

Spring 5-15-2017

Fracking in Pennsylvania: History, Geopolitics, and Public Health

Kathryn A. Susko
Fordham University

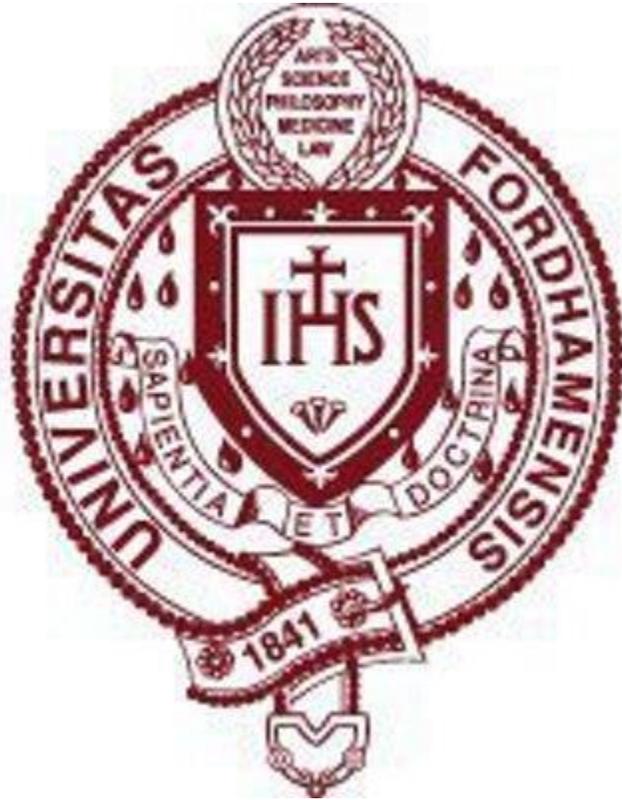
Follow this and additional works at: https://fordham.bepress.com/environ_2015

Recommended Citation

Susko, Kathryn A., "Fracking in Pennsylvania: History, Geopolitics, and Public Health" (2017). *Student Theses 2015-Present*. 44.
https://fordham.bepress.com/environ_2015/44

This is brought to you for free and open access by the Environmental Studies at DigitalResearch@Fordham. It has been accepted for inclusion in Student Theses 2015-Present by an authorized administrator of DigitalResearch@Fordham. For more information, please contact considine@fordham.edu.

**Fracking in Pennsylvania:
History, Geopolitics, and Public Health**



Kathryn Susko
Fordham University
Advisor: Dr. John van Buren
Submitted for Environmental Studies Degree
May 2017

Abstract

Hydraulic fracturing or fracking is the extraction of natural gas from deep within the earth through invasive drilling. This thesis explores the history of fracking, the geopolitical motivations for fracking in Pennsylvania, and the health risks associated with working and living near the sites. Seen within the context of the history and availability of our nation's natural resources, represents for energy companies an opportunity to extract large quantities of natural gas, yet these companies express contempt for citizens who suffer from the polluting effects of this industry and do not receive compensation. As for the geopolitics, there are evident geographical and political reasons why some parts of the nation have received more attention and contention regarding the usage of their land for fracking sites. Organizations like the PennEnvironment Research and Policy Center have put out annual reports and post current news on the fracking done in Pennsylvania with its disastrous effects on the earth and its inhabitants. The Center for Coalfield Justice is an organization based in Pennsylvania that works to educate and provoke change within Pennsylvanian communities. Together, the history, geopolitics, and public health aspects of fracking challenge its validity as a sustainable practice for extracting and using natural resources as it robs the land, the people, and the atmosphere with pollution.

Keywords: hydraulic fracturing, Pennsylvania, history, politics, environmental health

Table of Contents

Introduction What Has Fracking Done?

Chapter 1. Fracking by the Figures

Chapter 2. History of Fracking

Chapter 3. Geopolitics of Fracking

Chapter 4. Public Health Effects

Chapter 5. Conclusion: How Can We Fix This?

Introduction: What Has Fracking Done?

“Complaint Form #285711: Date Received: 12/16/2011. ‘Complainant lives in Wyalusing, Pa. Her well water turned purple on Thanksgiving Day. It ran Easter-Egg purple for about five minutes, then faded to normal, and then the well went dry. She is not comfortable with drinking her water/using it for cooking now and certainly will not have her children drink it.’ Wyalusing Twp. Bradford County.¹”

Complaints like #285711 are not uncommon in Pennsylvania. Ever since 1859, when drilling for oil and gas became a booming business, the environment and humans have suffered the consequences to no avail. This excerpt comes from the nonprofit investigative news source, the *Public Herald*. The co-founders of the *Public Herald*, Joshua Pribanic and Melissa Troutman, have dedicated their careers to exposing the fracking and shale gas scandals that plague many Pennsylvanians. The woman from the complaint above is one of the many victims of the Pennsylvania Department of Environmental Protection and its policy to shred complaints after five years. The complaint comes from their series called “Invisible Hand” where there are numerous other examples of people receiving the bureaucratic apology for why they have contaminated water. It is every citizen’s fear that his or her freedom could be turned down or compromised, but few can predict that this limitation will come in the form of potable drinking water. The Pennsylvania DEP has been forced to show their hand due to legislation in Pennsylvania called the “Right to Know Law”² which requires public information to be released when requested. There are, however, loopholes and backdoors that the Pennsylvania DEP utilizes to withhold information. Organizations like the *Public Herald*, the Center for Coalfield Justice, Earthworks, and State Impact NPR, and PennEnvironment all work with a similar goal in mind: to expose government agencies and energy companies through research and publications

¹ Joshua B. Pribanic “Cooked! An exclusive whistleblower report by Public Herald,” eriereader.com/article/cooked-an-exclusive-whistleblower-report-by-public-herald, (2015)

² “About The Right-To-Know Law”

of real stories and facts to lift the veil that has been put over Pennsylvania in regards to fracking and shale gas regulations.

In this thesis, a thorough look at the data, history, geopolitics, and public health behind fracking in Pennsylvania will be presented. In Chapter 1, data from the National Climate Assessment, the United Nation's Millennium Ecosystem Assessment, the United Nation's Intergovernmental Panel on Climate Change, and Miller's *Living in the Environment* will demonstrate a foundation for climate change and a call for more research on fracking. Earthworks, State Impact NPR, and PennEnvironment, and ExploreShale will supplement this foundation with more specific information on fracking in Pennsylvania but also the process itself. In Chapter 2, a historical review of fracking in this country and in Pennsylvania will give a clear look at how fracking has changed the landscape and its people. In Chapter 3, the geopolitical motivations for all the wells into Marcellus Shale will be expounded upon with references to politicians in Pennsylvania. The global tie of Pennsylvania natural gas exports will be made to show how the Pennsylvania geopolitics are actually global politics as well. In Chapter 4, the public health of Pennsylvanians, similar to the woman with the purple tap water, will be illustrated through interviews, testimonies, and medical records of how contamination and pollution play a role in the community. Concluding in Chapter 5, there will be recommendations for policy changes to current legislation and information on how to become more involved and informed.

Chapter 1. Fracking by the Figures

In one of the prime texts for students in the environmental field, there is a case study on reducing point source pollution in the United States. This text is Miller's *Living in the Environment*, and the study coincides, unsurprisingly, with fracking in that water pollution has been swept under the rug and unregulated for years. One of the biggest and common threats of fracking is that there is almost always a possibility that leakage, spillages, or explosions can occur near water supplies. The case study delves into the Clean Water Act of 1972 and its improvements for water quality in the United States; however, in 2006 the EPA found 45% of the country's lakes and 40% of streams were too polluted for swimming and fishing.³ In 2007, there were surveys conducted all over the country in the industrial and wastewater management facilities to examine the compliance of the Clean Water Act of 1972 which resulted with half of them exceeding the limits. There is no shortage, unfortunately, in this country of instances where water has been polluted, contaminated, and then covered up. In this case study, some of the causes were coal ash disposal, livestock runoff, and leaky gasoline storage tanks. How does water pollution and contamination relate to fracking in Pennsylvania?

The fracking process leaves too much room for error in how small oversight can pollute large quantities of private residential water rapidly. In Pennsylvania alone, there are 325,000 wells that have been drilled for oil and gas; over 12,000 have been abandoned or orphaned which are the riskiest and most likely to cause damage and contamination to water supplies.⁴

³ Miller, "20-5 How Can We Best Deal with Water Pollution?"

⁴ "Abandoned and Orphan Oil and Gas Wells and the Well Plugging Program"

What is fracking and where does it come from? Commonly referred to as fracking, hydraulic fracturing is the operation of using high pressured water and proppants pumped up to 10,000 feet in the earth into hard rock to release the natural gas that lies within the rock layers and pores. Proppants are sand or ceramic beads for when the water reaches the rock, these particles keep the holes open for the natural gas to flow through the pipes up to the surface. Chemical additives are experimented with for faster and efficient usage in conjunction with the water and proppants, although the recipes for these chemical concoctions are unknown to the public. The complete timeline for fracking can take anywhere from a few months up to a few years through picking a location for the well, production, and extraction of the natural gas.⁵ Using previous well sites' geophysics and the geologic information on Marcellus Shale, geologists and petroleum engineers advise natural gas companies where to begin construction. These geologists and petroleum engineers are vital to the entire process as they design the structures put into the earth, the chemical combinations used for the fracking fluid, and oversee the extraction of natural gas surfacing. The geophysics underground the earth are important for detection of Marcellus Shale formations and avoidance of provoking any seismic activity along tectonic plates. Marcellus Shale spans mostly from West Virginia, Pennsylvania, and New York over 90,000 square miles. It is predicted there are "hundreds of trillions cubic feet of natural gas" in the Marcellus formation.⁶ In 2011, 432.5 billion cubic feet of natural gas was extracted and 895 billion cubic feet in 2012.⁷ The Marcellus formation is from the Middle Devonian period about 390 million years ago; before the United States shifted away from Pangea, the location we

⁵ "Explore Shale. Marcellus Shale Development, Geology and Water." ExploreShale.org.2014.
<http://exploreshale.org/>.

⁶ Ibid.

⁷ Ibid.

know today of Marcellus was a large inland sea.⁸ Over millions of years, marine organisms and biomatter on the ocean floor were incorporated into the sediment, tectonic plates moved, and the extreme heat and pressure compressed this organic matter into hydrocarbons that we know today was natural gas.

In modern usage of wells, the combination of vertical and horizontal method drilling is successful. The vertical drilling is typically what has been utilized in the past, but the horizontal wells go with the grain of the Marcellus Shale for easier extraction of natural gas. The vertical wells range between 5,000 and 9,000 feet in the ground with the horizontal wells going up to about 10,000 feet below the surface.⁹ Typical private or residential water wells range between 200 and 500 feet in the ground. In Pennsylvania, the fracking sites must be at least 500 feet away from private or residential water wells and 300 feet away from streams or wetlands. While the private or residential wells 500 feet rule cannot be broken, there are loopholes and waivers that allow the 300 feet rule to be broken for streams and wetlands. The argument is that since the fracking is done thousands of feet into the earth, it should not interfere with any water supplies only 500 feet in the earth.

Stages of Fracking; From the Surface and Back. Aside from the procurement of leases and site permits, stage one is the perforation level. The steel boreholes are secured with cemented casings all around the pipes throughout the entire well past 50 feet under groundwater sources; the pipes themselves become smaller in diameter as they go deeper in the ground for the desired rising effect of natural gas rushing from the smaller volume piping to the larger volume towards the surface. Once all the pipes are set, an electric current is sent through by a wire to

⁸ “Exploreshale”

⁹ Ibid.

cause small holes in the steel cement, and into the shale.¹⁰ This is called perforating as it makes tiny holes in the pipes and the shale rock through electric current.

