AMERICAN PETROLEUM INSTITUTE

Petroleum University of Technology

# UNDERSTANDING NATURAL GAS MARKETS

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# Table of Contents

PREVIEW


Overview ..... 3

The North American Natural Gas Marketplace ..... 8

Natural Gas Supply ..... 14

Natural Gas Demand ..... 21

Natural Gas Exports ..... 26

How Natural Gas is Traded ..... 28

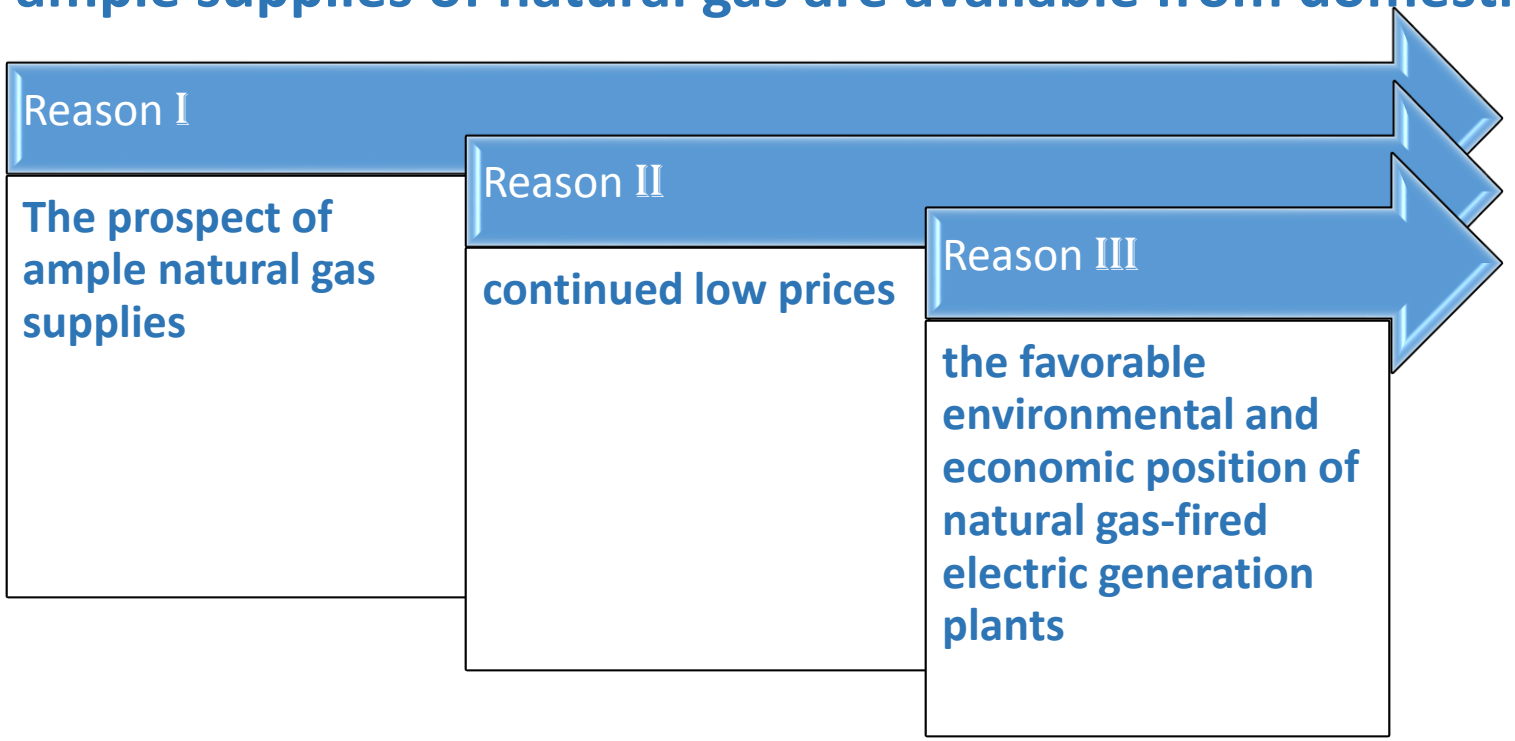
Futures and Other Financial Contracts ..... 31

Conclusion: A New Era For U.S. Natural Gas Markets ..... 34

## Overview

- Natural Gas is an Important Source of Energy for the United States.

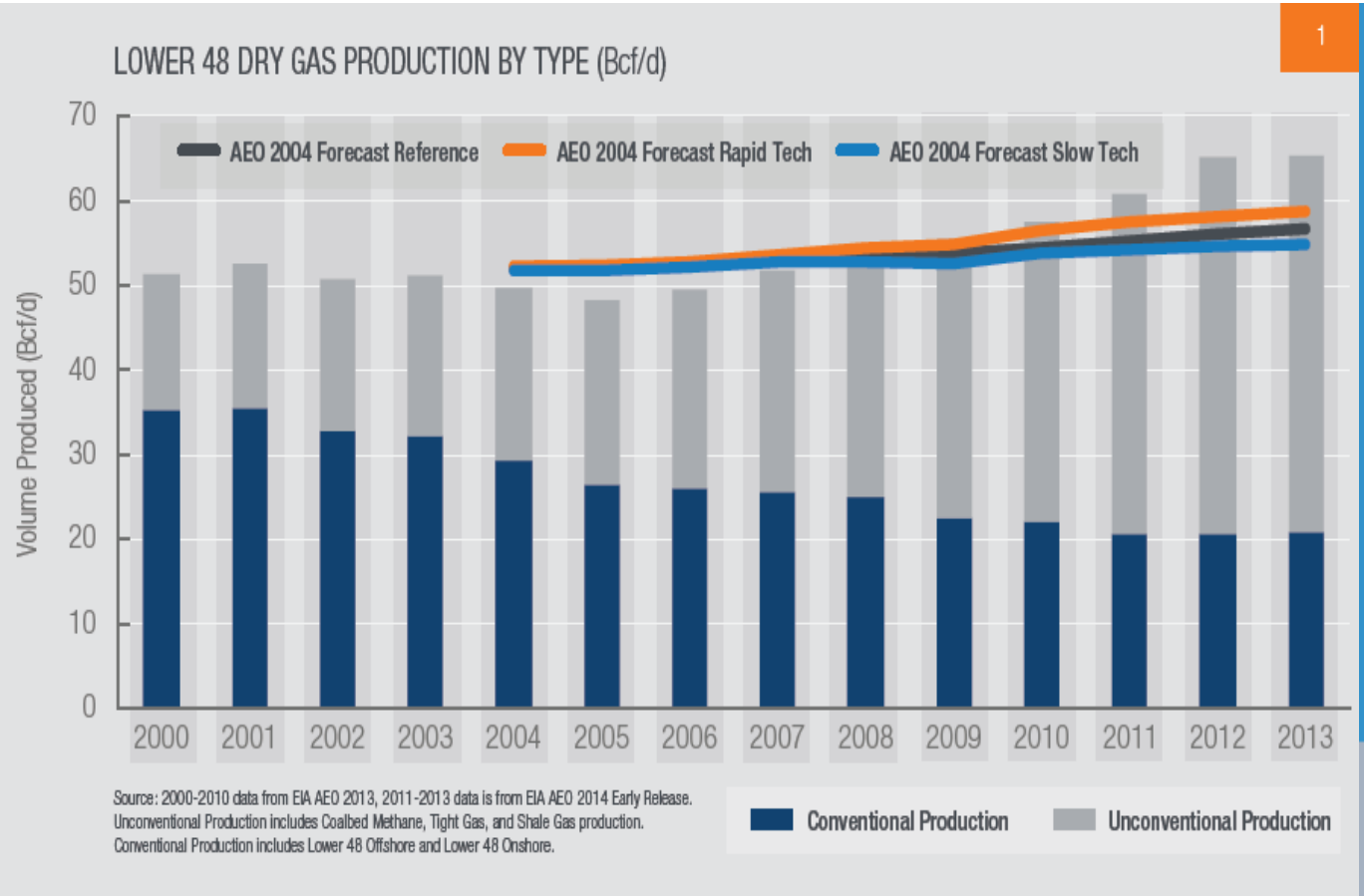
- Natural gas is an attractive fuel because it is clean burning and efficient, and ample supplies of natural gas are available from domestic resources.

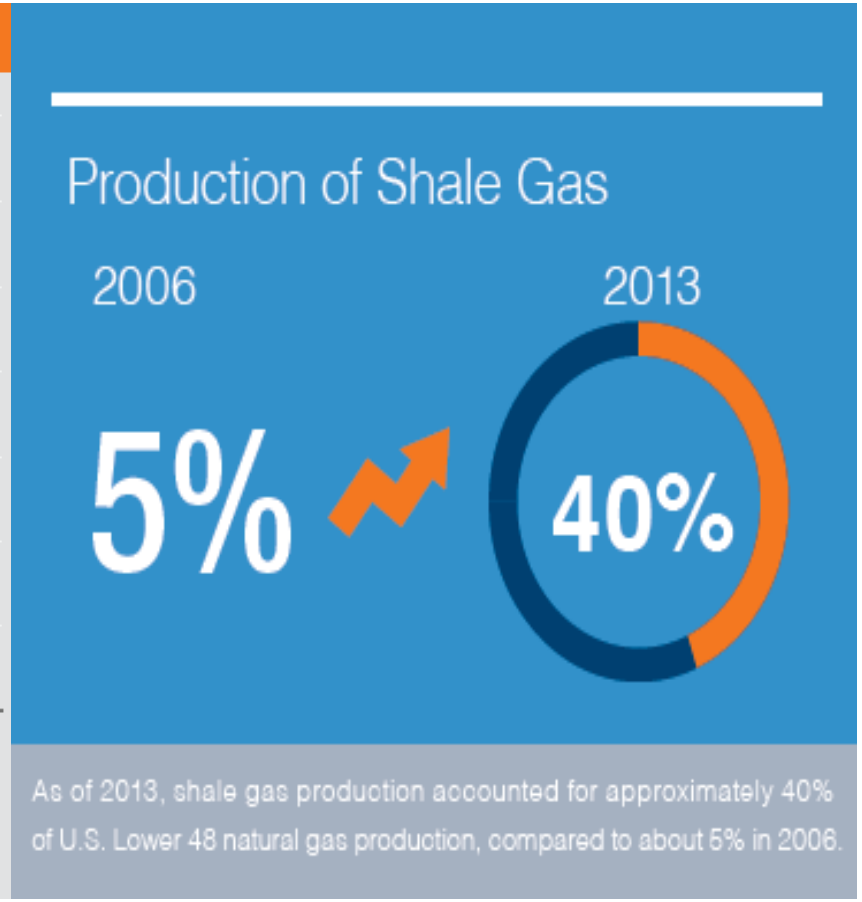



Growing U.S. demand for natural gas, especially in the electric and industrial sectors, and potentially for export as liquefied natural gas (LNG).

