

# Hydraulic Fracturing – An Introduction and Policy Considerations for States

By Brydon Ross

*Hydraulic fracturing and horizontal drilling have created new domestic energy frontiers and made the United States a net energy exporter for the first time in more than 60 years. Although the process has been used for decades to stimulate production from declining wells, new technological advancements have rapidly accelerated the development of unconventional reserves of fossil fuels that were either unknown or considered uneconomic just a few years ago. Despite the excitement over the potential economic benefits are underlying public safety and environmental concerns.*

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The scale and size of the ramp-up in production, as well as the resource estimates that have been unlocked by hydraulic fracturing, are staggering. Federal estimates of perhaps the best-known formation, the Marcellus Shale, are 141 trillion cubic feet of technically recoverable reserves. Ten years ago, the U.S. Geological Survey estimated that the Marcellus region only contained 2 trillion cubic feet of recoverable reserves.<sup>3</sup> That figure itself is hardly an insignificant sum considering that 1 billion cubic feet of natural gas can power 10,000 homes a year, but federal energy experts were off by a factor of 70 when it came to predicting the technological breakthrough that would happen only a few years later. The substantial increase in domestic natural gas supplies have led to the lowest prices for natural

gas in a decade. U.S. consumers could save \$16.5 billion on home energy bills this year with a typical household saving roughly \$145 at current prices, according to an economist with the Federal Reserve Bank of Dallas.<sup>4</sup>

Despite the excitement over the potential economic benefits are underlying public safety and environmental concerns. Many communities and advocacy groups believe that hydraulic fracturing may cause or contribute to groundwater pollution, increase harmful air emissions, increase strains on local water supplies, and could even contribute to seismic events during deep-well injection of wastewater disposal. Some states are pursuing more regulatory oversight of the drilling process to assuage these concerns, including providing more public information on the chemicals used when a well is fracked. States also face significant long-term economic considerations when setting up royalty and tax policy to capture the financial rewards of increased production. In addition, some critics worry that the substantial growth caused by hydraulic fracturing can stress the infrastructure of small communities unprepared for increased traffic, worker housing demands, and the cyclical nature of the industry.

## What is Hydraulic Fracturing?

Hydraulic fracturing is performed after a well is drilled and involves injecting large volumes of water, sand or propping agents and specialized chemicals under high pressure to fracture the formations holding the oil or natural gas. The sand or other propping agents hold the fractures open to

allow the oil or natural gas to flow freely out of the formation and into a production well. According to the U.S. Department of Energy and the Ground Water Protection Council, approximately 99.5 percent of the fracking solutions used to develop shale formations are comprised of freshwater and sand.<sup>5</sup> The remaining chemicals in fracking solutions have specifically designed and engineered purposes that vary depending on the formation. For example, some are used to prevent bacteria from corroding well structures or can contain friction-reducing additives for proppants to more effectively target a particular deposit. The use of these chemicals, however, worry public safety advocates and environmental groups because many fracking solutions contain substances like hydrochloric acid, which can be harmful to human health if consumed.

Wells used in the hydraulic fracturing process can be drilled vertically, horizontally or a combination of the two through directional drilling. Vertical segments of the well can extend beyond depths of 8,000 feet, and horizontal drilling can often occur several thousand feet away from a production pad where the well is located. Sound well construction processes are critical to protecting groundwater resources. The primary method used to prevent the migration of drilling fluids into groundwater supplies is called casing. Casing is the cementing of a steel pipe into the shale formation after a wellbore has drilled through different geologic sublevels to access the natural gas or oil. The casing must be able to withstand the pressure of the formation and prevent the drilled borehole from collapsing on itself. The specialized cement must ensure the integrity of the well's operations, as well as prevent corrosion or other factors unique to the formation.<sup>6</sup>

Fracking operations require tremendous amounts of water, depending on the size and type of formation being produced. The Environmental Protection Agency estimates that 50,000 to 350,000 gallons of water may be used to fracture one coalbed methane formation, while 2 million to 5 million gallons may be needed for one horizontal shale well.<sup>7</sup> Local surface water and groundwater supply the vast majority of fracking fluids, although some operators are beginning to develop water recycling efforts. When a formation is cracked, wastewater or flowback that contains heavy metals, salts and elements of the chemicals used in the fracking solution is produced. Typically, flowback is disposed of in permitted, deep underground injection wells or it may be discharged after treatment into surface waters to remove contaminants.<sup>8</sup>

### Environmental Concerns

Environmental advocacy groups and local communities near production areas have raised concerns that hydraulic fracturing has contaminated local drinking water with migration of flammable methane gas into wells and spills of chemical fluids into water tables. The most memorable scenes in the film *Gasland*, which is highly critical of hydraulic fracturing, were shots of homeowners igniting their faucet with a lighter because of methane concentrations in their water. The oil and natural gas industries have sharply objected to allegations of water contamination directly caused by hydraulic fracturing, and have said there is no single documented case proving causality of water contamination from the process itself. They note biogenic, or biologically generated, methane can occur naturally in the environment and can be found in local drinking water supplies when organic materials decompose over time.<sup>9</sup> Further, the industry contends any incidents related to methane well migration are from either naturally occurring methane or operator errors during well-bore casing or the cementing process itself.