The second stage is the actual fracturing phase. This is when the water, proppants, and chemicals are highly pressurized to create larger cracks upon the small perforated holes in the shale. Between 3 and 5 million gallons of fresh water are used in one well, and between 3 and 5 million pounds of proppants are used with this water.

The third stage is the production phase. Once the cracks have been created, the natural gas rushes out into the casing. Because there are thousands of holes in the pipes, a plugging procedure is needed to trap the natural gas within the pipes to be shot up to the surface. The gas flows to the top once all the plugs are set. These plugs are to ensure that the gas, slickwater, proppants, flowback, and anything a crew may put in the pipes stays within the pipes for the entire process. Slickwater is the product of the water and chemical additives utilized to break up the thick, viscous fluid that was produced in the beginning to push the proppants to the shale. The slickwater reduces the friction and energy needed for the natural gas to travel up the borehole. In addition to these chemical components, sometimes petroleum engineers include in their “frack program” of chemicals a protectant for the equipment and clogging prevention. So there are different mixtures of chemicals that petroleum engineers concoct to pump down the well, up the well, and at the well. Figure 1 below details the fracking process with water usage and scaling of how far the pipes go underground. The curve of the well is where the vertical drilling becomes horizontal welling. This is also referred to as “directional drilling” in which steering the drill through the ground can be done at the time of placement.¹¹ In addition to steering, more wells can stem off of a single surface location for more access to shale rock.

¹⁰ “Exploreshale”

¹¹ Ibid.

Construction of a well. A typical fracking well pad will take 1 to 2 weeks to build; this is where the site obtains its stability and can be up to 5 acres to prevent and contain spills. Pits are included on the surface where flowback can be collected. Flowback drifts to the surface for about 7 to 10 days with the desired extracted gas, however, flowback can continue for up to 3 to 4 weeks. These drilling and production pits can be lined or unlined; biocides, acids, volatile organic compounds, diesel fuel, metals, salts, radioactive materials, and unknown chemical mixtures from the fracking pumping are collected in this pits.¹² There are three different ways that fracking can contaminate water supplies; improperly managed water plans, spills at the surface, and methane migration. These pits are crucial for preventing contamination of any sort.

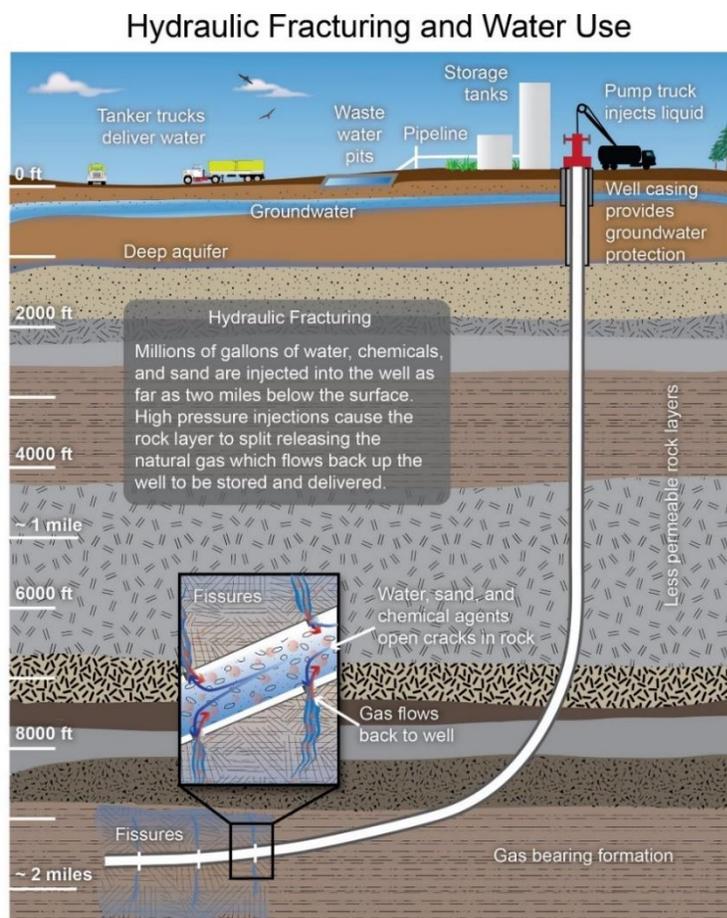


Figure 1 from the National Climate Assessment (Figure Source: NOAA NCDC)¹³

¹² “Exploreshale”

¹³ Nation Climate Assessment, “Examples of Energy, Water, and Land Linkages Shale Natural Gas and Hydraulic Fracturing”

What else can go wrong with a fracking well? Methane migration comes from the fact that natural gas is mostly made up of methane molecules; with leaks, spills, and high pressurized gaseous molecules being manipulated, methane migration is likely in places that do not enforce strict regulations for manufacturing natural gas. Leaks through the casings have occurred in the past due to lazy and inefficient sealing of the pipes; nowadays, there is a tool called the “cement bond logger” that uses sonic pulses to check the stability of the cement casing throughout the entire well.¹⁴ In the past, however, the abandoned or orphan wells were not properly managed; now they can be pulsed with these sonic waves to ensure the strength and durability of the casings. Plugging was not legally the same as it was in 1859 when drilling began in Pennsylvania. These abandoned or orphan wells are simply wells whose owners believed the wells had dried up and quickly moved on to find another location. Because the owner ditched the wells, the state of Pennsylvania is left to literally plug the pieces back together in order for water contamination and explosions to be avoided.

Today, companies seeking to drill must put up a bond to the state to promise to plug responsibly and adhere to state regulations. Unfortunately, the reason that abandoned wells were deemed dangerous and plugging bonds were needed was due to the fact that methane had leaked into the pipes causing massive explosions to erupt when another well was drilled into the abandoned one. In the commonwealth of Pennsylvania, there are over 12,000 abandoned or orphan wells that the government takes upon itself to plug and remedy. Each site or project is awarded up to \$250,000 under the “Act 13 Impact Fees for Plugging Abandoned/Orphan Wells” through the Marcellus Legacy Fund.¹⁵ Impact fees are taxes paid by natural gas and fracking

¹⁴ “Abandoned and Orphan Oil and Gas Wells and the Well Plugging Program”

¹⁵ Ibid.

companies to lease and obtain minerals from the earth. In some cases, the Marcellus Legacy Fund has worked to repair bridges and water supplies that were affected by fracking in the surrounding area.

Emissions from fracking. As mentioned earlier, the National Climate Assessment has conducted some research on shale gas and fracking. This assessment took a broad look at the world and specifically identified what data and research can teach us about a topic. “The U.S. Energy Information Administration projects a 29% increase in U.S. natural gas production by 2035, driven primarily by the economics of shale gas.”¹⁶ The assessment goes on to explain that methane produces fewer pollutants and could reduce greenhouse emissions better than carbon dioxide could, but the caveat is that reliance on antiquated and finite natural resources only delays the progress our society could make in alternative energy sources for future generations. The EPA estimates that 6.9 million megatons of methane has the equivalent global warming potential to 144.7 million megatons of carbon dioxide; methane is more potent than carbon dioxide, and increased dependence on methane would also increase the likelihood of leakage accidents from drilling, storage tanks, and pipelines.¹⁷

Not only does this global warming potential measure up staggeringly, the sheer amount of fresh water used for fracking would wreak havoc on the freshwater supply in the United States. According to the National Climate Assessment, one drill requires between 2 and 4 million gallons of water which is comparable to the water usage of 20 to 40 people in the United States or 3 to 6 Olympic sized swimming pools.¹⁸ The argument for reusing the water that comes back from a round of fracking is weak for several reasons. The water is heavily polluted with

¹⁶ “Annual Energy Outlook”

¹⁷ Ibid.

¹⁸ Ibid.

chemical, brine, and other particles, so the treatment of the water is heavy on energy consumption and expensive. Even with reusing this water, the ability to clean and have water that will not react negatively to the “frack program” concocted by the petroleum engineers is severely low. The water can only be recycled so many times until the previously legal amount of chemicals in the water builds up each time of recycling to become more of a liability and expense to purify.

Climate changes affected by fracking. Aside from the astronomically high projected usage of freshwater for fracking, the greenhouse gas effect would rise significantly as the methane’s global warming potential is quite high. The Intergovernmental Panel on Climate Change (IPCC) created by the United Nations is an organization with a mission to collect purely scientific and empirical data to learn from and educate others. The IPCC created a “Summary for Policy Makers” that includes advice and guidance for how legislation should choose policies given facts about the current situation on climate change.¹⁹ On possible causes of climate change, the summary states:

“Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century.”²⁰

It is evident here that researchers are extremely confident that continued use of carbon dioxide, methane, and nitrous oxide are not to be encouraged and are most certainly the cause for the destruction of our atmosphere. Fracking is one of the largest contributors to methane to the atmosphere, and agencies like the EPA and DEP should not ignore this fact any longer as

¹⁹ IPCC, “SPM 1.2 Causes of climate change”

²⁰ Ibid.

portrayed through the earlier presented case of the family with purple water from the *Public Herald*.

How fracking affects aspects of the person. Another important creation of the United Nations is the Millennium Ecosystem Assessment (MA) which tackles not only the current state of the ecosystem but applies the level of degradation of the ecosystem to the human condition. There are five main constituents for well-being of a person; basic material for a good life, health, good social relations, security, and freedom of choice and action.²¹ Basic material for a good life entails accessibility to essentials like food, water, shelter, clothing, and income. Health involves being free of disease, happy, and a general physical well-being of a person. Good social relations deals with the social environment, cohesion, and helping that a person experiences. Security is fairly straightforward in that a person feels safe and protected. And freedom of choice and action refers to how much a person feels he or she is able to do as they please and what makes him or her happy. In Figure 2, there is the interplay of ecosystem services on the constituents of well-being. The color, direction, and size of the arrow dictates how important and affected a constituent is by an ecosystem service.

²¹ MA, "Ecosystems and Human Well-Being Synthesis"



Figure 2: “Linkages Between Ecosystem Services and Human Well-being” (MA)²²

The inclusion of this illustration is meant to demonstrate how the ecosystem services change for people who live nearby fracking sites and how it plays into their general well-being. For example, starting small, perhaps the regulating factor of water purification is not guaranteed from water cycles naturally occurring after there was a surface spill at a fracking site in the area. The arrow is fairly large for this factor, but is medium colored on the spectrum in severity. It also pointed toward three constituents of health, security, and basic material for a good life. This does not seem like a minor issue, yet the consequences on a person’s well-being are greatly affected from the absence of water purification from the ecosystem. A larger issue at hand, such as absence of freshwater, would cause more distress and degradation on the ecosystem and the

²² MA, “Ecosystems and Human Well-Being Synthesis”

well-being of a person as shown in the figure. The arrows point toward security and basic material for a good life with the darkest color for the highest severity of mediation by socioeconomic factors. This hypothetical situation becomes real when there are people whose necessary water needs come solely from bottled water; fracking and these hypothetical situations are similar to the point source pollution EPA case study that show the very relevant and prominent stress of water potability and availability for people in this country. By accruing a knowledge of fracking and its consequences, there is room to improve, halt production, and consider exploring alternative energy options to fracking and natural gas.

Chapter 2 History of Fracking

In the Constitution of the Commonwealth of Pennsylvania in Article I, Section 27 the Natural Resources and Public Estate, it states,

“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's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.”²³

This legislation was built around providing the basic rights for the purest form of natural resources for all Pennsylvania residents. This part of the Constitution of the Commonwealth is used heavily in opposing fracking and natural gas companies that claim no harm is done to the environment, yet there are residents in Pennsylvania who are denied this right as a result of fracking. The history of fracking spans all over the United States in the creation of vertical and horizontal fracking, but Pennsylvania has a long history of extracting oil and natural gas long before fracking existed. Governors have had influence over the decree of fracking in Pennsylvania that varies between term and political leanings between Tom Wolf and Tom

²³ "CONSTITUTION OF THE COMMONWEALTH OF PENNSYLVANIA." Constitution of the Commonwealth of Pennsylvania. Commonwealth of Pennsylvania, 1977. Web.

