Is Fracking a 'Happy Solution' to our Energy Needs?

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A few weeks ago, John Mauldin called fracking a "happy solution" that will produce jobs, potentially solve our trade deficit and generate new tax revenue, though energy prices may rise in the process. But how excited should we be about the "shale revolution"?

Over the last few years, we have seen increasing enthusiasm – bordering on hype – over the idea that horizontal drilling plus hydraulic fracturing of shale rock to produce oil and gas, commonly referred to as "fracking," is changing everything. The US is about to be the leading oil-producing nation again, says the International Energy Agency. We have 100 years of abundant gas supplies, says President Obama. In the recent election, thanks to these developments, the candidates were actually debating how soon the United States would be "energy independent."

Largely due to fracking in North Dakota and Texas, US oil production has grown from five million barrels per day (bpd) in 2008 to about 6.5 million bpd now, though that is still much less than the total amount we use. Natural gas production over that time has risen from 21 trillion cubic feet per year to about 24.7 trillion cubic feet today, led by fracking for gas in Texas, Louisiana, and Pennsylvania. After decades of declining production, these reverses are big news.

That's indisputable. The question is "how big?"

Some background

First, a bit of geology. Oil and natural gas are ancient plant life that has been transformed by millions of years of pressure into hydrocarbons and captured in rock formations rather than escaping into the air. When these pressure-cooker carbons end up with a single carbon atom, the resulting methane is what we call natural gas. When there are two, three, or four carbons, the resulting "natural gas liquids" have mostly industrial uses, and while they are often included in statistical reports of oil production, they are not "oil." Molecules with more carbon atoms are liquids that are mostly used for transportation fuel – what we call oil. Refineries sort out all these molecules and remove various impurities. When gas and oil are found in large quantities in sandstone or other porous rock, we call that "conventional" oil or gas, because the fossil fuel can flow through pores in the rocks to reach a well. (Note that "gas" as I'm using it in this article refers to "natural gas" or methane, not to "gasoline.")

Sometimes, though, the gas is locked up in the shale rock where it formed, and it won't move, or the oil is so thick or impartially "cooked," that we have to use extreme "unconventional" technologies to get at it. Worldwide production of conventional oil has been on a plateau since

about 2005, so we have turned to "unconventional" production to keep the wheels of the world economy turning. The Canadian tar sands, for example, are a major "unconventional" oil source.

So is fracking of shale.

Shale is a very solid rock that forms numerous thin layers. When gas is present, it is found in pores barely larger than a single gas molecule. Oil engineers have combined several technologies developed over decades to drill horizontally along a shale layer, rather than vertically through it, and to apply a high-pressure mix of water, chemicals and sand through holes in the drill pipe to shatter, or fracture, the shale, allowing the gas or oil to move to the pipe and up to the surface. Fracked wells in oil country commonly produce a mixture of oil, gas, and natural gas liquids. (Some wells target gas alone; these are called "dry gas" wells.) It turns out there is a lot of oil and gas in those rocks, if you're willing to invest the money and energy necessary to get it, and, with technological changes, what couldn't be extracted economically a decade ago can be today.

Fracking today

So how is this working out in the real world? Let's look at some of the impacts.

Oil and gas are priced on a spot basis, based on today's mix of supply and demand, and prices are very volatile. Because natural gas is hard to transport globally, the American price is independent of the world price, and currently is much lower. Oil, in contrast, is traded around the world and normally has a much more uniform price globally. The large increase in US gas production caused US gas prices to collapse from over $13 per thousand cubic feet in 2008 to under $2 briefly this year, and they remain under $3.50. At such low prices, gas is cheaper than coal for use in electricity plants, and companies are replacing old coal plants with new gas-powered plants. Even a nuclear plant in Wisconsin was shut down in favor of gas generation. If gas prices go up, however, such decisions could prove hasty and shortsighted

The problem is that no one can make money producing gas at $3 per thousand cubic feet. The actual break-even price for shale gas production is estimated to be in the $6 to $8 range. The shale boom started when gas was higher than that, so companies eagerly paid for leasing rights and access to drilling rigs. Leases commonly require drilling to start within a few years or the lease is void, so there was a strong incentive to start production and secure the well rights. When everybody did that at once, a surplus of gas hit the market, prices collapsed, and drilling for dry gas abruptly slowed.

Two aspects of shale production make it radically different from conventional production. First, it takes a lot more energy (including many miles of steel tubing per well, for example) to extract energy out of these wells. Traditional wells have a ratio of energy returned on energy invested (EROEI) of 10- or 20-to-one, or an energy cost factor of 5 to 10%. The EROEI with fracking is in the

range of 5- or 10-to-one, or a cost factor of 10 to 20%. Professor Charles Hall of the State University of New York, a recognized expert in the field, claims that modern civilization will have trouble functioning with an average EROEI under 10-15, so shale oil and gas alone could not support our civilization at its current standard-of-living. EROEI roughly correlates with financial cost, and a typical fracking oil well in Texas now costs over $10 million to drill, compared to less than $1 million for a conventional well.

The other thing about extraction from shale is that it ends quickly. A conventional well's production declines at about 5-8% per year, and it can remain productive for decades. By contrast, the first-year decline in shale wells is over 60%, and about 90% of a well's production occurs in the first five years. That creates a "drilling treadmill," as new wells are needed simply to replace production from wells drilled a few years before.

Further, studies by Arthur Berman, David Hughes, and Rafael Sandrea have analyzed well-by-well data from existing mature oil and gas shale fields and concluded that the ultimate production from these sources is likely to be much more limited than optimists claim. While fields are large, covering many counties or even states, most production comes from a few "sweet spots," where drilling opportunities are limited by quality acreage. While the Bakken field in North Dakota is producing about 750,000 barrels per day now, and common projections are for production to reach two million bpd in a few years, both Hughes and Sandrea project a maximum of less than one million bpd within five years, and a sharp decline after that.