# **Understanding** Natural Gas Markets





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## The important trends now affecting the industry include the following:

- U.S. natural gas demand is increasingly served by domestic production from unconventional shale gas sources rather than imported natural gas from Canada and other conventional supplies.

- Natural gas use for electricity generation is poised to increase due to low natural gas prices and expectations that coal-fired power plants will continue to be retired due to environmental regulations. Low natural gas prices are also expected to drive demand growth in the industrial sector.

- The growth in shale gas production in shifting flows on the U.S. interstate pipeline network.

- The substantial production increases, and low prices in the U.S. relative to overseas, are leading to the development of both LNG and pipeline export projects. These projects could result in the U.S. becoming a net exporter of natural gas, whereas historically the U.S. was a net importer due to its reliance on Canadian natural gas supplies in meeting domestic consumption.

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❖**Key points:**

- **The shale gas revolution has led to U.S. natural gas supply growth that has exceeded demand growth. As a result, Canadian imports and other conventional supplies have been displaced, prices have fallen substantially and price volatility has declined to some extent.**

- **The last large price spike in the summer of 2008 gave way to a substantial price decline as shale gas production increased and the economic recession brought on by the global financial crisis decreased the demand for natural gas.**

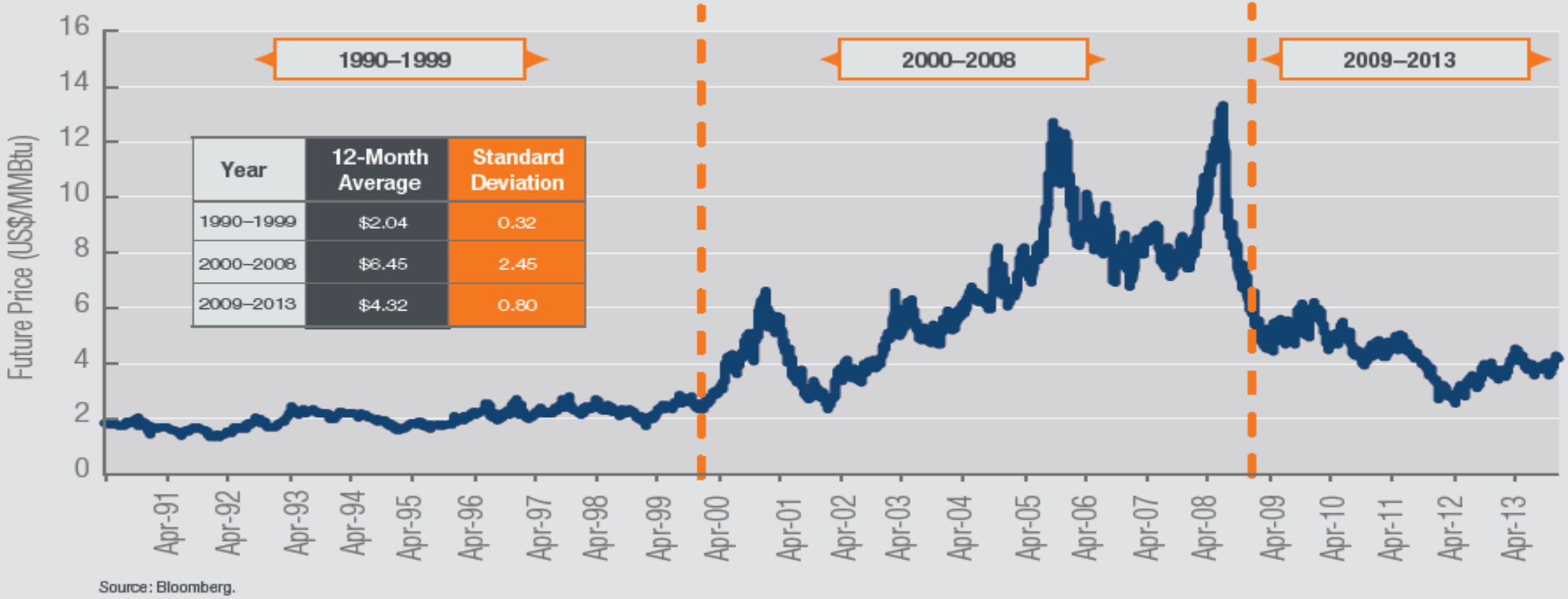
- **Demand has increased since 2009, domestic shale production has increased even faster. The result has been relatively low prices over the past several years, but not as low as the prices experienced during most of the 1990s.**

# **Understanding** Natural Gas Markets



2

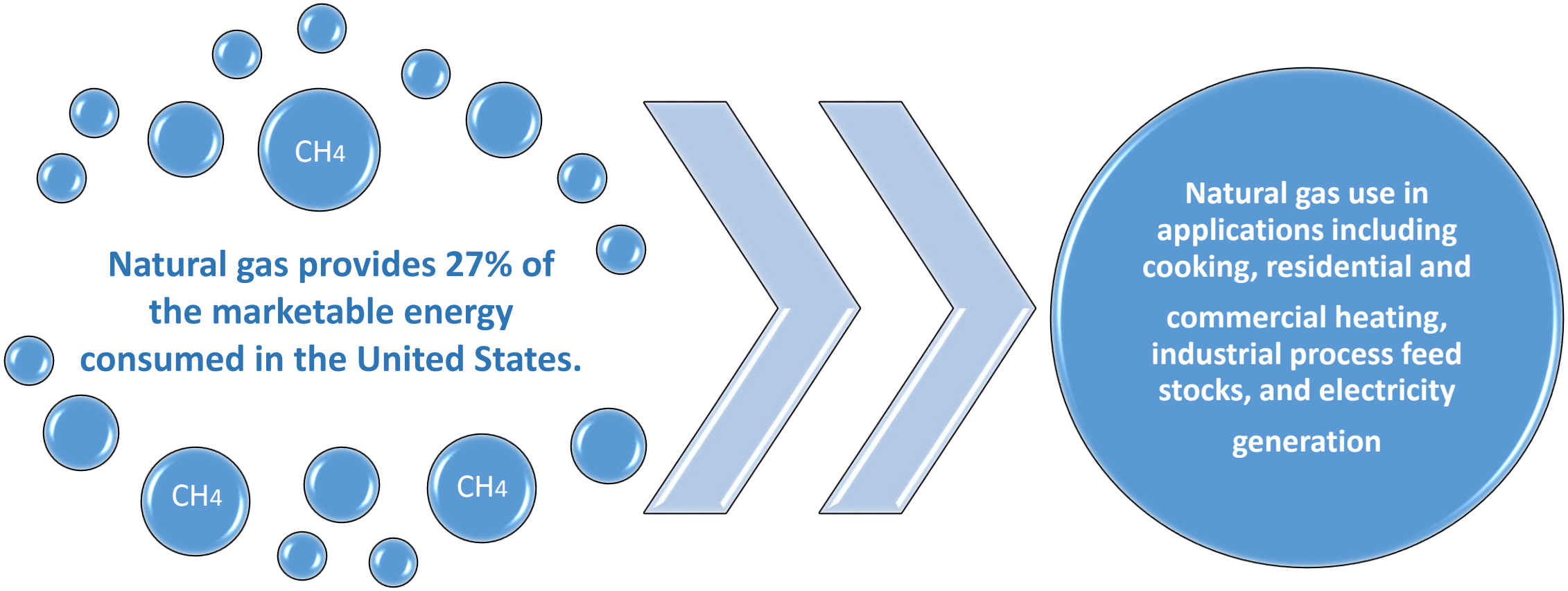
## NYMEX NATURAL GAS 12-MONTH AVERAGE FUTURE PRICES (April 1990-December 2013)




| Year | 12-Month Average | Standard Deviation |
|---|---|---|
| 1990–1999 | $2.04 | 0.32 |
| 2000–2008 | $6.45 | 2.45 |
| 2009–2013 | $4.32 | 0.80 |

Source: Bloomberg.

