A drilling rig in the Marcellus Shale in Pennsylvania

Dash for Gas, 21st-Century Style!

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Since the price deregulation in natural gas was enacted in the 1990s, there has been roughly one "dash for gas" every decade. These dashes for gas have influenced the globalization of the gas industry while being uniquely North American and European phenomena. The first two involved increasing demands from the power sectors in Europe and the United States which were chasing what appeared to be dwindling supplies. The current dash for gas is fundamentally different and is driven by flush supplies in North America chasing multiple new markets. The nature of the current dash for gas has more potential to induce a globalized market for natural gas than did the previous episodes.

Keywords: natural gas markets, deregulation, liquified natural gas, unconventional gas boom, global natural gas pricing

INTRODUCTION

In the 1970s, there was an old joke among oil men that went something like this[2]:

> An oil executive walks into a bar and sees a wildcatter staring into his drink.
>
> "What's the matter," says the oil executive, "another dry hole?"
>
> "Worse," says the wildcatter, "we found *gas*."

For many years, natural gas was viewed as a poor cousin to oil. This low-value by-product was simply "flared" at the wellhead (i.e. burned off at the point of gas production) or vented directly into the atmosphere. Gas pipeline infrastructure was costly to construct, and for many years, gas prices were tightly regulated by virtually all governments. The emergence of a "market" for natural gas did not take place until the United States began limited wellhead price deregulation in the 1970s and the European Union liberalized its cross-border gas trade a decade later.[3] Combined with a global excess supply of natural gas until the early 1970s, the reputation of the poor cousin certainly seemed deserved.

For a commodity considered to be a poor cousin, the history of natural gas trade over the past several decades has been one of unusual concern over gas supplies (either an excess or a shortage of supplies) and of an active governmental role in natural gas trade, until wellhead price deregulation. The prospect of increased supplies through unconventional drilling has set off another wave of potential opportunities in the gas market, but as the history of natural gas trade shows, every wave of interest has come with its own adjustment problems.

Since price deregulation in the 1990s, there has been roughly one so-called "dash for gas" every several years. The first two occurred in the United Kingdom and United States, in conjunction with restructuring of the electricity sector. The most recent one, centered on North America (but with a distinctly global flair) is fundamentally different. These dashes for gas, alongside recent growth in Asian demand for transoceanic shipments of liquified natural gas (LNG), have been critical to the evolution of the global natural gas industry. The dashes for gas have also been uniquely North American and European stories—at least up until the present.

A DIFFERENT TYPE OF COMMODITY

In theory, trade in natural gas should be easier and more peaceful than trade in other energy commodities such as crude oil and coal. Natural gas is generally uniform in quality or can easily be processed to produce a standardized commodity. Countries do not routinely invade one another for their natural gas supplies, as has happened countless times with oil (Fesharaki 2012). In practice, however, trade in natural gas can be quite difficult because of the exposure faced by both buyers and sellers. In other energy commodity markets, such as oil and coal, the risks are largely contained in exploration and production. Many transport modes can be used to get these commodities to market, and (at least in the oil market) a large number of buyers and sellers operate in a market that is global in scope. In contrast, the development of a gas field is inextricably tied to demand for the produced gas and to the existence of a pipeline infrastructure that will deliver the gas. This creates a "chicken and egg" problem because the pipeline cannot be justified without gas being produced on the upstream end. Thus, both buyers and sellers are exposed to transportation risks. It is because of this exposure that long-term contracts dominated the natural gas industry

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2 This joke was sourced from Fesharaki (2012) although its exact origin is unclear. The term *wildcatter* comes from the American oil industry and was used to describe people or firms drilling for oil in areas not previously thought to host productive formations.

3 Natural gas is priced at many different types of locations, depending on where transactions occur along the supply chain. "Wellhead" prices denote the price of gas at the point of production.

for many years. For example, during the 1950s and 1960s, long-term supply contracts locked in low prices basically for the productive life of entire gas fields.

