MANAGER INSIGHTS

U.S. Unconventional Natural Gas Resources: A Sustainable Competitive Advantage

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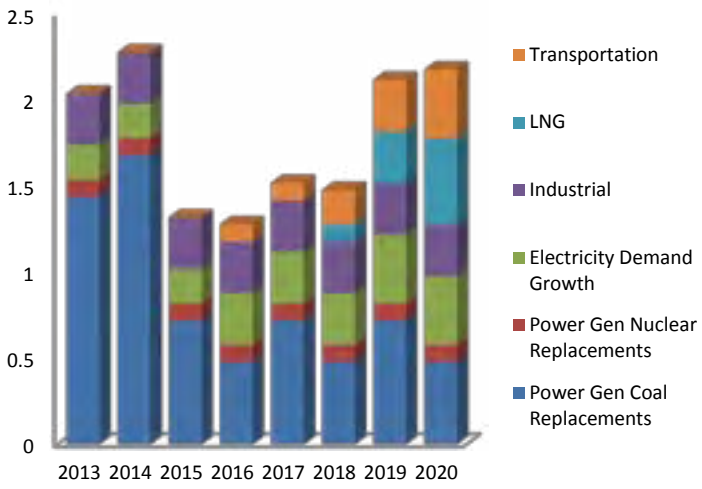
With over 25 years of experience working as both an exploration geologist and an analyst covering global energy companies, Shawn Reynolds is a veteran of the energy space. He has been quoted in myriad trade publications and has authored articles published in technical periodicals focusing on the reservoir architecture of potential hydrocarbon basins around the world.

The emergence of commercially viable unconventional natural gas resources (including shale, tight sands and coal bead methane) in the U.S. has, in my opinion, dramatically impacted the domestic natural gas supply industry and could have the potential to lead a secular transformation of the natural gas demand market. The combination and refinement of two critical technologies, extended reach horizontal drilling and hydraulic fracturing, have altered the marginal cost of production and enabled the economic supply of vast new reserves of natural gas at prices not seen in over a decade. In response to this supply availability and resultant price action, I believe we have seen and will continue to see a structural demand response. I think there are four key markets that will drive steadily higher natural gas consumption in the U.S. over the next 15 years: 1) power generation; 2) basic materials; 3) liquefied natural gas (LNG); and 4) transportation and industrial engine applications. Almost 2 billion cubic feet (Bcf) per year in incremental demand could come from these sources, potentially increasing natural gas demand by 15-25% within the next decade. Ultimately, I believe a new equilibrium price for U.S. natural gas may settle substantially higher than levels seen over the past several years. Nevertheless, I also believe that demand responses will drive infrastructure, industrial and commercial benefits to the U.S. that will serve as sustainable competitive advantages.

FIGURE 1: DEMAND TRENDS IN BCF/D BY CATEGORY



Source: U.S. Energy Information Administration; Simmons Research

During the 1990s, U.S. natural gas prices rose gradually, by roughly 50%, as domestic demand slowly burned through the gas bubble of the late 1970s and 1980s. As oil and gas exploration and production (E&P) companies steadily gained more confidence in a balancing supply/demand market, they began to broaden their search for new natural gas resources using innovative and enhanced technological applications. Seismic stratigraphy and bright-spot imaging initially facilitated the identification of huge conventional prospects in the Gulf of Mexico. Coal seams had been known for centuries to hold substantial quantities of methane gas, but it wasn't until the mid-1990s that a concerted industry effort coalesced to hone the processes necessary to produce commercial volumes. Eventually, a few E&P pioneers embraced the idea that the combination of horizontal drilling and hydraulic fracturing was the route to unlocking the vast reserves embedded in ubiquitous shale formations.

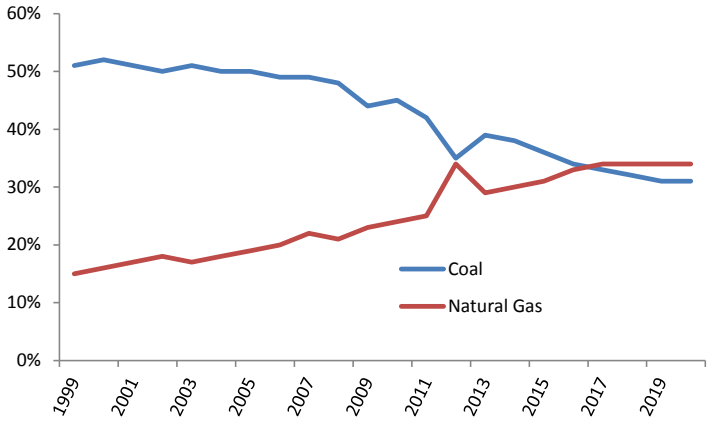
Shale rocks are the primary source of oil and gas for traditional reservoirs throughout the globe. The organic material that is infused in shale is converted into crude oil and natural gas by pressure and heat. As the shale formation gets buried deeper and deeper, oil and gas are squeezed out of the shale rock, migrating into more porous and permeable material, typically sandstone or limestone, and ultimately get trapped into a geographically and geometrically discrete deposit. However, much like any ordinary sponge, even though some of the hydrocarbon material is expelled from the shale, a significant amount is retained in the original host formation. The quest to extricate these reserves on a commercial basis has been the Holy Grail of exploration companies for many decades.

