FOCUS ON ENERGY

North America's New Oil Boom and the Quest for a Sustainable Energy Future

Given North America's long-running campaign to reduce fossil fuel dependence, it is ironic that the continent is witnessing a new oil and gas boom. It is all about hydraulic fracturing, or "fracking" of difficult-to-reach oil and gas formations. In the old days, an oil company drilled a well into a pool of oil and/or a bubble of gas, and the resource came flowing to the surface. This form of extraction is increasingly unproductive as the easily reached oil and gas reserves become exhausted. Abundant oil and gas remain, but tend to be trapped in rock formations, particularly shale and some coal beds, that need to be shaken up to release their treasure—hence, fracking.

The basics of fracking are not hard to grasp. Oil and gas-bearing formations, several thousand feet below the surface, are blasted under high pressure with large quantities of water, sand, and chemicals, cracking the rock to release trapped oil and gas. Increasingly the drilling is horizontal as well as vertical, travelling lengthwise through the formation, fracturing it further (Figure 2-4-1).

Fracking has led to new energy booms in locations never considered as oil regions or considered depleted of oil and gas. The Marcellus Shale area of Pennsylvania, for example, which had fewer than 20 gas wells prior to 2008, acquired 800 wells in 2009, and 5,500 in 2012. Permits were issued for another 5,500. The value of recoverable gas in Pennsylvania alone may be $500 billion. The number of wells drilled in New York State doubled to 13,687 between 2000 and 2008, with a potential for 80,000 wells total (although the state has been reluctant to issue new drilling permits pending additional study of environmental impacts). In Canada, the western provinces have embraced fracking to extract what may be 200 trillion cubic feet of natural gas in northeastern British Columbia and northwestern Alberta.

In the last several decades the fossil fuel potential of western North Dakota and eastern Montana has also become evident. The initial focus was on lignite coal, but shifted to oil production in the Bakken shale formation that underlies northwestern North Dakota (particularly around Williston), and parts of neighboring Montana, Saskatchewan, and Manitoba.

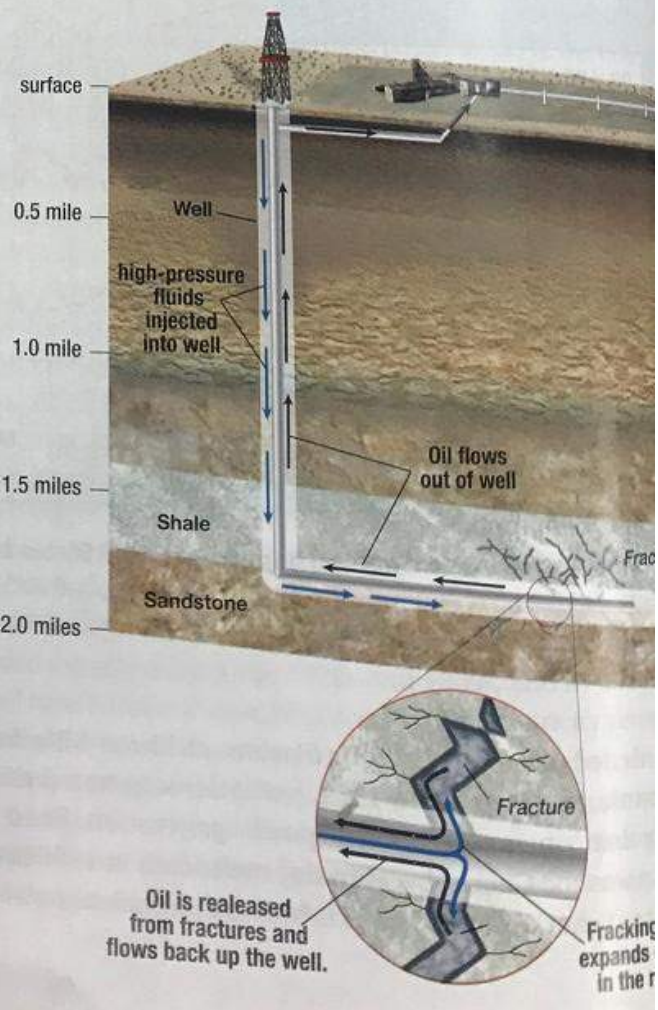
Fracking technology is used to dislodge nearly 660,000 barrels a day, making North Dakota second only to Texas as a domestic oil producer. Estimates suggest that the Bakken field may eventually produce up to 2 million barrels a day, and that the number of wells may increase from roughly 8,000 in 2012 to perhaps 40,000 when production becomes fully developed. Cities such as Williston are exploding in population, with the attendant demand for housing and public services. During the height of the recession of 2008, Williston's unemployment rate was less than 1 percent.

