

The Evolution of Natural Gas Markets

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Introduction

Natural gas use in the U.S. grew dramatically through the early 1970s. During most of this period, much of the natural gas produced in the U.S. was a by-product of crude oil production. The reservoirs that produced dry natural gas were generally large and provided easy targets for drilling and long-lived reserves.

Over the last 40 years, natural gas consumption in the U.S. has been cyclical. Natural gas consumption in the U.S. in 2003 was only modestly above the level in 1973. As is clear from Figure 1, U.S. gas consumption has varied dramatically. The reasons for the variations in demand were often rooted in market intervention by government.

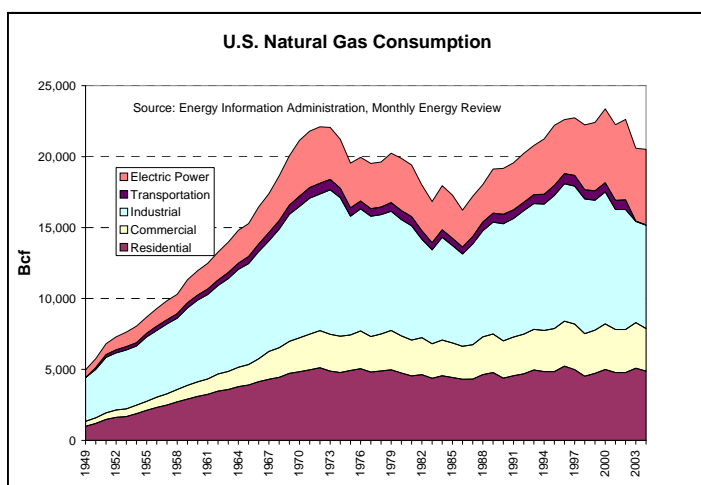


Fig. 1: U.S. consumption of natural gas has been impacted by price regulation and constraints on use of natural gas.

Federal regulation of prices for natural gas in interstate markets began in the 1950s and kept prices artificially low. The Federal Power Commission (FPC, predecessor to the Federal Energy Regulatory Commission) asserted jurisdiction over the price of natural gas delivered to pipelines for transportation in interstate markets. Although producers protested the price levels set by the FPC, the U.S. Supreme Court upheld the jurisdiction of the FPC in the Phillips case in 1954. As a result of regulation of prices at relatively low levels, demand rose and exploration declined.

The price regulations of the FPC did not apply to natural gas produced and delivered to customers in the same state. The price of natural gas in the Texas intrastate market rose to more than \$5 per MMBtu in the early 1980s.

In response to perceptions of inadequate availability of natural

gas, several laws were passed in 1978. The Powerplant and Industrial Fuel Use Act (PIFUA) required that use of natural gas as boiler fuel (including fuel for power generation, with certain narrow exceptions) cease by 1990 and prohibited the construction of new gas-fired power plants (except for gas-fired cogeneration facilities). The PIFUA destroyed gas demand by making it necessary for electric utilities to construct power plants to produce power from alternative fuels (primarily coal/lignite and nuclear fuel). Although the capital cost of such plants is high, the marginal cost of production is relatively low. Consequently, power production from solid fuels displaced generation from gas-fired plants.

The Natural Gas Policy Act (NGPA), also enacted in 1978, provided for gradual deregulation of natural gas prices in interstate markets. The NGPA allowed gas prices to rise to levels that justified exploration for and development of new gas resources. However, producers were optimistic about future prices and continued to provide gas volumes in excess of market needs, keeping prices relatively low.

The PIFUA restrictions on use of natural gas for power generation were repealed in steps (first repealing the requirement to eliminate the use of natural gas in existing plants, and then withdrawing the prohibition on construction of new gas-fired plants), allowing for growth of gas-fired power generation.

Demand for gas in the industrial sector grew along with demand in the power sector. While demand was increasing, existing gas reservoirs were maturing, access to reserves was restricted, and imports stagnated.

