Ensuring Natural Gas Availability

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I. Introduction

In the past year or so, the Federal Energy Regulatory Commission (the FERC) has sought industry input on how better to coordinate the electricity and natural gas industries.\(^\text{1}\) Spurred by some recent problems, particularly widespread scheduled blackouts during a cold-weather event in the southwest in 2011, the Commission has scheduled technical conferences on how to deal with a nation that is increasingly relying on gas-fired generation, given the growing abundance of low-priced natural gas and its role in displacing coal and oil-fired generation. Since the FERC’s concern involves two industries that it regulates, it is reasonable to ask whether better planning and coordination, and perhaps better incentives for the right kind of infrastructure (in gas pipelines and storage), are reasonable elements of a better-synchronized and more reliable energy supply business that best serves the public interest. It is also reasonable to see the industry comments emanating from the FERC initiative. As expected, the gas distributors wish to maintain the firm services that they have paid for, and rely upon, to meet their own needs. Similarly, the various independent system operators (ISOs) ask whether it is possible for pipeline companies to offer expanded services, beyond the traditional firm/interruptible variety, better to meet the needs of competitive gas-fired plants that connect to their grids.\(^\text{2}\)

But it is important to consider just what the FERC is trying to do—to deal with the coordination issues between the deregulated components of two energy industries. Since the development of competitive US power markets, much of the incremental generating capacity (70 percent, in the NYISO, for example) has come from merchant power suppliers at competitive prices.\(^\text{3}\) And for the gas industry, all of the gas is produced and sold in vigorously competitive spot markets complimented by the kind of vigorous futures markets that attend other

\(^\text{1}\) See: Federal Energy Regulatory Commission, Request for Comments of Commissioner Moeller on Coordination between the Natural Gas and Electricity Markets, February 3, 20120. Docket No. AD12-12-000.

\(^\text{2}\) See: Comments of the American Gas Association and Joint Comments from the various ISO, Docket No. AD12-12-000.

commodities. Likewise, while interstate pipelines charge cost-based rates for the capacity they are licensed by the FERC to sell, all of the interstate pipeline capacity is competitively bought and sold in an advanced, well-informed, liquid and web-based market under prices and terms that the FERC ceased regulating in any way in 2008. The FERC and other regulators have accomplished great things in the United States over the past 20 years in promoting competitive gas and electricity markets. Compared to those initiatives, the electricity/gas market coordination issues the FERC is studying are modest ones. The issues concern logistics, information and coordination. By in large, they do not involve infrastructure investment planning or market making—the markets are already there, and the FERC is not in the business of planning for either gas pipeline or electricity infrastructure development.

Such is not the case in the European Union (the EU), however. While the US gas industry is based upon well-defined property rights regarding spatial and temporal shipping capacity on the pipeline system, the EU gas industry is based on the socialization of both spatial and temporal aspects of the transport of gas. That is, investment in the US pipeline system rests on the underlying property rights; capital markets support new investment when credit-worthy shippers sign capacity-based contracts on particular FERC-licensed capacity projects. In the EU, there is no ability to tie transport contract quantities to specific facilities, or to tie prices to the cost of system use; to address this, central planning for the pricing, use, and expansion of the gas pipeline network is an integral part of the EU’s new 2009 regulations. Those regulations leave

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4 The comments the largest industry group, and American Gas Association, refer to US natural gas reserves as adequate for 100 years of supply at current consumption levels and a highly reliable pipeline and storage system. Docket No. AD12-12-000, Comments of the American Gas Association, March 13, 2012.

5 The fully-evolved nature of gas pipeline regulations in the U.S. is amply demonstrated in June 2008 by FERC Order No. 712, where the agency displayed its satisfaction with the competitiveness of the market in pipeline capacity entitlements. It permanently eliminated any cap on the prices at which legal gas transport entitlements trade in the market. It also facilitated the assignment of entitlements to competitive aggregators for the purpose of more efficiently selling transport rights in a competitive market. See: 123 FERC ¶ 61,286 (issued June 19, 2008).


We have the two most extensive pipeline systems in the world serving many millions of gas consumers—US and EU—that share nothing in common other than the fact they both somehow transport gas through pipelines. One system handles a competitive gas market through a competitive trade in property rights to transport over a cost-based-regulated interstate pipeline system. The other handles its gas supply (the price of which is tied by long-term contract to oil prices) through a regime that socializes the spatial and temporal realities of gas transport. Hence the EU needs to centrally plan for the use and expansion of the facilities because it has decided not to use prices and contracts—and the capital markets—to handle planning competitively. One is competitive; the other is centrally planned. So what?

Economists love to study power pools and design nodal pricing models managed by independent system operators (ISOs) to price, plan and authorize expansions to power grids. There are no such institutions in US gas supply—for traditional local gas companies or for the electric generation business. However, there are such planning models for the gas pipelines in the EU, and there are ISO (called transmission system operators—TSOs) all over the EU. In this paper, I describe how the gas pipeline industry served by such unexciting technology avoids such economic and regulatory intervention in the United States—but embraces it in the EU. I start with a review of the physical properties of the industry and then describe the economic features that distinguish it from other industries generally (asset specificity) and from electricity transmission (transacting on a network). Then I turn to the institutional features that drive wedges between the performance of gas industries in the United States versus the EU, and in US gas pipelines versus US oil pipelines. Those contrasts go far to explaining the substance of the competitive market in US interstate gas transport and the reason to be confident in the US gas supply industry’s ability to ensure future natural gas availability.
II. What does “Ensuring Gas Availability” Mean?