The problems associated with fracking may well affect the physical and settlement landscapes of production areas like the Bakken field. The problems, some known and some only worried about at this point, include:

- Water consumption: A single well may require 2–4 million gallons of water and several thousand gallons of chemicals to provide the fracturing force. Where does the water come from in dry climates, and where does the used fluid go? Used fluid that flows back to the surface often is stored in open lined pits that dot the landscape.
- Leaks: Improperly lined pits may leak dangerous contaminants into drinking water supplies. Boreholes created while drilling are lined with cement to keep water and chemicals from escaping as the well is being drilled, but cracks in the cement may allow contaminated water and gas to escape into the surroundings, including drinking water. Turn on the tap and the gas in the water catches fire!
- Fracking control: The fracking process is violent and is meant to crack rock. If the cracks expand beyond the designated rock formation and link up with other fissures and old wells, there could be "fracture communication" causing gas to migrate in unwanted and dangerous ways.

The growth of oil and gas production using new technologies like fracking should not distract decision makers from exploring renewable power sources (Figure 2-4-2), although these are geographically limited. For example, hydropower relies on a dam to back up water which then travels through turbines in the dam to generate electricity. But hydropower is terrain dependent—it needs a flowing river that can be backed up—and creating the reservoir can damage ecosystems and disrupt settlements. Wind power is cited as tomorrow's technology, but requires a windy region—for example, the western plains—and the propeller blades are a flight hazard for birds.

▼ **FIGURE 2-4-1 How fracking is done.** Fracking is an inherer process that involves coaxing oil and gas out of rock by cr formation that contains these resources.



The main problem with solar power, apart from the need for a sunny climate, is the expense of purchasing and installing equipment; electricity from fossil fuels often is still less expensive. Geothermal power makes use of hot spots close to the earth's surface that can be used as a source of steam to drive electricity-producing turbines at the surface. It is a clean energy source but limited in use to hot spots, which tend to be in tectonically active regions.

Biomass power is becoming more important. Plants, most commonly crops (corn, sugar cane), residues from forestry, and the organic materials in municipal and industrial wastes are converted into alcohol that can be used as a fuel (ethanol in North America) or methane for power generation. Biopower is largely carbon-neutral and may help slow global warming, but diverts food crops to fuel production. Nuclear power is a zero-carbon option, but disadvantages include huge start-up costs and the potentially catastrophic outcome of a plant failure.

As long as fossil fuels are available and affordable, they will continue to account for a substantial percentage of U.S. and Canadian energy consumption. As long as technologies such as those associated with fracking can be deployed in a cost-effective manner, creating new oil booms, the incentives to develop different power sources will be reduced. But as the connection between carbon-based pollutants and global warming is clarified, and the environmental impacts of hydraulic fracturing become apparent, the allure of a "fracked" energy landscape may be diminished.

Sources: U.S. Energy Information Administration, *Energy in Brief*, http://www.eia.gov/energy_in_brief/article/foreign_oil_dependence.cfm.; U.S. Department of the Interior, "Renewable Energy Sources in the United States," *National Atlas of the United States*, http://www.nationalatlas.gov/articles/people/a_energy.html. For additional reading, see also H. Jacoby and S. Paltsev, "Nuclear Exit, the US Energy Mix, and Carbon Dioxide Emissions," *Bulletin of the Atomic Scientists* 69 (2013): 34–43; and D. LePoire, "Exploring New Energy Alternatives," *The Futurist*, September/October 2011, 34–38.

▼ **Figure 2-4-2 Alternative energy possibilities in the United States.** Oil and gas hardly represent the only options available to the American energy-consuming public. These maps show where alternative energy options can best be deployed.
Source: Adapted from United States Department of the Interior, "Renewable Energy Sources in the United States," *National Atlas of the United States*. http://www.nationalatlas.gov/articles/people/a_energy.html