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## The United States of Gas: Why the Shale Revolution Could Have Happened Only in America

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### Abstract (summary)

Natural gas has been a godsend for the US. Already, gas has spurred a manufacturing renaissance, with investors spending and planning hundreds of billions of dollars on new facilities such as chemical, steel, and aluminum plants. The shale boom has created hundreds of thousands of new high-paying, middle-class jobs, and now, more than one million Americans work in the oil and gas industry. As much as other countries may envy this catalyst for domestic growth, they will not be able to replicate it, because only the US possesses the unique ingredients necessary to fully develop shale resources. A legal system that enshrines the private ownership of land and the resources below it, along with open capital markets and a reasonable regulatory system, has led to the growth of thousands of independent oil and gas companies, all of which are in intense competition with one another.

### Full Text

Less than a decade ago, the future of American energy looked bleak. Domestic production of both oil and gas was dwindling, and big U.S. energy companies, believing their fortunes lay offshore, had long since turned away from the mainland. But then something remarkable occurred: a surge of innovation allowed companies to extract vast quantities of natural gas trapped in once-inaccessible deposits of shale. The resulting abundance drove down U.S. gas prices to about one-third of the global average.

Natural gas has been a godsend for the United States. Already, gas has spurred a manufacturing renaissance, with investors spending and planning hundreds of billions of dollars on new facilities such as chemical, steel, and aluminum plants. The shale boom has created hundreds of thousands of new high-paying, middle-class jobs, and now, more than one million Americans work in the oil and gas industry—an increase of roughly 40 percent between 2007 and 2012. Moreover, because natural gas currently supplies about 25 percent of the total energy consumed in the United States (a figure that is rapidly growing), the boom is saving U.S. consumers hundreds of billions of dollars a year. Combined with the other benefits, those savings have given the United States a long-term economic advantage over its competitors and helped the country recover from the Great Recession.

As much as other countries may envy this catalyst for domestic growth, they will not be able to replicate it, because only the United States possesses the unique ingredients necessary to fully develop shale resources. A legal system that enshrines the private ownership of land and the resources below it, along with open capital markets and a reasonable regulatory system, has led to the growth of thousands of independent oil and gas companies, all of which are in intense competition with one another. As a result, nearly four million oil and gas wells have been drilled in the United States, versus 1.5 million in the rest of

the world. The bustle of drilling activity in the United States has also led to increases in innovation within the industry on an order of magnitude that other countries can only dream of.

Although other places, such as China and Europe, have substantial shale resources, they don't have the entrepreneur-friendly system needed to develop those resources quickly and productively. So long as politicians don't get in the way, then, the United States will profit handsomely from the shale revolution for decades to come.

#### BEHIND THE BOOM

The story of America's shale revolution involves classic Yankee ingenuity—although not on the part of big oil. Beginning in the 1970s, production from onshore U.S. oil and gas fields declined as those fields became what the industry calls "mature." So the major oil companies were forced to abandon the development of new resources on U.S. soil. In order to find giant new oil fields, they shifted their exploration efforts to remote foreign lands and deep offshore waters. Such investments were enormously expensive and often required decades to negotiate and develop. In order to build the capital resources and global reach necessary to deal with national governments and complete mammoth projects, the major oil companies began to acquire or merge with their peers. Oil, they recognized, was usually cheaper to buy on Wall Street than find in the ground.

Over the next few decades, however, these companies became excessively bureaucratic and developed tunnel vision. Focused principally on replacing their dwindling oil reserves, they invested their capital in giant foreign deposits, such as the Kashagan field, in Kazakhstan, which has an estimated 13 billion barrels of recoverable oil; its first phase of development alone cost \$50 billion.

Meanwhile, smaller, independent companies—which earn the lion's share of their revenue at the wellhead and little of it downstream (at the refining stage, for example)—were forced to innovate or die. Beginning in the late 1990s, natural gas prices were climbing, and the companies were learning that the United States' underground shale formations contained vast volumes of natural gas. So such firms as the Ghk Companies (of which I am the founder and CEO) attempted to crack open the shale in vertical wells and release the gas by injecting sand, water, and chemicals into the rock, a process known as hydraulic fracturing, or "fracking." But it simply wasn't profitable.

Then, George Mitchell, an independent oil man wildcatting in the Barnett formation, in Texas, began to break the code. His innovation was to drill horizontally into the shale, exposing thousands of feet of gas-bearing rock, rather than the 100 feet or so (or often just ten or 20 feet) encountered in a vertical well. In short order, gas prices got even higher and Mitchell's techniques got even better, and he started achieving some commercial success. In 2002, Devon Energy, sensing the coming revolution, bought Mitchell's company and ramped up the innovation necessary to develop the Barnett formation. Chesapeake Energy and other independent companies soon joined in, thus kicking off the U.S. shale boom. Within the decade, Chesapeake surpassed ExxonMobil as the largest U.S. natural gas supplier, and not long after, the United States surpassed Russia as the world's largest natural gas producer.

