facilitate a bottom-up approach to management. We use Pennsylvania as a case study due to the state's prevalence of fracking and the current policies and regulations in place for drilling.

I. Introduction

Scrutiny surrounding domestic and global energy prices and security in the United States has reached an all-time high (IEA 2022). In 2022, the Intergovernmental Panel on Climate Change (IPCC 2023) emphasized the critical crossroads humanity is currently facing to secure a sustainable and liveable future (IPCC 2023). At the heart of these discussions lie the revolutionary yet destructive process of hydraulic fracturing–or "fracking"–and the question of whether the industry should be moving towards expansion or obsolescence.

Fracking involves injecting highly pressurized, corrosive solutions of water, sand, and a chemical mixture into shale bedrock deposits that release hard-to-reach natural gas. (Denchak 2019). The practice began in 1859, when American businessman Edwin Drake drilled the first oil well in Oil City, Pennsylvania, and allowed many to tap into plentiful but formerly inaccessible natural gas reservoirs. According to the U.S. Energy Information Administration, approximately 917,000 oil and gas wells are operating in the country and are projected to increase within the coming years (EIA 2022). Abundant fracking opportunities have led to an economic boom in places like Western Pennsylvania due to the large Marcellus shale deposit—spanning 90,000 square miles over West Virginia, Pennsylvania, and New York—producing twenty-eight percent of the nation's total natural gas (Buckley 2019, 5-40; Susko 2017).

Fracking dominates discussions of the United States' economy and energy security. Though fracking is noted to improve economic opportunities for some, many have raised concerns about the environmental and social disruption the industry creates by a lack of regulation (i.e., Robinson Township v. Commonwealth). Additionally, fracking sites are not required to disclose the contents of proprietary fracking fluids that contain biologically harmful chemicals such as ethylene glycol and propargyl alcohol (Denchak 2019). Thousands of chemicals used in the fracking process are linked to health concerns but go unreported, making it difficult to assess the definite impact of fracking (Greenwood 2018). The public's lack of information and understanding regarding the hazardous chemicals from fracking plants contributes to the oil and gas industry's control of the land, the economy, human rights and health. This paper's proposal will follow the structure of Pennsylvania rules and regulations because there are 11,451 active wells, 876 plugged wells, and 582 inactive wells and over a million people living within two miles of a fracking site (Buckley 2019, 5-40). These findings demonstrate how Pennsylvania can be applied to the other regions where fracking occurs.

II. Environmental laws vs. loopholes

Pennsylvania state legislation has embedded environmental protection rights into the state constitution. Pennsylvania's Green Amendment is listed in Article I, Section 27 of the state's constitution, stating "the people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic, and esthetic values of the environment" (Pennsylvania 1971, § 27). The Green Amendment is a legal vehicle to protect the human right to clean air, water, and overall ecosystem on a constitutional level. A 2013 Pennsylvania Supreme Court ruling (Robinson Township v. Commonwealth), reaffirmed the state's environmental rights amendment, preventing fracking development. The legal strength of Pennsylvania's environmental rights amendment can be employed to challenge harmful practices of the oil and gas industry by proving fracking to be a violation of the fundamental human rights to clean water, air, and natural surroundings.

There are several federal acts already in place to regulate industrial pollution and protect natural resources. However, fracking operations are often exempted. The Safe Drinking Water Act (1974) and Clean Water Act (1972), are designed to protect the U.S. waterways from industrial pollution, which includes the oil and gas industry (SDWA 1974; CWA 1972). There are a variety of loopholes in federal laws that make fracking wastewater exempt from regulation. For example, language in the Safe Drinking Water Act (SDWA) allows fracking operators to discharge wastewater in waters covered by the SDWA, as long as the wastewater does not contain diesel (SDWA 1974, 61). As a result, hazardous wastewater continues to be discharged into waters designated for recreation and consumption.

