


6-2015

Framing Fracking: The Environmental and Social Implications of Hyraulic Fracturing

Lindsay Cohen

Union College - Schenectady, NY

Follow this and additional works at: <https://digitalworks.union.edu/theses>

 Part of the [Human Ecology Commons](#), [Hydraulic Engineering Commons](#), and the [Pharmacology, Toxicology and Environmental Health Commons](#)

Recommended Citation

Cohen, Lindsay, "Framing Fracking: The Environmental and Social Implications of Hyraulic Fracturing" (2015). *Honors Theses*. 286.
<https://digitalworks.union.edu/theses/286>

This Open Access is brought to you for free and open access by the Student Work at Union | Digital Works. It has been accepted for inclusion in Honors Theses by an authorized administrator of Union | Digital Works. For more information, please contact digitalworks@union.edu.

Framing Fracking;

The Environmental and Social Implications of Hydraulic Fracturing

By

Lindsay Cohen

* * * * *

Submitted in partial fulfillment of the requirements for Honors in the Departments of
Environmental Science and Sociology

UNION COLLEGE
June, 2015

Table of Contents:

Abstract 3

Introduction 4

Chapter 1: What is Hydraulic Fracturing? 6

Chapter 2: Fracking; the Pro's and Con's 19

Chapter 3: A Case Study 34

Chapter 4: Analysis & Conclusions 50

References 60

Abstract:

COHEN, LINDSAY Framing Fracking; The Environmental and Social Implications of Hydraulic Fracturing, June 2015

[Advisor: Professor Kaplan]

Hydraulic fracturing is a process currently used to obtain natural gas that is trapped in rock, which has low porosity and permeability. The natural gas obtained from this process has had positive impacts such as creating jobs and boosting our economy, but has also had some detrimental impacts on our environment, as well as people. The controversy behind the fracking industry sparks the need to research more into the big players in the fracking industry and their role in affecting our opinion of the industry. A case study was conducted on a municipality that has implemented hydraulic fracturing as well as a non-governmental organization that is against it. As expected, the results indicate that the key groups within this industry discuss and focus on specific parts of the fracking industry in order to alter public opinion in a way that is beneficial to them and their case for or against it.

Introduction:

Hydraulic fracturing (fracking) is a controversial process that the United States has begun to rely on heavily in order to extract natural gas that was previously unobtainable to us. As our country has tried to move away from our reliance on foreign energy sources, hydraulic fracturing has provided us with the opportunity to produce a domestic energy source that helps to meet our energy needs. The process of fracking has unfortunately become the apparent cause of many environmental and social issues, making it the topic of much debate. While the economic gains that fracking has produced for our country in recent years is undeniable, the environmental and social implications of the process can be startling. The practice lacks regulation by the federal government, is exempt from many existing environmental laws, and is almost completely overseen at a state government level, which often times may fail to regulate every issue. As we try to attain this resource and boost our economy, we are perhaps creating damaging and irreversible impacts on our environment that should not be overlooked.

As a nation, we need to step back and look at the true foundations of hydraulic fracturing and ask ourselves, is it really worth it? We need to consider our future, and weigh the benefits that we are experiencing currently, with the destruction that we are seeing now, and may continue to see in the future. A big part of how our opinions on this process have been formed over time has to do with framing. How are oil companies,

municipalities, and social and environmental organizations portraying the industry to us? How are the people we rely on to communicate the truths about the industry discussing this process to the general public, and in what ways have they tried to form our opinions around information that will benefit themselves rather than our nation's citizens and environment? After conducting a case study with a municipality that has implemented hydraulic fracturing, as well as a non-governmental organization that is against it, the concept of framing theory as it applies to the hydraulic fracturing debate could be observed.

CHAPTER 1: What is Hydraulic Fracturing?

HISTORY

Over recent years, hydraulic fracturing has become a widely used method of obtaining natural gas, as well as the subject of much debate (Ehrenberg, 2012). While we as a nation, and world, continue to search for alternative sources of energy to fuel our ever-growing world, fracking has quickly become the answer. For many years, we have been using natural gas as a common energy source. It fuels our vehicles, generates electricity, and heats our homes (Ehrenberg, 2012). Natural gas currently supplies 25% of the U.S. energy supply, and it is estimated this could go up to 50% by 2035 (Manuel, 2010). So why is fracking just recently the topic of debate? This is where human consumption of our natural resources comes into play.

As we continue to exhaust our reservoirs of natural gas, the wells that are easy to access with conventional drilling have begun to disappear (Ehrenberg, 2012). Meanwhile, our energy needs continued to rise, along with the need for a clean burning fuel for relatively cheap (Osborn, Vengosh, Warner & Jackson, 2011). Conventional natural gas is produced from sand carbonates such as limestone's or dolomites (Holloway and Rudd 2013). These are porous rocks that hold the gas within their pore spaces, making it mobile

and relatively simple to retrieve (Holloway and Rudd 2013). Natural gas is created on a geologic time scale, so while there were still large amounts of natural gas within the rock reservoirs such as sandstone, limestone and shale, we could not access it (Brantley and Meyendorff, 2013). These are the unconventional forms of natural gas, consisting of low permeability and porosity, making the gas hard to retrieve (Holloway and Rudd 2013). Hydraulic fracturing provides us with a method of retrieving it from rock with low permeability and porosity deep beneath the earth's surface (Gasland, 2010). The Environmental Protection Agency defines hydraulic fracturing as:

“...a well stimulation process used to maximize the extraction of underground resources; including oil, natural gas, geothermal energy, and even water. The oil and gas industry uses hydraulic fracturing to enhance subsurface fracture systems to allow oil or natural gas to move more freely from the rock pores to production wells that bring the oil or gas to the surface” (The EPA, 2012).

Fracking can be dated all the way back to the 1860's, founded by Lieutenant Carnal Edward A. Roberts when the first explosive was thrown down a well (MacRae, 2012). The idea was first introduced to the oil industry in Pennsylvania, and it then began to spread across the Appalachian area (MacRae, 2012). His method boasted great numbers in terms of output, along with grave danger with the use of his “Exploding Torpedo” (MacRae, 2012). Soon, while the basics of this model were used, the procedure of extraction changed to eliminate the use of explosives, making it a safer, yet still reliable technique for retrieving natural gas (MacRae, 2012). Fracking as we know it today, began in the early 1940's, as early oil drillers would produce small explosions beneath the earth's surface, and later

began to pump down pressurized water to increase flow (Brantley and Meyendorff, 2013). The “hydrafrac” process was first patented in 1949, and led to the fracturing of 332 wells in the first year and the creation of around 3,000 wells a month throughout the 1950’s (MacRae, 2012).

More recently, we have begun to extract unconventional forms of natural gas, which was previously unavailable to us with older fracturing methods. These unconventional reservoirs have natural gas that is highly dispersed in the rock, rather than being concentrated underground in one location (The EPA, 2014). While regular fracking could be used to obtain gas from conventional reservoirs, in 1980 hydraulic fracturing was implemented in order to retrieve the natural gas from unconventional reservoirs (The EPA, 2014). Now, vast new reservoirs of natural gas have been found thousands of feet below the earth’s surface (Manuel, 2010). One of the largest underground reserves in the U.S. called the Marcellus Shale, stretches across four states including, Pennsylvania, New York, Ohio and West Virginia (Fox, 2010). This find, as well as the discovery of many other underground reservoirs across the United States has allowed us to launch the largest gas drilling campaign in history (Fox, 2010). It has been estimated by the Federal Energy Administration that shale gas will grow from 23 percent of U.S. gas production in 2010, to 49 percent in 2035 (Restuccia, 2012)

CURRENT PRACTICE

Hydraulic fracturing is a complex process for retrieving natural gas held deep beneath the earth’s surface. It combines two techniques, hydraulic fracturing and

horizontal drilling in order to reach the reserves (Ehrenberg, 2012). This entire process begins first with the creation of the natural gas within the rock, by the decomposition of dead organisms over geologic time (Brantley and Meyendorff, 2013). While this process takes thousands of years, we are constantly discovering new reservoirs that we were not previously aware of. We have also become more able to extract unconventional forms of natural gas, which we had previously been unable to obtain. Once a reservoir has been discovered, the drilling process begins.

They start by drilling a well straight into the ground, typically a mile deep into the earth's surface but, possibly reaching three miles (Fox, 2010). A steel pipe is then set perpendicular from the bottom of the well, across the shale bed (Howarth, Ingraffea & Engelder, 2011). This is called 'conductor casing' (Zoback, Kitasei, Copithorne, 2010). A 'surface casing' is then inserted, which usually runs from the ground surface to the bottom of any underground source of drinking water (Zoback et al. 2010). The surface casing is then pumped full of cement, as required by most states (Zoback et al. 2010). Once the surface casing is put in, the fracking process begins (Earth Works Action, 2015).

After locating target zones where the oil or gas is contained, the casing is perforated in these areas (Earth Works Action, 2015). From there, millions of gallons of high-pressurized water mixed with chemicals, or 'fracking fluid' are pumped into the well (Brantley and Meyendorff, 2013). The fracking fluid will flow through the perforations and to the target area (Earth Works Action, 2015). This fracking fluid contains a wide variety of chemicals including, methanol, formaldehyde, ethylene glycol and hydrochloric acid, as well as proppants (Manuel, 2010). Most companies use a mixture containing 90% water,

9% 'proppants', which are glass beads or sand to hold open fissures, and 1% chemical additives (Ehrenberg, 2012). One fracked well will usually use between 2 and 8 million gallons of water throughout the entire fracking process (Ehrenberg, 2012). The chemicals are used to dissolve minerals within the rock, kill bacteria that could cause a blockage in the well, and insert sand within cracks in the rock to hold open the fractures that are created (Brantley and Meyendorff, 2013).

After the injection of the fracking fluid, internal pressure within the rock formation causes the rock to crack and eventually the fluid will return to the surface; this known as flow back (The EPA, August 2014; Earth Works Action 2015). Within this flow back can be the injected chemicals, as well as materials that occur naturally beneath the earth's surface such as brines, metals and hydrocarbons (The EPA, August 2014). The proppants within the frack fluid will stay within the cracks in the rock to keep them open (Earth Works Action, 2015). The flow back can be stored on site in tanks or pits, injected back underground, or sent to a waste water facility for treatment and then discharge (The EPA, August 2014). Some companies also find ways of recycling the flow back, and using it on future drilling projects (The EPA, August 2014). All of this depends on the regulations that are in place in the state where the drilling site is located.

