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Fracking Boom and the Development of America's Energy Resources

Travis Wright's first impressions of Williston, North Dakota, in January 2012 remain vivid. It was bitter cold and the Walmart parking lot was filled to overflowing with campers and RVs whose owners were using them as de facto homes while working in the oil fields. Once inside Walmart, Travis discovered pallets of goods blocking the aisles as the understaffed nighttime crew of stockers simply couldn't keep up with demand. He quickly learned to do his shopping in the middle of the night when the lines were only 30 minutes long. He learned later that this Walmart in Williston was the highest-grossing one in North America. The local economy was booming to such an extent that even paying $17 an hour for entry-level jobs, store officials couldn't find enough employees to work for that amount.

Travis — at 6′6″ and 280 pounds, his friends called him Big 'Un — was also astonished to learn how expensive it was to live in Williston. A one-bedroom apartment went for $2,000 a month while a singlewide mobile home was $2,400 a month and a 2,000-square-foot home rented for $4,500 a month. So many job seekers had flooded into Williston to land high-paying jobs that the cost of housing had skyrocketed — at least until additional housing could be built to accommodate the dramatic influx.

Travis also remembered how bitter cold it was. In January, the average high in Williston is 22 degrees and the average low is zero, with a median of just 11 degrees. The pace of business was beyond frantic: It was frenetic. In the previous two years, the population of Williston had increased by almost 50 percent from 14,700 to more than 20,000. The city issued a record 610 building permits in 2010, but was on pace to exceed 1,600 within two years. The town's tax revenues had jumped from less than $50 million in 2010 to more than $80 million three years later. The U.S. Census had just announced that Williston was the fastest growing "micropolitan" area (those with 10,000 to 50,000 residents) in the country.

He remembered having to send his meal at Applebee's back to the kitchen to have it cooked properly, a reflection of the restaurant's inability to find skilled cooks and its consequent willingness to hire anybody it could find to meet the demand. He remembered roughnecks with more money than good sense routinely getting into bar fights that were eventually broken up by police officers whose department was strained to the breaking point.

Travis remembered how easy it was for companies seeking workers to make promises that they later couldn't keep. It was a boom-town mentality; it was the wild, wild West.

Travis had been living and working in northern Idaho and was perusing Craigslist looking for more satisfying work that paid better. He ran across a listing offering a job to truck drivers with a CDL and experience to haul water in Williston. He couldn't believe his eyes at how much they were offering for the job. He applied online, and 24 hours later he received a phone call offering him the position. Upon arriving in Williston, he discovered that the position was not all that it was cracked up to be. However, after some fits and starts, he found a job driving a water truck to drilling sites. Water in immense quantities was needed in the fracking operation, and his hours were brutal: He turned the key in the ignition at dawn and turned it off after dark. The regular schedule for truckers was "15 and six": 15 days on and six days off.

He wasn't even sure exactly how much he was going to be paid. All he knew was that he was getting paid handsomely. When he got his first check, he was astonished: the withholding alone amounted to more than $1,800 on a paycheck covering just three weeks.

Today the frenetic pace in Williston has slowed somewhat. Travis now hauls fracking sand to well sites for a developer but is considering going into business for himself. His father told this writer that if he were a younger man he would consider moving to Williston to join his son in that business.

Ward Koeser has been Williston's mayor for 20 years and expects that the boom in his town will be permanent: "It's a boom town — that's a fact of life — but I believe this will become a premier town in North Dakota." The city put a moratorium on permits for the man camps that sprang up as the fracking revolution took off, hoping the restrictions would force the roughnecks into more permanent housing. The city has also banned camper vans from lining the streets and jamming the Walmart parking lot, saying that they no longer could serve as homes for their owners.

Indications that the boom is likely to be long-term are increasing: New restaurants are springing up, along with apartment buildings and a brand-new recreational center. The private equity firm of KKR and Company has announced plans to spend up to $150 million to develop a 164-acre residential community. Professionals are pouring into the city as well: doctors at the quickly-growing local hospital, engineers working for the oil companies, and the inevitable lawyers.