Early Historical Perspective Provides Insights

When the price of something is low, people typically demand more of it, and natural gas is no exception. With prices held low through regulation and long-term contracting, natural gas found a useful life as a fuel for industry and power-generation facilities. But the trouble with low prices is that no one wants to sell something on the cheap. Signs of shortages began to emerge during the 1960s and 1970s as exploration for gas declined, and exploration for oil also stagnated due to regulations that held oil prices low. Oil import quotas in place in the United States (lifted just prior to the oil embargo in 1973) provided additional disincentives to global oil and gas exploration. This perception of physical shortage coupled with regulations keeping prices low led to an odd set of circumstances that culminated in the U.S. Fuel Use Act of 1978, which limited the use of natural gas in industrial boilers, including power-generation facilities. So while one set of forces was keeping prices (somewhat artificially) low and acting to increase demand, reduced exploration was an opposing force that constrained consumption of natural gas.

In addition to the U.S. Fuel Use Act, the U.S. Natural Gas Pricing Act was also passed in 1978. This replaced the existing regime of gas price regulation with a complicated system of tiers meant to encourage the development of new natural gas assets. The basic idea was that "old" gas would continue to be priced at historically low levels while "new" gas developments could enjoy higher prices. This system was eventually replaced by full wellhead price deregulation in the early 1990s. While the tiered pricing system was complicated, it did work, and encouraged enough new gas development that shortages in gas supplies reversed to surpluses within a single decade. As a result, the restrictions imposed by the U.S. Fuel Use Act were progressively relaxed and eliminated in the 1980s. This first shot at natural gas price deregulation was followed in the ensuing years by similar initiatives to create more market-based gas pricing in the United Kingdom and the European Union.

Geographic Shift in the Supply–Demand Picture

The current dash for gas, which is the focus of this article, is different because it represents a confluence of regional excess supply seeking new markets with the prospective opening of new domestic and globalized markets. The "dash" in this case is not for the gas supply per se, but rather a rush to establish new market opportunities for unconventional gas supplies that could be exported. In many ways the current gas market is trying its hardest to follow Say's Law, which states that supply can create its own demand.

Much of the dynamic of the current dash for gas is due to a geographic shift in the global supply and demand picture for natural gas. Conventional gas reserves are concentrated in regions that have historically been important oil producers, such as Russia, the former Soviet states, and the Middle East. Unconventional gas resources—of which gas-bearing shales are an important component—are distributed more broadly (Fig. 1, for shale gas specifically). Production in North America has dominated the unconventional gas boom since its inception in the mid-2000s, and no other region (with the possible exception of China, with its coalbed methane resources) appears able to ramp up capacity anywhere nearly as quickly.

Although exact resource estimates for the global unconventional gas sector are uncertain because of imperfect or nonexistent resource estimates in many regions, these unconventional resources (which include tight gas and coalbed methane in addition to shale gas) could increase technically recoverable gas reserves by more than 65% globally (McGlade et al. 2013). Meanwhile, the growth in demand for natural gas in North America (the largest producer of unconventional resources) has been slow and limited to the power-generation sector.

The unconventional natural gas boom is, at the present time, primarily a North American phenomenon focused on extraction from shales and tight-sand formations, but many other countries have unconventional gas resources that could be extracted under the right political and market circumstances. Whether the unconventional gas boom remains centered on North America or not, it has the potential to change the geopolitics of energy. Unconventional natural gas could allow Asia to meet its energy needs without increased reliance on coal or oil and without needing to commit to risky pipeline projects (for example, to carry Russian gas through North Korea to the south). It could contribute to diversifying natural gas supplies in Europe (Bocora 2012). In the near term (at least until other countries are able to develop unconventional gas resources), this potential depends especially on the current North American dash to capture increased supplies and on how much of those supplies make it to global markets versus domestic markets in North America.

