FRET OR FETE:

Property Rights Policy Alternatives for Hydraulic Fracturing Oversight

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The nation is experiencing a natural gas and oil boom due in no small part to hydraulic fracturing. In many states, hydraulic fracturing has been the driver behind economic growth. Nonetheless, hydraulic fracturing is among the environmentalist movement's top targets. Their primary concerns focus on water use and water quality, but scientific research on the water issues associated with fracturing suggests those concerns are overblown. Indeed, the risks are real, but their occurrences are rare. Hence, rational policy analysis suggests that burdensome, top-down bureaucratic regulatory systems may not be the most efficient or effective approach to handling the rare risks associated with fracturing while also taking advantage of the economic benefits. Instead, a property rights approach would hold people accountable for their actions and allow productivity to continue.

Although hydraulic fracturing has been around since the 1940s, has only recently it become widely used as a result of advances in the process. Drilling a hydraulically fractured well is basically identical to drilling a conventional well, with the main difference stemming from the horizontal drilling component added to the fracturing process.[2]

After drilling the vertical well and encasing the pipe in cement, approximately 500 feet above the intended lateral zone, a special drill bit is inserted into the well that drills at a sloping angle eventually leveling out at a depth as much as a mile under the surface to drill horizontally. Piping is inserted and cement is pumped between the piping and the shale formation to seal the well.

The targeted lateral zone is prepped for the hydraulic fracturing process using an electrified perforation gun to perforate the pipe, cement casing, and shale formation. Because the perforations are not large enough to allow hydrocarbons to flow, a special fluid made of approximately 98 to 99 percent water and sand and 1 to 2 percent additives is pumped into the well to widen and hold open the cracks in the shale formation.[3] Upon completion of the hydraulic fracturing, a vacuum pulls out between 25 to 75 percent of the fracturing fluid (called flowback) as well as naturally-occurring fluid in the shale formation (called produced water). The vacuum also prompts the hydrocarbons to begin flowing.

The injection part of the hydraulic fracturing process is what has triggered most of the environmental concerns, although some local communities object to the economic activity itself because it can drive up housing prices, increase traffic, and put pressure on governmental infrastructure such as roads and schools.

According to the U.S. Energy Information Agency (EIA), there are 29 separate resource areas within 20 shale plays in the lower 48 states.[4] Thirty-one states have "actual or potential development activity."[5] Hydraulic fracturing has become an industry standard in hydrocarbon extraction within the United States. Approximately 47 percent[6] of all oil production and 43 percent[7] of natural gas extraction uses hydraulic fracturing. As a result of hydraulic fracturing, North American natural gas production is expected to make up 71 percent of world shale gas production by 2035.[8]

Due to concerns from environmentalists and local citizens, policy-makers have begun to examine and tout the environmental risks some claim are a direct result of hydraulic fracturing. Of the environmental concerns, three issues stand out—water use, water contamination, and induced

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seismic activity. Research shows that the risks associated with these concerns are real; however, it also shows they are smaller than opponents suggest.

Because hydraulic fracturing uses approximately two to five million gallons of water per well, a portion of which stays underground, many say the process will deplete water supplies.[9] It is true that 47 percent of the water used for hydraulic fracturing occurs in areas deemed "high or extremely high water stress"[10] zones, but hydraulic fracturing water use needs to be put in perspective.[11] New York City consumes five million gallons of water in just over six minutes; an irrigated golf course uses five million gallons of water in 23 days. Five million gallons of water are needed to produce 64 tons of steel, and 40 American households use five million gallons for annual indoor uses alone. The Susquehanna River Basin Commission concluded that water use in the Marcellus Shale in total "represents a little more than half of the amount currently used consumptively by the recreation sector (golf courses, water parks, ski resorts, etc.)"[12]

Compared to other forms of energy extraction, hydraulic fracturing is quite competitive in terms of water use. On a BTU basis, hydraulically fractured gas consumes 0.6 to 1.8 gallons of water per million BTUs of energy produced compared to 1 to 6 gallons per BTUs of energy produced for coal mining.[13]

