Center for American Progress

Drilling Down on Fracking Concerns

The Potential and Peril of Hydraulic Fracturing to Drill for Natural Gas

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Introduction

A widely used oil-and-gas drilling technique, hydraulic fracturing, is spreading rapidly to develop vast reserves of natural gas trapped in deep underground shale formations. Hydraulic fracking, however, is coming under more rigorous oversight by the press and state and federal agencies because of its contribution to air and water pollution. This attention is welcome to ensure that health and safety will be protected if gas is to be more widely used as a cleaner replacement for coal in electric plants and foreign oil as a transportation fuel. We must also more accurately measure carbon dioxide and other pollution from the combustion of gas compared to coal and oil.

This issue brief explores the ecological and economic issues of "fracking," as it is increasingly coming to be known in the areas of the country where natural gas is tapped due to the technology. Cutting to the chase, our conclusion is this—hydraulic fracturing needs to be done carefully and be well-monitored, with particular attention paid to the full scope of carbon dioxide released into our atmosphere to gauge accurately the consequences of global warming due to the expanded use of natural gas.

What is fracking and what does it do and cause?

Not so long ago, the subject of hydraulic fracturing of oil and gas wells to stimulate production from deep rock formations was largely the province of petroleum engineers, drilling companies, and a small number of environmental activists.

No more. The rapid expansion of shale gas wells because of hydraulic fracturing is now the subject of widespread nationwide attention. Combined with advanced horizontal drilling techniques, which open up new ways to tap natural gas reserves, hydraulic fracturing (also called hydrofracking, or simply fracking) opens up vast new natural gas

reserves from the Barnett Shale formation in Texas to the Marcellus Shale that runs from the northeast tip of Tennessee to upstate New York. With the inclusion of newly accessible shale gas plays, the United States now boasts estimated reserves of gas that could last a century or more.

As a result, natural gas is becoming an increasingly important component of the U.S. electricity generation and energy mix, sometimes touted as a potential magic bullet for moving us to a lower-carbon future. But the environmental consequences of the surge in gas drilling using hydraulic fracturing mean we should be cautious—we should continue to push for a diverse portfolio of cleaner energy while also exploring the safest ways to tap these new reserves using hydraulic fracturing.

The process, which involves injecting huge volumes of water mixed with sand and chemicals deep underground to fracture rock formations and release trapped gas, is becoming increasingly controversial, with concerns about possible contamination of underground drinking water supplies alongside revelations of surface water contamination by the wastewater that is a byproduct of drilling.

Concerns about this technique led late last year to a partial moratorium in New York state on new drilling permits that allow fracking. Nationally, advocates want to repeal a 2005 congressional exemption of fracking from oversight under the Safe Drinking Water Act. Many activists also want to require drilling companies to publicly disclose the chemicals they use, as other industries do under the Community Right to Know law. Industry historically resists such calls, though a number of companies have recently dropped their opposition, saying they will publicize the chemicals they use.

These natural gas operations also produce smog-forming pollutants, contributing to air pollution problems in places such as western Wyoming and the Fort Worth area. Indeed, natural gas wells produce so much air pollution that smog in the area around Pinedale, Wyoming is sometimes as bad as in Los Angeles. And these shale gas wells can release fugitive methane, which is a potent global warming pollutant.

In a recent investigation, for example, *The New York Times* reported on rivers and waterways that serve public water systems in Pennsylvania being contaminated with naturally occurring radioactive materials, such as radium, as a result of drilling activities. The series has also raised serious questions about the adequacy of oversight by state and federal agencies including the Environmental Protection Agency. In its first story, the newspaper reported:

> With hydrofracking, a well can produce over a million gallons of wastewater that is often laced with highly corrosive salts, carcinogens like benzene and radioactive elements like radium, all of which can occur naturally thousands of feet underground. Other carcinogenic materials can be added to the wastewater by the chemicals

> used in the hydrofracking itself. While the existence of the toxic wastes has been reported, thousands of internal documents obtained by The New York Times from the Environmental Protection Agency, state regulators and drillers show that the dangers to the environment and health are greater than previously understood.