Corbett. An overview of the history of fracking in the country, Pennsylvania's ties to the oil and natural gas companies over the years, and the differences that governmental leadership brings are to come in this chapter.

Edwin Drake, pioneer of oil drilling. On August 27, 1859, Edwin Drake drilled the first oil well in present day Oil City, Pennsylvania.²⁴ Drilling for oil was not safe unlike today, as it is a practiced craft. In this area, people would collect the oil that made its way to the surface without invasive techniques like drilling. At this time, the only oil company that existed was the Pennsylvania Rock Oil Company of New York.²⁵ Drake was picked up for work by them, and was clever enough to think of breaking the rocks underground in order to release the oil to allow easier flow back to the surface. His well went 75 feet deep into the earth, and he had struck black gold; this effect was immediate but observed the next day as the oil moved slowly through the night to form a pond around the drill. He then used any sort of container he could scrounge up such as whiskey barrels, troughs, jugs, and tubs to scoop up oil.²⁶ While Drake's story seems like an underdog success story, it is far from it. The oil and gas companies used his method without proper compensation for his intellectual property and product. In 1880, Drake died of medical complications in Bethlehem, Pennsylvania but later moved to Titusville near Oil City.²⁷ Being the first to implement this drilling method should have meant lifelong wealth for his family, but Drake had not secured a patent on his method. This method has been altered and developed over the past 158 years to define what modern fracking is today.

²⁴ Wile, Rob. "153 Years Ago Today, An Unemployed Sick Man Drilled The First Modern Oil Well." Business Insider. Business Insider, 27 Aug. 2012. Web.

²⁵ Ibid.

²⁶ Ibid.

²⁷ Ibid.

After the Civil War, a man by the name of Edward Roberts patented a technique he called the “exploding torpedo” for this company the Roberts Petroleum Torpedo Company.²⁸ This method involved loading 15 to 20 pounds of gunpowder into a metal device down the borehole that would explode when it reached the oil level in the ground; his technique was highly successful in obtaining the trapped gas that was untapped to secure him the US patent no. 59,936 in 1866.²⁹ Many observed his method but did not want to pay to use it, so they would develop slightly different homemade torpedoes for nighttime usage. It was a highly competitive market, and any new successful method was up for grabs whether legal or not.

How oil wells became fracking wells. After two wells in Oil City, Pennsylvania were drilled and dried, new techniques were needed to obtain the oil deeper in the earth. Gas and oil companies toiled with ideas for years. In 1947, in the Hugoton gas fields in Kansas, Floyd Farris from Stanolind Oil and Gas conducted the first gel injection into drilling, but it did not have the desired effects. The injection fluid was actually gelled gasoline and sand that was smashing through a limestone formation thought to have gas.³⁰ The first real successes were seen in Holliday, Texas and Duncan, Oklahoma using the modern day fracking procedures through Halliburton and Stanolind Oil and Gas Companies. While Drake’s well was drilled in 1859, the experimental wells drilled by Halliburton in Texas and Oklahoma were drilled almost 100 years later in 1949. Thus, the fracking boom began and was quickly adapted to gas fields all around the country. Halliburton is one of the largest oil and gas companies in the world with its headquarters in Texas. These methods for early extraction were not as highly developed or technology heavy as they are today.

²⁸ Heinberg, Richard. "Technology to the Rescue." Resilience.org. Resilience.org, 01 Oct. 2013. Web.

²⁹ Heinberg, Richard

³⁰ Manfreda, John. "The Real History Of Fracking." OilPrice.com. OilPrice.com, 24 Feb. 2017. Web.

George Mitchell, the Father of Fracking. The shale formation in Texas is called the Barnett shale formation; previously mentioned, the Marcellus shale formation in Pennsylvania is over 390 million years old, and this Barnett formation is over 300 million years old. It comes from the Mississippian Era and contains one of the largest deposits of gas in the world.³¹ With formations deep within the earth over 300 million years old, how were companies to get this gas out of the ground? They were scraping the surface of gas that could potentially come from these formations. There had to be an easier way to obtain this natural gas. George Mitchell attended Texas A&M University for petroleum engineering and geology.³² He started working at American Oil Company, was a reservist in the Army, and served during World War II as part of the Army's Corps of Engineers. Shortly after the war, he collaborated with his brother, Johnny Mitchell and an oil broker named H. Merlyn Christie to open their own business for drilling.³³ They consulting on other companies' projects, secured investors, and built up their reputation to make themselves a respectable oil drilling company. While still in his consulting days, Mitchell was brought in to evaluate an area that was commonly known as the "wildcatter's graveyard" due to the nomadic drilling done so many unsuccessful times. Wildcatting refers to the searching of oil.

There were positive geologic reports that Mitchell urged the group to lease the most land as possible in this area; it soon became the Boonsville Bend Conglomerate gas field and Mitchell's first huge success. This triumph gave them the reputation they needed to take out more substantial loans to fund projects and eventually led to the creation of their public

³¹ Diana Davids Hinton; The Seventeen-Year Overnight Wonder: George Mitchell and Unlocking the Barnett Shale. *J Am Hist* 2012; 99 (1): 229-235. doi: 10.1093/jahist/jas064

³² Ibid.

³³ Ibid.

company, Mitchell Energy & Development Corporation in 1972.³⁴ Mitchell's corporation leased land that he found later to encompass the majority of the Barnett shale formation. At this time, he knew what he wanted and needed to break through this shale. The Natural Gas Policy Act of 1978 was a motivator for Mitchell as whatever levels of natural gas he could drill, there would be a sizeable payout for his corporation.³⁵ The act allowed drillers to set the wellhead price because of the shortage at this time due to OPEC embargoes and difficulties.³⁶ Mitchell trudged on for the next seventeen years with drilling and revamping his techniques for what he believed be buried within the Barnett shale formation. During these seventeen years, he challenged his geologists to figure out some way through the shale barriers. He spent time, effort, and millions of dollars experimenting with great success in 1977 with the first modern day fracking well in place. The years of trial and error led his engineers and geologists to develop fracking at a lower cost than ever before at \$150,000 per well.³⁷ This became one of the largest shale booms in the country and changed the American mindset of energy as it could be produced in house eliminating complete reliance on foreign nations and companies such as OPEC.

Government Funding for Horizontal Drilling. Dan Steward was a former vice president Mitchell Energy & Development Corporation who participated in a 2011 interview about the government involvement in aiding and funding Mitchell's project into the Barnett shale. In the 1980's, the government was desperate for natural gas at this time and looked to extract in the Appalachian basin where Marcellus shale is located.³⁸ Mitchell was hungry for more innovation

³⁴ Diana Davids Hinton; The Seventeen-Year Overnight Wonder: George Mitchell and Unlocking the Barnett Shale. *J Am Hist* 2012; 99 (1): 229-235. doi: 10.1093/jahist/jas064

³⁵ Ibid.

³⁶ Ibid.

³⁷ Ibid.

³⁸ Shellenberger, Michael. "Interview with Dan Steward, Former Mitchell Energy Vice President." *The Breakthrough Institute*. Rockefeller Philanthropy Advisors, INC, 12 Dec. 2011. Web.

on his fracking technique that brought massive success for his corporation. He sought funding from the Department of Energy (DOE) and Gas Research Institute (GRI) in 1991 for resources and brainpower to discover more than his corporation could do on their own; the Devonian or Marcellus shale was similar to the Mississippian or Barnett shale that Mitchell was pushing for, and the government could provide insight for him. The DOE and GRI provided Mitchell with his first horizontal well for Barnett; they essentially split the cost down the middle for Mitchell to use and experiment with the new method of horizontal drilling to provide data for the federal government in their interest of obtaining the Appalachian basin shale.³⁹ The majority of interaction between the three organizations and work done on the shale formations was mostly kept a secret until the real validity and utility of shale gas in 2000 was proven.⁴⁰ His development of slickwater was in conjunction with Union Pacific Resources (UPR), and it became the new and improved method for fracking. Slickwater allowed faster and easier fracking compared to that of gelled solutions. Steward was forthright and open about Mitchell, government involvement, and cooperative in this interview with the *BreakThrough*. There could be something said about an employee of the oil and gas companies that allows discussion and interaction about their history and development over the years.

Fracking Regulation in the United States. The Natural Gas Act in 1938 allowed the Federal Power Commission (FPC) to set prices and regulation on pipelines, and later was revised to allow pricing at wellheads to give a more standardized guideline for gas pricing.⁴¹ The shortage of gas, however, caused the federal government to lift regulation from wellheads giving

³⁹ Shellenberger, Michael. "Interview with Dan Steward, Former Mitchell Energy Vice President." The Breakthrough Institute. Rockefeller Philanthropy Advisors, INC, 12 Dec. 2011. Web.

⁴⁰ Ibid.

⁴¹ Barbara Warner, Jennifer Shapiro; Fractured, Fragmented Federalism: A Study in Fracking Regulatory Policy. Publius 2013; 43 (3): 474-496. doi: 10.1093/publius/pjt014

companies more freedom in pricing, moving assets, and exploring more reserves for potential natural gas deposits. The U.S. government needed to remain a key player in the energy market or else OPEC could raise prices and put embargoes on dealings with the U.S. that would leave us powerless and with few options. Over the years, regulation in the energy market was loose, funded, and given more leeway due to the rising populations, new technology, and massive increase of energy at a lower and efficient cost. For this reason, the fracking industry has slipped through the cracks on more than a few occasions. The Resource Conservation and Recovery Act of 1976 allowed oil and gas waste to be exempted from the category of hazardous waste.⁴² The EPA does not require that fracking companies adhere to the Emergency Planning and Community Right to Know Act that requires the toxic chemical content of fracking fluid to be released to the public.⁴³ This can then violate into the Clean Water Act due to the possible leakage and contamination that can occur at the site of a fracking well or pit; fracking companies are not regulated by the Clean Water Act (CWA) or the Hazardous Materials Transportation Act (HMTA). These acts were enacted for a reason in federal courts and legislation and specifically for the prevention of potentially life-threatening chemicals from seeping into water supplies. And yet, the fracking industry sees another exemption from the Safe Drinking Water Act (SDWA). Under the SDWA, underground injection wells are to be regulated as they come close to groundwater and drinking water aquifers, but the Halliburton Loophole in the Energy Policy Act of 2005 “modif[ied] the definition of ‘underground injection’ to exempt all chemicals used in fracking, except diesel fuel.”⁴⁴ The Energy Policy Act of 2005 provided less federal involvement and gave states jurisdiction over regulation. While decentralizing this power to states is

⁴² Barbara Warner, Jennifer Shapiro; *Fractured, Fragmented Federalism: A Study in Fracking Regulatory Policy*. *Publius* 2013; 43 (3): 474-496. doi: 10.1093/publius/pjt014

⁴³ *Ibid.*

⁴⁴ *Ibid.*

seemingly positive, state governments vary drastically in how strict or loose regulations are applied to fracking companies. In a later chapter, the political leanings and motivations at the state level will be discussed.

Environmental Changes in Landscape Observed. When fracking was developed, the need for energy independence was vital in the United States. Due to the desperation of the government to pump up supplies of natural gas, many regulations were overlooked causing long-term damage to the environment. One of Pennsylvania's largest economies lies in agriculture. Livestock and livestock products are 70% of Pennsylvania's income; milk is the largest livestock product making Pennsylvania the leading producer of milk.⁴⁵ Beef cattle reign in as the second largest agricultural practice, followed by chicken eggs, greenhouse and nursery products, and mushrooms. The state also enjoys economic success from corn, hay, soybean, wheat, tobacco, oats, sweet corn, potatoes, tomatoes, beans, cabbage, apples, grapes, peaches, and strawberries.⁴⁶ Pennsylvania reached its highest production level in agricultural, food, and wood products in bringing in over \$1 billion in exports.⁴⁷ It is also home to companies like Hershey Foods Corporation and H. J. Heinz that bring in immense revenue and employment for Pennsylvania. So why bring up Hershey chocolate and soybean profits?