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In addition, burning methane (CH4) produces carbon dioxide and water, thus adding water to the hydrological cycle. Assume that a hydraulic fracturing well uses five million gallons of water, leaves 80 percent underground, and produces 1 billion cubic feet of gas over its 10 year life span. Burning the gas will replace the four million gallons left underground in 6 months and produce 11 million gallons over 10 years. Of course, the "new" water in the hydrological cycle is in a different place and form, e.g. in the atmosphere, but the net hydrological effect is positive.

Of course, in the arid western states experiencing pressure on the demand for residential, commercial, and agricultural water, adding hydraulic fracturing demands is non-trivial. Balancing these demands, however, need not require banning hydraulic fracturing. The solution is to develop well-functioning water markets—as explained further below—to ensure water rights are fully defined and transferable; price signals would lead to efficient water use.

In addition to water scarcity, there are claims that the hydraulic fracturing process will contaminate groundwater. One alleged source of contamination is the fracturing fluids, but there is little evidence to support this allegation. Indeed, studies from Duke University ("found no evidence for contamination of drinking-water samples with deep saline brines or fracturing fluids.")[14], University of Texas at Austin ("none of the water well claims involve hydraulic fracturing fluid additives and none of these constituents has been found by chemical testing of water wells")[15], Massachusetts Institute of Technology (MIT) ("there has been concern that these fractures can also penetrate shallow freshwater zones and contaminate them with fracturing fluid, but there is no evidence that this is occurring")[16], and even the U.S. Environmental Protection Agency ("the Agency has concluded that the injection of hydraulic fracturing fluids into CBM wells poses minimal threat to USDWs") find no evidence of fracturing fluid contamination in water sources.[17]

The other potential source of groundwater contamination is methane leakage, and there is some evidence of methane in water supplies nearby hydraulic fracturing sites. Although the Duke University study found methane levels about 17 times greater than expected, the University of Texas at Austin report suggests that the higher methane levels may not be due to hydraulic fracturing, but are naturally occurring in the water sources. Others have questioned the Duke University report's methodology highlighting that the regions they tested are known to have naturally-occurring methane in the water, that they did not randomly sample test zones, and that they did not conduct pre-and-post fracturing tests.[18] The MIT report concludes that even if methane contamination from hydraulic fracturing is occurring, it is because of poor well design and preparation, both of which can be and are easily remedied. Again, while there is a risk of methane contamination—and it is not even clear whether methane contamination would actually affect one's health—the issue can be resolved by properly instilling market risk assessment, i.e. increasing the price of risky behavior relative to thoughtful risk control.[19]

Finally, there is concern that hydraulic fracturing will induce seismic activity. Initially, many fault the actual fracturing process for induced earthquakes, but if there is a seismic threat, it results from the disposal of flowback and produced water.[20] If improperly disposed of, this water can lubricate subterranean rock formations, causing them to shift.

Even if slippage can theoretically cause earthquakes, the likelihood that they would be significant is trivial. Research conducted by Arthur McGarr of the U.S. Geological Survey (USGS) shows that the magnitude of an earthquake has a proportional relationship to the volume of fluid disposed.[21] Roughly 10,000 cubic meters of fluid could yield a maximum magnitude of 3.3, increasing by approximately 0.4 with each doubling of the fluid. His calculations aim to find the maximum magnitude; as McGarr notes, "the earthquakes may end up being much smaller, but you want to be prepared for the worst-case scenario." By McGarr's calculations, five million gallons of water would generate, at most, a 3.7 magnitude earthquake—and even this might be overstating the magnitude as not all of the five million gallons of water returns to the surface.