For those of us who lived through the gas problems in the United States in the 1970s and 1980s, after the OPEC oil embargo turned energy industries on their heads, *natural gas availability* generally means avoiding economic shortages of the fuel. During that era, the longstanding battles between gas producing interests and gas distributors in the United States that began in the 1950s—ranging from the Supreme Court to Congress to the Federal Power Commission (FPC)—contributed to a gas shortage in interstate markets that economists at the time estimated to cost $2.5-5 billion per year in increased energy costs and lost production.\(^8\) Those problems, among others, brought about calls by prominent jurists and economists (including a currently-sitting Supreme Court Justice) for the elimination of federal regulation of the gas industry.\(^9\) Indeed, that shortage of gas, in markets served by US interstate pipelines, led in the 1980s and 1990s a series of events that saw those pipeline companies voluntarily open their pipelines to independent shippers and eventually exit the gas trade entirely. Today, US interstate pipelines simply transport gas owned by others by contract. They operate under a longstanding regulatory regime that limits their prices to a transparent *cost of service* for the capacity that their FERC licenses permit them to sell. But the FERC also safeguards and facilitates unregulated and transparent “Coasian” markets for the re-sale of the capacity on electronic exchanges.\(^10\) Those Coasian markets have allowed the use and expansion of the regulated interstate pipeline system to be a highly competitive activity.

It took enormous amounts of work, and great regulatory battles between organized and interested parties, to get US interstate pipelines out of the gas trade. They did not exit that business willingly. For almost a century, gas pipeline companies had been the main buyers and sellers of gas in the United States—just like the member-state pipeline companies are today the

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\(^8\) The economic shortages of the 1970s were not due to the inadequacy of infrastructure, but rather the desire of gas sellers to evade commodity price controls until the perceived inevitability of their lifting. See: Pierce, R.J., “Reconstituting the Natural Gas Industry, from the Wellhead to the Burnertip,” *Energy Law Journal*, Vol. 9, No. 1 (1988), p. 10.


main buyers and sellers of gas in the European Union (EU)—or oil pipeline joint ventures (or LLPs and MLPs) own much of the oil shipped on their interstate oil pipelines. For the interstate gas pipelines of a century ago, owning the gas they shipped, and being free of the burdens of railroad-inspired common carriage (and the Interstate Commerce Commission), was the sine qua non for the business. For investors in those times—before transparency in contracts, financial information or the Securities and Exchange Commission—transacting through contracts with independent pipelines was a commercial impossibility. Investors would not sink money into gas pipelines unless they were both vertically integrated and strictly controlled access to the lines. And Congressional legislators, from states who wanted to enjoy natural gas service, and who shaped the regulatory laws, said so.

Things changed. Congress took a veritable meat cleaver to vertically integrated interstate gas pipelines in 1935, in what an economist of the era called “the most stringent, corrective legislation that ever was enacted against an American industry… [a] remedy well suited to the patient.” Then Congress passed far-sighted regulatory legislation in 1938. Then the courts, Congress, the federal regulator, the pipelines and the US gas distributors battled for more than 40 years about the price of the gas bought by those pipelines for re-sale to those distributors and their many millions of gas consumers. The basic character of those battles are simple enough to characterize: semi-rival regulated pipeline companies, which profit only through a return on their regulated transport investments, simply do not make responsible agents for the purchase of gas on behalf of captive distribution utilities, in illiquid markets dominated by long-term contracts.

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12 Senator Joseph P. Foraker (R. Ohio): “If it should go out, after they have raised the [§5,000,000] to build the line, that any man can take possession of it to bring gas there for his own purposes, and that the line is to be under the charge of the Interstate Commerce Commission, I think it will be the end of the enterprise.” Congressional Record—Senate, 59th Congress, 1st Session (May 4, 1906), p. 6371.

13 Troxel, E., Economics of Public Utilities, p. 172. He was describing the Public Utilities Holding Company Act of 1935. 49 Stat. 803 (1935). Corporate lawyer John Foster Dulles, later President Eisenhower’s Secretary of State, was so convinced that the Holding Company Act would not survive Constitutional challenge that he gathered the executives of the leading holding companies into his Wall Street office, saying: “My strong advice to you gentlemen is to do nothing. Do not comply; resist the law with all your might, and soon everything will be alright.” Dulles was wrong, but the episode illustrates the challenges Congress has generally in crafting legislation to control American business. (Shamir, R., Managing Legal Uncertainties: Elite Lawyers and the New Deal, Duke University Press (1995), p. 67)

14 Natural Gas Act of 1938, 52 Stat, pp. 821-833. The Act was approved on June 21, 1938.
Trouble was inevitable until the interstate pipelines ceased interposing themselves into gas transactions and let sellers and buyers deal with each other directly.

