2012

Regulation of Hydraulic Fracturing of Shale Gas Formations in the United States

Fatemeh Z. Bagheri, Pepperdine University

Available at: https://works.bepress.com/fatemeh_bagheri/1/
Regulation of Hydraulic Fracturing of Shale Gas Formations in the United States

Fatemeh Z. Bagheri
Pepperdine University
School of Public Policy

Environmental Regulation, Business & Society

12/5/2012
The History & Process of Hydraulic Fracturing

Hydraulic fracturing has a long history and was first developed in Sweden in 1878 and was used for offshore drilling in the 1930s. The version of the hydraulic fracturing technique in existence today was first used in 1947. However, it was not commercially used until 1998 (Cummans 2012). The practice has been used in other states across the country and at almost every site that it has been introduced controversy has surrounded the prospects for pursuing the gas extraction project. Hydraulic fracturing has made it possible to extract oil and gas that were economically inaccessible and is used in areas with tights sands, shale, and coal bed methane formations.

This analysis will focus on the practice of hydraulic fracturing technology in extracting shale gas. There are thirty-one states in the continental United States which have significant shale gas reserves or where industry has shown interest in shale gas development (CEEP 2012). According to the Environmental Working Group, since the year 2000, approximately 120,000 wells have been drilled by oil and gas companies and 270,000 wells have been drilled since the 1980s (Horwitt 2009). According to the Energy Information Administration, it is currently estimated “that the U.S. will rely on shale gas for roughly 45% of our energy needs by the year 2035” (Demelle 2011).

Shale gas extraction occurs in shale formations which are composed of many thin layers. Shale is a type of sedimentary rock and is compacted together tightly with natural pressure. The largest hydraulic fracturing opportunities in the U.S. lie in large shale play formations, some of them being Barnett Shale in Texas, Bakken Shale in North Dakota, Haynesville Shale in Louisiana, Marcellus Shale in the Appalachian Basin, and Raton Basin in Colorado (Cummans 2012). There are shale plays throughout the United States with smaller, but significant shale plays in California as well as other states.

Hydraulic fracturing involves spreading the fractures in a rock layer using pressurized fluids in order to release oil and gas that isn't economically viable to extract using traditional drilling
techniques. First, a vertical hole is drilled and is about a mile in length, then a horizontal branch is drilled about half a mile in length. A small package consisting of ball-bearing-like shrapnel and light explosives is sent into the drilled hole and is detonated. The shrapnel punctures the bore hole allowing small perforations to open up in the pipe. Up to seven million gallons of slick water is pumped in the hole to fracture the shale rock, causing shale gas to be released. The water blasts through those perforations in the pipe into the shale at a force of more than nine thousand pounds of pressure per square inch and shatters the shale for a few yards on either “side of the pipe, allowing the gas embedded in it to rise under its own pressure and escape” (McKibben 2012). Once the water has been injected into the ground, it is then contaminated from exposure to oil and natural brines.

**Economic Aspects of Hydraulic Fracturing**

**Benefits of Hydraulic Fracturing**

Economists at Citigroup report hydraulic fracturing will create up to 3.6 million new jobs by 2020 and will increase economic output in the United States by 2-3% per year. There are many areas throughout the country that have been proposed for the practice, which would generate jobs. The practice has also proven reduced reliance on foreign oil, has been a boon to energy-intensive industries like metals manufacture and fertilizer production, has benefited the energy industry, and has boosted the water-treatment business due to cleanup of water recovered (Trecker 2012). Cheap natural gas has displaced coal and has become America’s top source for electricity. It is also bringing back jobs to once-decaying states like Ohio (Plummer 2012). According to “the publication ‘Rocky Mountain States Natural Gas: Resource Potential and Prerequisites to Expanded Production’ the significance of the energy resources of the Mountain West to meeting the nation’s energy challenge” (American Petroleum Institute 2011). This publication was prepared by the Department of Energy (DOE).