Not only did independent companies transform the natural gas industry; they did the same with oil. The newfound gas supplies had caused the price of U.S. natural gas to drop from a high of over \$13.50 per thousand cubic feet in 2008 to around \$3-\$4 per thousand cubic feet in 2009. Natural gas had become so cheap that the independents were again forced to innovate to stay alive. With gas selling at the equivalent of less than \$25 per barrel of oil, but oil selling at about \$100 per barrel, they began applying the technologies they had successfully developed for gas to extract oil from shale formations with low permeability, known in the industry as "tight" reservoirs. And the results were similarly impressive—such that the United States now stands to surpass Russia as the world's second-biggest oil producer by the end of the decade and, according to the International Energy Agency, could even surpass Saudi Arabia to become the world's largest producer by then.

None of this could have happened without the United States' unique legal framework. It grants landowners the rights not only to the surface of their property but also to everything below—all the way, theoretically, to the center of the earth. In the rest of the world, these mineral rights are virtually all owned, or strictly controlled, by sovereign governments. In the United States, any company can strike a deal with a willing landowner to lease the rights to the oil and gas beneath his land and start drilling, a setup that has spawned Darwinian competition among entrepreneurs in order to survive and grow. And so the United States boasts more than 6,000 independent oil and gas companies and an equal number of associated service companies, compared with the handful of independents and service companies that exist overseas.

At each of these American companies' wells, dozens of minds work on each part of the development process. Using 3-D models of subsurface seismic activity, engineers, often remotely and in real time, monitor the exact location the drill bit, so that it can stay in the most prolific zones of the shale formation, and optimize the size of the cracks created by fracking, so that they are neither too large nor too small. It's as if each well has its own miniature Silicon Valley. Having been repeated thousands of

times, these and many other techniques have allowed companies to maximize their productivity, cutting their costs and well completion times in half from where they began.

Consider how much can change in one year alone. In 2013, on properties in Oklahoma in which the ghk Companies hold interests covering 150 square miles, one large U.S. independent company drilled and completed over 100 horizontal wells. Had those wells been drilled vertically, they would have exposed only about 1,000 feet of shale, whereas horizontal drilling allowed nearly 100 miles to be exposed. And rather than performing the 100 injections of fracking fluid that a vertical well would have made possible, the company was able to perform between 1,000 and 2,000 of them. The company's engineers also tinkered with such variables as the type of drill bits used, the weight applied while drilling, the rotation speed of the drill, and the size and number of fracking treatments. Thanks to that continuous experimentation, plus the savings from scale (for example, ordering tubular steel in bulk), the company managed to slash its costs by 40 percent over 18 months and still boost its productivity. The result: in 2014, six or seven rigs will be able to drill more wells and produce as much oil and gas as 12 rigs were able to the year before.

Since the shale boom began, over a decade ago, companies have drilled about 150,000 horizontal wells in the United States, a monumental undertaking that has cost approximately \$1 trillion. The rest of the world, however, has drilled only hundreds of horizontal wells. And because each borehole runs horizontally for about one mile (and sometimes even two miles) and is subjected to ten or more fracking injections, companies in the United States have fracked about 150,000 miles of shale about two million times. That adds up to around a thousand times as much shale exposed inside the United States as outside it.

#### LESSER RIVALS

It is highly unlikely that other countries will ever catch up to the United States. True, China and Europe sit on vast shale resources (in China's case, possibly containing more natural gas than U.S. reserves). But those resources won't get extracted anytime soon. Since other countries cannot sustain thousands of independent oil and gas companies, their resources must be exploited by bureaucratic, slow-moving national companies and international giants (which have to deal with even more bureaucratic governments and often Byzantine legal and regulatory systems). Hammering out huge shale deals in foreign countries and then completing the resulting projects will take decades. Even in China, where the government exercises near-complete control of both surface and subsurface land use, only a few national companies and a few more foreign ones are planning on developing shale gas. And because fewer minds will be working on fewer operations, it will take longer to move up the learning curve and the productivity gains will be smaller than in the United States. So costs will be high, and profits, thin.

In many democracies, development is also being slowed by the "not in my backyard" syndrome. Unlike Oklahomans and Texans, who have grown up with the oil and gas industry, foreign populations are usually unfamiliar with it; most of the 1.5 million oil and gas wells outside the United States are located either in deep offshore waters or remote onshore areas. And because governments in other countries own or control virtually all the underground resource rights, landowners have no skin in the game. Receiving none of the economic benefits and facing only the downsides of intrusive projects in their own backyards, they justifiably tend to resist drilling projects.