Increased production of unconventional fuels also can increase ozone and smog-forming emissions. According to a September 2011 article in *The New York Times*, nearly 30 percent of all the natural gas produced in North Dakota from the Bakken Shale formation is flared, which is a deliberate burning of excess gas that is produced along with oil from wells due to a lack of pipeline infrastructure or other economic incentives to store it. Nationwide, up to 100 million cubic feet of natural gas, which could heat 500,000 homes, is flared.<sup>10</sup>

State regulators are dealing with another challenge—competing interests for water usage, especially in the drought-stricken Southwest and West. For example, the Eagle Ford shale has been a significant financial boon for what is historically a more economically depressed part of south Texas. Because of the formation's unique geology, however, water usage for fracking a single well can take up to 13 million gallons of water or three to four times as much water as is needed to develop a well in the Fort Worth area.<sup>11</sup> Industry supporters have noted a recent study by the Texas Water Development Board to assuage concerns. The study found that oil and gas drilling comprised only 1 percent of the state's overall water usage, compared to 56 percent for commercial agriculture, and that wells are rarely refracked. Critics and opponents of fracking in Texas have disputed those results because the demand for well construction is expected to expand

significantly from 2,000 wells to 25,000 wells over the coming decades. Further, concentrated pressure on the usage of freshwater aquifers during drought conditions places added stress on agriculture operations that have property rights, but not mineral rights, which allow drilling operations to tap water resources without the consent of the landowner.<sup>12</sup> To address these resource concerns, Texas law now requires hydraulic fracturing operators, beginning in February 2012, to publicly disclose the total amount of water used to develop a formation.<sup>13</sup>

### The States' Oversight Role

States historically have primary jurisdiction and oversight of hydraulic fracturing production. Regulatory action covering the practice of hydraulic fracturing began soon after the technology was developed in the late 1940s, many years before Congress passed the Clean Water Act or Safe Drinking Water Act.<sup>14</sup> The Safe Drinking Water Act requires the EPA to delegate primary enforcement to states for the underground injection and disposal of fluids or brines regarding oil and natural gas production as long as they have adopted basic federal requirements to prevent injected fluids from contaminating groundwater sources. States may choose to forego their oversight authority and instead have the EPA administer their underground injection control programs.<sup>15</sup> In addition, states may enact more stringent requirements than those found in federal law. The 2005 Energy Policy Act, made the role of state regulation more explicit. It excluded the "underground injection of fluids or propping agents (other than diesel fuels)" of hydraulic fracturing operations from requiring a federal permit under the Safe Drinking Water Act.<sup>16</sup>

### Chemical Disclosure

Several states—including Arkansas, Colorado, Texas and Wyoming—have addressed public concerns regarding the disclosure of fracking solutions used by companies when developing shale formations. Many states and private companies require operators to publicly disclose the chemical makeup of fracturing solutions on the website, *www.FracFocus.org*. Those opposed to hydraulic fracturing contend that disclosure is often a term of art in some states, and that accessing information is too burdensome or that the information does not fully explain to the public the potential health hazards of chemicals in fracking solutions. For example, well operators disclose chemical information to the Pennsylvania Department of Environmental Protection, but the

only way concerned citizens can access the entirety of those records is by scheduling an appointment and physically viewing them in person because many small producers do not also disclose information to FracFocus.<sup>17</sup>

Variances in state laws have limited the full description and amount of chemicals used in the fracking process because of industry concerns that trade secrets and proprietary information would be revealed, causing economic harm. Large oilfield services companies like Halliburton have noted that complete disclosure of all its proprietary information would cost the company \$375 million, as it has spent tens of millions of dollars in developing new fracking fluids.<sup>18</sup>

In addition, the Obama administration's advisory panel on hydraulic fracturing and other environmental groups have been critical of the format used by FracFocus because the information on the website is not available in spreadsheet format, thus limiting broad analysis, and that some chemicals that are not covered by worker safety laws are often omitted from public disclosure.<sup>19</sup> Despite these criticisms, Wyoming's disclosure law is often described as an effective example of strong state oversight, and it even served as the framework for the Bureau of Land Management's recent proposal to require chemical disclosure of fracking operations on federal land. Under the state law, companies must disclose the chemical compounds used in fracking solutions before operations begin, as well as provide the actual names of chemical additives, compound type and their concentration rates both before and after a well is stimulated. In order to protect a trade secret used in solutions, an operator must obtain approval from the state that the compound is indeed proprietary in nature.