That is disheartening, since a lot of current policymaking assumes that abundant and cheap gas and oil will be ours for many years to come, and the problem is what we will do with it all. Oil companies are lobbying to lift restrictions on exporting American crude oil and to build gas-exporting facilities. It has been suggested that one purpose of those proposals is to link our market to the (higher-priced) world market. By contrast, companies building new electricity generating facilities and designing new trucks are counting on cheap gas (under $6) in the future, and they are likely to be disappointed.

The shale boom has enabled – or perhaps, some say, was itself enabled by – financial wizardry on Wall Street. Recent changes in how the SEC allows corporations to report their oil and gas reserves have made shale holdings a valuable tool for supporting stock prices, leading to a wave of fee-generating M&A activity. Additionally, some firms are securitizing packages of leases, bringing back memories of subprime mortgages. With low interest rates, capital is plentiful, and those who wanted to explore these newly productive oilfields did not have trouble raising money, at least to get the shale boom started. Once again, the opportunities for gain in the financial economy overrode the realities of the "real" economy.

Thus, shale oil and gas may be both less plentiful and less affordable than many assume, and should not form the basis for long-term assumptions about energy independence or a new economy.

Environmental issues

Between ongoing droughts in the Midwest and superstorm Sandy in New York, more Americans are accepting the idea that the climate is changing for the worse, and that human beings and our fossil fuels are largely responsible. One attraction of natural gas is that it produces less CO2 at the point of use than coal does, so replacing coal with gas seems to many people like prudent change.

But since a lot of methane is released in the fracking process, there is considerable dispute about what the net benefit of gas really is. Moreover, the growing use of gas in the US is not reducing the production of coal but rather is facilitating more exports of coal to China, India, and Europe. While this helps our trade balance, it does not do much for climate control.

One long-term strategy for limiting climate change is to replace fossil fuels with "renewable energy," mostly wind and solar-based systems, while also using the energy we have more efficiently. But such alternatives are not as attractive as fossil fuels from either a cost or reliability perspective (if they were, we would already be using them), even though they may be necessary in the future. It normally takes decades for a society to transition to a new energy system, and cheap gas is making it hard to get support for these new technologies (or for nuclear, which is even more expensive than renewable energy sources).

And what about more immediate environmental concerns? The most common objection to fracking is not the false promises discussed above but its impact on the world we live in. In John Mauldin's piece, he said that, according to "true experts, properly done, horizontal drilling and fracking pose no danger to the environment." (Of course, "properly done," there would be no automobile accidents or outbreaks of food poisoning, either.) Here are a few legitimate concerns that have been raised about fracking's environmental effects:

- Fracking uses millions of gallons of water per well, most of which is unusable thereafter. There is competition for water rights between oil companies on one hand and farmers and ranchers on the other. Last summer Pennsylvania suspended fracking for a while, due to low stream flows.

- The mix of chemicals used in fracking is treated as proprietary, is not subject to much regulation, and therefore is not tested for environmental safety before use. Not surprisingly, when leakages and spills have occurred, they have harmed people and farm animals.

- Possible pollution of drinking water is a matter of considerable debate. Although fracking is normally done well below the water table, there are natural fissures in the rock that can allow chemicals to migrate. The disposal of used fracking water is another major source of concern, although some operators are experimenting with ways to recycle and reuse the fracking water.

- Earthquakes in areas that don't commonly have them, including Ohio and Oklahoma, have been linked to fracking activities nearby.

- The shale production process requires thousands of wells, and each well requires dozens of heavy truck trips to carry the drilling equipment, pipe, and water and chemicals to the well site, often over rural roads not built for such intense traffic. In many cases it is not clear whose responsibility it is to pay for the road damage.

- The impact on a community of a blizzard of drilling activity is very disruptive, and recovery when the oil folks leave town in a year or three may be quite difficult. When it requires $15 per hour to get people to work in a fast food restaurant, as Mauldin describes in his story, people living on fixed incomes or not participating in the drilling boom will be adversely affected.

- In contrast to long-lived conventional wells, as I noted above, shale wells will likely have a short productive life. Who will be responsible for the long-term monitoring of the spent wells? The record of other extractive industries does not give cause for much optimism.

Creating a happier solution

Rex Tillerson, CEO of ExxonMobil, recently told the *Wall Street Journal* that our American system of private ownership of mineral rights, the fact that we have independent drilling companies, and our mature system of refined rules and experienced industry personnel "ensures that all natural resources are fully developed" in this country. Whatever the concerns, in other words, it is likely that extraction of oil and gas from shale deposits will continue. It is also likely that it will not turn out to be the "happy solution" that Mauldin and others want to see.

This boom (or is it a bubble?) creates a unique opportunity. The burst of new oil and gas is like winning a lottery. As most financial advisors know, sudden wealth can only enable long-term security if serious planning is involved at the outset. That's what we should be doing now.

We need a new energy system, both because climate impacts are growing and fuel supplies are limited. Building it out will require a lot of capital and extensive labor – all fueled by a lot of energy – before the new electricity starts to flow. Rather than seeing how fast we can use up our bounty with cheaper electricity, business as usual, and disregard for the consequences, we should invest

this one-time abundance to promote long-term low-carbon prosperity. If we do, once prices are back up and production has dropped back to normal levels we will have something to base an economy on. If we don't, we'll just end up with a shale oil and gas hangover and nothing to show for our binge.

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