**Costs of Hydraulic Fracturing**

Some costs associated with the practice of hydraulic fracturing are the regulation of the practice, including aspects like compliance, knowledge, and monitoring. Regulation is a long term
cost, but can offset larger and greater future costs that may rise if regulation is not implemented. Also, “if natural gas is not produced cleanly, it will not prove to be so cheap either. Full disclosure is a price worth paying,” (The Economist 2011) however this is a cost many gas producers do not want to incur. This cost is tied to the cost of regulation because disclosure of chemicals used in the process of hydraulic fracturing falls under disclosure laws. Some people may consider the displacement of coal as a benefit of hydraulic fracturing; however it can also be considered a cost because “scientists are hotly debating just how much climate benefit actually comes from swapping out coal for natural gas, given that many gas wells and pipelines leak methane, a potent greenhouse gas” (Plummer 2012). The leaking of methane will end up being a heavy cost to bear in the future if proper regulation surrounding gas wells and pipelines are not delineated in legislation. Often it is cheaper to prevent a negative occurrence from happening as opposed to treating it once it has taken place.

Subsidies are also an element to look at when assessing the economic costs of hydraulic fracturing. Since subsidies are paid for by taxes and The Gas Research Institute, overseen by federal regulators, was funded partially by a Federal Energy Regulatory Commission approved surcharge on gas prices. The Gas Research Institute subsidized Mitchell Energy's first horizontal well in 1991. From 1980-2000, the Section 29 tax credit for unconventional gas incentivized shale gas drilling. This development took place right after Mitchell Energy successfully cracked the Barnett Shale in Texas. The first successful multi-fracture directional drill was completed by a joint DOE-private venture in 1986 (Trembath 2012). The subsidization helped in the area of finding solutions to key technical problems that would not have been able to be achieved by private investors because of the risk involved. The subsidies incentivizing research and development have ended.

**Impacts**
Aside from assessing economic aspects, the environmental and social (including health) impacts that may result from the practice also need to be assessed. The practice as it stands can have negative impacts on the water, air, and land in communities surrounding hydraulic fracturing.

**Environmental Impacts**

**Water**

One aspect hydraulic fracturing operations do not consider when choosing a project site is the landscape surrounding the project’s implementation. Many of the project sites are inland and “fracking uses a tremendous amount of water, a severely undervalued resource inland” (The Economist 2011). Often the cost of hydraulic fracturing comes from the transportation of massive amounts of water to hydraulic fracturing sites since they are inland. Since hydraulic fracturing involves injecting chemical laden water into the ground, some “communities are worried that the chemicals used to pry open the shale rock can contaminate nearby drinking water supplies” (Plummer 2012). “In some fracking towns, people have been able to set their tap water on fire,” (The Economist 2011) aptly called the “flaming faucet” occurrence resulting from “methane migration and the chemicals mixed with water and then injected into fracking wells under high pressure” (McKibben 2012). According to The Economist (2011), over 2,500 fracking products composed of 750 chemicals in the span of four year (2005-2009) was utilized by oil and gas companies, but “rigorous scientific study has been scant since 2000 allowing drilling companies to be exempt from federal safe drinking water statutes and hence not required to list the chemicals they push down wells” (McKibben 2012). This was supported by Dick Cheney, the Vice President at the time.

Apart from drinking water that can be affected from a process like hydraulic fracturing, “the briny soup that pours out of the fracking wells in large volume can also affect rivers and streams”(McKibben 2012). Even though most of the chemically loaded slick water injected into the wells stays belowground, “for every million gallons, [between] 200,000 to 400,000 gallons will be regurgitated back to the surface, bringing with it, not only the chemicals it included in the first place, but traces of the oil-laced drilling mud, and all the other noxious chemicals that were already
trapped down there in the rock: iron and chromium, radium and [large quantities of] salt” (McKibben 2012). A look at the case of Dunkard Creek, a nature lovers’ haven which runs forty miles along the Pennsylvania – West Virginia border and with 161 aquatic species, shows that a disaster can result when bad water leaks into small streams. In September 2009 largely everything died in the course of a few days, except invasive microscopic algae that normally live in estuaries along the Texas coast. This bloom of “golden algae” killed everything else. The algae would have never bloomed in this region if the drilling companies would have been disposing there wastewater in the correct way. Because of the drilling companies’ illegal actions, Dunkard Creek turned into brine (McKibben 2012). This case study shows what a drastic negative effect this practice can have on the environment especially when there are no incentives in place to act the ‘right’ way.