### Moratoriums, Bans and New Regulations

Some states, like New York, have reacted strongly to slow down the development of shale deposits and have been a high-profile battleground for policy related to fracking. Former Gov. David Paterson vetoed the legislature's ban on the practice in 2009, but he issued an executive order directing further environmental review, which has essentially created a de facto moratorium until the state Department of Environmental Conservation issues a final decision. Although a 2011 draft report from the department recommended allowing fracking on private lands, Gov. Andrew Cuomo's 2012 budget did not include any additional funds for new regulatory staff signaling that the state's

review will continue for some time.<sup>20</sup> The Vermont House of Representatives in February passed a three-year moratorium on any hydraulic fracturing activities even though no producer has applied for a permit to use the technique. “I don’t think we should be fracking for natural gas in Vermont,” Gov. Peter Shumlin said in expressing his concerns about chemicals used in the process, according to the *Burlington Free Press*.<sup>21</sup>

In addition to outright prohibitions, state legislation relating to wastewater treatment, disposal and transportation has markedly increased. According to an *Associated Press* analysis, hydraulic fracturing generated roughly 10 million barrels of flowback or wastewater in the last half of 2011, with 97 percent of it either being recycled, or sent to deep underground injection wells or waste treatment plants.<sup>22</sup> Sending flowback to municipal sewage treatment plants has become increasingly worrisome for regulators in states like Pennsylvania. The Pennsylvania Department of Environmental Protection has found high concentrations of dissolved salts like bromide in treated water; the dissolved salts have proved harmful to water quality and public health. In April 2011, Gov. Tom Corbett directed that all drilling operations in the state voluntarily comply with a ban on sending flowback to wastewater treatment plants. To date, all drillers in the Marcellus Shale have complied, but the state’s unique geology is not suitably porous enough for permanent storage in deep underground injection wells.<sup>23</sup> Large and sophisticated operators are recycling large amounts of their flowback. Range Resources, for example, recycled approximately 90 percent of its wastewater in 2010 and set a goal of 100 percent for 2011.

But the economics and the sheer volumes of flowback have caused producers to look for disposal options out of state. During the last half of 2011, the amount of Marcellus Shale flowback injected into deep reservoirs tripled, with much of it being sent to wells in Ohio. A series of high-profile earthquakes in northeastern Ohio from Christmas 2011 to New Year’s Day near well sites have raised the specter of potentially increasing seismic activity when injecting thousands of gallons of water in reservoirs at high pressure. In response to public concerns, Ohio Gov. John Kasich shut down wastewater injection within five miles of the well where the earthquakes were taking place. Ohio state officials have pointed out that 176 wells have been operating since the mid-1980s without any significant incidents, but that well activity near a fault line likely caused pressure to build, which triggered the

seismic activity.<sup>24</sup> Legislation introduced in both Maryland and New Jersey would ban the shipment and treating of wastewater from fracking operations in the nearby Marcellus region, further pressuring industry to invest in recycling efforts.

### New Economic Considerations

Expanded drilling has given state policymakers more than just environmental questions to ponder. Newfound revenue from the growth has filled state coffers and rejuvenated economic activity despite the nationally weak recovery. In February 2012, the Pennsylvania legislature approved legislation that would direct more than \$200 million a year in shale impact fees to local communities and counties from drilling in the Marcellus region.<sup>25</sup> Some critics of the deal claim that money was left on the table and that more favorable terms could have been negotiated for the state and local communities. They warn against the cyclical boom-bust potential the industry could have on small communities when prices drop or when local services and roads become overwhelmed by increased traffic and growth. Many fracking critics argue that the industry’s growth highlights the deficiencies between severance tax and royalty policies of states with mature extraction industries and those beginning to experience the shale wave. Several states outside traditional production areas have property tax laws dating back to the 1930s. For instance, some states may have an income tax on wages, but no laws to tax the royalties a landowner receives from allowing oil and gas operations on their property.<sup>26</sup> Instituting new fees or new taxes requires a careful balancing act by policymakers to harness the economic benefits of shale production without creating voter backlash or negatively impacting jobs dependent on natural gas prices.