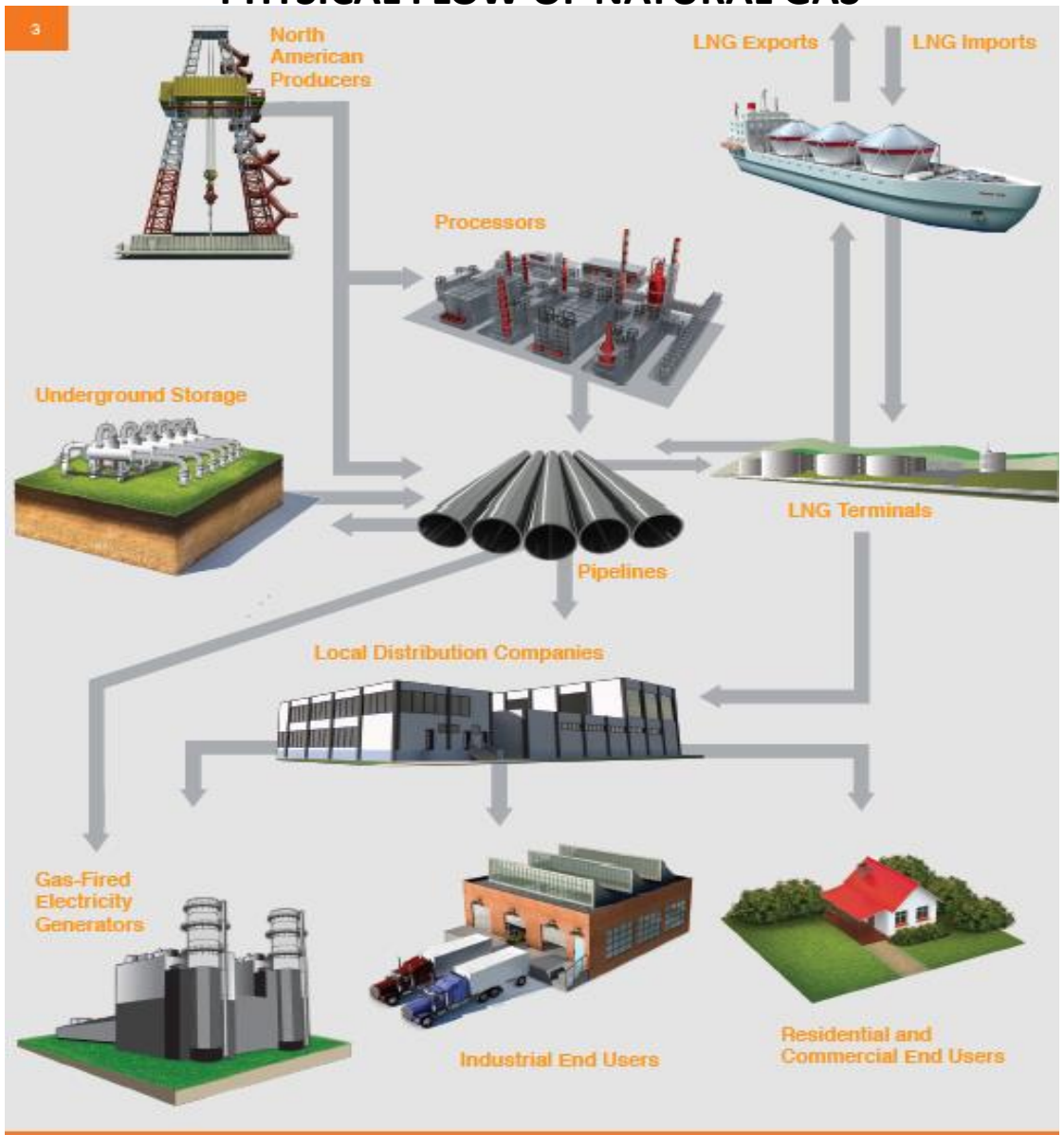
## The North American Natural Gas Marketplace



## Physical Structure of the U.S. Natural Gas Industry:

- Exploration and Production
- Processing
- Transportation
- Storage
- Local Distribution
- Liquefied Natural Gas

**PHYSICAL FLOW OF NATURAL GAS**



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- The U.S. currently imports **less than one percent** of its natural gas in the form of LNG (compared to a peak of **three percent in 2007**) primarily from the Everett terminal near Boston and the Elba Island terminal in Georgia, two of eleven existing U.S. LNG import terminals.

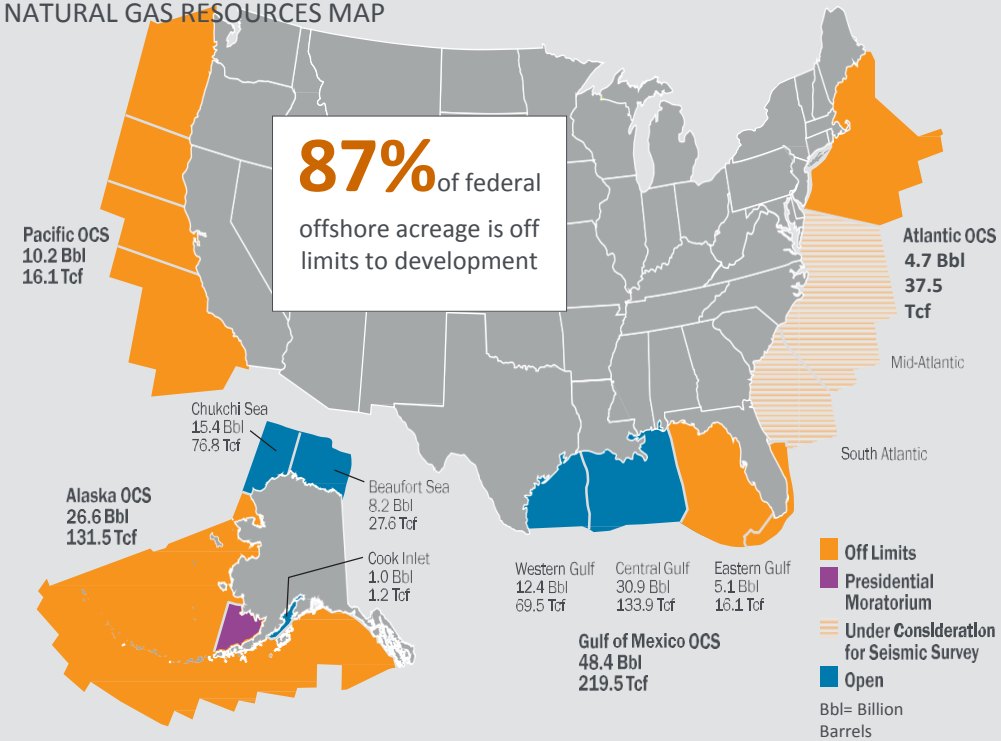
- The growth in shale gas production in the U.S. has resulted in proposals to develop LNG export terminals to liquefy and ship natural gas produced in the U.S. to overseas markets.

# **Understanding** Natural Gas Markets



5

OFFSHORE UNDISCOVERED TECHNICALLY RECOVERABLE FEDERAL OIL AND NATURAL GAS RESOURCES MAP




Source: API primer "Offshore Access to Oil and Natural Gas Resources," July 2014.

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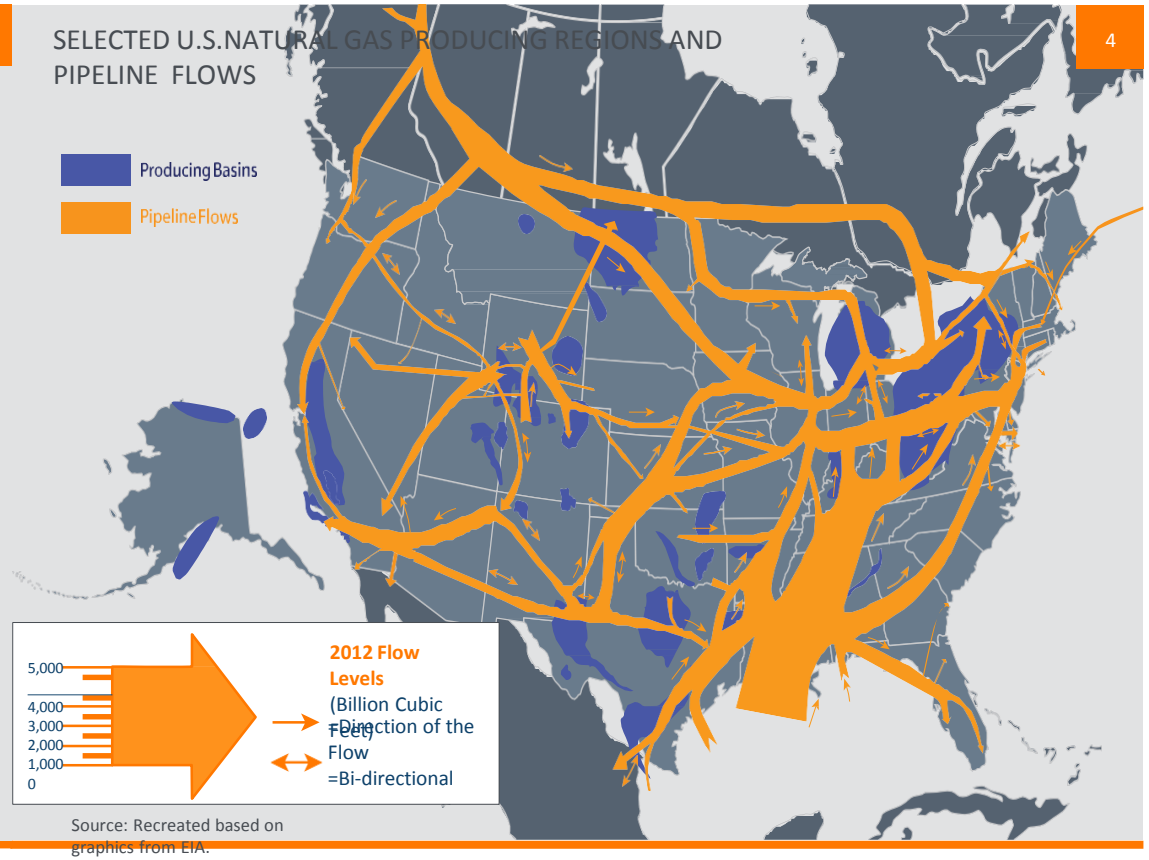
SELECTED U.S.NATURAL GAS PRODUCING REGIONS AND PIPELINE FLOWS




Source: Recreated based on graphics from EIA.

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- Once natural gas is produced and processed, it is injected into pipelines for transmission to end-use customers and local distribution companies.

- Transmission and distribution costs are a significant portion of the total cost of delivered natural gas.

- The rates charged by both natural gas pipelines and local distribution companies are regulated at the federal and state level.

