

# Hydraulic Fracturing: A Policy Analysis

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On my honor, as a student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Papers in Science, Technology, and Society Courses.

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The views expressed in this paper are those of the author and do not represent the positions of the U.S. Environmental Protection Agency.

## **Executive Summary**

Hydraulic fracturing, or fracking, is a well stimulation process used to obtain natural gas from shale formations several thousand feet below the earth's surface. As fracking has expanded over the last several years, safety concerns have increased. Allegations of natural gas entering private water supplies, well explosions, and polluted streams have sparked controversy about fracking. Thus, Congress directed the Environmental Protection Agency (EPA) in fiscal year 2010 to conduct a study of hydraulic fracturing and its potential impacts on drinking water. However, the urgency of fracking concerns has prompted some members of both the public and the government to request that EPA act now to regulate or halt hydraulic fracturing.

Although an array of policy options is available to EPA, this report discusses three. First, EPA could delay regulatory decisions about hydraulic fracturing until the study is complete. In this case, the current practice of states regulating hydraulic fracturing would continue in the interim. Second, EPA could put a moratorium on all fracking operations until the study is complete and proper regulations can be developed. Third, EPA could begin to regulate hydraulic fracturing now, particularly with the passage of the Fracking Responsibility and Awareness of Chemicals (FRAC) Act. Further regulations could be developed as the study progresses.

Ultimately, this report recommends that the FRAC Act be passed and EPA immediately begin to regulate hydraulic fracturing. This politically feasible policy balances the need to protect the public's health and the environment with the economic gains from hydraulic fracturing. In contrast, a moratorium would be difficult to implement and could significantly impact the natural gas industry and the US economy. Waiting to regulate fracking at the federal level until after the study fails to address concerns over the safety of fracking operations.

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## **Hydraulic Fracturing: A Policy Analysis for EPA**

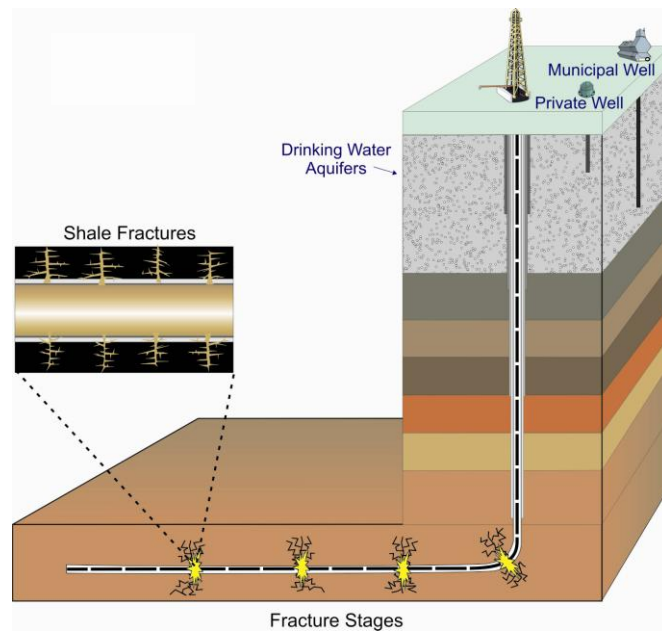
Hydraulic fracturing, or fracking, is a well stimulation process used to obtain natural resources from underground geological formations. Although used in several different applications, including the extraction of oil and geothermal energy, hydraulic fracturing in natural gas production from shale formations has recently taken center stage. It is estimated that shale gas will comprise over 20% of the total U.S. gas supply by 2020 (Energy Information Administration, 2009). As hydraulic fracturing has expanded, the public, media, and Congress have expressed rising concerns about the practice. Allegations of natural gas entering private water supplies, well explosions, and polluted streams have sparked controversy about fracking. In response, Congress directed the Environmental Protection Agency (EPA) in fiscal year 2010 to study hydraulic fracturing and its potential impacts on drinking water. The goal of this study is to determine whether hydraulic fracturing endangers drinking water and, if so, how these risks can be mitigated. The results of the study, expected by the end of 2012, will help inform EPA's regulatory response to hydraulic fracturing. However, given the urgency of fracking concerns, some members of both the public and the government have called for EPA to regulate or halt hydraulic fracturing now. Thus, EPA must consider the policy options available to address these concerns.

This report has multiple objectives: to provide background on hydraulic fracturing, to describe EPA's planned study, to discuss policy options for hydraulic fracturing, and to recommend which policy EPA should adopt.

## Background on Hydraulic Fracturing

Hydraulic fracturing has been used since the 1940s in more than one million wells in the U.S. (American Petroleum Institute [API], 2010). Fracking is a multi-step process. First, production wells are drilled to provide access to the geologic formation that holds the natural gas. In the case of shale production, wells may be drilled vertically or combined with horizontal or directional sections. Figure 1 depicts a well that is

drilled vertically to the depth of the shale formation and then horizontally through the shale. Wells may be drilled up to 10,000 feet below the earth's surface and may extend several thousand feet away from the production well (ProPublica, 2010). Next, fracking fluid is injected into the well at a high pressure to create fractures in the shale. Anywhere from



*Figure 1: Hydraulic Fracturing Well. Wells may be drilled both vertically and horizontally. EPA, 2010c.*

1.2 to 3.5 million gallons of water may be used in a single fracking project (Andrews, 2009). The fluid is mainly composed of sand and water, with some chemicals added for a variety of purposes, such as preventing corrosion or shale deposits in the well piping (Ground Water Protection Council and ALL Consulting, 2009). The sand in the mixture helps to hold the fractures open so that natural gas is free to escape from the shale up the well. Along with the natural gas, anywhere from 15-80% of the fracking fluids are returned to the surface. This is called the flowback water and it is stored in open pits or tanks. It may be transported to

wastewater treatment plants, injected into underground tanks, or recycled for reuse at the well.