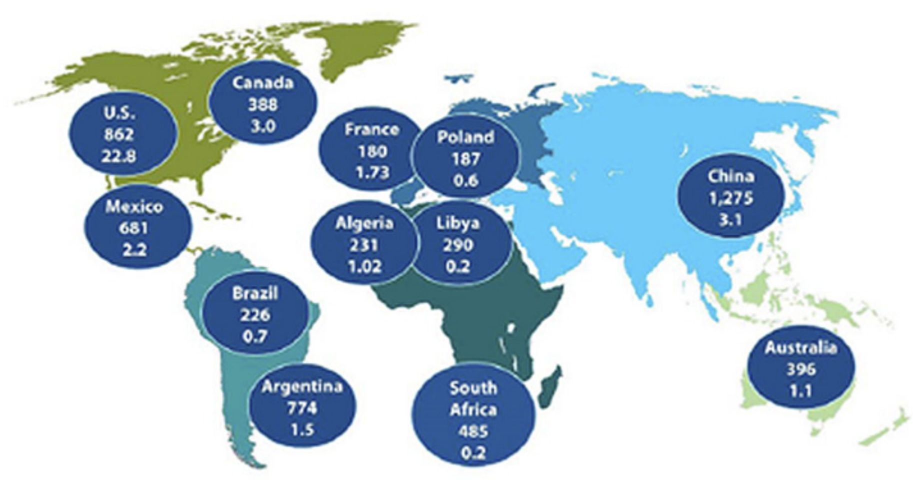

Figure 1 Estimates of technically recoverable shale gas reserves (trillion cubic feet; top number in each bubble) and annual natural gas demand (trillion cubic feet per year; bottom number in each bubble) for several countries where technically recoverable reserve estimates have been made. Source: U.S. Energy Information Administration (www.eia.gov/analysis/studies/worldshalegas)

THE DASH DURING THE 1990S AND 2000S

Natural Gas for Power Generation

The original dash for gas began in the United Kingdom during the 1990s shortly after electricity generation was deregulated (Winskel 2002). This market transformation had an immediate and dramatic result with the rapid adoption of combined-cycle gas turbine (CCGT) technology for power stations within the UK (Watson 1997; Kern 2012). The exact reasons for this rapid transition are unclear and debated somewhat, but at least three factors likely contributed. First, one of the primary motivations for electricity restructuring in the United Kingdom was to reduce the political power of the coal-mining union. This was successful and coal prices rose as supply shrank, making natural gas competitive. Second, advances in CCGT technology made those investment decisions look increasingly attractive relative to coal-fired plants. Third, there were fewer regulatory strings attached to the new CCGT entrants, and the flexible operation of the natural gas plants matched well with the UK electricity market structure, in which generators would offer supplies into a half-hourly auction known as the "pool" (Wolak and Patrick 2001).

The resulting movement towards CCGTs became known as (and was even celebrated by the government as) the "dash for gas," and natural gas demand increased in the United Kingdom by 20% in the space of several years from the mid-1990s through the early 2000s. Because gas was plentiful from North Sea fields and coal prices were still relatively high, electricity prices were kept low, which made the United Kingdom's electricity restructuring experiment seem like a success.

However, the dash for gas could not stop the laws of economics. After the demand for gas went up and the demand for coal went down, so went their prices. Beginning around 2004, both gas and electricity prices began to spike dramatically in the United Kingdom (Wolak and Patrick 2001). FIGURE 2 illustrates this price spike for natural gas. The lesson of the dash for gas in the United Kingdom amounted to more than just the simple economics of coal–gas competition—it illustrated how overleveraging a single fuel source or technology might look good when the fuel price is low, but exposed both consumers and producers to volatility. This lesson has been hard-learned in many parts of the world. Most recently, for example, a heavy reliance on natural gas for power generation in the New England states of the United States, combined with scarce gas transmission capacity, resulted in both gas and electricity price spikes in each of the winters of 2012–2013 and 2013–2014.