Air

Hydraulic fracturing produces “excess gas [which] is often vented off, producing air pollution” (Plummer 2012) the process also “gives off methane, a potent heat-trapper” (The Economist 2011). The EPA has reported that “oil and natural gas production and processing accounts for nearly 40 percent of all U.S. methane emissions” (2012). The oil and gas industry is the nation’s biggest methane source. Natural gas development point and non-point sources contribute five times more benzene than any other emission source, including the likely benzene emission sources like on-road vehicles, wildfires, and wood burning (McKenzie 2012).

Aside from the process itself polluting the air, fully constructed and prepared natural gas wells can cause air pollution problems too. For example, in Wyoming the air quality standards no longer meet federal guidelines because of fumes seeping from the state’s 27,000 wells, vapors that contain benzene and toluene (McKibben 2012). According to a study led by Robert Howarth of Cornell University “greenhouse-gas emissions over the life cycle of natural-gas production could actually be considerably higher than those of coal per unit of energy provided” (The Economist 2011). This may be the case partly because “these methane emissions are at least 30% more than and perhaps more than twice as great as those from conventional gas” with the higher emissions from shale gas occurring when wells are hydraulically fractured -- as methane escapes from flow-
back (Howarth, Santoro, & Ingraffea 2011). These figures do not take into consideration that gas can be burned more efficiently than coal, which the supplementary material does note by stating,

“Our estimate of GHG footprint of fuels does not include the efficiency of final use. If we examine electricity production, current power plants in the US are 30% to 37% efficient if powered by coal and 28% to 58% if powered by natural gas...When viewed on the 20-year time horizon, the GHG footprint for producing electricity from shale gas is 15% less than that for coal, when we assume the lowest methane emissions and highest efficiency of use for producing electricity. However, at the high-end estimates for methane emissions the GHG footprint is 43% higher than that for coal even when burned at high efficiency” (Howarth, Santoro, & Ingraffea 2011).

Essentially, depending on the practices used during the preparation of wells, the actual extraction process, the transportation, and burning, emissions of greenhouse gasses can be more negligible than that of coal, or can be far worse than people can ever imagine.

*Land*

The BLM conducted a study in 2006 and found that roughly 24 percent of public lands onshore (23.8 million acres) are accessible under standard industry lease terms and “based on current resource estimates, these lands are expected to contain 13 percent of the gas resources” (American Petroleum Institute 2011). Approximately one-third of government owned lands have been set aside as national parks, wildlife refuges or wilderness areas all of which the oil and gas industry states they are not looking to explore for drilling, nor do they want to drill in wilderness areas where drilling is banned (American Petroleum Institute 2011). Originally, the Interior Department proposed oil companies disclose the chemicals they intend to use in drilling before starting a well; this was in order to acknowledge the concerns of landowners and communities about potential groundwater pollution. However, on May 4th, 2012 the Obama administration “proposed a rule governing hydraulic fracturing for oil and gas on public lands that will for the first time require disclosure of the chemicals used in the process” (Broder 2012). The oil industry has received significant concessions with this proposed rule because “companies will have to reveal the composition of fluids only after they have completed drilling. This is a sharp change from the government’s original proposal, which would have required disclosure of the chemicals 30 days before a well could be started” (Broder 2012).
Hydraulic fracturing has the potential to affect public infrastructure through induced earthquakes resulting from underground disposal of the process’ wastewater. The National Research Council compiled a report identifying “eight cases in which seismic events were linked to wastewater disposal wells (not necessarily all for fracking wastes) in Ohio, Arkansas and Colorado” (Dutzik & Ridlington 2012). Ohio has more wastewater disposal resulting from Marcellus shale drilling with “more than 500 million gallons of hydraulic fracturing wastewater disposed in underground wells in 2011” (Dutzik & Ridlington 2012). The Youngstown area in Ohio also experienced a series of earthquakes in 2011, which prompted Ohio officials to investigate potential links between the earthquakes and a nearby injection well. The results the study came to did not determine a conclusive link between the injection well and the earthquakes, but it found that “[a] number of coincidental circumstances appear to make a compelling argument for the recent Youngstown-area seismic events to have been induced (by the injection well)” (Dutzik & Ridlington 2012). The earthquakes have not caused significant damage, but they raise concerns about the potential for damage to public infrastructure (such as water and sewer lines) as well as private property and the size and impact of the earthquakes are not predictable either (Dutzik & Ridlington 2012).