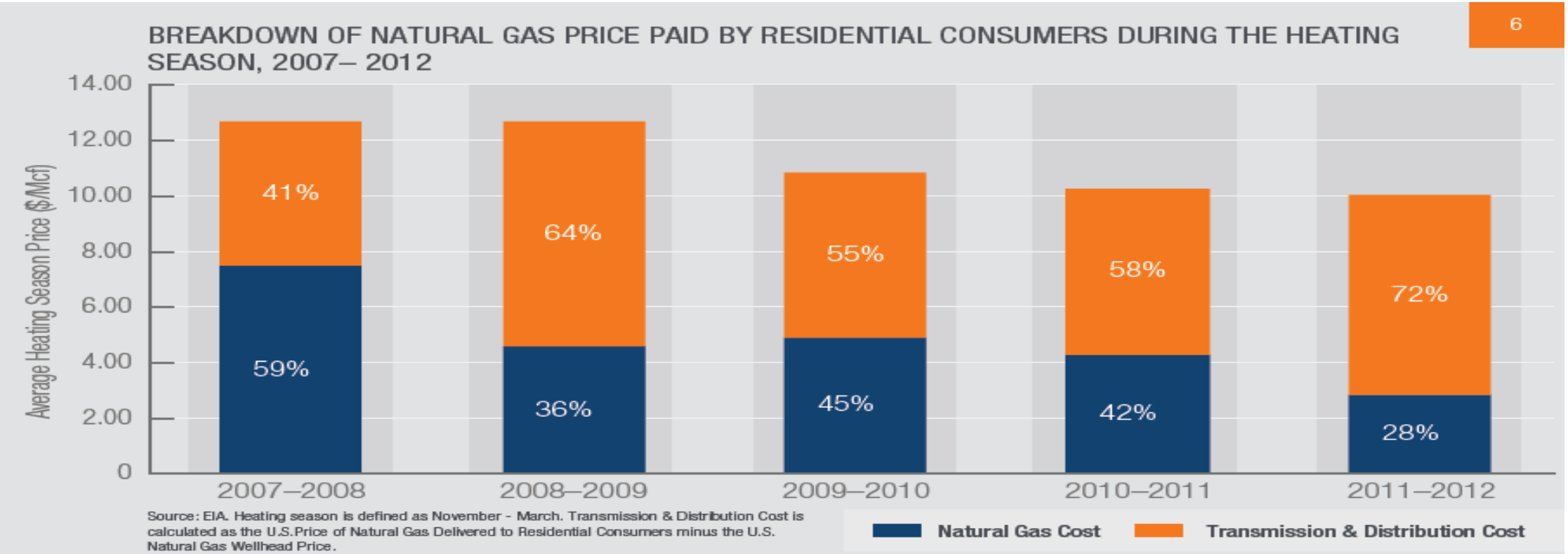
Natural Gas Tanker

Off-Shore

Processing Plant

# **Understanding** Natural Gas Markets






**In recent years, the cost of the natural gas itself has decreased from 59% in 2007-2008 to 28% in 2011-2012 of the delivered natural gas cost paid by residential consumers during the heating season (November through March), while transmission and distribution charges have increased from 41% to 72% of the consumer's average heating season cost.**

**See Figure 6**

## Natural Gas Supply

- Shales are fine-grained sedimentary rocks that can be rich sources of petroleum and natural gas.
- Technically recoverable natural gas resources in the U.S. have been estimated at 2,431 Tcf currently, compared to 1,594 Tcf in 2005
- The largest shale production is from the Marcellus (35%), Haynesville (12%), Barnett (14%), and Eagle Ford (12%) shale formations (with all other shales combining to total roughly 27%).

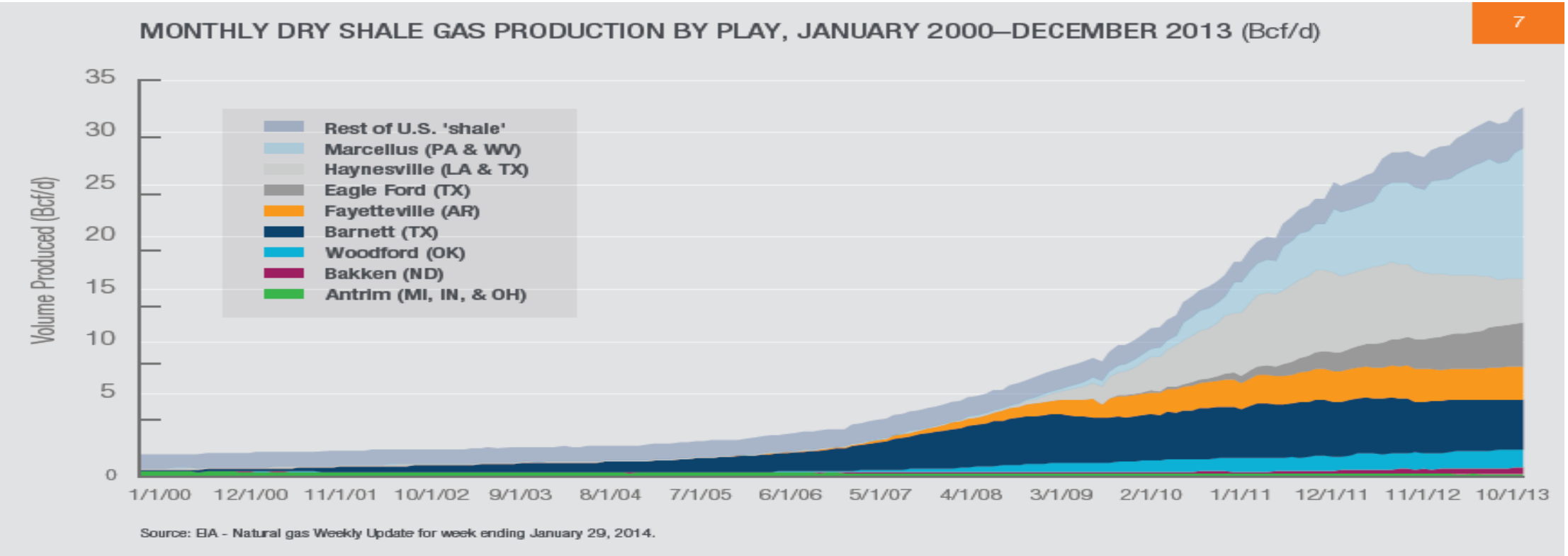



**Figure 7 shows the substantial growth in annual shale gas production from less than 5 Bcf/d in early 2007 to nearly 30 Bcf/d more recently.**

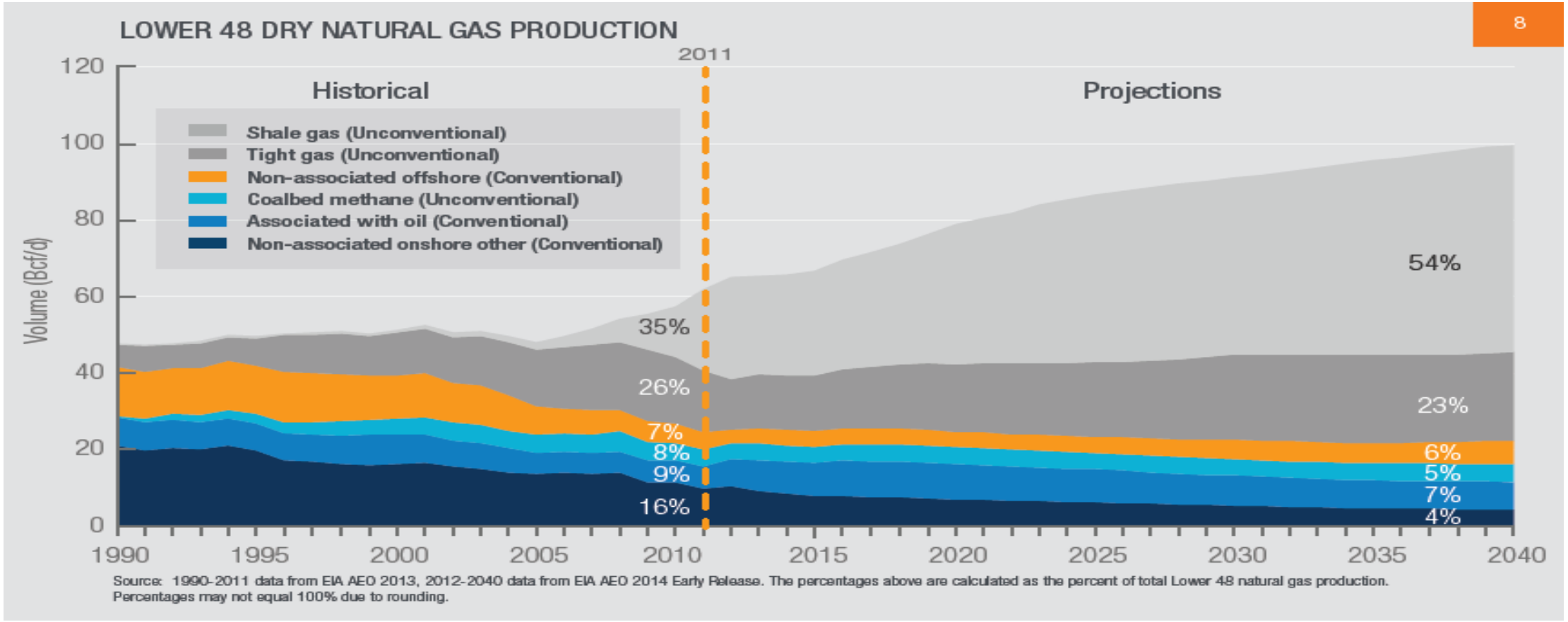



**Figure 8 shows U.S. Lower 48 production of natural gas by source, with shale gas accounting for a significantly increasing proportion of total U.S. Lower 48 natural gas production. Shale gas production is projected to account for over 50% of U.S. Lower 48 natural gas production by 2040, and gas produced by hydraulic fracturing will account for nearly 80% of natural gas production in the future.**

