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THE GREEN SIDE OF FRACKING

ISSUE SNAPSHOT

- While little doubt remains about the positive impacts of fracking in lowering energy costs and providing economic opportunity to regions of the United States rich in shale oil and gas, some question whether its environmental risks outweigh those benefits.
- In fact, a review of the literature shows fracking contributed significantly to the 15 percent fall in carbon emissions from power generation between 2007 and 2013. While fracking processes could lead to some increase in methane emissions, the net impact is positive for the climate and for air quality overall.
- Fracking itself poses little risk of groundwater or surface water contamination, but there is some risk of contamination from ancillary extraction activities. Nonetheless, EPA reviews have documented that actual cases of contamination are exceedingly rare, as are demonstrated examples of fracking processes having any appreciable impact on freshwater availability.

INTRODUCTION

Originally patented in 1949, hydraulic fracturing – known colloquially as "fracking"[1] – is a process to recover oil and gas from shale rock. In the fracking process, water, sand and other materials are pumped deep below the surface, where the pressure from opens small fractures in the shale rock that allow the oil and gas within to be extracted more easily. While the fracking process has been in use for more than 75 years, it is only within the last 10 years that refinements in the process, combined with other technologies (such as horizontal drilling), have made it economical to recover significant quantities of oil and gas from shale.

As with many environmental issues, the debate over hydraulic fracturing is often framed as a conflict between what's good for the economy and what's good for the environment.

The economic case for fracking is strong. According to a recent analysis by the Brookings Institution, fracking has been responsible for annual declines in residential natural gas bills of $13 billion[2] a year between 2007 and 2013, an average savings of $200 a year per household. Analysis by IHS Inc.'s Cambridge Energy Research Associates (IHS CERA) found that, in 2012, the fracking-led energy boom contributed $283 billion to U.S. gross domestic product, an increase of more than $1,200 in income per household.[3]

But do these economic benefits necessitate sacrificing environmental quality? The answer, in brief, is no. Many of the claimed environmental harms from hydraulic fracturing do not stand up to scrutiny, while other concerns can be managed and limited by effective oversight. Fracking is not only an economic boon, but it is also a net positive for the environment.

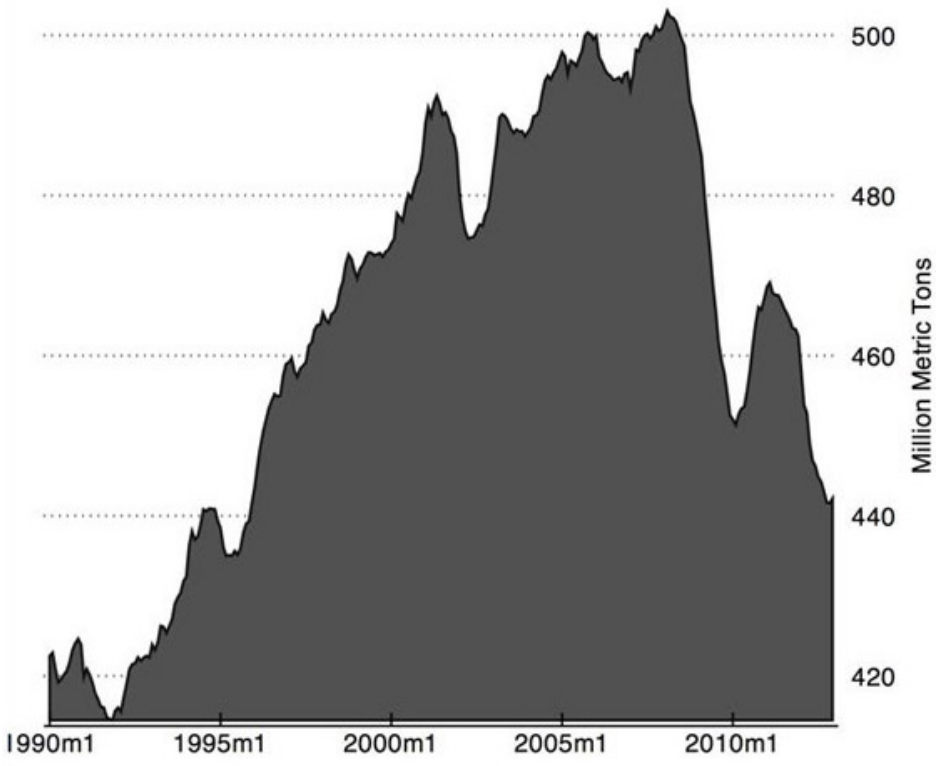
CLIMATE EFFECTS OF FRACKING

U.S. greenhouse gas (GHG) emissions have fallen significantly in recent years. U.S. GHG emissions in 2013 were lower than in 1995, and per-capita emissions are comparable to emissions levels in the mid-1960s.