Figure 2 shows the entire fracking process.

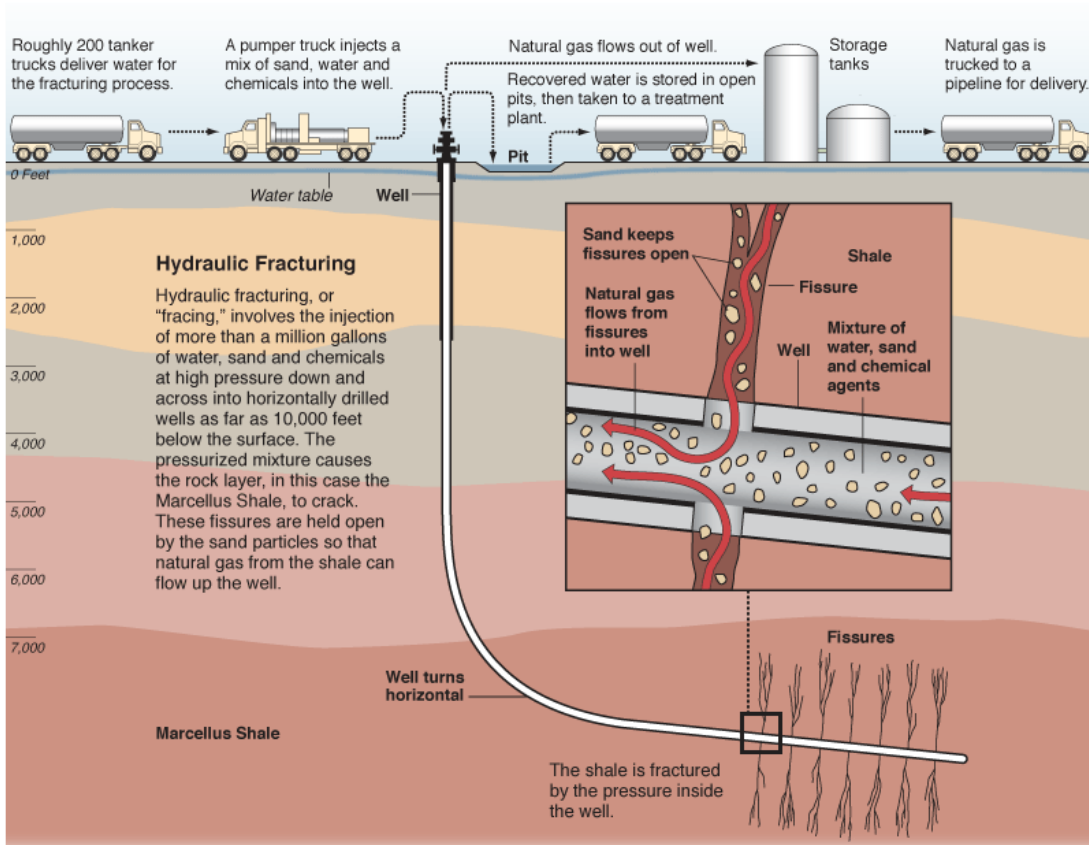


Figure 2. Hydraulic Fracturing Site Schematic. Water is involved in numerous stages of hydraulic fracturing. Propublica credit Al Granberg, 2010.

The use of hydraulic fracturing has rapidly increased in the last few years to access unconventional sources of natural gas, including tight-gas, coal-bed methane, and shale formations. Production of natural gas from unconventional sources has grown almost 65% in the last decade, so that unconventional production now composes 46% of the total U.S. production (Ground Water Protection Council and ALL Consulting, 2009). Figure 3 illustrates the large increases in unconventional gas production anticipated for the future. There are several reasons for this expansion. For one, natural gas is cleaner burning than coal or oil and can be produced domestically. In fact, natural gas emits half as much CO<sub>2</sub> as coal and 30% less than fuel oil

(Ground Water Protection Council and ALL Consulting, 2009). Therefore, natural gas could significantly reduce our country's carbon emissions. Further, the U.S. has abundant natural gas reserves, which could lower our dependence on foreign countries for energy. Hydraulic fracturing is needed to access unconventional natural gas resources. In the past, natural gas was mainly extracted from "conventional sources," like sandstone and other rocks close to the earth's surface. However, recently discovered unconventional sources of natural gas, like shale

