

# Unconventional Development & Energy Independence

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**Take Away Points**

- Unconventional development continues to dramatically change the U.S. economic landscape.
- U.S. has already moved from being an anticipated importer to major exporter of natural gas.
- U.S. has moved being the largest crude oil producer.
- U.S. likely to be a net exporter by 2036 under continued high prices.
- Impacts go far beyond resource independence and are now reaching into manufacturing.
- U.S. likely to unwind decades worth of global manufacturing market share losses.

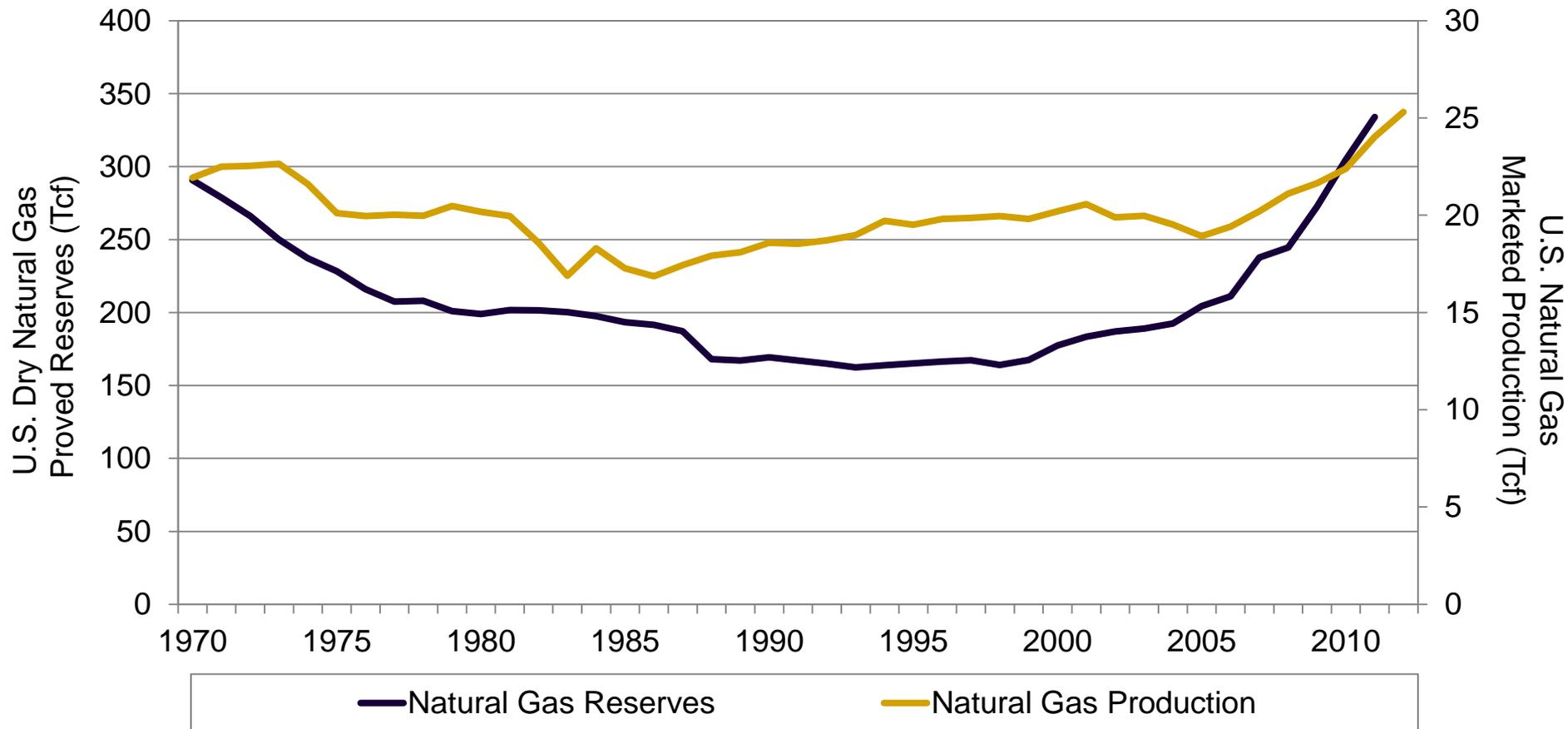
**Unconventional Development &  
Energy Resource Independence**





## Changes in Natural Gas Reserves and Production

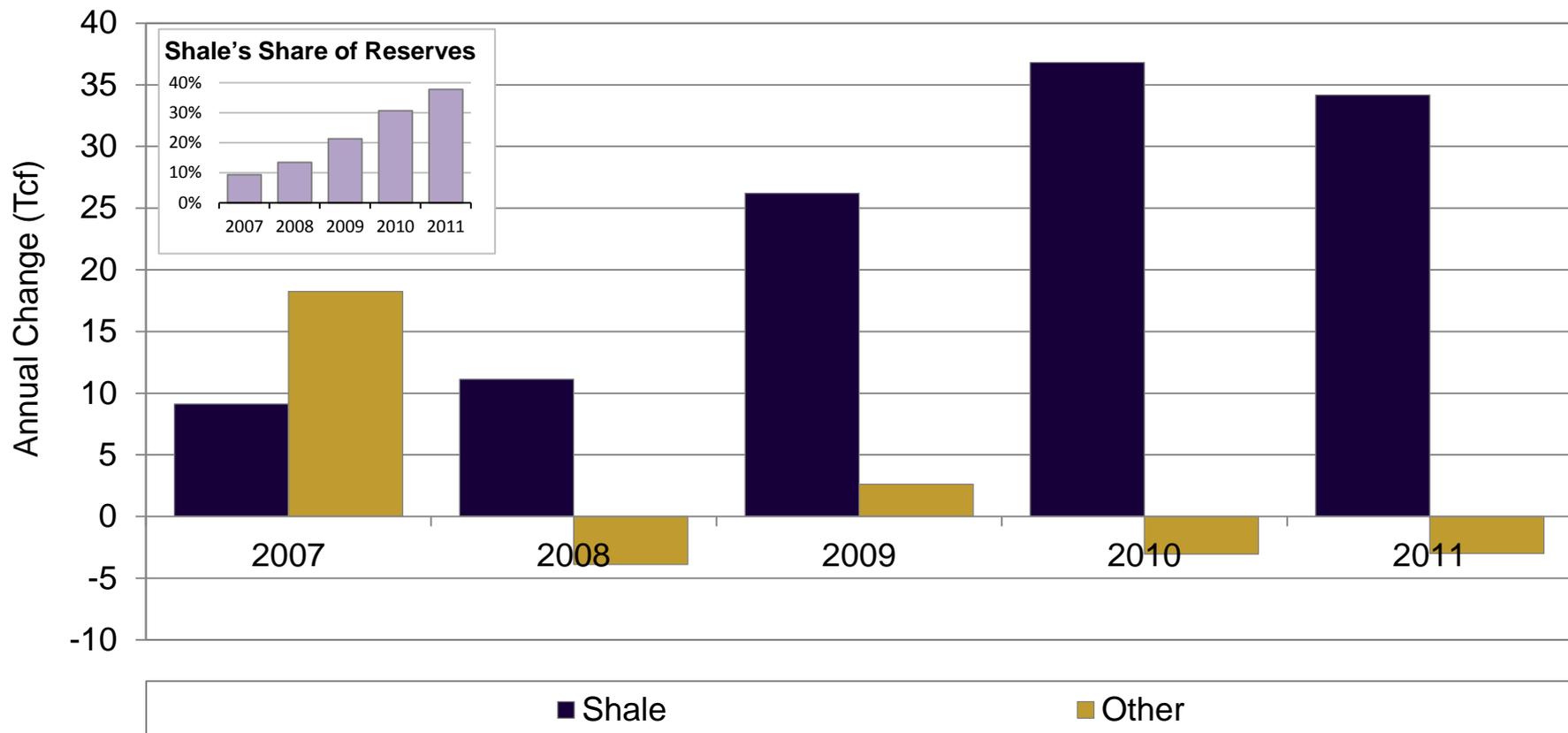
**Natural gas production and reserves are at levels not seen since the 1970s and both U.S. natural gas production and reserves are now at an all time recorded peak.**