*"Another farmer reported that 140 of his cows were exposed to hydrofracking fluid when wastewater impoundment was allegedly slit, and the fluid drained into a pasture and a pond. 'These farmers saw workers slitting the liner to decrease the amount of liquid in the impoundment in order to refill it,' said Bamberger. 'We have heard it now on several occasions.' Of the 140 cows, about 70 died, and there were high incidences of stillborn and stunted calves."*⁴⁸

⁴⁵ "PA.Gov." Pennsylvania Agriculture. Pennsylvania Department of Agriculture, 2017. Web.

⁴⁶ Ibid.

⁴⁷ Ibid.

⁴⁸ Good, Kate. "No Fraccident: How Animals Are Hurt By Fracking." One Green Planet. One Green Planet, 29 Jan. 2014. Web.

This testimony was from one of the many farmers interviewed from the *Cornell Chronicle*. Pennsylvania depends on the livestock's survival and production rates in order to continue making export figures like \$1 billion as made in 2000. Part of this report also stated that "Pennsylvania's meat, poultry, and fish products generate more than \$4.3 billion in sales annually."⁴⁹ In order to maintain the health of animals and meet Food and Drug Administration (FDA) regulations, farmers have to be vigilant in preventing any sort of chemicals or outbreak of disease to exist among livestock and crops. Farmers' efforts are thwarted when their state government allows fracking companies to slide by with exemptions from vital legislation that was created to protect the rights of farmers and residents alike in Pennsylvania. The proximity of fracking sites to farms increases the chance of leakage and contamination of water supplies and grass that can lead to instances such as the farmer who lost 70 cows to wastewater poisoning his livestock. Having the release of fracking chemicals pumped into the ground would benefit the general public, farmers, and livestock. Referring back to Article I, Section 27 of the Pennsylvania Constitution, residents and any visitor have a natural born right to pure and clean resources in Pennsylvania. No regulation leads to a violation of the Constitution plain and simple. The few that we, as citizens of the United States, elect to represent us need to take firmer stances on regulation of fracking companies if rights and liberties are to be protected.

Chapter 3: Geopolitics of Fracking

In 1789, Benjamin Franklin wrote in a letter to Jean-Baptiste Leroy, "Our new Constitution is now established, and has an appearance that promises permanency; but in this world nothing can be said to be certain, except death and taxes."⁵⁰ Benjamin Franklin was an

⁴⁹ "PA.Gov." Pennsylvania Agriculture. Pennsylvania Department of Agriculture, 2017. Web.
⁵⁰ Shapiro, Fred. "Quotes Uncovered: Death and Taxes." Freakonomics. February 17, 2011.
<http://freakonomics.com/2011/02/17/quotes-uncovered-death-and-taxes/>.

influential man ahead of his time back in 1789, but in Pennsylvania in 2017, taxes are not certain. As mentioned in a previous chapter, impact fees are imposed and collected in Pennsylvania on unconventional gas wells drilling for natural gas. It is the payment that companies pay for impacting the earth, surrounding environment, and community near where the drilling takes place. Pennsylvania has become one of the largest producers of natural gas in the United States, but how much is going back to fixing the infrastructure, education system, and social programs? Pennsylvania residents see less than 1% coming from taxes and fees from natural gas wells in their state's tax revenue. Impact fees only pose a small fee in comparison to severance taxes for natural gas wells; this fee is applied individually to the production at the wellhead instead of a flat tax as a severance tax would pose on all natural gas pumped out of these unconventional wells. As a reminder, unconventional wells are wells that are drilling into unconventional formations such as the Marcellus Shale formation. The average price per well was \$50,000 with some smaller wells capping at \$10,000 for the impact fees.⁵¹ The total amount collected from impact fees in the Pennsylvania in 2015-2016 was \$225 million.⁵² This amount is then divided up among the Unconventional Gas Well Fund, the Marcellus Shale Legacy, and state impact funds. These funds go to the restoration and preservation of the environment and infrastructure damaged by the drilling and manufacturing of natural gas. The massive water needed for fracking, trucks transporting the water and gas to and from the sites, and the frack pits all degrade the environment. This amount is seemingly appropriate to a person who is unaware of the potential funds that could be coming back to Pennsylvania through severance taxes. Only

⁵¹ Pachon, Angela , and Dillon Weber. "A Tale of Two Taxes: Impact Fee and the Severance Tax in Pennsylvania." A Tale of Two Taxes: Impact Fee and the Severance Tax in Pennsylvania | Kleinman Center for Energy Policy. September 02, 2015. <http://kleinmanenergy.upenn.edu/policy-digests/tale-two-taxes-impact-fee-and-severance-tax-pennsylvania>.

⁵² Ibid.

eleven states do not have severance taxes posed; Pennsylvania is by far the largest producer of natural gas from that group of eleven states and the thirty-nine remaining. The predicted severance tax for Pennsylvania could be a 5% tax resulting in \$923.62 million.⁵³ States that compete with Pennsylvania for natural gas like Texas, Oklahoma, and Colorado have severance taxes that range from 5% to 7.5% depending on the average market value.⁵⁴ The installation of severance taxes as proposed by Governor Wolf would benefit the education system in Pennsylvania that suffered from severe cuts back in 2011 that have not been restored as yet. The severance tax, if passed by legislation, would cause extraction companies exponentially higher fees and taxes than they had ever experienced before. Due to this, extraction companies are less than eager for severance taxes to be applied to their natural gas pumped. Residents in Pennsylvania should have been seeing this tax and the benefits reaped by these taxes long ago, so as to say, this severance tax is long overdue.

From the Governor to Governor. Governor Tom Corbett, Governor Tom Wolf's predecessor, was a major player in maintaining Pennsylvania's status as a large producer of natural gas and sought to expand the business. His campaign and demeanor during his term was spent against severance taxes and promised to not raise taxes. One of Corbett's biggest contributions to the environmental community was supporting the creation of Act 13 which instated the impact fees on wells. It was the first step for Pennsylvania residents to start seeing some of the nonrenewable resource's benefits. While Corbett knew other states were giving more back to residents through the severance taxes, this start expanded to other new regulations such

⁵³ Pachon, Angela , and Dillon Weber. "A Tale of Two Taxes: Impact Fee and the Severance Tax in Pennsylvania." A Tale of Two Taxes: Impact Fee and the Severance Tax in Pennsylvania | Kleinman Center for Energy Policy. September 02, 2015. <http://kleinmanenergy.upenn.edu/policy-digests/tale-two-taxes-impact-fee-and-severance-tax-pennsylvania>.

⁵⁴ Ibid.

as larger liability zones near drilling sites and that companies would be required to send their chemical content from fracking fluid to the DEP. This, however, is not as straightforward as it seems. A report is sent to the DEP within 30 days of drilling from the extraction companies to be reviewed. If the chemicals are deemed as hazardous or potentially harmful to a water supply, they are reviewed by the federal Occupational Safety and Health Administration (OSHA) and again by the DEP.⁵⁵ Each fracking program created by petroleum engineers has a “chemical abstract service number” that can be uniquely identified like fingerprints.⁵⁶ These disclosure regulations do not give this information readily to the public; the report is filed away in one of their offices when they deem the chemicals hazardous. The Right to Know Law allows citizens to request public information such as these reports once the drilling has occurred, but the chemical contents of the fracking fluid that could potentially be in the ground and water supply are categorized as “trade secrets” and not part of the information that necessitates legal release under the Right to Know Law.⁵⁷ All in all, Corbett’s Act 13 for impact fees may have been the first step for creating legislation where it did not exist before, but it barely serves the greater population of Pennsylvania residents’ wellbeing, health, and safety.

There was promise when Governor Wolf was elected into office as he was a democrat with energy policies differing from natural gas expansion like Corbett. Governor Wolf had interest in restoring the \$1 billion education budget cut that was seen under Corbett.⁵⁸ Wolf aims to have a \$400 million increase for the basic education subsidy and \$100 million increase for

⁵⁵ Detrow, Scott. "How Pennsylvania’s Fracking Chemical Disclosure Rules Stack Up Against Other States." NPR State Impact. August 12, 2011. <https://stateimpact.npr.org/pennsylvania/2011/08/12/whats-in-the-frack-how-pennsylvanias-chemical-disclosure-rules-stack-up-against-other-states/>.

⁵⁶ Ibid.

⁵⁷ Ibid.

⁵⁸ "The Pennsylvania State Education Association." PSEA.org – How does Gov. Wolf's state budget proposal impact your school district? 2017. <https://www.psea.org/apps/budget/budgetimpact.aspx>.

special education subsidy as well.⁵⁹ Over 23,000 jobs in teaching and support staff have been cut due to these intense education budget cuts from 2011.⁶⁰ With the increased funds coming from severance taxes in Pennsylvania, the education budget could finally be evened out and actually start benefitting the residents in Pennsylvania.⁶¹ His proposal is similar to West Virginia's in which the volume and sale of the natural gas are taken into consideration when taxing and collecting fees. Pennsylvania has been suffering greatly with budget cuts even though billions of dollars are underneath the surface; the projected fees and taxes would cover the amount Wolf sees going to education, and the remainder would be proportionally returned to areas where there are more drills. Since Governor Wolf has come into office and promised many reforms with the natural gas industry and education budgets, this has all been conjecture going on for the past three years. Wolf could not have predicted that Donald Trump would become the President of the United States nor that Mr. Trump would advocate for a 40% cut for the EPA. This does not bode well for Governor Wolf's plans in restoring Pennsylvania's education and infrastructure systems, but it also does not bode well for the environmental community as a whole. It begs the question, how did we get in this situation anyway?

Dick Cheney and the Halliburton Way Prior to George W. Bush's appointment to presidential office in 2000, Dick Cheney was the CEO of Halliburton Company, an integral company in the creation of fracking. Not only was Halliburton known for helping to create fracking, but they were the cause of the Deepwater Horizon explosion and the Halliburton Loophole. Deepwater Horizon was the offshore drilling rig that exploded which resulted in 11

⁵⁹ "The Pennsylvania State Education Association." PSEA.org – How does Gov. Wolf's state budget proposal impact your school district? 2017. <https://www.psea.org/apps/budget/budgetimpact.aspx>.

⁶⁰ Ibid.

⁶¹ Cusick, Marie. "Wolf's budget plan calls for new tax on natural gas industry." NPR State Impact. March 03, 2015. <https://stateimpact.npr.org/pennsylvania/2015/03/03/wolfs-budget-plan-calls-for-new-tax-on-natural-gas-industry/>.

deaths and over \$1 billion paid in lawsuits and damages. The Halliburton Loophole, however, was intentional and deliberate by Dick Cheney. The loophole refers to fracking fluid not having to be regulated under the Safe Drinking Water Act of 2005.⁶² The loophole took the EPA off of the counsel that could go in and regulate fracking sites for contaminated water. This legislation is fueled by the fracking community's massive endowment that can be allocated and lobbied for in government; citizens in the United States, sadly enough, do not have as strong a voice and persuasion when politicians have been covering up unsafe practices and making exemptions like the Halliburton Loophole. Lobbying organizations such as the Interstate Oil and Gas Compact Commission (IOGCC) are in unique positions with the government where they do not have to register lobbyists, the government pays for their offices and salary, and cause major influence for the fracking industry.⁶³ They refer to the IOGCC as the "shadow lobbyists" for fracking community helping prevent regulation from touching fracking. It was said that, "The group [IOGCC] has worked behind the scenes for decades to prevent federal regulation so stridently that in 1978, the Justice Department argued it should be disbanded because it had evolved into an advocacy organization."⁶⁴ They were not disbanded and have a larger force than they did in 1978; their representatives span across over 30 different states and helped in passing the Halliburton Loophole in 2005. More attention is being paid to organizations like IOGCC and more scrutiny is coming for governmental agencies like the EPA and DEP. This information and research is finally coming to light as more residents, universities, and publications sources are calling fracking companies out for their unjust practices. Efforts to amend this loophole

62 "The Halliburton Loophole." Earthworks.

https://www.earthworksaction.org/issues/detail/inadequate_regulation_of_hydraulic_fracturing#.WNluWfkrI2w.