Not to be outdone by their counterparts in the United Kingdom, power-generation companies in the United States went on their own dash for gas following the restructuring of the electricity sector during the mid and late 1990s. The amount of natural gas used for power generation in the United States essentially doubled between the mid-1990s and 2008 (when the global recession began to affect power demand and the unconventional gas revolution took off), as shown in FIGURE 3. Since natural gas demand in other sectors of the economy had been essentially flat or declining (more detail is shown in FIGURE 4), particularly in the industrial sector, the demands from the power-generation sector began to represent the "swing demand" that drove the pricing in the North American natural gas market. The resulting upward swings in price and in price volatility are also shown in FIGURE 3.

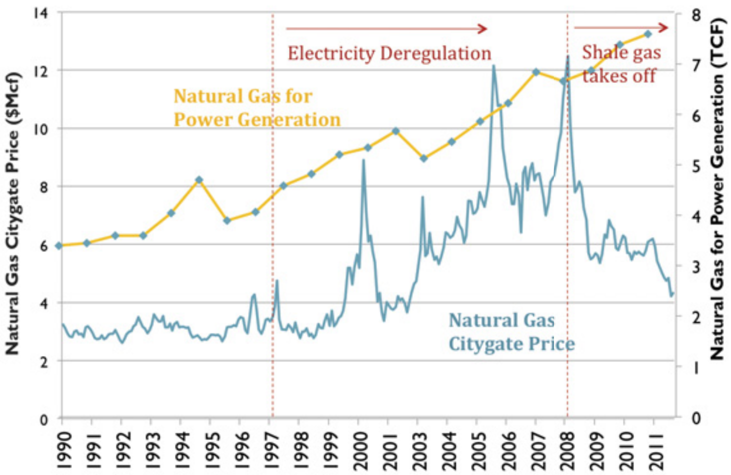

FIGURE 3 Natural gas price, in dollar per thousand cubic feet ($/Mcf) and the consumption of natural gas for power generation in the United States, in trillion cubic feet (TCF), from 1990 to 2012. DATA TAKEN FROM THE U.S. ENERGY INFORMATION ADMINISTRATION NATURAL GAS DATA PAGE (WWW.EIA.GOV/NATURALGAS)

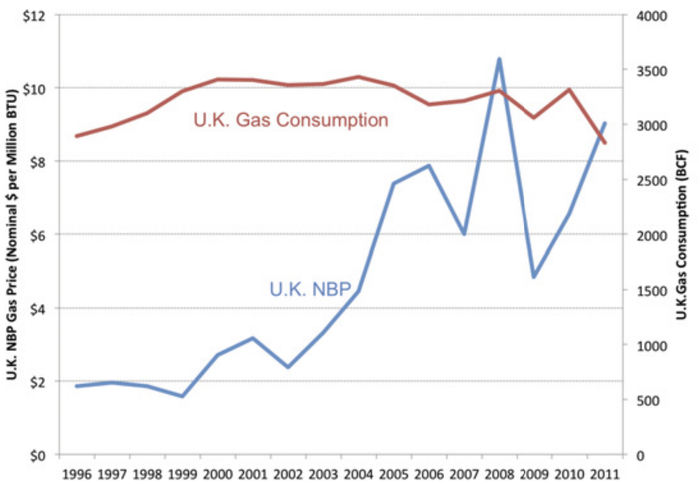

FIGURE 2 Natural gas prices at the U.K. national balancing point (NPB) and national gas consumption in billion cubic feet (BCF). DATA TAKEN FROM THE BP STATISTICAL REVIEW OF WORLD ENERGY (WWW.BP.COM/EN/GLOBAL/CORPORATE/ABOUT-BP/ENERGY-ECONOMICS/STATISTICAL-REVIEW-OF-WORLD-ENERGY.HTML)

Just as in the United Kingdom case, the United States had a number of reasons for the shift towards natural gas in power generation. Relative to other technologies, natural gas plants could more flexibly integrate into the deregulated markets being established in the United States, covering roughly half the states and two-thirds of electricity demand. Like their counterparts in the United Kingdom, American electricity markets featured auction structures where the prices could change every hour or every half hour. In fact, as computational power advanced, some electricity markets began calculating prices on a five-minute basis, starting in the mid-2000s. Increasingly stringent environmental controls on coal-fired generation also implicitly encouraged the construction of gas-fired plants, as have (ironically) mandates for renewable energy such as wind and solar power. Natural gas plants do not benefit directly from these mandates, but they are sufficiently flexible to be able to provide backup services to electric-grid operators in the event that renewable energy sources cannot provide electricity as desired.

