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Hydraulic Fracturing: Considerations for Planners

By Gloria Wenman

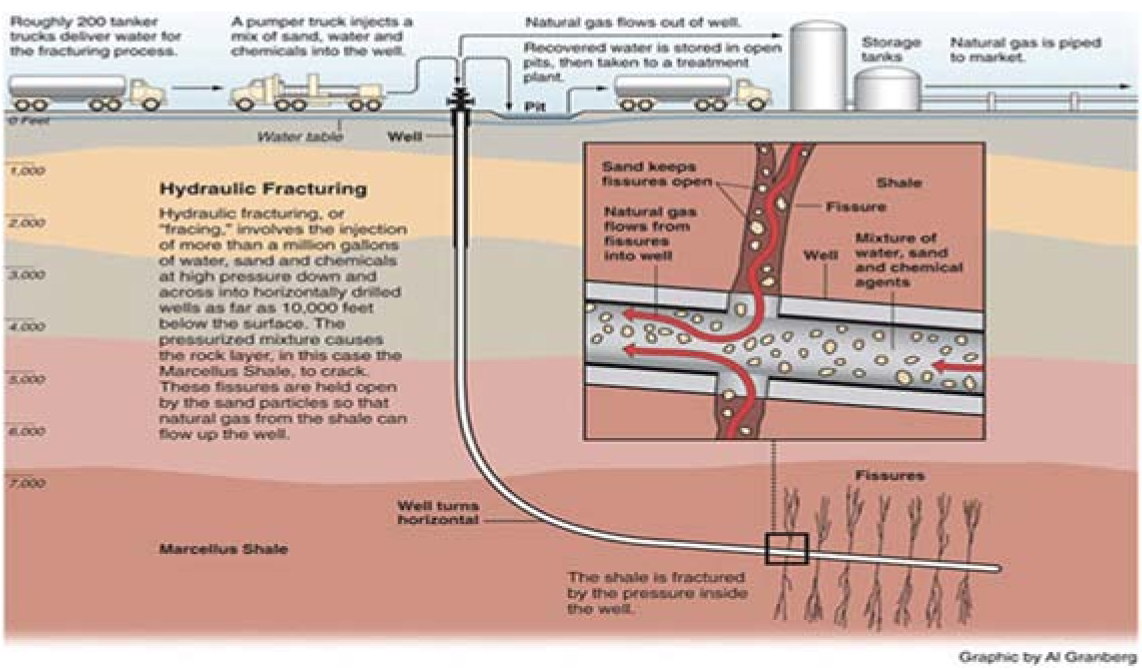
Hydraulic fracturing has been in the news of late. Some articles tout the process as the next reliable source for meeting the nation's energy needs. Others deride it as a process that poisons the environment.

The shale gas reserves tapped by hydraulic fracturing are located throughout the United States, some underlying urban areas. For that reason, more and more local governments must consider the environmental and economic impacts of hydraulic fracturing. As the experts on zoning — and therefore the possible location of wellheads and pipelines — planners should have a basic understanding of the process of hydraulic fracturing and its possible impacts on water, soil, and air, as well as local residents and businesses.

What Is Hydraulic Fracturing?

The United States Energy Information Administration (EIA) and researcher Peter Valkó define hydraulic fracturing as the insertion of long bore pipes into the ground while injecting water and chemicals under pressure. This process fractures the shale layer, allowing natural gas to escape through the pipes.

Figure 1



The hydraulic fracturing process. Graphic by Al Granberg, courtesy ProPublica (**http://www.propublica.org/special/hydraulic-fracturing-national**).

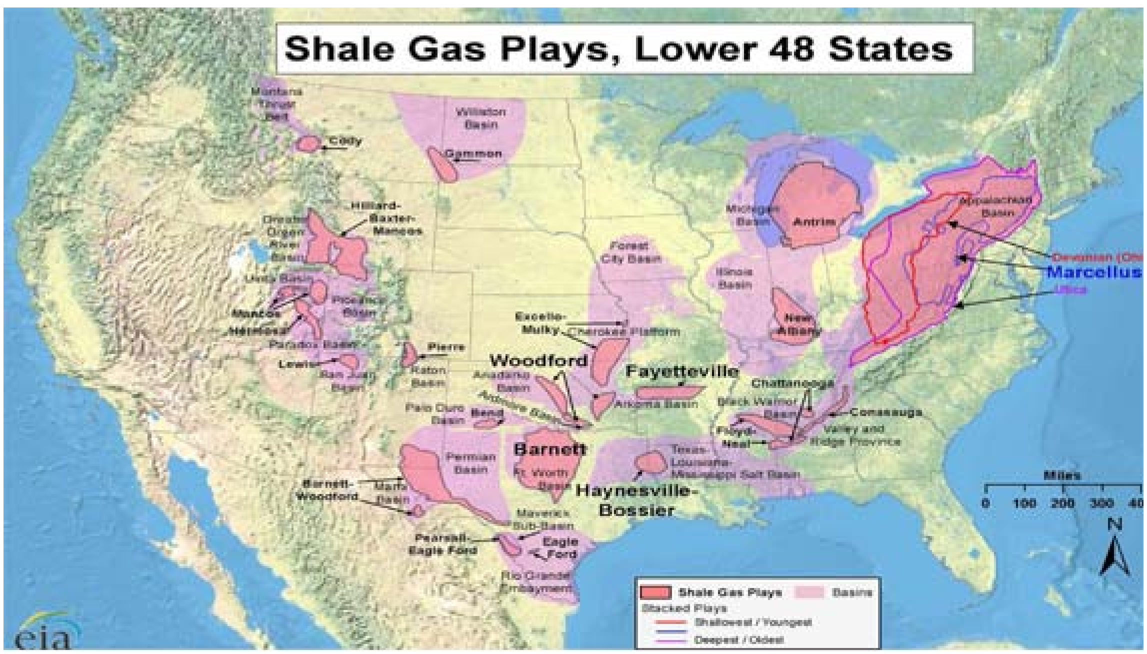
Although the process has been around for many years, new technologies have lowered extraction costs, and major energy production companies are entering the industry. Each company uses its own proprietary mix of chemicals, which vary depending upon the rock structure of the individual site.