The gas market in the United States is today highly competitive. Natural gas is available in abundance, and competition is driving gas prices down to evidently-sustainable levels far below their oil-equivalent values. The gas market has seen the widespread application of new gas extraction technology permitting the rapid development of heretofore economically unobtainable “unconventional” gas supplies. The new pipelines needed to connect those unconventional gas supplies are licensed quickly by the federal regulators. The result is low gas prices for consumers, lower electricity prices as lower fuel costs drive down the competitive price of electricity, the re-birth of the US petrochemical industry, the displacement of gas for coal generation and its effect on carbon emissions, among other things, including impressively high returns for the independent interstate pipeline industry.\(^\text{15}\) By any reasonable measure, removing pipeline companies from the gas trade was well worth it.

This is not to say that the birth of these new markets have not caused logistical, planning or coordination problems, either in the gas market or in related industries such as power generation. However, those of us who lived through the creation of these competitive US gas and pipeline transport markets tend to make sharp distinctions between economic shortages in the availability of gas or pipeline capacity and the planning/logistical problems of ensuring adequate supplies during, for example, the coldest and windiest days of a 1-in-50 winter cold snap as occurred during the cold weather event of February 1-5, 2011 in the southwest region of the United States.\(^\text{16}\) Those at the FERC, and in the industry, are right to work toward better planning and coordination between competitive gas and power markets and the need for the public to avoid scheduled blackouts that are due to weather-induced fuel unavailability. But comparisons to regulated transmission adequacy planning for US power pools (where electric


transmission markets have transacting problems that gas pipeline markets do not have), or the European experience (which has great institutional problems that have prevented the development of a competitive gas market at all), do not work for the gas industry in the United States. The gas industry has never had “top-down” planning in a century of regulation. Nor has it had shortages of pipeline capital since the Great Depression—before the US interstate gas pipeline industry came under the federal regulatory system we have today.

III.  Pipelines are Pipelines

Perhaps the only thing that distinguishes gas markets from those of other bulk commodities, like coal, cement, or the like, is that pipelines are the only economical way to transport that commodity any meaningful distance. Pipelines have served this function in the gas market for well more than a century. And ever since power equipment replaced hand shovels and welds replaced rivets and screw fittings nothing much has changed in the technical analysis of pipelines.

A.  The Simple Physics of Pipelines

Those economists dealing with gas pipelines now know, from pipeline engineers and pipeline cost studies, that gas pipelines exhibit powerful economies of scale. The simple reason for this is the generally-accepted rule of thumb that there is a linear relationship between the construction cost of a pipeline and its diameter while the capacity of a pipeline is related to the square of the diameter. If capacity squares with diameter, while construction costs rise in proportion, then it would appear that the average cost of increased pipeline capacity is an ever-declining function. Such defines a natural monopoly, like that in the familiar figure below.\footnote{See: Keeler, T.E., Rails, Freight and Public Policy, The Brookings Institution, Washington, D.C. (1983), p. 49.}
Do pipelines really exhibit such economies of scale? I plotted data for gas pipeline construction costs in 1980 dollars, from the 1935 to 1980, in the following figure. With those data I add a simple nonlinear trend line. Allowing for a certain noise in the information, the data collected at various times on gas pipeline construction costs confirm the rule of thumb. Pipeline costs are generally linear in diameter, with capacity increasing with diameter at a factor of the ratio of area to radius, or $2\pi r$. There is nothing in these data to indicate that the average cost for gas pipeline capacity is anything other than downward sloping over the entire range of existing pipeline sizes.

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Of course when it comes to transporting gas long distances, installed pipeline capacity is only one measure of the total costs of delivery. Gas normally exits at producing wells at great pressure that often has to be stepped-down before it is processed to remove petroleum liquids and other impurities in order to enter gas transmission lines. Once in transmission pipelines, however, the flow of gas is caused by pressure differential, which becomes lower as the gas moves from the inlet towards the outlet of the pipeline. The greater the pressure differential the greater will be the capacity of the line. And following both the rule of thumb and the observation of pipeline costs, we have the 101-year-old Weymouth’s formula.\(^\text{19}\)

\(^{19}\) See Leeston, A.M, et al (1963), pages 69, 78. The formula is attributed to Mr. R. Weymouth (from a paper read in 1912 before the Society of Mechanical Engineers). Other, more empirical but generally equivalent approximations to Weymouth’s formula appeared later, known as the Panhandle and Modified Panhandle equations, whose developments
\[ Q = 670.8d^{8/3} \sqrt[2]{\frac{P_1^2 - P_2^2}{GL}} \]

Here, \( Q \) is the cubic feet per hour, \( d \) is the internal diameter of the pipe, \( P_1 \) and \( P_2 \) are the inlet and out pressures, respectively, \( G \) is the specific gravity of the gas and \( L \) is the length of the pipe. While this formula was modified over time as pipeline companies gathered new information on construction and operating costs, those modifications are not material in the search for economies of scale or the natural monopoly features of single pipelines traversing the countryside. The capacity of the lines is an exponential function (8/3, or 2.66) of the diameter, and it drops by the square root of the inverse of the pipeline length.

For economists interested in pipelines, this is as far as the analysis can go—the rest is up to the engineers. Pipelines are big, dumb (i.e., mute) inanimate objects, representing almost pure capacity, that are subject to cost relationships that have been well-known for over a century. How modern fuel markets relate to the pipelines that serve them has very little to do with these cost relationships. Rather, modern fuel markets thrive or fail in relation to the institutions that govern pipeline behavior.