## Annual Changes in U.S. Natural Gas Proved Reserves (Shale and Other)

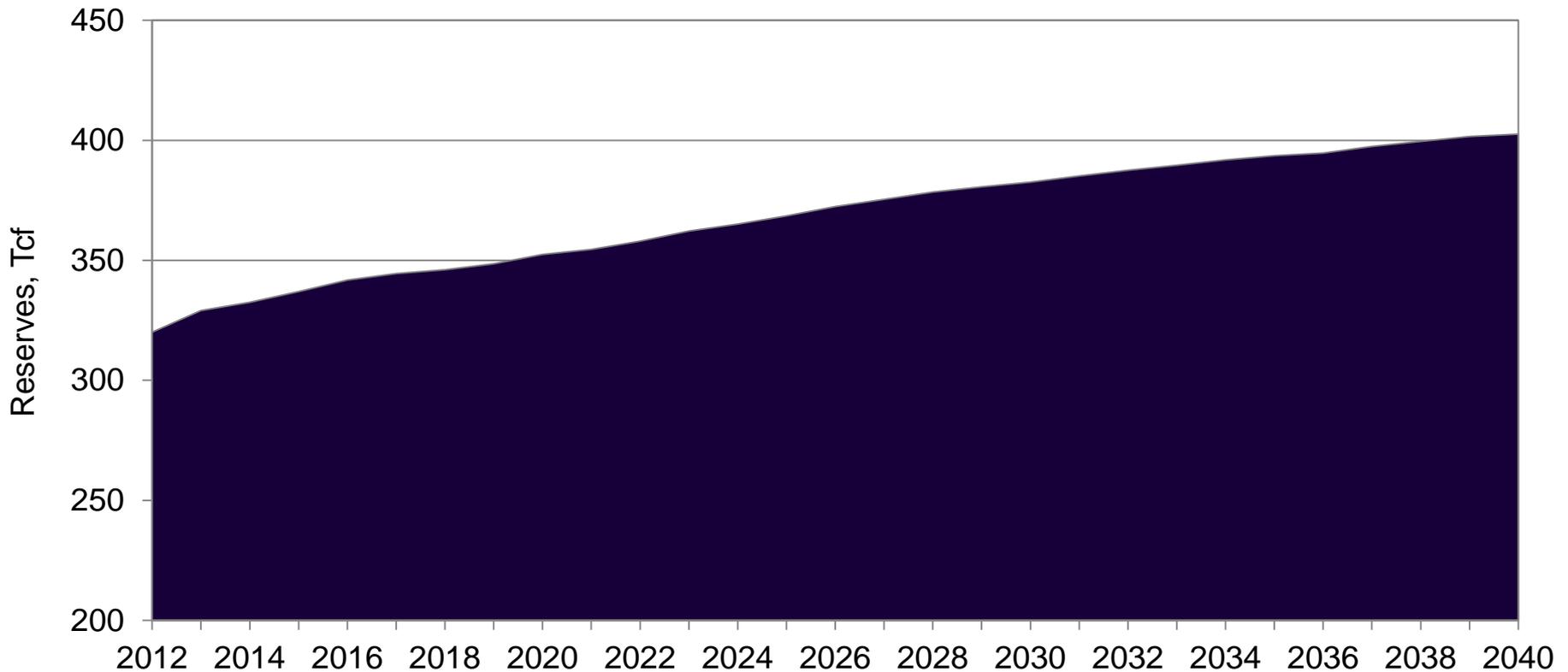
**Expanded exploration and development of unconventional resources has driven increases in natural gas proved reserves in recent years. Net additions in shale natural gas reserves totaled 34.2 Tcf in 2011, outpacing the overall net decrease in natural gas reserves from all other sources combined.**





Annual Energy Outlook, Natural Gas Reserves

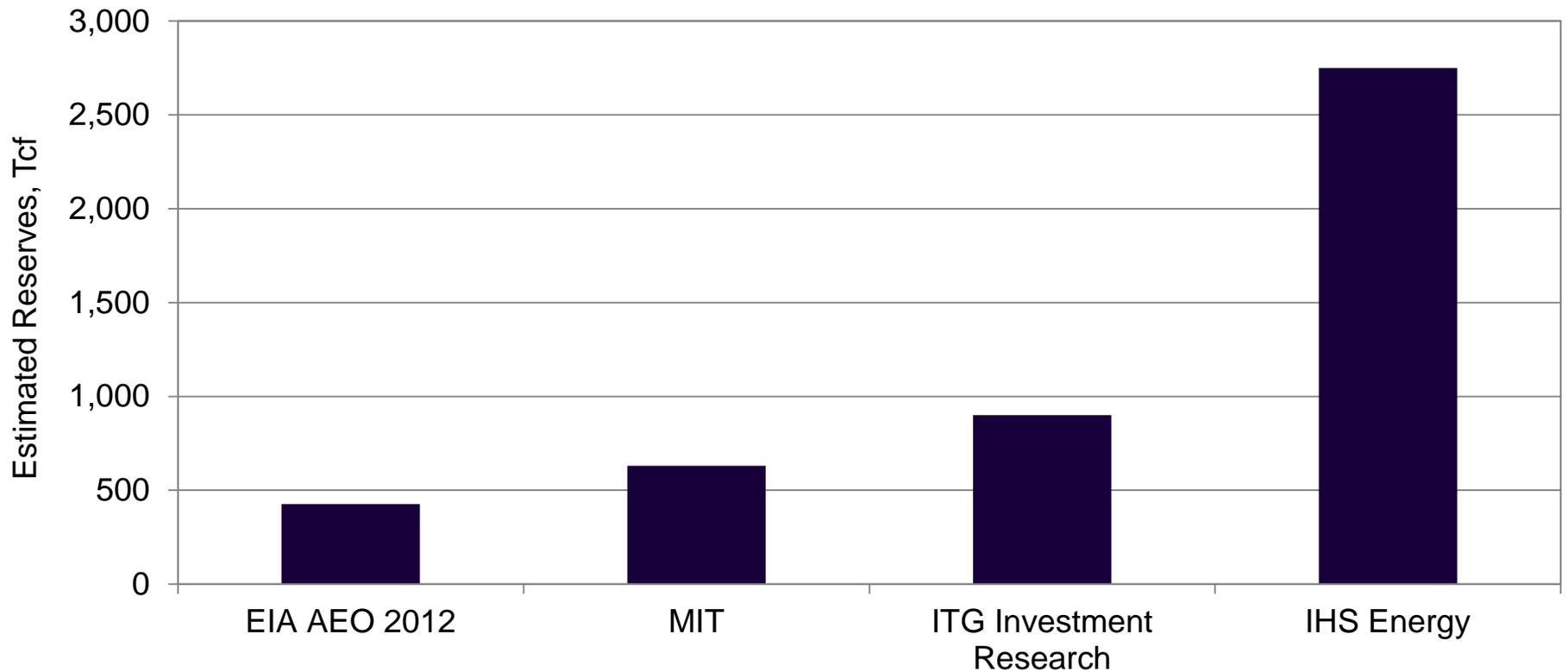
**Unconventional resources are not a “flash in the pan” and are anticipated to continue to increase over the next two decades or more.**





Alternative Natural Gas Reserve Forecasts

There are a wide range of unconventional shale gas reserve estimates from as low as 436 Tcf to as high as 2,750 Tcf. This represents a range of between 18 years to over 100 years of available natural gas resources based upon current consumption levels.<sup>1</sup>