Social/Health Impacts

It has become increasingly common for natural gas development to occur near where people live, work, and play. A “review of 4,956 well locations revealed that 26% of the well locations reviewed are located 150 to 1,000 feet from a building intended for human occupancy, including homes, out buildings, businesses, residential living facilities, schools, and hospitals” (McKenzie 2012) and “rigs have cropped up in backyards across the Northeast, as 11,400 new wells get drilled each year” (Plummer 2012). The reason this is a public health concern is because the “the transport of these air pollutants to nearby residences and population centers” (McKenzie 2012) is significant and can cause cancer and non-cancer health risks.

Non-cancer health risks
Results from a study done indicates that the group of people who are affected more by non-cancer hazard index from air emissions due to extraction of natural gas, are those who live near wells. This was determined using a relatively short-term period, but high emission are put off during the short well completion period. Exposure to trimethylbenzenes, alkanes, and xylenes is what primarily drives the hazard index (McKenzie 2012). All of these chemicals have neurological and/or respiratory effects. Some specific health effects associated with benzene are leukemia, anemia, other blood disorders, and immunological effects. Inhalation of chemicals like trimethylbenzenes, xylenes, benzene, and alkanes can cause “dizziness, headaches, and fatigue at lower exposures to numbness in the limbs, incoordination, tremors, temporary limb paralysis, and unconsciousness at higher exposures” (McKenzie 2012). These risks are all severe and are not to be taken lightly.

*Cancer health risks*

The EPA typically considers risks below 1 in a million to be so small as to be negligible. As with the non-cancer health risks, the “cancer risk estimates were 10 in a million for residents near wells and 6 in a million for residents farther from wells” (McKenzie 2012). These measurements are above a ‘negligible risk’ and risks such as these should be considered, especially if the federal lands proposed for use are in near proximity to residences or communities. As mentioned before, “the health effects resulting from air emissions during development of unconventional natural gas resources are most likely to occur in residents living nearest to the well pads during the short term well completion period and warrant further study” (2012).

*Politics, Government Agencies & Legislation*

One of the reasons strong legislation has not been imposed on the practice of hydraulic fracturing is reflected in part by the fact that people like Vice President Dick Cheney, whose former company Halliburton is a player in the fracking boom, did not pursue rigorous scientific study (McKibben 2012). Here we see the classic conflict of interest that has stifled the implementation of regulation on the use of hydraulic fracturing to extract shale gas, as it has in other regulatory areas.
Gas (and oil) companies are able to make use of many exemptions that are found in most major federal environmental laws. It has been asserted that the federal government (namely the Federal Power Commission, now the Federal Energy Regulatory Commission) was in collaboration with the gas industry to open the Gas Research Institute to develop new drilling and extraction methods. This resulted in The Eastern Gas Shales Project in 1976, an initiative of the federal Energy Research and Development Administration since more work was needed in the area (Trembath 2012). For these reasons, it is believed that the interconnectivity that exists limits how much the federal government is willing to impose on the practice of hydraulic fracturing in shale rock.

The most recent legislation that remotely addresses the practice of hydraulic fracturing is the Safe Drinking Water Act, with the most recent language added via the Energy Policy Act of 2005. The act states.