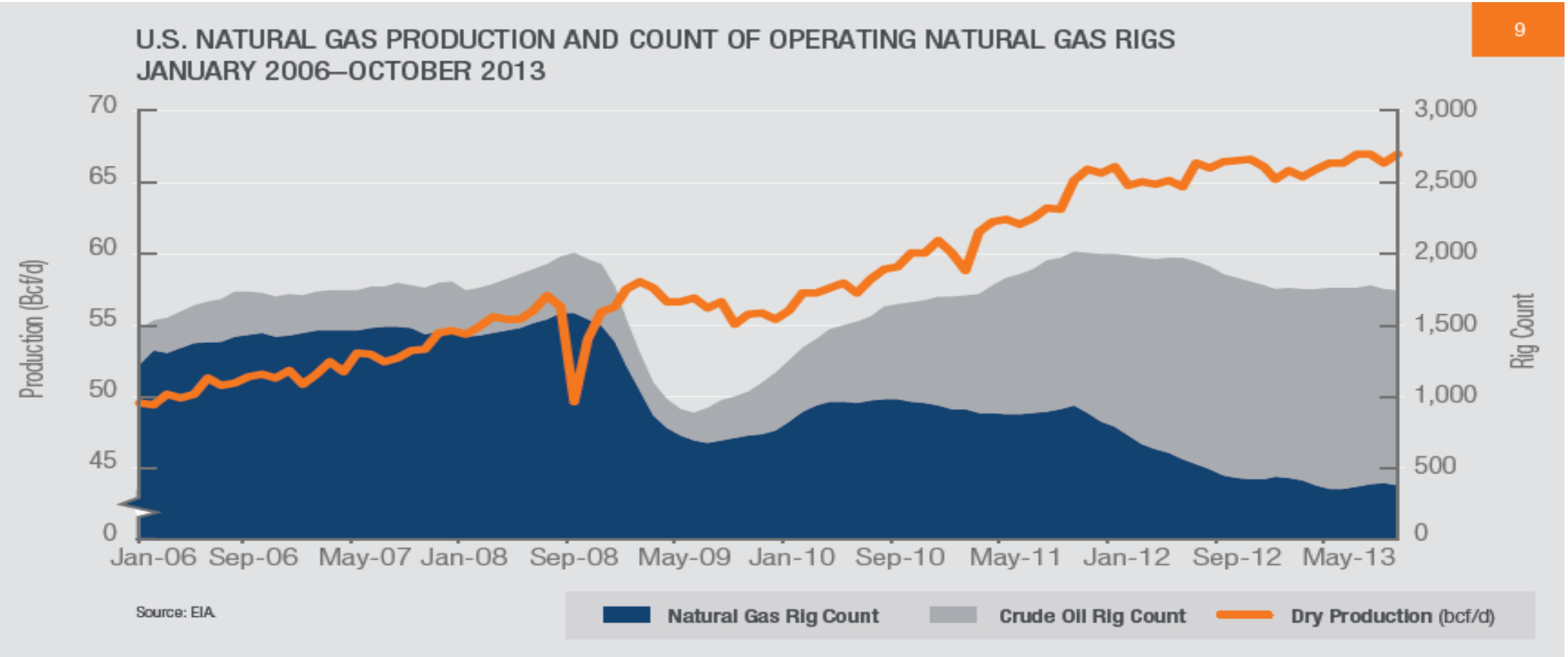



**Figure 9 show that total natural gas production has continued to grow even as rigs increasingly have been directed towards oil drilling and away from natural gas.**

- An important factor that affects drilling activity in the U.S. is the price of natural gas liquids (NGLs) that are produced in some areas as a byproduct of natural gas production.

- NGLs are removed from the natural gas stream at natural gas processing and fractionation plants and sold separately.

- High NGL prices (which typically have followed the trends in oil rather than natural gas prices) make it profitable to separate NGLs from natural gas and sell them as a separate product.

# **Understanding** Natural Gas Markets



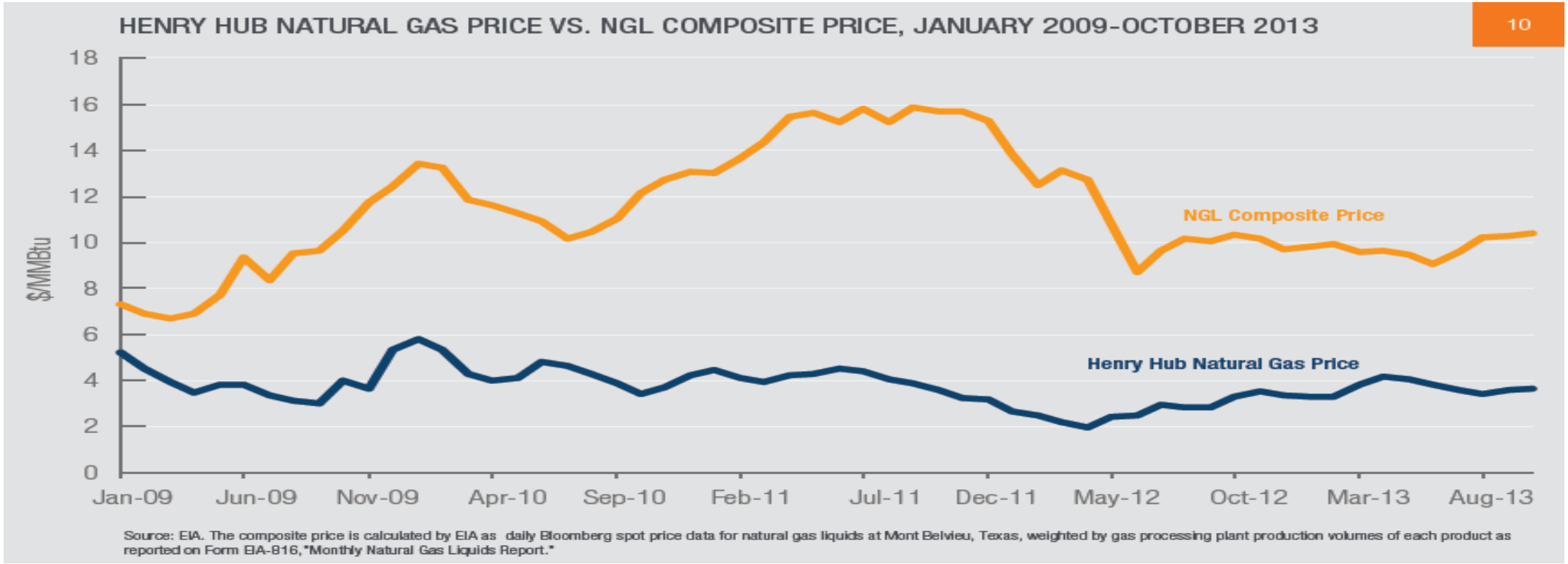
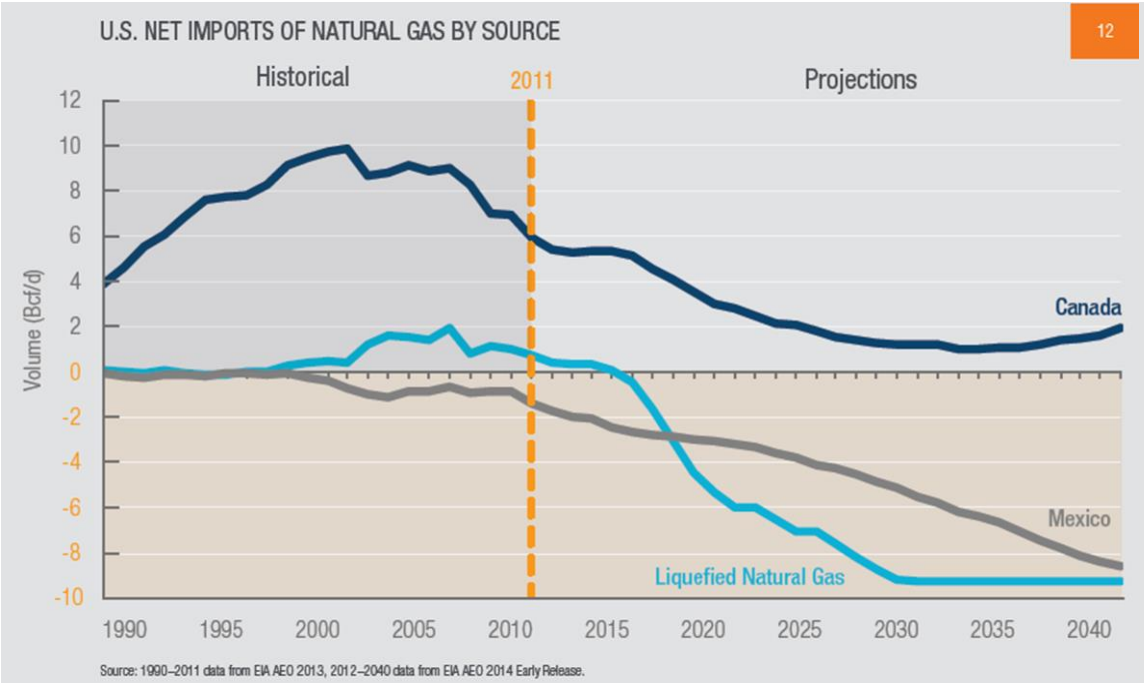
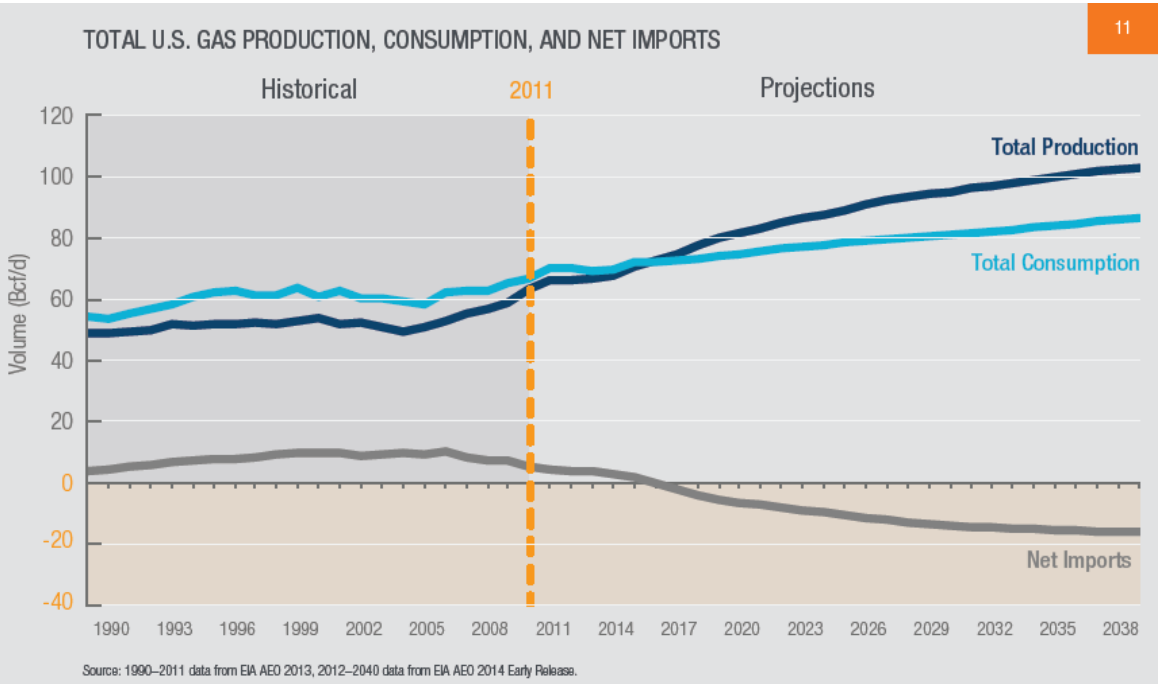