According to the USGS, such an earthquake would be "felt only by a person at rest…especially on upper floors of buildings.[22] Many people [would] not recognize it as an earthquake. Standing motor cars may rock slightly…similar to the passing of a truck." Michigan Technological University classifies a 3.7 magnitude as a minor earthquake and estimates that approximately 30,000 of this magnitude occur naturally every year.[23] Again, while a risk, draconian measures like bans or moratoria are unnecessary given the minimal intensity. Efficient market risk control would be able to prevent improper water disposal mitigating such concerns.

Whatever the risks of hydraulic fracturing, they must be weighed against the benefits. When the Great Recession hit the United States and doubled unemployment rates, one unlikely state—North Dakota—largely escaped the downturn. North Dakota's unemployment rate jumped from 3 percent to just over 4 percent between December 2007 and June 2009. The main reason for North Dakota's resilience was the state's oil and gas production, which grew steadily during this period.[24] In December 2007, average daily oil and gas production was 136,021 barrels. By June 2009, the average daily production jumped 58 percent to 215,073 barrels. Behind this explosion of oil and gas production was (and continues to be) the hydraulic fracturing of the Bakken shale play.

And the benefits are not confined to North Dakota. Based on a study by IHS Global, an international information company, in 2012, hydraulic fracturing direct, indirect, or induced employment topped 1.75 million. By 2035, they project the industry will support (either directly, indirectly, or induced) almost double what it currently does—3.5 million jobs. Naturally the vast majority—73 percent—of the employment is in producing states, but even without any possible production, the other states still reap 27 percent of the employment gains. Additionally, in 2012, hydraulic fracturing activity added $238 billion to the national economy, projected to grow to $475 billion by 2035. And without raising any tax rates or instituting new taxes, state government revenue will increase from an annual level of $63 billion in 2012 to over $125 billion in 2035.[25]

Good environmental risk analysis asks several questions. What (if any) is the environmental problem? How does it compare to the problems arising from alternative means of energy production? And how can the risks be mitigated? All forms of energy resource extraction and production, even so-called green energy, have its risks. For instance, a giant solar power plant in California uses 350,000 mirrors to focus the sun's heat on boilers atop a tower to create air temperatures of 1,000 degrees Fahrenheit. During the testing phase, workers found dozens of dead birds, from peregrine falcons to sparrows, scattered around the site.[26]

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Obviously hydraulic fracturing has risks, but they are rare and even though rare risks need to be addressed, they do not require oppressive regulation or production moratoria. Unfortunately, rare risks have been sufficient to generate rather draconian solutions including moratoria or total bans on fracturing. Bans or moratoria zealously eliminate all the benefits of cleaner, cheaper energy in an effort to remove all perceived risks. It requires balancing the risks against the benefits and getting the incentives right so that those making decisions are accountable.

The good news is that many policymakers recognize the net benefits of hydraulic fracturing and therefore have limited moratoria and bans. Of the 31 states that have actual or potential fracturing production, 58 percent (18 states) have no local or statewide bans or moratoria. Only Vermont, New York, North Carolina, and Maryland have effective statewide bans or moratoria on the process. Eight states without statewide bans or moratoria allow localities to impose such draconian measures, however.[27] Not surprisingly, Robert Cheren, an associate at the international law firm Squire Sanders, theorizes that the localities more likely to impose bans or moratoria are those that will benefit little to none from hydraulic fracturing.[28] Hence many of the bans or moratoria have little real impact on energy production, other than to fuel hysteria.

The preferred alternative for risk mitigation in most states has been comprehensive start-to-finish bureaucratic regulation. Using a variety of tools, such as permitting, disclosure, and production requirements, states are regulating everything from well selection to dust control to waste disposal to local infrastructure impacts. Penalties for non-compliance range from fines to well forfeiture. Almost all regulatory authority rests with state agencies as, for the most part, federal laws and agency decisions have limited their overview. However, the EPA is currently conducting a wide examination of the process to determine its environmental effects.

Downsides to this approach are two-fold. First, the process is very burdensome, complex, and expensive—for both the government agency doing the regulating and the company being regulated. Regulation, at its very nature, imposes costs—largely stemming from compliance—which are then passed along to consumers.