63 Coleman, Jesse. "Meet the Shadow Lobbyists Protecting Fracking From Regulation: The IOGCC." Greenpeace USA. April 12, 2016. <http://www.greenpeace.org/usa/shadow-lobbyists-protecting-fracking-regulation-iogcc/>.

⁶⁴ Ibid.

legislation have been put forth by congressmen since 2009 with the attempt to pass the Fracturing Responsibility and Awareness of Chemicals Act (FRAC Act) which would mandate that fracking fluid be regulated under the Safe Drinking Water Act effectively erasing the Halliburton Loophole.⁶⁵ It has not been passed nor has the Congress pushed for its action in recent years. And so, the loophole persists to exist in our country. It is possible that the motivation to continue natural gas and fracking expansion is not from an in-house source but external factors that stress our economy and political system from across the world.

Russia as a Major Natural Gas and Oil Player. On the global scale of fracking, Russia has been providing the majority share of the European countries' natural gas supply for years through their company, Gazprom.⁶⁶ The nationwide sentiment and competitive spirit in the United States against Russia began in the late 1940s with the Cold War. To this day, we see in legislation and in our economy that the United States strives to be independent and improve in relation to Russia. If the United States had to depend on another nation for nonrenewable resource more heavily than we do today, it would hurt the possibility of regulation our nation wishes to see with safe drinking water and fracking. For example, Poland relies almost exclusively upon Russia and their fracking processes for their natural gas supply.⁶⁷ In a study done in England about Poland's dependence on the Soviet Union historically, a Russian representative stated, "Although Poland's energy mix is diverse and the role of gas in this mix is relatively small, Poland remains reluctantly reliant upon Russia for most of its gas imports. Against the historical backdrop of Soviet influence on Poland, the question of Russian gas

⁶⁵ "The Halliburton Loophole." Earthworks.

https://www.earthworksaction.org/issues/detail/inadequate_regulation_of_hydraulic_fracturing#.WNluWfkrI2w.

⁶⁶ Jaspal, Rusi, Brigitte Nerlich, and Szczepan Lemańczyk. "Fracking in the Polish press: Geopolitics and national identity." *Fracking in the Polish press: Geopolitics and national identity*. April 19, 2014.

<http://www.sciencedirect.com/science/article/pii/S0301421514004984>.

⁶⁷ Ibid.

remains a point of geopolitical contention.”⁶⁸ Resources do become points of contention and result in battles as seen throughout history for territory; we are in a unique time of technological advances that we can shift dependence from nonrenewable resources to renewable ones, but as of now, the United States is motivated to remain independent and develop in-house processes and supplies to maintain the status as a powerhouse. If the United States were to become dependent on Russia, there would be political, economic, and stateside morale deficits. It is not an excuse for the United States’ government to cover up, exempt the fracking industry from regulation, and allow water supplies to become contaminated due to the possible threat of becoming dependent on another nation for resources; but it is noticed as a stressor on the government elected officials that they experience pressure to find ways to remain separate from external resources as seen by the Poland and Russian dependence example.

Penn State’s Gift to the Fracking Industry. “Our policy is pretty much not to participate in these types of things even if they are considered off the record.”^{69*} This statement comes from an employee from the EQT Corporation that denied comment for an interview and provided their company’s website instead. EQT is a petroleum and natural gas company based out of Pittsburgh that is the largest producer of natural gas in the Appalachian Basin.⁷⁰ It is understandable that an employee of a major fracking company would not comment on any sort of question or interview on behalf of his company; there are strict guidelines and regulations within fracking companies as exemplified by this employee’s statement. Any comment misconstrued or released to the

⁶⁸ Jaspal, Rusi, Brigitte Nerlich, and Szczepan Lemańczyk. "Fracking in the Polish press: Geopolitics and national identity." *Fracking in the Polish press: Geopolitics and national identity*. April 19, 2014. <http://www.sciencedirect.com/science/article/pii/S0301421514004984>.

⁶⁹ Anonymous, “Inquiry to Fracking Practices.” Interview by Kathryn Susko, *February 6, 2017*

*It should be noted that I approached the employee with question on behalf of myself for a thesis project through Fordham University; I did not say that an interview or questions would in any form be off the record.

⁷⁰ S&P Global Market Intelligence. "Company Overview of EQT Production Company." *Bloomberg.com*. <http://www.bloomberg.com/research/stocks/private/snapshot.asp?privcapId=4220285>.

media could result in an employee's termination. While no comment or questions were taken from this employee, he opened up more research and investigation from the company's website in their partnership with Penn State University. Over the years, Penn State's Geosciences Department has released massively influential studies to persuade fracking companies and governmental agencies resulting in benefit to fracking. Two men, Timothy Considine and Terry Engelder, are among Penn State faculty to aid the fracking industry. Timothy Considine had received a \$100,000 grant from the Marcellus Shale Coalition to fund research that "produc[ed] industry-friendly research on economic and energy issues."⁷¹ Marcellus Shale Coalition is one of the largest lobbying groups for the fracking industry. There is even a "Marcellus Center for Outreach and Research (MCOR)" at Penn State funded by General Electric and ExxonMobil.⁷² They remain that they do not promote fracking and fund programs for fracking, but former Governor Corbett received more than \$2.6 million in campaign funds from personnel in these oil and gas companies.⁷³ Due to the overwhelming influence that Penn State research conducted by Terry Engelder, Yale University conducted their own studies to confirm or deny Penn State's claims. Engelder's claim was that "injecting frack water into deep shale was safe" and funded by the fracking industry with a researcher from Royal Dutch Shell.⁷⁴ Yale's research was funded by the Heinz Endowments based in Pittsburgh. The Yale researchers were unable to test and experiment with fracking wells as the companies denied their research, but they conducted health surveys of residents in Washington County outside of Pittsburgh. They found that 39% of those

⁷¹ Brasch, Walter. "The Other Scandal at Penn State: Fracking." Buzzflash. May 09, 2014. <http://www.truth-out.org/buzzflash/commentary/the-other-scandal-at-penn-state-fracking/18639-the-other-scandal-at-penn-state-fracking>.

⁷² Ibid.

⁷³ Ibid.

⁷⁴ Conti, David. "Yale, Penn State studies offer conflicting views of fracking." TribLIVE.com. September 11, 2014. <http://triblive.com/business/headlines/6772348-74/health-state-studies>.

living within 1 kilometer to fracking wells reported higher levels of respiratory issues and skin problems than those who lived farther away from the well sites.⁷⁵ It is unfortunate that the largest university in Pennsylvania has direct funding for faculty, students, and a department, MCOR, influencing their academic research and leanings. It is a shame that a university sways students' opinions without presenting the entire argument; with the release and highlighted exploitation of Pennsylvania residents who have been denied their rights to clean, pure, and safe resources, news sources like the Public Herald and StateImpactNPR can be expected to weigh more heavily in cleaning up Pennsylvania.

Chapter 4: Public Health

*“By September 19th two residents living 800 feet from JKLM’s well site reported foamy drinking water at their private water supplies, later described as “soap” by the company. About 72 hours later, two more residents reported foamy water 9,000 feet away from JKML’s operation.”*⁷⁶

This foamy water was found in residential water sources in 2015. JKLM Energy is an energy company in Potter County, Pennsylvania and had seven private water sources and two public drinking water sources affected from pollution from natural gas.⁷⁷ The energy company lost one of their drills deep within the earth, and they attempted to use illegal chemicals for fracking to retrieve the drill. 98 gallons of surfactant was pumped 708 feet below the ground to save this well; at this time, residents began to see the foamy-like substance coming from their water supplies.⁷⁸ JKLM provided backup water supplies for those affected by the contamination,

⁷⁵ Conti, David. "Yale, Penn State studies offer conflicting views of fracking." TribLIVE.com. September 11, 2014. <http://triblive.com/business/headlines/6772348-74/health-state-studies>.

⁷⁶ Troutman, Melissa, and Joshua Pribanic. "BREAKING: Oil & Gas Drilling Impacts Public Drinking Water Supplies in Potter County." PUBLIC HERALD. December 07, 2016. Accessed April 18, 2017. <http://publicherald.org/breaking-oil-gas-drilling-impacts-public-drinking-water-supplies-in-potter-county/>.

⁷⁷ Ibid.

⁷⁸ Ibid.

and they also tested their other wells within the area for possible contamination. Isopropanol was the chemical used and described by JKLM to be no more than a non-toxic soapy surfactant. Isopropanol, however, is flammable, explosive in vapor or air mixtures, causes redness in eyes, dry skin, cough, dizziness, drowsiness, headache, sore throat, abdominal pain, labored breathing, nausea, unconsciousness, and vomiting.⁷⁹ It is colorless, easily absorbed into the through inhalation, attacks plastics, can cause central nervous system damage, and can defat skin.⁸⁰ This is a frightening reality for residents in Potter County, Pennsylvania. Only one of these symptoms should have been enough for JKLM Energy to have released a report or notice that there was a potential for contamination in the water supply. Public health is not to be toyed with; these health consequences could cause painful and long-lasting effects because of a company's pride and negligence to alert the public. The DEP took its time investigating the possible contamination and stated that they could not release a notice until they had proven the contamination. Once it was cleared two weeks later, they released this statement, "The Notice of Violation includes: Failure to prevent pollution of fresh groundwater; Drilling through fresh groundwater with a substance other than air, freshwater or freshwater based drilling fluids; and Violations of Pennsylvania's Clean Streams Law."⁸¹ Afterward when people reached out to the DEP for help and water services, they were denied and referred to call JKLM Energy due their company causing the contamination. JKLM Energy attempted to remedy their fault in leaking chemicals by supplying water for residents affected and conducting their own investigations on other wells,

⁷⁹ Troutman, Melissa, and Joshua Pribanic. "BREAKING: Oil & Gas Drilling Impacts Public Drinking Water Supplies in Potter County." PUBLIC HERALD. December 07, 2016. Accessed April 18, 2017. <http://publicherald.org/breaking-oil-gas-drilling-impacts-public-drinking-water-supplies-in-potter-county/>.

⁸⁰ Ibid.

⁸¹ Ibid.

but the DEP was not helpful or professional in serving the public with their environmental concerns.

“The Harvard Law School’s May 2014 report concluded that the most common errors in DEP’s water contamination investigations were: PADEP does not explain the water sample analysis; PADEP does not explain how it reached its conclusion; PADEP indicates that it does not have adequate information to make a determination; the letters are confusing and/or inconsistent with others in the same geographic area.”⁸²

This is disgraceful and immoral to cook reports of water contamination. Isopropanol is one of the many chemicals that companies pump extensively into the ground to conduct fracking. It would be one thing if the findings from Harvard Law School were simple mistakes of entering data incorrectly, but these actions are deliberate and blatantly intended to mask the effects of fracking contamination. Citizens of Pennsylvania and the United States should be able to rely upon their governmental agencies like the DEP as it is the Department of Environmental Protection. The Pennsylvania DEP is doing everything but protecting the environment when they sweep data and reports under the rug from residents.