Such is the case in Europe, where the problem is magnified by a hyperactive green movement determined to block the development of shale gas. France has banned fracking entirely, and Germany has put a de facto moratorium in place. Without a massive change in attitude, Europe will take even longer than China to develop its shale gas resources. Even if it does develop them, the results will be less robust and very slow in coming.

Europe is also burdened by misguided energy policies. At the beginning of this century, European politicians argued that their continent should lead the world in shifting to green energy and reducing carbon dioxide emissions. They committed tens of billions of dollars of taxpayers' money to subsidize green energy projects, principally to develop wind and solar power, that were not yet efficient or reliable enough to compete. Unfortunately, it is doubtful that Europe's move toward green energy will result in the utopian future its advocates have predicted. In order to meet growing power demands, dirty coal freed up by the U.S. shift to natural gas is already finding its way to Europe. The reality is that these European countries have saddled themselves with a costly, not very efficient energy infrastructure that will act as a brake on long-term economic growth. And so while the United States reindustrializes, Europe, without new political leaders who better understand the economics of energy, may well face decades of deindustrialization and economic stagnation.

#### THE GIFT THAT KEEPS ON GIVING

The shale revolution has its naysayers, who point to the cyclical nature of natural gas prices in the past to argue that future price spikes could render the fuel unreliable and costly. But past volatility resulted from stringent government price controls followed by a complex process of deregulation and from the high risk involved in exploring for pockets of conventional natural gas. In other words, prices were subject to both the vagaries of national policy and the complexities of subsurface geology.

Neither of those problems exists today, since price controls were abandoned long ago and U.S. companies now know exactly where vast quantities of accessible natural gas lie, and so the extraction of gas is a reliable manufacturing process rather than a crapshoot. The future price of natural gas will be determined not so much by the size of the supplies of gas found, as was the case with conventional natural gas, as by the manufacturing cost of extraction. Prices, therefore, should stay steady in the long run, possibly even for the next half century. They may even fall as the industry continues to lower costs and improve productivity at the wellhead. Additional innovation downstream-in the transportation, distribution, and consumption sectors- has not yet even truly begun. When it does, efficiency gains will generate billions of dollars more in consumer savings.

The bottom line is that thanks to the shale revolution, the United States has already insulated itself from unpredictable fluctuations in global natural gas prices and is coming close to doing so in terms of oil prices. Domestic oil shortages due to foreign natural disasters or political disruptions could someday become a thing of the past, particularly if natural gas starts fueling U.S. cars and trucks. Growing energy independence will give Washington a leg up on its competitors. Should the flow of oil be threatened by some event in the Middle East, such as the fall of the Saudi regime, the United States will be able to weather the storm better than any other large economy.

Cheap and abundant natural gas adds to the country's geopolitical capital in a more direct way: it significantly strengthens the U.S. economy. Americans pay a fraction of the price for natural gas that the rest of the world's consumers do, saving as much as \$300 billion annually compared with consumers in China and Europe. Already, the development of the United States' enormous shale oil and gas reserves has boosted U.S. gdp by as much as one percent. In fact, without the growing oil and gas revolution, the U.S. economy would likely have slipped back into recession and added hundreds of thousands of fewer jobs. Today, most of the states enjoying the shale boom have lower levels of joblessness than the national average: thanks to drilling in the Bakken formation, for example, North Dakota's unemployment rate is only 2.6 percent, the lowest in the country. The United States' growing economic advantage could last until the middle of this century or beyond.

Unless, that is, it is squandered. In California and New York, two of the country's largest economies, antifracking activists and state politicians have managed to slow the development of shale resources to a snail's pace. Both states contain large shale formations (the Monterey in California and the Marcellus in New York), the development of which would provide a major boost to both state and national economic growth. Politicians need to recognize that today America has an unprecedented opportunity for long-term economic growth that can generate good middle-class jobs, help it leave the Great Recession behind for good, and grant it geopolitical advantages over its competitors for decades to come. It would be a shame not to seize it.

#### **AuthorAffiliation**

ROBERT A. HEFNER III is Founder and CEO of the GHK Companies, the author of The Grand Energy Transition, and the creator of the documentary of the same name.

Born to a family of Oklahoma oil men, ROBERT HEFNER earned a geology degree from the University of Oklahoma in 1957 and went on to pioneer ultra-deep natural gas exploration, drilling some of the world's deepest wells and unlocking reserves 30,000 feet below the earth's surface. Today, he is the owner of the GHK Companies, an oil and gas firm based in Oklahoma City, as well as an author, philanthropist, and collector of modern Chinese art. In "The United States of Gas" (page 9), he explains why the shale revolution could have taken off only in the United States.

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