Once the fractures in the rock are made, the gas becomes 'wet'. The water pressure is then reduced, and the chemicals are extracted from the well (Fox, 2010). The 'wet' natural gas is then made into a form ready for commercial use; it moves up the steel pipe and well, and the excess water and chemicals that are mixed with it are removed (Fox, 2010). In the end, about 300,000 barrels of natural gas are produced and shipped off to

different locations in the United States, on a daily basis (Dangers of Fracking, 10/20/2014). On a typical area of Marcellus shale, drilling and fracturing is about a three-week process, and then the natural gas beneath the well can start to be obtained (Zoback et al. 2010). While the rate of the wells production will usually slow quickly within the first few months, it will usually continue to be economically productive for five to ten years (Zoback et al. 2010).

REGULATIONS

As the fracking industry has continued to grow, standards and regulations have begun to be put into place at multiple levels including federal, state and local. While research is still being done on many aspects of fracking and the impacts it has, the Environmental Protection Agency (EPA), has acknowledged four key issues with the current process (The EPA, October 2014). The issues are: stress on surface water and groundwater supplies from withdrawal of large volumes of water used in the process, contamination of groundwater drinking sources and surface water due to spills, and poor well construction, adverse impacts from discharge into surface water, and air pollution due to the release of volatile organic compounds and greenhouse gases (The EPA, October 2014). While these issues are continuously addressed by state and federal agencies, Congress has also implemented a study run by the EPA to determine the effects of fracking on our drinking water (The EPA, October 2014). In 1999, the Environmental Protection Agency began their first study on hydraulic fracturing in methane coalbeds in order to better understand its effects on underground drinking water sources (The EPA, 2012).

Two of the main federal acts that come to mind when discussing hydraulic fracturing are the Clean Air Act, and the Clean Water Act. The Clean Air Act, which was first implemented in 1970, was designed to protect the public from different kinds of air pollution, stemming from multiple different sources (The EPA, 2013). The Clean Water Act, was passed in 1972, with the goal of, “[restoring] and [maintaining] the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources, providing assistance to publicly owned treatment works for the improvement of wastewater treatment, and maintaining the integrity of wetlands” (The EPA, November 2014)

Unfortunately, both the Clean Air and Water Acts do not put any specific regulations on hydraulic fracturing, and in cases where they do; the government has deemed the fracking industry exempt. Currently, the EPA only monitors reporting on greenhouse gas emissions from fracking under the Clean Air Act (The EPA, October 2014). For example, the Energy Policy Act of 2005 excluded hydraulic fracking from the Safe Drinking Water Act, unless they were using diesel fuels (The EPA, October 2014).

In 2003, the EPA created a memorandum of agreement with the companies that conduct hydraulic fracturing operations to make sure diesel fuel was not being used in fracturing fluids (The EPA, 2012). This was put into place due to the known contamination it could cause with underground sources of drinking water (The EPA, 2012). The EPA does offer guidelines and suggestions on practices that would keep to the act, but does not enforce them as regulations (The EPA, October 2014). The EPA also works with state and local governments to assist in responding to incidents, educate on accident prevention,

assist in emergencies, perform inspections, and issue permits to make sure existing laws are abided by (The EPA, October 2014).

In April of 2012, the Environmental Protection agency finally began to crack down on hydraulic fracturing, and released their first set of regulations (Koenig, 2012). President Obama began this movement when he signed an executive order, which discussed the importance of using our nations natural gas resources while not causing concern or harm in any way to the American people:

“It is vital the we take full advantage of our natural gas resources, while giving American families and communities confidence that natural and cultural resources, air and water quality, and public health and safety will not be compromised.”

(Restuccia, 2012)

The main goal of the EPA with these regulations is to reduce toxic air pollution that is released during the hydraulic fracturing process (Restuccia, 2012).

The EPA focused their efforts on adjusting some of the current standards that have been set under acts such as the Clean Air Act, and National Emission Standards for Hazardous Air Pollutants (NESHAP) (Jackson, 2012). They have established emission limits for sources of emissions that are currently not being controlled, due to the exception of hydraulic fracturing from many acts that are already in place (Jackson, 2012). These limits are what the Environmental Protection Agency believes can be achieved by

companies if they are using the most current greening technology available (Jackson, 2012).

With the use of the green completion technologies, or reduced emission completions (REC's) it is the hope that volatile organic compound emissions will be greatly reduced. The Environmental Protection Agency gave companies almost three years to implement the new regulations into their current practices, as the regulations will be fully instated in January of 2015 (Koenig, 2012). The policy forces all fracking operations to install new equipment, a form of 'green completion technology' (Koenig, 2012). In the past, air pollution emitted from the natural gas drilling sites could either escape into the air, be burnt, or captured and sold as natural gas using green completion technologies (Koenig, 2012). The goal of the EPA is to eliminate the other two processes, which emit pollutants into our air, in turn reducing the present smog-forming emissions that are released by the fracking process, by up to 95% (Koenig, 2012).

The rules are specifically stated in the government document that was put out by the Environmental Protection Agency. Individual storage vessels at drilling operations that have more than 6 tons of volatile organic compound emissions a year, must achieve at least a 95% reduction of emissions (Jackson, 2012). They also set a limit on the natural gas bleed rate of 6 scfh for continuous bleeds located between the wellhead and the point at which the gas enters the transmission and storage area (Jackson, 2012). For pneumatic controller at the gas processing plant, the bleed limit is zero scfh (Jackson, 2012). Sites must also have a 95% reduction in VOC emissions from, "...wet seal centrifugal compressors located between the wellhead and the point at which the gas enters the

transmission and storage segment” (Jackson, 2012). Besides these more important regulations, many other small changes have been implemented on the fracking industry, for which they must begin to abide by 2015 (Jackson, 2012).

On May 19, 2014 the Environmental Protection Agency implemented a new law under section eight of the Toxic Substance Control Act (The EPA, October 2014). It is an Advance Notice of Proposed Rulemaking; proposed in hopes of obtaining information on the chemicals used in hydraulic fracturing, while also making the information available to the public (The EPA, October 2014). The hope is that this regulation will aid in keeping the public comfortably informed, while also allowing the EPA and other agencies to check up on chemicals used by companies, especially those that are concerning to the public (The EPA, October 2014).

While these regulations show that the safety of our nations air, and water resources, as well as the health of the American people is finally being put first, some government officials as well as companies feel it is economically, not possible for the fracking industry to meet the new standards and still produce enough natural gas to meet the current needs of the American people (Koenig, 2014). Those against the new environmental regulations feel they could negatively impact the recent boom in natural gas production we are currently experiencing, which has brought gas prices down to a ten year low (Koenig, 2014).

The EPA is also working with two environmental programs in order to address fracking issues associated with air quality. With the Natural Gas STAR program, they have been able to identify new technologies that can reduce methane emissions in the U.S. and

abroad in a cost-effective manner (EPA, October 2014). Also in conjunction with the Clean Construction USA program, the EPA is working towards cleaner fuels and ways to innovate hydraulic fracturing equipment and vehicles to reduce emissions (EPA, October 2014).

“...Municipal bans, moratoria, and zoning laws are being passed across the country, but federal and state level action is necessary to reverse the spread of fracking” (The Urgent Case for a Ban on Fracking, 2015).

While government agencies, specifically the Environmental Protection Agency have been working on implementing some standards for protection of people and our environment from the harms of hydraulic fracturing, states have also put their own regulations in place, as they are often the ones issuing drilling permits (EPA, October 2014). Many states have focused their regulations on the pre-drilling, groundwater and surface water impact, liquid wastes and fluids and solid wastes (ALS Global, 2014). They aim to address any issues they feel are not being fully addressed by the Federal government, especially those of public and environmental concern.

Pre-drilling regulations at the state and local level look at the drilling site location, well design, chemicals used and permits (ALS Global, 2014). Some states will conduct testing on the sites water previous to the drilling process, so that it can be tested throughout to see the impact of the fracking process (ALS Global, 2014). Usually the tests are not broad but test certain indicators such as pH, alkalinity, sulfate and common metals (ALS Global, 2014). Generally, ground and surface water testing is not required throughout the process, but some states will implement it on specific sites of concern (The Urgent Case for a Ban on Fracking, 2015). The treatment of wastewater is under state regulations

unless it is being injected into the ground, in which case the federal government would also be involved (ALS Global, 2014).

More recently, the governor of New York State, Andrew Cuomo has banned fracking within the state (Kaplan, 2014). While New York holds a sufficient amount of natural gas that can now be reached with hydraulic fracturing, it has instead become the second state in the country, after Vermont in 2012, to have a ban on fracking in place (Kaplan, 2014). The governor has made this decision based on the inherent health risks that fracking poses, as confirmed by a study done by Dr. Zucker, the acting state health commissioner (Kaplan, 2014). The ban itself has gotten a lot of mixed feedback including relief from some, while others are fuming as they see this as a lost opportunity for an economic boost in the state (Carl, 2014). This ban also goes against Cuomo's previous stance on fracking in which he viewed the industry as an "economic stimulus and a way to reduce carbon emissions when closing old coal plants" (Conca, 2014). This ban also leads to the continued dependence on dirty forms of energy that we are trying to move away from (Conca, 2014).

CONCLUSION

The fracking process concept itself, has been around for over a century now, and has allowed the United States and many other countries to obtain natural gas from below the earth's surface, and provide an alternative energy source. As we continued to exploit this natural resource, the sources became harder to find and harder to reach. With our enhanced technologies, we were able to find a new way to obtain the natural gas that is tightly held up in bedrock, rather than free flowing underground. This is when the boom of

hydraulic fracturing began, as this alternative process allowed us to pull natural gas from sources that had been previously unobtainable.