Fracking Hazards that Impact the Environment. There are several fracking hazards that have potential to harm the environment and ultimately the humans who live within these environments. Spills from drilling, frack pits, wastewater, contamination, and explosions top the list of potential hazards that may come from fracking. Oil and gas wastewater can leak into the environment from broken pipelines, transport tankers, storage ponds and tanks on location, and the migration of chemicals from insufficient casings. It is important to understand how the

⁸² Troutman, Melissa, and Joshua Pribanic. "BREAKING: Oil & Gas Drilling Impacts Public Drinking Water Supplies in Potter County." PUBLIC HERALD. December 07, 2016. Accessed April 18, 2017. <http://publicherald.org/breaking-oil-gas-drilling-impacts-public-drinking-water-supplies-in-potter-county/>.

leaking occurs and how it impacts the environment as this contamination will affect biodiversity in vegetation, water supplies, animals, and eventually humans if the contamination becomes too severe and uncontrollable. Wastewater from Pennsylvania sites is transported far from the location of drilling to as far as Ohio and West Virginia. In that time and distance, spillages are possible due to the increased fracking sites in Pennsylvania; recall that each fracking site requires between 3 and 5 million gallons of freshwater to operate a well. This enormous supply of water used must be handled properly and disposed of with extreme care. Otherwise if not handled with care, events like the JKLM Energy leakage results in foamy toxic water for residents within proximity to the wells.

There were five key components a studied found impacted an area in regards to the proximity of fracking sites and humans. “(1) the closer to a hydraulic fracking well, the higher the risk of groundwater and drinking water well contamination; (2) residents living nearest to a fracking well experience a higher human health risk due to exposure to gas emissions during the fracking process; (3) huge and high density gas emissions are detected and recorded close to fracking wells; (4) fracking induces seismicity and small earthquakes are recorded close to fracking wells; and (5) hydraulic fracking directly changes local environment and landscape characteristics.”⁸³ This information may seem obvious in that having a residence near an operation that pumps massive amounts of secret chemicals into the ground, uses several million gallons of water, and has a history of contamination would make a person at a higher risk for health impacts. This study harped on the fact that being within 0.8km or 0.49 mi of a fracking site resulted in the higher possibility of air pollution, infected groundwater, methane migration,

⁸³ Meng, Qingmin, and Steve Ashby. "Distance: A critical aspect for environmental impact assessment of hydraulic fracking." *The Extractive Industries and Society* 1, no. 2 (November 2014): 124-26. doi:10.1016/j.exis.2014.07.004.

small earthquakes, and landscape changes.⁸⁴ There are a multitude of side effects from fracking that require further studies to be conducted in order to best prevent and remedy situation that cause public health concerns to those living near fracking sites.

Some researchers were particularly concerned with the endocrine activity levels that animals were experiencing near the fracking sites that had spills and leakages. The endocrine systems deals with hormone levels, pituitary gland, ovaries, testes, thyroid gland, and adrenal glands; this basically covers one of the most essential and highly functioning parts of the body. There was one study that examined “...*the effects of exposing pregnant mice to mixtures of chemicals simulating real-world fracking wastewater.*”⁸⁵ There were four water sources given to mice with two being within safe drinking standards near fracking sites. The effects were measured in the offspring that came from the pregnant mice who drank the contaminated water samples. Male mice exhibited lower sperm count, increased testis weight, and increased blood testosterone. Female mice exhibited lower levels of “levels of prolactin, follicle-stimulating hormone, and luteinizing hormone.”⁸⁶ The study conducted with the pregnant mice tested 24 chemicals used by gas and oil companies when fracking occurs; 23 were found to activate or inhibit the endocrine systems processes.⁸⁷ Their findings concluded that endocrine-disrupting chemicals (EDCs) are present in vitro and in vivo when water contaminated near fracking sites is consumed. This is particularly concerning due to the fact that humans can legally drink some of

⁸⁴ Meng, Qingmin, and Steve Ashby. "Distance: A critical aspect for environmental impact assessment of hydraulic fracking." *The Extractive Industries and Society* 1, no. 2 (November 2014): 124-26. doi:10.1016/j.exis.2014.07.004.

⁸⁵ Konkel, Lindsey. 2016. "Salting the Earth The Environmental Impact of Oil and Gas Wastewater Spills." *Environmental Health Perspectives* 124, no. 12: A230-A235. GreenFILE, EBSCOhost (accessed April 18, 2017). <http://www.sciencedirect.com/science/article/pii/S0301421514004984>.

⁸⁶ Ibid.

⁸⁷ Kassotis, Christopher D., Kara C. Klemp, Danh C. Vu, Chung-Ho Lin, Chun-Xia Meng, Cynthia L. Besch-Williford, Lisa Pinatti, R. Thomas Zoeller, Erma Z. Drobnis, Victoria D. Balise, Chiamaka J. Isiguzo, Michelle A. Williams, Donald E. Tillitt, and Susan C. Nagel. "Endocrine-Disrupting Activity of Hydraulic Fracturing Chemicals and Adverse Health Outcomes After Prenatal Exposure in Male Mice." *Endocrinology* 156, no. 12 (December 01, 2015): 4458-473. doi:10.1210/en.2015-1375.

this water under safe water drinking regulations at this time, and the fact that mice are valid test subjects for determining how humans react to certain stimuli. Future studies need to be conducted on the adverse health effects that come from contaminants found in water supplies and the surrounding environments near fracking sites. There are a few issues, however, in determining which chemicals are used, to what capacity, and when these chemicals are leaked into the environment is often withheld from the public.

Risk Assessment and the Secrets of Fracking. This is where risk assessment is key and necessary for preventing contamination and remedying any contaminates that may have seeped into the environment. The fracking fluids are created by the petroleum engineers at a fracking well and protected under the Uniform Trade Secrets Act (UTSA).⁸⁸ If the knowledge of these chemicals were known to the public, then scientists and water authorities could understand the potential threats that fracking sites bring. At this time, under the UTSA, Campari, Coca-Cola, and Google's PageRank are protected. These products are protected due to their unique formula that is commercially valuable and is competitive and so they are protected.⁸⁹ The fracking industry falls under this category as well due to the lucrative business brought in by fracking; the chemical formulas can then be deemed as a trade secret because they are unique to locations, petroleum engineers, and companies in the industry. As seen with JKLM Energy and their foamy water product, it would be crucial for those drinking the water and testing the water to know which chemicals were pumped into the ground to prevent health issues and environmental damage. The dallying about that companies do to protect their secret formulas puts lives at risk just to make a buck. Trade secrets are logical when applied to an item like Coca-Cola or Campari

⁸⁸ "UNIFORM TRADE SECRETS ACT WITH 1985 AMENDMENTS." UNIFORM TRADE SECRETS ACT WITH 1985 AMENDMENTSUNIFORM TRADE SECRETS ACT WITH 1985 AMENDMENTS. August 1985. http://www.uniformlaws.org/shared/docs/trade%20secrets/utsa_final_85.pdf.

⁸⁹ Ibid.

when they go through FDA regulations to be deemed fit for consumption, yet fracking water does not have to be held to the same standard and receives the trade secret treatment.

Health Concerns from Fracking. Due to a lack of previous evidence citing that fracking causes health issues, the media and general public are demanding more information and research. A study conducted in Pittsburgh, Pennsylvania examined migraine headaches, fatigue levels, and chronic rhinosinusitis (CRS) of residents with metrics “incorporat[ing] well phase, location, total depth, daily gas production and inverse distance–squared to patient residences.”⁹⁰ The data collected is presented in a table below detailing the symptoms and characteristics of participants in the study. Their study found that migraines, fatigue levels, and CRS were in fact associated with fracking being in close proximity to the participants’ homes. The associations were found to be stronger when more than one symptom was present for a participant. Many of the participants with CRS symptoms noticed that their symptoms appeared after the rise of fracking in their area. The limiting information and surrounding toxicants, allergens, secondhand smoke, psychosocial stressors, occupation, medical disorders, and exposure to environmental chemicals were all considered within the metrics used in this study to best collect data specifically from fracking sites effects on the participants.⁹¹ Air pollution and conventional gas and oil wells for not taken

⁹⁰ Tustin, Aaron W., Annemarie G. Hirsch, Sara G. Rasmussen, Joan A. Casey, Karen Bandeen-Roche, and Brian S. Schwartz. 2017. "Associations between Unconventional Natural Gas Development and Nasal and Sinus, Migraine Headache, and Fatigue Symptoms in Pennsylvania." *Environmental Health Perspectives* 125, no. 2: 189-197. GreenFILE, EBSCOhost (accessed April 18, 2017).

⁹¹ Tustin, Aaron W., Annemarie G. Hirsch, Sara G. Rasmussen, Joan A. Casey, Karen Bandeen-Roche, and Brian S. Schwartz. 2017. "Associations between Unconventional Natural Gas Development and Nasal and Sinus, Migraine Headache, and Fatigue Symptoms in Pennsylvania." *Environmental Health Perspectives* 125, no. 2: 189-197. GreenFILE, EBSCOhost (accessed April 18, 2017).

into consideration for this study as their effect and production rates were much lower than the unconventional gas drilling or fracking.⁹²

The United States as an Example. The United States produces many studies about fracking in regard to health effects, more efficient drilling, and the results of fracking as beneficial to economies. These studies done in the United States have been bought off by large gas and oil companies to maintain the image that fracking is fine for the environment and people

Table 2. Characteristics of study population by self-reported outcome(s).