A podiatrist from Florida, Dr. Guy Slann, moved to Williston last summer and plans to relocate his family there permanently once his children finish high school. He said, "It's underserved and has a booming economy. How many places are there like that? Florida will be just fine without another podiatrist."

Williston isn't the only town experiencing boom times, nor is North Dakota alone in enjoying it. The state's unemployment rate is the lowest in the country, and state representatives are wondering what to do with a $2 billion surplus, even after fully funding state employee pension obligations.

The Permian Basin and Eagle Ford oil-holding formations are driving a similar economic boom in Texas, creating thousands of new high-paying jobs there as well. Economist Mark Perry calls the two states "Saudi Dakota" and "Saudi Texas" because their production of oil and gas and their byproducts now easily and regularly exceed that of Saudi Arabia.

The average American driver is enjoying the boom as well. With gasoline prices dropping to less than

$3 a gallon in more than half the states, with predictions that they could fall another 15 or 20 cents a gallon in the next few months, Perry estimates that the average family will save an astonishing $700 a year and likely more as gas prices continue to fall.

Where We Went Right

What's different now?

After shortages of oil caused long lines at gas stations in 1973, then-President Jimmy Carter claimed in an address to the nation in April 1977:

The oil and natural gas that we rely on for 75% of our energy are simply running out. In spite of increased efforts, domestic production has been dropping steadily at about 6% a year….

Just to stay even we need the production of a new Texas every year, an Alaskan North Slope every nine months, or a new Saudi Arabia every three years. Obviously, this cannot continue.

And it didn't. Thanks to free-market incentives based on private property, the freedom to make and enforce contracts, and the profit motive, new technology knocked into a cocked hat Carter's dour predictions about a cold and dark future.

Thanks to the combination of horizontal drilling into and the hydraulic fracturing of shale formations, along with new discoveries of shale formations (i.e., the Marcellus Shale under Pennsylvania is vastly larger than initially estimated), the amount of recoverable oil and natural gas using these technologies has exploded. Improved ability to increase the production from existing wells also continues to force reserve estimates to be adjusted upward.

Estimates vary on how much recoverable oil is buried in the Bakken formation (which lies beneath Williston and stretches from North Dakota northward into Canada and west into Montana), partly because it is so large and partly because of the ever-changing technology. It occupies more than 200,000 square miles, and initial estimates failed to come even close to its present potential. For instance, back in 1995, the U.S. Geological Survey estimated that there were 150 million barrels of oil "technically recoverable" from the Bakken shale. In April 2008, the USGS revised that number upward to four billion barrels — an increase of more than 2,500 percent over the 1995 estimate.

Even that estimate was too low. In 2010, geologists at Continental Resources, the major drilling operator in North Dakota, estimated Bakken at eight billion barrels recoverable. Other estimates range from 24 billion to a potentially mind-numbing 500 billion barrels. The USGS currently estimates that, so far, just 500 million barrels have been extracted — just one-tenth of one percent of what might potentially be available. As one construction company manager put it, not only Williston but the entire state of North Dakota is "transitioning into a rapid growth economy rather than a boom."

It's difficult to pinpoint exactly when the fracking boom took off. Production charts show the turning point at around 2005, with most production curves going exponential not just in Bakken but also in the Permian Basin and Barnett and Eagle Ford formations in Texas. In addition there are the Pierre Shale and Niobrara Formations in Colorado and the Marcellus Formation in the Appalachian Basin in the Eastern United States, as well as the Utica Shale formation beneath Ohio and Pennsylvania. At present, oil production from these formations is closing in on 10 million barrels per day, providing more than half of America's energy oil needs, which is causing imports of oil to drop to the lowest level in decades.

According to data released by the Energy Information Administration (EIA) in September, when counting total petroleum production — crude oil and other petroleum products such as natural gas plant liquids, lease condensate, and refined petroleum products — the United States produced more than 14 million barrels per day (bpd) in June, which exceeded that of Saudi Arabia at 11.6 million bpd. June represents the 20th straight month of this remarkable achievement.