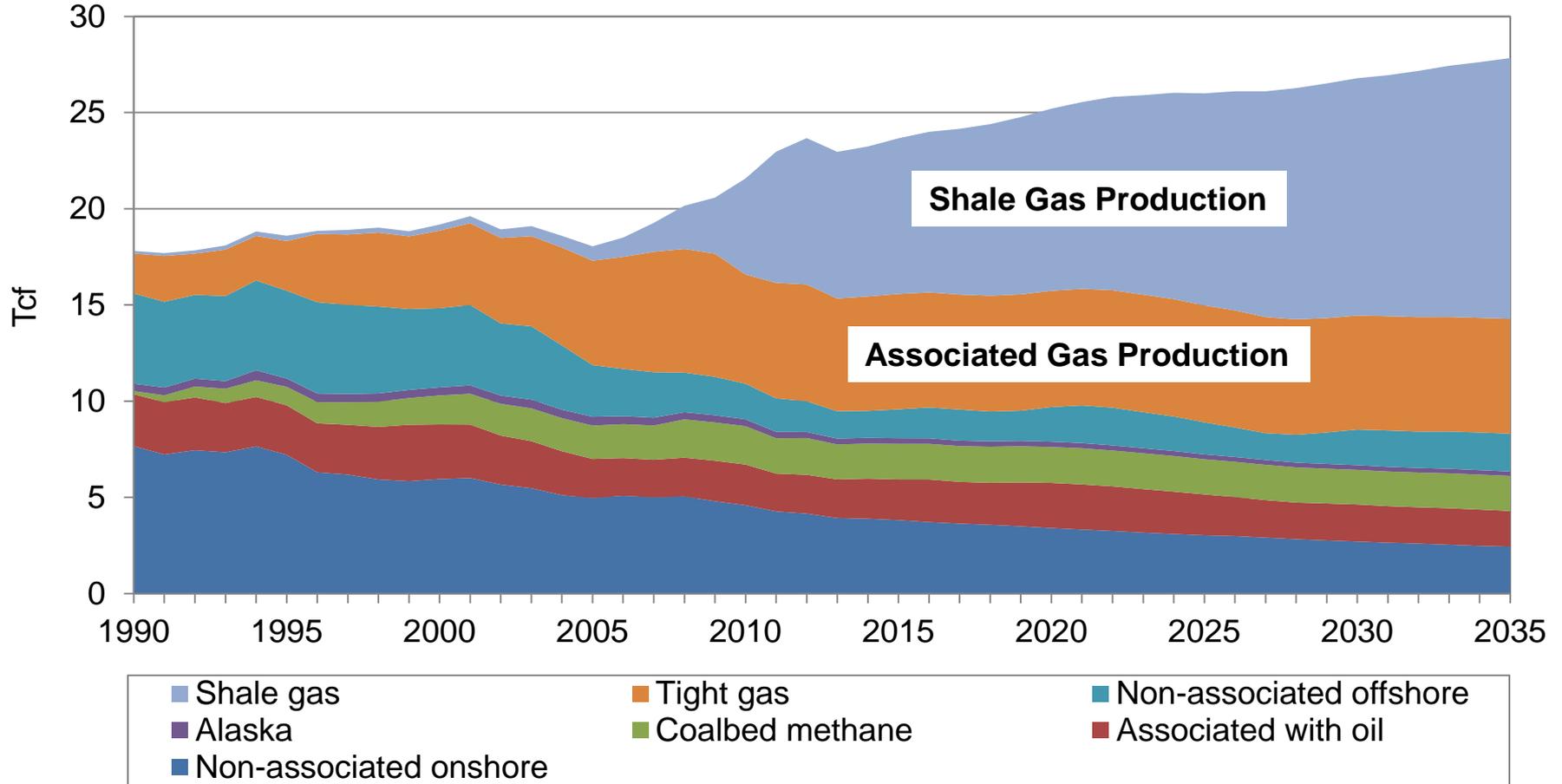


Note: <sup>1</sup>Assumes an annual consumption level of 24.3 Tcf. The MIT study reached a mean estimate of technically recoverable resources of 631 Tcf with an 80 percent confidence interval of 418 to 871 Tcf. The ITG estimates of recoverable resources is for 10 overlapping plays, totaling 900 Tcf. These are the same 10 plays as estimated by the EIA's AEO (resulting in 426 Tcf). IHS Energy estimates show that total recoverable shale in the U.S. could be as high as 2,750 Tcf, significantly higher than their estimate of 1,268 in 2010.



Forecast U.S. Natural Gas Production

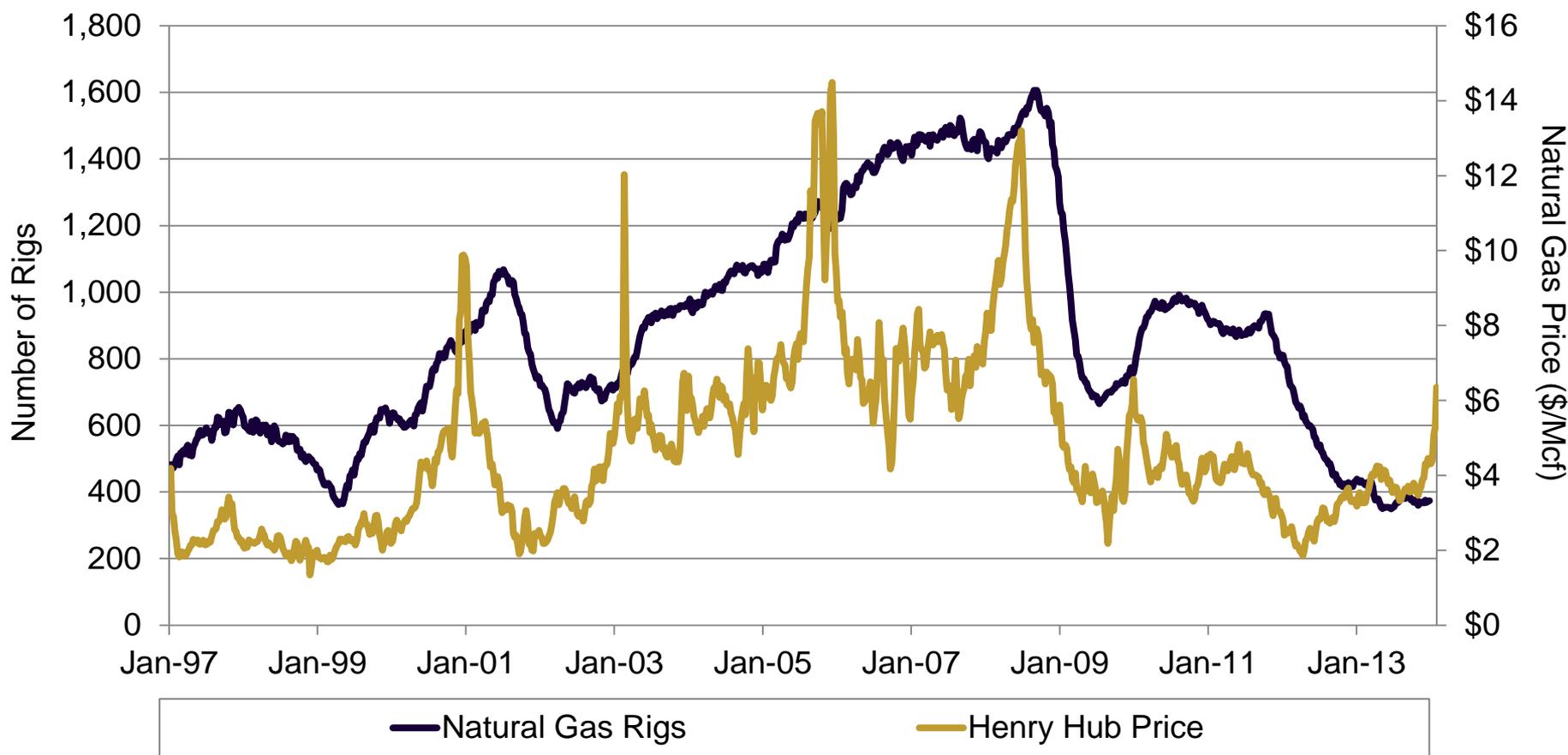
Shale availability will drive U.S. natural gas supply.





## U.S. Natural Gas Rig Count and Henry Hub Price

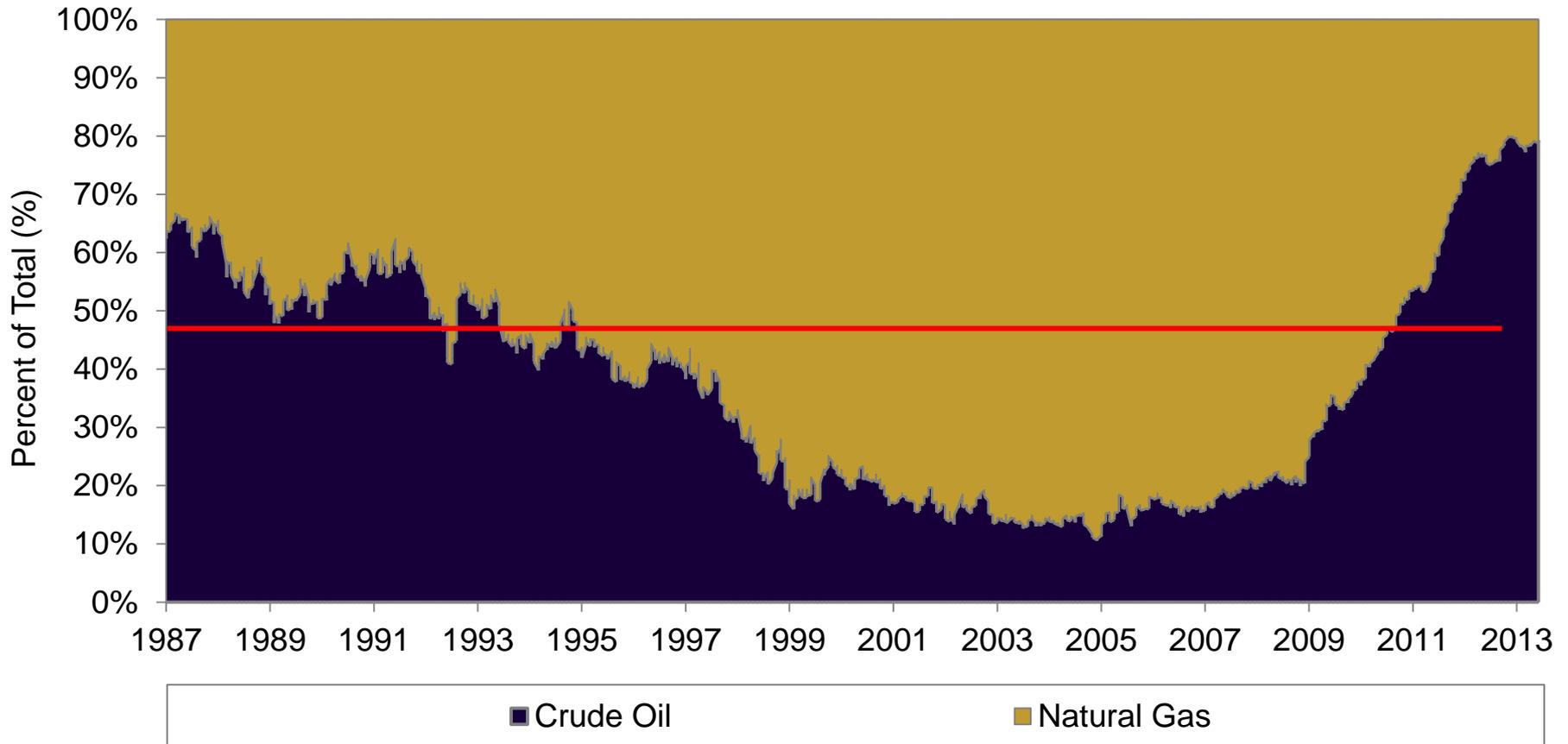
**Natural gas rigs closely follow the natural gas spot price. Price decrease that started in 2007 has reduced gas drilling attractiveness.**