Post-Deregulation Era Favors Gas-Fired Generation

The way in which power plants were financed during the post-deregulation era in the United States also introduced incentives to favor gas-fired power generation over other technologies. Those areas that adopted competitive markets stopped the practice of guaranteeing cost recovery for new power plants. New power-generation plants would need to earn profits from selling valued services to electric system operators.

This change shifted patterns of investment capital in important ways. Power plant projects, which under the previous regulated regime would have been guaranteed cost recovery over a 20- or 30-year period, now had to compete with other investment vehicles that could earn a large return on investment in a much shorter time horizon. This was advantageous for natural gas plants because of shorter build times. For example, a natural gas plant can be constructed and producing electricity within a year or two, whereas a similarly sized coal or nuclear plant might take a decade or longer for siting and construction.

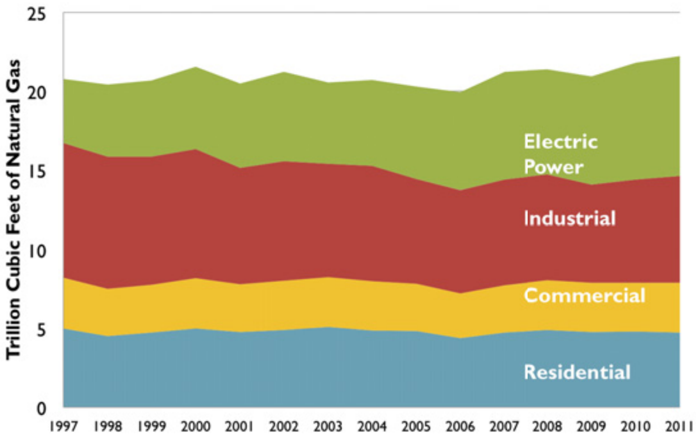

Figure 4 Natural gas consumption in the United States, by sector, 1997–2011. Data taken from the U.S. Energy Information Administration natural gas data page (www.eia.gov/naturalgas)

In North America, the rapid shift towards natural gas for power generation was seen as something of a foregone conclusion, given the difficult market and regulatory realities faced by the coal sector. The only problem was finding sufficient gas to fuel all the plants. Natural gas supplies had been perceived to be so scarce for so many years that another foregone conclusion was that North America would need to ready itself to become a large importer of natural gas. In fact, around the same time that the U.S. Fuel Use Act was passed, a handmade "clock" in Washington, D.C., famously ticked down towards the day when North America would run out of economically recoverable natural gas. More than a dozen LNG import terminals were constructed, primarily along the Gulf and East Coasts, and some attention in energy-policy circles was turned towards the prospect of the United States needing to manage potential cartel-like behavior in an increasingly globalized gas market.

DASH FOR GAS, 21ST-CENTURY STYLE

The realization that vast quantities of wet and dry gas could be recovered economically from shales, tight sands, and other "unconventional" formations at any number of places globally, but especially in North America, has turned the dash-for-gas story on its head. Remember that the two previous dashes for gas were driven by the demand side, with the increasing demand from the gas-fired power-generation sector chasing what appeared to be dwindling supplies. In contrast, the current dash for gas has a very different motivation, with potential markets clamoring to be ready to access a large pool of low-cost supplies. Living in the land of plenty, however, does not provide insulation from market volatility.

