



White Paper

An Electric Gas Market Calls for Flexibility

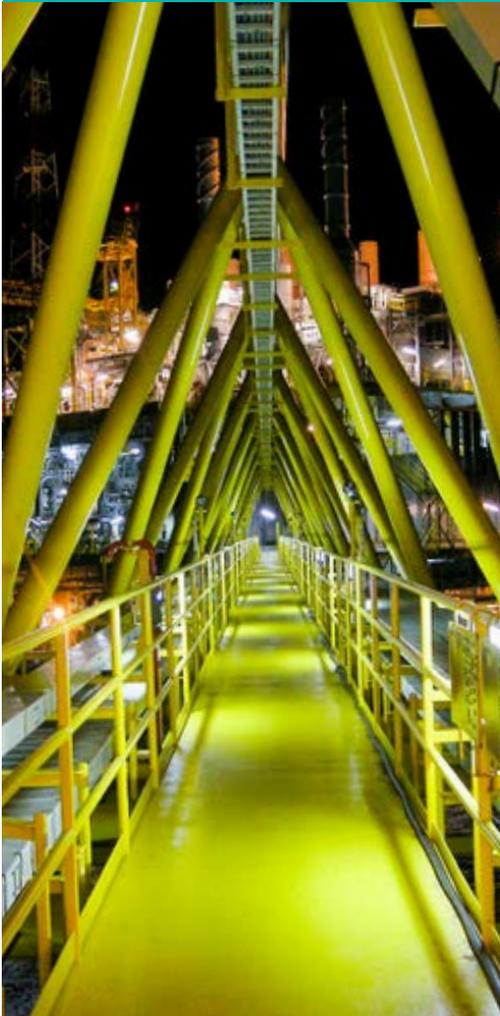
By Frank Brock and Michael Sloan, ICF

Shareables

- By 2035, 76% of U.S. production will come from shale, mostly due to growth in the Marcellus/Utica.
- By 2035, gas will make up over 50% of total generation, and gas consumption in the power sector will surpass 16 Tcf per year.
- Changes in the market are driving an increase in the need for flexibility and increasing the value of the market participants capable of providing that flexibility.

Executive Summary

The rise of shale gas production and the growth of gas use for electric generation are re-shaping the gas market and requiring gas consumers to change the way they think about contracting for gas supplies, pipeline and storage capacity, and balancing, scheduling and other ancillary services. Contracting requirements for power providers will depend on a number of factors, including their dispatch requirements, their options for receiving gas including the type and availability of distribution and transportation services, and changes in natural gas production and markets. LDCs will need to account for changing power generation impacts on scheduling and balancing requirements in their gas supply and infrastructure planning process.





Generator Perspectives

The growth in electric generation capacity using natural gas is leading to a shift in the way that electric generators need to think about and contract for natural gas. The deliverability and balancing requirements associated with natural gas power generation demand create additional stress natural gas transportation and distribution infrastructure. While the natural gas system can accommodate some growth in power generation demand, the expected growth in demand is likely to exceed system capabilities to provide balancing services. As a result, instead of thinking of natural gas as a commodity that will always be available at a given price, generators will need to consider the whole supply chain—supply basins, interstate pipeline options, storage and ancillary services, and plant delivery options—when developing a fuel supply plan. While generators will require different types of gas services depending on their geographic locations, their daily and seasonal dispatches, and the designs of the electricity markets they serve, increasingly they will need to contract for these services to ensure availability when needed.