**Figure 10 shows that Recent NGL prices have been high relative to natural gas prices, which has provided a strong incentive for producers to shift their focus from dry gas plays to liquids-rich gas plays.**

# **Understanding** Natural Gas Markets






**Historically, U.S. natural gas consumption exceeded production, and the difference was made up by natural gas imports by pipeline from Canada as well as a relatively small amount of LNG imports from overseas locations. With the growth in domestic shale gas supplies, imports have been declining and forecasts indicate that the U.S. will become a net exporter of natural gas later this decade.**

**These exports will likely include pipeline exports to Mexico, and exports in the form of LNG. Net imports from Canada are likely to continue, but at substantially lower levels than in the past .**

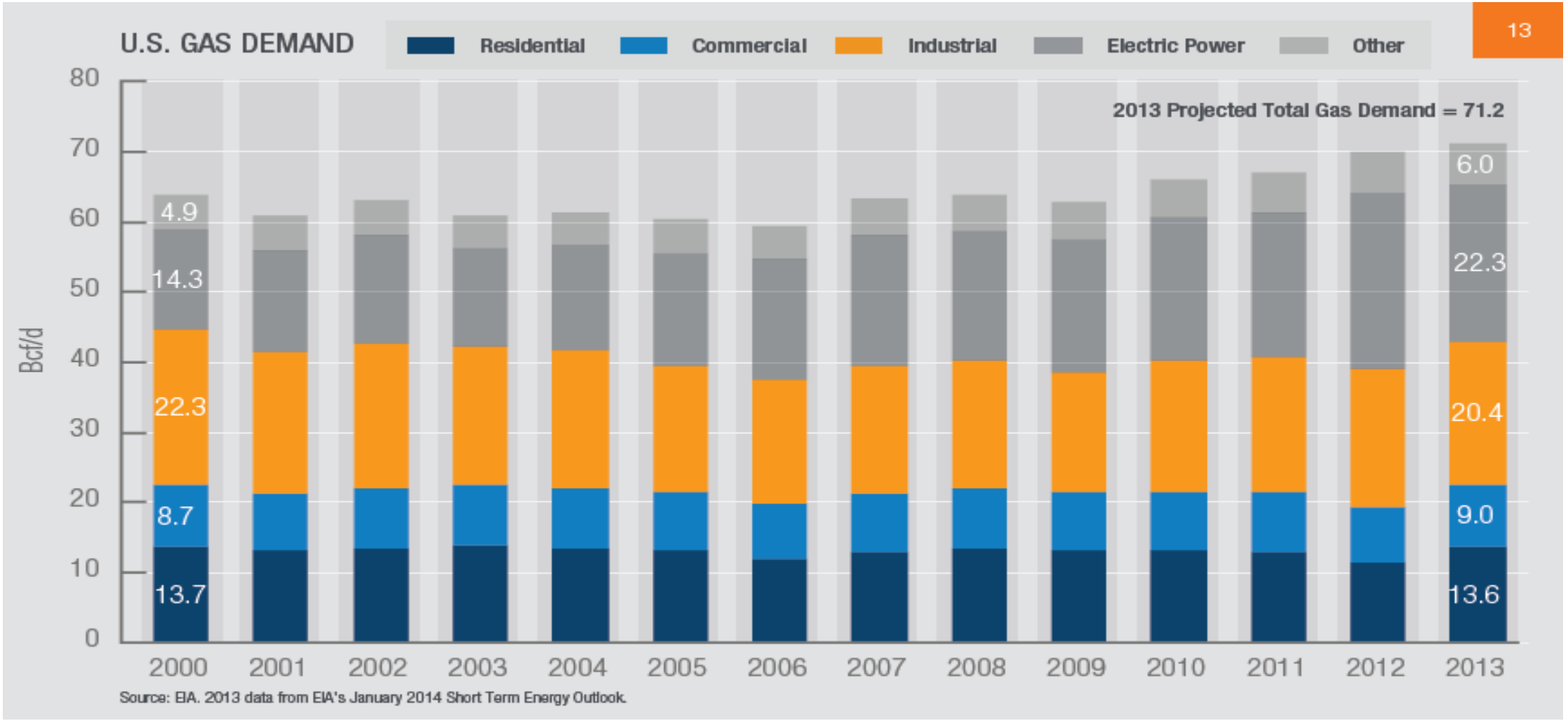
**See Figure 11 & 12**

## Natural Gas Demand

- Recent declines in natural gas prices are also explained by the fact that the demand for natural gas has not grown as rapidly as the growth in supplies.
- overall consumption was flat or declining between 2000 and 2006, with some demand growth occurring in the 2007-2013 period.
- Residential and commercial use of natural gas has been relatively steady over the 2000-2013 period.
- Industrial natural gas demand generally declined during the 2000-2009 period in response to high and volatile gas prices, while natural gas demand for power generation increased during this period, offsetting the declines in industrial demand.
- In 2012, natural gas use for power generation surged as a result of low natural gas prices. Low prices caused natural gas-fired electricity generating facilities to run more often and in some cases ahead of coal-fired plants.
- Natural gas demand is highly "seasonal" in nature, with significant "peaks" in the winter heating season, as illustrated in **Figure 14**.

# **Understanding** Natural Gas Markets





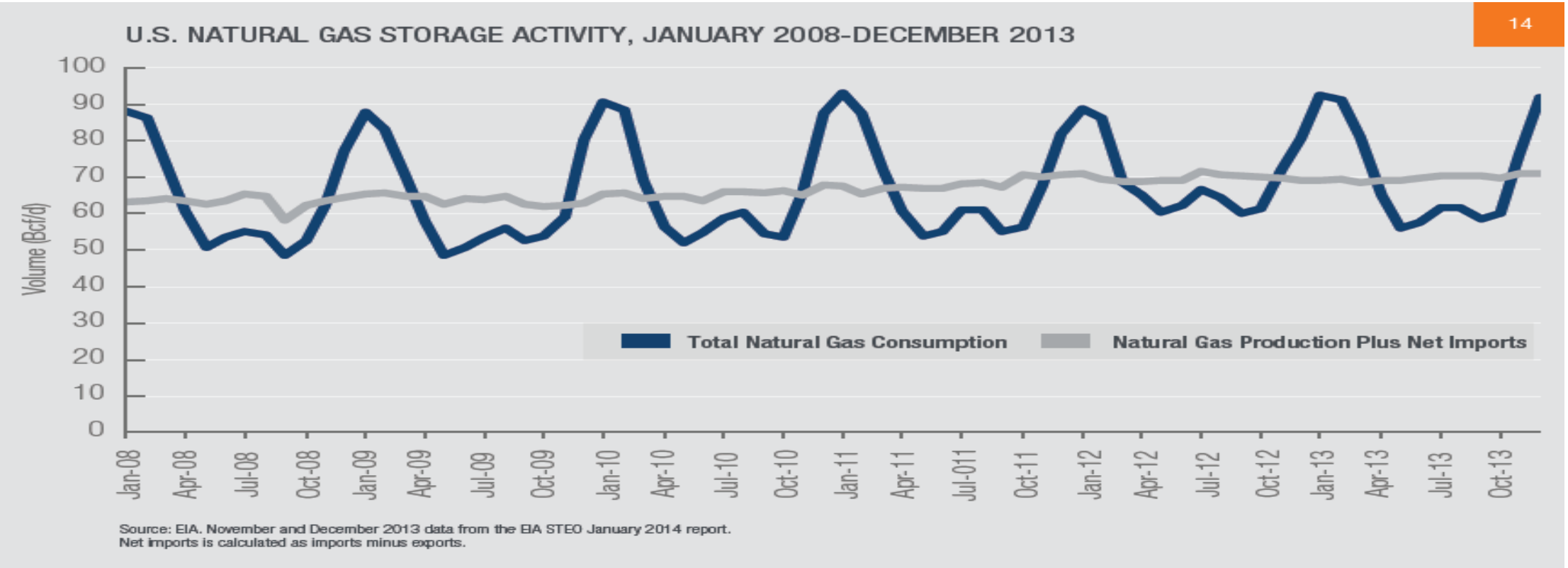
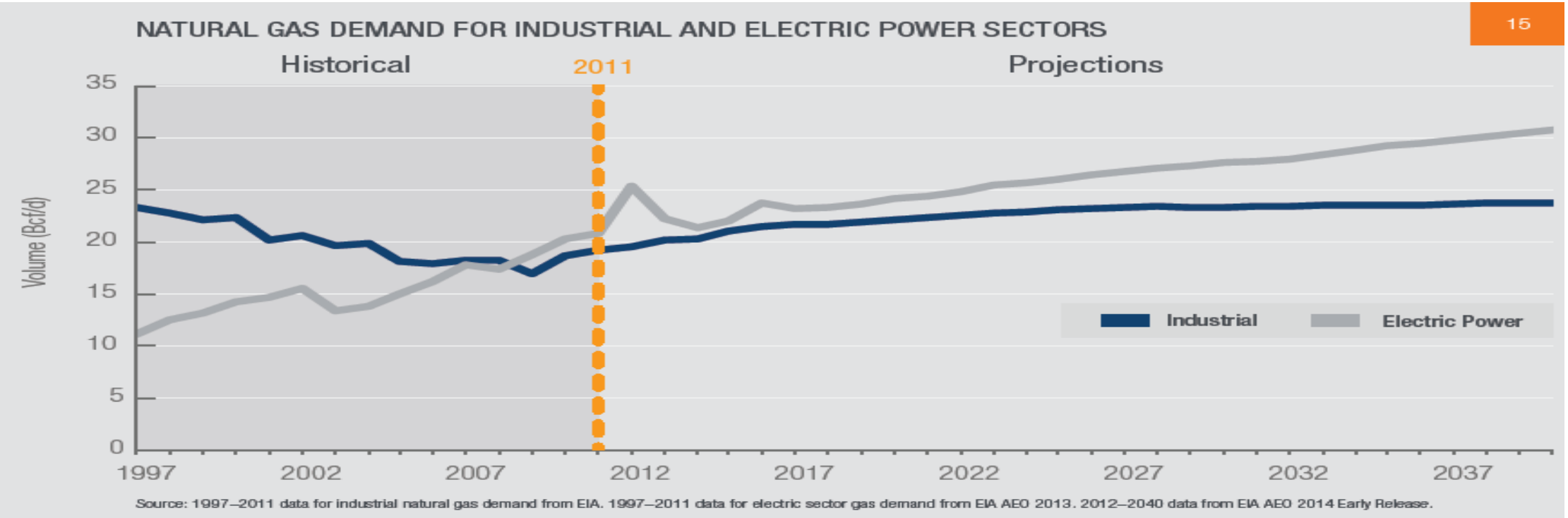