U.S. Oil/Gas Rig Split

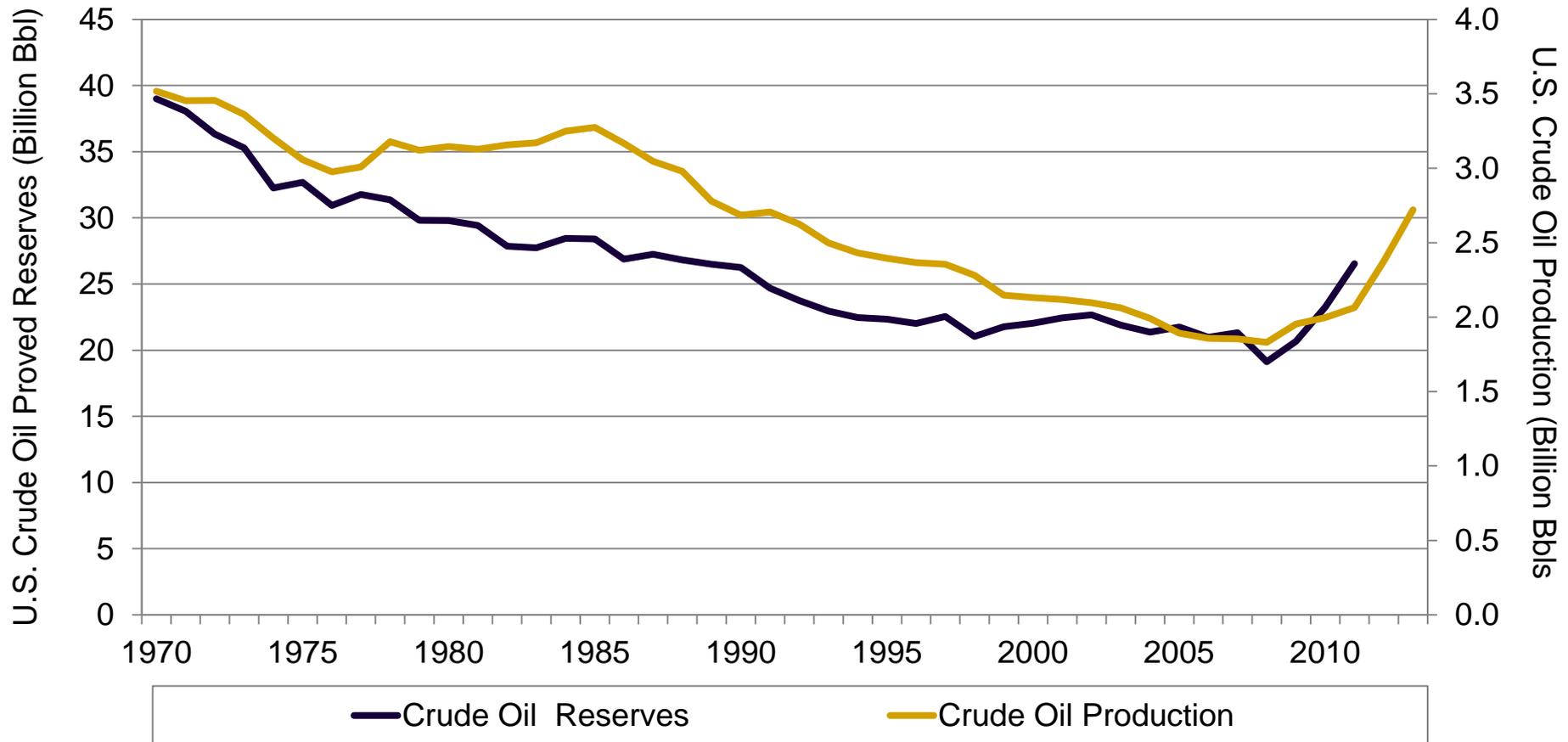
**Drilling emphasis over the past 20 years has almost exclusively concentrated on developing new natural gas wells. This has shifted to crude oil drilling emphasis over the past two years.**





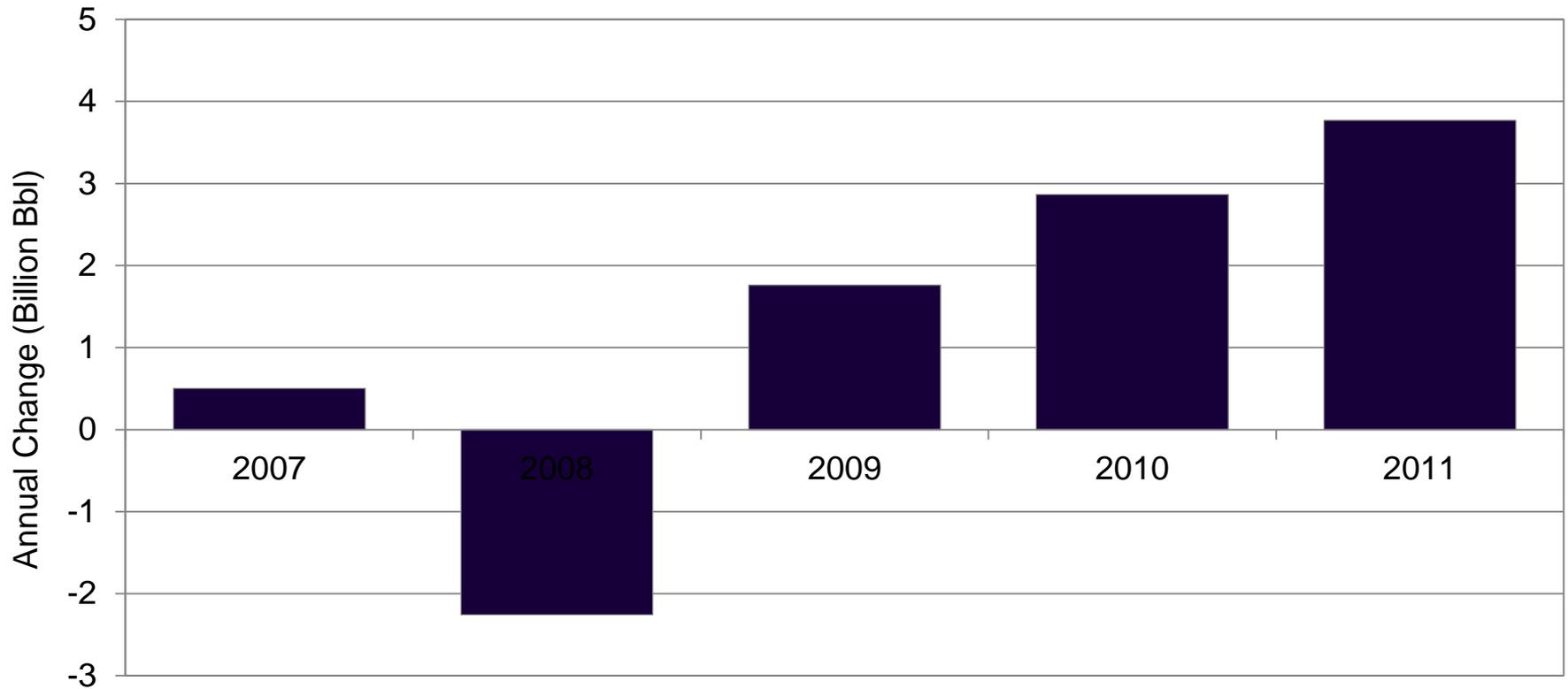
## Changes in Crude Oil Reserves and Production