The process itself is quite complex, involving many important steps that must be done properly. After finding a suitable location, the well is dug, and soon after the fracturing process begins as frack fluid is pumped down the well in order to hold open fissures in rocks created by small explosions. Natural gas is released from these cracks, and collected for use by the general population. While hydraulic fracturing allows us to tap a comparatively clean energy source that would be otherwise unavailable to us, it does come with some issues which government agencies and local and state governments are working to regulate. While this is a relatively new practice, and not much research has been conducted in every aspect of it, where regulations have been seen fit, the government has made sure to place regulations on drilling companies. These regulations will likely continue to grow, as the general population and environmental groups push the government to oversee hydraulic fracturing operations more strictly.

CHAPTER 2: Fracking; The Pros & Cons

ENVIRONMENTAL IMPLICATIONS

The facts, as well as opinions on hydraulic fracturing are extremely varied, and one could easily present an argument both for and against the process. As with many things, there are both positive and negatives to hydraulic fracturing, in terms of our environment. Presently, one of the more prevalent issues seems to be with water, and more specifically fracking fluid runoff into underground reserves (Manuel, 2010). This process can put vital aquifers at risk for generations by creating new pathways for the potential flow of contaminants now and for years and decades into the future (The Urgent Case for a Ban on Fracking, 2015). Fracking fluid, as discussed in chapter one is a chemical mixture that is pumped into the wells, that allows the gas held deep within the rock to be extracted. While this is perhaps the only way these gases could be obtained, many environmentalists, scientists and the general population see this mixture as a big problem (Brantley and Meyendorff, 2013).

The problem starts with the fact that not all of this fracking fluid can be recovered from the ground; up to 70% may be left beneath the earth's surface and it is not biodegradable (Dangers of Fracking, 10/20/2015)! The long list of up to six-hundred

chemicals that are in fracking fluid are unappealing to many people, but are especially unappealing to scientists (Dangers of Fracking, 10/20/2015). In fact, a study done by the House Energy and Commerce Committee found that fourteen of the major gas and oil companies use seven hundred and fifty different chemicals in their fracking fluid (Waxman, Markey & DeGette, 2011). These chemicals include acids, detergents, and poisons that are not regulated by federal laws (Brantley and Meyendorff, 2013). Of the chemicals found in the House Energy and Commerce Committee survey, “25 of the chemicals are listed as hazardous by the Clean Air Act, nine are regulated under the Safe Drinking Water Act, and fourteen are known as human carcinogens” (Ehrenberg, 2012). It has also been found that water that is contaminated with these chemicals can cause sensory, respiratory, and neurological damage to humans (Dangers of Fracking, 10/20/2015).

While the main concern is focused on our ground water reserves, there is also evidence about the negative effects that frac fluid can have on surface water as well as the contamination of soil (Earth Works Action, 2015). The frack water that can be recovered is often dumped in areas that allow it to get into our waterways, and especially into people’s drinking water (Manuel, 2010). One study done by Zoback, shed light on the direct impacts that fracking fluid can have on our environment if accidentally released (Zoback et al. 2010). In 2009, a leaky pipeline in Pennsylvania released 4,000 gallons of frac fluid into a nearby creek killing many fish and invertebrates within it (Zoback et al. 2010). At another site where 300,000 gallons of wastewater was intentionally released into a hardwood forest, scientists found that trees lost their leaves and over a two year period most of them died (Ehrenberg, 2012). Wastewater from this process, mostly composed of used frac fluid,

has clearly played a role in the production of detrimental effects on different ecosystem environments that were exposed.

One of the more notorious claims pertaining to drinking water and fracking fluid is that people living in close proximity to wells are able to light their tap drinking water on fire (Dangers of Fracking, 10/20/2015). Although companies will insist that this is just a coincidence, or that the methane levels in the water are still not at a toxic level to humans, even though the water can be lit on fire, this issue is very concerning (Dangers of Fracking, 10/20/2015). While there are mixed implications about the exact effects that frac fluid would have on drinking water, the observed effects, and the unknowns would lead one to believe that more research should be done before the fracking process continues.

Along with the concerns over the direct pollution of our water from fracking fluid, comes the worry of the release of methane gas into the air and groundwater, from the fractures made in the shale. Many argue that methane does naturally exist in groundwater, but others believe the amounts we are seeing are not naturally occurring (Ehrenberg, 2012). Although research is still relatively minimal at this time, some research has shown that the amounts of methane we are seeing in groundwater near drilling sites are definitely not normal. One study found that around 75% of well samples within one kilometer of Marcellus Shale drilling sites were contaminated with methane that was released from the shale drilling process (Howarth et al. 2011). Another study, sampled 60 private wells in upstate New York and northeastern Pennsylvania (Osborn et al. 2011). They found that of the 60 wells they sampled, methane content was on average seventeen times higher in wells near active fracturing operations than in those located in areas where fracking

operations were not taking place (Osborn et al. 2011). Along with this, the contamination of personal wells with methane can literally turn homes into explosive hazards, as the methane is extremely flammable and flowing through pipes throughout entire homes (The Urgent Case for a Ban on Fracking, 2015).

This goes hand in hand with the concerns about 'blowouts' and the effects that they have on the environment. A blowout is a term for the uncontrolled release of oil or gas from the well that can occur during the drilling or fracking processes (Ehrenberg, 2012). Although there is blowout prevention equipment that is required in many states, if for some reason it is not used or fails, "pressurized fluid and gas can explode out of the well head" (Ehrenberg, 2012). This can injure people, as it also releases large amounts of pollutants (Ehrenberg, 2012). Many stress the importance of fully understanding the drill site you are working on, as one recent blowout was blamed on the unknown existence of an abandoned coalmine that had caused a large pocket of methane to explode (Zoback et al. 2010). There is also the need for stricter regulations, as well as better training of individuals, because a mistake by one misinformed driller can cause a blowout that could have damaging effects (Zoback et al. 2010).

The exact impacts that fracking has on global warming are a not entirely clear. While some may argue that hydraulic fracturing and the natural gas we obtain from it is currently one of our cleanest sources of energy developed on our soil, others would argue that the release of methane, one of the most potent greenhouse gases into the atmosphere counteracts that (Howarth et al. 2011; Ehrenberg, 2012). It is estimated that over the lifetime production of a shale gas well 3.6-7.9% of methane is accidentally released into the

atmosphere, as compared to conventional wells that release between 1.7-6% (Howarth et al. 2011). While the release of methane is obviously an issue associated with the process, the Environmental Protection Agency found that from 1990 to 2012 methane emissions from natural gas production fell 17% while production increased 37% over the same period of time (2014). This leads to mixed ideas on the process, as the facts provided by different agencies often differ.

Along with this, methane is not the only gas released by the fracking process that we have to be concerned about. Air quality can also be negatively affected by other organic compounds that become mobilized during the fracturing and gas extraction process (Earth Works Action, 2015). A study conducted in 2011 revealed that 37% of the chemicals used for hydraulic fracturing have the ability to become airborne; they are volatile (Colborn et al. 2011). While these may not all be released from the fracturing process alone, they may remain within the frac fluid that is extracted and later become airborne if not removed from the frac fluid correctly (Earth Works Action, 2015).

Fracking also possess an issue in terms of the amount of water used in the process, as it is an extremely water intensive process. A study done in 2010 by the Environmental Protection Agency found that, "70 – 140 billion gallons of water are used to frack 35,000 wells in the United States each year...this is equal to the annual water consumption of 40 – 80 cities with a population of 50,000" (Environmental Protection Agency, 2011). Coalbed methane wells use 50,000 – 350,000 gallons of water a well, which is a lot less than a shale well that uses 2 – 10 million gallons per well, neither is very appealing (Earth Works Action, January 2015). Yet, while many will support fracking over our coal industry, if all

the environmental impacts are considered, it can become a pretty close race. Water is a vital resource to human survival, and the amount that is contaminated during the fracking process may make the process more detrimental than many realize.

Another concern to consider is the fact that the fracking process itself is not the only source of the pollution or water issues. For example, the retrieval of proppants, which as discussed in chapter one helps to hold open fractures for easier retrieval of natural gas, is also a water intensive process that creates its own pollution. Proppants are used by the hundreds of thousands, to millions of pounds at one single fracking site (Earth Works Action, January 2015). The proppants itself come from sand mines, in which the process requires a lot of water to retrieve them, releases air emissions, and raises health concerns due to the health problems that are related to the crystalline silica involved in the process (Earth Works Action, January 2015). When looking at the impacts of fracking, we must also consider the industries associated with it that allow the process to take place, and the impacts they are also having on people and the environment.

The large amounts of water used, as well as the natural gas obtained is transported by trucks; leading to yet another environmental concern. So, while the process itself continues to deplete our fresh water supplies, the transport of two to five million gallons of water requires about 1,400 truck trips (Earth Works Action, January 2015). These trucks create problems with air quality, as well as safety issues and an increase in road repairs (Begos & Fahey, 2014). It would be nice to see some companies take responsibility for the carbon emissions of all of these trucks, or for our government to impose a carbon tax for this specific issue.

Along with the excessive use of water, rapid growth of the fracking industry brings the overarching need to find somewhere to dispose of it, a way to treat it, or a way to reuse it (Earth Works Action, January 2015). For example, from 2010 to 2011 Pennsylvania saw a 70% increase in the amount of wastewater they needed to take care of due to the increased development by the fracking industry on the Marcellus Shale in their state (Earth Works Action, January 2015). Furthermore, the wastewater has become more difficult and expensive to take care of thanks to stricter regulations as well as a new finding by the USGS (Earth Works Action, January 2015). They found that not only does the frac fluid that returns to the surface as flow back contain chemicals but it also contains rock formation materials including brines, heavy metals, radionuclides and organics (Soeder & Kappel, 2009). Hopefully in the future the fracking industry can look into alternatives to replace the long list of chemicals they are currently utilizing in their frac fluid. A non-toxic frac fluid is definitely a feasible concept; many offshore operations use non-toxic frac fluids that will not harm marine organisms (Earth Works Action, January 2015).

Another concern of many scientists and people living in close proximity to drilling areas is pertaining to small earthquakes that they believe to be caused by fracking. This too is a controversial subject in which some scientists claim that yes, there may be small earthquakes, but none that can be felt by or are of danger to people; there are no earthquakes caused by fracking at all; or there is imminent danger of catastrophic earthquakes due to fracking (Ehrenberg, 2012). Each of these arguments has their own 'research' and backing, making it quite unclear as to whether or not this should be a cause for concern, or viewed as biased research and beliefs to add to the fracking panic.

