Hydraulic Fracturing in Wyoming: Benefits, Concerns, & Solutions

Authors: Ella Canning, Alex Coster, Davison Donnelly, Josh Sullivan-Phillips

Created: 2015

Introduction

Fracking operation taking over farmland
Image Source: WildEarth Guardians licensed under CC BY-NC-ND 2.0

Hydraulic fracking has become an increasingly popular method of natural gas extraction in the United States. The United States has extensive reserves of natural gas that can be used for commercial purposes. Large quantities of groundwater and surface water mixed with chemical additives are pressurized and injected into well sites. This creates cracks in shale formations which releases oil and gas that are gathered at the surface (EPA, 2015). While this has caused economic benefits for gas drilling companies, states, and the federal government, it has also resulted in negative environmental impacts, turning fracking into a major issue of contention. The problem needs to be addressed in order to satisfy each stakeholder involved in the issue. Acknowledging the values of each stakeholder involved as well as conducting more scientific research are the two key challenges that governments are now faced with. In our case study, we will determine the impacts of hydraulic fracking in the state of Wyoming, examine current governance methods, and suggest possible solutions for the future.

Framing The Problem

Hydraulic fracking in Wyoming has resulted in two fundamental conflicting outcomes: positive economic effects and negative environmental effects. While fracking operations in the state have increased government revenue and produced jobs for its residents, it has simultaneously adversely impacted the environment and residents' health. For these reasons, fracking has become a challenging problem to address. One of the fundamental elements of the problem is the large number of stakeholders involved, all of whom have different opinions and values regarding fracking. The second primary element of the problem is the low level of scientific knowledge of fracking itself. These are the two basic characteristics that make up a "wicked problem" (Walters, Aydelotte, & Miller, 2000). When combined, it becomes extremely difficult to reach solutions that will satisfy each stakeholder.

There are two key issues that arise from hydraulic fracking operations. First and foremost, there is the issue of value uncertainty. There is a wide range of stakeholders involved with the problem of hydraulic fracking. There are the oil and gas companies that run the fracking operations in Wyoming such as Halliburton, Devon Energy, and Chesapeake (Mooney, 2011). Companies such as these are in favour of fracking since it has generated substantial revenue. Fracking stimulated economic growth after the recession of 2008 and was widely regarded as a positive source for energy (Mitka, 2012). In Wyoming, it has been predicted that over the coming year fracking will produce a budget surplus of over $1 billion as well as achieve the nation's lowest unemployment rates at 6.4% (Gruver, 2011). For these reasons, fracking companies highly value the industry and want to continue to operate in the state. Other stakeholders that shares the same opinion are the resource suppliers that are involved with fracking companies. This includes companies that provide production inputs for fracking companies which also includes labour – the employees of the resource suppliers. The local government also benefits from fracking since it receives large economic gains through taxation. Severance taxes have been placed on natural gas which has produced millions for state governments (Fisk, 2013). This budget surplus can be spent on important sectors such as health, education, and infrastructure in the state, which incentivizes them to continue operations. Furthermore, fracking is seen as the preferred method of extraction since it produces less greenhouse gas emissions than industry alternatives (Fisk, 2013).

While there are clear economic gains being made as a result of fracking activity, other stakeholders share a different opinion. Fracking has generated a considerable amount of environmental degradation and has negatively affected the health of residents who live nearby. Ozone pollution, contamination of groundwater, and overuse of water supplies are some of the primary outcomes of fracking, and concerns of key stakeholders. Stakeholders that oppose its operation argue that government oversight is lacking. Non-governmental organizations, farmers, conservationists, and members of the general public urge policymakers to put in place clear and concise governance methods in order to prevent environmental and human health degradation.

Secondly, there is the issue of low scientific knowledge of hydraulic fracturing. As this industry has developed at such an accelerated rate, it is exceedingly hard to envision what long term health and environmental impacts it will have, as well as competently manage existing issues. For instance, ozone is released into the atmosphere when natural gas drilling occurs, but the gravity of the pollution created and its effects on people's health is unknown. Environmental issues surrounding fracking such as groundwater contamination, air pollution, and excessive water consumption have not been researched adequately. Due to the infancy of the industry, and the only recent effort to monitor its effects, there remains a large gap in knowledge surrounding the impacts of hydraulic fracking. In addition to known issues, there is always the possibility of new health and environmental issues emerging from fracking operations. As they are unpredictable in nature, knowledge of how to manage these issues in the future is uncertain.