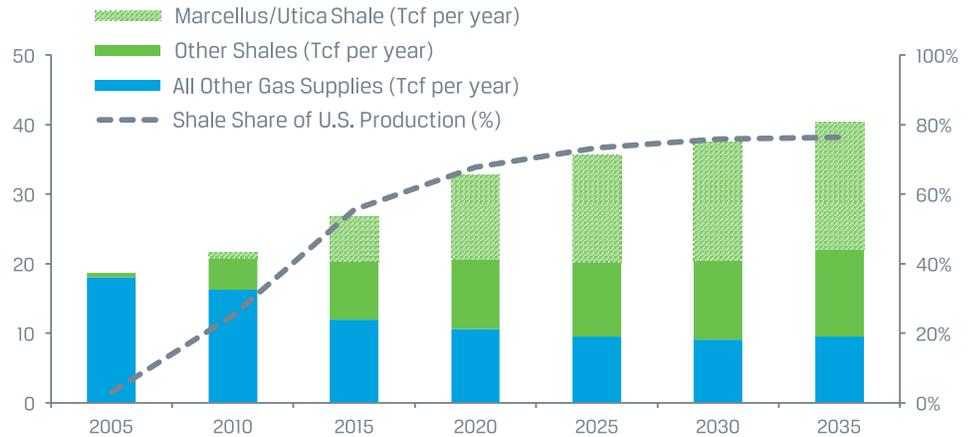
The growth in power generation demand and the growth in shale gas production is also changing the outlook for natural gas contracting by natural gas local distribution companies. The growth in shale gas production has opened new supply sources at attractive prices but also presents challenges. They need to adjust the mix of gas supplies, pipeline capacity, and storage contracts to take advantage of new supplies. Also, as electric generation becomes a larger share of the gas load, LDCs need to adapt their operations and add new services to accommodate this growth.

Ongoing Changes in Natural Gas Markets

In just ten years, shale gas has grown to become the dominant source of natural gas supplies in the U.S. The overlapping Marcellus and Utica shales stretching across the northeast U.S. were not the first shale plays to be developed, but they quickly emerged as the fastest growing production regions in North America. Due to their large size and low cost, ICF projects Marcellus/Utica shales will continue to be the primary sources of incremental gas supplies over the next twenty years, with production increasing to over 18 trillion cubic feet (Tcf) per year by 2035 (Exhibit 1).

In 2015, 56% of U.S. production came from shale. By 2035, shale will reach 76%, mostly due to growth in the Marcellus/Utica

EXHIBIT 1. US NATURAL GAS PRODUCTION

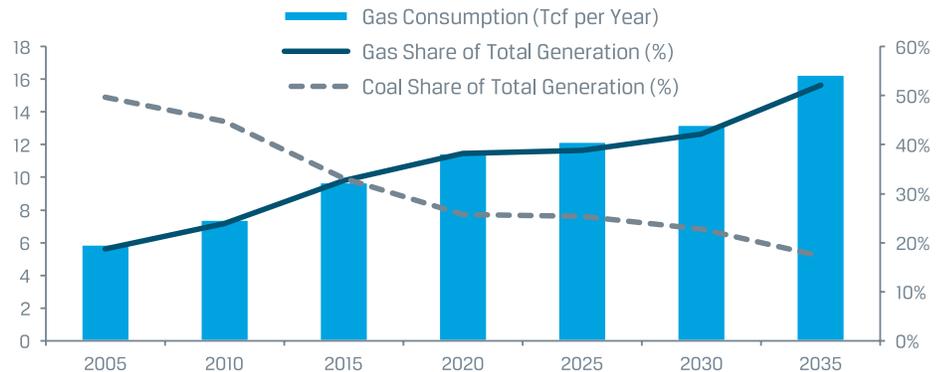


Source: ICF

The growth of Marcellus/Utica production along with declining production in some traditional supply basins along the Gulf Coast has changed pipeline flows across North America, displacing flows to the northeast from western Canada, the Gulf Coast, and the Rockies, and reversing pipelines to flow gas out of Marcellus/Utica. While Marcellus/Utica is close to consumers in the northeastern U.S., production growth has outpaced the development of outbound capacity. Resulting pipeline congestion frequently limits the availability of spot gas supplies from Marcellus/Utica in downstream markets areas.