Most scientists will agree upon the fact that some small earthquakes can be linked with hydraulic fracturing (Ehrenberg, 2012). While this is true, they also believe them to be extremely rare, and incredibly avoidable with proper monitoring (Ehrenberg, 2012). In all of the wells presently in the United States it was found that only eight of them had seismic activity due to the injection of fluids, and that all eight of these caused no damage and were likely not felt by the local population (Brantley & Meyendorff, 2013).

One study done by William Ellsworth, suggests that the fracturing site itself may not be cause for earthquake concern but rather the location of where wastewater from the process is deposited (Ellsworth, 2014). He found that there was an increase in the number of earthquakes in areas nearby to frac fluid disposal locations (Ellsworth, 2014). Based on his findings, Ellsworth believes that fracking fluid may act as a 'grease' when deposited along faults, leading to an increase in seismic activity (Ellsworth, 2014). Another study was done in Texas after a small town had begun experiencing earthquakes for the first time in it's 142-year history (Zoback et al. 2010). This study also found that the injection of wastewater in to salt-water wells was the likely cause of the increased seismic activity, rather than the hydraulic fracturing itself (Zoback et al. 2010).

While the negative environmental impacts currently overshadow the positives, they do indeed exist. Those who are able to look beyond the many environmental issues that are still up for debate, see a clean energy source, that decreases our nations CO2 emissions and puts us on the right track to finding and using a fully-renewable energy supply (Zoback et al. 2010). The use of greater amounts of natural gas is our nation's first step towards cleaner energy, as we increase the use of natural gas and decrease the use of dirty fuels

such as coal. While everyone acknowledges that this is not the cleanest source of energy our present technologies are able to come up with, currently it provides us with a cleaner source than the past, as we transition into a clean, renewable energy using nation (Ehrenberg, 2012).

SOCIAL IMPLICATIONS

As a nation, we have continued to deplete our own natural resources, as well as contribute to the depletion of other nation's natural resources. While the population of our world, and the U.S. continues to increase, and more and more countries become developed, our natural resources and energy sources continue to decline at alarming rates. As the great minds of our generation continue to search for alternatives to replace our depleting resources, fracking has provided us with a quick fix to the problem and possibly an answer to a potential energy crisis (Ehrenberg, 2012). We can now easily obtain natural gas, which had previously been unattainable to us. Yet, in a way, we have become a victim of the global energy market, in which our sole concern has become to create our own energy at any cost, rather than rely on other countries (Finewood & Stroup, 2012).

Many view natural gas as one of the cleaner sources of energy that we use, much cleaner than oil and coal (Howarth et al. 2011). While it may be cleaner than oil and coal, that does not make it clean. As a nation, we see the natural gas we obtain from fracking as our very own resource for energy, we do not need to depend on other countries, which is likely what makes it so appealing. Along with this, it is believed by some scientists, that with our current technology, paired with the implementation of strict laws, all apparent

dangers associated with fracking could be eliminated, although many strongly disagree with this (Ehrenberg, 2014).

A study done by the Wall Street Journal in 2015 found that over fifteen million Americans are currently living within one mile of a well drilled after the year 2000 (The Urgent Case for a Ban on Fracking, 2015). While for ethical reasons it is not possible to conduct scientific studies concerning the exact impact that frac fluids may have on people; scientists have recently begun to research its effects on the people who have accidentally been exposed over the years of the process (Ehrenberg, 2012). Perhaps the biggest current social implication of this process is the contamination of groundwater by methane as well as frac fluid. Many people in rural areas use this water as a source of drinking water, as well as for businesses in terms of watering crops or supporting other farming practices; they rely on their water for income (The Social Costs of Fracking, 2013). This reliance on water that has now been contaminated can be detrimental to people's health, as well as their businesses.

Many people who support fracking often refer to the many jobs that it has created over the years (Zoback et al. 2010). With the hydraulic fracturing industry creating 300,000 barrels of natural gas a day, a large work force is needed to have this amount of production, along with the fact that the work can be spread across a wide array of professions (Dangers of Fracking, November 2015). Hydraulic fracturing currently supports 2.1 million American jobs, while providing a more secure energy future for America (Energy from Shale, 2015). The backing for this industry is also centered on a belief that economic prosperity as well as social mobility for individuals and families will

all be the result of an abundance of energy from our own country and stable jobs (Energy from Shale, 2015).

While the creation of jobs is a given with the development of any new industry, these jobs are often given to out of town, or out of state workers (The Social Costs of Fracking, 2013). This in turn leads to a sudden increase in population of many small town areas where fracking operations take place. Unfortunately, while fracking provides jobs for some, it forces others, often those whom lived in the town prior, to lose money, while rent increases, and a small town tries to compensate for its over population (The Social Costs of Fracking, 2013).

Although some people have seen the benefits of hydraulic fracturing, it seems that our government may be one of the biggest players in this big business (Anonymous, 2014). Presently, the United States Energy Information Administration (EIA) has come out with estimates on future shale gas production of the most active wells in the U.S. (Anonymous, 2014). While no estimate can be 100% correct, the estimates of independent academic researchers who have tested the same wells tell a much different story (Anonymous, 2014). Government agencies such as the International Energy Agency predict that global production of shale gas will, “more than triple between 2012 and 2040”, however a team of scientists in Texas have found quite the opposite. Their research tells them that in the coming years the production of the natural gas from our most active wells will reach their peaks, and rapidly decline from there (Anonymous, 2014).

While there is no way of foreseeing whose research is correct, independent researchers stand to gain nothing by reporting false findings in terms of the fracking

industry, yet the estimates of government agencies will directly affect how much we as a nation and as citizens decide to invest in this industry (Anonymous, 2014). Along with this, rather than investing more in 'tracking and assessing' our natural gas resources, we invest in the hope that these vague estimates are correct (Anonymous, 2014). We also continue to invest in the process of retrieving the gas but ignoring the consequence. The reality is that a time will come when we must pay to offset the methane and carbon emissions from this process, clean the polluted water that is used, and address all of the other unforeseeable impacts that hydraulic fracturing may have on our nation and world (Anonymous, 2014). Eventually, the taxpayer's dollars that we are currently paying towards an unpredictable industry will then be paid to fix what we have ruined (Anonymous, 2014).

One way that big businesses behind fracking have been able to uphold the "good intentions" of the fracking industry and represent it as a positive, is by associating it with clean renewable energy sources such as solar, wind and geothermal. For example, they invested 11 billion dollars to help the development of renewable energy sources between 2000 and 2012, as a way of showing that they are for a greener America too (Energy From Shale, 1/2015). They have also invested 81 billion dollars over the same time period, in technologies that will mitigate greenhouse gases emitted from the fracking process (Energy From Shale, 1/2015).

As a nation, we have begun to look at fracking with 'economic logic', which has allowed many to, "normalize the impact of fracking on our resources" (Finewood & Stroup, 2012). In the past, once we ran out of natural gas from a conventional well, it was too expensive, or we did not have the technology, to retrieve any more natural gas from that

area. Now, “ [hydraulic fracturing] contribute[s] to one of the largest domestic energy booms in U.S history” (Soeder, 2010; Gold, 2012). We have used hydraulic fracturing to answer our concerns of energy security, while also contributing to rural economic growth, yet we do not fully acknowledge the “social, economic and ecological costs that far out way the benefits” (Finewood & Stroup, 2012).

Although there have not been many studies in terms of the fracking industry, the studies that have been done are often prepared and funded by the natural gas industry (Barth, 2013). This often leads to some skewed conclusions that, “generally concludes that there will be large positive economic impacts to both states and local communities” (Barth, 2013). Industry sponsored studies often don’t address environmental problems caused by fracking, but rather focus on increased employment, income and tax revenue growth (Barth, 2013). Economic gains are also often exaggerated due to the misrepresentations of the state and the workers being studied. Often, studies will compare the gains that states like Pennsylvania will see, to gains that Texas has experienced from the industry (Barth, 2013). A state like Texas already has a big gas industry, they have the skilled labor force as well as the necessary materials and equipment that will allow them to easily profit from the increase in the natural gas industry (Barth, 2013). A state like Pennsylvania will have to bring in skilled workers and equipment from other states in order to support their rapidly growing industry (Barth, 2013). Along with this, economic impact is also often exaggerated because many of the workers are brought in from other areas, and send their money back to their families elsewhere (Barth, 2013). This leads to an improved economy in another area rather than the shale region (Barth, 2013).

Studies not funded by the natural gas industry, often find much less optimistic estimates for the success and economic gains produced by the industry (Barth, 2013). Many discuss the 'natural gas curse'; "countries with wealth in terms of natural resources tend to grow more slowly than resource poor countries" (Sachs & Warner, 2001). This pattern is most prominent in regions that have an 'extractive industry' (Barth, 2013). Studies have found a negative relationship between growth of the economy and having an abundance of natural resources, but did find that when the resource is developed at a slow pace there is a better chance that the economy and society will have time to adjust (Barth, 2013).

"Counties that were not focused on fossil fuel extraction as an economic development strategy experienced higher growth rates, more diverse economies, better educated populations, a smaller gap between high and low income households, and more retirement and investment income" (Headwaters Economics, 2009).

Boom-bust cycles should also be considered when looking at the economic gains of a community from the hydraulic fracturing industry (Barth, 2013). As history has shown, places that suddenly rely heavily on an extractive industry to boost their economy often end up crashing once that resource runs out (Barth, 2013). "A sustainable economic future should be based around safe energy solutions, efficiency, conservation, and renewable energy resources"; hydraulic fracturing does not provide this (The Urgent Case for a Ban on Fracking, 2015).

The energy-water nexus discusses how energy and water are ‘inextricably linked’, and therefore humans depend on both for survival (Sehlke, 2009). There is also a hydro-social cycle in which the relationship between water and society defined by, “transformations embedded in and infused by class, gender, ethnic or other power struggles” (Swyn & Gedouw, 2009). As water and energy consumption increase, human populations become more vulnerable; hydraulic fracturing has allowed us to greatly increase our energy consumption while also contaminating large amounts of water (Finewood & Stroup, 2012). Fracking has a direct impact on our energy and water resources which both greatly impact our society.