Historians argue as to when the first oil well appeared on the scene in the United States. Some claim it was the Thorla-McKee Well in Ohio in 1814, while others claim the Burkesville, Kentucky, well in 1828. Still others claim the wells developed at Burning Springs, West Virginia, in 1836. But each of those wells was drilled for salt, not oil, with oil merely being an often-inconvenient byproduct of the drilling.

George Bissell and Edwin Drake are rightly named for the honor of drilling the first well deliberately designed to extract oil near Titusville, Pennsylvania, in August 1859. This Drake Well was the first to tap the enormous resources of the Appalachian Basin formation that extends over much of Western Pennsylvania up into Western New York State and down the Ohio River Valley into the states of Ohio, Kentucky, and West Virginia.

Historians are much clearer, however, in naming the "Father of Fracking": George Phydias Mitchell, who died last summer at the age of 94. The year before his death, *Economist* magazine noted his vital role in the development of fracking:

The rise has been helped along by a variety of factors.... But the biggest difference was due to the efforts of one man: George Mitchell ... who saw the potential for improving a known technology: fracking....

Big oil and gas companies were interested in shale gas but could not make the breakthrough in fracking to get the gas to flow. Mitchell spent 10 years and $6 million to crack the problem.

Following his death, energy historian Daniel Yergin, author of *The Prize and The Quest* and now vice-chairman of IHS, Inc., an international energy consulting company, paid homage to Mitchell:

He is responsible for what is the most important innovation in world energy so far this century. Before his breakthrough, shale gas had another name — "uneconomic" gas. It was thought that there was no way to commercially extract it.

He proved it could be done. His breakthrough in hydraulic fracturing, when combined with horizontal drilling, set off the revolution in unconventional oil and gas that we see today.

Russell Gold, the senior energy reporter for the *Wall Street Journal*, explained in his book *The Boom: How Fracking Ignited the American Energy Revolution and Changed the World* how Mitchell's fracking process works:

The first step is to drill a long well straight down which is then typically turned so that the hole, known as a wellbore, runs parallel to the surface, traveling through the horizontal layer of shale....

When the drill bit churns its way into [the shale formation], the oil and gas stampede into the well.

But shale is so solid that next to nothing enters the well unless it is "stimulated." A company pumps in liquid — mostly water, mixed with sand and a cocktail of chemicals to reduce friction, thicken the water, and kill any hitchhiking bacteria carried from the surface — under extraordinary pressure. Water doesn't compress, so when [it is] forced up against the rock at rising pressure it will cause the rock to

break.

When it breaks, the frack fluid rushes out of the well and into the newly opened space. The fluid often carries sand which will remain behind to prop open the new fractures and prevent them from closing up again when the liquid is retrieved.…

A driller might execute dozens of fracks along the horizontal leg of a well, transforming an impermeable block into rock riddled with tiny cracks.

Controversy

Fracking has made possible tapping massive amounts of oil that otherwise would be unrecoverable, greatly benefiting the energy economy for developers and consumers alike. But not everyone is pleased with this development. Critics include not only environmental groups and think tanks, such as the Club of Rome, which claim fracking is destroying the environment (see "Fracking Mythbusters"), but even citizens living in the boom areas who don't want drilling in their backyards. Efforts by energy companies to extract oil from the Barnett Shale formation have been so extensive that there is hardly a citizen living above ground there who can't see a fracking well from his front yard.

And some of them don't like what they see and hear. The rumble of trucks bringing sand and water and equipment and roughnecks to the well at all hours of the day and night not only degrades the roads but also impairs life as these citizens used to know it. Those who have sold their mineral rights to the energy developers are putting up with the circus atmosphere in exchange for a regular monthly check sometimes amounting to thousands of dollars.

Those without leases, however, are increasingly taking a different point of view and are complaining to local authorities about the intrusion that fracking is making into their lives.