**Crude oil production and reserves are climbing back to levels not seen since the 1980s.**





Annual Changes in U.S. Crude Oil Proved Reserves (Shale and Other)



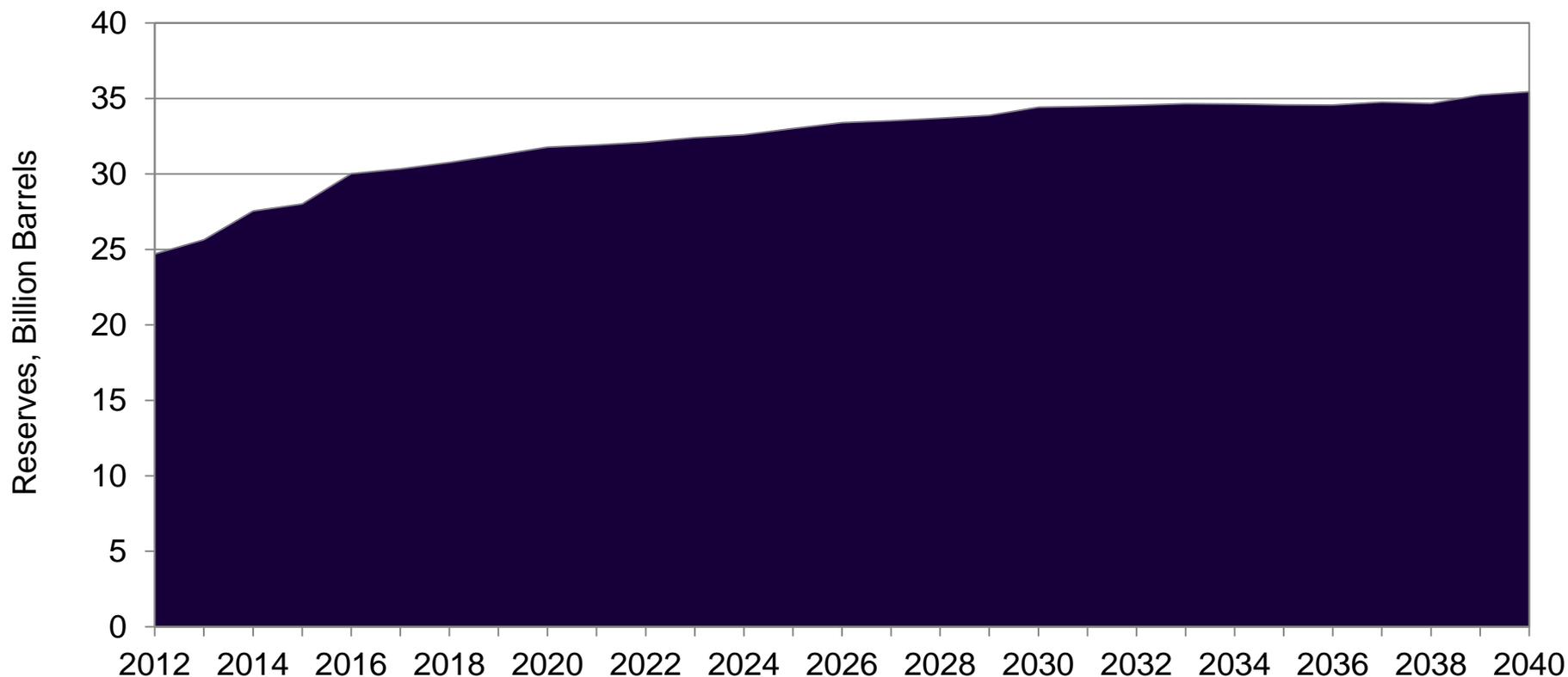
Note: Includes crude oil and lease condensate.

Source: Energy Information Administration, U.S. Department of Energy.



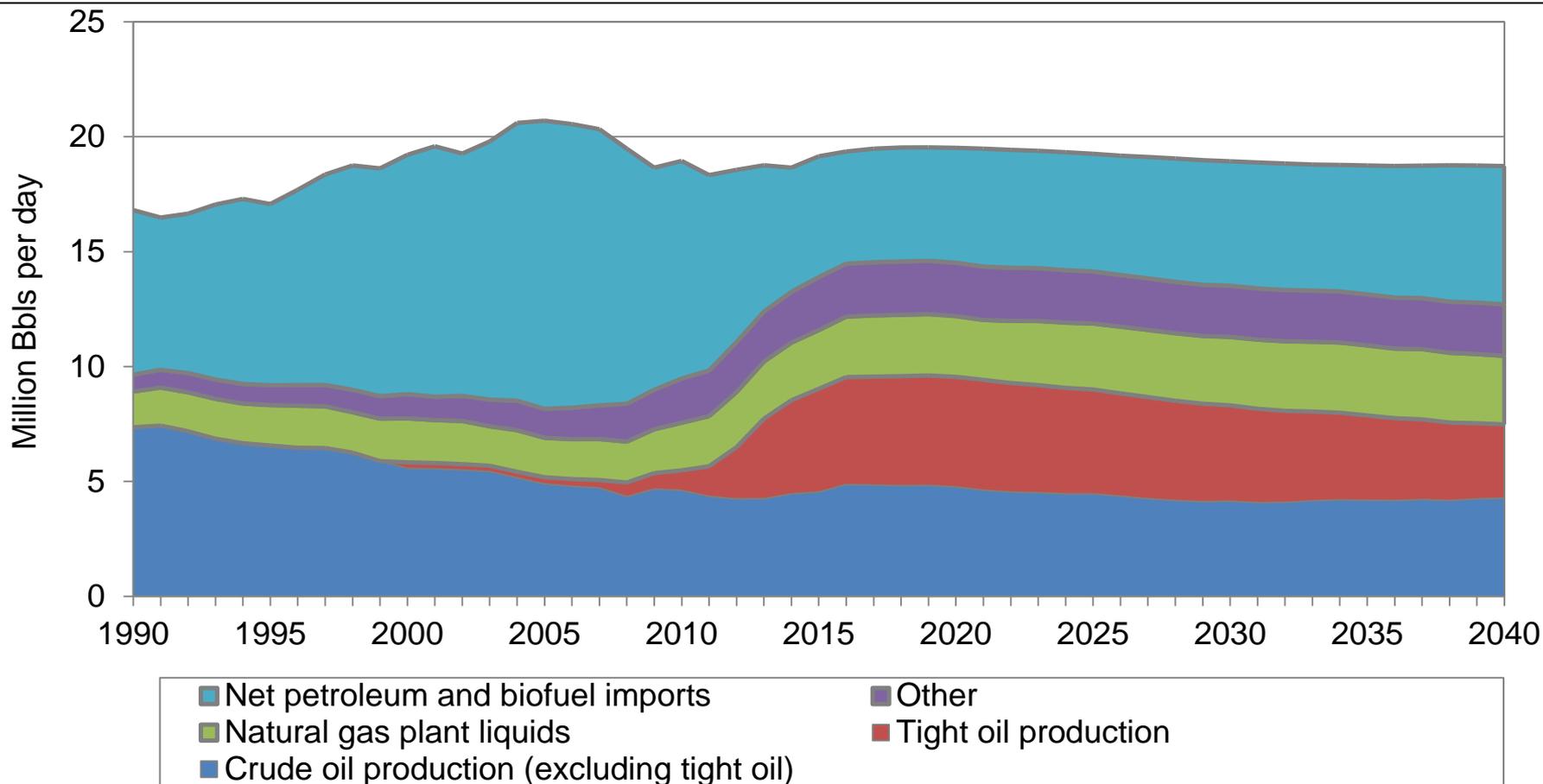
Annual Energy Outlook, Crude Oil Reserves

**Crude oil reserves are expected to increase over 20 percent by 2016 and then gradually increase by 18 percent another to 2040.**