CHAPTER 3: A Case Study

METHODS

After looking at all of the facts, suspicions and opinions surrounding hydraulic fracturing, two case studies were conducted in order to obtain information first hand from those experiencing the effects of fracking. An in depth analysis was done after conducting interviews with two of the main players in the hydraulic fracturing industry. Interviews were conducted with an environmentally focused social organization that is against fracking and a municipality that has implemented fracking. An interview with similar questions was conducted with each of these groups that showed their views on the practice, and how they differ. From this information, conclusions could be drawn on what hydraulic fracturing really is doing for our environment, our economy and us. The information was looked comparatively and applied to the general concept of framing theory:

“...Framing comprises a set of concepts and theoretical perspectives on how individuals, groups, and societies organize, perceive, and communicate about reality. Framing involves the social construction of a social phenomenon - by mass media sources, political or social movements, political leaders, or other actors and organizations. It is an inevitable process of selective influence over the individual's

perception of the meanings attributed to words or phrases.” (Framing Social Sciences, 2015)

Seeing as hydraulic fracturing is such a controversial issue, it is important to understand how different players in the industry frame their discussions on the industry to the general public in order to better understand why there are so many differing opinions.

After conducting research, some of the more prominent social organizations and municipalities within the fracking industry became evident. Organizations that were contacted were chosen on the basis that, the group focused on concern for our environment yet also had some sort of social aspect. The social group needed to have one or multiple staff members focused on hydraulic fracking, and more specifically list hydraulic fracturing as one of their main focuses or issues they work with. This was done because in the beginning of the research process, it became clear that although many environmentalist groups did have some opinions on hydraulic fracturing, those without specialists in the area were unable to answer the interview questions with the amount of knowledge and information that was needed. After reaching out to five different social groups, Food and Water Watch was the first group to respond to the interview.

When choosing a municipality, counties that were located on well known shale beds, where a large amount of drilling is done and has been increasing over recent years were contacted first. Bradford County, in Pennsylvania was chosen because they are located on the Marcellus Shale, which is the closest prominent shale bed in our area. Bradford County also has an advisory committee for the exploration of their natural gas source, which was focused on informing and educating the public. This made it clear that Bradford County has

experienced all aspects of the fracking industry and therefore the information about the industry there, as well as their personal experiences would be relevant to the study.

Each of interviews consisted of eight short questions, which were sent to the interviewees via email, which they then returned with their responses. Therefore a written record of everything they said was obtained for analysis. It was also helpful, because many of the people that were contacted had busy schedules and emailing allowed them to complete the interview on their own time and therefore more thoroughly. The interview content covered four main areas, the background of the interviewee, the industry itself, the regulations on the industry and public education pertaining to the industry. First, questions to gauge the interviewee's level of education, job title and position were asked. From there, interviewees were asked questions pertaining what they viewed as the advantages and disadvantages of hydraulic fracturing, specifically referring to the social, environmental and economic influences. They were asked to discuss if they felt the current regulations on fracking were effective and fair, or if they felt more needed to be put into place. Lastly, the interviewees were asked how they believed the majority of the public feels about hydraulic fracturing, and whether or not there needs to be more education about the industry as a whole.

FOOD AND WATER WATCH

Food and Water Watch is a non-governmental organization, and consumer rights group based in Washington D.C. (Food & Water Watch, 2/10/2015). At the organization's start up in the fall of 2005, they had just twelve members; today they have over sixty staff members and many social and environmental victories under their belt (Food & Water

Watch, 2/10/2015). They have won many environmental and social battles, from convincing Starbucks to stop using milk from cows that have been treated with artificial growth hormones, to raising nationwide awareness about the issues with our bottled water industry (Food & Water Watch, 2/10/2015). The simplest way to communicate the goals of this organization is that they want healthy food and clean water for everyone (Food & Water Watch, 2/10/2015). They, “advocate for common sense policies that will result in healthy, safe food and access to safe and affordable drinking water”. They have their base in the United States, but also have representatives working towards their goals in countries around the world including Mexico, Europe, Africa and Latin America (Food & Water Watch, 2/10/2015).

As one can imagine, their goals have led the company to focus on mostly environmental issues that are interfering with them. They believe that corporations as well as our government put profit before people, and they want this to change (Food & Water Watch, 2/10/2015)! Currently, they focus on issues including but not limited to, climate change, bottled water, factory farms, genetically modified foods, water privatization and of course fracking (Food & Water Watch, 2/10/2015). They strive for a, “...world where all people have the wholesome food, clean water, and sustainable energy they need to thrive. Food and Water Watch advocates for, “public control of water resources and services, strong conservation measures and tough regulation of toxic emissions... [they] work to stop the financialization of nature and the privatization of our common resources...” (Food & Water Watch, 2/10/2015).

As a non-governmental business or NGO, Food and Water Watch is not a part of the government, nor is it a for profit business. As a voluntary citizens group, Food and Water Watch receives a lot of their funding from trusts, grants, and donations. They receive no government grants and members pay no dues to be a part to Food and Water Watch. For example, in 2012 they received 2.5 million dollars from the National Philanthropic Trust, and have also received about \$700,000 from the Park Foundation since 2008 (Big Green Radicals, 2/25/2015). As an NGO Food and Water Watch relies solely on revenue in the form of donations, they are funded by U.S citizens and those groups and trusts that want to support them in their fight against key environmental and social issues.

Their most recent published annual budget report is from 2012, during which their budget was \$10,185,112.00 for the year (Food & Water Watch, 2/10/2015). Food and Water Watch focused this budget on public and policy maker education, lobbying, media, and internet activism in support of the issues they see as most important. In 2012, 13% (\$1,355,060) was spent on administration, 7.5% (759,655) was spent on fundraising, 45% (\$4,531,310) on issues related to food, 25% (\$2,577,542) on issues related to water, and 9.5% (\$961,553) on issues related to common resources (Food & Water Watch, 2/10/2015). This budget is also not solely focused on their personal efforts for change; Food and Water Watch will often spend parts of their budget to support grass roots organizations that are working for a cause that they too are working for. They use their budget to advocate for their causes, while also helping other's advocate for those same causes in areas they may not be able to reach.

Food and Water Watch has an overarching focus on issues concerning our food and water. In terms of water, they focus on many varying issues that affect our water resources including, bottled water, fracking, Triclosan, public water infrastructure, water privatization, water conservation, and desalination (Food & Water Watch, 2/10/2015). They have created a social movement called 'Take Back the Tap', in which they educate people about bottled water versus tap, and have people pledge to stop buying bottled water (Food & Water Watch, 2/10/2015). They are working to inform people about Triclosan, an antimicrobial pesticide that can be found in many of our everyday products such as hand soap, toothpaste and body lotion (Food & Water Watch, 2/10/2015). They have taken a stance on our current water infrastructure, and are demanding upgrades and repairs, that should have been done years ago to the systems that deliver our tap water to us.

The privatization of water is another serious issue they are trying to combat, by making people aware that multinational corporations are buying up our water resources, and concerned about profit rather than the community they should be serving (Food & Water Watch, 2/10/2015). They are teaching people about conservation, and how we can use our water smarter and better to ensure we do not waste this valuable resource (Food & Water Watch, 2/10/2015). They are showing people that desalination is not the answer to our shortage in fresh water and will in fact cause more harm than good (Food & Water Watch, 2/10/2015). In general, Food and Water Watch is working to educate and inform us of what is happening with arguably the most important resource to mankind (Food & Water Watch, 2/10/2015). They are educating and looking for a joint effort in reform to

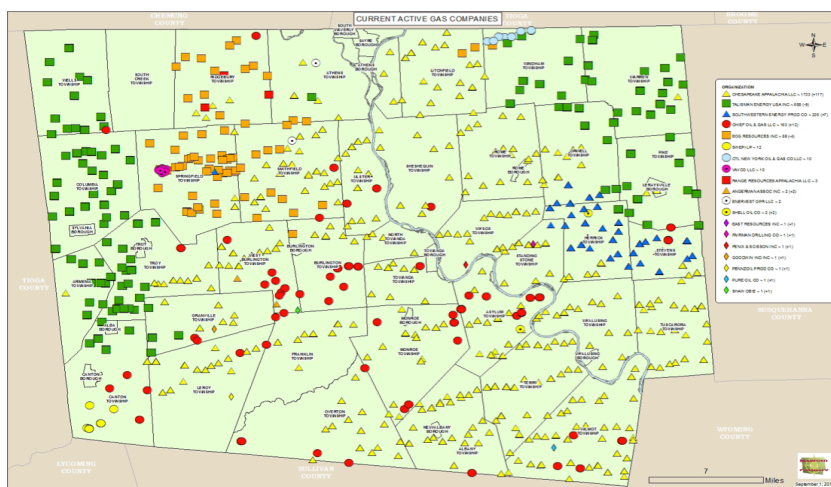
bring water back to a resource that all should have the right to, rather than a profitable commodity (Food & Water Watch, 2/10/2015).

In terms of Fracking, Food and Water Watch fully believes that we as a nation need to ban it, now (Food & Water Watch, 2/10/2015)! On their website, a petition can be found to do just that (Food & Water Watch, 2/10/2015). In 2013, they released a case study of Pennsylvania entitled, 'The Social Costs of Fracking', as well as a case study on why we need to ban fracking, "The Urgent Case for a Ban on Fracking", which have been referred to in chapters one and two. They have helped to get regulations passed, while aiding local communities in protecting themselves from fracking (Food & Water Watch, 2/10/2015). They acknowledge that they are mostly up against big companies who have a lot of money, and encourage us, as citizens to donate money to the cause to help offset this, as well as educate ourselves on the dangers of hydraulic fracturing (Food & Water Watch, 2/10/2015).

After getting in contact with Food and Water Watch, an interview was conducted with Alison Grass, a researcher for the water program there. Alison has her master's degree in urban and regional planning, with a specialization in environmental planning, along with four years of research experience (Grass, 2015; Food and Water Watch 2/10/2015). Alison has been working at Food and Water Watch for three and a half years where she, "conducts research on issues associated with the corporate control of common water resources, affordable public tap water, and the implications of hydraulic fracturing" (Food and Water Watch, 2/10/2015).