**B. Asset Specificity, or “Marginal Costs with a Ball and Chain”**

When President Jimmy Carter appointed Professor Alfred E. Kahn of Cornell University to deregulate the U.S. airline industry in the late 1970s, Kahn described the nature of the airline transport business as “marginal costs with wings”—capable of moving its capacity flexibly as its market demanded, as long as it was unhindered by complex entry and pricing regulation. By comparison, the pipeline business might be described as “marginal costs with a ball and chain.” Pipelines cannot shift from one location to another as Kahn’s airliners could. As the vehicles for the inland transport of oil and gas, the vast capital resources that pipelines tie up for decades along their routes is land-bound and immobile. Pipelines are built from one spot to another; to serve particular oil and gas producers at one end and refineries, gas distributors or power plants at the other. Opportunism on either end of such arrangements—oil producers shipping crude oil paralleled the Panhandle Eastern Pipe Line Company, which became the first lengthy United States pipeline company in the early 1930s, bringing Oklahoma and Kansas gas to Illinois.
another way or gas distributors taking from another source—can strand pipelines and wreck the value of the invested capital. Conversely, pipeline companies that refuse to serve can disrupt production and distribution operations (as Russia’s Gazprom did to the Ukraine in 2009).  

The immobility of capital sunk into pipelines, those lines’ high up-front costs, their unusual longevity, and their general uselessness for any purpose other than that for which they were designed make for a peculiar kind of industry. For those who commit capital to pipelines, avoiding opportunism or uncertainty on the part of producers or refiners/users of oil and gas, and vice versa, is extremely important. Oliver Williamson calls this mutual capital-based dependence “asset specificity.” It is not surprising that, left alone, pipelines tend to vertically integrate with particular oil and gas producers to deal with asset specificity and avoid such uncertainty and risk to capital. But vertical integration has its own perils when pipelines are involved: oil and gas producers tend to use integrated pipelines as weapons against non-integrated rivals, harming competition in the production and supply of those fuels. Governments have taken various approaches to the balancing act of facilitating the flow of capital to the pipeline business—by far the most efficient method of inland fuel transport—while at the same time trying to prevent pipelines from being used to damage competition in oil and gas markets. In North America, the US and Canada sought that balance through regulation of investor-owned pipelines. Most of the rest of the world sought that balance by building monopoly government pipelines with taxpayer funds (although many of those pipelines were sold to investor-owners in the worldwide privatization wave of the late 20th century). All of those efforts—either private or public—depend on a range of governance institutions to track costs, set prices, raise (or lower) barriers to competitive entry and support (or inhibit) markets in the fuels they carry. Evaluating markets served by these inanimate objects subject to age-old physical constraints is all about institutions.

C. **Transacting on a Network: Pipelines Versus Wires**

The distinctly differing technologies of gas and electric transport/transmission systems make for fundamentally different transacting requirements. Transacting by contract between points on a pipeline system is easy when the pipeline is engineered to handle the distinct physical needs of suppliers and consumers. While everyone’s gas is commingled, it is a matter of straightforward accounting to compute whose gas is flowing where. Such transacting is impossible under current technology for AC electricity grids. Economists designing modern power markets have long recognized this transacting problem for electric grids even if they have not referred to it in the language of transaction cost economics, as such. As a result, economists and regulators have designed all newly competitive power markets with regulated governance organizations to deal with the electric grid operation, pricing and investment—the independent system operators (ISOs). Regulating the system operation, pricing and expansion of a pooled transmission grid serving diverse suppliers and users is a complicated affair with its own direct costs, externalities, inefficiencies and uncertainties. Under current technology, competitive power markets have no other choice.

But it does not make sense to apply such a transacting scheme—with its regulation, uncertain governance, unpredictability and uncertainty in pricing and planning—to an industry that could, and did, grow up transacting inalienable property rights without regulatory oversight outside of licensing and ratemaking.

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21 In her 2002 book on power markets, my late colleague Sally Hunt usefully recognized the technical distinction between gas pipeline systems and power transmission networks:

[T]he pipeline contracts are not complicated— they are for point-to-point transport on a given system—a contract path. In electricity, the transmission system is a grid; the laws of physics mean that electricity does not flow over the designated contract path. (In other words, point-to-point in gas is equivalent to contract path, whereas in electric, point-to-point is different from the contract path). What this means is that the physical laws governing flows of electricity on the grid make it extremely difficult to create a system of tradable property rights in transmission capacity that can facilitate trading power. Rights are both difficult to define and to enforce. … what [gas users] paid for and what they use is unambiguous in gas, and is not in electricity. (Hunt, S., *Making Competition Work in Electricity*, John Wiley & Sons, New York (2002), p. 400.)
D. Has the US Government Ever Planned a Fuel Pipeline?

The US government has indeed planned and financed a major new pipeline project. Once—in 1942. Indeed, that project, part of the Texas Eastern system, continues to serve Northeast US markets (and my own home).

Before World War II, the gas pipeline industry was generally an American phenomenon. Some of these gas pipelines were impressive and expensive, but they did not represent a network on a continental scale. Barely more than a quarter of gas marketed in the United States was shipped through these pipelines across state lines. By the late 1930s, however, construction of new pipelines slowed, with not a single significant pipeline appearing after 1937.

