**Fracking’s Future**

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SUPPLIES OF NATURAL GAS now economically recoverable from shale in the United States could accommodate the country’s domestic demand for natural gas at current levels of consumption for more than a hundred years: an economic and strategic boon, and, at least in the near term, an important stepping-stone toward lower-carbon, greener energy.

But even though natural gas is relatively “clean”—particularly relative to coal burned to generate electricity—the “fracking” process used to produce the new supplies poses significant environmental risks. We must ensure that procedures and policies are in place to minimize potential damage to local and regional air quality and to protect essential water resources. We need to make sure that extraction of the gas (consisting mainly of methane, with small amounts of other gases) from shale and its transport to market does not result in a significant increase in “fugitive” (*inadvertent or accidental)* emissions of methane (CH4)—which is 10 times more powerful as a climate-altering agent, molecule per molecule, than carbon dioxide (CO2, the most abundant greenhouse gas). Further, we will need to recognize from the outset that cheap natural gas may delay the transition to truly carbon-free, sustainable solar- and wind-energy supplies that remain crucial in light of our worsening climate-change crisis

**The Gas Gift**

Lower-priced natural gas has had important consequences for the U.S. economy. Approximately one-quarter of primary energy (mainly coal, gas, oil, nuclear, and hydro) consumed in the United States in 2011 was supplied by natural gas. Electricity generation accounted for 31 percent of total natural-gas demand, followed by consumption in the industrial (28 percent), residential (19 percent), and commercial (13 percent) sectors. Natural gas is used as an industrial energy source in manufacturing products ranging from steel and glass to paper and clothing. It is the raw material for fertilizer, paints, plastics, antifreeze, dyes, photographic film, medicines, and explosives. More than half of all commercial establishments and residences are heated using gas, which is widely deployed as well for cooking and as fuel for water heaters, clothes driers, and other household appliances. Consumers have benefited directly from lower gas-utility bills, and industrial customers have benefited by switching fuels—as have chemical and other processors that use gas as a feedstock. Abundant, cheap natural gas has been of general benefit to electric-utility customers as power suppliers have substituted it for coal to fire their generators.

The shift from coal to gas in the electricity sector has also yielded *(produced)* an environmental bonus—a *significant* reduction in emissions of CO2, because CO2 emissions *per unit of electricity generated* using coal are more than double those produced using gas. Approximately half of U.S. electricity was produced using coal in 2005, but by last March, coal’s contribution had dropped to an unprecedented *(never done or known before)* low of 34 percent. Meanwhile, the U.S. Energy Information Administration (EIA) reported that domestic emissions of CO2 during the first quarter of 2012 fell to the lowest level recorded since 1992. An ancillary (*providing something additional to the main function)*  benefit of the coal-to-gas switch has been a significant reduction in emissions of sulfur dioxide, the cause of acid rain, because many of the older coal-burning plants selectively idled *(not having much activity)*by the price-induced fuel switch were not equipped to remove this pollutant from their stack gases.

**Supply and Demand**

An even larger opportunity may lie in exports. Natural-gas prices in Europe and Asia were five to seven times those in the United States during the first half of 2012; Japan is an especially eager consumer, given the wholesale closure of its nuclear-electric generating capacity in the wake of the Fukushima earthquake, tsunami, and power-plant crisis in March 2011. But exports require multibillion-dollar investments in facilities for liquefaction of gas and in the ports through which liquefied *(making something a liquid)* natural gas (LNG) can be shipped. Exxon Mobil Corporation, the largest producer of natural gas in the United States, has taken steps to form a $10-billion partnership for LNG exports. If this and other investments proceed, and the prices realized for LNG are high enough to justify further shale-gas drilling, the U.S. economy could benefit from significant energy exports—and the importing countries might also realize environmental benefits. China, where coal is the principal fuel source, could profit in particular: a cleaner source of energy would mean less local pollution from coal (including emissions of particulates, sulfur, mercury, etc.). And the global environment would benefit overall from a reduction in—or lessened growth of—CO2 emissions. (China became the leading source of such emissions in 2006.)

To date, then, we can say conclusively that a shift to natural gas from coal has changed the U.S. energy system in ways that yield economic and environmental gains. But there are serious environmental challenges associated with freeing that gas from the shale and distributing it to consumers.

**A Fracking Primer**

THE FIRST STEP in extracting gas from shale involves drilling vertically to reach the shale layer, typically a kilometer or more below the surface. Drilling then continues horizontally, extending a kilometer or more from the vertical shaft, and the vertical and horizontal components of the well are lined with steel casing, cemented in place. The horizontal extension of the casing is then perforated, using explosives; thereafter, water, carrying sand and proprietary chemicals, is injected into the well at high pressure. The water encounters the shale through the perforations, generating a series of small fractures in the rock (hence the nickname, “fracking”); the sand in the water keeps the cracks open, while the chemicals enhance release of gas from the shale. The injected water flows back up to the surface when the pressure in the well is released following completion of the fracking procedure. Then the well starts to produce natural gas.

As many as 25 fracture stages (per horizontal leg) may be involved in preparing a single site for production, each requiring injection of more than 400,000 gallons of water—a possible total of more than 10 million gallons before the well is fully operational. A portion of the injected water flows back to the surface, heavily contaminated with the fracking chemicals and others it has absorbed from the shale. Depending on the local geology, this “return water” may also include radioactive elements.

A fraction of the contaminated water that returns to the surface is recycled and reinjected into the well to facilitate the next phase of the fracking process. But a larger proportion is stored temporarily in lined ponds on site for eventual transfer (most commonly by truck) to conventional water-treatment facilities. Care must be exercised to protect groundwater from spillage and to guard against potential leakage from the ponds. Moreover, the facilities to which the contaminated water is eventually transferred may be ill-prepared to deal with the challenges posed by its unusual chemical composition; for instance, conventional treatment facilities are not equipped to deal with radioactive materials—which under the circumstances could be transferred to the water bodies receiving the treated effluent.

Finally, careless drilling and production from fracked wells can result in fugitive emissions of methane from the shale below. Such inadvertent releases of methane could more than offset the advantages otherwise realized by reducing emissions of CO2 through substituting natural gas for other fuels.

**Homework:**

In preparation for the Socratic seminar, select the three strongest pieces of evidence *for* fracking and the three strongest pieces of evidence *against* fracking. Then, answer the following questions in complete sentences.

1. What do you think is the strongest piece of evidence for fracking? Why?
2. What do you think is the strongest piece of evidence against fracking? Why?
3. Do you think we should allow fracking in New York? Why or why not?