BRADFORD COUNTY, PENNSYLVANIA

Bradford is a small county in northeastern Pennsylvania with a population of about 63,000 people (Bradford County Pa, 2/10/2015). They pride themselves on 'natural beauty', 'breathtaking vistas' and 'winding country roads' (Bradford County Pa, 2/10/2015). Beginning in 2008, Bradford began to rapidly increase their drilling for natural gas, as they sit on a large area of the Marcellus Shale (Bradford County Pa, 2/10/2015). With hundreds of wells being built and a 20% increase in the fracking process there, it is clear that they have quickly become a frack town (Bradford County Pa, 2/10/2015). They presently have many different national and international companies leasing out and drilling wells on their land (Bradford County Pa, 2/10/2015). Bradford county has also released a 'Natural Gas Primer'; a document created to help better educate their residents on the natural gas industry in their town, including where wells are, what companies are drilling, and what kind of extraction is taking place (Stolinas, 2015).



Map from the Bradford County Natural Gas Primer: Showing the different gas companies in charge of each active natural gas well in the county

Pennsylvania, as a state has been a big part of the hydraulic fracturing boom in general, because it sits on so much of the Marcellus Shale. The DEP, or Department of Environmental Protection is responsible for putting in place Pennsylvania's environmental laws and regulations (DEP, 2/25/2015). The boom in the state has led to important bills being put in place by the DEP and other state agencies, to help regulate the practices of the gas companies, and make sure the industry stays safe in terms of the environment and people. New regulations also focus on the financial aspects of the industry, ensuring that they are held accountable, in terms of money, for any negative effects of the process. One of the more important bills put in place, that has greatly impacted the hydraulic fracturing industry in Bradford County is Act 13 (NPR State Impact, 2/25/2015)

Act 13 has put in place an 'impact fee' in Pennsylvania, in which gas companies must pay per well for any negative effects (NPR State Impact, 2/25/2015). The fee paid differs each year, depending upon the price of gas and the consumer price index, but each year a significant amount of money is paid by gas companies in 'impact fees' (NPR State Impact, 2/25/2015). The impact fee has brought \$630 million to Pennsylvania since being implemented, with 60% of that money being used at the local level (NPR State Impact, 2/25/2015). In past years, Bradford County has received some of the highest amounts of compensation from the fracking industry. In 2013, they received the highest amount of compensation out of every county in Pennsylvania, acquiring seven million dollars (NPR State Impact, 2/25/2015).

Act 13 also has many other important aspects of it that helped to expand regulations on the fracking industry in Pennsylvania. The bill made it so gas companies are required to

disclose all chemicals used throughout the fracking process, including those used in the frac fluid (NPR State Impact, 2/25/2015). This is very important because as discussed in chapter one, there is no federal law that require this, and often times many dangerous chemicals are being used. The bill also increased the 'driller zone liability' to 2,500 feet from the well, more than doubling the original zone that was set at 1,500 feet (NPR State Impact, 2/25/2015). This means that gas companies are now responsible for any serious issues, such as water contamination, that is within 2,500 feet of their well (NPR State Impact, 2/25/2015). Lastly, the bill increased the penalty for not following any of the set regulations to \$75,000 (NPR State Impact, 2/25/2015).

In light of the fracking boom in their county, they have put together a Natural Gas Advisory Committee for which they appointed Bradford county citizens on July 10, 2008 (Bradford County Pa, 2/10/2015). They hoped that this committee would be able to give information as well as feedback to the commissioners as to how hydraulic fracturing was going in their county (Bradford County Pa, 2/10/2015). This committee meets four times a year with the goal of, " ...[developing relationships with the industry and [their] community, encourage a diverse forum from which to learn about this developing industry, [and] develop opportunities for public education and understanding" (Bradford County Pa, 2/10/2015).

After contacting Bradford County, an interview was conducted with Raymond Stolinas, the Planning Director for the Bradford County Department of Community Planning and Mapping Services (Stolinas, 2015). Raymond received his Bachelor of Science in Geography from Pennsylvania State University; concentrated in cartography, GIS and

Remote Sensing (Stolinas, 2015). As a nationally certified planner under the American Planning Association, Stolinas has been working for Bradford County for twenty-four years (Stolinas, 2015). The Bradford County Department of Community Planning and Mapping Services is, “an administrative agency for the Bradford Planning Commission... under direct supervision of the Bradford County Commissioners, a three member board of elected officials that have authority over multiple offices...” (Stolinas, 2015).

DATA

The stand that Food and Water Watch takes on hydraulic fracturing is pretty straightforward; it should be banned throughout the entire country. Grass states that she, and Food and Water Watch can find no inherent advantages to the process, while citing multitudes of disadvantages.

“Fracking takes a huge toll on affected communities, generates massive volumes of toxic waste, creates hazardous air pollution problems, poses long-term risks to vital drinking water resources and threatens to lock in catastrophic changes in our climate” (Grass, 2015).

Grass believes that no number of regulations can make hydraulic fracturing safe, and those regulations in place are extremely unsuccessful. Most fracking operations are not regulated by the federal government but rather on a “state-to-state basis”, leaving a lot of room for spills and accidents. Along with this, Grass discussed the loophole created by the Energy Policy Act of 2005, which made fracking exempt from many environmental laws

and provisions such as the Safe Drinking Water Act. For example, she states that companies can claim that contents of their frac fluid are trade secrets, so they are therefore not required to share the chemicals they use with anyone. Frac fluid happens to be one of the biggest components of hydraulic fracturing; yet the exact components of this mixture can be easily kept a secret.

Grass cited a report to communicate how she believes the general public views fracking. In this report it is stated that, “51% of U.S. adults are opposed to increased fracking as are 66% of scientists and 73% of biologists/medical scientists” (Grass, 2015). Grass believes that there does need to be more education for the general public about hydraulic fracturing. She feels that we need be more aware about,

“...the repercussions of fracking, [including] the spills of toxic fracking fluid and wastewater, groundwater contamination from methane and frac fluid, local and regional air pollution problems, explosions and fires, and climate-threatening levels of methane emissions” (Grass, 2015).

Bradford County Pennsylvania has taken a different stance on fracking, as they have implemented it in their county and are continuing to build the industry. Stolinas says that the initial decision to bring fracking to their county was not an ‘official community decision’ (Stolinas, 2015). Rather, natural gas companies began to contact landowners of the land that they wished to explore, “establish[ing] lease agreements and payment arrangements based on a per acre price, for use of underground minerals from various geologic layers...” (Stolinas, 2015). While the county itself was not involved with many of the decisions to lease land to the industry, these agreements could only take place if the companies agreed

to, “...comply with Pennsylvania’s Oil and Gas Act regulated by the PA Department of Environmental Protection” (Stolinas, 2015).

Stolinas believes that the biggest advantage to the hydraulic fracturing industry coming to Bradford County are the economic benefits:

“Natural Gas Exploration and Development has contributed, in large part, economic benefits to land owners, farmers, laborers, municipal and county governments, and cities and communities along the eastern seaboard. First, large land owners, mostly those in the farming community, received bonus lease payments for the use of their property...Many aging farmers can now make a living and continue to farm, [while] receiv[ing] lease and royalty payments to augment farming activities...As of 2013 almost \$4.3 billion have been distributed to landowners through natural gas royalties.” (Stolinas, 2015)

Businesses throughout Bradford County have been impacted positively. Farmers now have the ability to grow more crops, afford more animal stock and buy new equipment, while businesses in their small town were able to expand to meet the needs of the “transient population that natural gas has brought to [their] county” (Stolinas, 2015).

Along with the advantages brought by the industry, Governor Tom Corbett put Act 13 in place, which is referred to as the ‘Impact Fee’ to help offset any problems caused by the industry (Stolinas, 2015). “The Impact Fee distributed funds from the natural gas industry to boroughs, townships, and counties dealing with impacts from the development

of the industry... Bradford County has received approximately \$58,093,942.00 in impact fees” to date (Stolinas, 2015). The impacts fees are used to cover:

“...Construction, repair and maintenance of roads, bridges, and other public infrastructure; Water, storm water and sewer system construction, maintenance and repair; Emergency preparedness and public safety... Environmental programs including trails, parks, and recreation, open space, flood plain management, conservation districts and agricultural preservation; Preservation and reclamation of surface and subsurface water and groundwater supplies; tax deductions Projects to increase the availability if safe and affordable housing to residents; Records management, geographic information systems, and information technology...Career and technical centers for training of workers in the oil and gas industry; Local and regional planning initiatives under the PA Municipalities Planning Code”

Pennsylvania is now the third highest producer in the natural gas industry. Bradford County has played a big role in that, producing enough natural gas to serve 9,524,474 homes/day over a six-month period in 2013 (Stolinas, 2015). With the rapid increase in the industry, the need for people with job experience in the oilfield industry was at such a high demand that it has led to two universities located within the region altering their curriculum to offer “educational opportunities in the gas and oilfield industry” (Stolinas, 2015).

Stolinas states that the county has experienced some of the disadvantages that come with the hydraulic fracturing industry, which he believes would come with any new

industry. One of the biggest problems they are experiencing is with transportation.

Bradford County experienced:

“Major increases in traffic on existing roadways and intersections between 2007-2010, where average annual daily traffic grew by 1% and average daily truck traffic grew by 13%. Road damage in Rural Townships occurred due to heavy equipment and truck traffic, as many repairs needed to be coordinated by the natural gas companies through road use maintenance agreements” (Stolinas, 2015)

Residents with limited income also suffered, as they became unable to afford housing.

“Some residents were even displaced to other areas due to rental prices almost tripling or quadrupling in price per month”. With the industry also came a large increase in accidents and emergency calls. This left volunteer Emergency Service Personnel, with ambulance, fire and State Police ‘over extended’. “Traffic accidents increased from 2009-2010 [52.4%] and DUI incidents increased from 2009 to 2010 [58.8%]” (Stolinas, 2015).

In terms of regulations, Stolinas says, “ We trust that natural gas companies follow PA DEP requirements on well cementing and casing standards to protect upper reaches of the aquifer...these are some of the most important regulations that natural gas companies follow along with proper protections when it comes to the treatment of used frac water” (Stolinas 2015). These regulations are very important because everyone in Bradford County relies on ground water sources for drinking, whether it’s coming from a private well or municipal water connections. The PA DEP reviews and approves permits, inspects natural gas well sites, and has overall control of the process in this way.