WWII changed the gas industry. In early 1942, U-boats were sinking up to a dozen oil tankers a month on the east coast of the United States. It was an extreme national emergency, for not enough oil reached the cities of Washington, New York and Boston to fuel the rapidly expanding war effort. Whole trains of rail tank cars were thrown together and rushed into service to help with the shortfall. But tank cars were an expensive and inefficient way to ship oil compared to tankers and barges. The following chart shows how, from a tiny share of oil deliveries in 1941, two new federally-financed oil pipelines grew to become the biggest source of East Coast oil by the end of the war. They were the first large diameter, long distance petroleum pipelines in the world.

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22 Before World War II, Europe’s production of natural gas was insignificant outside of some local gas use in the traditional oil and gas producing countries of Poland and Romania. The Canadian natural gas industry started after the war as well, as did those in South America (Argentina and Bolivia). Mexico had been shipping natural gas for industrial use around its oil and gas producing properties in the Yucatan since about 1930, but these were very small and local efforts until the 1950s. See: Leeston, A. M., Crichton, J. A., and Jacobs, J C., The Dynamic Natural Gas Industry, University of Oklahoma Press, Normal Oklahoma (1963), Chapter 14 (“The Natural Gas Industry in Foreign Countries”).


Oil Deliveries to the East Coast of the United States
January 1941 to August 1945.

Source: Johnson (1967)

But it was a wartime effort only. Believing that the introduction of major new petroleum pipelines to the major East Coast markets would severely disrupt the industry in ways that they could not foresee, the US oil industry wanted nothing to do with them after the war. Eventually, the newly-formed Texas Eastern Gas Pipeline Company won the bid to acquire the assets and covert them to natural gas—the last US pipelines to begin with government planning and financing.

IV. It's All About Institutions

Large pipeline systems exist in various parts of the world, but three are useful for illustrating how the performance of fuel markets depend on the institutions used to govern pipeline relations. In this section, I draw two contrasts: (1) between the gas industries in the United States and the EU; and (2) between the oil and gas industries in North America.
A. The Institutional Divide between North America versus the European Union and its Consequences

I have elsewhere described the sources of the institutional divide between the gas industries in the United States and Europe. There are six critical institutional differences: (1) Europe has internal sovereign borders; the US does not; (2) third-party access (TPA) applies in the EU, not in the US; (3) there are no independent gas distributors in the EU to agitate effectively on behalf of their own consumers; (4) information on finances or operations for pipelines is not public in the EU; (5) pipeline companies in the EU generally transport their own affiliated gas supplies, while no US pipelines do; and (6) there is no EU licensor of capacity that parallels FERC pipeline licenses. There is a seventh that affects the pace of shale gas development: in Continental Europe, the State owns mineral rights beneath the surface, while in North America the landowner does, making for very different incentives in the desire to extract that resource.

The result of these deep institutional differences appears in the following two graphs. US gas prices split from oil prices immediately after the great 2008 run-up and subsequent collapse of oil prices after the credit crisis in 2009—as the figure below shows. It has hovered in the $3/Mbtu range throughout all of 2012, compared to a comparable oil-equivalent energy price of around $9/Mbtu. The comparison with Europe is stark, where most flowing gas supplies are linked under long-term contacts to the oil price, the result of which is evident in the figure below. The difference in gas prices, on roughly equivalent volumes, is that EU gas consumers pay about $1 billion every four days (€1 billion every five days) more than their US counterparts.

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To be sure, it is not the pipelines themselves, or where they travel, that cause EU consumers to pay €1 Billion more than their US counterparts every five days. Rather, it is the way those pipelines are owned, governed and regulated that accounts for the differences,
particularly the way in which the regulatory rules have been created to effectively insulate each member state’s incumbent gas company from competitive entry of other gas suppliers or other pipeline companies.

**B. The Institutional Divide Between US Oil and Gas Pipelines and its Consequences**

Liquid petroleum (crude and oil products pipelines) and natural gas pipelines perform essentially similar inland transport functions. Often enough, pipelines built to transport gas are converted to transporting oil (or vice versa). Nevertheless, despite their technological and operational similarities and capability to be converted from one type of fuel to the other, the ability of the two systems to respond flexibly to transport bottlenecks is very different. These differences stem from US interstate oil and interstate gas pipelines being subject to quite dissimilar kinds of federal regulatory legislation. Interstate oil pipelines are “common carriers” according to the 1906 Hepburn Amendment to the 1887 Interstate Commerce Act,26 while interstate gas pipelines are “contract carriers” subject to the Natural Gas Act of 1938.27 The property rights over federally-licensed capacity that form the foundation of the competitive Coasian market in gas transport do not exist for oil pipelines—for the capacity is not federally licensed and common carriage rules prevent the sale of exclusive capacity in any event.28

Without the ability to sell exclusive capacity, as such, and apply to the FERC for a license that will override all state and local issues of eminent domain, the barriers facing new crude oil pipeline development are considerably greater than for gas pipelines.29 A consequence of this difficulty in building oil pipelines is that it is hard to secure new rights of way to build new pipelines when oil production and use patterns shift. Such a problem has occurred in the