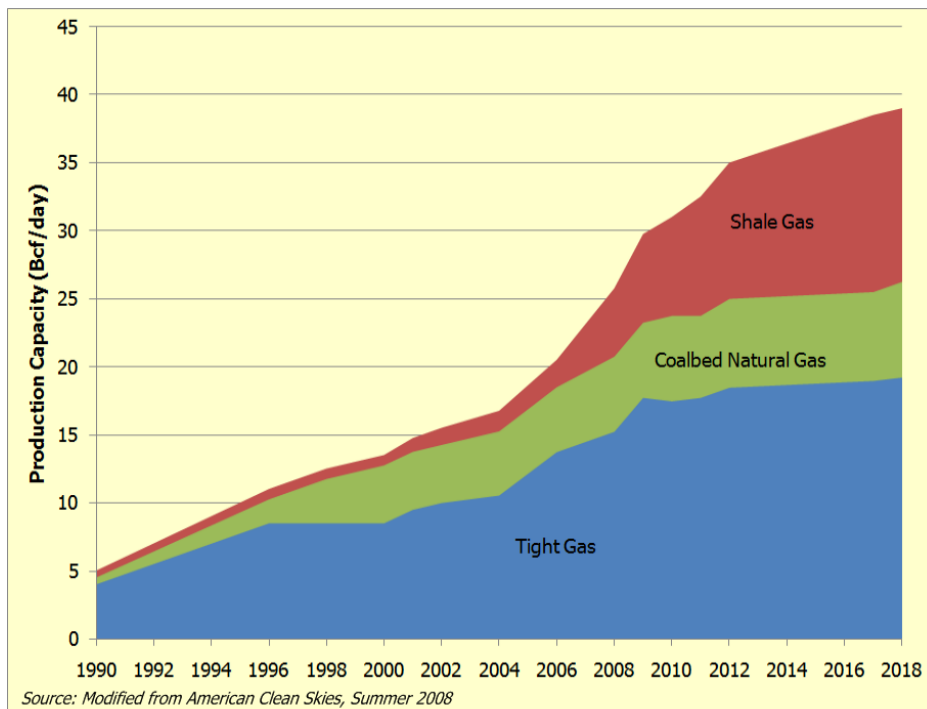


Figure 3: United States Unconventional Gas Outlook. The production capacity of unconventional gas is expected to increase significantly in the future Ground Water Protection Council and ALL Consulting, 2009.

formations several thousand feet below the earth's surface, hold large quantities of natural gas. These sources are critical components of the U.S.'s natural gas supply. In fact, some studies estimate that up to 80% of natural gas wells drilled in the next decade will require fracking to be productive (API, 2010). Technology for fracking has improved in the past few years. Drilling techniques can now effectively create fractures in specific places in the wellbore to increase productively and speed up drilling (Seale, 2007). Thus, the production of natural gas from

unconventional sources has become more economical as demand has increased and technological improvements have lowered production costs.

As hydraulic fracturing has expanded, the oil and gas industry have maintained that it is a safe practice critical to our nation's clean energy future. According to the American Petroleum Institute, fracking technology has been used in nearly one million wells in the U.S. with a good environmental track record (API, 2010). Industry members claim that proper safety measures are

taken to ensure that drilling does not endanger public safety. For example, steel casing and surrounding layers of concrete are installed around the portion of the well that passes through underground sources of drinking water. Also, fracturing usually occurs several thousand feet below most aquifers and usable groundwater. A properly cased wellhead and the significant depth between fracking and water tables are both illustrated in Figure 4. Additionally,

analysis conducted by the American Petroleum Institute and others found that the potential for groundwater to be

impacted by the injection of fracking fluids into the ground is low. They estimated the probability of groundwater being impacted by the pumping of fluids used during hydraulic

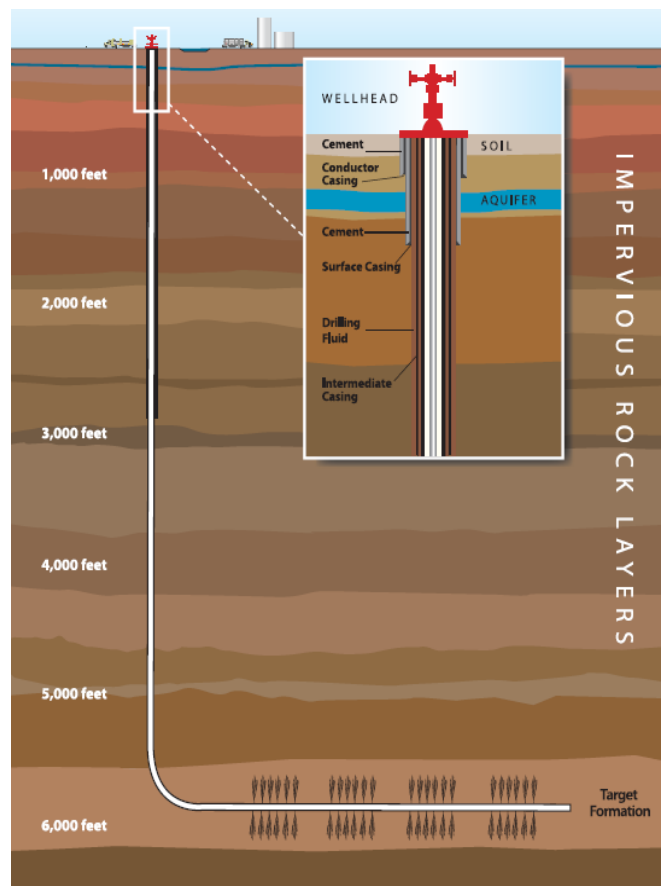


Figure 4: Groundwater Protection through Proper Well Construction. Well casing used to protect ground water and fracking location. American Petroleum Institute,

fracturing of shale wells to be less than  $2 \times 10^{-8}$  (Ground Water Protection Council and ALL Consulting, 2009). However, despite the industry's assurance that fracking is safe, several concerns have persisted among the public.