III. The debate within the fracking industry

i. Benefits of fracking

Fracking is a controversial technology that causes much disagreement among stakeholders, communities, and climate experts in regard to its benefits and consequences for the economy, environment, and society. Since 2007, the U.S. has significantly decreased its dependence on other countries for oil and gas. From 2007 to 2017, the U.S. decreased the amount of oil it imported from sixty to twenty-four percent (Sica and Huber 2017, 337-343). Fracking also benefited households and the job market by lowering gas bills for Americans from 2007 to 2013, yielding savings of $200 per year for gas-consuming households (Dews 2015). Communities near fracking sites also benefit from an increase in temporary job opportunities. So far, the fracking industry has generated 2.7 million jobs in the U.S. and is projected to produce approximately 3.5 million more by 2035 (IPAA 2015; Persico 2020). In 2020, Pennsylvania Department of Environmental Protection's (PA DEP) Energy Programs Office reported that the natural gas industry supports approximately 21,000 jobs across the state (Pennsylvania Department of Environmental Protection Energy Programs Office). However, opponents of fracking argue its negative impacts on the environment and public health outweigh the economic and cleaner energy benefits.

ii. Consequences of fracking: Economy

Although arguments in favor of fracking frequently reference its economic benefit, fracking employment follows a disruptive and uncertain "boom-and-bust

cycle" where the "boom" phase creates threats by the industry's own sustainability failures, leading to rises in unemployment and drops in production (Mayfield et al. 2019, 1122-1131). After the boom period ends, communities are left with weaker economies due to the gas companies moving out of these regions (Feser and Sweeney 2003, 38-67). People within these communities lose their jobs and investors lose the money put into these drilling sites. Resulting in communities having a higher likelihood of becoming economically insecure (Wilson 2023).

Due to the large Marcellus shale deposit in Pennsylvania, fracking opportunities are abundant but still have detrimental impacts on the local communities. Fracking in Pennsylvania is connected to an increase in the price of rent, housing shortages, and damage to housing units due to the massive influx of temporary workers (Williamson and Kolb 2015, 3-40). Pennsylvania school districts near fracking sites are known to have lower revenues and funding compared to similar school districts not near fracking sites (Kelly and Schafft 2020, 23-39). In addition to potentially damaging economic factors, fracking is well known for its negative impacts on the health of the natural environment and human beings.

iii. Consequences of fracking: Environmental health

Fracking is labeled as a cleaner alternative in energy production compared to other fossil fuel extraction methods. This is because transitional fuel obtained from fracking emits forty-five percent less carbon dioxide per energy unit than coal (Ellingson et al. 2016). However, many fracking wells are poorly managed and are known to have methane leakages ranging from two to seven-point-nine percent during the fracking process (Leahy 2019) and five to eight percent after drilling ends (Groom 2020). Methane is a potent greenhouse gas that is 80 times more powerful than carbon dioxide. Despite its shorter lifespan, its chemical structure allows it to trap more heat per molecule than carbon dioxide (IEA 2021).

The creation of these fracking sites promotes deforestation and land conversion, resulting in habitat loss for animal and plant species. The loss makes the land more susceptible to invasive and non-native species. As ecological niches change from fracking and species diversity decreases, changes to the terrestrial environment occur (Meng 2017, 953-957). Impacted species then move to find resources no longer in their native areas. This disrupts ecosystems and harms animals and plants near drilling sites.

Further impacting ecosystems, fracking is linked to human-induced earthquakes. These earthquakes are caused by the injection of fracking fluid when drilling occurs and the disposal of wastewater through underground injections (Earthworks 2022). These earthquakes raise concern because they can disturb the ground and impact animals, waterways, and soil as their habitat and food sources are destroyed or heavily damaged (Gillen and Kiviat 2012, 320-331). Despite earthquakes being relatively rare in the eastern U.S. (i.e. Pennsylvania, Ohio and West Virginia) when compared to the central U.S. (i.e. Oklahoma and Texas), there have been over 600 small earthquakes linked to fracking in the eastern U.S. (Seismological Society of America 2019).