To encourage movement to this energy source, regulatory agencies currently grant exemptions from environmental rules. With increasing energy consumption, the hope is that hydraulic fracturing will provide long-term, low-cost energy production.

Although the technology to release trapped gas has been around since the early 1900s, shale gas production has only recently become financially viable for big business. For example, the Barnett Shale hydraulic fracturing site in northeast Texas has been in operation since 2000 and now produces over 5 billion cubic feet per day of natural gas. Researcher Kenneth Barry Medlock reports that this phenomenal expansion from relatively little production by independent entrepreneurs to the big market and major players is due in part to the well-developed and competitive U.S. regulatory framework governing the transport, marketing, and minerals rights of natural gas infrastructure.

Shale production sites are located throughout the United States and the world. Often the production sites are located near the end use market. Although this cuts down on transportation and reduces greenhouse gas emissions from transport vehicles, it raises concerns about negative health impacts on nearby populations. Attorneys Barclay Richard Nicholson and Kadian Blanson report on lawsuits filed against hydraulic fracturing operators alleging contamination and pollution caused by the close proximity of collection sites, gas compressor stations, pipelines, and drills (*Heinkel-Wolfe v. Williams Production Co., LLC.*, No. 2010-43055-362 [Denton County 362nd District Court, Nov. 3, 2010]). In 2011, the United States Environmental Protection Agency requested that the federal government file a complaint in U.S. District Court for injunctive relief against a hydraulic fracturing operator, alleging imminent and substantial endangerment to health of persons and insufficient action by state and local authorities to address endangerment (*United States v. Range Production Co.,* No. 3:11-cv-00116 [ND Tex., Jan. 18, 2011]).

Figure 2



Shale production sites in the lower 48 states. Source: U.S. Energy Information Administration (May 9, 2011).

Because the widespread application of hydraulic fracturing is relatively new, the long-term environmental impacts are not well understood. Current measurements indicate that hydraulic fracturing produces fewer greenhouse gases, but researcher Robert Howarth reports that shale gas releases greater amounts of greenhouse gases over a longer period of time, with a higher proportion of emissions of methane gas than other methods of energy production such as carbon intense fuels. Local air quality can also be negatively affected by the diesel-run pumps used to push the liquids into the ground and extract the natural gas. In addition, drills, compressors, and transport trucks produce ozone emissions.

Key Regulatory Considerations

The Barnett Shale site is primarily located under an urban area — Fort Worth, Tarrant County, Texas — but is estimated to extend under a total of 19 Texas counties, with 11 of them currently hosting hydraulic fracturing operations. Considered the first urban site, the Barnett Shale site is expected to set precedents for future municipal planning of hydraulic fracturing operations, according to attorney R. Marcus Cady.

Municipalities have police powers to enact drilling ordinances, but takings claims and conflicts with higher (state and federal) authorities may impede choices, as in Texas where mineral rights have historically been given supremacy in court cases. In addition, many shale fields lie under large tracts of land and even traverse state borders, necessitating collaboration between states to ensure compatibility among state regulations. Local planners considering a hydraulic fracturing proposal will therefore have a wide range of environmental and regulatory issues to consider.

While the majority of states in the U.S. have their own system of self-government, legal professor Thomas A. Mitchell reports that "home rule" states grant legislative supremacy to municipalities within their corporate boundaries through zoning and land use regulations. In some states, home rule authority oversees drilling ordinances. These ordinances cover how far from existing structures wells may be drilled and compressor stations placed, ambient noise levels of stations, drilling of fresh water wells, landscaping and screening, saltwater disposal, height of drilling rigs, measures for controlling air and water quality, road repairs, and appointment of inspectors. Setback requirements vary, but operations can be as close as 200 feet to a habitable structure — business or residence — with rigs as high as 150 feet.