The documentary "Gasland," which aired on HBO in June, 2010, presented many of these concerns about hydraulic fracturing. In the movie, Josh Fox travels across the nation to fracking sites where citizens have complained about the practice polluting their water supplies. Citizens are filmed igniting water as it comes out of their taps, holding up murky jars of tap water, and describing health problems they have experienced due to hydraulic fracturing. Although the public has cited many negative effects on their water supply from hydraulic fracturing, the exact mechanisms of the interaction between fracking and drinking water is unclear.

Water is involved in many parts of the fracking process, as seen in Figure 2. There are four main phases of water use in fracking operations where potential problems could originate: first, in the acquisition of water for well drilling and fracturing operations; second, in the mixing of water with chemicals and proppant (e.g., sand, ceramic beads) for the fracturing operation, including injection and return of wastewater to the surface; third, in the storage of wastewater; and fourth, in the disposal, treatment, or recycling of wastewater.

Fracking could affect both surface and ground water quantity and quality. It can reduce the volume of available drinking water, and may introduce contaminants into drinking water supplies. Contaminants in fracking fluid could migrate through fractures in the rock into water aquifers, leak from production wells, leach from storage pits, or enter drinking water supplies in

a number of other ways. Due to the uncertainties surrounding these risks, Congress identified the need for a “focused study of this topic” (EPA, 2010a). Thus, EPA has begun planning a study to examine the relationship between hydraulic fracturing and drinking water.

## **EPA Study**

EPA is currently planning a study, expected to begin in early 2011, to assess whether hydraulic fracturing poses risks to drinking water supplies. The goal of this study is to provide scientific data and information on the risks hydraulic fracturing operations may pose to drinking water. This will help both the Agency and Congress determine the best policy actions to ensure that fracking does not endanger public health or the environment.

Multiple steps are required to plan and execute the study. First, EPA has to prepare a study plan containing the research questions that will guide the study and how they will be answered. These questions will be developed through a review of existing literature, meetings with federal and state partners, input from the industry and environmental organizations, and public meetings. Next, this study plan has to be peer-reviewed by the Science Advisory Board, which will offer recommendations to further develop the study plan. Once finalized, the study will begin, with initial results available in approximately two years.

As of mid-July, EPA has made significant progress on planning its study. The Agency has met with the public in three different regions, industry members, non-governmental organizations, and Federal and State stakeholders. EPA has begun to develop a database to collect information about fracking and to review the literature. The study is likely to include several case studies, and

work has begun to identify candidate sites for these studies. The Science Advisory Board (SAB) has provided initial advice regarding the scope of EPA's study and the stakeholder process. The peer review process involving the SAB is set to begin in early October.

While EPA has acted to carry out a study to assess the risks associated with hydraulic fracturing, many still suggest that EPA needs to take more immediate action to regulate fracking. Thus, the additional policy options available to EPA should be assessed.

### **Policy Options**

EPA is in a difficult position when it comes to making a policy decision about hydraulic fracturing for several reasons. First, the current governmental policy for hydraulic fracturing is unclear. EPA lacks authority under the Safe Drinking Water Act to regulate fracking operations. The Act, passed by Congress in 1974, is one of EPA's primary tools for "regulating what can and cannot be injected into the ground" to ensure a safe drinking water supply (Tronche, 2009). However, hydraulic fracturing operations are exempted from the Safe Drinking Water Act. This is due to an amendment in the Energy Policy Act of 2005, which specified that the term underground injection excludes "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, 2010b). This effectively exempted the oil and gas industry from EPA regulations.

In the absence of federal regulation, states have developed their own policies for fracking, which vary greatly (Clark, 2010). There are fracking operations in 34 states, all with different policies carried out by a different agencies, ranging from the Texas Railroad Commission to the Department of Environmental Protection in Pennsylvania (Ground Water Protection Council and ALL Consulting, 2009). Such diversity of state policies makes it even more difficult to create a clear national policy.

The second reason formulating an EPA policy is so challenging deals with timing. While EPA does not expect its study to start until the beginning of January, 2011, with the initial results not due for two years, the public's concerns about fracking are urgent. EPA needs the hard science and answers that will come from the study to make a sound decision about regulations for hydraulic fracturing, but it also has a responsibility to protect the health of the public and the environment now.

Third, EPA's policy will inevitably require some level of compromise. While many members of the public and environmental organizations want hydraulic fracturing to be halted altogether, the oil and gas industry is steadfast in their support of the practice. Placing a moratorium on fracking would not only impact the oil and gas industry, but would also remove a valuable source of cleaner, domestic fuel for America. However, allowing fracking to continue may pose risks to the safety of the American public and could create irreparable damage to the environment. EPA must consider both the benefits and risks associated with hydraulic fracturing.