**Forecast U.S. Crude Oil Production**

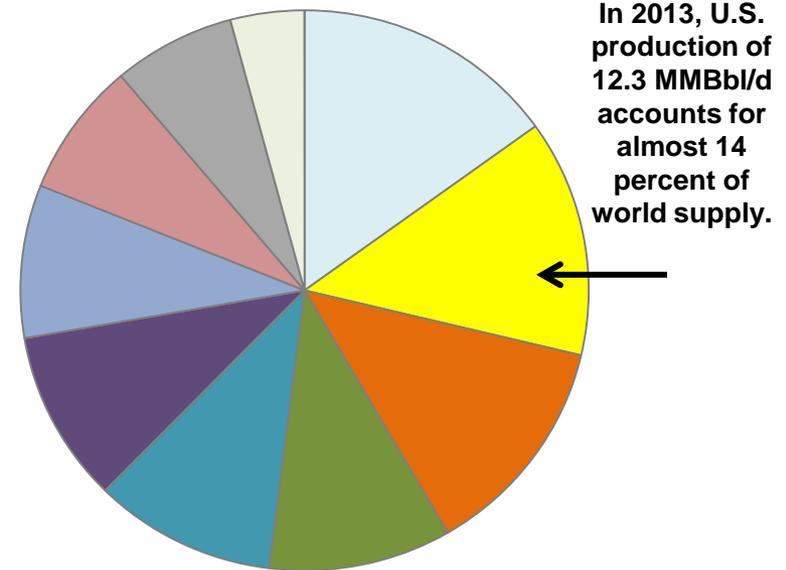
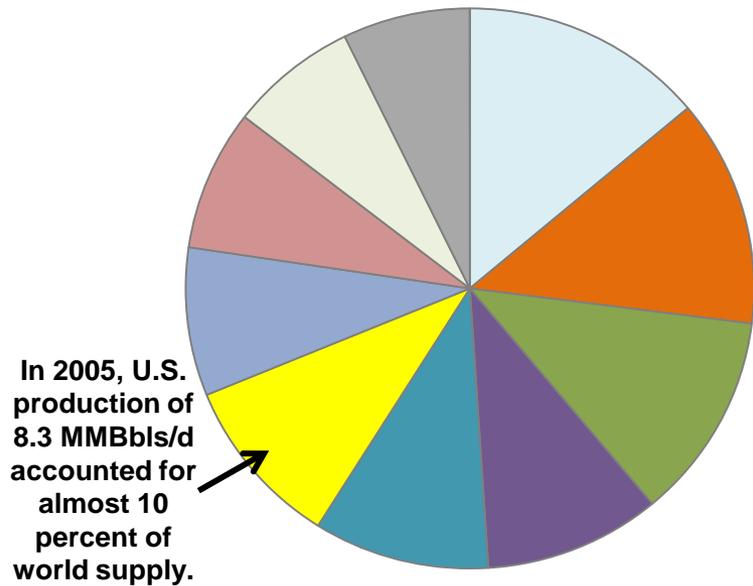
**U.S. production of crude oil is expected to increase at an average annual rate of four percent through 2016. Tight oil production increases from 1.31 million barrels per day in 2011 to 4.8 million barrels per day in 2020, an increase of 266 percent.**





## International Oil Supply, 2005 and 2013

**U.S. oil production has increased since 2005 surpassing Saudi Arabia, Africa and the rest of the Middle East.**



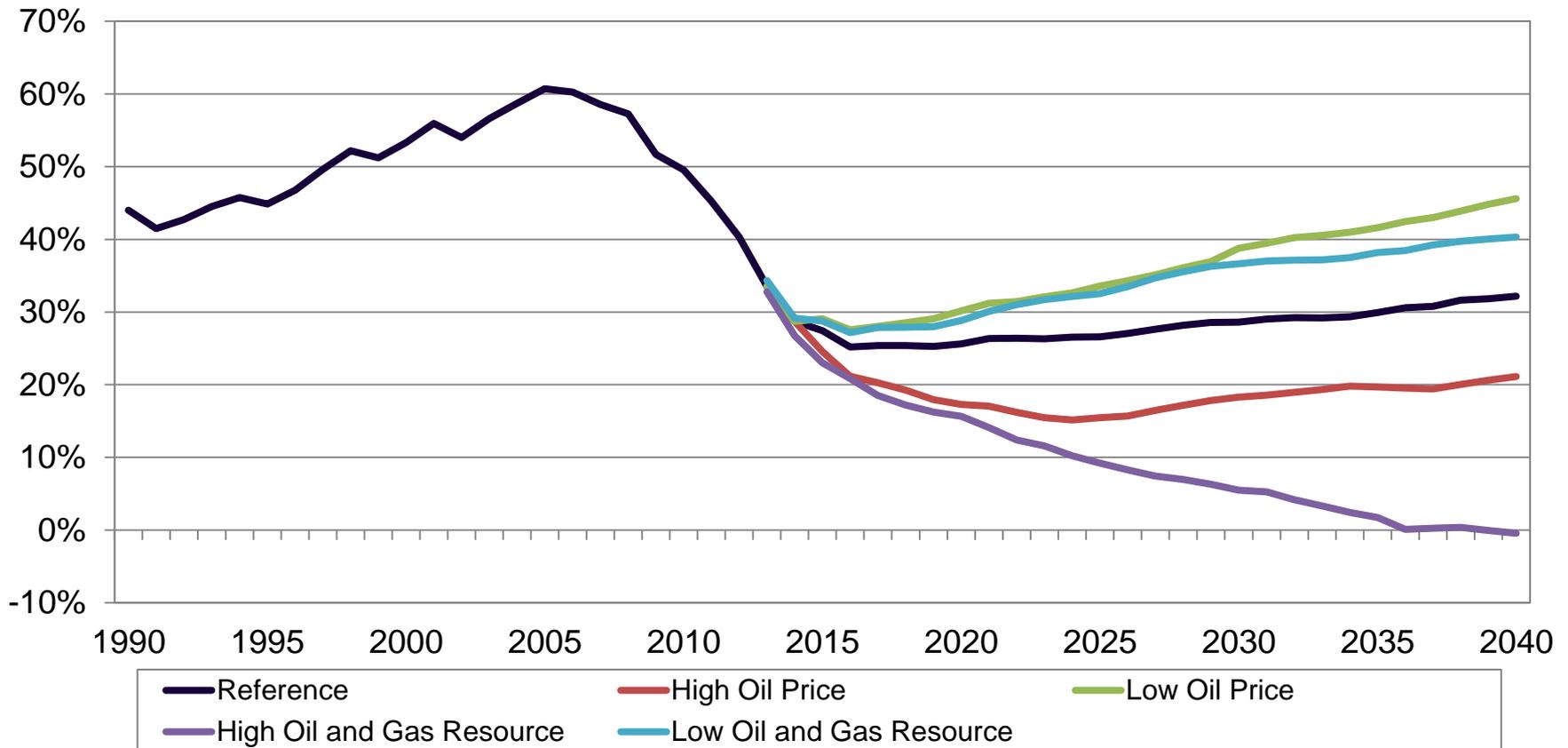
■ Eurasia, 13.9%	■ Saudi Arabia, 13.1%
■ Africa, 11.9%	■ Asia & Oceania, 10.0%
■ Middle East, 10.0%	■ U.S., 9.8%
■ Central & S. America, 8.6%	■ N. America, 8.1%
■ Europe, 7.3%	■ Iran & Iraq, 7.2%

■ Eurasia, 15.1%	■ U.S., 13.7%
■ Saudi Arabia, 12.9%	■ Africa, 10.4%
■ Middle East, 10.4%	■ Asia & Oceania, 9.9%
■ Central & S. America, 8.8%	■ N. America, 7.8%
■ Iran & Iraq, 6.9%	■ Europe, 4.2%



## Net Import Share of U.S. Petroleum and Liquid Fuels, 1990 – 2040

The share of U.S. net crude oil and product imports has been falling since 2005. The EIA expects the net import share to decrease to 26 percent in 2023. If however, high prices encourage U.S. development, the share of net imports could drop to zero by 2036.



## **Manufacturing & Economic Independence**

**Overview: Why Future Economic Development Will Not be Uniformly Distributed**

While the nature of manufacturing has admittedly changed given the “outsourcing” prior to the 2008-2009 financial meltdown, the U.S. economy is beginning to emerge as a new manufacturing powerhouse.

However, the U.S. economic recovery, and regional economic development opportunities over the next decade will likely be concentrated in a few states and regions. What determines the “winners” and “losers” in this economic resurgence?