Due to this culmination of value uncertainty of stakeholders and lack of scientific knowledge regarding its operational effects, the issue of hydraulic fracking can be seen as a bona fide "wicked problem." It is now left to the parties involved to try and discern what factors they prioritize. Issues of monetary gain will always be the top priority of industries involved, but the focus of all the stakeholders should be set on the environmental and health related repercussions. Gaining scientific knowledge about the impacts of fracking is the most important factor to solve this difficult issue. Once the impacts are understood, stakeholders can try and find a solution that accurately balances the economic benefits with the known environmental detriments.

Dangers of oil and gas extraction sites on public lands. Image source: WildEarth Guardians licensed under CC BY-NC-ND 2.0

Governance Framework

The US federal government has little power to regulate fracking, since individual states are the ones that have autonomy to manage resource extraction. The federal government does however pass public health legislation that fracking companies have to abide by. The most pertinent Acts of this legislation are the Clean Water Act and the Safe Drinking Water Act, which are enforced by the Environmental Protection Agency (EPA). While these are positive methods of governance for water supplies, fracking operations have been excluded from certain federal level environmental legislation. An example of one of these pieces of legislation is the Underground Injection Control (UIC) program which is included under the

Safe Drinking Water Act (EPA, 2014). Therefore, in order to mitigate negative environmental impacts, new methods of governance of specifically hydraulic fracking operations must be put in place.

The real power to manage, regulate, and enforce fracking policies resides with state and local governments. It has been suggested that this power should reside with states, so they can best balance their own environmental protection and economic expansion. Local governments get to choose what drilling sites are appropriate for fracking operations; they have the power to allocate land, grant drilling permits, and create zoning laws (Warner & Shapiro, 2013). The state of Wyoming's desire to have autonomy over managing natural gas extraction led them to become one of the first states to create comprehensive fracking regulations (Cook, 2014). This was an attempt to pre-empt federal regulations being made that could interfere with business. The Wyoming Oil and Gas Conservation Commission (WOGCC) has taken steps to ensure fracking remains state regulated by passing a mandatory 'well by well' chemical disclosure law, which promoted an increase in government transparency regarding oil and gas companies' secret fracking chemical formulae (Balzofiore, 2015). This law is perhaps the most successful fracking regulation to date: the increase in inspection costs means that wells are planned more carefully and in fewer numbers, and the state is able to monitor what chemicals are used by the companies.

Moving Forward: Possible Solutions

In order to mitigate the adverse environmental and health effects created by fracking operations, investment in new technology is needed. Numerous sources have proven that environmentally friendly technology and extraction methods are plausible, but vary in regards to time frame. This section will describe some of the short term and long term solutions.

Vehicles and equipment used in well construction and operation produce particulates and carbon emissions. Air pollution from fracking can be minimized by updating well equipment. Apache, a Houston-based oil and gas operator, uses natural gas powered vehicles instead of diesel engines, cutting emissions and saving 40% of their fuel costs (Kiger, 2014). There is financial incentive for other companies to follow suit. Fracking wells also have a tendency to leak methane, a greenhouse gas that can be 86 times as potent as carbon-dioxide: as much as 5% of wells leak immediately and more than half leak after 30 years (Twomey, D., Twomey, R., Farias, C., & Farias, G., 2014). Infrared cameras that sense methane escaping from leaky wells can be installed. The cameras, which cost about \$80,000-\$100,000 each, will cut pollution and lost revenue by alerting operators to the location of the leak (Kiger, 2014). Furthermore, moving from pressure-monitoring pneumatic controllers to lower-bleed designs reduces gas losses; a U.S. nation-wide change would reduce emissions by 35 billion cubic feet annually, saving gas companies more lost revenue (Kiger, 2014). Reducing the environmental impact and running a cost-effective business run hand-in-hand.