Fracking also threatens the ecological health of clean water sources such as lakes, rivers, and streams. Increased levels of chloride, methane, and salt levels have been reported in groundwater and wells near fracking sites (Wilkin et al. 2015, 95-96; Bonetti, Leuz, and Michelon 2021, 896-902). This can be harmful to aquatic wildlife, as well as plants (Missouri Department of Natural Resources). These facts are particularly troubling in Pennsylvania, where water treatment and delivery systems are out of date. According to the Pennsylvania Annual Drinking Water Report, there were over 28,000 Safe Drinking Water Act violations in 2022 (Wilson 2023). Future violations are projected to arise as water levels drop due to droughts and upstream withdrawals from drilling activities, causing higher levels of pollutants and contaminants to stay in the water (Wilson 2023). Additionally, 210 out of 421 watersheds with fracking activities in close proximity to them were determined to be important surface drinking water sources. As freshwater is threatened by fracking, it stretches from local communities and small-scale ecosystems to state—or even nationwide communities and large-scale ecosystems (Wilson 2023).

iv. Consequences of fracking: Public health

Air and water contamination caused by fracking negatively affect the health and wellbeing of humans

in many ways. Research finds an increased risk of both adult and childhood cancer. Adults were at risk of developing various cancers: including hematologic, leukemia, and urinary, while children living within 2 km of a fracking site are two-to-three times more likely to develop leukemia between ages two and seven (Clark et al. 2022; Finkel 2016, 198-206). Contamination increased risk of pregnancy complications and birth defects, including low birth weight and premature birth rates (Hill and Ma 2022). For individuals living in fracking communities, there is a heightened risk of asthma, disordered sleep, and mental health disorders (Rasmussen et al. 2016, 1334-1343; Weinberger et al. 2017, 112-115; Casey et al. 2018). These impacts also spread to the elderly, who experience an increased mortality risk from fracking (Li et al. 2022, 177-18)

IV. Policy recommendations

i. Increase setback requirement to 1000 m with no exemptions

Increasing current setback requirements from 500 m to 1,000 m is essential to keep communities near fracking sites safe from dangerous air and water pollutants. Research recommends a minimum site distance of 1,000 m (3,280 ft) away from residential dwellings in order to ensure public safety (Phillips 2022). Pennsylvania has increased setback requirements in the past to align with public interest. In 2012, the Pennsylvania state legislature passed Act 13, which increased setback requirements from 200 ft to 500 ft However, a recent study found that the current 500 ft requirement is ineffective in preventing fracking incidents on site from impacting nearby residents—since 2012, they have occurred with the same frequency. The study also found that "the majority (up to sixty-five percent) of observed setback incidents in PA were likely due to one of the other two codified exemption mechanisms—landowner consent waivers and/or operator requested distance variances" (Michanowicz et. al 2021). To ensure public health interests are safeguarded, the law must prohibit access to such exemptions. It is pertinent that wells currently operating within the 1,000 m are capped. A policy review by Wyatt G. Sassman of the University of Denver Sturm College of Law recommends phasing out oil and gas extraction through a proximity-based approach (Sassman 2023). The phase-out plan mandates capping and closing oil and gas wells, with priority given to wells closest to populated areas (Sassman 2023, 749-780). The average cost of capping a fracking well is $33,000, but can go as high as $800,000 if complications arise (Decker 2023). The federal government would assist the process to ensure wells are capped, this is shown by the Infrastructure Investment and Jobs Act passed in 2021 with bipartisan support. This act allocated $1 trillion to states across the country in order to provide funding for various infrastructure projects—with $400 million granted to Pennsylvania, these funds will be used to cap wells (Pennsylvania Department of Environmental Protection). This provides a framework for a feasible transition away from fossil fuels and towards renewable energy while addressing human health priorities first.

ii. Manage methane (CH_4) leaks and improve monitoring systems

The methane emitted from fracking operations, either active or inactive, is poorly quantified. This means fracking has a larger impact on climate change. In the U.S., about 13 million metric tons of fugitive emissions have been emitted from poorly monitored oil and gas wells. Fugitive emissions are escaped methane that seeps out of broken valves into the surrounding environment (Sarmiento et al. 2012). This not only negatively impacts the environment but also negatively impacts the industry's economy by contributing to an approximately $2 billion loss in revenue in the U.S. (NevadaNano 2018). Companies operating sites must be held accountable and to a higher standard, requiring them to implement better-measuring systems for detecting and monitoring methane leakages. Improving site detection for methane will improve insight into the leakage rates and understanding of the variability in drilling areas. By using onsite qualitative measuring systems, data collected can aid efforts to reduce fracking's environmental footprint in the future (Driscoll and Maclachlan 2017, 2436-2439)

iii. Mandated disclosure reports

Some states, including Texas and Montana, require oil and gas companies to disclose the potentially harmful chemicals used in fracking fluids (Konschnik 2014, 319-359). These mandated disclosure reports typically include the ingredient name, chemical