From personal experience, Stolinas sees that, “a majority of residents have not protested against the growth and development of the natural gas industry here...”(Stolinas, 2015). While residents are concerned with companies abiding by the standards set by the PA DEP, they have only ever protested against a particular gas company that diminished their royalty payments. Many property owners signed agreements guaranteeing them at least 12.5% royalty on extracted gas, which they are now not receiving. Stolinas feels that more education needs to be provided about hydraulic fracturing, especially to those places, “experiencing extracting activities”. There has been a lot of public education in Bradford County as the industry expanded there, including the education of the general public and elected officials. In discussing education for the community as well as county representatives:

“Our community and Natural Gas Subcommittee has also continued educating ourselves on future trends and issues with the industry... Our Natural Gas Primer was our initial attempt at educating residents on the progression of the industry in our county. We continue to engage all types of industry representatives from neighboring counties conducting specific planning projects to representatives from power plants, gas liquefaction companies, geologists and water quality specialists to learn about all segments of explorations and development.”

Bradford County is very dedicated to educating their citizens and representatives so that they are always up to date on all advances and issues with the industry.

CHAPTER 4: Analysis & Conclusions

ANALYSIS

The data obtained from the interviews, shows some similarities as well as differences from what was found in the research discussed in chapters one and two. Food and Water Watch seems to be on forefront of the movement to ban hydraulic fracturing in our nation, and is definitely not alone in their views on hydraulic fracturing. While bans are not highly likely in the near future, as many states and people stand to gain immensely in terms of money and jobs, it is becoming evident that there needs to be great reform in this industry due to the issues discussed in the research as well as by Food and Water Watch. While they are demanding what may seem like a lot, when they state that fracking should be banned in the entire country, it is definitely feasible. For example, with New York State becoming the second state in the nation to completely ban fracking, it shows that although they stood to profit immensely from the industry, they were still able to say no; a ban is possible if states can overlook the potential, yet uncertain and likely temporary economic gains.

All of the disadvantages stated by Grass were also found in chapters one and two. There are countless environmental issues associated with the process that can be catastrophic in the future if we continue to go on as we are. While Grass concludes that her and Food and Water Watch see no advantages to hydraulic fracturing, the research did identify some. It can definitely be argued that the negative environmental and social impacts of this process greatly outweigh the positive, but the positive cannot be ignored. As a nation in recovery from an economic crisis, fracking provides jobs, and profits that were greatly needed throughout the country. This will always be seen as a positive, as there is no one who doesn't enjoy a thriving economy. However the ultimate costs of this economic gain should be weighed and considered, which is likely why Food and Water Watch see no benefits at all. They have looked past the immediate economic and energy gains, and looked towards the uncertain and damaging future of the industry.

In terms of regulations on the industry, Grass focuses on many of the same issues discussed in chapters one and two. There is a complete lack of regulation on this industry at the Federal level, and rather the allowance of the fracking industry to be exempt from existing laws. Fracking has been exempt from the Safe Drinking Water Act, allowing it to continue to pump ambiguous chemicals into the earth, which will likely reach many of our underground and above ground water resources. Laws and regulations are now being passed on a state-to-state basis, but still, they do not fully protect people and the environment from potential dangers. Grass believes that no regulations can make this process one hundred percent safe, and while this statement seems like an exaggeration, based on evidence it has thus far proven to be true.

Grass' belief that the public needs to be better educated about the repercussions of fracking is definitely accurate. Even when doing research, it can often become unclear about what is fact and what is an exaggeration or rather the exaggerated finding of a study to benefit a specific party. There needs to be more mediated discussion about this process, as well as an agreed upon motive of the scientific community so that there are no longer mixed messages on this topic. If the general public can become informed in a way that is not biased, they will be able to come to their own conclusions about the process and what the next's steps should be within this industry.

Bradford County, and Mr. Stolinas, have experienced the hydraulic fracturing industry first hand in their county. In discussing the advantages to this industry, Stolinas turns the attention immediately to the economic benefits that come with fracking. This is exactly what was found in the research as well; when trying to shed light on the positive aspects of this industry, most authors, or scientists would discuss economic gain and job opportunities. While this may be true, the research also found that many people are looking at the immediate economic benefits without acknowledging the future costs we must pay to remediate our environment, or the impacts on a boomtown once the wells stop producing. Stolinas is doing just this; in his interview he has acknowledged all of the economic impacts of this industry, while basically ignoring the negative aspects of hydraulic fracturing. He is careful with his word choice, and says that the negative impacts they have experienced are those that would "come with any new industry". This is likely a considerable overgeneralization, as he tries to dull down the negative impacts by saying they are normal. He does discuss how the impact fee and other regulations have been put in place in order to deal with negative impacts, but unfortunately no one can truly foresee the

future of this industry clearly enough to guarantee that in the long run our country, and its citizens will come out on top, and the benefits will far out way the detriments.

In terms of regulations, Stolinas really commended the Impact Fee, or Act 13 for what it has done for Pennsylvania as a whole and Bradford County in terms of the fracking industry. Bradford County has been receiving some of the highest amounts of compensation from the fracking industry to help offset costs of any of the damaging impacts the industry has had. But, while Stolinas praises this act and the regulations it has put into place, it is a bit off-putting that Bradford County has received almost sixty million dollars thus far to pay for damages. The regulations set forth by the state are beneficial, but sixty million dollars in damages to a small town is alarming. The state has taken firm action, which is good to see as research has shown that some states lack very necessary regulations, but the fact that this much money was needed and continues to be needed by counties to fix fracking related issues should throw up some red flags. This act encourages the fracking industry to continue using the same detrimental practices and just pay for the harm they produce rather than find ways to change what they are doing so that no harm is done in the first place.

After examining the data, there are also distinct differences in how Food and Water Watch and Mr. Stolinas from Bradford County, discussed hydraulic fracturing. In looking at how each person framed his or her argument for or against fracking, one can see clear evidence of what is discussed by framing theory; each party answered questions about fracking in a way to that would alter an individual's perception of fracking toward a view that is more similar to theirs. Food and Water Watch is very clearly against hydraulic

fracturing, while Bradford County and Mr. Stolinas have found many benefits with the industry and support it.

Grass, from Food and Water Watch discussed their strong opposition to hydraulic fracturing, pointing out the environmental and social issues associated with. Grass focused on connecting the environmental and social issues, making them more important to an individual as they could see how they would be personally affected. On the opposite side of the argument, Stolinas showed his support for the hydraulic fracturing industry, focusing on all of the social and economic benefits for Bradford County. In fact, in the five pages of response to the interview, Stolinas did not discuss environmental implications of hydraulic fracturing once. His main focus was money, he discussed how local residents benefitted economically, along with businesses, while also making it clear that the fracking industry pays for any of the negative effects they have on the county, such as road damage.

In terms of regulations, Food and Water Watch made it clear that no regulations could make this practice safe. Grass focuses on how the fracking industry often works through loopholes in Federal regulations, making it necessary for states to have their own regulations as well; which are often not enough. Stolinas focused his argument on how Pennsylvania has their own regulations in place that are closely followed by the hydraulic fracturing companies. He made sure to mention the protection of ground water resources under their acts, as water contamination is often a big issue related to hydraulic fracturing.

In looking at the interview responses as a whole, length of responses is something that was extremely different. Grass was able to answer all of the questions in fewer than two pages while Stolinas' response was over five pages. Food and Water Watch was able to

get their point across with short yet convincing responses. They stated the facts, and could influence the readers' views more easily giving the impression that they knew their view was correct and therefore do not need to further explain it with a lot of detail. Stolinas provided a lot of detail along with statistics to support his argument for hydraulic fracturing. Since there is already a negative connotation associated with hydraulic fracturing, it could be true that Stolinas felt he had to take a more defensive stance in his response in order to change swayed opinions of the majority of people.

When discussing the public's view of hydraulic fracturing, Grass presented statistics based on a study, to show the general consensus on fracking. Stolinas says that he has experienced no protest of hydraulic fracturing in his county, which leads him to imply that everyone is okay with it. While residents may not be avidly protesting, one may wonder if residents fully supported fracking in their county, especially those who were not gaining anything economically. It seems that Stolinas tried to use economics and money to make hydraulic fracturing look like a positive industry. While the economic benefits of the industry can be seen in areas where fracking is taking place, Stolinas' argument does a poor job of addressing what would happen if their natural gas resource were to become depleted. Along with this, by not acknowledging the many environmental implications of the practice, he makes it seem as though he cannot defend fracking when it comes to these problems. These issues also come with a negative economic cost, which is addressed by Stolinas by assuring the public that the fracking industry will pay to fix them, rather than assuring us that they are working towards eliminating or minimizing the negative impacts of hydraulic fracturing.

SUMMARY & CONCLUSION

The hydraulic fracturing industry has been a large topic of debate in the U.S. over recent years, and for good reason. There are many risks, negative impacts and overall uncertainties that are associated with this process. While it has provided the U.S. with our own domestic energy source and some energy independence, there is no guarantee that these sources will continue to be productive to the extent that is predicted. Along with this, the energy independence has come at the cost of our environment, water resources, and people's health. Supporters of the industry will refer to economic prosperity, and an increase in job opportunities in shale regions, when posing their argument for the expansion of the industry. However, the research in this field may be very unreliable, as it has been made clear that government agencies as well as those backed by oil and gas companies will have research findings that seem to exaggerate positive impacts and continued prosperity as compared to research done by private institutions. There is currently no way to guarantee the continued success of the industry, nor to correctly calculate gains when considering the costs to the environment and people.

In terms of regulations, the hydraulic fracturing industry has been fortunate to be exempt from many federal regulations, and therefore only affected by state regulations. The problem with this is that until recently, many states were unaware of what regulations needed to be put in place until a good amount of damage was done. The federal government has almost removed itself from having to place many regulations on the process, as it seem that they too support the industry and see the financial gains and energy independence as the most important aspect. As discussed, many states have

stepped up to put regulations in place, such as New York and Vermont placing complete bans on the process, or Pennsylvania putting Act 13 in place to hold the industry responsible financially for any negative impacts. While all of these regulations are beginning to reduce the freedom that was once given to the fracking industry and oil companies, many, including Food and Water Watch, still believe that no amount of regulations can make this process safe for people and the environment and it should therefore be banned across the country.