In its second story, the newspaper reported that even though the industry is moving toward more recycling of drilling wastewater, public health dangers remain:

> Nor has recycling eliminated environmental and health risks. Some methods can leave behind salts or sludge highly concentrated with radioactive material and other contaminants that can be dangerous to people and aquatic life if they get into waterways.
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> Some well operators are also selling their waste, rather than paying to dispose of it. Because it is so salty, they have found ready buyers in communities that spread it on roads for de-icing in the winter and for dust suppression in the summer. When ice melts or rain falls, the waste can run off roads and end up in the drinking supply.

And in its final report, the newspaper was highly critical of EPA investigations into the possible environmental harms from fracking:

> More than a quarter-century of efforts by some lawmakers and regulators to force the federal government to police the industry better have been thwarted, as E.P.A. studies have been repeatedly narrowed in scope and important findings have been removed.

Responding to the revelations by *The New York Times* series, Rep. Edward J. Markey (D-MA), the ranking Democrat on the House Committee on Natural Resources, called for EPA to conduct an investigation.

These disturbing revelations raise the prospect that natural gas production could pollute our rivers and streams. The natural gas industry has repeatedly claimed that fracking can be done safely. We now know we need a full investigation into exactly how fracking is done and what it does to our drinking water and our environment. Americans should not have to consume radioactive materials from their drinking water as a byproduct of natural gas production.

In response, EPA administrator Lisa Jackson told Congress she would travel to Pennsylvania to prod EPA officials there about the charges. "We intend to do our jobs," she said. The EPA is currently designing a two-year study of fracking's effects on the environment and health, but *The New York Times* reported in its third article that some areas of inquiry had been dropped because of pressure from the oil and gas industry.

Separately, the Pennsylvania Department of Environmental Protection released the results of 2010 testing of seven rivers for radioactivity, reporting that "all samples showed levels at or below the normal naturally occurring background levels of radioactivity." The EPA has asked the agency to conduct more tests.

Lessons from Pennsylvania

Pennsylvania is an excellent example of the promise and peril of fracking. The size and extent of the natural gas development boom in Pennsylvania—57,469 producing wells at the end of 2010, up by more than 8,000 in four years—poses new challenges and necessitates new safeguards to protect public health and the environment.

Examples of the problems stemming from the boom in hydraulic fracturing include the contamination of drinking water in Dimock Township, a mud spill in Sproul State Forest, and a 32-mile fish kill in Dunkard Creek that wiped out at least 16 species of freshwater mussels and 18 species of fish.

Total dissolved solids, or TDS, a measure of all elements dissolved in water including carbonates, sulfates, and nitrates are found in high concentrations in fracturing wastewater. Pennsylvania's waterways cannot dilute all of these pollutants. In 2008 and 2009, TDS levels exceeded drinking water standards in the Monongahela River, the source of drinking water for some residents of Pittsburgh. Pennsylvania's water treatment plants are not equipped to remove them from the water supplied to residents.

Recognizing this problem, the state imposed more stringent TDS discharge limitations in 2009 to end the practice of unlimited discharges of drilling waste to rivers and streams. An even higher standard was applied specifically to the natural gas sector that took effect in August 2010. It seeks to ensure that TDS in streams in Pennsylvania do not exceed the safe drinking water standard of 500 milligrams per liter.

Still needed, however, is a requirement that drillers track their wastewater from the time it is withdrawn to the time it is disposed. There should be full public transparency, including the disclosure of chemicals used, and their amounts. As *The New York Times* detailed, there is also inadequate testing for radium and most of the municipal and industrial plants that treat drilling wastewater are not designed to remove such pollution.