Municipalities may be held liable for the ordinances they enact that allow hydraulic fracturing by overwriting property ownership rights without just compensation, thus leading to litigation. Local governments should be aware of the legal precedents set in *Pennsylvania Coal Company v. Mahon* (260 U.S. 393, 1922) and *Keystone Bituminous Coal Association v. DeBenedictis* (480 U.S. 470, 1987) to ensure that hydraulic fracturing ordinances are within the U.S. Supreme Court's implied limitation on use and enjoyment of private property.

Key Environmental Considerations

Hydraulic fracturing raises a wide range of environmental issues, including the potential for excessive water use, soil and water contamination, air pollution, seismic hazards, and effects on views.

Water Use

Each horizontal well in the Barnett Shale uses approximately three million gallons of fresh water. Although this water is returned as "flow-back water," it is severely contaminated and must be disposed of. This amount of water use could equate to 60 percent of available water supply in regions where area residents and other businesses use 45 to 90 percent in their day-to-day activities. The mineral estate — property rights that confer to the holder the right to exploit an area for the minerals it harbors — is not limited to groundwater; this means that if groundwater is too depleted, operators can start tapping into surface water. Water shortages, rationing, and drought could easily be the end result.

In addition to flow-back water, hydraulic fracturing also returns produced water — a natural water layer that resides within the oil and natural gas reserves and rises to the surface during the fracturing process. It contains more salt particles per million than ocean water and is not usable for other purposes.

Soil and Water Contamination

Either of the returned water supplies — flow-back water or produced water — could render soil unsuitable for any type of vegetation, creating barren wastelands. Storage pits are dug and additional wells drilled to house the contaminated water until it can be properly disposed of, but water from pits and wells can seep into surrounding areas and can be flushed from pits during heavy rainstorms or flooding.

Although permit applications typically consider these issues, not all storage wells or pits are covered, nor are they assiduously maintained. In Aledo, Texas, wells were shut down because of underground leaks and aboveground spills. In Brock, Texas, transmission pipes were reported to have ruptured from brine corrosion, killing surface vegetation at plant farms.

Air Pollution

Escaping natural gas from hydraulic fracturing operations accounts for approximately 24 percent of domestic, man-made methane emissions (2 percent of greenhouse gas emissions). Exhaust emissions from hydraulic compressor stations and trucks transporting the gas contribute to the total air emissions associated with hydraulic fracturing.

Seismological Considerations

Hydraulic fracturing purposefully causes micro-quakes to release natural gas. Although research has shown that these micro-quakes do not reach the surface, there is concern that increased drilling could lead to larger quakes that could negatively affect surface structures and groundwater reservoirs.

Effect on Views

Excavation for natural gas wells changes the surface of the land, sometimes only temporarily but in some cases permanently. Trees are uprooted and hillsides restructured, roads and containing walls are built, and wellhead structures soar overhead. Views from residences and businesses are altered.

A Viable Energy Source for the Long Term?

With declining reserves of crude oil, natural gas changed from being a nuisance in the production of crude oil to a new source of domestic energy. However, legal professors Hannah Wiseman and Thomas A. Mitchell note that because of its limited supply — estimated at about 100 years — natural gas is best seen as a "bridge fuel" between reliance on foreign oil and renewable energy production sources. And as the practice of hydraulic fracturing becomes more mainstream, concerns about groundwater contamination from flow-back water, accidental chemical spills, waste disposal, air quality, the land footprint of drilling activities, pipeline placement and safety, and the amount of water used will also increase.

Any decision to shift from reliance on foreign oil to domestically produced energy is a switch to reliance on domestic water resources. In the end, it is not just the limited supply of natural gas but also the limited supply of potable water that will inform policy decisions on future energy production and use. The massive amounts of water used in the hydraulic fracturing process could lead to potential conflict of use and risks to area residents.

Referring to this interdependency between energy production and water use as the "energy-water nexus," U.S. Army Corps of Engineers attorney Ann Drobot explored the transformation of America's energy economy to one of sustainable energy. With population growth and climate change, the potable water needs of the United States (and the world) are changing. Drobot notes that sustainable water management that integrates energy and water-related policies is an important aspect of planning for hydraulic fracturing.

Planning for the Future

Hydraulic fracturing allows for extraction of a low-cost energy resource. This potential should not overwhelm the decision-making process. Adequate care should be taken to maintain air and water quality, preserve the visual landscape, and reduce other negative long-term impacts.

Municipalities will be the judges of whether to allow hydraulic fracturing to take place in their immediate environs. Discussion should include what to do when this resource is no longer available or the negative impacts too far outweigh the net gain.

Although building a larger tax base can be attractive, zoning and regulatory decisions must be based on long-term impacts rather than short-term gains. Good information is needed to determine suitable placement of potential wellheads; to require best practices among building and drilling contractors, hydraulic fracturing operators, and transportation contractors; and to understand how to manage drilling hazards. Being aware of and planning for hazards reduces the possibility of risks and enables implementation of mitigation measures.

Resources

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