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27 Ibid, 103.
28 Much of the discussion in Chapters 6 and 7 in *The Political Economy of Pipelines* (pp. 97-152) concerns the details of where these two still-active legislative controls came from and now they affect the competitiveness of the oil and gas pipeline systems as they serve those two respective inland fuel markets.
29 This is not to say that the FERC has not recently approved methods to mimic for oil pipelines some of the rights that gas pipeline shippers enjoy, by setting priorities on shipments and even, most recently, providing for the assigning of pro-rationing rights to other shippers. See Shell Pipeline Co., L.P., 139 FERC ¶ 61, 228 (2012) and Shell Pipeline Co., L.P., 141 FERC ¶ 61,017 (2012).
past few years as the direction of crude oil movements in the United States has shifted. Historically, oil moved north from the Gulf of Mexico toward the oil hub of Cushing, Oklahoma and the mid-continent oil refineries. The development of tar sands oil in North Dakota and Alberta have shifted the flow in the direction of Cushing and south. That oil could only readily move to the Gulf from Cushing by reversing the flow of existing oil pipelines or converting lesser-used gas pipelines for that purpose.

The difficulty in accomplishing either is evident in the existing and projected (futures-market-based) basis spreads between the price of crude oil at Cushing and the world market price (represented by the Brent crude oil price). Discounts for crude oil at Cushing have remained well above $10/barrel for more than three years, when the reasonable cost of transport by pipeline is in the vicinity of $3.50 to $4.00. Century-old federal oil pipeline regulations, which inhibit the necessary market responses, lie at the heart of this difference.
Notes and Sources:
Data from Bloomberg, L.P.
Brent crude oil spot prices were only available beginning May 19, 2003.
There is another way to picture the difficulty in pushing through new oil pipelines, as shown in the figure below. Given the lack of federal licensing authority, combined with various other elements that make new crude oil pipeline planning and construction considerably more troublesome than for the independent, contract-based gas pipeline market, we just saw “the year of the tank car” in 2012.30 (The reader may wish to turn back a few pages to re-examine the growth in rail tank cars for interstate crude oil shipments 1942 and 1943.) Both of the remarkable booms in oil tank cars link directly to the trouble in building new oil pipelines. In 1942-43, large-scale pipelines were at the edge of the technological envelope. In 2012-13, the problems are no longer technological, but institutional and regulatory. While it is true that tank cars provide a type of flexibility that pipelines do not (Kahn would say “marginal costs on wheels”), the biggest market is between two fixed points—the tar sands fields in North Dakota/Alberta and refineries on the Gulf Coast. In that market, where rail costs perhaps 2-4 times oil pipeline costs per barrel, rail cars (costing well more than $100,000 apiece with an 18 month backlog in early 2013) are only a temporary stopgap until various pipeline options (reversal of oil pipelines, conversion of underutilized gas pipelines, new builds) come on line.

V. Even a Well-Designed Market Needs Information and Logistics

The property-right-based gas pipeline market makes the competitive gas market possible but has taken time for actors in the market to get used to. Three recent market stresses since 2000 highlight the response of the US market for natural gas.

A. Chicago Cold Snap of 1996

The beginning of the heating season of 1995-1996 began with below normal temperatures. This resulted in large natural gas storage withdrawals that could not be readily replaced with storage injections because the low temperatures and corresponding high natural gas demand persisted for an extended period of time. When temperatures again dropped dramatically across the Midwestern US, there was not enough available gas in storage to meet the spiking demand. Accordingly, the local price of natural gas spiked. The figure below displays the price differential for the Chicago city gate pricing point relative to the Henry Hub. The cold snap in 1997 was much like the one in 1996, but market and traders had learned from the year before, and the temporary rise in basis differentials was only one fifth as high.
B. California Energy Crisis of 2000-2001

Supply constraints, among other factors, resulted in widespread electricity shortages across the Western US during the much-publicized California Energy crisis of 2000-2001. Accordingly, the price of natural gas spiked because of the increased value of electricity generated in natural gas burning power plants. The figure below shows the basis price for the SoCal Border natural gas pricing point relative to the Henry Hub price.

Source: Natural Gas Intelligence Press
C. Hurricanes Katrina and Rita in 2005

The figure below shows the range and average of the 84 basis differentials relative to the price at Henry Hub in Louisiana between April 2005 and April 2006. During this period of already tightening energy supplies, hurricanes Katrina and Rita disrupted a large portion of the US natural gas supply and production. In addition to completely shutting down the Henry Hub for a day and week, respectively, Hurricanes Katrina and Rita led to different and larger than normal supply-demand imbalances across the country, and thus larger basis spreads.
In each of the three cases above, the market responded to an exogenous shock to supply and/or demand, the spot price moved according to the local supply and demand for natural gas, and the market was able to clear. In order for this to occur, adequate pipeline capacity must be available and able to respond to changing market conditions.