While some of this decline is no doubt due to the 2007 to 2009 recession and its aftermath, emissions declines have continued into the recovery. U.S. emissions declined faster and farther than almost any other country. Emissions from power generation fell 15.4 percent between 2007 and 2013.[5]

Analysis from Yale Climate Connections concluded that, while there were multiple factors in the emissions decline,

FIGURE I: U.S. ANNUAL CARBON EMISSIONS FROM ENERGY



SOURCE: Yale Climate Connections analysis of U.S. Energy Information Administration data[4]

"the transition from coal to natural gas for electricity generation has probably been the single largest contributor." Other studies have found a smaller effect from fuel switching, but still a substantial one.[6]

This transition from coal electricity to natural gas has been enabled largely by the decline in natural-gas prices due to fracking. After reaching highs of more than $12 per thousand cubic feet in June 2008, the price of natural gas for electricity fell rapidly to less than $5 one year later, and ultimately fell below $3 in August 2012.[7] Prices have since rebounded somewhat, but even at current levels, fracking has made natural gas cost-competitive with coal. In 2005, 50 percent of America's electricity came from coal, compared with 19 percent from natural gas. Today, coal's share of the power market has fallen to 36 percent, while natural gas increased to 29 percent.[8]

Both coal and natural gas are fossil fuels, but when it comes to carbon-dioxide emissions, not all fossil fuels are created equal. Burning natural gas releases about half the CO_2 per unit of electricity generated as does coal. By helping to reduce the price of natural gas, fracking has therefore been a major factor in recent CO_2 reductions.

Fracking also has led to emissions reductions in other ways. Globally, governments spend around $540 billion a year on subsidies for fossil-fuel use. Most of these subsidies are provided by developing nations and are meant to offset the high cost of basic-energy needs. Subsidizing fossil fuel use is bad policy, but removing the subsidies poses its own set of difficulties, as the poor in many developing nations are particularly dependent on affordable energy. However, as oil prices have fallen, also thanks to fracking, several countries have moved to scale back or eliminate their fossil-fuel subsidies.[9]

METHANE EMISSIONS FROM FRACKING

Opponents of hydraulic fracturing claim that any reductions in CO_2 emissions are offset by increases in methane emissions. Methane (CH4) is a more potent greenhouse gas than CO_2, albeit one with a far shorter life span in the atmosphere. Once emitted, CO_2 stays in the atmosphere for hundreds or even thousands of years. By contrast, methane breaks down in the atmosphere after about a decade. Nevertheless, over shorter time horizons, methane has a greater warming effect than does an equal amount of CO_2. Over a 100-year time period, the warming effect of a ton of CH4 is 25 times greater than a ton of CO_2.[10]

While some methane clearly does escape during oil and gas production from fracked wells, most analyses have concluded that, even factoring in methane emissions, electricity from natural gas still has half the total greenhouse gas footprint of an equivalent amount of coal.[11]

FRACKING AND AIR QUALITY

The shift from coal to natural gas also has benefits for air quality, generally.

For an equivalent amount of electricity generated, power plant use of natural gas produces less than a third as much of the nitrogen oxides, and about 1 percent as much of the sulfur oxides, as coal. Burning natural gas also produces far fewer particulates than coal per unit of energy generated. Burning coal also produces emissions of other hazardous substances, such as mercury, which are not present in natural gas.[12]

While overall emissions from natural gas are lower, certain local areas may experience an increase in certain types of emissions due to an increase in energy production activities in that area. It is important to keep such cases in perspective. For example, in 2009, a private environmental consulting firm found evidence of "carcinogenic and neurotoxin compounds" near shale wells and compressor stations in Dish, Texas.[13] However, the levels of these compounds were sufficiently low that, while exposure might cause headaches or nausea, short-term exposure would not cause a toxic reaction.[14] A later investigation by the Texas Department of State Health Services found no evidence of widespread exposure to the compounds among Dish residents.[15]

Proper regulation and oversight to prevent such events is appropriate, but the scale of the effects does not compare to the widespread exposure to high level of ozone, particulates and other emissions from more emissions-intensive fuel sources.

FRACKING'S EFFECTS ON WATER QUALITY

Much of the criticism of hydraulic fracturing from an environmental perspective has focused on water quality. There have been numerous claims that hydraulic fracturing has contaminated drinking water or poses other risks to water quality. The precise mechanism by which impairment of water quality is supposed to occur varies greatly from allegation to allegation, but can be grouped into several categories. First are claims that the fracking process itself could contaminate water supplies. Despite numerous investigations, there are currently no cases where the fracking process has been shown to have contaminated groundwater supplies in Texas.[16] Indeed, geological considerations make direct contamination via fracking unlikely. While groundwater supplies typically lie a few hundred feet below the earth's surface, shale oil and gas resides several thousand feet down. For fracking to contaminate groundwater, chemicals from the process would have to migrate up through thousands of feet of solid rock.