**Figure 14 shows the pattern of natural gas production and storage. The relatively flat light blue line shows natural gas production and imports into the United States. The figure shows production remains essentially flat throughout the year, but, as the darker blue line shows, consumption rises dramatically in the winter and falls in the spring through the early fall.**

# **Understanding** Natural Gas Markets

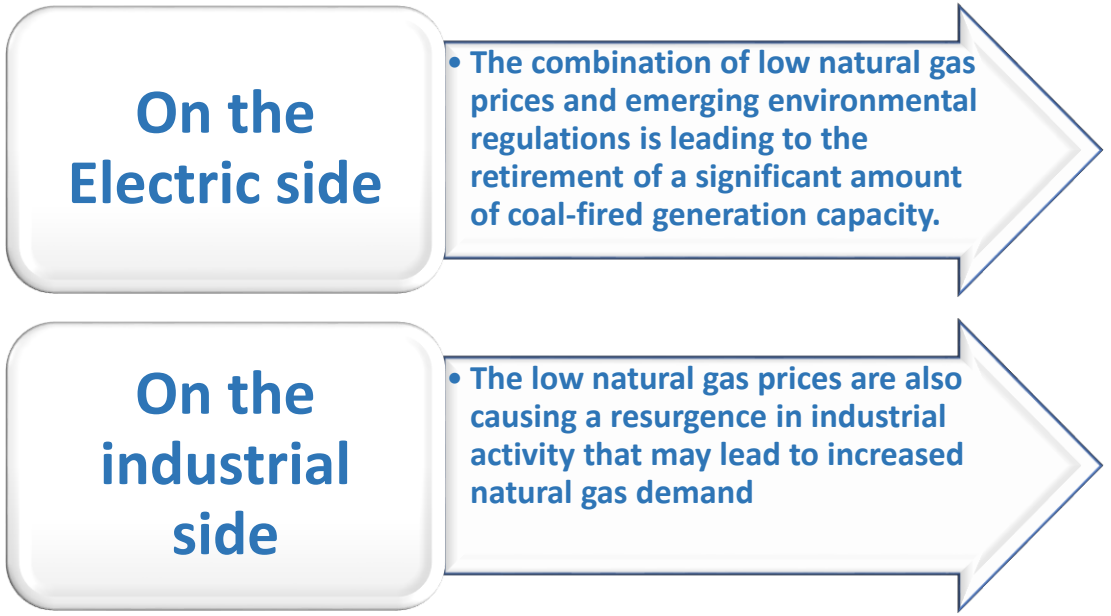





**The low natural gas prices are leading many analysts to believe that there will be substantial natural gas demand growth in the future, especially in the electric and industrial sectors**

# **Understanding** Natural Gas Markets

**The effects of the low prices of natural gas:**




**there will be substantial natural gas demand growth in the future**

## Natural Gas Exports

❖ **Low natural gas prices in North America are leading to proposals for the development of large LNG export projects. LNG export projects have been announced on the Gulf Coast, East Coast, and West Coast of the United States, as well as in Alaska and British Columbia.**

❖ **How many of LNG export projects advance to the construction phase is uncertain:**

- Uncertainty in how much LNG demand there will be from overseas countries.
- These projects require substantial capital
- These projects also require approval from regulatory bodies.
- Some projects also face certain infrastructure challenges that may put them at a disadvantage.
- It is expected that the U.S. also will export natural gas to Mexico and Canada

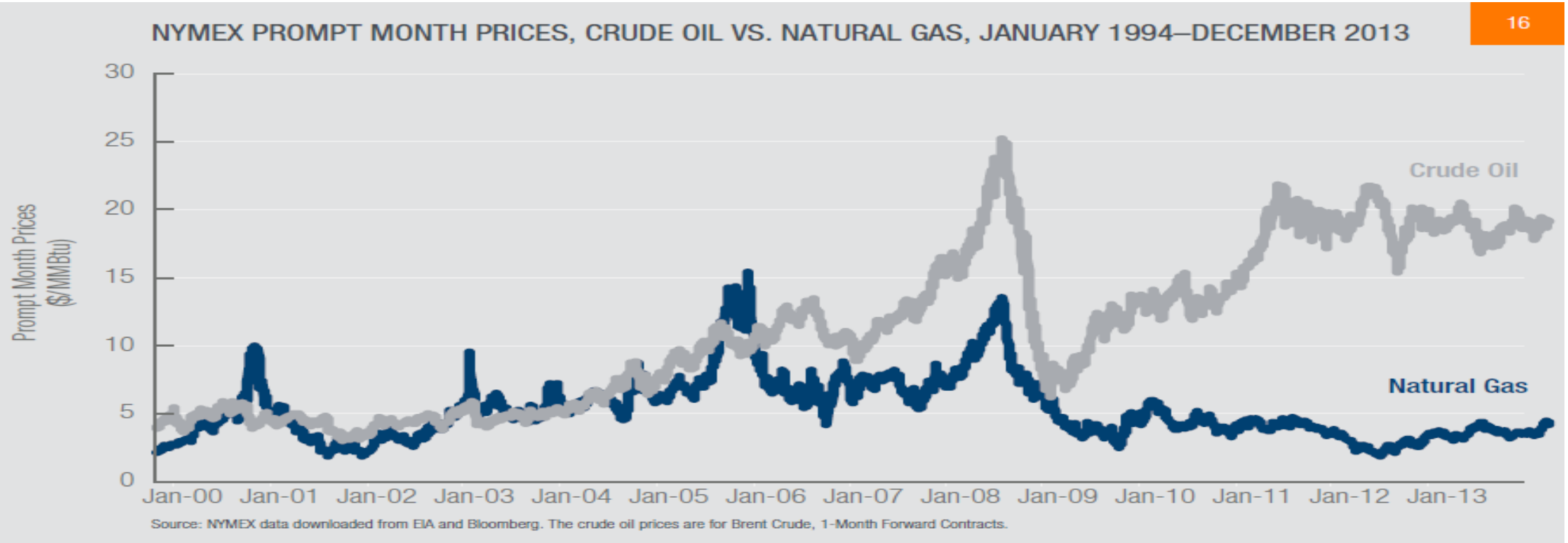



**Figure 16 shows the relationship between U.S. natural gas prices at Henry Hub and oil prices as measured by the Brent benchmark world oil price. Starting around 2009, U.S. natural gas prices began to disconnect substantially from oil prices as a result of the increase in shale gas production.**

## How Natural Gas is Traded

- The natural gas industry in the United States is highly competitive, with literally thousands of producers.
- Some producers have the ability to market their natural gas and may sell it directly to local distribution companies or to large industrial buyers of natural gas.
- Other producers sell their gas to marketers who have the ability to aggregate natural gas into quantities that fit the needs of different types of buyers and to transport gas to their buyers.
- Marketers may be large or small and sell to local distribution companies or to commercial or industrial customers connected directly to pipelines or served by local distribution companies.
- Marketers and other buyers and sellers of natural gas are able to use financial instruments traded on exchanges to hedge the risks associated with price volatility.

# **Understanding** Natural Gas Markets

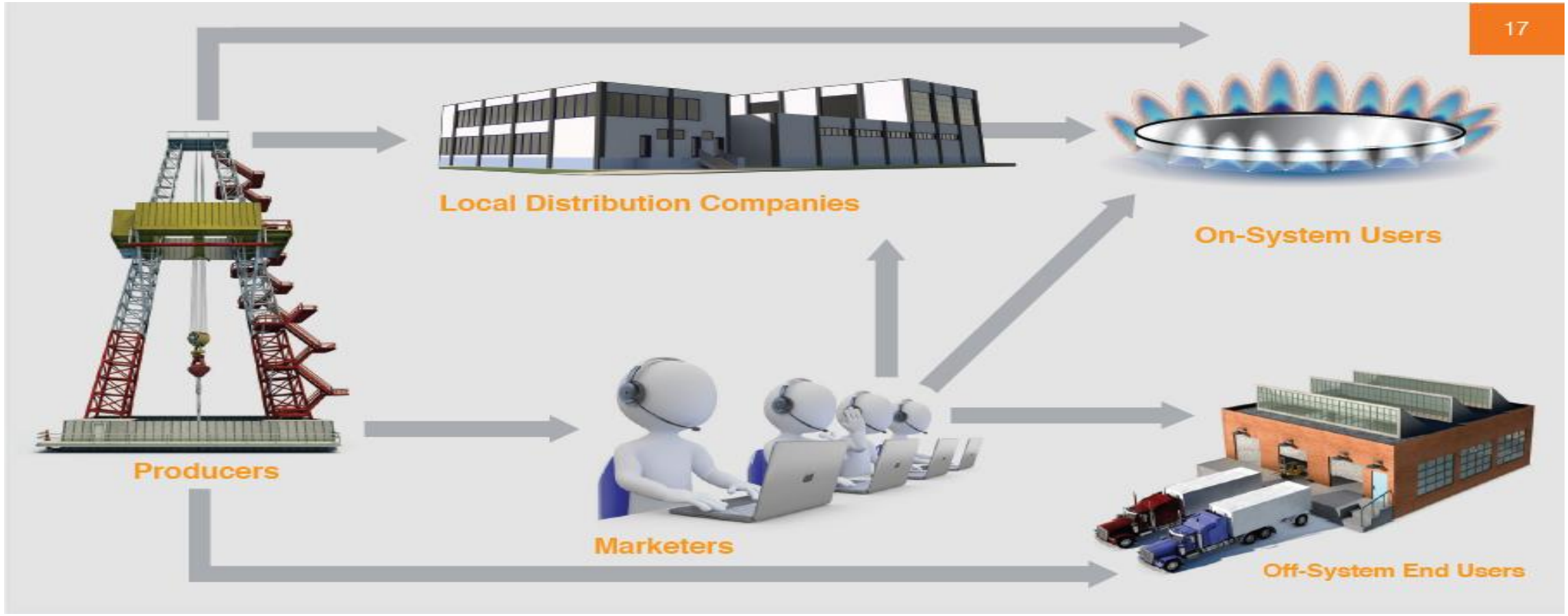



**Figure 17 shows schematically some of the types of natural gas transactions that take place as gas makes its way from the fields where it is produced to end users' burner tips.**