Given these complications, there are numerous policy decisions to be made by EPA. This report will discuss three main policy directions the government could take regarding hydraulic fracturing. First, EPA could delay all regulatory decisions about hydraulic fracturing until the study is complete, allowing states to continue to regulate hydraulic fracturing in the interim. Second, EPA could put a moratorium on all fracking operations until the study is complete and proper regulations can be developed. Third, EPA could begin to regulate hydraulic fracturing now, particularly with the passage of the Fracking Responsibility and Awareness of Chemicals (FRAC) Act. Further regulations could be developed as the study progresses.

These three scenarios will be discussed and judged based on three criteria: political feasibility, economic impact, and protection of public health and the environment. These criteria help illustrate the conflicting concerns EPA must consider when formulating a policy on fracking. Economic gain and environmental risk from fracking are in conflict. Thus, the policies must be analyzed both in terms of whether they meet these criteria and then which criteria are most important.

*Option 1: Wait until study completion to regulate*

One option is for EPA to wait to make any regulatory decisions about hydraulic fracturing until the study is complete. States are now responsible for regulating fracking operations. The States have adopted a multitude of different fracking policies, some more protective than others. Some argue that states are more fit than the federal government to regulate natural gas operations like fracking due to the geographic and geologic differences throughout the U.S. and their closer proximity to operations. According to a report by ALL Consulting and the Groundwater

Protection Council, “the States have broad powers to regulate, permit, and enforce all activities—the drilling and fracture of the well, production operations, management and disposal of wastes, and abandonment and plugging of the well” (2009). Since the States already have regulatory power over hydraulic fracturing, it would be politically feasible to leave the issue to the States. This would avoid any conflicts between EPA and state regulators while pleasing the oil and gas industry.

However, the number of complaints that have arisen over hydraulic fracturing suggests that state regulations may not be sufficient to protect public health and the environment. A report done by Environmental Working Group found “there is not nearly enough manpower to handle the volume of wells” at the state level (Cusolito, 2010). In 2008, Pennsylvania had 35 inspectors in charge of more than 74,000 wells (Cusolito, 2010). The report also estimates that in many cases “the concentration of petroleum distillates used in a single well could be enough to contaminate 650 million gallons of water—the same amount consumed daily by New York City residents” (Cusolito, 2010). This represents a huge risk to drinking water, as fracking chemicals could permanently contaminate large volumes of essential water. Also, states rarely “require companies to provide detailed information on types and quantities of chemicals being used... Nor do companies have to monitor water quality when there are drinking water formations in close proximity to areas where hydraulic fracturing occurs” (Earthworks). Whether due to a lack of resources, pressure from oil and gas companies, or other considerations, states are not doing enough to regulate hydraulic fracturing. Without a national standard or action by EPA, states lack the impetus and accountability to act on hydraulic fracturing.

Therefore, EPA should not wait to regulate fracking operations until the projected study completion date of December, 2012. . Although this policy is politically feasible and positive for natural gas companies and the U.S. economy, EPA has a responsibility to respond sooner to the public's concerns.

*Option 2: Moratorium on hydraulic fracturing*

Second, EPA could choose to immediately halt all fracking operations until the study is complete. The results of the study would then be used to develop proper regulations covering issues like well permitting, aquifer protection, reporting of chemicals used, requirements for flowback disposal, and enforcement and inspection measures. Most likely the states would enforce these regulations, as is the case with most oil and natural gas regulations today. This decision would be entirely successful in protecting both the public health and the environment, as no fracking would be allowed for at least two years. Fracking would then be controlled by EPA to ensure a priority is placed on the public's health and the environment. However, it would be difficult politically for EPA to put a moratorium on all fracking operations. EPA does not have authority under the Safe Drinking Water Act to regulate hydraulic fracturing, so it would have to justify a moratorium some other way. For example, Section 1431 of the Safe Drinking Water Act could be used:

Section 1431 grants EPA Administrator emergency powers to issue orders and commence civil action to protect public water systems or underground sources of drinking water... when (1) a contaminant present in or likely to enter a public drinking water supply system or underground drinking water source poses a substantial threat to public health, and (2) state or local officials have not taken adequate action. (Andrews, 2009)

EPA would have to prove these two conditions have been met to act. In addition, there are several other regulatory acts that EPA could use to validate a moratorium.

Imposing a moratorium on hydraulic fracturing would be a significant exercise of EPA's authority and a politically unpopular move. This is evidenced by the controversy that has arisen in the government over the Supreme Court's ruling in 2007 that EPA has legal authority to regulate greenhouse gases under the Clean Air Act (Abrams, 2010). Numerous senators have spoken against this ruling, with an amendment to remove the authority only narrowly failing in the Senate. Not only would EPA face much opposition and have a difficult time establishing its authority to halt hydraulic fracturing, it would be hard to implement such a decision. Officials at the state level would be met with considerable resistance from the oil and gas industry when enforcing the moratorium. This policy would also have severe economic implications. The coalition of independent oil and gas companies claims the hydraulic fracturing industry "employs 1.2 million people, spent \$226 billion in 2007 on domestic exploration and production and that same year paid private landowners \$30 billion in royalties" (Mulkern, 2009). In addition to putting a large number of Americans out of work and suspending the income from taxes and royalties, a moratorium would significantly reduce domestic natural gas supplies. This means the U.S. would have to import more natural gas or utilize other, less clean, fossil fuels such as coal. Therefore, although a moratorium would protect the public health and environment, it would create numerous political and economic problems, making it a poor policy choice.