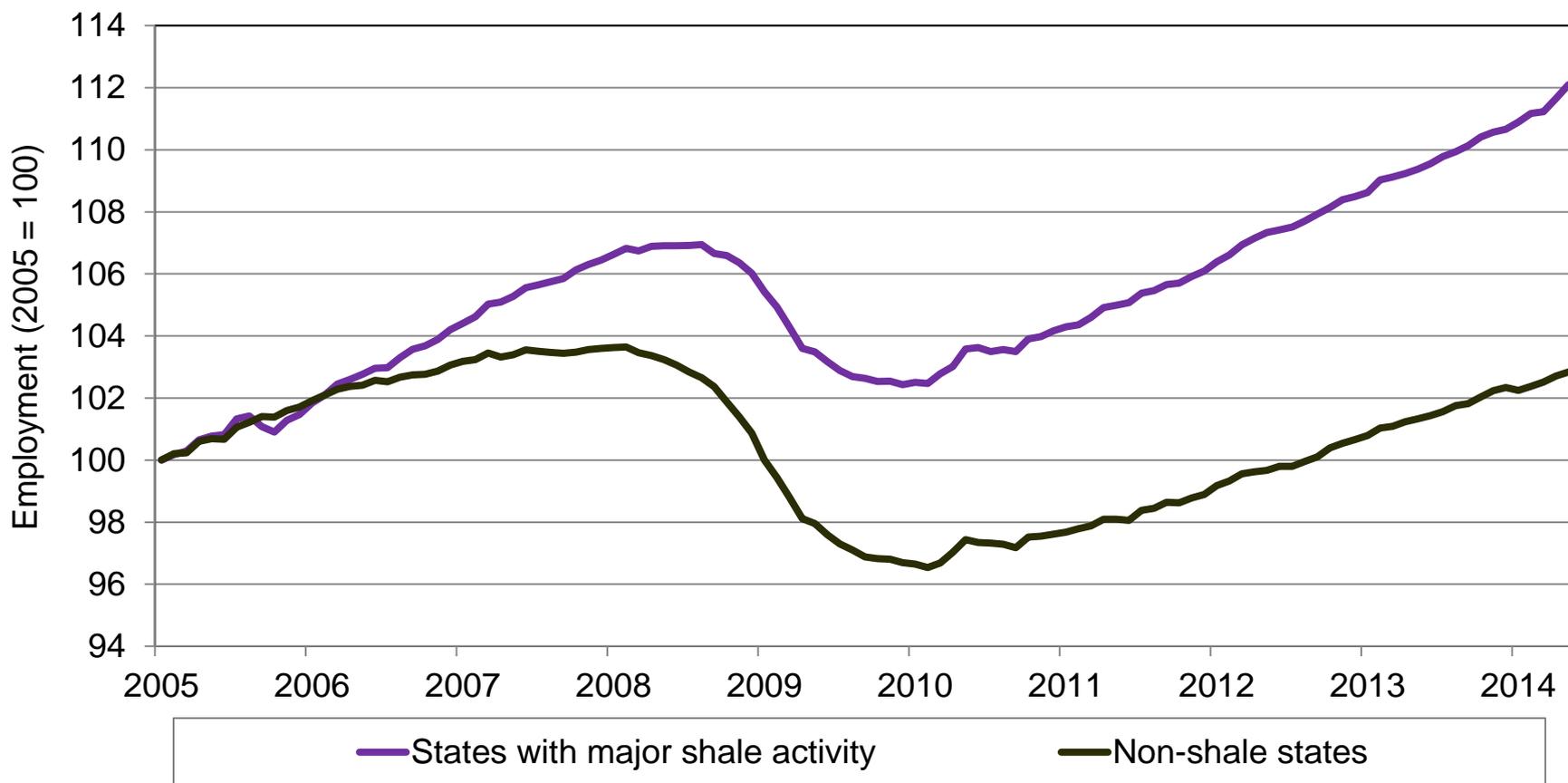
The “winners” will be those areas with access to low-cost energy supplies and transportation infrastructure that can move those supplies to rapidly emerging economic development opportunities in manufacturing that were unimaginable as recently as five years ago.

Other important factors influencing manufacturing siting locations includes the presence of a skilled labor force, competitive wage levels, supportive tax policies, as well as fair and stable regulations and regulatory practices.



Relative Employment Changes, Shale vs. Non-Shale States (2005=100)

**Total employment and employment growth has been faster in unconventional shale-based states than in those without these unconventional resources.**

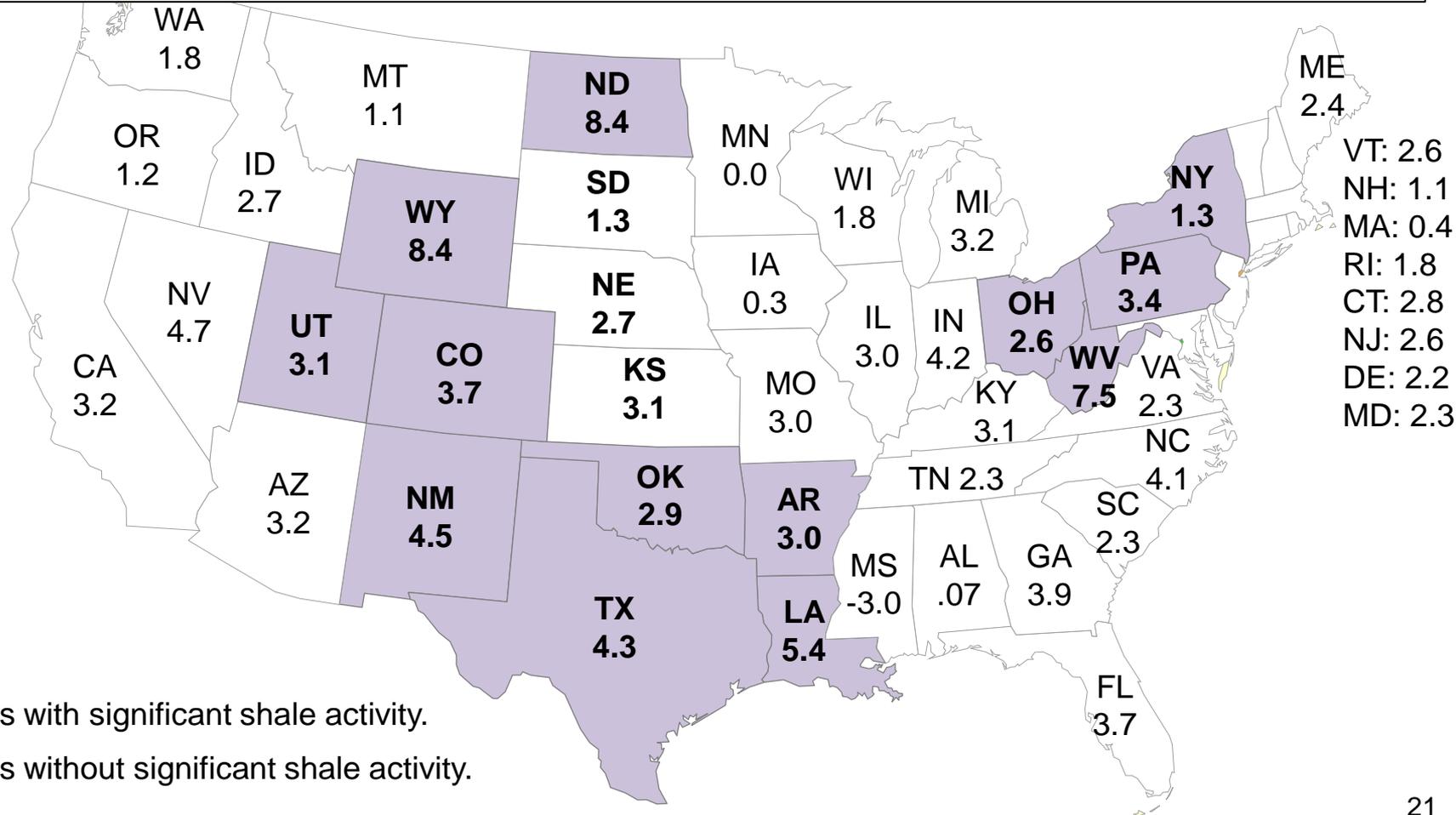


Note: Shale states include Arkansas, Colorado, Louisiana, North Dakota, Pennsylvania, Utah and Texas  
Source: Bureau of Labor Statistics



## Percent Change in Real Quarterly GDP by State, 2013:III TO 2013:IV

Many of the states with significant shale activity have the highest growth in quarterly GDP. North Dakota, Wyoming and West Virginia have the highest rates (8.4 percent, 8.4 percent and 7.5 percent, respectively). Louisiana is the third highest at 5.4 percent.