"The term 'underground injection' – (A) means the subsurface emplacement of fluids by well injection; and (B) excludes – (i) the underground injection of natural gas for purposes of storage; and (ii) the underground injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations related to oil, gas, or geothermal production activities" (EPA May 2012).

Fundamentally this excludes many of the procedures that do cause problems in the long run. For example, as mentioned before, it is often the underground injection of fluids or propping agents that is excluded, which often has dire effects on surrounding habitats if certain levels of equipment and practices are not met. One aspect that is regulated heavily is the “use of diesel fuel during hydraulic fracturing” and “is still regulated by the UIC program” (EPA May 2012). Ultimately, the act sets standards and requires permits for the underground injection of hazardous substances so that these materials do not endanger Underground Sources of Drinking Water (SDWA 2008).

The Clean Water Act (CWA) also has an influence on the practice of hydraulic fracturing. Companies have been able to drill under the act since 1980 with exemptions that set standards for storm water discharge despite the potential for significant runoff from thousands of well pads, pipelines and other infrastructure. Beginning in 1992, the EPA required storm water permits for oil and gas construction facilities of five acres or more. In the 2005 Energy Bill, Congress extended
the exemption to all oil and gas construction facilities (Environmental Working Group 2009). The CWA requires anyone who wants to discharge pollutants to first obtain an NPDES permit; if the permit is not obtained, the discharge will be considered illegal. Therefore the “disposal of flowback [as a result of hydraulic fracturing] into surface waters of the United States is regulated by the National Pollutant Discharge Elimination System (NPDES) permit program, [which is authorized by] The Clean Water Act (EPA May 2012). The NPDES permit program is part of the office of wastewater management in the Water Permits Division (WPD) within the Environmental Protection Agency.

The Clean Air Act limits emissions of nearly 190 toxic air pollutants, including emissions from oil and gas companies. The EPA must set standards for emissions of air toxics (hazardous air pollutants). Air toxics are considered to be known or suspected of causing cancer and other serious health effects, many of which were mentioned above. Aside from setting standards, the EPA must conduct a residual risk review & technology reviews of these air toxic emission standards one time, eight years after the standards were issued. As it stands now “existing air toxics standards for oil and natural gas production, and the standards for natural gas transmission and storage were issued in 1999” (EPA April 2012). Drilling sites are not treated as an aggregated unit under the Clean Air Act, even though typically, smaller sources of emissions grouped together that produce pollution above certain thresholds are treated as such.

Another act that relates to the process of hydraulic fracturing is the Comprehensive, Response, Compensation, and Liability Act (CERCLA); this act holds most industries accountable for cleaning up hazardous waste. Unfortunately many wells are exempt from CERCLA. It was passed in 1980 and amended in 1986 and allows the federal government to respond to releases of hazardous substances that threaten human health or the environment. A trust fund (Superfund) was created and was to be used to clean up contaminated sites. Initially, the fund was financed via taxes on the chemical and petroleum industries, but Congress abolished the taxes and the fund is paid for through general revenues. This results in a fund that is too small to meet cleanup goals.
The liability exemption for drilling companies remains (Mall et al. 2007). The superfund allows Potentially Responsible Parties (PRPs) to be held responsible for clean-up costs for a release or threatened release of a “hazardous substance,” but the law defines this as excluding oil and natural gas (CERCLA 2008). Accordingly, the industry has little incentive to clean up its hazardous waste and to minimize leaks and spills, which often results in “cut and run” jobs leaving communities to clean up the pollution left behind. Likewise, according to the National Environmental Policy Act of 1969 (NEPA), certain gas drilling activities are exempt, like hydraulic fracturing, eliminating the need to conduct environmental impact statements. What this ends up doing is making the public prove that such activities would be unsafe.

Finally in 2009, The Fracturing Responsibility and Awareness of Chemicals Act was introduced to both houses of Congress on June 9, 2009 (111th Congress). The aim of this act is to define hydraulic fracturing as a regulated activity under the Safe Drinking Water Act. The energy industry would be required to disclose chemicals it mixes in its mixture of water, sand, and proppants. This bill was never enacted and the 112th Congress reintroduced the bill on March 15, 2011 and has been referred to committee. The congressional committee “will consider it before sending it on to the House or Senate as a whole” (Govtrack).