In 2009, ProPublica, a nonprofit investigative journalism group, found similar problems in New York. ProPublica reported that the state's Department of Environmental Conservation tested 13 samples of drilling wastewater and found "they contain levels of radium-226, a derivative of uranium, as high as 267 times the limit safe for discharge into the environment and thousands of times the limit safe for people to drink."

Clearly, water testing needs to be done on a more regular and thorough basis. Similarly, we must conduct rigorous pre-drilling testing near well sites and inspections of well sites at every phase of the drilling process. In addition, regular testing of drinking water needs to be done not just for radium and dissolved solids but also for methane, chlorides, and metals.

With the right technology, fracking can be cleaner

Fracking requires enormous amounts of water, up to 5 million gallons of water for a single well. After the fracturing procedure completes, 15 to 80 percent of the fluid returns to the surface as waste water, often contaminated by fracturing chemicals and subsurface contaminants including toxic organic compounds, heavy metals, and naturally occurring radioactive materials. Untreated, this wastewater can have detrimental environmental and health effects.

While studies find that natural gas drilling releases dangerous pollutants into air and water, drilling and fracking do not have to be so dirty. Advanced technologies to scrub air of emissions and purify water produced at the well-head are available and ready to deploy. Working with energy companies, the EPA's Natural Gas Star Program supports techniques to capture and reuse methane, a greenhouse gas that traps heat at 23 times the rate of carbon dioxide. And despite the claims of some in the gas industry, those technologies can be employed at little or no cost.

Currently, the most common practice for disposing of wastewater is to inject untreated water back into empty wells. Some drilling companies evaporate wastewater in large ponds, leaving condensed waste products that must then be trucked to treatment plants or to other states that have less stringent waste treatment rules. Wastewater is also often reused or just dumped into waterways. All those methods have environmental risks and costs.

But a number of companies are developing and deploying cost-effective water purification systems to make "flow back" waste water clean and reusable. 212resources Corp., headquartered in Salt Lake City, provides water recovery services with a patented vapor compression, turbulent flow, and flash evaporation systems to purify a variety of wastewater constituents.

Another company, Purestream Technology, also in Salt Lake City, offers a technology that sits at the well head and treats massive volumes of wastewater, scrubbing out hydrocarbons, toxic organic compounds, heavy metals, excess oil and gas, and naturally occurring radioactive materials, leaving water that is more pure than standard EPA approved drinking water. The waste product from this method is a fraction of that of evaporation ponds, and can be easily and more cheaply trucked to a treatment plant. The pure water

resulting from this process can be evaporated back into the environment or can be safely used again in additional fracking processes, saving millions of gallons of water for more sustainable uses.

Purestream's system is now deployed by West Virginia-based PDC Mountaineer LLC, at the Marcellus Shale in Taylor County, West Virginia. The system will evaporate and purify waste water at the site of drilling. The company has also contracted with SM Energy Co. to deploy at their second Marcellus Shale site in McKean County, Pennsylvania.

Natural gas drilling can also release damaging air pollution, including volatile organic compounds such as the potent greenhouse gas methane, along with nitrogen oxides. Current practices to dispose of such air pollutants involve flaring volatile organic compounds, which only adds pollution and wastes precious fuel sources.

Purestream's system uses water and controlled exhaust pressure to reduce air pollution. This system scrubs and destroys 99 percent of smog-forming volatile organic compounds and nitrogen-oxide gases. It also reduces soot, or particulate matter. These pollutants can spark asthma attacks and other respiratory ailments.

Instead of releasing the methane and other volatile organic compounds into the air, Purestream's system mines them as a power source, using the heat generated from their combustion to power the air and water purification systems. Another company, Anguil Environmental Systems Inc., headquartered in Milwaukee, offers a similar technology, the Regenerative Thermal Oxidizer, which destroys air pollution through a process of high temperature thermal oxidation, using a mix of temperature, residence time, turbulence, and oxygen. It also reuses the thermal energy to generate itself.