Fracking needs an enormous amount of freshwater, which returns to the surface as 'flow-back water' during operation; wells expel between 1500-4500m^3 a week (Altee & Hilal, 2014). Companies have begun reusing as much as 95% of flow-back water to reduce fresh water consumption (Benavides, 2015). This practice improves water efficiency, cuts down on waste-water transportation and treatment costs, and improves the company image. Once the solution reaches a salinity level of 100,000mg/L, however, machinery begins to corrode and the water must be treated before further use (Altee & Hilal, 2014). Reusing flowback also slows the rate retention ponds and injection wells must be built. Class II Injection wells are designated by the Underground Injection Control program (UIC) to isolate the wastewater underground, far from any groundwater source (Clark, Burnham, Harto, & Horner, 2013). Retention ponds and injection wells are considered a last resort, due to their health hazards and potential to contaminate groundwater. Retention ponds should always be fenced off, monitored, properly labelled, and lined with thick, impermeable, concrete layers to prevent wastewater seepage. Ponds should also be covered to prevent overfilling and spillage during extreme precipitation events, the most easily preventable method of environment contamination (Clark et al, 2013).

Due to the large amount of shale gas in the USA, approximately 23.4 trillion m^3, fracking will become an increasingly relevant energy source for the USA (Clark et al, 2013). Longer term fracking necessitates the creation of sustainable regulations governing fracking as well as the development of technologies that will clean wastewater, reduce water usage, clean up contaminated sites, and access shale gas more efficiently.

Fracking's water consumption is its most dividing issue: fracking companies must reduce water use and properly treat their wastewater. GasFrac, an Alberta-based energy services firm, uses a propane-based gel instead of water to extract natural gas from shale, drastically reducing water usage (Kiger, 2014). The gel is used at 1/8 the rate of water and can be merged into the flow being extracted from the ground for collection (Kiger, 2014). Millions of gallons of water a week can be saved or diverted into other sectors of the economy. Equally as important, this negates the creation of fracking wastewater.

Fracking wastewater is a hypersaline solution high in total dissolved solids not easily treated by Reverse Osmosis or Bioreactors (Altaee & Hilal, 2014). Since current water treatment methods are expensive and energy intensive, a cheaper, more efficient technique is needed. ABS Materials is developing a water-purification machine which uses Osorb, a glass-like substance that effectively separates chemicals from water through nanoscale pores, acting like a hydrocarbon 'sponge' (Ondrey, 2012). Osorb is promising because of its ability to be re-used multiple times, and may be able to detect on-site gas leaks as well. Osorb can drastically improve the wastewater recycling capacity of fracking wells, clean up oil spills, and purify polluted water bodies. Researching technologies like GasFrac's gel and Osorb can be expensive, and fracking companies will continue to consume water if it is cheaper to do so. The creation of federal fracking laws will encourage fracking companies to adapt water efficient methods, reduce pollution, and invest in sustainable technologies.

The ultimate solution to fracking is to abandon the practice, become less dependent on fossil fuels and increase investment in sustainable energy production. In the long-term, we must divert investments and subsidies from fossil-fuels into more sustainable energy sources. Bio-fuels can be used to "ween" ourselves off oil and gas. Glycerol bio-fuels derived from sugarcane, corn, and beets combined with lignocellulosic biomass could supply one-fifth of the US energy sector's current demands, or approximately 2 billion barrels of oil annually, by 2050 (Mateus, Schreiner, Garcez, & Lopes, 2015). Lignocellulosic biomass is a second generation biofuel derived from woody crops and agricultural residues, and is the largest known renewable carbohydrate source (Mateus et al., 2015). Agricultural waste and debris can be recycled into bio-fuel, offsetting dependence on oil, thus bio-fuel is a bridge to a more sustainable energy future.

The future of energy production lies in investing across a spectrum of sustainable sources. US President Obama's 2009 American Recovery & Reinvestment Act (ARRA) included $100 billion intended for building retrofits, public transportation, and investment into renewable energy projects like solar, wind, and geothermal (Pollin, 2012). These funds assist sustainable energy research, provide capital to start-up companies, subsidize wind and solar generation, while creating three times as many jobs as spending the same amount of money on the fossil fuel sector (Pollin, 2012). Further subsidizing sustainable energy programs by following the direction of ARRA provides a safety net for emerging technologies, giving them time to develop before being tested on the open market.

Oil refinery, Wyoming. Image Source: WildEarth Guardians licensed under CC BY-NC-ND 2.0

Conclusion

The combination of value uncertainty and scientific uncertainty characterize hydraulic fracking as a wicked problem. Solutions to problems such as these are challenging to come by due to the large amount of stakeholder opinion involved. Many people are in favour of fracking operations due to its assurance of economic benefits for the state of Wyoming, but many other people are against fracking regardless of the economic gains. It is clear that fracking results in negative environmental and health effects. The goal for the future of gas drilling companies will be to mitigate these negative outcomes in order to satisfy each stakeholder's values. As we have suggested above, there are methods being looked at to achieve this goal. These suggestions are undoubtedly positive and proactive ones, but there is always the possibility of new challenges emerging from these temporary solutions. The treatment of water to render it reusable may end up costing much more than expected, or switching from water to a propane-based gel may have adverse effects too, hence the reason why fracking is such a complex problem.