A second group of claims concern contamination due not to fracking itself, but to other parts of the oil-production process. For example, leaks from well casings or from chemicals stored on the surface could contaminate groundwater or surface-water supplies. While such contamination is possible, a recent Environmental Protection Agency review found that actual incidents of contamination are rare.[17] The EPA's report also notes:

> "The risk of contamination of drinking water by well leaks decreases by a factor of approximately one thousand when surface casing extends below the bottom of the drinking-water resource."[18]

A survey of oil and gas wells hydraulically fractured by nine oil and gas service companies in 2009 and 2010 estimated that 97 percent of the wells had cement across a portion of the casing installed through the bottom of the protected groundwater resource identified by well operators.[19] The EPA's review identified just 10 incidents of contamination in Texas that were deemed related to drilling and construction activities among a survey of 250,000 oil and gas wells.[20] For the most part, "the contamination incidents were associated with wells that were constructed before Texas revised its regulations on cementing in 1969." Similarly, the EPA found that, of 151 recorded instances of fracking fluid spills, "fluids reached surface water in 13 (9 percent of 151) cases and soil in 97 (64 percent) cases. None of the spills of hydraulic fracturing fluid were reported to have reached ground water."[21]

So while there is some theoretical risk of contamination, real-world instances of this are rare, if not practically nonexistent. Where risks do occur, they typically involve issues such as well casings that are not specific to hydraulic fracturing, but are common to all oil-and-gas production, as well as to other forms of energy production.

FRACKING'S IMPACT ON WATER AVAILABILITY

Some criticisms of hydraulic fracturing focus not on water quality, but on water quantity. Specifically, it is sometimes claimed that fracking uses too much water, and that extensive hydraulic fracturing could create water shortages elsewhere.

As with previous criticisms, these claims are largely unfounded. In most parts of the country, water use by hydraulic fracturing operations represent less than 1 percent of the fresh water that is locally available. Water used for fracking does represent a significantly higher fraction of total water use in a handful of counties in South and West Texas. However, a detailed case study of fracking in South Texas found that, even in this areas, water supplies for hydraulic fracturing were generally adequate. Excessive drawdown of local groundwater was found in only 6 percent of the Eagle Ford Shale, and the potential impacts of these drawdowns could be avoided by a shift toward brackish water instead of fresh water.[22]

As with air quality, water use for hydraulic fracturing has to be compared to the water use that would be required to produce the largely coal-power electricity that natural gas displaces. A 2013 analysis found that "water saved by using natural gas combined cycle plants relative to coal steam turbine plants is 25–50 times greater than the amount of water used in hydraulic fracturing to extract the gas."[23]

CONCLUSION

Every source of energy has plusses and minuses. Wind farms provide zero carbon electricity, but this energy is intermittent and the turbines themselves can kill birds and other species. Hydroelectric dams can provide reliable power, but can radically alter local ecosystems. To evaluate an energy source properly, one must look at it not in the abstract, but in comparison to the most likely alternatives.

Judged from this perspective, the environmental record of hydraulic fracturing looks pretty good. Fracked natural gas has supplanted significant amounts of coal electricity, delivering low cost electricity with half the levels of greenhouse gas emissions. Emissions of other harmful compounds are also drastically less. Fracking poses little risk to water quality, and uses less water than coal. While hydraulic fracturing can pose environmental challenges, particularly in certain local areas, these can be managed via appropriate regulation and oversight.

ENDNOTES

1. The proper spelling of this process is a matter of some dispute. Many in the industry prefer "frac-ing" whereas journalistic and media accounts typically use "fracking." This paper uses "fracking."

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4. Zeke Hausfather, "What's Behind the Good News Declines in U.S. CO_2 Emissions," Yale Climate Connections, May 29, 2013. http://www.yaleclimateconnections.org/2013/05/whats-behind-the-good-news-declines-in-u-s-co2-emissions/

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6. Cf. Kuishuang Feng et al, "Drivers of the US CO_2 emissions 1997–2013," *Nature Communications* 6, Article number: 7714, July 21, 2015.

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8. Energy Information Administration, "Electric Power Monthly with Data for June 2015," Table 1.1, August 2015.http://www.eia.gov/electricity/monthly/pdf/epm.pdf

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13. Wolf Eagle Environmental, "Town of DISH, Texas Ambient Air Monitoring Analysis – Final Report," 2009. http://townofdish.com/objects/DISH_-_final_%20report_revised.pdf

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16. Ernest J. Moniz, et al., "The Future of Natural Gas," Massachusetts Institute of Technology, p. 40, 2011. http://mitei.mit.edu/system/files/NaturalGas_Report.pdf

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18. EPA Assessment, ES-14.

19. Ibid.

20. Scott Kell, "State Oil and Gas Agency Groundwater Investigations and Their Role in Advancing Regulatory Reforms, A Two-State Review: Ohio and Texas," Ground Water Protection Council, August 2011. http://fracfocus.org/sites/default/files/publications/state_oil__gas_agency_groundwater_investigations_optimized.pdf

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