Southlake, Texas, is one example. It is an affluent community boasting a mean household income of more than $216,000, whose ZIP Code is ranked as the richest in the United States in towns with a population between 10,000 and 25,000 people. It is located within the Dallas-Fort Worth metropolitan area and is the home of numerous active and retired professional football players, including Terry Bradshaw, Tony Romo, DeMarcus Ware, Marcus Spears, Pat Summerall, and Julius Jones. It also was, until 2009, a calm, placid, pretty, and peaceful place to live. That year, John Terrell was elected mayor of Southlake on his pledge to "preserve Southlake as a great place to live, work and play." As Gold explained:

His plan went well for a few months until Exxon Mobil applied to drill a gas well. The ensuing fight shredded the city's self-image as a place of fraternal goodwill and easy access to upscale shopping.

"Get the Frack out of Here" signs appeared on well-kept lawns. Two citizens groups emerged: the anti-drilling Southlake Taxpayers Against Neighborhood Drilling (STAND) and the pro-drilling Southlake Citizens For Property Rights.

The groups sued each other and the city.

So intense became the debate that, a year later, Exxon withdrew its application to drill.

As the debate over fracking continues to intensify, the question then arises: What's next? Charles Hall, a professor of systems ecology at the State University of New York, put it well:

We have had a wonderful ride on cheap oil. Sustaining anything like that for the future in a world where the population still grows, and the environmental problems that affect the resources that people are dependent upon mount, will be an enormous challenge.

Hall holds that cheap oil and natural gas are a temporary phenomenon that only mask and delay a more serious discussion over what comes next.

The question has nothing to do with the theory of "peak oil" proposed by M. King Hubbert in 1956, which states that fossil fuel production in a given region over time would follow roughly a bell-shaped curve. At some point, goes the theory, production of oil and natural gas will reach a peak and then start to decline. Hubbert predicted the peak of oil and gas production would occur in the United States in the early 1970s.

For a while it appeared that Hubbert's theory had validity, as oil production in the United States peaked at a little over 10 million barrels per day in the mid-70s. As it started to decline, however, Mitchell's hydraulic fracking process entered the picture, and the curve turned upward once again. As professor emeritus of economics at the Massachusetts Institute of Technology Morris Adelman (no relation to the author) put it: "No mineral, including oil, will ever be exhausted. If and when the cost of finding and extracting goes above the price consumers are willing to pay, the [oil and gas] industry will begin to disappear."

But a much bigger question is whether the energy industry itself will someday disappear. Put simply, is there such a thing as "peak energy"? The answer to that question is a flat "no." The First Law of Thermodynamics states that energycan be transformed from one form to another but cannot be created or destroyed. The trick is in finding it, and then affording the cost to harness it when it's found.

Where to Now?

The various sources for the energy that we consume have changed in the past, and they will surely change in the future. Prior to the industrial revolution, our energy came mostly from wood — but concerns that growing energy demands would deplete the forests quickly vanished when other energy sources — coal, oil, natural gas — became widely used. In fact, oil and natural gas are relatively new sources of energy: The first commercial oil well was not drilled in the United States until 1859. And nuclear power is newer still.

What sources might we rely on for our energy needs a hundred years from now? There is no way of knowing for sure. It may include energy sources we don't even know exist, just as nuclear power was unheard of prior to the splitting of the atom in the 20th century.

But it is entirely reasonable to expect nuclear power to play a much bigger role in the years ahead than it is now — not only because of the vast amounts of energy that can be tapped from this source but also because environmentalists are warming up to its potential. Let's take a look at it, keeping in mind that this is just one reason why "peak energy" is a silly notion.

Gwyneth Cravens, a hard-core environmentalist, was one of the first to change her mind regarding generating power through the use of fourth-generation (4G) nuclear power plants. In 2008, her transformative book, Power to Save the World: The Truth About Nuclear Energy, shocked environmentalists around the world and changed many minds. For instance, one hard-core environmentalist reviewed the book and described her conversion:

Until I read Gwyneth Cravens' *Power to Save the World*, I would've described myself as an anti-nuke, pro-solar-and-wind-mills mom and responsible inhabitant of this planet.

[Now I] can't help but recognize [my] own misconceptions and outdated information about nuclear energy….

While no industrial power source is trouble-free, it's clear that carbon-free nuclear power is vastly preferable to burning coal.