In spite of the lack of regulation on this practice, for the next two years, all gas producers will have to at the very least burn or flare their wasted gas, which will reduce hazardous compounds by 95 percent. Then, starting in 2015, all gas producers will have to undertake a more comprehensive strategy known as “green completion,” in which leaked and vented gas is captured to resell (Plummer 2012). However, when the government proposed chemical disclosure rules mandating disclosure thirty days before operation began, “the industry objected, saying that the additional paperwork would slow the permitting process and potentially jeopardize trade secrets. The government then agreed to allow companies to reveal the contents of drilling fluids after the operation had been completed” (Broder 2012). The reasoning given by officials at the Department
of Interior is that having a record would allow scientists to trace any future contamination and the
time of disclosure of fluid composition is irrelevant.

At this time in the absence of federal oversight, regulatory action that has been
implemented, in any rigorous manner, has been at the state level. For example the Center for
Energy Economics and Policy has conducted a study in order to “provide an overview of the
regulatory patterns, similarities, and differences among states” (CEEP 2012). Many states have
either local bans and moratoria or statewide moratoriums on various parts of the horizontal
drilling and hydraulic fracturing process. For example, New York State has statewide moratorium
as well as more than 50 local bans and moratoria. Many states that have implemented local or
municipal bans are in the midst of legal proceedings over the legality of local regulation of shale gas
extraction. Some regulators and constituents think the regulation of shale gas extraction should be
left up to the state governments since they have more resources than the local governments do.
Two New York judges recently upheld local ordinances banning the practice; West Virginia shows a
different story where a judge ruled a local ordinance unconstitutional and unenforceable. Although
Texas and Colorado do not allow local or municipal bans, several local governments in these states
have passed moratoria on the shale gas development process. The moratorium in New Jersey is set
to expire in December 2012 and Maryland’s in June 2014. North Carolina passed legislation in
2012 allowing horizontal drilling, but will not be allowed to commence until a regulatory
framework is in place. The regulatory framework should occur sometime in the next two years
(CEEP 2012). However, of the thirty-one states in the study, eighteen states did not have any bans
or moratoria on the practice.

Litigation

In January 2009, Wild Earth Guardians and the San Juan Citizens Alliance sued the EPA,
alleging that the Agency “had failed to review the new source performance standards and the major
source air toxic standards for the oil and natural gas industry” (EPA April 2012). New source
performance standards (NSPS) need to be specified for industrial categories that “cause, or
significantly contribute to, air pollution that may endanger public health or welfare” by the EPA according to the Clean Air Act. The “EPA is required to review these standards every eight years; the existing NSPS – for VOCs and SO2 – were issued in 1985” (EPA April 2012).

**Alternatives & Recommendation**

Many opponents of hydraulic fracturing think banning of the practice is the most practical solution because of the negative environmental and social aspects that come along with it. The implications of banning hydraulic fracturing are a continued reliance on foreign oil, the further development and use of coal, and the stagnation of the oil and gas industry within the United States. Economically speaking the banning of the practice would reduce the amount of state and local taxes received from the industry as well as taxes that would come from the labor force. As a result of the many negative externalities that have been found as a result of hydraulic fracturing, groups like the Natural Resources Defense Council are pushing the EPA to regulate methane directly. They argue there are a slew of proven technologies to limit methane leaks from natural gas production (Plummer 2012) and should be utilized. Instead of banning the practice, technologies that are technically feasible and commercially profitable can be used in order to mitigate the risks that come with the practice. However, in order to mitigate the risk, the alterations to technology would need to be comprehensive. If this is done, then 80% of the methane emitted can be captured and “the oil & gas industry can generate $2 billion in additional revenue from these methane savings” (Gowrishankar 2012).