Horizontal drilling and hydraulic fracturing have been used by the oil and gas industry since the 1940s and 1950s. In fact, extended reach horizontal drilling has been standard practice in the Russian oil fields since the modern inception of the industry in the mid-1940s, and ultra-extended horizontal wells have been used in the U.K. and Russia for decades. Similarly, fracturing has been used as a stimulation technology to enhance oil and gas production almost since the beginning of the domestic U.S. industry. For some time, nearly every well drilled onshore in the U.S. has been fracture stimulated in one fashion or another. Hence, I do not think that it is the invention of these technologies that has led to the unconventional resource awakening, but rather the extension and refinement of their capabilities, and ultimately the integration of their application.

I believe the impact this development has had on the upstream oil and gas industry's fundamental business model is substantial. The traditional approach to exploration resulted in success or failure – either hydrocarbons were discovered or the well was deemed dry. Explorationists used Monte Carlo simulations, option theory and various other probabilistic risk assessments to aid in the construction of a drilling portfolio that would, in aggregate, deliver profitable returns on exploration capital. The advent of the unconventional approach eliminated the largest and most difficult to quantify risk of drilling the well – whether hydrocarbons exist or not. By definition, an unconventional reservoir has oil and/or gas present. The critical business decision is whether the hydrocarbons can be produced on an economical basis. The discovery process has now transmuted from a risk taking system to a manufacturing efficiency and optimization exercise. As a result, an immense and precisely documented inventory of primarily gas reserves has been established and, vitally, the extraction costs are well known. Thus, to the great benefit of U.S. consumers, there is unique visibility on the security of supply and of the cost of that supply.

In my view, structural demand adjustments are already taking place in response to this new industry framework. And while economics generally have been the primary driver, I believe regulatory and governmental influences have had, and will likely continue to have, significant influence on future consumption patterns. This is most readily observed in the electric power generation market. Gas for coal substitution in the power sector has been prominent since 2005. However, in 2012, with natural gas prices falling to below $2/Mcf (the lowest in over a decade) coinciding with numerous proposed EPA mandates to limit or eliminate coal-fired generation capacity (e.g. MATS, CSPAR, CCR, etc.), switching from gas to coal ramped dramatically and natural gas, for the first time, accounted for more electricity output than coal. A correction in thermal coal prices in 2012 has made it more competitive on a price basis and currently, coal has regained its position as the leading fuel for generation. However, its share is still below historical norms and expected coal plant retirements will, in my opinion, eventually lead to natural gas becoming the dominant power generation fuel.

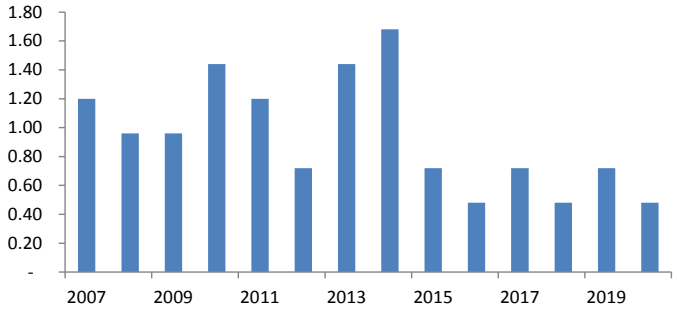
FIGURE 2: SHARE OF GENERATION CAPACITY



Source: IEA, Goldman Sachs Research

Outlooks vary widely, but even conservative estimates suggest a substantial increase in natural gas-fired power generation capacity over the next few years.

FIGURE 3: NATURAL GAS INCREMENTAL DEMAND FROM ADDITIONAL POWER GENERATION CAPACITY



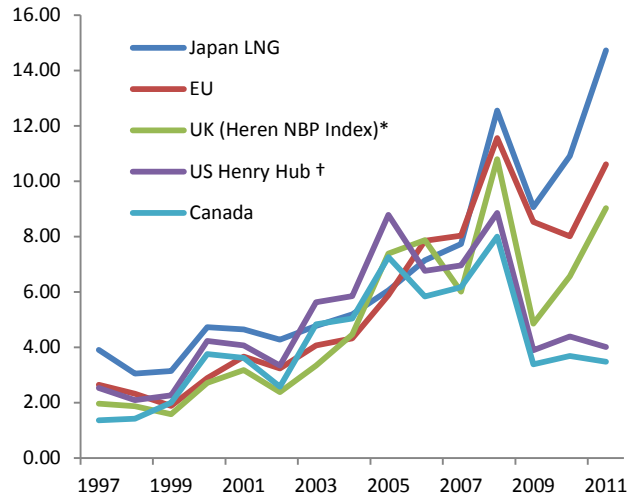
Source: U.S. Energy Information Administration; Goldman Sachs Research