Secondly, watching regulations get made is like watching a butcher make sausage; it's not pretty.

As public choice theory suggests, regulation is not without its faults or problems. Since regulatory bureaucracies are not influenced by normal market-price mechanisms, which private industries use to guide behavior and decision-making, they, instead, rely on regulatory goals or missions, which at times can be vague. Similarly, due to a lack of clear oversight, these agencies are easily captured by a wide array of special interests.[29] For hydraulic fracturing, for example, the regulatory agency could as easily be captured by environmentalist groups as they could by oil and gas companies. This capture, then, could lead to inefficient regulatory decisions that, for example, overemphasize the costs while disregarding the benefits and without proper market-mechanisms to guide decisions, the impact of this inefficiency would go unnoticed for some time.

Behind regulations to mitigate risk are special interests, such as existing oil and gas extraction companies, large and small, who want the regulatory bar set higher for new entrants into the marketplace. Regulatory barriers to entry create an implicit subsidy to existing companies who can capture the regulatory agencies, and generate income for lawyers who litigate regulations and violations thereof.[30]

Moreover, if companies carefully follow regulatory requirements, they are seldom held liable if something does go wrong, standing behind the argument that they did what they were told. And when fines are imposed, they generally are paid to the government, not the people who have been harmed.

However, certain market mechanisms, largely already in existence in other sectors, can work to mitigate the real but rare risks associated with hydraulic fracturing while taking advantage of the process' benefits, all the while not imposing the unintended consequences of bureaucratic regulation. Secure property rights and strict accountability are crucial to any manufacturing process, and hydraulic fracturing is no exception. For instance, if hydraulic fracturing does contaminate neighboring wells, companies should be held accountable.

Of course, this requires proving causality, which is not always easy, especially when the fracturing boom has created many independent potential contaminant sources and many different potential recipients of the contaminants. One way of ensuring accountability is to add radioisotopes to fluids. Just as barbed wire and branding evolved on the western frontier to better define property rights to land and cattle[31], new scientific advancements with isotopic tracers are making is it possible to assign a finger-print to fracturing well water, thus allowing identification and traceability. Commonly used by the Lawrence Livermore National Laboratory to "to learn about groundwater sources, ages, travel, times, and flow paths and to determine the path and extent of contaminant movement in the water,"[32] by assigning a particular isotope to water used in each well, regulators and harmed third parties could identify what water came from which well and hence hold well owners accountable for any damage they might cause.

Ensuring causality leads to two important realities: 1) if damages are incurred, investigators can accurately attach blame to the responsible parties ensuring proper recourse and thus, 2) if operators know they will be held liable for their actions, they have more incentive to prevent such behavior in the first place.

As previously mentioned, 47 percent of the water used for hydraulic fracturing occurs in areas deemed "high or extremely high water stress" zones. The common inference from this statistic is that we are running out of water, but a more appropriate inference is that we are running out of cheap water. Many of the inputs to fracturing—from laborers to the apartments they live in—are scarce. As a result, prices of those inputs rise, inducing producers to use less of them and suppliers to make them more available.

That same process would result if we encouraged tapping water markets.[33] Especially in the western states where the prior appropriation system allocates water rights on a first-in time, first-in right basis, the essentials are there for water markets. If hydraulic fracturing companies must buy their water from farmers, municipalities, or even government agencies at market prices, they will have an incentive to conserve on water use. Indeed, even without high market clearing prices, well drillers who pay something for their water are finding ways to reduce water use and to reclaim from waste water. With water markets, the price of water will reflect its scarcity and give drillers an incentive to reduce water use. For example, it currently costs between 10 and 14 cents per gallon to deliver fresh water to a hydraulic fracturing well in the Bakken, making the total water cost per well $400,000. Companies can sharply reduce the cost of water by removing chemicals and rock debris from the flowback or produced water and recycling it for use in other wells. They are also are searching for ways to fracture using propane gel and compressed air.[34]