It may seem strange that North America is in the midst of yet another dash for gas. After all, there is little regional pressure from the demand side to develop new gas supplies. As shown in Figure 4, demand in the United States has been flat for more than a decade. Little capacity currently exists to move North American gas to other parts of the world. In the post-2008 period, even a continued rise in gas demand in the power-generation sector has not held prices high, as shown in the right-hand portion of Figure 3. Moreover, the increase in gas demand for power generation has come largely at the expense of the coal-fired generation sector. Figure 5 illustrates how power generated from coal in the United States is at its lowest level in decades. For example, in the spring of 2012 coal's share of electricity generation was less than 40%, the lowest level since the late 1970s.

While the shift towards gas and away from coal for power generation has been rapid and dramatic, there are no guarantees that it will be permanent. In North America and Europe, new gas-fired power generation capacity competes with new capacity from wind and other renewable fuels. In countries with rapidly developing power sectors, coal is still an appealing fuel for new power stations. Any competition between natural gas and coal in the power-generation sector will quickly reverse itself with any shifts in the price of gas relative to the price of coal. For example, the cold North American winter of 2013–2014 reversed much of the previous decline in coal-fired power generation as household-heating demand bid up the market price of natural gas in most areas of the continent. Clean-energy mandates have increased the demand for power generation from other alternative fuels as well.

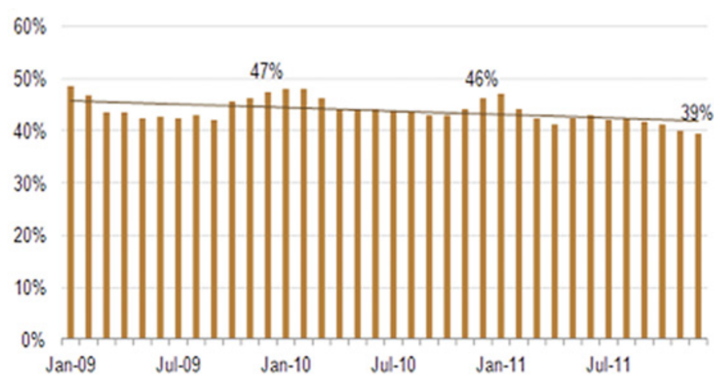

Figure 5 Share of total United States electricity generation provided by coal in the shale gas era, 2009–2012. Source: U.S. Energy Information Administration (www.eia.gov/todayinenergy/detail.cfm?id=5331)

Looking Ahead

Currently, nearly one-third of all natural gas produced in the United States is from shales or other unconventional formations, and this share is projected to continue growing, as shown in Figure 6 and discussed in a recent report by the U.S. Congressional Research Service (Ratner and Tiemann 2013). Expectations are that current low prices (see Fig. 3) will persist, more or less, over a time frame of perhaps a decade or more. While rig activity has shifted some, from dry gas areas (such as northern Pennsylvania) to wet gas regions or oil shale plays, gas production from shales has continued to rise. With market prices projected to average near the \$3/mmBTU (million BTU) or \$4/mmBTU level (in inflation-adjusted terms) over a foreseeable time horizon, it is not at all clear whether future or even current production in dry gas areas can attain acceptable returns on investment. Figure 7 illustrates the variation in break-even prices required in different shale gas regions. The break-even price is a function of geography and also of the composition of the produced hydrocarbons (note that the break-even price for wet gas plays is about half of that for dry gas plays).

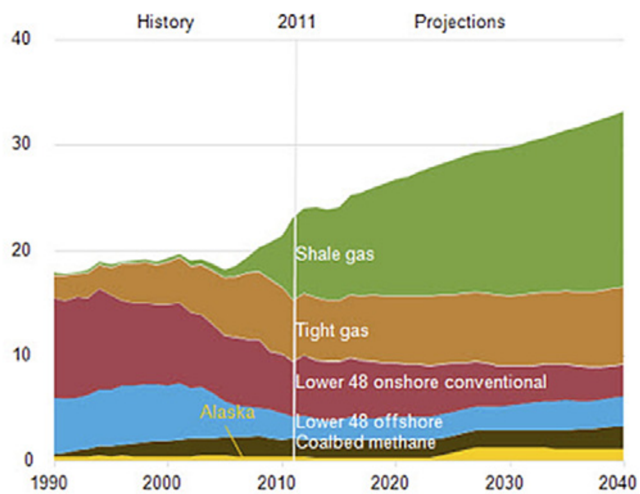

Figure 6 Historical and projected (from 2011) natural gas production (trillion cubic feet) by source in the United States. Figure source: U.S. Energy Information Administration, Annual Energy Outlook (www.eia.gov/forecasts/aeo/index.cfm).