At the same time, increasing shale gas production has reduced prices, making gas-fired generation increasingly competitive versus coal. Since 2007, gas's share of total generation has doubled from 17% to 34%, and it now provides more generation than any other single fuel. Gas use in the power sector has increased by 50%, reaching 10 Tcf in 2016 (Exhibit 2). Electric generation is now the largest source of demand for natural gas in the U.S., accounting for over one-third of domestic consumption in 2016. Even without more stringent federal environmental regulation, efficient new gas-fired capacity will continue to gain share versus coal. By 2035, ICF projects gas will fuel over half of U.S. electricity generation and power sector gas demand will reach 16 Tcf annually.

EXHIBIT 2. GROWTH OF GAS USE IN THE POWER SECTOR



Source: ICF



The rise of shale gas production and growth in power sector gas use have combined to place increasing stress on midstream infrastructure—the pipelines and storage facilities that provide transportation and other services to all gas consumers. Gas-fired generation used to be concentrated in the summer months, the low season for residential and commercial gas demand. As it replaces base-loaded coal, gas-fired generation is increasing in the winter months, when pipeline capacity can be scarce due to high demand for residential/commercial space heating. The 2014 Polar Vortex offers insight into the consequences of this congestion: during the coldest days of January 2014, PJM—which overlays the Marcellus/Utica—had over 9 gigawatts of capacity offline because they were unable to access gas supplies.¹

Managing Market Changes—the LDC Perspective

A local distribution company (LDC) typically enters long-term (ten-plus years) firm contracts with multiple pipelines to provide long-haul transportation from supply basins to its service territory. These contracts provide the LDC surety of service to needed to meet its regulating authority's standards of prudent planning. However, given the continuing changes both in market dynamics and pipeline flows, LDCs will have to carefully consider how they contract for new capacity as existing contracts expire.

For example, consider how flows on Williams Transcontinental Pipeline (Transco) have changed over the past five years. Transco was originally designed to carry gas supplies north from the Gulf Coast to markets along the East Coast. As Marcellus/Utica production has grown, Transco's north-bound flows into Georgia have declined, while flows between North Carolina and Virginia have reversed, with gas now flowing south (Exhibit 3).

EXHIBIT 3. CHANGES IN TRANSCONTINENTAL PIPELINE FLOWS, MMCFD



Source: PointLogic Energy

As Northeast and Mid-Atlantic shippers increasingly rely on Marcellus/Utica supplies, more capacity has become available to South Atlantic shippers on the southern end of Transco's system, even as new supplies also flow in from the north. For the moment, these trends have made the South Atlantic states relatively supply rich, with gas flowing into the region from both the south and north. As Marcellus/Utica production grows and new LNG export terminals augment demand along the Gulf Coast, the reversal of Transco will push

¹ Polar Vortex Review, September 2014, North America Electric Reliability Council.

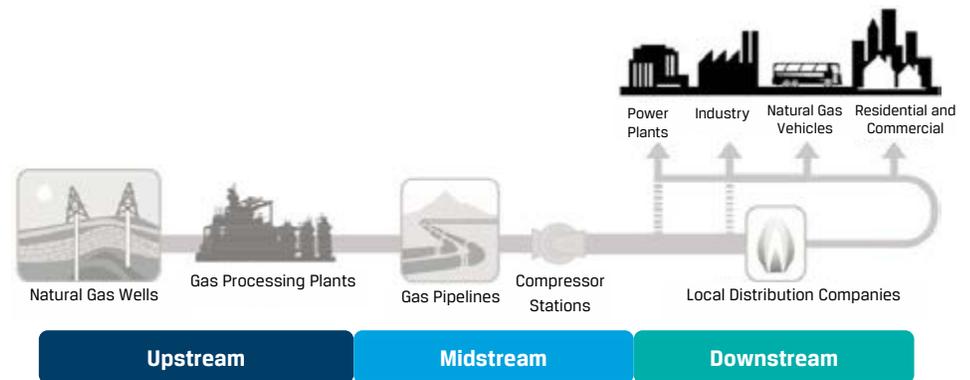
Farther south as Gulf Coast shippers seek access to northeast gas supplies. In the future, this will lead to more competition for capacity on the southern end of Transco's system.

