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The Changing Landscape of Gas Infrastructure in the U.S.

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The U.S. gas infrastructure has undergone significant changes in the last decade. The oil story has been closely covered by the media both domestically and internationally. We are all aware that domestic U.S. oil production has risen so dramatically that its dependency on imports has fallen to the extent that it could affect foreign policy, but what of the gas surge which preceded it? What lingering effects will it have?

This article looks at the last 15 years in five-year increments and examines the changes in the gas infrastructure over that period to understand what has happened and just how rapidly it has changed.

2000: A New Era for the U.S. as Gas Ran Dry

When the world was entering the new millennium, the U.S. was believed by all to be rapidly depleting its economically producible hydrocarbons. All of the natural gas supply sources available to the U.S. within the North American continent were becoming increasingly expensive.

The industry was moving to ever deeper offshore oil and gas fields and looking at increasingly distant fields in the Canadian wilds. Exploration expenditure was focused on international plays which were seen as the engine of growth for the oil and gas majors.

From 2000-2005, U.S. gas production levels were forecast to fall, thus requiring a ramp up in imports from Canada and via LNG terminals to meet domestic demand. There was a steady rise in natural gas prices at the Henry Hub in order to stimulate supply. In 2000, daily production averaged 52 Bcf/d with consumption at 64 Bcf/d, the difference being made up from net imports.

The challenge the gas industry faced was to get natural gas from remote overseas markets in to the U.S. and this was done principally via well-understood entry points on the Canadian border. These points were already interconnected to intrastate gas pipeline systems designed to serve demand centers.

Likewise, the majority of new LNG plants were conceived to substitute for depleting Gulf production, using the pipeline capacity that was going unused as production from traditional sources declined. The imported gas would all be treated to pipeline specifications, so the industry was expecting a decline in U.S. natural gas processing capacity, and few changes to the pipeline infrastructure were contemplated at the time. A glance at Figure 1 will show that there was no appreciable shale gas production.

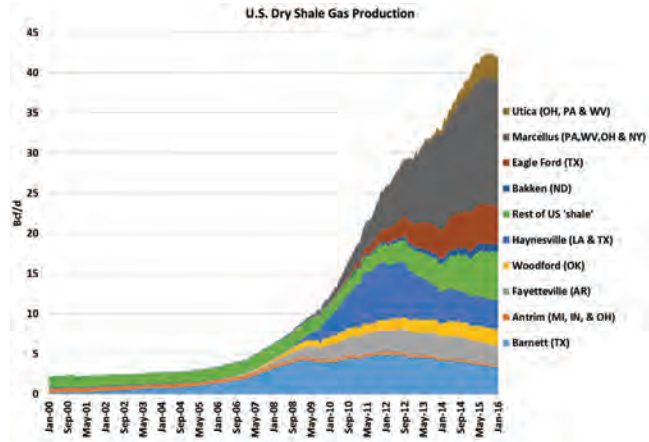

Figure 1: Shale gas production in the U.S. 2010-2016, EIA.

In 2000, Henry Hub gas averaged $4.31/MMBtu while West Texas Intermediate (WTI) averaged $30.30 per barrel and was on the verge to commence its steady ascent to $100 per barrel by 2008. Once adjusted for inflation, Henry Hub becomes $3.13 and WTI $22.40 in today's terms.

2005: Natural Gas Prices Peak, LNG Import Construction Commences

By 2005, domestic production had declined to 51 Bcf/d and consumption had fallen by almost 7% compared with 2000, to 60 Bcf/d. With flat U.S. production it was U.S. net imports that suffered with a drop of 25%. As for pricing, WTI had increased 85% to $56.54 with Henry Hub following it to $8.69 MMBtu. The experts' discussions and analysts' presentations to the gas industry had "Demand Destruction" as a major topic particularly in the petrochemical sector which was simply going to have to relocate overseas to gas-rich regions.

Analysts' forecasts showed rising prices and a "hard floor" of $5 per MMBtu. It was believed that Henry Hub prices could not fall below this level due to the immutable geological fundamentals in North America. The industry and analysts had still not seen or predicted the game changer that shale was about to become. As an example, Cheniere began construction of the Sabine LNG import terminal in 2005, as did Freeport LNG. Nobody expected or could predict that these facilities would end up becoming "white elephants" almost as they came into service, due to the looming changes in the industry.