The number of wells that companies can justify drilling in a low-commodity-price environment is not clear, yet drilling and production activity has continued during a period flush with surplus supply. In some North American shale gas plays, lease terms signed during the initial rush to acquire mineral rights specified that leases would expire unless drilling began by some specified date. The corporate structure now being employed by many gas exploration and production companies—the "master limited partnership"—compels them to produce as much as possible, since profits must flow through to investors and (unlike conventional corporate entities) cannot be sequestered for future reinvestment (*The Economist* 2013).

The 21st-century dash for gas is thus the story of impatient suppliers in one region (North America) chasing uncertain domestic and global new markets, rather than impatient consumers chasing uncertain supplies. Consumers of natural gas in North America have promoted the development of new domestic markets, but such development will undoubtedly be slow (e.g. building infrastructure for natural gas transportation or getting industry and the commercial building sector to adopt gas-fired combined heat and power; both are slow processes that would likely require some governmental coordination). Not surprisingly, producers have responded by promoting the export of LNG, in an effort to gain access to higher-priced markets in which to sell.

THE GAS MARKET GETS OILIER

Chasing higher-priced demands through globalization of continental gas markets is increasingly viewed as an attractive opportunity for producers in the current North American shale gas boom. In some ways this is more attractive than seeking out low-priced markets domestically in the United States. Many other countries also have large exploitable shale gas reserves, but a ramp-up in production in other parts of the world is unlikely to happen at the speed with which it has occurred in the United States. Few other countries have the combination of access to capital and infrastructure, privately held mineral rights, and permissive regulatory structures as in the active shale-producing regions of North America. Chinese coalbed methane is one possibility, as are unconventional resources in Australia (conditional on a successful expansion of export capacity, which has proven to be expensive). North American gas producers have suddenly found themselves in the position of being able to act as suppliers to the rest of the world, if only the infrastructure were in place to allow for those exports. In the United States, there have been fifteen applications for LNG export, five of which have been at least partially permitted. The permit process is laborious, involving multiple arms of the United States government, particularly when countries that do not have free-trade agreements with the United States are involved.

Toward a Global Pricing Model—The Henry Hub or the Oil Index?

North America has long had a natural gas market isolated from markets in Asia or in Europe (Van Vactor 2010). This isolation and the way natural gas deregulation progressed in the United States explain why the North American market has a very different way of pricing natural gas than markets in other regions of the world. Most of the world has long indexed natural gas supply contracts to the price of oil. Because the global market for oil has not softened,

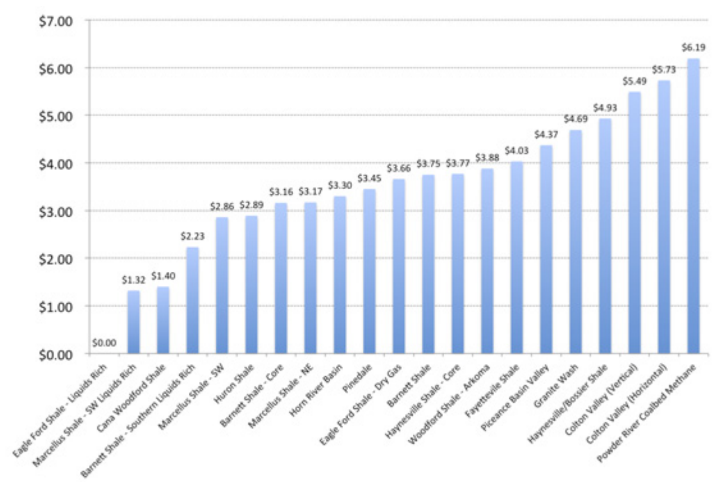

Figure 7 Break-even costs (in dollars per million BTUs of natural gas) for different natural gas plays, assuming a 10% return on revenue (after tax). Source: Blumsack et al. (2012), based on information provided by Crédit Suisse

natural gas prices in Asia and Europe have been three to seven times higher than prices in North America over the last few years.