LDCs must also consider how to adapt to shifting system loads as residential and commercial demand remain relatively flat and electric generation demand increases. This offers the LDC an opportunity for growth but also presents a number of challenges. Electric generators often have large short-term swings in consumption as they ramp up and down in response to intra-day fluctuations in electricity loads. As a result, they require deliverability and balancing services that are much different from an LDC's typical portfolio of services. LDCs will need new resources like high deliverability storage to meet generators' service requirements while still maintaining system reliability. For South Atlantic shippers, this could mean contracting with salt dome storage fields along the Gulf Coast or adding new on-system LNG storage.

Contracting from the Electric Generator's Perspective

Plant operators often think about natural gas in terms of available supplies at the nearest interstate pipeline zone or hub. For long-term planning, this new era of abundant supply and congested pipelines make it important to look at the entire supply chain—the supply basins, interstate pipelines, storage facilities, and distribution systems—as well as the counter-parties for gas transactions.

EXHIBIT 4. NATURAL GAS SUPPLY CHAIN



Source: Natural Gas Council

Upstream Supplies

A power plant's geographic location typically determines the mix of production basins it can access, but supply options can change over time. Gas consumers in the southeast U.S. traditionally looked toward the Gulf Coast for supplies; however, the rise of Marcellus/Utica production has opened an alternative supply. As new sources continue to replace production in older basins, building a flexible supply plan will allow generators to take advantage of lower-cost options and increase the reliability of their gas supplies.

When assessing supply options, one must consider trends in liquidity and pricing at different locations, as well as the availability of pipeline capacity back to the basin. For example, while many fuel managers would like to purchase gas indexed to Dominion South Point—a major price point in Marcellus/Utica that typically sells at discount to Henry Hub—constraints on outbound pipeline capacity make it difficult to access. This is one reason why its price remains relatively low.

A natural gas marketer can assist in managing supply diversity. A marketer does not fit neatly into any one spot along the natural gas supply chain; it may be an affiliate of a producer, pipeline, or local utility, or a separate entity unaffiliated with any other players. In whatever form, the marketer links natural gas buyers with sellers and typically assembles a portfolio of gas supplies from one or more upstream sources. In many cases, a marketer can provide all the intermediate steps of a purchase, including arranging transportation, providing storage services, and accounting. Despite the cost of these services, it is often more cost effective to purchase gas supplies through a marketer, especially when the purchased volumes are relatively small. Even if opting to use a marketer, fuel managers need to do their homework. In addition to the marketer's cost, they should consider its financial stability and the fit between its services and the plant's needs; for example, does the marketer allow for intraday nominations, and if so at what cost? Thinking ahead about the gas volumes and services needed is an essential step in assessing supply options.

Long-haul Transportation

As mentioned above, the availability of interstate pipeline capacity near the plant may limit which supply basins are accessible. However, fuel managers must keep in mind that new pipeline capacity is constantly being added, and new pipelines may open new supply options. For example, Williams' Atlantic Sunrise project will create a bridge between the rich production area in northeastern Pennsylvania and the Transco mainline, allowing gas consumers as far south as Georgia to access these supplies.

Whether a fuel manager should select firm (FT) or interruptible (IT) transportation service depends on several factors. Historically in the ISO/RTO markets, there was no mechanism for generators to recover the cost of holding a firm capacity contract, so the majority opted to use IT. Following the 2014 Polar Vortex outages, the emerging "pay for performance" standards will incentivize plants that participate in these capacity markets to hold FT.

For the vertically integrated electric utilities in the southeastern U.S., FT costs can be rolled into to cost of service. However, even if there is cost recovery for FT service, other considerations may apply. For example, a peaking plant with oil-fuel back-up may not require FT service to ensure dispatch, while a large, base-loaded combined-cycle plant with no oil backup may require 100% FT; many other plants will fall in between. A fuel manager relying on IT service should consider that recent mild winters may have masked the potential for IT capacity scarcity and price spikes, which often occur on cold winter days.