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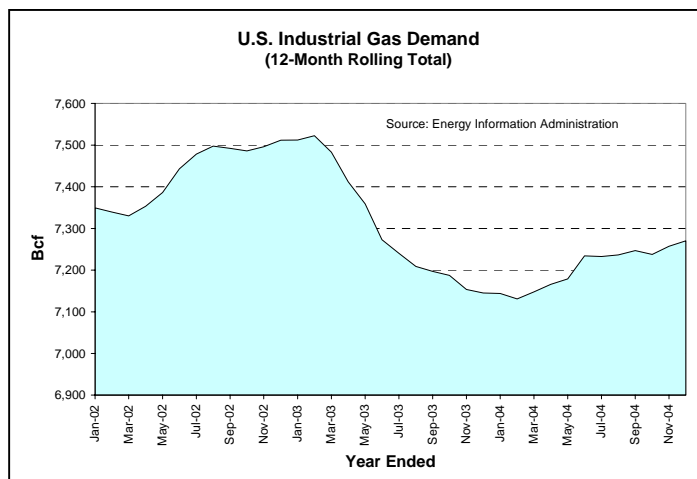


Fig. 2: Industrial demand for natural gas declined due to the economic downturn and increases in the price of natural gas. Demand has increased with the economic recovery.

The Evolution of Natural Gas Markets (Cont'd)

Demand for Natural Gas

The use of natural gas is diverse, ranging from cooking and home heating, to fuel for power and steam production, to feedstock for production of various products including fertilizer and a broad range of petrochemicals. As illustrated in Figure 1, gas utilization increased dramatically from 1986 to 2000, driven primarily by attractive prices and growth in demand for power generation and industrial uses. As long as natural gas appeared to be economical, demand increased. With low gas prices, it remained attractive to keep less-efficient plants in operation and to construct new plants that used natural gas as fuel or feedstock. Furthermore, low gas prices made it difficult for foreign sources to compete with domestic production of natural gas and of products derived from or dependent on natural gas.

As shown in Figure 2, industrial gas demand has stagnated as prices have increased. There are several credible reasons for the stagnation:

- Higher natural gas prices have made it more attractive to import some products rather than produce them domestically (especially ammonia-based fertilizer) and have made alternative feedstocks attractive (corn-oil for plastics and naphtha for various petrochemicals, for example)
- Plants that didn't use natural gas efficiently have been shut down
- Low efficiency boilers in industrial plants have been replaced with highly efficient boilers or cogeneration

A portion of the reduction of gas demand in the industrial sector was a result of the downturn in the economy in 2000. However, the more significant reductions have resulted from (1) elimination of non-economic uses and (2) efficiency improvements.

In the power generation sector, higher-efficiency combined-cycle power plants and cogeneration plants have displaced older gas-fired steam plants for power production, lowering gas demand in areas with substantial gas-fired generation

Demand for gas in winter remains high because it is driven by heating loads that are not particularly responsive to spot-market prices, partially because local distribution company (LDC) rates don't track prices in the spot-markets.

Natural Gas Supply

Reserves

The U.S. has substantial natural gas reserves. Reserves are classified as:

- Proven – Reserves that are reasonably well defined based on drilling and seismic data

- Discovered Undeveloped – Resources that are expected to exist based on geologic and seismic data, but have not been proven by drilling

- Unproved – Resources that are expected to exist

The National Petroleum Council (NPC), in its 2003 report to the Department of Energy (“Balancing Natural Gas Policy, Fueling the Demands of A Growing Economy”), estimated that the U.S. has reserves as follows (lower 48 and offshore):

• Proven	175 Tcf
• Discovered Undeveloped	766
• Unproved	207

However, the report pointed out that a substantial portion of the reserves is off limits due to drilling moratoria.