The search for answers

Policymakers need to get to the bottom of the many questions relating to hydraulic fracturing, ensuring that the public health and environment are well protected from the production of shale gas. Also, a better understanding of whether switching to natural gas will produce significant reductions in carbon dioxide pollution is essential before we commit to a massive expansion of natural gas use.

The Center for American Progress advised such a cautious approach in an August 2009 report about the potential for natural gas to serve as a "bridge fuel" to a lower-carbon economy written by CAP president and CEO John Podesta and United Nations Foundation president Timothy E. Wirth. While advocating the expansion of natural gas to replace dirty coal and foreign oil, they also detailed their concerns about the toxic chemicals that fracking can employ, the release of the potent greenhouse gas methane associated with natural gas production, and air pollution problems:

> There are other legitimate public health and global warming concerns about the impacts from natural gas production. Adjacent communities are concerned about the public health impacts from the use and release of toxic substances, both naturally occurring and those used in the natural gas production process such as benzene, formaldehyde, or radioactive materials. The process also yields significant amounts of air pollution. The gas production from the Barnett Shale in the five counties near Dallas-Fort Worth creates more emissions of smog-forming compounds than motor vehicles.
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> Any proposal to incentivize the development of natural gas must also address the potential health and global warming impacts of developing this resource. It makes little sense to encourage natural gas use as a lower greenhouse gas alternative to coal or oil combustion if natural gas production yields sizeable amounts of toxic, air, or global warming pollution.

In the 2009 report, Podesta and Wirth recommend a comprehensive EPA analysis, after which state governments—or the federal government in the absence of state action—can determine appropriate measures to protect public health and the environment:

> As a first step, the EPA must undertake a comprehensive scientific analysis of the air, land, water, and global warming impacts from natural gas production, including a lifecycle greenhouse gas analysis. It should review the effectiveness of federal and state programs at protecting people, air, land, and water from gas production side effects. The EPA should also review new and emerging technologies to reduce this pollution. Based on the science, the analysis should recommend best management practices for companies and additional government safeguards that require pollution reductions.

The issue of the total carbon pollution resulting from natural gas production is a critical one. Resolving questions about it could well determine whether natural gas becomes, as Exelon Corporation CEO John W. Rowe said recently, "a genuine elixir that will deliver the cleaner energy we need to compete in the world."

But previous assumptions that gas yields half or less carbon pollution than coal are coming under new scrutiny. What is needed is a definitive new EPA study of the so-called lifecycle greenhouse gas emissions—from extraction to distribution, to use to release into the atmosphere—from natural gas, one that takes into account changing industry practices as shale gas becomes more important and better estimates of fugitive methane emissions from sources such as leaky pipes and valves.

The United States and other nations face an urgent need to reduce carbon dioxide and other global warming pollution. Already the abundance of inexpensive natural gas has led the Energy Information Administration to project that gas will be the fastest growing

source for electricity generation between now and 2035. Ample, inexpensive supplies of natural gas could reduce pollution by replacing dirty coal plants, and powering trucks and buses by gas. But it is imperative to ensure that we don't exacerbate one major public health threat while trying to solve another one.

Actions to achieve more certainty on that point include:

- Giving EPA the authority to oversee hydraulic fracturing under the Safe Drinking Water Act, and requiring full public disclosure of the chemicals used in the process under the Community Right to Know law

- Requiring drillers to track and disclose what happens to wastewater from withdrawal from wells to its disposal

- Mandating adequate tests for radioactive elements and other contaminants in wastewater and regular testing of water supplies near drill sites before, during, and after drilling, to detect contaminants

- EPA shall develop air and water emission limits based on best management practices, and the states shall enforce them. To pay for enforcement and wastewater treatment costs, gas producers should pay a very small fee per trillion cubic feet

- EPA's voluntary Natural Gas Star program to capture fugitive methane should be made mandatory for wells above a certain size. EPA reports that current participants turn a profit from selling the methane, so this will not add to producers costs

- Making a comprehensive and credible study of the lifecycle greenhouse gas emissions from the production and use of natural gas

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