**D. The Cold Weather Event of February 1-5, 2011**

Much has been made of the problems that occurred in New Mexico when the worst winter storm in 50 years hit the southwestern region on the United States in February 2011. During that event, a total of 210 individual generating units in the Electric Reliability Council of Texas, Inc. (ERCOT) had an outage or a failure to start. Combined with other events with generators in Arizona and New Mexico, about 4.4 million electric customers suffered controlled blackouts. In the analysis of unavailable generation, about 10 percent was attributed to a

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31 For example, in terms of convective heat loss (the combination of low temperatures and wind speed), El Paso Texas recorded the most severe weather event in 49 years. See: Federal Energy Regulatory Commission and North American Electric Reliability Corporation, Report on Outages and Curtailments During the Southwest Cold Weather Event of February 1-5, 2011,” August 2011, p. 169.
curtailment of gas supplies. Most power plant failures owed to the cold weather itself or mechanical/operator failures.\textsuperscript{32}

In addition, 50,000 natural gas customers in New Mexico, Arizona and Texas experienced extensive curtailments of service. While the sources of the weather-related problems were diverse, a large component owed to various failures of planning and weatherization to permit cold starts of electric plants (including operator error), and also a widespread freeze-off of gas wellheads (which is a relatively normal occurrence as frozen water obstructs wellheads). The cold-weather events did have an effect on the price of gas, but it was short lived (limited to about three days) and highly localized—the Henry Hub price barely moved, as shown below.\textsuperscript{33}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{GDD_Midpoint_Basis_to_Henry_Hub.png}
\caption{GDD Midpoint Basis to Henry Hub}
\end{figure}

The events—both predictable and unpredictable—have caused the FERC to schedule a series of coordination meeting around the country to study how better to handle logistical coordination between electricity and gas supply in the face of severe weather and other


\textsuperscript{33} Ibid., p. 138.
disruptions that can tax the ability of the gas supply system to respond to heightened electricity and gas demand.

VI. Adequate Infrastructure/Investment

A number of the questions put to me by the conference organizers relate to concerns about adequate pipeline investment:

A. Top-Down Planning?

Whether there is any involvement by regulated or bureaucratic governance organizations, like TSOs, in the planning and financing depends on whether there is a market for the movement of fuel or not. For example, some of the most complicated planning and logistical models that exist concern the transport, refining, distribution and retailing of gasoline. But that is all a private affair, taking place outside regulation (that is, since the OPEC oil crisis of the early 1970s when state “energy czars” directed gasoline supplies during the shortages).

Similarly, the gas pipeline system in the US has for more than 100 years depended solely on private investment, either in the form of vertically-integrated pipelines investments before 1935, or independent pipeline ventures based on the Natural Gas Act and its supportive institutions after WWII. There is no practical possibility of top-down government involvement in the planning of gas pipeline capacity in the US, as the industry grew up under private planning and investor ownership, which has satisfied the requirements of the plurality of interests that the system serves.

Of course none of these institutions, nor the pluralities of interests that the serve, exist in the EU. That jurisdiction has purposely avoided adopting the institution of contract carriage and open access on the US model and is attempting to create virtual markets for gas with virtual transport models based on the UK experience. These choices almost guarantee the expansion of the gas pipeline system in Europe with public funds (or at least private funds with socialized prices guaranteed by regulators). The choice of planning is almost purely a function of the underlying regulatory institutions and allowed vertically-integrated market structures—not on the need for better coordination, as such.
B. **Market Signals for Pipeline Capacity and Role of Long-Term Contracts?**

Despite having been dragged through a restructuring process that essentially compelled them to exit the gas trade (even if it was somewhat unfairly called “voluntary” at the time), US gas pipelines remain reasonably highly profitable.\(^3^4\) I show below the largest of the pipeline holding companies, their market shares in 2009 and their average estimated return on equity in the table below.

**Summary Table of Parent Company Market Share (2009)**

<table>
<thead>
<tr>
<th>Parent Company</th>
<th>Number of Pipelines Owned</th>
<th>2009 Rate Base ($000)</th>
<th>Market Share</th>
<th>Average Estimated ROE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berkshire Hathaway Inc.</td>
<td>2</td>
<td>3,346,125</td>
<td>5.1%</td>
<td>19.76%</td>
</tr>
<tr>
<td>Spectra Energy Corp</td>
<td>5</td>
<td>4,453,808</td>
<td>6.8%</td>
<td>18.68%</td>
</tr>
<tr>
<td>Williams Companies, Inc.</td>
<td>3</td>
<td>4,812,198</td>
<td>7.4%</td>
<td>17.85%</td>
</tr>
<tr>
<td>El Paso Corporation</td>
<td>7</td>
<td>8,572,920</td>
<td>13.2%</td>
<td>16.47%</td>
</tr>
<tr>
<td>TransCanada Corporation</td>
<td>7</td>
<td>4,267,743</td>
<td>6.6%</td>
<td>14.89%</td>
</tr>
</tbody>
</table>

*Note: Author calculations.*

In the past few years, investment in new infrastructure to accommodate unconventional gas supplies has been very vigorous, as has the profitability of the sector and the ease with which new pipelines are planned and licensed by the FERC. The following figures show the extent of new pipeline construction since the completion of the rules for contract capacity trading in 2000. The number of project and miles of pipeline capacity spiked with the rising gas prices, leading up to the high prices of 2008, after which the shifting pattern of gas production with available capacity (shortening the transit for much of the gas in the northeastern United States) has meant more numerous and smaller projects. With the development of market-area shale gas, the projects are less numerous and more geared to small “interconnectors” to connect existing interstate pipelines to the most productive shale producing regions. For example, 34 licensed projects in 2007 averaged 82 miles each; nine projects in 2012 averaged 12 miles each.

