

## The Shale Boom Shifts Into Higher Gear

*Oil production is becoming a modern manufacturing process, with frackers using the 'just-in-time' approach.*

By Donald L. Luskin and Michael Warren

Have the American entrepreneurs who developed horizontal drilling and hydraulic fracturing—"fracking"—done their jobs too well? The increase in domestic crude oil production of 3.6 million barrels a day in less than four years, reversing almost four decades of decline, has created a spectacular macroeconomic anomaly—a crash in oil prices without a recession to cause it.

Now, in response to sharply lower prices, domestic oil producers have shed jobs and cut operating rigs by more than half. This has sent shock waves through the entire U.S. economy. The drop in fixed assets for drilling, alone, slashed about half a percentage point off first quarter gross domestic product.

The crash in oil prices wasn't due to lower demand. Petroleum demand in the U.S. is at its highest since 2010, and demand in China is higher than ever. Nor was the crash due to monopolistic OPEC manipulation. To be sure, the cartel, led by Saudi Arabia, chose not to cut production to support falling prices. But looking at the fracking tidal wave in the U.S., OPEC was only following the old Chinese proverb: When faced with the inevitable, try to enjoy it.

Now the question is whether U.S. frackers can adapt to the lower prices they created. Fracking blossomed following the trough of the Great Recession, when oil prices were, on average and adjusted for inflation, the highest in history—even higher than in the 1970s. It was an ideal price environment for entrepreneurs to perform some very expensive experiments, ultimately learning how to drill holes two miles under a frozen prairie, turn the wellbore 90 degrees, drill out another mile or two, then hydraulically force a designer cocktail of water, sand and secret sauce down the hole to liberate petroleum molecules trapped since dinosaurs strode the earth.

The nimblest and smartest competitors have worked relentlessly to increase their productivity. Leading-edge operators report that they can produce more profitably today at a price of \$65 a barrel than they could at \$95 a barrel three years ago. Where can they be profitable three years hence—\$40 a barrel? \$30? The oil patch today is afire with the same technological imperative and competitive mission that has powered the U.S. electronics revolution—think Moore's Law—to dash headlong down the learning curve, crushing costs and prices and making up for it in volume.

Today's surge in production is coming predominantly from wells that are horizontally drilled and hydraulically fractured from drill pads with multiple wells. Because such wells exhaust quickly, many more of them must be drilled. The conventional wisdom is that fracking is

therefore less amenable to the economies of scale exploited by traditional methods. But for today's shale operators, that's a feature, not a bug.

For one thing, the increase in the number of wells—which, necessarily, entails a great diversity of geologies and formations—means a commensurate increase in learning about a galaxy of processes that can be tweaked, combined and recombined to increase production and reduce costs. It's simple: When you get more at-bats, you become a better batter.

Consider what frackers have had to learn to do. Today's long laterals can extend up to 15,000 feet, running within undulating formations that can sprawl over hundreds of square miles. The ability to keep the drill bit in the middle of the formation has required improved 3-D seismic research and ever-increasing advances in telemetry and remote guidance, to locate and drain a productive area. It's like learning to pilot a drone flying two miles underground, and through rock. It was difficult and expensive at first. Now it is known art.

Wells in light tight-oil formations can be drilled and completed for millions—not billions—of dollars, and the majority of the estimated recovery will occur within a year or two of bringing it on line. Capacity across a diversified portfolio of wells can be turned on when future prices justify it, and off when they don't. That turns upside-down the traditional model of oil megaprojects that require billions in upfront capital, years of lead time, and always-on production irrespective of price.

All this means that, for the first time in history, oil production is becoming a modern manufacturing process. The frackers are engaged in “just-in-time” production, analogous to the methods pioneered by Japanese manufacturers in the 1970s and 1980s, which led directly to hyper-efficient global supply-chain management perfected by Wal-Mart in the 1990s.

And with today's low prices, the frackers are having to adapt another lesson from Japanese manufacturing—kaizen (continuous improvement). That imperative for greater efficiency is transforming the ecosystem of firms that bring oil from shale formations to the gas tank—drillers, but also oil-service companies, railroads, pipelines and refiners.

So anyone who looks at the fall in the number of U.S. oil rigs and thinks that OPEC has won has a big surprise coming. If oil prices move up, even a little bit from here, U.S. frackers will finish hundreds of uncompleted wells, unleashing a new flood of supply. The cartel is no longer the swing producer.

Yes, additional cheap oil from OPEC could lower prices. But withholding that supply—or even a disruption to it arising from regional instability—can't raise prices as it has in the past, because even slightly higher prices bring in waves of just-in-time production from U.S. frackers. The American fracker is the man at the margin now. And as his productivity continues to improve, that margin moves lower and lower.

Sixty years ago, American geophysicist M. King Hubbert postulated that fossil-fuel production would follow a Malthusian bell-shaped curve. This so-called Hubbert Curve predicted that U.S. oil production would peak in the 1970s and decline rapidly and

permanently thereafter. King's work has given a pseudoscientific gloss to the pronouncements of catastrophists preaching "peak oil."

Now Hubbert's Curve has been trumped by Moore's Law. There will be no limits to growth in the global economy in a few years when, thanks to American ingenuity and entrepreneurship unleashed upon shale formations world-wide, oil—like transistors—becomes, for all practical purposes, free. And the lower oil prices go, the more money the frackers can make.

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