*Option 3: FRAC Act and regulate now*

Thirdly, EPA could immediately begin to regulate hydraulic fracturing, with more regulations developed as the study progresses. The clearest way to do this is through the Fracking Responsibility and Awareness of Chemicals (FRAC) Act. The FRAC Act was introduced by

DeGette, Hinchey, and Polis in the House of Representatives, and Casey and Schumer in the Senate in June 2009 (Earthworks). The bills would amend the Safe Drinking Water Act to give EPA authority over hydraulic fracturing and require the energy industry to disclose the chemicals it uses in fracking operations, something that has largely been protected in the past as trade secrets (Lustgarten, 2009). This would allow EPA to begin establishing basic regulations on fracking operations, which could be refined and adjusted as more information is gathered throughout the study. For example, EPA could immediately require fracking companies to comply with the Safe Drinking Water Act. Requiring companies to disclose the chemicals they use would keep them more accountable. In 2003, EPA signed a “memorandum of agreement” with three oil and gas companies “agreeing to limit the amount of diesel they use in fracturing” (Soraghan, 2010). However, both Halliburton and BJ Services acknowledged in 2008 that they had used diesel in hydraulic fracturing. The FRAC Act would make companies more transparent and prevent violations like this.

Placing oil and gas companies under the regulations of the Safe Drinking Water Act would help ensure that water sources are protected. This would be a critical first step in developing more specific regulations for fracking, like requirements for well construction and casing, water use, flowback storage, treatment, and disposal, and water-quality monitoring. Although these regulations would still take some time to develop, EPA could immediately begin working with the State governments, industry members, public, organizations, and other stakeholders to create them. The FRAC Act would give EPA the necessary authority to work with other parties to hold oil and gas companies responsible for the safety of fracking operations.

That said, passing the FRAC Act is likely to be politically challenging, as much opposition has arisen to the act since its introduction in June. Oil and gas companies argue that regulations would be costly. Industry research estimates that complying with federal oversight would add approximately \$100,000 to the cost of each new natural gas well in the United States (Lustgarten, 2009). According to a report by Advanced Resources International for the Department of Energy, this cost could even be over \$150,000 (2009). These higher costs would reduce the number of wells drilled, thus decreasing the natural gas available for use. However, regulating fracking would not be as contentious as halting it all together. Also, the release of Gasland and well explosions in Pennsylvania have heightened concern over fracking, thus giving support to the FRAC Act. Even if the FRAC Act is not passed, EPA could still use its authority, such as that granted under Section 1431 of the Safe Drinking Water Act, to place some regulations on fracking. There are also several other regulatory authorities granted to the EPA which could be cited as justification for fracking regulations.

Although passing the FRAC Act and regulating hydraulic fracturing face some political opposition and have some associated costs, the benefits to the public and to the environment outweigh these costs. This is a relatively moderate policy option and not as extreme as the other two choices. It best balances the need for EPA to act to protect the public's health in light of all the complaints about fracking with the importance of natural gas to our nation's energy future.

In conclusion, while fracking technology is providing a clear economic benefit and a source of cleaner, domestic energy, additional oversight is needed to protect the public and the environment. The FRAC Act appears to be the first step in this process, with additional regulatory options to be identified throughout EPA's study. To ensure these regulations are

properly developed and implemented, there needs to be a clear involvement of all stakeholders, including federal agencies, state governments, the public, industry, and environmental organizations.

## Works Cited

Abrams, Jim. (2010, June 10). *Senators Aim to Block EPA Greenhouse Gas Rules*. The Washington Times. Retrieved from:  
<http://www.washingtontimes.com/news/2010/jun/10/senators-aim-block-epa-greenhouse-gas-rules/>

Advanced Resources International, Incorporated. (2009 Jan). *Potential Economic and Energy Supply Impacts of Proposals to Modify Federal Environmental Laws Applicable to the U.S. Oil and Gas Exploration and Production Industry*. Prepared for the U.S. Department of Energy Office of Fossil Energy. Retrieved from:  
[http://s3.amazonaws.com/publica/assets/natural\\_gas/oil\\_gas\\_enviro\\_n\\_proposals\\_report\\_jan2009.pdf](http://s3.amazonaws.com/publica/assets/natural_gas/oil_gas_enviro_n_proposals_report_jan2009.pdf)

American Petroleum Institute. (2010, June 14). *Hydraulic Fracturing*. Retrieved from:  
<http://www.api.org/policy/exploration/hydraulicfracturing/>

Andrews, Anthony, Coordinator. (2009, Oct 30). *Unconventional Gas Shales: Development, Technology, and Policy Issues*. Prepared by the Congressional Research Service for Members and Committees of Congress. Retrieved from: <http://www.fas.org/sgp/crs/misc/R40894.pdf>

Clark, Jeffrey Bossert. (2010, May 11). *United States: EPA Announces Study on Hydraulic Fracturing Practices Used in Gas and Oil Production On March 18, 2010, United States*

Environmental Protection. *Mondaq*. Retrieved from:  
<http://www.mondaq.com/unitedstates/article.asp?articleid=98236>