Governance methods may change as well with new political authority in the country. Furthermore, stakeholders will have to sacrifice some of their values in order to reach an agreed upon solution. For all these reasons, hydraulic fracking in Wyoming and the U.S. in general, undoubtedly faces challenges in the future for suppressing adverse environmental and health effects and simultaneously maintaining economic profits.

References

Altaee, A., & Hilal, N. (2014). Dual stage forward osmosis/pressure retarded osmosis process for hypersaline solutions and fracking wastewater treatment. *Desalination, 350,* 79-85. doi:10.1016/j.desal.2014.07.013

Balzofiore, J.A. (2015). EPA's fracking fluids report could help stop negative state moves. Natural Gas Production, 32(4), 9 14. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/gas.21863/abstract

Bazant, Z.P., Salviato, M., Chau, V.T., Viswanathan, H., Zubelewicz, A. (2014). Why fracking works. *Journal of Applied Mechanics, 81*(10), 101010-101010-10. doi:10.1115/1.4028192.

Benavides, P.T., & Diwekar, U. (2015). Optimal design of absorbents for NORM removal from produced water in natural gas fracking. *Chemical Engineering Science*. *137*, 964-976. doi:10.1016/j.ces.2015.07.012

Centner, T.J., & Hatzenbuhler, H.. (2012). Regulation of water pollution from hydraulic fracturing in horizontally-drilled wells in the Marcellus shale region, USA. *Water, 4*(4), 983-994. doi:10.3390/w4040983

Clark, C. E., Burnham, A. J., Harto, C. B., & Horner, R. M. (2012). The technology and policy of hydraulic fracturing and potential environmental impacts of shale gas development. *Environmental Practice. 14*(4), 249-261. http://dx.doi.org.ezproxy.library.ubc.ca/10.1017/S1466046612000415

Cook, J. J. (2014). Who's Regulating Who? Analyzing Fracking Policy in Colorado, Wyoming, and Louisiana. *Environmental Practice*, *16*(02), 102-112.

Environmental Protection Agency (EPA). (2015). *EPA's Study of Hydraulic Fracturing and Its Potential Impact on Drinking Water Resources.* Washington, D.C. Retrieved from http://www2.epa.gov/hfstudy/hydraulic-fracturing-water-cycle

Fisk, J. (2013). The Right to Know? State Politics of Fracking Disclosure. *Review of Policy Research, 30,* 345-365.

Gruver, M. Wyoming's natural gas boom comes with smog attached. *NBC News.* 3 September 2011.

Kiger, P. J. (2014). *Green fracking?5 technologies for cleaner shale energy.* Retrieved from

National Geographic website: http://news.nationalgeographic.com/news/energy/2014/03/140319-5-technologies-for-greener-fracking/

Mateus, Schreiner, Garcez, & Lopes. (2015). Engineering biological systems toward a sustainable bioeconomy. *Journal of Industrial Microbiology &Biotechnology, 42*(6), 813-838. Retrieved from:http://link.springer.com.ezproxy.library.ubc.ca/article/10.1007/s10295-015-1606-9/fulltext.html

Mitka, M. (2012). Rigorous evidence slim for determining health risks from natural gas fracking. *JAMA, 307* (20), 2135-2136. Retrieved from http://jama.jamanetwork.com/article.aspx?articleid=1167312

Mooney, C. (2011). The truth about fracking. *Scientific American, 305* (5), 80-85. Retrieved from http://www.acfan.org/wp-content/uploads/2011/11/truth-casings.pdf

Ondrey, G. (2012). Nano-engineered glass absorbs organic contaminants .. *Chemical Engineering, 119*(2), 10. Retrieved from http://search.proquest.com/docview/921996160/abstract?accountid=14656

Pollin, Robert. (2012). Economic prospects: Getting real on jobs and the environment: Pipelines, fracking, or clean energy? *New Labor Forum*. *21*(3), 84-87. Retrieved from http://muse.jhu.edu.ezproxy.library.ubc.ca/journals/new_labor_forum/v021/21.3.pollin.html