What is discussed by framing theory can be seen in the ways that important players in the hydraulic fracturing industry communicate fracking to the general public. There is a skew in research findings; where by findings from different people with different organizations will communicate different things. For example, one study may say that the current wells will continue to produce years into the future while an independent study would show that the well has already peaked and production will shortly begin to decline. It is also evident that different players will opt to discuss only certain areas of the industry that would make their argument the most appealing and convincing to the general public. A municipal government employee who supports fracking in their county will highlight economic gains, increased job opportunities and the financial accountability that the state holds the fracking industry to. Where as a non-governmental organization against fracking, will generally discuss the environmental consequences that are often irrevocable and also affect human health and well being. They will also highlight the future consequences, and that it is highly unlikely that the benefits we are experiencing now will outweigh the negative impacts and the price we will have to pay to repair them.

Overall, it seems that hydraulic fracturing poses a much greater risk, than overall benefits and gains that we have and will experience as a nation. While many are looking to fracking as a green energy source, and therefore a positive step for the environment, this is extremely misleading. Although natural gas is not as dirty as coal and other conventional energy sources, it is in no way clean. As a nation we should focus our energy goals on moving towards renewables, rather than wasting our time, money, and resources on an industry surrounded by uncertainties and a lot of unhappy citizens. One way we should begin to look at hydraulic fracturing is with the precautionary principle in mind (Goleman, Bennet & Zenobia, 2012). “When an activity threatens to have a damaging impact on the environment or human health, precautionary actions should be taken regardless of whether a cause-and-effect relationship has been scientifically confirmed” (Goleman, Bennet & Zenobia, 2012). While the many impacts of hydraulic fracturing may be unintended or unanticipated, the impacts are evident and often clearly related to the hydraulic fracturing process. The industry should be working toward making the process harmless in all aspects, or it should not be continued. All responsibility should lie on the industry and more specifically gas and oil companies should negative consequences be found. Rather than relying so heavily on hydraulic fracturing until it is 100% proven harmful, we should move away from the practice until it is proven or made harmless.

FOR FURTHER STUDY

Due to the time constraint and workload of this thesis, only a small number of interviews could be conducted. Originally, an interview was supposed to be conducted with one of the gas companies that actually perform the drilling and hydraulic fracturing

operations. This proved to be extremely difficult, as it was very hard and ended up being not possible to get in contact with anyone who felt they would be able to answer the interview questions after sending emails to and calling at least ten different oil companies. An interview from an oil company would have provided a different outlook on the fracking process that was not obtained from the two people that were interviewed. Because these large gas companies almost certainly want people to support the fracking industry, it would be interesting to see how they would present fracking to the public, and how they would frame their responses in comparison to Food and Water Watch and Bradford County.

It could also be beneficial to conduct multiple interviews within each of the three categories studied; a social group or non-profit/non-governmental organization against fracking, a town or municipality that has implemented fracking, and an oil or gas company that conducts the fracking processes. It would be interesting to see if there is consistency in framing between groups within the same category, as well as where consistencies and differences fall between groups in different categories.

Another way one could further look at how hydraulic fracturing is being framed is by conducting a content analysis. If the resources were available, one could gather video or voice recordings of talks and speeches given on hydraulic fracturing by different big players in the fracking industry. From there, you could observe manifest as well as latent content of discussions on hydraulic fracturing, trying to find the most significant differences in how different players approach the public about the issues.

REFERENCES:

- Anonymous. 2014. "The Uncertain Dash for Gas." *Nature* 516(7).
- Barth, J. 2013. "the Economic Impact of Shale Gas Development on State and Local Economies: Benefits, Costs and Uncertainties." *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy*:85-101.
- Brantley, S. and A. Meyendorff. 2013. "The Facts on Fracking." *The New York Times*, March 13, .
- Carl, J. "Why New York is Wrong about Fracking."
- Conca, James. 2014. "New York Fracking Ban Contrary to State's Energy Future." *Forbes*, December 27 .
- Dong, Linda. n.d. "Dangers of Fracking.", Retrieved October 20, 2014. (<http://www.dangersoffracking.com>).
- Headwaters Economics. 2009. "'Fossil Fuel Extraction as a County Economic Development Strategy: Are Energy-Focusing Counties Benefiting?" Bozeman, MT: Energy and the West Series, Retrieved n.d, 2014. (<http://www.headwaterseconomics.org/energy>).
- Ehrenberg, R. 2012. "The Facts Behind the Frack: Scientists Weigh in on the Hydraulic Fracturing Debate." *Science News* 128:20-25.

- Ellsworth, W. 2014. "Man-made Earthquakes Update.", Retrieved January 25, 2015.
(http://www.usgs.gov/blogs/features/usgs_top_story/man-made-earthquakes/).
- Finewood, Michael and Laura Stroup. 2012. "Fracking and the Neoliberalization of the Hydro-Social Cycle in Pennsylvania's Marcellus Shale." *Journal of Contemporary Water Research & Education* (147):72-79.
- Fox, J. [Producer]. 2010. *Gasland*. Documentary.
- Goleman, D., L. Bennett and Z. Barlow. 2012. *Ecoliterate: How Educators are Cultivating Emotional, Social and Ecological Intelligence*. San Francisco: Jossey-Bass.
- Grass, Allison. "Hydraulic Fracturing Interview." Personal Interview.
- Howarth, A., T. Ingraffea and T. Englander. 2011. "Should Fracking Stop?" *Nature*(477):271-275.
- Holloway, M. and O. Rudd. 2013. *Fracking: The Operations and Environmental Consequences of Hydraulic Fracturing*. Hoboken, NJ: John Wiley & Sons.
- Kaplan, Thomas. 2014. "Citing Health Risks, Cuomo Bans Fracking in New York State." *The New York Times*, .
- Koenig, Brian. 2012. "EPA Issues First-Ever Regulations on Fracking." *The New American*, April 19, .
- MacRae, Michael. 2012. "Fracking: A Look Back.", Retrieved November, 2014.
(<https://www.asme.org/engineering-topics/articles/fossil-power/fracking-a-look-back>).
- Manuel, John. "EPA Tackles Fracking." *Environmental Health Perspectives*(188):199.
- Osborn, Stephen, Avner Vengosh, Nathaniel Warner and Robert Jackson. 2011. "Methane Contamination of Drinking Water Accompanying Gas-Well Drilling and Hydraulic

- Fracturing." *Proceedings of the National Academy of Sciences of the United States of America*(108):8172-8176.
- Restuccia, Andrew. 2012. "EPA Finalizes First Ever Air Pollution Rules for Natural-Gas." *The Hill*, April 18, .
- Sachs, Jeffery and Andrew Warner. 2001. "The Curse of Natural Resources." *European Economic Review* (45):827-838.
- Sehlke, G. 2009. What is "The energy-water nexus"? *Journal of Contemporary Water Research and Education* 142(1): 1-2.
- Soeder, Daniel. 2010. The Marcellus Shale: Resources and reservations. *Eos* 91(32): 277.
- Soeder, Daniel and William Kappel. 2009. "Water Resources and Natural Gas Production from the Marcellus Shale." *USGS Geological Survey Fact Sheet*:3032.
- Stolinas, Raymond. "Hydraulic Fracturing Interview." Personal Interview.
- Waxman, Henry, Edward Markey and Diana DeGette. 2011. *Chemicals Used in Hydraulic Fracturing*.United States House of Representatives Committee on Energy and Commerce.
- Zoback, Mark, Saya Kitasei and Bradford Copithorne. 2010. "Addressing the Environmental Risks from Shale Gas Development." *World Watch Institute*:1-18.
- "Energy From Shale.", Retrieved January 26, 2015. (www.energyfromshale.org).
- "Food & Water Watch."2015. Big Green Radicals, Retrieved 2/25, 2015. (<https://www.biggreenradicals.com/group/food-water-watch/>).
- "Hydraulic Fracturing Background Information."2012. The Environmental Protection Agency, Retrieved November 12, 2014.

(http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_hydr_owh.at.cfm).

"Clean Air Act Requirements and History."2013. The Environmental Protection Agency, Retrieved November 12, 2014. (<http://www.epa.gov/air/caa/requirements.html>).

The Social Costs of Fracking. 2013. Food and Water Watch.

The Environmental Protection Agency, Retrieved November 15, 2014.

(<http://www2.epa.gov/laws-regulations/summary-clean-water-act>).

"Hydraulic Fracturing." 2014. The Environmental Protection Agency, Retrieved November 13, 2014. (<http://www2.epa.gov/hydraulicfracturing>).

"The Process of Hydraulic Fracturing."2014. The Environmental Protection Agency, Retrieved November 15, 2014. (<http://www2.epa.gov/hydraulicfracturing/process-hydraulic-fracturing>).

"Natural Gas Information - Bradford County."2015. , Retrieved February 10, 2015. (<http://www.bradfordcountypa.org/Natural-Gas.asp?specifTab=6>).

"Pennsylvania Department of Environmental Protection."2015. DEP, Retrieved February 25, 2015. (http://www.depweb.state.pa.us/portal/server.pt/community/dep_home/5968).

The Urgent Case for a Ban on Fracking. 2015. Food and Water Watch.

n.d. Food and Water Watch, Retrieved February 10, 2015. (www.foodandwaterwatch.org).

"Fracking Regulations by State."n.d. ALS Global, Retrieved November 20, 2014. (<http://www.alsglobal.com/en/Our-Services/LifeSciences/Environmental>

/Capabilities/North-America-Capabilities/USA/Oil-and-Gasoline-Testing/ Oil-and-Gas-Production-and-Midstream-Support/Fracking-Regulations-by-State#>.).

"Hydraulic Fracturing 101."n.d. , 2014.

(http://www.earthworksaction.org/issues/detail/hydraulic_fracturing_101#.VQOY60vfPwK).

"Framing (Social Sciences)."2015. , Retrieved 3/3, 2015.

([http://en.wikipedia.org/wiki/Framing_\(social_sciences\)](http://en.wikipedia.org/wiki/Framing_(social_sciences))).