Cusolito, Kara. (2010, June 21). *The Next Drilling Disaster?* The Nation. Retrieved from:  
<http://www.thenation.com/article/next-drilling-disaster>

Earthworks. *Hydraulic Fracturing of Oil and Gas Wells*. Retrieved from:  
<http://www.earthworksaction.org/hydrfracking.cfm>

Energy Information Administration. (2009 March). Annual Energy Outlook 2009  
With Projections to 2030. Retrieved from:  
[http://www.eia.doe.gov/oiaf/archive/aeo09/pdf/0383\(2009\).pdf](http://www.eia.doe.gov/oiaf/archive/aeo09/pdf/0383(2009).pdf)

Environmental Protection Agency [EPA]. (2010a). *Hydraulic Fracturing*. Retrieved from:  
[http://www.epa.gov/safewater/uic/wells\\_hydrofrac.html](http://www.epa.gov/safewater/uic/wells_hydrofrac.html)

Environmental Protection Agency [EPA]. (2010b). *Regulation of Hydraulic Fracturing by the  
Office of Water*. Retrieved from: [http://www.epa.gov/safewater/uic/wells\\_hydroreg.html](http://www.epa.gov/safewater/uic/wells_hydroreg.html)

Environmental Protection Agency [EPA]. (2010c). *Hydraulic Fracturing Research Study*.  
Retrieved from: <http://www.epa.gov/safewater/uic/pdfs/hfresearchstudyfs.pdf>

Ground Water Protection Council and ALL Consulting (2009 April). *Modern Shale Gas  
Development in the United States: A Primer*. Prepared for the U.S. Department of Energy Office

of Fossil Energy. Retrieved from: [http://www.netl.doe.gov/technologies/oil-gas/publications/EPreports/Shale\\_Gas\\_Primer\\_2009.pdf](http://www.netl.doe.gov/technologies/oil-gas/publications/EPreports/Shale_Gas_Primer_2009.pdf)

Lustgarten, Abrahm. (2009, June 9). FRAC Act—Congress Introduces Twin Bills to Control Drilling and Protect Drinking Water. *ProPublica*. Retrieved from: <http://www.propublica.org/article/frac-act-congress-introduces-bills-to-control-drilling-609>

Mulkern, Anne C. (2009, May 7). Industry Campaign Targets ‘Hydraulic Fracturing’ Bill. *New York Times*. Retrieved from: <http://www.nytimes.com/gwire/2009/05/07/07greenwire-industry-campaign-targets-hydraulic-fracturing-10572.html>

ProPublica. (2010). *Hydraulic Fracturing*. Retrieved from: <http://www.propublica.org/special/hydraulic-fracturing>

Seale, Rocky. (2007, June/July). Open-hole completion system enables multi-stage fracturing and stimulation along horizontal wellbores. *Drilling Contractor*. Retrieved from: [http://drillingcontractor.org/dcp/dc-julyaug07/DC\\_July07\\_PackersPlus.pdf](http://drillingcontractor.org/dcp/dc-julyaug07/DC_July07_PackersPlus.pdf)

Soraghan, Mike. (2010, Feb 19). Two Oil-Field Companies Acknowledge Fracking With Diesel. *New York Times*. Retrieved from: <http://www.nytimes.com/gwire/2010/02/19/19greenwire-two-oil-field-companies-acknowledge-fracking-w-90863.html>

Tronche, John-Laurent. (2009, June 8). *States or Feds: Who gets to regulate hydraulic fracturing?*. Fort-Worth Business Press. Retrieved from:  
<http://www.fwbusinesspress.com/display.php?id=10369>

## **Bibliography**

Abrams, Jim. (2010, June 10). *Senators Aim to Block EPA Greenhouse Gas Rules*. The Washington Times. Retrieved from:  
<http://www.washingtontimes.com/news/2010/jun/10/senators-aim-block-epa-greenhouse-gas-rules/>

Advanced Resources International, Incorporated. (2009 Jan). *Potential Economic and Energy Supply Impacts of Proposals to Modify Federal Environmental Laws Applicable to the U.S. Oil and Gas Exploration and Production Industry*. Prepared for the U.S. Department of Energy Office of Fossil Energy. Retrieved from:  
[http://s3.amazonaws.com/publica/assets/natural\\_gas/oil\\_gas\\_envirn\\_proposals\\_report\\_jan2009.pdf](http://s3.amazonaws.com/publica/assets/natural_gas/oil_gas_envirn_proposals_report_jan2009.pdf)

American Petroleum Institute. (2010, June 14). *Hydraulic Fracturing*. Retrieved from:  
<http://www.api.org/policy/exploration/hydraulicfracturing/>

Andrews, Anthony, Coordinator. (2009, Oct 30). *Unconventional Gas Shales: Development, Technology, and Policy Issues*. Prepared by the Congressional Research Service for Members and Committees of Congress. Retrieved from: <http://www.fas.org/sgp/crs/misc/R40894.pdf>  
dsf

Burdeau, Cain. (2010, March 18). EPA to Study 'Fracking' Gas Drilling Method. *ABC News*. Retrieved from: <http://abcnews.go.com/Business/wireStory?id=10141059>