Shale gas production still had not taken off significantly in 2005 although there was some growth and early indications of technological change. The shale revolution would start after this time frame and grow through 2008. However, the initial growth was primarily gas and oil would follow later, (see Figure 1).

2010 Change is Evident

In early 2010, shale gas production was almost six times greater than in 2000, with most of that growth occurring over just the previous 36 months. The shale gas era had clearly arrived and it revolutionized the industry. The revolution started in gas and remained focused there for the next few years. The E&P companies had not yet discovered that oil would economically flow through shales, too. Indeed, some thought oil simply wouldn't flow in sufficient volumes through shale rocks. As late as 2005, conventional wisdom was that oil couldn't

Figure 2: Shale Gas Plays, Lower 48 States

be produced commercially from shale.

Mark Papa, the former CEO of EOG recalls that, at the 2007 Goldman Sachs energy conference, numerous companies told of the vast gas reserves they had discovered. He thought to himself that "the gas price in North America is about to be ruined for the next 30 to 40 years." At this time, we did see a complete collapse of the natural gas price in North America and the birth of many gas utilization projects, including the possibility of LNG exports.

The initial production came from the Barnett Shale, the area located around and under Dallas/Fort Worth, TX, see Fig. 2. This is a traditional production region for oil and gas, so more production in this area fits with the supply and consumption patterns. By 2010, this new production in the Southwest pushed the benchmark price at Henry Hub down to $4.36 per MMBtu. In early 2010, the real game changer, the Marcellus was not a factor. So, although natural gas prices were softening across the nation, the major price differentials were still in place between regions.

During this phase of the shale development, upstream companies were targeting the addition of 'valuable natural gas reserves' to their portfolios, assuming Henry Hub prices of $5 MMBtu and above. It's worth noting that U.S. gas consumption has risen steadily since the 2008 crash. This growth is driven by the low cost of gas compared with oil products and its comparison to coal. By far, the single largest growth sector is power, accounting for 83%.

According to the National Petroleum Council, between 2008 and 2010 over 3,000 miles of interstate pipeline was built to transport shale gas from the Southeast to other regions. The infrastructure was required because these first shale areas were far from the demand areas. The Marcellus was much different due to its proximity to Northeast gas demand. Figure 3 shows clearly the commencement of the shale gas boom and the rush to install long-haul transportation to bring this gas to market. Today, gas production is forecast to grow steadily, principally from the Marcellus and Utica, requiring some incremental capacity though nothing like the rate of the boom years.

2015: U.S. Gas Prices and Flows Reverse

The U.S. gas map was radically changed by the huge Marcellus and Utica reserves and the rapid production from them. These two huge resource bases sit adjacent to the major demand centers of the Northeast. The Marcellus rapidly became the powerhouse for growth in gas production and is forecast to remain so with