Alaskan “discovered undeveloped” and “unproved” reserves would add another 295 Tcf of resources.^{1,2} However, the reserves in Alaska will be of little benefit until there is means of delivery to markets. There have long been proposals to construct pipeline facilities to move gas from the Alaskan north slope to the lower 48 states. However, construction of such pipelines will require significant financial commitment and/or government guarantees to become financially viable.

Access to reserves has become more difficult. While drilling for natural gas and oil is common in the Gulf of Mexico, drilling isn't currently allowed in federal waters off Florida, the Atlantic coast, and the Pacific coast.

In addition, substantial portions of the reserves in the Rocky Mountain region are on federal lands and obtaining permits for drilling is contentious. Since producers face uncertain timing for obtaining drilling permits, the financial risk is higher.

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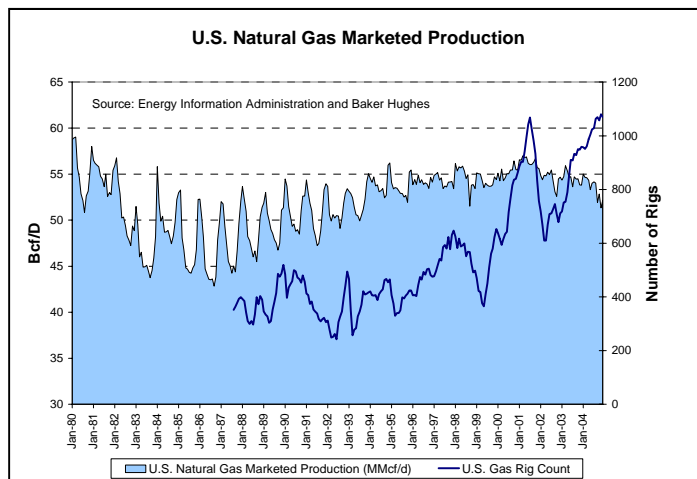


Fig. 3: U.S. natural gas production has declined even though the number of rigs drilling for natural gas has reached record levels.

The Evolution of Natural Gas Markets (Cont'd)

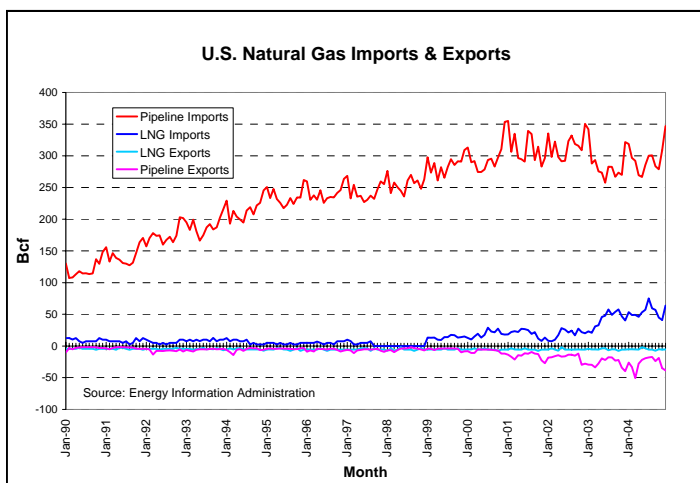


Fig. 4: Imports of natural gas from Canada have declined and imports of LNG are only slightly greater than total exports.

Production

U.S. production of natural gas is regionally diversified with the greatest production in the federal waters of the Gulf of Mexico and in Texas. Oklahoma and Louisiana also provide a significant portion of domestic production. California, Kansas, New Mexico, the Rocky Mountains, the Southeast, and a few other areas have gas production but the volumes are much less. Alaska has significant gas production potential but there is currently no means of transporting it to the lower-48.

U.S. natural gas production has declined significantly. (See Figure 3.) Many wells have been drilled but the productive capacity of most natural gas wells declines rapidly.