One technology that has been looked at is green completions. This technology prevents vented, leaked or otherwise wasted natural gas from seeping through the wells as they are being stimulated and readied for natural gas extraction. According to the EPA, “green completions, (reduced emission completions/RECs) continue to be identified as the best system of emission reduction, but a transition period was put in place (until January 1, 2015) to ensure green completion equipment is broadly available” (2012). During the transition period, emissions must be reduced by using combustion devices and flaring. The practice of green completion yields a
Regulation of Hydraulic Fracturing of Shale Gas Formations in the United States

nearly 95 percent reduction in volatile organic (EPA April 2012). In the meantime, the wasteful practice of flaring needs to occur, but eliminates many of the volatile organic compounds.

Other tools to be used in conjunction with green completion technologies are: plunger lift systems which are used to remove blockages caused by liquids accumulation in older wells, in a way that captures methane; TEG dehydrator emission controls would need to be put in place to reduce methane leakage from TEG dehydrators (they remove moisture from natural gas before it is transported) using additional equipment and process optimization; desiccant dehydrators would nearly eliminate methane leakage during the process of removing moisture from natural gas, with the use of special water-absorbing salts; dry seal systems mitigate methane leakage from centrifugal compressors, which are used during natural gas processing and pipeline transportation, with the use of more effective seals; improved compressor maintenance controls the leakage from reciprocating compressors, through timely rod packing replacements; low-bleed or no-bleed pneumatic controllers limit the leakage from pneumatic controllers, which control gas pressure and flow, with the use of special reduced-leakage systems; adequate pipeline maintenance and repair allows for methane flowing through pipelines to be captured while problems in pipelines are fixed; vapor recovery units capture methane leaked from crude oil when it is stored in tanks; leak monitoring and repair needs to be implemented to detect and capture methane leaks, which are typically colorless and odorless, from numerous locations at an oil & gas facility, using advanced leak monitoring equipment and enhanced operational practices (Gowrishankar 2012).

Methods to prevent methane leakage are outlined above, which is an important concern; however these methods do not address the other concerns that accompany hydraulic fracturing. Regulation would also need to address wastewater disposal and determine what the least impactful method would be. For instance, wastewater can be captured in huge on-site tanks and pushed back down “injection wells,” however this process apparently triggered the temblor in Youngstown. This process also leaves behind large quantities of salty residue, which is not ideal because disposal of the salty residue is necessary. Furthermore, the wells can keep oozing out their toxic load for
many years after drilling is done (McKibben 2012). Earthquakes, though not preventable when using the practice, can be reduced or mitigated through implementation of “a traffic light system; operators would have to monitor tremors and if they started to get bigger fracking would have to stop. They would also have to avoid fracking near known active faults” (Stephenson 2012). As far as health risk prevention goes, efforts should be directed towards reducing air emission exposures for people living and working near wells during well completions (McKenzie 2012). It should be ensured that hydraulic fracturing is not near residences, schools, or hospitals since near proximity to projects have shown to increases cancer and non-cancer risks. If the shale gas can only be accessed via residential areas or near schools or hospitals, then it needs to be determined whether the entire public benefit (and company benefit) that comes from extracting natural gas outweighs the right to property and whether eminent domain should be applied. In such cases fair market value for properties would be payable to property owners.

**Conclusion**

A patchwork of policies that exist primarily on a state to state basis is no longer the way hydraulic fracturing should be regulated because it is not effective, especially when some states have no regulation on some of the procedures involved in the process. Given the amount of time the practice has been in existence, the federal government has had plenty of time to conduct studies in order to protect not only the constituents of the United States, but to also protect the environment. However, a reasonable time frame needs to be offered to the industry in order to ensure appropriate technologies are implemented properly to mitigate risks and to ensure maintenance of facilities is kept to stringent standards. A patchwork of policies that do not connect with one another and ultimately do not reflect the underlying connection between policies, economics, the environment, people, and the future of the earth, should not be the way business is done.
References


Index of photos to accompany explanations found in the section entitled The History & Process of Hydraulic Fracturing

Source: The Breakthrough Institute
Regulation of Hydraulic Fracturing of Shale Gas Formations in the United States

Hydraulic Fracturing Water Cycle

Source: Environmental Protection Agency