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### Notes

<sup>1</sup>The Economic and Employment Contributions of Shale Gas in the United States. IHS Global (USA) Inc. December 2011, p.5.

<sup>2</sup>“Oil and Gas Boom Lifts U.S. Economy.” Russell Gold, *Wall Street Journal*. February 8, 2012.

<sup>3</sup>2012 Annual Energy Outlook, Early Release Overview. Energy Information Administration, p. 9.

<sup>4</sup>“Shale Gas \$100 Billion Savings to U.S. Exceed Tax Cuts: Energy.” Mark Chediak, *Bloomberg*. January 26, 2012.

<sup>5</sup>Modern Shale Gas Development in the United States: A Primer. U.S. Department of Energy Office of Fossil Energy, April 2009, p. 61.

<sup>6</sup>“Hydraulic Fracturing Operations – Well Construction

and Integrity Guidelines.” API Guidance Document HF1, First Edition, October 2009, pp. 2–5.

<sup>7</sup> Environmental Protection Agency, Office of Research and Development Hydraulic Fracturing Study Fact Sheet. June 2010. <http://www.epa.gov/owindian/tribal/pdf/hydraulic-fracturing-fact-sheet.pdf>.

<sup>8</sup> “Hydraulic Fracturing and Safe Drinking Water Act Issues.” Mary Tiemann, Adam Vann. Congressional Research Service, April 15, 2011, p. 1

<sup>9</sup> Colorado Oil and Gas Conservation Commission Fact Sheet <http://cogcc.state.co.us/library/GASLAND%20DOC.pdf>.

<sup>10</sup> “In North Dakota, Flames of Wasted Natural Gas Light the Prairie.” Clifford Krauss, *New York Times*. September 26, 2011.

<sup>11</sup> “Worst Drought in More Than a Century Strikes Texas Oil Boom.” Joe Carroll, *Bloomberg*, June 13, 2011.

<sup>12</sup> “Oil’s Growing Thirst for Water.” Russell Gold and Ana Campoy, *Wall Street Journal*. December 5, 2011.

<sup>13</sup> Texas Administrative Code, Title 16, Chapter 3, Rule §3.29.

<sup>14</sup> Testimony of Gerry Baker, Associate Executive Director of the Interstate Oil and Gas Compact Commission. Before the House Committee on Natural Resources, June 18, 2009, p. 2.

<sup>15</sup> Tiemann, Vann, p.7.

<sup>16</sup> The Energy Policy Act of 2005 (PL 109-58), Section 322.

<sup>17</sup> “More States Ordering Disclosure of Fracking Chemicals.” Andrew Maykuth, *Philadelphia Enquirer*. January 22, 2012.

<sup>18</sup> “Wyoming Natural Gas Rules Point the Way for Public Disclosure of Chemicals Used.” Mike Soraghan, *Greenwire*. December 20, 2010.

<sup>19</sup> “BLM Proposes More Disclosure than Most States.” Mike Soraghan, *Greenwire*. February 6, 2012.

<sup>20</sup> “Cuomo: No Hydrofracking Funds in State Budget.” Jon Campbell, *Ithaca Journal*. January 16, 2012.

<sup>21</sup> “Vermont Legislature Considers Ban on Hydrofracking.” Terri Hallenbeck, *Burlington Free Press*. January 26, 2012.

<sup>22</sup> “Marcellus Shale Gas Drillers Recycling More Waste.” Kevin Begos, *Associated Press*. February 17, 2012.

<sup>23</sup> “PA Drillers Told to Stop Sending Wastewater to Treatment Plants.” Andrew Maykuth, *Philadelphia Inquirer*. April 20, 2011.

<sup>24</sup> “Company Cautions Linking Well, Ohio Quakes.” Julie Carr Smith, *Columbus Dispatch*. January 12, 2012.

<sup>25</sup> “Pennsylvania Senate Approves Plan to Let Counties Tax Natural Gas Wells.” Romy Varghese, *Bloomberg*. February 7, 2012.

<sup>26</sup> “Some States Unprepared for Shale Energy Boom.” Dennis Cauchon, *USA Today*. February 23, 2012.

## About the Author

**Brydon Ross** joined CSG in January 2012 as the director of energy and environmental policy after nearly 11 years in Washington, D.C. He worked for the Senate Committee on Environment and Public Works as well as several U.S. senators across the Southeast on energy, natural resource development, environment, wetlands and agricultural policy issues. Most recently, he served as the director of government relations for the Association of Oil Pipe Lines (AOPL) before joining the staff of CSG.

Brydon is a graduate of the U.S. Naval War College with an M.A. in National Security and Strategic Studies and is a graduate of Centre College in Danville, Ky., with a B.A. in History.