abstract service number, concentration in the fluid, and supplier name (Bonetti, Leuz, and Michelon 2023, 1-37). Although these reports do not limit the hazardous activities of oil and gas companies, a goal-oriented approach to disclosure design can promote other regulation requirements and place public pressure on companies to change their behavior (Konschnik 2014, 319-359). With a goal-oriented approach, drafters specify policy goals, identify the target audience for each goal, and consider the feedback loops used by the audiences so disclosure information is spread easily (Konschnik 2014, 319-359). Studies show this can lead to significant reductions of chloride, barium, and strontium concentrations in local water resources (Bonetti, Leuz, and Michelon 2023, 1-37). Mandated disclosure reports are not without drawbacks. For example, limiting the disclosure of chemicals to only those labeled as "hazardous" can lead to underreporting because the chemical products (which contain a variety of undisclosed chemicals) within fracking fluids often have nondescript names, like Supermax and OGC-7 (Konschnik 2014, 319-359). Few state disclosure mandates clarify that companies must report all chemicals used in a well instead of all products (Konschnik 2014, 319-359). Oil and gas companies can also request the confidentiality of chemicals for trade secret protection, and U.S. law currently assumes all protected trade secrets are safe for public health (Fink 2019, 971-1024). However, in Montana, code 82-10-604 mandates any company requesting confidentiality of chemicals explicitly provide a detailed and multi-layered explanation showing the public why certain chemicals are valid trade secrets (Fink 2019, 971-1024; Montana Code Annotated 2021). When fracking disclosure policies are created with specific goals in mind, the disclosed information is less likely to be debated (Konschnik 2014, 319-359). Adopting a step-by-step disclosure process where communities understand exact reasons why oil and gas companies seek trade secret protection promotes transparency that is currently lacking with local communities.

iv. Pre-data mandates and bottom-up approach for management

Fracking companies must pay for potentially affected communities' pre-data measurements of water and air quality before drilling begins because oil and gas companies profit while communities are faced with pollution, destruction of ecosystems, and potential health hazards. Pre-data is a valuable defense in lawsuits for individuals who experience water and air contamination from fracking (Sassman 2023, 749-780). With pre-data, community members can lead a bottom-up approach for management that places public pressure on fracking companies to change their behavior. To ensure water samples are taken correctly and air monitors function properly, we recommend trained personnel are assigned outside of oil and gas companies to eliminate inaccurate and biased reporting.

This recommendation is not without challenges. In 2017, the Bureau of Land Management (BLM) rescinded a 2015 final rule on hydraulic fracturing that led to increased disclosure of chemical content in fracking fluids (Bureau of Land Management 2017). Under this new rule, at least two previous regulations be "identified for elimination" for every new regulation issued (Federal Register 2017, 9339). The executive order also states it is "essential" for the costs of oil and gas companies' regulatory compliance to be reduced, unless "required by law or approved in writing" by the Director of Office Management and Budget (Federal Register 2017, 9339). This complicates the proposed policy recommendation that seeks to increase costs of oil and gas companies' regulatory compliance; however, this is essential to ensure proper testing for an accurate report on water and air quality. To make this legally feasible, another executive order must be made, reversing the 2017 rule.

V. Conclusion

Fracking is a controversial topic due to the benefits it can have on our local and national economies. Though demand for these fossil fuels is high, the long-term consequences are too grave to overlook. To prevent further degradation of environmental and human health from fracking, it is vital to implement a plan that phases out fossil fuel extraction through this method wherever possible, and where not possible, modifying the regulatory process. Steps in this plan include prioritizing setback requirements away from local communities to reduce health risks, using new systems that manage and record the leakage of gasses from fracking sites, implementing mandates requiring fracking companies to disclose water and air quality conditions before extraction, and ensuring a

bottom-up approach is used for communities to maximize their influence. Although this approach requires continued diligence and support long-term, it is possible to alleviate the damages done to human and environmental health. Due to the urgency of this task, serious challenges would arise legally, economically, and politically. Legislation pertaining to fracking has been passed before, but those laws do not include any regulations for harm reduction. Adopting the recommended phaseout plan helps to combat destructive fracking methods as we face the pressing need to prioritize our environment and public health in the race against climate change.

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