# **Understanding** Natural Gas Markets



- **Most residential and commercial customers purchase natural gas from a local distribution company.**
- **Many industrial customers have the option to purchase natural gas from a marketer or producer instead of from the distribution company.**
- **Figure 18 shows some of the points where natural gas for physical delivery is actively traded in the continental United States and Canada.**

## Futures and Other Financial Contracts

- Natural gas derivatives are traded on the New York Mercantile Exchange.
- A NYMEX natural gas futures contract requires the seller to deliver (and the buyer to take delivery of) natural gas at the contractually agreed price, in a specified future month, at the Henry Hub.
- Derivatives such as the NYMEX futures contract make it possible for market participants to reduce the risk that results from highly volatile natural gas prices in the physical market.

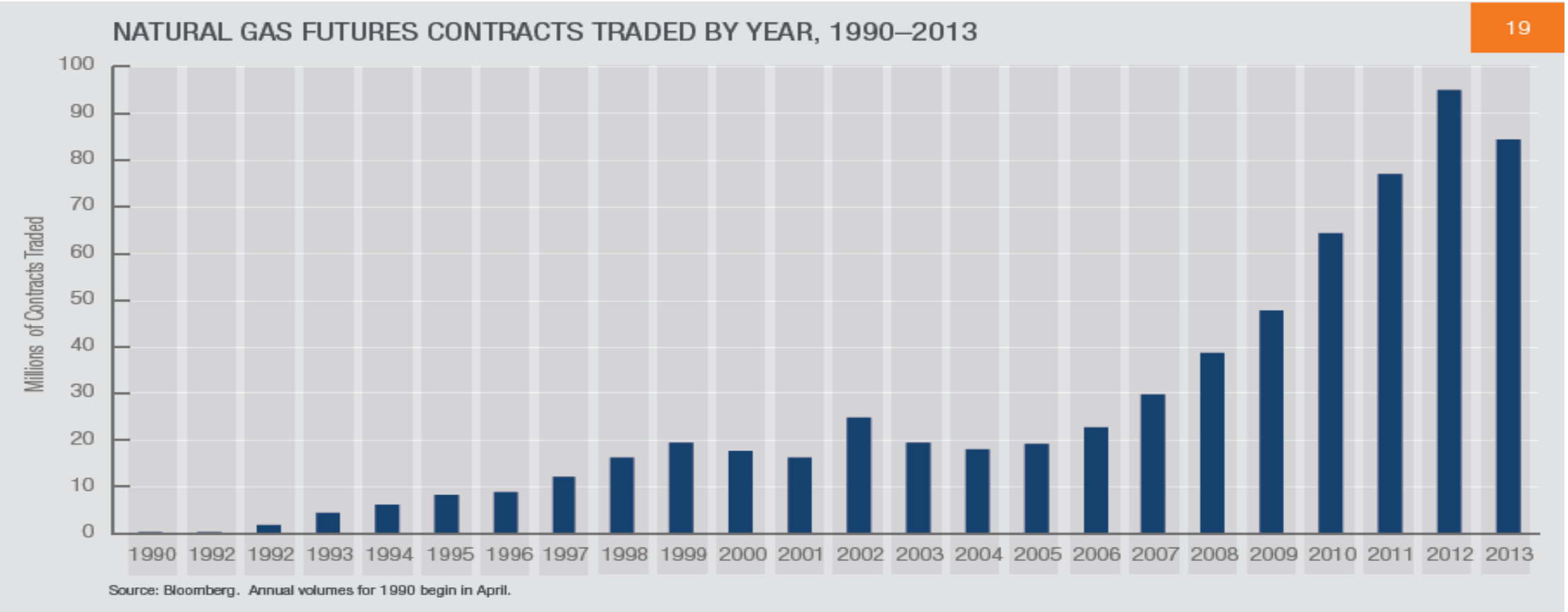



**Figure 19 shows the number of natural gas contracts traded on the NYMEX each year between 1990 and 2013.**

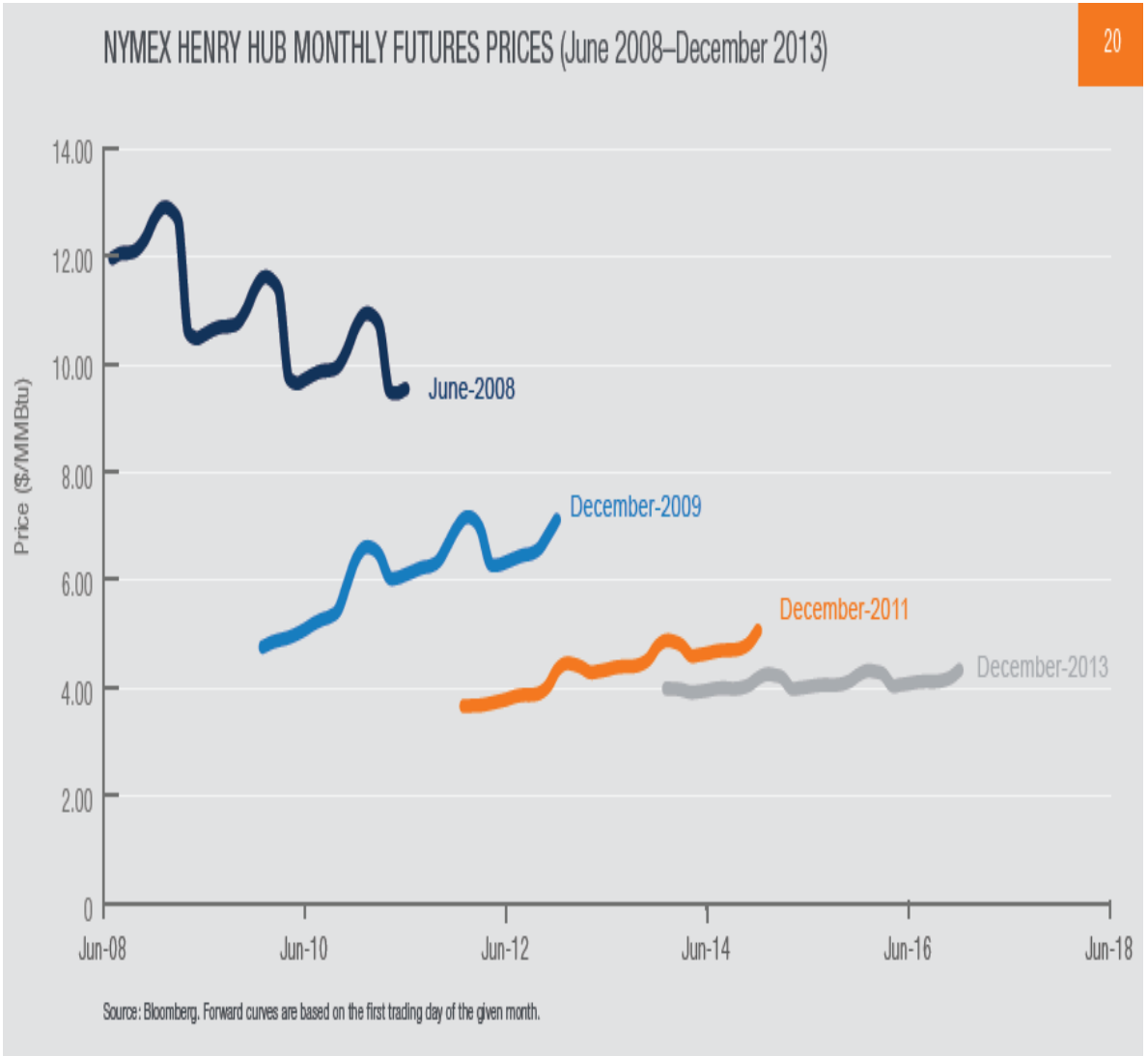
# Understanding Natural Gas Markets



- **Figure 20** shows some of the recent movement in natural gas futures prices at different points in time over the past few years.

- Each line in the figure shows prices for natural gas to be delivered in each of the next 36 months.

- In June 2008, before shale supplies started coming on line in substantial quantities, the market was expecting relatively high prices with significant peaks during the winter period versus the summer period. More recently, as larger quantities of shale production have come on line, market participants expected lower prices to prevail that have less of a winter peak than was the case historically.



# Conclusion: A New Era For U.S. Natural Gas Markets

- The U.S. natural gas industry has changed dramatically as a result of technological advancements that have resulted in increasing domestic production, especially from shale resources.
- These new supplies of natural gas have resulted in lower prices and reduced price volatility, and expectations of increasing demand.
- Natural gas use for electricity generation is expected to grow, in part due to the expected retirement of some coal-fired generation capacity.
- Industrial consumption of natural gas is also expected to increase due to a resurgence of petrochemical plants, especially in the U.S. Gulf Coast.
- Low domestic prices relative to the prices available in world markets are also leading to proposals to export natural gas as LNG.
- The emergence of shale gas in abundance has profoundly changed the market for natural gas in the U.S. in recent years, and perhaps for the foreseeable future.

# **Understanding** Natural Gas Markets

## Thanks for your listening