Characteristic	Overall study population	Individuals with no primary outcome		Individuals with one or more primary outcomes						
		Reference group ^a	Individuals who were neither cases nor controls ^b	Current CRS only	Migraine headache only	Higher levels of fatigue only	Current CRS and migraine	Current CRS and higher levels of fatigue	Migraine and higher levels of fatigue	Current CRS, migraine headache, and higher levels of fatigue
Total number, <i>n</i>	7,785	1,380	2,889	738	580	666	268	347	420	497
Sex, <i>n</i> (%)										
Male	2,909 (37.4)	656 (47.5)	1,242 (43.0)	335 (45.4)	113 (19.5)	233 (35.0)	50 (18.7)	126 (36.3)	63 (15.0)	91 (18.3)
Female	4,876 (62.6)	724 (52.5)	1,647 (57.0)	403 (54.6)	467 (80.5)	433 (65.0)	218 (81.3)	221 (63.7)	357 (85.0)	406 (81.7)
Race/ethnicity, <i>n</i> (%)										
White non-Hispanic	7,043 (90.5)	1,183 (85.7)	2,653 (91.8)	707 (95.8)	508 (87.6)	598 (89.8)	257 (95.9)	333 (96.0)	357 (85.0)	447 (89.9)
Other	742 (9.5)	197 (14.3)	236 (8.2)	31 (4.2)	72 (12.4)	68 (10.2)	11 (4.1)	14 (4.0)	63 (15.0)	50 (10.1)
Age in years, mean ± sd	55.3 ± 16.1	58.8 ± 17.0	57.6 ± 15.9	57.1 ± 14.9	46.1 ± 14.3	57.3 ± 15.1	48.5 ± 13.2	56.1 ± 14.7	46.5 ± 13.6	47.8 ± 13.1
Smoking status, <i>n</i> (%)										
Never	4,268 (54.8)	805 (58.3)	1,615 (55.9)	404 (54.7)	340 (58.6)	334 (50.2)	141 (52.6)	178 (51.3)	220 (52.4)	231 (46.5)
Current	1,130 (14.5)	134 (9.7)	353 (12.2)	100 (13.6)	96 (16.6)	113 (17.0)	57 (21.3)	61 (17.6)	86 (20.5)	130 (26.2)
Former	2,387 (30.7)	441 (32.0)	921 (31.9)	234 (31.7)	144 (24.8)	219 (32.9)	70 (26.1)	108 (31.1)	114 (27.1)	136 (27.4)
History of receiving medical assistance, <i>n</i> (%)										
Never	6,876 (88.3)	1,286 (93.2)	2,690 (93.1)	694 (94.0)	467 (80.5)	588 (88.3)	216 (80.6)	293 (84.4)	302 (71.9)	340 (68.4)
Ever	909 (11.7)	94 (6.8)	199 (6.9)	44 (6.0)	113 (19.5)	78 (11.7)	52 (19.4)	54 (15.6)	118 (28.1)	157 (31.6)
Body mass index (kg/m ²), mean ± sd	30.2 ± 7.0	29.0 ± 6.3	29.9 ± 6.5	30.4 ± 7.0	29.7 ± 7.3	31.7 ± 7.9	29.8 ± 7.3	31.3 ± 7.4	31.7 ± 7.7	31.2 ± 8.1
Place type, <i>n</i> (%)										
Township	4,949 (63.6)	907 (65.7)	1,900 (65.8)	476 (64.5)	332 (57.2)	417 (62.6)	170 (63.4)	213 (61.4)	242 (57.6)	292 (58.8)
Borough	2,135 (27.4)	371 (26.9)	762 (26.4)	188 (25.5)	183 (31.6)	192 (28.8)	72 (26.9)	101 (29.1)	122 (29.0)	144 (29.0)
Census tract in city	701 (9.0)	102 (7.4)	227 (7.9)	74 (10.0)	65 (11.2)	57 (8.6)	26 (9.7)	33 (9.5)	56 (13.3)	61 (12.3)
Community socioeconomic deprivation, mean ± sd	0.0 ± 3.6	-0.3 ± 3.6	-0.1 ± 3.6	-0.1 ± 3.5	0.3 ± 3.7	0.1 ± 3.6	0.2 ± 3.5	0.1 ± 3.7	0.6 ± 3.7	0.6 ± 3.8
UNGD activity metric, <i>n</i> (%) ^c										
Quartile 1 [-0.61 to -0.47]	1,946 (25.0)	358 (25.9)	745 (25.8)	181 (24.5)	140 (24.1)	155 (23.3)	63 (23.5)	91 (26.2)	101 (24.0)	112 (22.5)
Quartile 2 [-0.47 to -0.39]	1,946 (25.0)	345 (25.0)	731 (25.3)	187 (25.3)	145 (25.0)	174 (26.1)	65 (24.3)	83 (23.9)	92 (21.9)	124 (24.9)
Quartile 3 [-0.39 to -0.16]	1,946 (25.0)	373 (27.0)	733 (25.4)	188 (25.5)	131 (22.6)	172 (25.8)	70 (26.1)	73 (21.0)	98 (23.3)	108 (21.7)
Quartile 4 [> -0.16]	1,947 (25.0)	304 (22.0)	680 (23.5)	182 (24.7)	164 (28.3)	165 (24.8)	70 (26.1)	100 (28.8)	129 (30.7)	153 (30.8)

Notes: CRS, chronic rhinosinusitis; sd, standard deviation; UNGD, unconventional natural gas development. Percentages may not total 100 because of rounding.

^aIndividuals in the reference group reported no past or current CRS; no headache-related nausea, photophobia, or disability; and lower levels (≤ 25th percentile) of fatigue.

^bThese individuals did not meet criteria for any primary outcome and were excluded from the reference group because of past CRS, intermediate probability of migraine headache, moderate levels of fatigue, or a combination of any of these symptoms.

^cUNGD activity was averaged over the 90 days before the survey.

Figure 3 “Characteristics of study population by self-reported outcome(s)”⁹³

⁹² Tustin, Aaron W., Annemarie G. Hirsch, Sara G. Rasmussen, Joan A. Casey, Karen Bandeen-Roche, and Brian S. Schwartz. 2017. "Associations between Unconventional Natural Gas Development and Nasal and Sinus, Migraine Headache, and Fatigue Symptoms in Pennsylvania." *Environmental Health Perspectives* 125, no. 2: 189-197. GreenFILE, EBSCOhost (accessed April 18, 2017).

⁹³ Ibid.

living nearby fracking sites. This information has misinformed many over the years, and it continues to impact countries around the world to increase or at least consider increasing their fracking activity. In Karoo, South Africa, a survey was taken to collect an image of how the people in Karoo perceive fracking. The majority did not understand what fracking was, the benefits, or the consequences that come along with fracking.⁹⁴ There was also a pattern that those who believed in low risk from fracking were more in support of the government than those who saw more potential risk from fracking.⁹⁵ As one of the strongest, wealthiest, and most powerful nations in the world, the United States needs to do a better job at producing proper documents that represent the facts of fracking and what one can expect from a fracking site near his or her house. Other countries believe that they can become part of the natural gas market with the “high success” exhibited by the United States; this is misleading as yes, there are extremely high financial gains from fracking, but the citizens of the United States suffer more than money can heal them from their ailments. It is upsetting that health of residents is not taken more seriously when conducting business as these residents are the consumers of the gas procured from these sites. The environment and people alike are suffering, yet the image projected to the world is that fracking is benefitting our economy and the people are thriving as well. In reality, many people and landscapes are being sideswiped to make way for more drills.

Chapter 5: Conclusion: How Can We Fix This?

It can be daunting to think that that there is nothing a person could do when faced with big oil and gas companies controlling energy supplies and influencing the regulation for their companies. It seems as though there should be a third party surveying and ensuring that all

⁹⁴ Willems, Mieke. "Health risk perception of Karoo residents related to fracking, South Africa." PhD diss., University of Cape Town, 2015.

⁹⁵ Ibid.

procedures done by the companies are legal, safe, and benefit the general public. But no fear, there are a multitude of ways to become involved in the decision making surrounding fracking. First and foremost, the most important step in becoming involved is to become informed. Through this discussion, fracking has been presented through its process, historical background, geopolitical standings, and adverse health effects to paint a larger and direct approach to fracking in Pennsylvania.

Fracking is process that involves drilling deep into the earth to tap into shale formations to release natural gas to be collected and distributed. The natural gas obtained comes from millions of years ago when Pangea existed and plates moved to form the present-day continents. All this shifting of tectonic plates caused highly pressurized marine material to transition over millions of years into the hydrocarbons seen as natural gas. Wells can go as far as 10,000 feet into the earth during the process, and two types of wells are utilized for better steering of the project. Horizontal and vertical drilling are used to best reach the shale that may have been out of reach through sole use of vertical drills in the past. Petroleum engineers and geologists are highly involved in the process with their guidance, chemical fracking program, and execution drilling. The fracking program is a highly sensitive and unique combination that companies desire to keep unknown in order to maintain competitive edge. Geologists use geophysics to create images of the plates and formations underground to avoid seismic activity, possible failings of a well, and proper execution of the well drilling.

It is important to understand how this process works as once the unique chemicals go into the ground, they are pressurized to pump into shale, pump gas out, and plug the holes created to attain gas. The chemicals and gas then flow up to the surface to be collected; oftentimes the chemicals are not contained much as the gas is due to the value of the gas over the chemicals.

The gas is put straight into holding tanks or trucks to be transported and manufactured. From a few days to several weeks, chemical mixtures from the well flow up to be collected in pits near the drill site. Sometimes these pits are not lined leaving room for spills or seepage into water supplies. With the chemical flowback, millions of gallons of water used, and the transport of the waste and natural gas; it is no wonder that fracking has a large environmental impact on land, water, and air.

Edward Drake was one of the first drilling pioneers in discovering how pools of oil could be collected from breaking up rocks underground. It was the beginning of gas boom that can be seen in today's world. After Drake, came Edward Roberts who would use torpedoes to make larger explosions for higher gains not seen from Drake's wells. Both men were swindled by larger oil and gas companies that used their ideas and made immensely profitable companies. This competitive edge still exists today with George Mitchell creating the most efficient and productive wells as fracking uses today. His competitive spirit drove him for years to create this innovative procedure that received government attention and money.

Fracking regulation was decentralized quickly after the market saw high profits and companies realized they could influence how fracking was treated legally with a little monetary persuasion. Prices were set by the proprietor of the wellhead to remain competitive and pump out as much gas as possible to compete against OPEC. Impact fees were collected at a fraction of the real cost and benefit that oil and gas companies experience from successful wells. Severance taxes would be the real proportional tax applied to well production rates to fully outweigh the costs to the community and benefit the larger population. Severance taxes provide typically triple the amount of impact fees and could do a great deal to heal the earth in which the drilling took place, contain pollutants, and prevent ailments to the community members who live

within close proximity to the drilling sites. There are many loopholes, lobbying, and pay outs that allow oil and gas companies to continue drilling with very little supervision or interference. This lack of interference leads to minor and major health effects stemming from water contamination mostly.

Since the beginning, fracking has affected communities by creating jobs, providing mass quantities of fuel on American soil, and improving our nation's economy. Over time, however, fracking has also brought communities high rates of pollution, lethal water contamination, lawsuits, environment degradation, and discontent in the community with how the oil and gas companies treat them. The easiest ways to detect water contamination is through observation when water smells funky or is an abnormal color like purple. In some cases, however, chemical leakage into water supplies can be odor and colorless. This causes a dangerous situation for communities as high volumes of this contaminated water could be ingested before the common man is alerted to the fact that there are unknown and unsafe chemicals in the drinking water. Some studies have been done to survey how the air pollution too has created adverse health effects when residents are near drilling sites. The trucks and manufacturing of the gas requires large and many types of machinery to complete the process. There are many hoops that oil and gas companies are permitted to avoid with legislation being in favor of their companies.

In this thesis alone, there are several stated acts and laws that give oil and gas companies free reign over the earth to do as they please without technically breaking the law. The Clean Water Act of 1972, Act 13 Impact Fees for Plugging Abandoned/Orphan Wells, Article I Section 27 of the Constitution of the Commonwealth of Pennsylvania, Halliburton Loophole, Natural Gas Policy Act of 1938 and 1978, the Resource Conservation and Recovery Act of 1976, Hazardous Materials Transportation Act, and the Safe Drinking Water Act are legislation

directly affected and manipulated by oil and gas companies through fracking. Fracking chemicals are defined differently legally through most legislation listed, especially the Halliburton Loophole, to allow unsafe levels of chemicals to be used and pumped into the ground without much supervision. One of the more beneficial pieces of legislation is under Act 13 with the use of impact fees to plug old and leaking wells and to repair the environment surrounding the drilling sites. Congress could seek to create and pass more laws and acts like that of Act 13 for improved treatment of community members and the environment. After the Halliburton Loophole was created, there were several members of congress vying for the protection of water supplies and the natural rights for residents to have clean and pure resources. The Fracturing Responsibility and Awareness of Chemicals Act, FRAC Act, would effectively eliminate the effects of the Halliburton Loophole and create a more amicable interaction between oil and gas companies and community members. It is no favorable for oil and gas companies to allow for legislation to be passed that regulates their business as their business models have always existed without regulation, and the new laws would cause revenue decreases and extra procedures added to adhere legally. It may sound like a poor situation for the fracking companies to be in, but with the billions of dollars pulled in every year and the lack of empathy for humanity and the environment, it should be a non-issue for the companies to adapt to the literal global and climate change caused by nonrenewable resources.

With the history of fracking, the process, the geopolitics, and public health effects in mind, there is more that can be done by a member of the community. Becoming informed is vital for taking action. There are many resources ranging from online, print sources, attending local government meetings, and speaking with people whose lives have been impacted by fracking are great ways to become more informed with your hometown. Even park cleanups can be beneficial

in the fight against pollution from fracking as any decrease of pollution will aid in the cleaning the air, land, and water. If there is a specific issue or concern that someone may have, reaching out to your state congress can help. In the state of Pennsylvania, Pat Toomey and Bob Casey Jr. are the senators who have excellent contact pages on their websites to file complaints or to seek out information. Their sites are as listed: <https://www.toomey.senate.gov/?p=contact> and <https://www.casey.senate.gov/contact/>. It is not a futile goal to reach to local community members, friends, family, and state government for help and information on fracking. What will lead to eradication of poor fracking regulation is the people. Together, people's voices can make the impact that residents of Pennsylvania, the United States, and the world need to combat the rapidly changing earth and atmosphere seen through the exponential rise of climate change in our world.