Twomey, D. F., Twomey, R. F., Farias, C., & Farias, G. (2014). Fracking: Blasting the bedrock of business. *Competition Forum, 12*(1), 204-216. Retrieved fromhttp://ezproxy.library.ubc.ca/login?url=http://search.proquest.com/docview/1640568309?account id=14656

Walters, L., Aydelotte, J. and Miller, J. (2000). Putting More Public in Policy Analysis. *Public Administration Review, 60* (4), 349-359. Retrieved from http://www.jstor.org/stable/3110455?pq-origsite=summon&seq=7#page_scan_tab_contents

Warner, B., & Shapiro, J. (2013). Fractured, fragmented federalism: A study in fracking regulatory policy. *Publius: The Journal of Federalism*, pjt014.

WildEarth Guardians. (2014). *DSCN2011* [photograph]. Retrieved from https://www.flickr.com/photos/wildearth_guardians/14965790902/in/photolist-oNtAeC-oLQmw-oLQq6f-oNzLk6-ow19Sn-ow2jh2-owniyN-oNPUCb-oNRGSB-oNQ6u1-8hcNFd-oLtcRh-f1B LmA-ow1isC-ow12Xm-ownvsC-nM4Y9A-oNzP1B-ownkrf-ownEq6-oLPUPu-oNQ8db-oNzSk H-ow1N1Z-ownN9o-ow1MKQ-oNRHzt-oQHuMW-ow2Lv2-oNzQhK-ow2Rqd-ow2875-oNzQ Jg-oNPXRf-owmVoY-ow2yPB-oLPWqA-owmXBe-oNREh6-oNPQVm-oNRCPg-ownoPC-ow2Rdi-oNQ3DG-oNRL4X-oNzV6c-ownAwV-oLQ3Md-oLQ2Yu-owmWZx

WildEarth Guardians (2014). *DSCN2186* [photograph]. Retrieved fromhttps://www.flickr.com/photos/wildearth_guardians/14967074511/in/photolist-hEy7xV-hEy1br–hEz9Li-hEyotU-hEzkSr-owneWi-niRuGE-ownbCq-oNRX7D-oFPzZB-oFP9Ts-oFPt5L-oNRVR T-oNAaNP-oNRYh4-owndsr-8hcP21-oNQdSC-ownf6Y-oYiDDM-rLEp2C-q98Hpk-eJ97H8-kp FHL2-kpJanC-r4NoU9-qMij3L-qMsrxM-qMssTn-qMjDyu-q7SFcU-r4JiK8-r4TgDv-qMiivU-r2A2yo-qMstov-qWsDBo-kpJ8Go-wi6i2u-kpGu2e-kpGv6D-kpFJ9M-kpFJgF-oFQbrp-hEzriB-oN AcLg-hEy368-hEzf4c-hEydJy-hEzcy2/

WildEarth Guardians (2014). *DSCN2028* [photograph]. Retrieved fromhttps://www.flickr.com/photos/wildearth_guardians/14966995531/in/photolist-oNzLk6-ow19Sn- ow2jh2-oNS7dV-owniyN-oNPUCb-oLPUPu-oNRGSB-oNQ8db-oNQ6u1-oNzSkH-8hcNFd-oLt cRh-f1BLmA-ow1isC-ow12Xm-ow1N1Z-ownN9o-ow1MKQ-ownvsC-nM4Y9A-oNzP1B-oNR Hzt-oQHuMW-ow2Lv2-oNzQhK-ownkrf-ow2Rqd-ownEq6-ow2875-oNzQJg-oNPXRf-owmVo Y-ow2yPB-oLPWqA-owmXBe-oNREh6-oNPQVm-oNRCPg-ownoPC-ow2Rdi-oNQ3DG-oNR L4X-oNzV6c-ownAwV-oLQ3Md-oLQ2Yu-own36V-owmWZx-ownsNj

Wikipedia Commons (2010). Unknown Author. Colorado, Utah, and Wyoming oil shale deposits. Retrieved from

https://commons.wikimedia.org/wiki/File:Colorado,_Utah_and_Wyoming_oil_shale_deposits.jpg

- Previous
-

Site Registration

If you want to add yourself to this blog, please log in.

The Department of Geography - Environment and Sustainability Program
Vancouver Campus
1984 West Mall
Vancouver, BC Canada V6T 1Z2
Tel 604 822 2663
Website www.geog.ubc.ca/