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Bridge or Crutch?

LAST WEEK, THE U.S. ENERGY INFORMATION ADMINISTRATION (EIA) REPORTED THAT THE COUNTRY produced more crude oil than it imported for the first time in two decades.* Over the past 5 years, the United States has reduced its dependence on imported oil by nearly 50%, largely through the use of hydraulic fracturing ("hydrofracking") to tap into oil resources in shale rock in the northern Great Plains. The United States is now also the world leader in shale gas production: 39% of domestic gas supplies are derived from this unconventional resource.† Although this change in the nation's energy portfolio is welcome news, scientists and policymakers need to be wary of complacency.

The development of home-grown energy has a number of clear benefits. Beyond the obvious positive impacts on the balance of payments, domestic jobs, and reducing national security concerns, inexpensive domestic natural gas is less of an environmental concern than other fossil fuels for electricity generation. For example, by converting coal-fired power plants to ones that run off of natural gas, mercury pollution is avoided. In addition, for the same amount of energy production, natural gas emits less CO_2 when burned than either oil or coal, thus mitigating some global warming.

However, questions remain as to the net impact of the switch to natural gas. Hydrofracking is a consumptive use of water, and the disposal of that water deep underground has been linked to an uptick in small to moderate earthquakes.‡ To truly compare the emissions from burning natural gas to other solutions, one must accurately account for CO_2 gas that is inadvertently released to the atmosphere in the production process. Scientists have been quick to constrain this contribution to climate warming using a variety of approaches, with the conclusion that the gas lost during production is less than 0.5%.§ Although such emissions are not significant enough to change the conclusion that natural gas has a lower CO_2 footprint than coal or oil, the fugitive gas problem should be eliminated with better technology. Furthermore, every shift in the energy marketplace has global reactions. The change to gas at the expense of coal in the United States increases the amount of coal available for export. The important question is, what is the net change in the global load of mercury and CO_2?

It is unknown how long the U.S. gas and oil booms will continue. Wells drilled into discontinuous shale rock formations peak in their production after the first year and then decline rapidly. The formations are not sufficiently permeable to allow free flow of the hydrocarbons through naturally existing pore spaces, and only artificially induced fractures provide access to fluids. Predictions of when this resource will be depleted have been notoriously unreliable, because as technology advances and prices increase, it will be possible to produce fossil fuels that were previously technically or economically not accessible. Alternatively, we could deplete domestic gas rapidly and become dependent for our energy needs on China, ranked number 1 among 41 nations assessed for future technically recoverable shale gas resources (according to the EIA).

Most important, the current energy bonanza should not impede a rapid transition to a renewable energy future. Renewable energy technologies can retain the same benefits of the current gas boom, but they have clear global benefits as well. Some of the renewable technologies under development are distributed and individualized, such as personal solar cells with power storage, which are far more suited to the quarter of the world that has no access to electricity. However, if the developed world does not bring these technologies to market, they will not be available to anyone. Natural gas has been touted as a bridge to our renewable energy future. Let's make sure it is indeed a bridge and not a crutch.

— Marcia McNutt

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*www.eia.gov/forecasts/steo/pdf/steo_full.pdf. †www.eia.gov/todayinenergy/detail.cfm?id=13491&src=Natural-b2. ‡W. L. Ellsworth, *Science* **341**, 1225942 (2013); R. D. Vidic *et al.*, *Science* **340**, 1235009 (2013). §D. T. Allen *et al., Proc. Natl. Acad. Sci. U.S.A.* 10.1073/pnas.1304880110 (2013).

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