The number of rigs actively drilling for natural gas in the U.S. has risen to record levels as the amount of gas produced per well drilled has declined. It now takes a far larger number of wells to maintain productive capacity at levels necessary to meet needs. In addition, the risks associated with drilling gas wells have increased as the large reservoirs have been depleted. Exploration and production companies are drilling in smaller reservoirs and the risk of not finding substantial gas production is greater.

It should be noted that the current tightness of gas markets impacts the need for gas storage capacity. Figure 3 clearly shows that through the mid-1990s, gas production provided a portion of the winter peaking capability in the industry. This was possible because of excess gas production capacity. Now there is no excess production capacity and gas reservoirs are operated at full capability. In addition, the loss of industrial demand makes total gas demand more seasonal.

Given these changes, it is expected that utilization of gas storage will increase and more storage capacity will be needed.

Imports and Exports

U.S. domestic natural gas production isn't sufficient to meet all natural gas needs in the nation. As illustrated in Figure 4, Canada has long been a major supplier of natural gas to the U.S. However, imports from Canada have faltered as reserves have been depleted, drilling success has declined, gas has been shut-in to protect oil production, and gas demand in Canada has grown.

The U.S. has long been an exporter of liquefied natural gas (LNG). Relatively small volumes of LNG are shipped from Alaska to Japan. This has been attractive because there have been no LNG receiving terminals on the west coast of North America and the value of LNG has been higher in Japan.

In addition, the U.S. has had LNG import facilities for many years. Terminals were constructed at four sites in the Atlantic and Gulf coasts. The existing terminals were built in the 1970s to augment domestic supply. However, for a long period, there were no deliveries of LNG to the U.S. terminals. (Some of the terminals remained in use as storage facilities.) Low domestic prices made it impossible for LNG to be competitive.

Higher prices in the last few years have made it attractive to deliver LNG to the U.S. In July 2004, deliveries exceeded 2 billion cubic feet (Bcf) per day. LNG imports have since declined.

There have been many proposals for development of new LNG import terminals and for expansion of the existing terminals. Some of the new terminals and expansion projects have received approval. Engineering and construction is in process for several projects. However, other projects have been stymied by concerns over security and environmental impacts as well as provincialism.

Some of the issues that must be addressed in order for LNG to play a significant role in gas supply for the U.S. are:

- Availability of adequate gas reserves and liquefaction capacity to support the world's demand for LNG
- Price regimes high enough to make it attractive to deliver LNG to the U.S.
- Ability to accommodate the higher levels of natural gas liquids (NGLs; ethane, butane, propane, pentane, and hexane) in LNG supplies from some sources
- Pipeline transportation capacity to take gas away from the terminals to markets (Some of the proposed terminals are to be located in areas with limited pipeline access)

The Evolution of Natural Gas Markets (Cont'd)

Weather Impacts on Gas Production

Domestic gas production was significantly impacted by the tropical storms and hurricanes in the Gulf of Mexico. More than 20 percent of the production from the Gulf was shut in as a result of damage to platforms, sea-floor facilities, and pipelines. The amount of production has gradually recovered (the volume shut-in has declined) but the Minerals Management Service (MMS) doesn't expect full recovery until mid-2005. As of early February, the amount of gas production lost was more than 156 Bcf, approximately three days of gas supply for the U.S.

Natural Gas Prices

The more precarious balance of gas production and consumption has caused prices to rise dramatically. Over the last two years, natural gas prices have generally followed oil prices. (See Figure 5.)

The prices for world crude oil supplies have been influenced by:

- World oil demand: Demand rose as usage in China, India, and other nations increased while consumption in other markets remained high
- The value of the U.S. dollar: The value of the dollar has declined relative to other major currencies, especially the Euro (See Figure 6.)

It also appears that the interest of non-commercial traders has influenced the prices of both crude oil and natural gas. The percentage of total open interest in natural gas futures and swaps held by non-commercial traders has grown significantly in the last few years.

