

The Rush to Drill for Natural Gas: A Public Health Cautionary Tale

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Efforts to identify alternative sources of energy have focused on extracting natural gas from vast shale deposits. The Marcellus Shale, located in western New York, Pennsylvania, and Ohio, is estimated to contain enough natural gas to supply the United States for the next 45 years.

New drilling technology—horizontal drilling and high-volume hydraulic fracturing of shale (fracking)—has made gas extraction much more economically feasible. However, this technique poses a threat to the environment and to the public's health. There is evidence that many of the chemicals used in fracking can damage the lungs, liver, kidneys, blood, and brain.

We discuss the controversial technique of fracking and raise the issue of how to balance the need for energy with the protection of the public's health. (*Am J Public Health*. 2011;101:784–785. doi:10.2105/AJPH.2010.300089)

LONG BEFORE THE DISAS-

trous oil spill in the Gulf of Mexico, there have been calls for the United States to wean itself from foreign oil by exploring alternative energy sources. Nuclear power and coal have their own sets of problems; therefore, natural gas is increasingly viewed as a viable alternative to meeting US energy needs. There are trillions of cubic feet of recoverable natural gas in the Marcellus shale, for example, more than enough for the next 45 years.¹ Relying on natural gas will make it easier to meet federal air quality standards for conventional pollutants such as smog and mercury. But for the lack of effective technology, this source of energy would have been tapped long ago. However, natural gas extraction has its own set of health and environmental problems that must be assessed carefully before wholesale drilling is embraced.

Over the past decade, there has been a surge in drilling for natural gas in shale rock. For example, the Marcellus Shale, a black shale formation that lies up to 10 000 feet below ground surface extending over 54 000 square miles primarily in New York and Pennsylvania, contains between 168 trillion to 516 trillion cubic feet of natural gas.² The economic benefit of drilling for natural gas is potentially huge for landowners, states, and industry. There are estimates of more than \$500 billion in recoverable gas in Pennsylvania alone.³ Whereas in the past the thinness of the formation and tightness of the shale made drilling for and extraction of natural gas difficult and expensive, new technologies that allow for horizontal

drilling and high-volume hydraulic fracturing of shale (fracking) have made extraction much more economically feasible.

Hydraulic fracturing relies on pumping as much as five million gallons of surface water mixed with tons of chemicals and solids (e.g., sand) under high pressure to create fractures and open joints in the shale, thus releasing the flow of gas. From 2000 to 2008, the number of active gas wells drilled in New York State nearly doubled from 6845 to 13 687, and over the next decades an additional 80 000 wells could be drilled.⁴ The rush to drill without sufficient health and environmental impact studies, however, has caused concern. In response, the New York State Department of Environmental Conservation stopped issuing drilling permits so that impact studies could be conducted.⁵ Although New York State issued a moratorium, drilling continues at a fast pace in neighboring Pennsylvania, where there are more than 350 000 active and inactive gas wells. Industry estimates indicate that over the next 20 to 30 years an additional 300 000 new wells could be drilled by using fracking technology.⁶

As drilling companies are not legally required to list the chemical compounds used in fracking, it is difficult to assess the full scope of the contents of fracking fluids. However, toxic mud and fluid byproducts from the drilling and fracking as well as spills of oil and gas wastes are not uncommon. Of the more than 8600 abandoned wells in Pennsylvania in 2009 alone, taxpayers paid to plug 259 because of leaking natural gas, oil,

and acid mine drainage into the groundwater, surface water, and air.⁷ Postmineral extraction cleanup costs are substantial, including restoration of damaged or contaminated streams and soil, improper handling of wastewater disposal, and improper disposal of radioactive material and hazardous waste. In August 2010, the Environmental Protection Agency (EPA) sent letters to nine drilling companies requesting detailed information about the chemicals contained in fluids used in fracking. Such information is deemed essential to understand better the potential health and environmental effects of hydraulic fracturing.

Additionally, fracking has raised concerns regarding the way it may damage underground water supplies. No state has adequate regulations on drilling, particularly the disposal of the polluted water. Although drilling companies are expected to submit water management plans to the appropriate state agencies that oversee environmental protection, often there is little state oversight; companies are expected to self-report violations, which they do not do voluntarily. In Pennsylvania, several drilling companies have been charged with illegal water withdrawals and others have been found to be operating without permits. The state does not have a comprehensive underground water monitoring system in place, and no comprehensive data exist on spills.

Soil contamination also has not been addressed fully. Drilling sludge (a mixture that includes drilling mud and rock cuttings containing hydrocarbons, radioactive

material, and heavy metals) is brought to the surface during the drilling phase. Flowback waste fluids, a byproduct of the fracking phase, must be disposed of safely because they can potentially contaminate air and soil. Radioactive hazardous waste needs to be taken to special disposal sites. However, clandestine dumping is widely suspected, thus further jeopardizing both soil and watersheds.

Little research has been done on the potential adverse health effects of fracking. Witter et al. reviewed the available literature, which showed evidence of risk to human health ranging from the comparatively benign to the more serious.⁸ One study, based on Pennsylvania Department of Environmental Protection and the Susquehanna River Basin Commission Material Safety Data Sheets for 41 products used in fracturing operations, assessed the chemicals used in fracturing and found that 73% of the products had between 6 and 14 different adverse health effects including skin, eye, and sensory organ damage; respiratory distress including asthma; gastrointestinal and liver disease; brain and nervous system harms; cancers; and negative reproductive effects.⁹ Some of the negative health effects appeared fairly immediately after exposure whereas others appeared months or years later, as was the case with some cancers, harm to the reproductive system, or developmental effects. Of concern is that endocrine-disrupting chemicals may alter developmental pathways, manifesting decades after exposure or even transgenerationally by altering epigenetic pathways. Hydrofracking fluid and flowback fluids contain candidate endocrine disruptors, but because of the lack of disclosure by the drilling companies of the

individual chemicals with their unique Chemical Abstracts Service registry numbers used in fracking fluids, it is difficult to truly assess their potential adverse effects, and so the cumulative exposure impact is not known.

Because fracking has the potential for environmental and health harm, we advocate using the precautionary principle, which asserts that the burden of proof for potentially harmful actions rests on the assurance of safety in areas of scientific uncertainty (analogous to and partially derived from *primum, non nocere* [first, do no harm]). Inherent in the principle is that preventive action should be taken in the face of uncertainty, the burden of proof should be shifted to the proponents of an activity, alternatives to possibly harmful actions need to be explored, and there should be increased public participation in decision-making.¹⁰

In March 2010, the EPA announced that it would conduct a detailed study of the environmental and health impacts of fracking. We hope that before drilling in the Marcellus Shale becomes harmful, legislators and the natural gas industry will follow the EPA's and New York State's lead and pause to reflect on recent and past oil and gas disasters by agreeing to a moratorium on hydraulic fracturing. We argue that it would be prudent to invoke the precautionary principle before further degradation and damage to the public's health and the environment occur. The stakes are high as the disaster in the Gulf, the worst oil spill in US history to date, so visibly demonstrates. ■

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