Local Delivery

While some plants have dedicated service pipelines that connect them directly to an interstate pipeline system, other plants receive their gas through an LDC. A plant that is connected to an LDC can be a "full service" customer (meaning gas supplies are purchased from the LDC), but more often a plant will contract with the LDC for transportation service. This means the LDC transports customer-purchased gas from an agreed-upon interconnect between an interstate pipeline and the LDC to the plant. As an LDC transportation customer, the plant is responsible for making upstream gas supply and interstate pipeline transportation arrangements, which can be done independently or through a gas marketer.

Being an LDC transportation customer has advantages and disadvantages. LDCs typically have multiple connections to interstate pipelines, and they may allow deliveries into their system at different locations, which provides more options for purchasing upstream supplies and transportation. An LDC may also offer storage and balancing services that allow for more flexible management of fuel receipts.

One downside of relying on LDC transportation is the potential for service interruptions. An LDC's primary concern is to provide service to its "core" residential and commercial customers. LDC transportation agreements typically have provisions that allow the LDC to interrupt service in the event of operation problems on its distribution system or on the interstate pipelines that feed its system; there may even be a provision for interruption if temperatures drop below a certain level. Under these circumstances, even if an operator has firm upstream supply and transportation to an LDC-approved point, interruptions to gas delivery are still possible. An LDC may also place tight restrictions on maximum daily and hourly consumption rates. It is important to understand these risks and limitations and assess options to mitigate them, such as oil backup.

Other Services

In addition to transportation and distribution services, generators typically require other services to provide for greater flexibility in gas receipts and deliveries. For example, interstate pipelines often provide no-notice service, which allows a shipper to receive delivery of a quantity different from what it has nominated, up to its firm entitlement, without incurring an imbalance penalty. No-notice service is generally priced at a premium to firm transportation service and is particularly valuable during periods of high demand when transportation capacity may be completely used.

In addition to marketer agreements or LDCs, storage services can also be provided by an interstate pipeline or an independent storage service provider. The ability to store large quantities of natural gas improves reliability and usually has a moderating influence on natural gas prices. Traditionally, storage has been used to balance seasonal loads, augmenting supply during the winter and acting as an additional demand component during the injection season. Storage can also be a component of hedging strategies, helping shippers manage the risk of price

movements. High deliverability storage, usually provided by salt cavern facilities, can turn over inventory frequently and quickly, allowing for additional uses and giving users greater flexibility.

Park and loan service (PAL) allows a shipper to balance receipts and deliveries of gas by providing short-term load balancing. Using the PAL service, shippers can take less gas than scheduled, parking their excess supply in the pipeline at times when the demand is lower than anticipated. If demand is higher than expected, shippers can adjust their take upward, in effect borrowing gas from the pipeline.

Pooling services can be provided in conjunction with FT or IT capacity. It allows shippers to aggregate natural gas supplies from multiple receipt points to serve several contracts, without tying a particular receipt point to a particular contract. Pooling can be especially useful when managing fuel purchases for multiple power plants connected to the same pipeline.

The Need for Flexibility

LDCs and electric generators have very different perspectives on the natural gas market, but they share some common needs. Foremost among them is the need for flexibility when building their gas supply and services portfolios. For LDCs, this means assessing supply options and contracting for pipeline capacity in such a way that will allow them to respond to future changes in basin development. LDCs must also adapt their service offerings to meet the needs of new customers, like electric generators. Electric generators need to look beyond spot prices at the nearest hub and consider the full supply chain, including the mix of services they need, as well as ensuring that they have contracted with their natural gas service provider for the flexibility necessary to meet their operational requirements.

New pipeline capacity is needed to ensure deliverability from the new low-cost sources of supply. Growth in power generation will increase the need for additional balancing services to be provided by pipelines and LDC's. Together, the changes in the market are driving an increase in the need for flexibility and increasing the value of the market participants capable of providing that flexibility.

While the changes in supply and demand are increasing the need for flexibility in natural gas systems, the changes in supply and demand are also reducing the flexibility of the existing system to meet requirements. As a result, power generators and LDC's that require the flexibility are less likely to meet these needs without changing contracting practices and signing agreements with providers capable of delivering these services.

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