Natural Gas: Introduction and Sector Overview

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Discussion references.

- Technical
- Economic
- Structural
- Regulatory
Technical
The natural gas industry ("value chain").

Production (Upstream) → Transmission (Midstream) → Distribution (Downstream)

- Natural Gas Wells
- Gas Processing Plant
- Underground Storage
- Natural Gas transmission
- Main Line Sales
- Local Distribution Company (utility)
- Consumers

Source: Energy Information Administration, Department of Energy
Natural gas formations and wells.
Natural gas is a naturally occurring fossil fuel that is typically mined from resources under the earth’s surface.

What we think of as “natural gas” is really comprised of several different hydrocarbons that includes methane (CH$_4$), ethane (C$_2$H$_6$), propane (C$_3$H$_8$), butane (C$_4$H$_{10}$) and other “natural gas liquids” or “NGLs.”

Methane is often referred to as “pipeline quality gas” and is what we are referring to when we think about natural gas that is sold by utilities.
What is natural gas transmission?

Natural gas transmission service is needed to move natural gas from **producing areas** to **consuming areas**. The long-distance pipeline is needed to move natural gas from “Point A” to ‘Point B.”

Natural gas transmission operators **receive** natural gas from a source by a shipper, then move that gas to a **delivery point** defined by the shipper. The gas transmission company is paid for moving the gas from receiving the gas at “Point A” and moving that gas to the delivery point (“Point B”).
Natural gas infrastructure originates in the producing areas and terminates in (near) consuming areas. The definition of producing areas, and their importance, is changing rapidly with unconventional development.

Legend
- Interstate Pipeline
- Intrastate Pipeline
- = Salt-Cavern Storage
- ★ = Depleted-reservoir and Aquifer Storage
Natural gas storage serves two primary functions: to meet seasonal demands for gas (base-load storage); and to meet short-term peaks in demand (peaking storage). Peaks in natural gas demand can range from a few hours to a few days, typically during unusually cold winter weather.

To ensure that adequate natural gas supplies are available to meet seasonal customer requirements, underground natural gas storage facilities are filled during low utilization periods in what is commonly called the “injection season,” typically between April through October of any given year.

Natural gas that is placed into storage is ultimately moved to markets to supplement domestic production and imports during what is referred to as the “withdrawal season” between the fall/winter peak usage months of November to March.
Greater price uncertainty and volatility often lead to more significant storage needs.

Why do we store natural gas?

(1) **Reliability**: insurance on supply interruptions (outages/curtailments).

(2) **Risk management**: insurance on rapid and large price changes (volatility).

(3) **Profitability**: opportunities for storage service sales related to market changes.
Natural gas distribution ("utilities").

What we think of as natural gas "utilities" are typically the distribution portion of the industry (local distribution companies or "LDCs"). This part of the system takes natural gas from higher pressure transmission lines and distributes the natural gas to end users.

Distribution systems are comprised of various types of regulators, valves, meters, mains and service lines.

Red line markets the point of the "city gate" or demarcation from the high pressure (transmission) to lower pressure (distribution) systems.

Source: citizensenergygroup.com
Structural
Natural gas markets are comprised of buyers and sellers as well as several other market participants that facilitate the transfer (trade) of natural gas commodity to end-users (buyers).

**Buyers**
- Households
- Businesses
- Industry

**Sellers and Middlemen**
- Utilities
- Producers
- Marketers
- Marketers
Utility types.

<table>
<thead>
<tr>
<th>Number of Companies</th>
<th>Customers (millions)</th>
<th>Total Sales (Tcf)</th>
<th>Customers Share (%)</th>
<th>Share of Total Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investor Owned</td>
<td>153</td>
<td>63.2</td>
<td>5,597</td>
<td>86.0%</td>
</tr>
<tr>
<td>Municipally Owned</td>
<td>916</td>
<td>5.1</td>
<td>693</td>
<td>7.0%</td>
</tr>
<tr>
<td>Privately Owned</td>
<td>102</td>
<td>4.6</td>
<td>344</td>
<td>6.2%</td>
</tr>
<tr>
<td>Cooperative</td>
<td>31</td>
<td>0.2</td>
<td>236</td>
<td>0.3%</td>
</tr>
<tr>
<td>Other Ownership</td>
<td>12</td>
<td>0.4</td>
<td>452</td>
<td>0.6%</td>
</tr>
</tbody>
</table>

Source: EIA-176.
Economic – Supply
Unlike conventional resources, shale plays (natural gas, liquids, and crudes) are located almost ubiquitously throughout the U.S. and are the primary reason for the decrease in overall and regional natural gas prices.
Shale (unconventional) wells differ from “conventional” wells since they are **drilled horizontally and not vertically**.

- **Horizontal segments are then “fractured”** with higher pressure water, chemicals and silica to break up the formation.

- **The fractionation process releases/liberates the hydrocarbons.**

- **Some environmental and water use concerns** expressed in some areas of the country on this drilling process.

Source: Energy Tomorrow.
Natural gas production and reserves are at levels not seen since the 1970s and both U.S. natural gas production and reserves are now at an all-time recorded peak.

Source: U.S. Energy Information Administration.
Economic – Demand
Natural gas is important for all consumers

- Residential
- Commercial
- Industrial
  - Furnace/Heat
  - Boiler/Steam
  - Feedstock
  - Power Generation
- Power Generation
Historic natural gas sales trends.

Natural gas sales are not typically volatile. Residential/commercial very slow growing, **power generation & industrial represent the growth part of the market.**

Source: U.S. Energy Information Administration.
Regulatory
Federal regulatory agencies in the energy industry.

[Logos of various regulatory agencies]

Wholesale v. retail transactions.

Transactional distinctions are importance since (a) players are different, (b) regulation differs, (c) outcomes and efficiency gains can be different.
How do we regulate gas utilities?

Regulatory Process

Rates & Service Offerings
- Revenue Requirement
- Cost of Capital
- Cost Allocation/Rate Design

Resource Planning
- Gas Supply Plans
- Integrity Management
- Other Resource Procurement
Conclusions
Conclusions

• Natural gas is comprised of a production, transmission and distribution sector.

• While utility regulation focuses on the distribution and some of the transmission functions, understanding the entire value chain is important for regulation.

• Understanding production and commodity markets, for instance, is important in the evaluation of utility procurement and gas supply plans.

• Understanding pipeline operations is also important in understanding regional constraints that can impact system planning and reliability.

• Big challenge: how does a fossil fuel-based industry survive in a zero-carbon world with 100 percent renewable energy goals?