North American gas pricing is based on a much different model, where the price in a specific location (say, Pennsylvania or California) is indexed to a centralized "marker" price, with differences between the marker price and the local price representing transportation cost differentials. The marker price used in North America is called the "Henry Hub," which refers to a major junction point in the North American gas pipeline network.

There is some movement towards a Hub-like pricing model for the rest of the world, to accommodate expected increased supplies of North American LNG. The first supply contracts for export from North America, for example, have largely been indexed to the Henry Hub price. This lowers prices for consumers importing North American LNG, but also lowers profits for the exporting companies (since the export price would be higher if contracts were based on prevailing oil prices, at least in today's oil-export market). Reports have generally estimated that as long as North American exports do not exceed 9 or 10 billion cubic feet per day (roughly equivalent to four or five export terminals the size of Sabine Pass, the first LNG export facility approved in the United States), the upward pressure on the Henry Hub price associated with LNG exporting would likely be small (US EIA 2012; Levine 2013).

Even if the rest of the world eventually moves towards a Hub-like pricing model (for which there is no guarantee), this would not eliminate the risk of price volatility. LNG supply-chain costs are very large (in the tens of billions of dollars), and as mentioned above, long-term contracts will probably continue to dominate because of the exposure faced by both buyers and sellers. This is a fundamental difference from global trade in oil, which can be more accommodating of spot markets—a barrel of oil stuck at sea can likely find a willing buyer reasonably quickly (although the seller may not necessarily be happy with the price). The prospective LNG market is different because of the commodity-specific investments necessary to facilitate LNG trade. While long-term contracts will probably continue to dominate the LNG market, the volume of short-term trading activity has been growing at a faster rate than overall LNG trade, with spot transactions exceeding 20% of the overall LNG market (Fesharaki 2012). Spot transactions at these levels provide the first evidence that cargoes of LNG on the open seas can search for higher-priced markets. Even if the Hub pricing model eventually dominates the oil-indexing model, the resulting global gas market would involve competition between regional gas production centers. As in the world oil market, the likely outcome would be that LNG supply contracts are indexed to one or more global gas pricing points (Henry Hub is one possibility, as would be the Japanese LNG price or a basket of the European "National Balancing Points"). This pricing model lowers transaction costs in global trade but could have the side effect that political and market events originating in one local gas market could reverberate throughout global gas trade.

CONCLUSION

The rapid emergence of unconventional gas plays, which could increase global gas supplies by more than 65%, has set off the third "dash for gas" in the last thirty years. The real hallmark of a 21st-century dash for gas is the global nature of the players chasing North American supplies. The dashes for gas in the 1990s (United Kingdom) and in the 2000s (United States) hinted at an increasingly globalized gas market but were largely driven by single-demand sectors in those countries.

Despite these globalization pressures, the current dash for gas is something of a two-headed beast. On the one hand, exploration and production companies in North America want higher prices for continued incentives to develop new plays. On the other hand, consumers in North America like the idea of low gas prices persisting forever, and manufacturers complain about uncertainty in future gas prices (particularly if export policies are loosened), tying energy policy to industrial policy in the major shale gas–producing region of the world.

North American energy politics is an important part of the story because gas production from unconventional reservoirs is unlikely to arise as rapidly in any other region of the world as it has in Canada and the United States. Nevertheless, the current dash for gas seems likely to culminate in a combination of the development of domestic gas markets in North America and some amount of LNG exports from North America to Europe and perhaps Asia. The magnitude of any near-term North American export activity on global gas market dynamics may be marginal, given the political sensitivities surrounding natural gas exports.

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