Another anti-nuke environmentalist experienced the same conversion:

Before I read it, I was certain that I knew that nuclear energy was highly risky and a threat to all. I now understand that I actually knew very little. Despite every good intention, I had been pulled into a mindless groupthink about Three Mile Island, Chernobyl and by the very green movement I love.

So persuasive was Cravens' book that she has been repeatedly invited to give presentations about the advantages of 4G nuclear power to such pro-green groups as the Brookings Institution and the Progressive Policy Institute.

In December 2013, noted environmentalist film director Robert Stone (Earth Days, American Babylon) reversed course and presented the film Pandora's Promise at Robert Redford's Sundance Film Festival. In his film Stone tells of the personal radical conversions of environmentalists and energy experts from being fiercely anti-nuclear energy to becoming strongly pro-nuclear power, risking their careers and reputations in the process. Available on YouTube, Pandora's Promise has received praise from expected sources such as Danny Roderick, president and chief executive officer of Westinghouse Electric Company, a leading nuclear energy company and worldwide supplier of nuclear plant products and technologies. Said Roderick:

CNN Films' documentary Pandora's Promise correctly suggests that nuclear power is the safest, most stable and most secure option for … providing a readily available supply of clean and abundant energy — from sources that are affordable, scalable to meet long-term demand and that do not compound the problem of global climate change.

While the United States remains stuck in the quagmire of the present anti-nuclear mind-set, other countries around the world are building nuclear power plants as fast as they can fabricate them. At present there are 430 nuclear reactors worldwide with more than 70 in some phase of project development or construction in 14 countries, 27 of them in China alone. Although there are six new 4G nuclear power plants under construction in the United States, none of them will be coming online before 2020.

With the continuing conversions of people such as Victor Stenger, the anti-nuclear stance of traditional environmentalists is rapidly evaporating. Stenger, with advanced degrees in physics from UCLA and positions on the faculties of the University of Heidelberg in Germany and Oxford in England, talked up the advantages of nuclear power to his audience at Huffington Post. In an article dated January 2012, Stenger gave the obligatory lip service to the dangers of pollution by burning carbon fuels:

According to the World Health Organization, urban outdoor air pollution is estimated to cause 1.3 million deaths worldwide per year from respiratory infections, heart disease, and lung cancer.

Indoor air pollution is estimated to cause approximately 2 million premature deaths mostly in developing countries. Almost half of these deaths are due to pneumonia in children under five years of

age.

The source in both cases is carbon combustion from fossil fuels or biomass.

The overwhelming majority of climate scientists tell us that the greenhouse gases generated by human carbon combustion are likely to trigger disastrous global climate change in the decades ahead. And even those who deny this surely must admit that the world would be a better place if we could find an economically feasible and safe alternative to the use of carbon combustion as our primary source of energy.

And then he delights to tell his audience that he has found just that alternative: nuclear power. He wrote:

Currently the liquid fluoride thorium reactor (LFTR) is having a resurgence of interest worldwide. Let me list the advantages of an electrical power plant based on LFTR as compared to conventional nuclear and fossil fuel plants:

Thorium is plentiful and inexpensive. 1 ton … can power a 1,000-megawatt plant for a year. 1 pound of thorium yields as much power [as] 3.5 million tons of coal.

[LFTR] obviates the need for a large, expensive containment dome [because it has] little danger of explosion.…

Any spilled fuel solidifies instead of escaping into the environment.

The radioactive waste is much less than from conventional plants and [is] far more manageable.

[It] can't be used to build bombs.

And, saving what many environmentalists would view as the best for last, Stenger concluded, "Liquid fluoride thorium reactors could provide the world's energy needs *carbon free for 1,000 years*." (Emphasis added.)

It is inevitable that the current fracking boom will eventually end, potentially giving 4G nuclear power generation its time in the sun. Without opposition from environmentalists such as Stenger and Cravens, that time is likely to come sooner than later. It's not unreasonable to expect that within the next one or two generations nuclear power will be providing a vastly greater part of the world's energy needs, even as that world increases its thirst for energy to drive increasingly energy-centric technology.

Nor, as already indicated, is it unreasonable to speculate that there could be even more marvelous ways of generating energy as unknown to us today as nuclear power was at the beginning of the 20th century.

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