Current domestic natural gas prices are some of the lowest in the world and, I believe, they have helped create a global competitive advantage for U.S. manufacturers. Refiners, petrochemical producers, fertilizer companies, steel manufactures and many other basic materials companies are benefiting greatly from cheap natural gas which is used as both a fuel and a feedstock. There has been a renaissance of commodity petrochemical output, particularly in the Gulf Coast region. Plant restarts and expansions have been significant and new greenfield capacity has also been announced. These are projected to grow U.S. petrochemical volumes roughly 3% per year for the foreseeable future, and may exceed the growth of the overall U.S. economy. Planned expansions typically tend to be located in non-traditional locations such as Shell's new facility in Pennsylvania, which intends to capitalize on the huge, low cost reserves of the Marcellus Shale.

A massive price differential exists between North American natural gas supply and most other sources delivered worldwide. The attempt to capture this arbitrage has led to numerous proposals to establish LNG exports. Plans are significantly advanced in western Canada, which could see large export volumes initiated in the next five years. In the U.S. and Canada, 12 liquefaction and export projects have been launched and, I believe, it is likely that at least one or two will advance to reality.

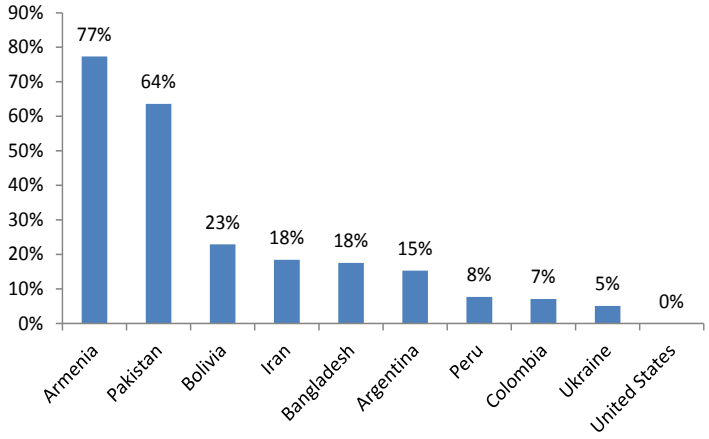
A recent Department of Energy study evaluated scenarios ranging from LNG exports of 6-12 billion cubic feet per day (Bcf/d) and found no longer term deleterious effects on the U.S. economy. It would appear a conservative assumption that the U.S. could be exporting at least 1-3 Bcf/d beginning three to five years from now.

FIGURE 4: NORTH AMERICAN NATURAL GAS (PURPLE) MUCH LOWER THAN REST OF WORLD



Source: BP

FIGURE 5: NATURAL GAS VEHICLES AS A PERCENTAGE OF TOTAL VEHICLES



Source: NGV Global, http://www.iangv.org/current-ngv-stats/

In my opinion, perhaps the most alluring new source of natural gas demand could be in the form of increased gas-fired engine usage via natural gas vehicles (NGVs) and/or in various industrial applications. Despite being poorly recognized in the U.S., the NGV market has been well established for decades in countries as far flung as New Zealand, Argentina and Pakistan. Currently it is estimated that there are more than 17 million NGVs operating worldwide. Natural gas can be used as a fuel in many different transportation modes and classes of vehicles – motorcycles, cars, vans, light and heavy duty trucks, buses, lift trucks, locomotives, and even ships and ferries. NGV usage in the U.S. is very much in its infancy (see chart above right) with fewer than 200,000 vehicles on the road today, representing a 0.1% penetration rate. This compares to some 2.9 million natural gas vehicles a country such as Pakistan, with a penetration rate of 64%, and 1.9 million NGV's in Argentina, with a penetration rate of 15%.

Nevertheless, adoption of the technology in the U.S. is increasing, particularly for large fleet operators. Currently, there are more than 7,000 buses in municipal service across North America fueled by natural gas. LA Metro has one of the largest transit fleets, boasting more than 1,500 natural gas buses. It recently ordered 900 new buses, moving it closer to its goal of being 100% natural gas. While these numbers do not yet necessarily translate into a meaningful portion of gas consumption, I believe even minor penetration could lead to significant demand. For example, conversion of roughly 10% of the passenger car fleet could require approximately 6 Bcf/d. Conversion of a similar level of long-haul trucks could add another 1-6 Bcf/d to demand.

The development of enormous unconventional natural gas reserves has already impacted the industry's supply curve, leading to lower prices. In text book fashion, a consumption response is occurring which I believe will lead to a gradual shift in the demand curve, and ultimately a higher price to balance the North American natural gas market. Despite any expectation of stronger prices, I believe the U.S. will continue to be the beneficiary of a significant competitive advantage in the form of relatively cheap energy supplies for many years to come.

Investments in the unconventional oil and gas sector are exposed to certain risks that include, among others, volatility of energy prices, exploration and production spending, operating hazards, limited production history, royalty interests, liens and other burdens, third-party pipeline availability and capacity, and an evolving regulatory environment.