Bibliography

- Anonymous, "Inquiry to Fracking Practices." Interview by Kathryn Susko, *February 6, 2017*
- Barbara Warner, Jennifer Shapiro; *Fractured, Fragmented Federalism: A Study in Fracking Regulatory Policy*, *Publius* 2013; 43 (3): 474-496. doi: 10.1093/publius/pjt014
- Brasch, Walter M. *Fracking Pennsylvania: Flirting with Disaster*, Carmichael, CA: Greeley & Stone, 2013, Print
- Brasch, Walter. "The Other Scandal at Penn State: Fracking." *Buzzflash*. May 09, 2014. <http://www.truth-out.org/buzzflash/commentary/the-other-scandal-at-penn-state-fracking/18639-the-other-scandal-at-penn-state-fracking>.
- Briggle, Adam. *A Field Philosopher's Guide to Fracking: How One Texas Town Stood up to Big Oil and Gas*. New York London: Liveright Corporation, 2015. Print.
- Coleman, Jesse. "Meet the Shadow Lobbyists Protecting Fracking From Regulation: The IOGCC." *Greenpeace USA*. April 12, 2016. <http://www.greenpeace.org/usa/shadow-lobbyists-protecting-fracking-regulation-iogcc/>.
- "CONSTITUTION OF THE COMMONWEALTH OF PENNSYLVANIA." Constitution of the Commonwealth of Pennsylvania. Commonwealth of Pennsylvania, 1977. Web.
- Conti, David. "Yale, Penn State studies offer conflicting views of fracking." *TribLIVE.com*. September 11, 2014. <http://triblive.com/business/headlines/6772348-74/health-state-studies>.

Cusick, Marie. "Wolf's budget plan calls for new tax on natural gas industry." NPR State Impact. March 03, 2015.

<https://stateimpact.npr.org/pennsylvania/2015/03/03/wolfs-budget-plan-calls-for-new-tax-on-natural-gas-industry/>.

Detrow, Scott. "How Pennsylvania's Fracking Chemical Disclosure Rules Stack Up Against Other States." NPR State Impact. August 12, 2011.

<https://stateimpact.npr.org/pennsylvania/2011/08/12/whats-in-the-frack-how-pennsylvanias-chemical-disclosure-rules-stack-up-against-other-states/>.

Diana Davids Hinton; The Seventeen-Year Overnight Wonder: George Mitchell and Unlocking the Barnett Shale. J Am Hist 2012; 99 (1): 229-235. doi: 10.1093/jahist/jas064

EIA, 2012: Annual Energy Outlook 2012 with Projections to 2035. DOE/EIA-0383(2012). 239 pp., U.S. Energy Information Administration, Washington, D.C

[Environ Health Perspect](#). 2011 Jul 1; 119(7): a289. Published online 2011 Jul

1. doi: [10.1289/ehp.119-a289](https://doi.org/10.1289/ehp.119-a289) PMID: PMC3222989 News | Forum, Drinking Water Quality, Energy, Industry Issues, Mining, Natural Resources, Water Pollution

Environmental Costs and Benefits of Fracking Annual Review of Environment and Resources Vol. 39: 327-362 (Volume publication date October 2014) First

published online as a Review in Advance on August 11, 2014

DOI: 10.1146/annurev-environ-031113-144051

"Explore Shale. Marcellus Shale Development, Geology and Water." ExploreShale.org. 2014. <http://exploreshale.org/>.

Finewood, M. H. and Stroup, L. J. (2012), Fracking and the Neoliberalization of the Hydro-Social Cycle in Pennsylvania's Marcellus Shale. *Journal of Contemporary Water Research & Education*, 147: 72–79. doi:10.1111/j.1936-704X.2012.03104.x

Fones-Wolf, Ken. *Glass Towns: Industry, Labor and Political Economy in Appalachia, 1890-1930s*. Urbana: U of Illinois, 2007. Print.

Gold, Russell. *The Boom: How Fracking Ignited the American Energy Revolution and Changed the World*. New York: Simon & Schuster Paperbacks, 2014. Print.

Good, Kate. "No Fraccident: How Animals Are Hurt By Fracking." *One Green Planet*. One Green Planet, 29 Jan. 2014. Web.

Haley, Marsha, Michael McCawley, Anne C. Epstein, Bob Arrington, and Elizabeth Ferrell Bjerke. 2016. "Adequacy of Current State Setbacks for Directional High-Volume Hydraulic Fracturing in the Marcellus, Barnett, and Niobrara Shale Plays." *Environmental Health Perspectives* 124, no. 9: 1323-1333. GreenFILE, EBSCOhost (accessed April 18, 2017).

"The Halliburton Loophole." Earthworks.

https://www.earthworksaction.org/issues/detail/inadequate_regulation_of_hydraulic_fracturing#.WNluWfkrI2w

ic_fracturing#.WNluWfkrI2w.

"The Health Implications of Fracking: Article in the Lancet – Frack Free

Somerset." *Frack Free Somerset*. N.p., 01 Mar. 2014. Web.

Heinberg, Richard. "Technology to the Rescue." *Resilience.org*. Resilience.org, 01 Oct. 2013. Web.

Huff, Mickey, and Andrew Lee Roth. Censored 2014: Fearless Speech in Fateful Times:

The Top Censored Stories and Media Analysis of 2012-13. N.p.: n.p., n.d. Print.

IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I,

II and III to the Fifth Assessment Report of the Intergovernmental Panel on

Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)].

IPCC, Geneva, Switzerland, 151 pp.

Jaspal, Rusi, Brigitte Nerlich, and Szczepan Lemańczyk. "Fracking in the Polish press:

Geopolitics and national identity." *Fracking in the Polish press: Geopolitics and*

national identity. April 19, 2014.

Kassotis, Christopher D., Kara C. Klemp, Danh C. Vu, Chung-Ho Lin, Chun-Xia Meng,

Cynthia L. Besch-Williford, Lisa Pinatti, R. Thomas Zoeller, Erma Z. Drobnis,

Victoria D. Balise, Chiamaka J. Isiguzo, Michelle A. Williams, Donald E. Tillitt,

and Susan C. Nagel. "Endocrine-Disrupting Activity of Hydraulic Fracturing

Chemicals and Adverse Health Outcomes After Prenatal Exposure in Male

Mice." *Endocrinology* 156, no. 12 (December 01, 2015): 4458-473.

doi:10.1210/en.2015-1375.

Konkel, Lindsey. 2016. "Salting the Earth The Environmental Impact of Oil and Gas

Wastewater Spills." *Environmental Health Perspectives* 124, no. 12: A230-

A235. GreenFILE, EBSCOhost (accessed April 18, 2017).

<http://www.sciencedirect.com/science/article/pii/S0301421514004984>.

Madelon L. Finkel and Adam Law. The Rush to Drill for Natural Gas: A Public Health

Cautionary Tale. *American Journal of Public Health*: May 2011, Vol. 101, No. 5,

pp. 784-785. doi: 10.2105/AJPH.2010.300089

- Malin, Stephanie A., and Kathryn Teigen DeMaster. "A devil's bargain: Rural environmental injustices and hydraulic fracturing on Pennsylvania's farms." *Journal Of Rural Studies* 47, no. Part A (October 1, 2016): 278-290. ScienceDirect, EBSCOhost (accessed February 27, 2017).
- Manfreda, John. "The Real History Of Fracking." OilPrice.com. OilPrice.com, 24 Feb. 2017. Web.
- Meng, Qingmin, and Steve Ashby. "Distance: A critical aspect for environmental impact assessment of hydraulic fracking." *The Extractive Industries and Society* 1, no. 2 (November 2014): 124-26. doi:10.1016/j.exis.2014.07.004.
- Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC.
- Miller, G. Tyler. *Living in the Environment*. Place of Publication Not Identified: Brooks Cole, 2014. Print.
- Nature* 477, 271–275 (15 September 2011) doi:10.1038/477271a Published online 14 September 2011
- Pachon, Angela , and Dillon Weber. "A Tale of Two Taxes: Impact Fee and the Severance Tax in Pennsylvania." *A Tale of Two Taxes: Impact Fee and the Severance Tax in Pennsylvania | Kleinman Center for Energy Policy*. September 02, 2015. <http://kleinmanenergy.upenn.edu/policy-digests/tale-two-taxes-impact-fee-and-severance-tax-pennsylvania>.
- "PA.Gov." *Pennsylvania Agriculture*. Pennsylvania Department of Agriculture, 2017. Web.

"The Pennsylvania State Education Association." PSEA.org – How does Gov. Wolf's state budget proposal impact your school district? 2017.

<https://www.psea.org/apps/budget/budgetimpact.aspx>.

S&P Global Market Intelligence. "Company Overview of EQT Production Company."

Bloomberg.com. <http://www.bloomberg.com/research/stocks/private/snapshot.asp?privcapId=4220285>.

Scientific American 305, 80 - 85 (2011) Published online: 18 October 2011

| doi:10.1038/scientificamerican1111-80

Sernovitz, Gary. *The Green and the Black: The Complete Story of the Shale Revolution, the Fight over Fracking, and the Future of Energy*. New York: St. Martin's, 2016. Print.

Shapiro, Fred. "Quotes Uncovered: Death and Taxes." *Freakonomics*. February 17, 2011.

<http://freakonomics.com/2011/02/17/quotes-uncovered-death-and-taxes/>.

Shellenberger, Michael. "Interview with Dan Steward, Former Mitchell Energy Vice

President." *The Breakthrough Institute*. Rockefeller Philanthropy Advisors, INC, 12 Dec. 2011. Web.

Tankersley, G. J. *The Story of Consolidated Natural Gas Company: Innovation,*

Ingenuity, and Accomplishment. New York: Newcomen Society in North America, 1980. Print.

Troutman, Melissa, and Joshua Pribanic. "BREAKING: Oil & Gas Drilling Impacts

Public Drinking Water Supplies in Potter County." *PUBLIC HERALD*.

December 07, 2016. Accessed April 18, 2017. <http://publicherald.org/breaking-oil-gas-drilling-impacts-public-drinking-water-supplies-in-potter-county/>.

- Tustin, Aaron W., Annemarie G. Hirsch, Sara G. Rasmussen, Joan A. Casey, Karen Bandeen-Roche, and Brian S. Schwartz. 2017. "Associations between Unconventional Natural Gas Development and Nasal and Sinus, Migraine Headache, and Fatigue Symptoms in Pennsylvania." *Environmental Health Perspectives* 125, no. 2: 189-197. GreenFILE, EBSCOhost (accessed April 18, 2017).
- "What We Do." Center for Coalfield Justice. CoalfieldJustice, n.d. Web. 05 Dec. 2016.
- "Who Pays the Cost of Fracking." PennEnvironment Research and PolicyCenter. N.p., 16 July 2013. Web. 18 Sept. 2016.
- Wilber, Tom. *Under the Surface: Fracking, Fortunes and the Fate of the Marcellus Shale*. Ithaca: Cornell UP, 2012. Print.
- Wile, Rob. "153 Years Ago Today, An Unemployed Sick Man Drilled The First Modern Oil Well." *Business Insider*. Business Insider, 27 Aug. 2012. Web.
- Willems, Mieke. "Health risk perception of Karoo residents related to fracking, South Africa." PhD diss., University of Cape Town, 2015.