Clark, Jeffrey Bossert. (2010, May 11). United States: EPA Announces Study on Hydraulic Fracturing Practices Used in Gas and Oil Production On March 18, 2010, United States Environmental Protection. *Mondaq*. Retrieved from: <http://www.mondaq.com/unitedstates/article.asp?articleid=98236>

Cusolito, Kara. (2010, June 21). *The Next Drilling Disaster?* The Nation. Retrieved from: <http://www.thenation.com/article/next-drilling-disaster>

Earthworks. *Hydraulic Fracturing of Oil and Gas Wells*. Retrieved from: <http://www.earthworksaction.org/hydrfracking.cfm>

Energy Information Administration. (2009 March). Annual Energy Outlook 2009 With Projections to 2030. Retrieved from: [http://www.eia.doe.gov/oiaf/archive/aeo09/pdf/0383\(2009\).pdf](http://www.eia.doe.gov/oiaf/archive/aeo09/pdf/0383(2009).pdf)

Environmental Protection Agency [EPA]. (2010a). *Hydraulic Fracturing*. Retrieved from: [http://www.epa.gov/safewater/uic/wells\\_hydrofrac.html](http://www.epa.gov/safewater/uic/wells_hydrofrac.html)

Environmental Protection Agency [EPA]. (2010b). *Regulation of Hydraulic Fracturing by the Office of Water*. Retrieved from: [http://www.epa.gov/safewater/uic/wells\\_hydroreg.html](http://www.epa.gov/safewater/uic/wells_hydroreg.html)

Environmental Protection Agency [EPA]. (2010c). *Hydraulic Fracturing Research Study*. Retrieved from: <http://www.epa.gov/safewater/uic/pdfs/hfresearchstudyfs.pdf>

Ground Water Protection Council and ALL Consulting (2009 April). *Modern Shale Gas Development in the United States: A Primer*. Prepared for the U.S. Department of Energy Office of Fossil Energy. Retrieved from: [http://www.netl.doe.gov/technologies/oil-gas/publications/EPreports/Shale\\_Gas\\_Primer\\_2009.pdf](http://www.netl.doe.gov/technologies/oil-gas/publications/EPreports/Shale_Gas_Primer_2009.pdf)

Horwitt, Dusty. (2010, Jan 10) *Drilling Around the Law*. Environmental Working Group. Retrieved from: <http://www.ewg.org/files/EWG-2009drillingaroundthelaw.pdf>

Lustgarten, Abrahm. (2009, Aug 25). EPA: Chemicals Found in Wyo. Drinking Water Might Be From Fracking. *ProPublica*. Retrieved from: <http://www.propublica.org/article/epa-chemicals-found-in-wyo.-drinking-water-might-be-from-fracking-825>

Lustgarten, Abrahm. (2009, June 9). FRAC Act—Congress Introduces Twin Bills to Control Drilling and Protect Drinking Water. *ProPublica*. Retrieved from: <http://www.propublica.org/article/frac-act-congress-introduces-bills-to-control-drilling-609>

Massachusetts Institute of Technology (2010 June). *The Future of Natural Gas*. Interim Report. Retrieved from: <http://web.mit.edu/mitei/research/studies/report-natural-gas.pdf>

Mulkern, Anne C. (2009, May 7). Industry Campaign Targets 'Hydraulic Fracturing' Bill. *New York Times*. Retrieved from: <http://www.nytimes.com/gwire/2009/05/07/07greenwire-industry-campaign-targets-hydraulic-fracturing-10572.html>

NYS Department of Environmental Conservation. (2009 Sept). *DRAFT Supplemental Generic Environmental Impact Statement On The Oil, Gas and Solution Mining Regulatory Program*. Retrieved from: <ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf>

ProPublica. (2010). *Hydraulic Fracturing*. Retrieved from: <http://www.propublica.org/special/hydraulic-fracturing>

Roosevelt, Margot. (2010, June 18). Gulf oil spill worsens -- but what about the safety of gas fracking?. *Los Angeles Times*. Retrieved from: <http://latimesblogs.latimes.com/greenspace/2010/06/gulf-oil-spill-bp-hydraulic-fracturing-gas-fracking-.html>

Rubinkam, Michael. (2010, April 15). Pa. Regulators Shut Down Cabot Drilling. *The Associated Press*. Retrieved from: <http://www.pressconnects.com/article/20100415/NEWS11/4150364/Pa.-regulators-shut-down-Cabot-drilling>

Seale, Rocky. (2007, June/July). Open-hole completion system enables multi-stage fracturing and stimulation along horizontal wellbores. *Drilling Contractor*. Retrieved from: [http://drillingcontractor.org/dcp/dc-julyaug07/DC\\_July07\\_PackersPlus.pdf](http://drillingcontractor.org/dcp/dc-julyaug07/DC_July07_PackersPlus.pdf)

Sorghan, Mike. (2010, Feb 19). Two Oil-Field Companies Acknowledge Fracking With Diesel. *New York Times*. Retrieved from: <http://www.nytimes.com/gwire/2010/02/19/19greenwire-two-oil-field-companies-acknowledge-fracking-w-90863.html>

Tronche, John-Laurent. (2009, June 8). *States or Feds: Who gets to regulate hydraulic fracturing?*. Fort-Worth Business Press. Retrieved from: <http://www.fwbusinesspress.com/display.php?id=10369>