Although water markets can encourage conservation of water use, they do not necessarily deal with problems of water contamination or induced seismic activity. For these concerns, other property rights approaches, such as bonding and insurance, self-regulation, and "corporate" verification/certification, would punish risky behavior and encourage more efficient, thoughtful risk assessment. Surety bonding, insurance, or some combination of the two would promote best practices by making risky behavior prohibitively expensive. Shifting risk to a fiducially-responsible third-party creates a strong incentive to mandate good behavior (or at least, make risky behavior expensive). The insurance company would set common standards at a point where their expected policy payout would not exceed their expected premiums (or in the case of surety bonding, they would set the interest rate at a level where payout would not exceed interest payments). Since the cost of cleaning up contaminated water or the wreckage of an earthquake could be expensive, these insurance or surety bonding companies would either set their premiums or interest rates at levels high enough to cover the risks or to impose strict operating standards to make coverage affordable and manageable. The insurance or surety bonding company would then assume the regulatory role. If necessary, extraction companies could be compelled to have insurance or be bonded prior to drilling (similar to the requirement that drivers have auto insurance).

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Another alternative is self-regulation, which as Peter DeMarzo, Michael Fishman, Kathleen Hagerty[35] and Louis Stern[36] discover in two separate studies, functions best when the threat of government regulation is strong, thus incentivizing the industry to exert more pressure on bad actors to ensure consistent best practices. It is also more successful when the risky actions of one actor have a massively detrimental effect on the rest of the industry.

An example of successful self-regulation is the nuclear power industry's Institute of Nuclear Power Operation (INPO). Established after the 1979 Three Mile Island incident, the INPO sets "performance objectives, criteria, and guidelines for the nuclear power industry," regularly inspects nuclear power plants, and assists plants in improving operation performance. In summation, the INPO evaluates power plants, trains and accredits inspectors and plant operators, provides industry wide analysis and information exchanges, and assists plants.[37] In many ways, the INPO serves as an internal watchdog handling many of the normal regulatory roles. Of course, the Nuclear Regulatory Commission (NRC) does have federal regulatory authority over nuclear power plants, but it sometimes decides not to replicate reviews the INPO first handles.[38]

If the hydraulic fracturing industry were to follow the INPO model, it should do so before an incident triggers a heavier hand from regulators as in the case of the Three Mile Island incident. The proactive formation of an industry-wide self-regulating entity could work with state and federal regulatory agencies to create best practices across the country, limit moral hazard, and improve the industr y's public perception. Such incentives would be backed with the threat of greater government regulation. Strong inter-industry pressure would ensure that all fracturing operators engage and cooperate with the self-regulatory agency.

A third alternative, which could work hand-in-hand with self-regulation, is the creation of a for-profit company that serves as a verification and certification entity. Fracturing well operators could contract with this company to verify that their wells meet certain standards. Underwriters Laboratories, Inc. (UL) provides a model for this approach, mostly for electronics and other consumer products. One of its major business divisions already deals with environmental sustainability. Since a company would be concerned both about its bottom-line and its reputation, there would be incentives to promote and ensure stringent best practices. Market pressures could increase the demand for certified and verified oil or gas thereby resulting in hydraulic fracturing operators contracting such a service. As a last resort, government regulators could mandate third-party verification and certification prior to permitting, thus removing such verification and certification from the political process.

Good environmental policy weighs the risks alongside the benefits. Although top-down government regulation overseen by bureaucracies has been the norm in the hydraulic fracturing revolution, it has not been effective in weighing the risks and benefits when the risks are rare but real and the benefits are clearly great. Using market mechanisms, including liability for damages, would align incentives for well owners and operators to account for potential risks and hold them more directly accountable to victims of incidents associated with hydraulic fracturing. This would efficiently and effectively improve on the regulatory process by reducing the costs and complexities of mitigating risks and by eliminating some of the politics that protects those who are at the regulatory table.

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