\(^{3^4}\) See: Makholm and Strunk (2009), and Makholm and Olson (2009).
Ease of New Licensing

To be sure, the competitive US market for gas is causing unintended regional price spikes. Low US gas prices have affected the Everett LNG terminal in Boston, which was constructed in the 1970s to bypass the high cost of interstate pipeline shipping from the Gulf Coast. From that time until the mid-2000s, that LNG terminal imported regular cargoes, and helped supply the Boston-based peak demand. That situation has changed, as Everett imports fewer cargoes and the two new New England offshore terminals are unlikely to see cargoes at all. The lack of LNG to support the winter needle peak has caused basis differentials at the Algonquin Hub to spike three times to the $6-$7 range in the past 18 months. Both of the traditional pipeline suppliers to the region (Algonquin and Tennessee pipelines) have initiated or planned projects to increase peak capacity to the region. The optimal solution may well depend
on some mix of LNG and pipeline capacity weighted against the anticipated weather-driven prices spikes—a situation that, as the FERC reports, the gas users in the region are themselves taking steps to remedy.  

**VII. Conclusion**

My late colleague Alfred Kahn would (and did) respond vigorously to calls for more regulatory intervention into the airline industry after deregulation. He never claimed that simple deregulation of pricing and entry would solve all of the industrial and consumer problems with airline rates and services. But he always maintained that the benefits of deregulation far outweighed the costs of unnecessary regulation—a point about which few economists would disagree. Safety and security concerns aside, when it came to entry and exit to routes and markets, and above all prices and the profitability of carriers, Fred always maintained that the carriers were on their own. To him, a in air transport would result from competition in routes and fares. The era of *regulation* in those respects ended during his time at the Civil Aeronautics Board in the 1970s, and the benefits to the public in terms of low cost for discretionary travel—to say nothing of safer travel and saved lives—was the payoff. There was no turning back.

There is also no turning back from the features that characterize the US gas market and the pipelines that permit that market to be so vigorously competitive. The regulatory model for the industry was forged in Congress in the 1930s to serve a plurality of interests in the middle of the Great Depression—oil and gas producing companies, pipeline owners, and gas distributors principally among them. The difficulty that Congress has in regulating any aspect of US business (particularly in the oil industry) is demonstrated in the longstanding nature of those regulations, as they have served as the foundation for everything that has come since. With great struggle from 1938 to 2000, pipeline companies exited the gas trade, and, except for temporary and localized affairs, do nothing to inhibit the most vigorous gas trade. The huge gas price disparity between the US and Europe, reflecting about $100 billion per year in cost savings for the US vis-à-vis Europe, is a testament to what gas markets can do when pipeline interests stay out of the way of gas markets and focus on their contract transport role. With competition in the

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supply of gas, and competition in the use and expansion of the pipeline system, the resulting low price of gas has brought the US petrochemical industry back and contributes to a smaller price for electricity on a wide scale.

To the extent there is a problem with gas/electricity coordination, it would appear to be the result of competitive gas-fired plants that have not yet had the need to plan for storage, alternate fuels or firm service—items that would dent their earnings. The ISOs themselves are looking at their requirements and trying to determine whether it makes sense to enhance, for example, the dual fuel requirements. They are analyzing all of their policies and rules to determine whether they can mitigate the new risks associated with a greater concentration of gas-fired generation. The ISOs have questioned the whether traditional “firm” and “interruptible” services efficiently meet the needs of the intersection of the gas and electricity markets. But those ISOs also have to contend with a pipeline system representing firm delivery capacity that was largely built to serve, and almost completely underwritten by, gas distributors and their connected users. Traditional firm services were tailor made for the requirements of gas distributors, and the type of pricing of those services (including straight-fixed-variable and incremental pricing) have been key parts of the foundation for the highly competitive deregulated capacity market.\(^\text{36}\) Any new pipeline services or prices targeted at power generators would have to consider their effect both on traditional services for gas distributors and the working of the highly successful deregulated pipeline capacity market.

Top-down planning for the gas industry in Europe appears to be the choice of Brussels, which has issued three sets of regulatory rules since 1998. Great institutional barriers prevent the emulation of the US experience in removing pipelines from the gas trade, and the path that the EU has chosen is to live with those barriers while attempting to create a model for “competitive” gas supply, perhaps in concert with competitive power generation, to elicit efficiency and rivalry in the industry. Economists in the EU are hard at work creating the models for socialized regional and temporal gas transmission contracts that rely on TSO-based planning for the adequacy and expansion of the various member-state gas systems. Such models may or may not

\(^{36}\) See *The Political Economy of Pipelines*, pp. 140-149.
ensure the adequacy of gas supply to the EU. But they do nothing to foster the entry of new transport links or gas supplies—the drivers for innovation and low prices seen in the United States.

Solutions to the problems caused by the increased share of natural gas in the US generating portfolio, and the need for those assets to be useful in times of weather-induced stress, would appear to lie in better information, more coordination and improved logistics—not in top-down planning or market modelling. Given that the demands in New England (with its historical LNG resources) are different from those in the southwest US (which has never had LNG), it is also likely true that one new set of rules will not satisfy every region. Overall, with the work undertaken over the past two decades to create deregulated US power and gas markets, there is little likelihood that the FERC would choose to implement a solution to such coordination problems that would inhibit the continuing success of these markets—or to intrude into the private planning of both gas and power markets.
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