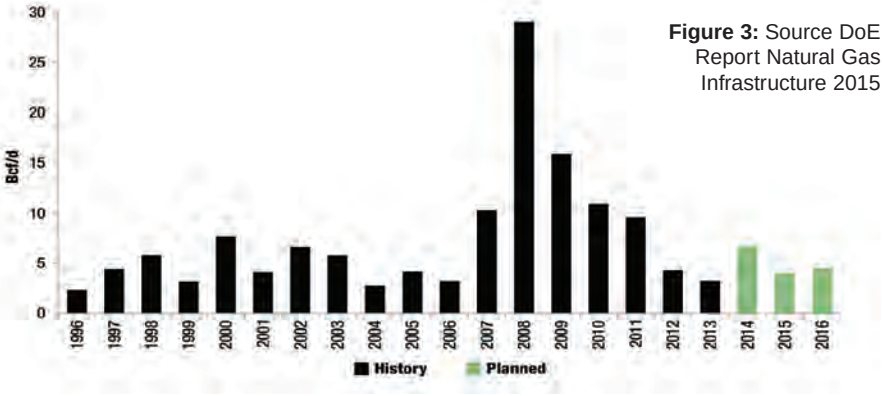

Figure 3: Source DoE Report Natural Gas Infrastructure 2015

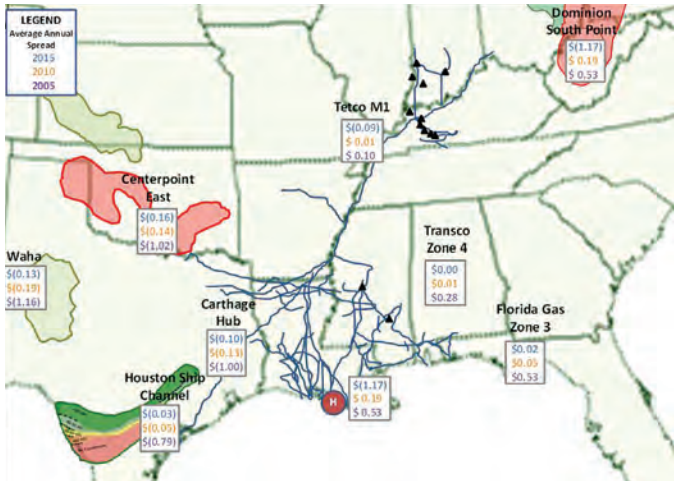

Figure 4: Evolution of Henry Hub and basis differentials, 2005-2015

the Utica. In contrast, Haynesville gas production has fallen significantly during the period 2005-2010.

Major gas reserves are now literally "all over the map" having an immediate impact on pricing structures and infrastructure. Figure 4 shows what has happened to basis differentials over the period. The strong pricing that was traditional in the northeast has reversed as the region became oversupplied. Better gas prices are available at Henry Hub than at what were once regarded as the peripheries of the gas network. This price signal set off a number of flow reversal projects to take gas from north to south and from east to west.

HGL – Even Faster Growth

The production of hydrocarbon gas liquids (ethane, propane, butanes and natural gasoline (pentanes plus)) grew faster than natural gas production from 2008 to date with propane growing 1½ times faster. This growth has turned the U.S. from an importer of HGLs to an exporter.

Where Are We Headed?

Natural gas usage has surged in the power industry as it has replaced coal as the preferred fuel for electrical generation. In 2015, 14GW of coal capacity was retired, driven mainly by older, smaller plants with an average age of 54 years. According to the EIA, there will be 8.0GW of natural gas fired power added in 2016. There is another revolution going on. In 2016 16.3GW of

renewable power will be added with solar at 9.5GW and wind at 6.8GW.

The DoE's comprehensive study in 2015 concluded that the diversity of producing regions means that there need not be that much more buildout of the interstate infrastructure: 38-42 Bcf/d from 2015-2030 or 2.7 Bcf/d vs. the initial buildout of 127 Bcf from 1998 to 2013 or 8.5 Bcf/d.

All the signals indicate that U.S. natural gas prices will remain low across the nation, given the diversity of supply points and the excellent infrastructure inter-connecting them. The constraint on the growth of our industry is the demand for gas with the power sector being a key driver. Policymakers are likely to have a lot of direct influence on just how much market share natural gas picks-up.

The EPA's Clean Power Plan is set to change the course of the nation's energy mix and this could be a major boost to gas utilization. Lastly, LNG exports from the U.S. are set to grow in time. Today, there is a problem with oversupply in LNG markets as numerous plants come online into markets which simply don't have the demand that was anticipated when these facilities were conceived.

Combined with oil trading between $35-40, LNG investments are not attractive today. The fundamentals are strong, given that in the U.S. LNG production can compete with that produced elsewhere. The problem lies in international gas markets where growth is slow and prices are currently weak.

The U.S. looks well set for steady, predictable growth in gas production and utilization. The reserves are there, the production technology is getting progressively better and now the transportation infrastructure is in place. The last decade shows how amazingly fast our industry has reacted to the opportunities afforded in all sectors, including upstream, midstream and downstream. We could well see similar rapid changes in gas utilization as the demand base adjusts itself. ***P&GJ***

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