The New York Mercantile Exchange recently released a report³ indicating that the hedge funds that are active in energy markets

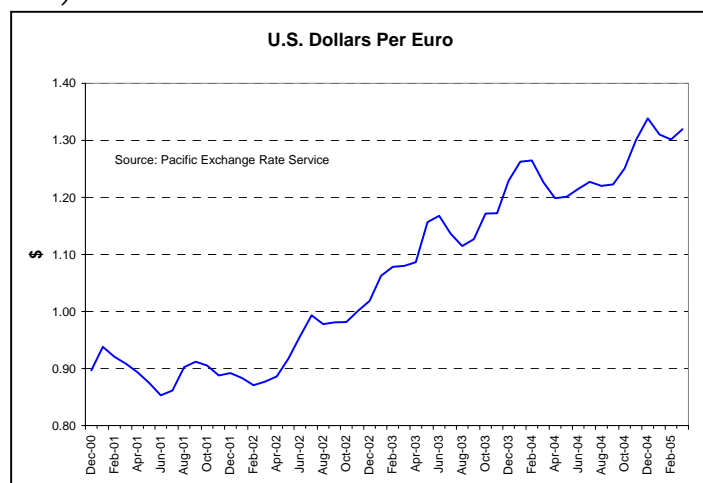


Fig. 6: The value of the U.S. dollar has declined relative to other currencies, especially the Euro.

do not contribute to price volatility. However, the report did not conclude that the participation of the hedge funds doesn't result in higher forward prices.

Conclusions

At present, North American gas markets are precariously balanced. Traditional resources are maturing. Although there are substantial gas reserves, access to new resources is constrained and risks for gas exploration and production have increased. It is essential that permitting processes for gas reserves on federal lands be improved to provide access to gas reserves and reduce regulatory uncertainty.

LNG can make a significant contribution to U.S. natural gas supply but it will be necessary to find and develop supply sources, construct receiving terminals, and adequately address quality and transportation issues. Greater access to LNG will not necessarily reduce prices.

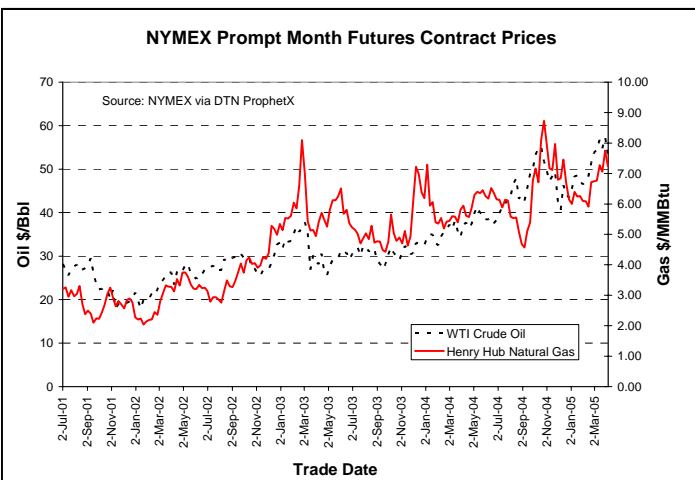


Fig. 5: The prices of NYMEX futures contracts for natural gas have generally moved with prices of WTI crude oil contracts.

Notes:

1. Since the time of the report, some oil and gas companies have reduced their reserve estimates in order to comply with the Securities Exchange Commission's (SEC's) requirements. The reductions imply that reserves complying with SEC standards are less than estimated by the NPC from public reports. However, the reductions do not mean that the resources don't exist.
2. In a recent paper ("Presenting the Full Picture," by Peter J. Newman and Victor A. Burk of Deloitte), it was recommended that the SEC reconsider its reporting requirements to conform to the realities of current markets.
3. "A Review of Recent Hedge Fund Participation in NYMEX Natural Gas and Crude Oil Futures Markets," March 1, 2005