**Overview: Why Energy-Based Manufacturing**

What is “energy-based manufacturing?”

Energy-based manufacturing is comprised of industries that focus or rely heavily on energy as the primary input to make their respective products.

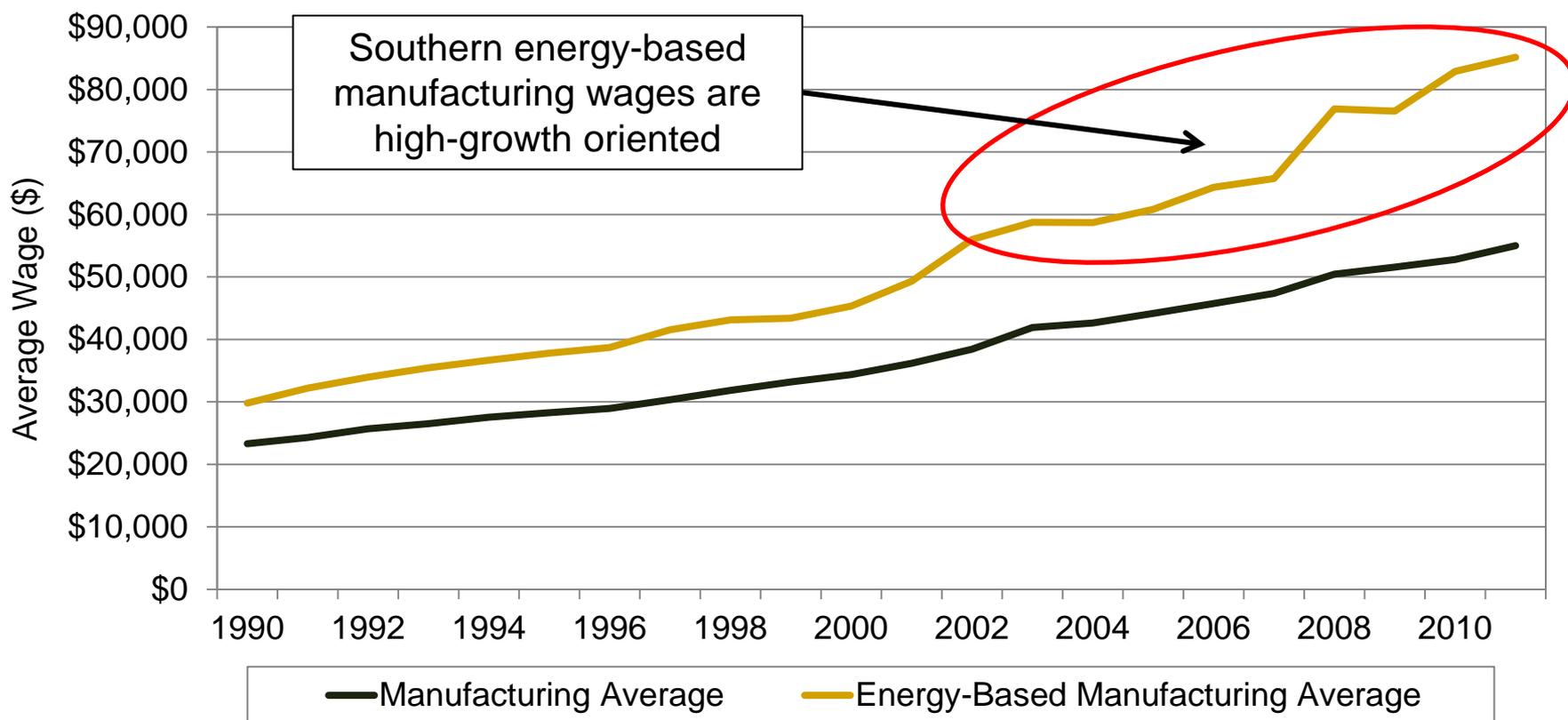
Energy is typically a “feedstock” for these industries which use energy to make a number of different products much like a baker uses a common input (flour) to make a variety of different products (biscuits, baguettes, pizza dough).

These energy-based manufacturing industries are large, capital-intensive, and compete globally. Energy-based manufacturing wages are even higher than the already-above average manufacturing wage levels.



## Southern Manufacturing Wages vs. Southern Energy-Based Manufacturing Wages

**Energy-based manufacturing wages in the South are higher than the average manufacturing wage. In 2012, the average energy-based manufacturing wage was 1.5 times that of the average manufacturing wage growing at average annual rate of 5.2 percent (compared to the manufacturing average of 4.2 percent)**



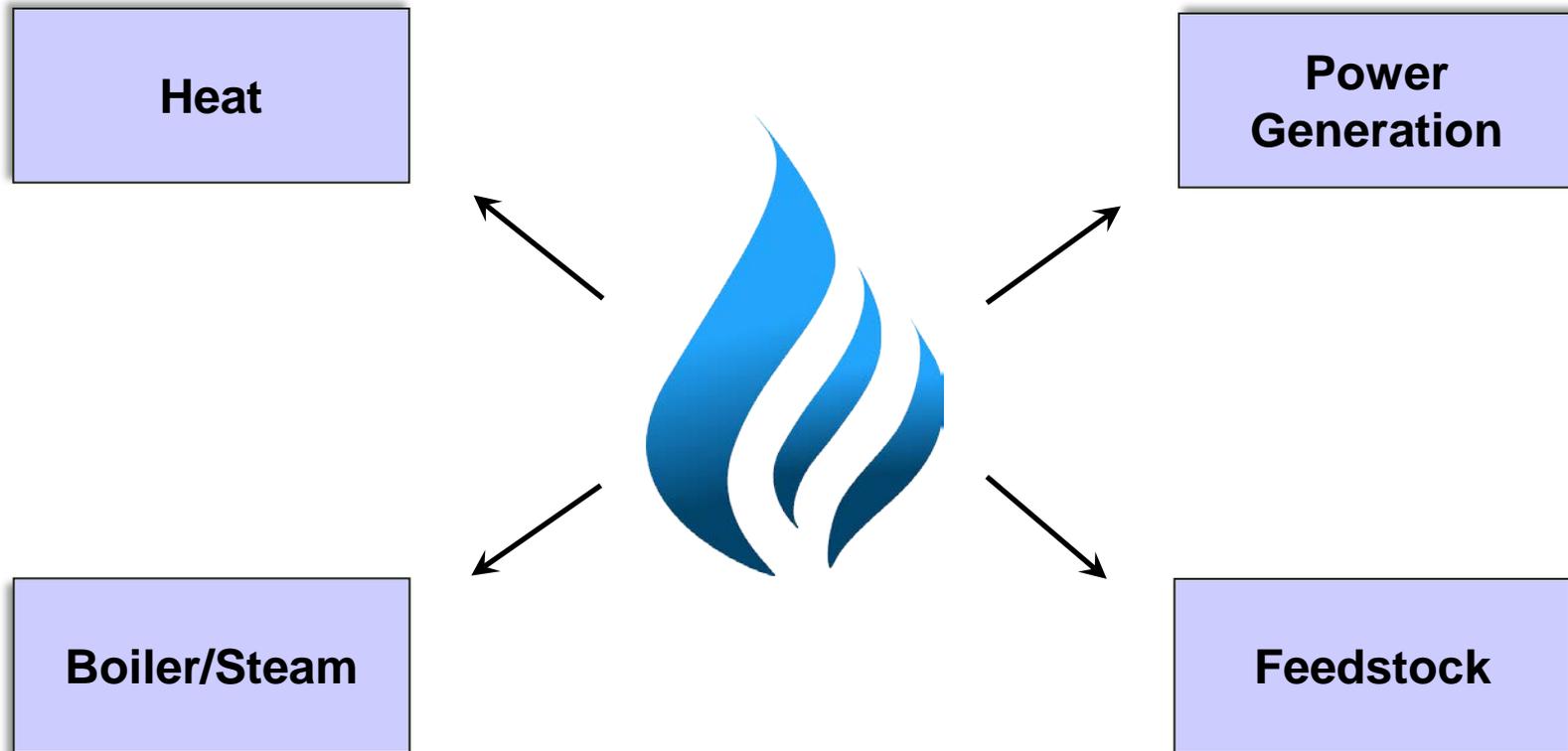
Note: Energy-based manufacturing includes: petroleum and coal products; chemical; and plastics and rubber products manufacturing.

Source: Bureau of Economic Analysis, U.S. Department of Commerce.



**Industrial Natural Gas Usage**

**Manufacturing industries use natural gas in a range of applications that include the generation of heat, steam, and power. Feedstock uses are equally important and are the building blocks of modern petrochemical manufacturing.**





**What the Strategic Factors Driving this Renewed Interest?**

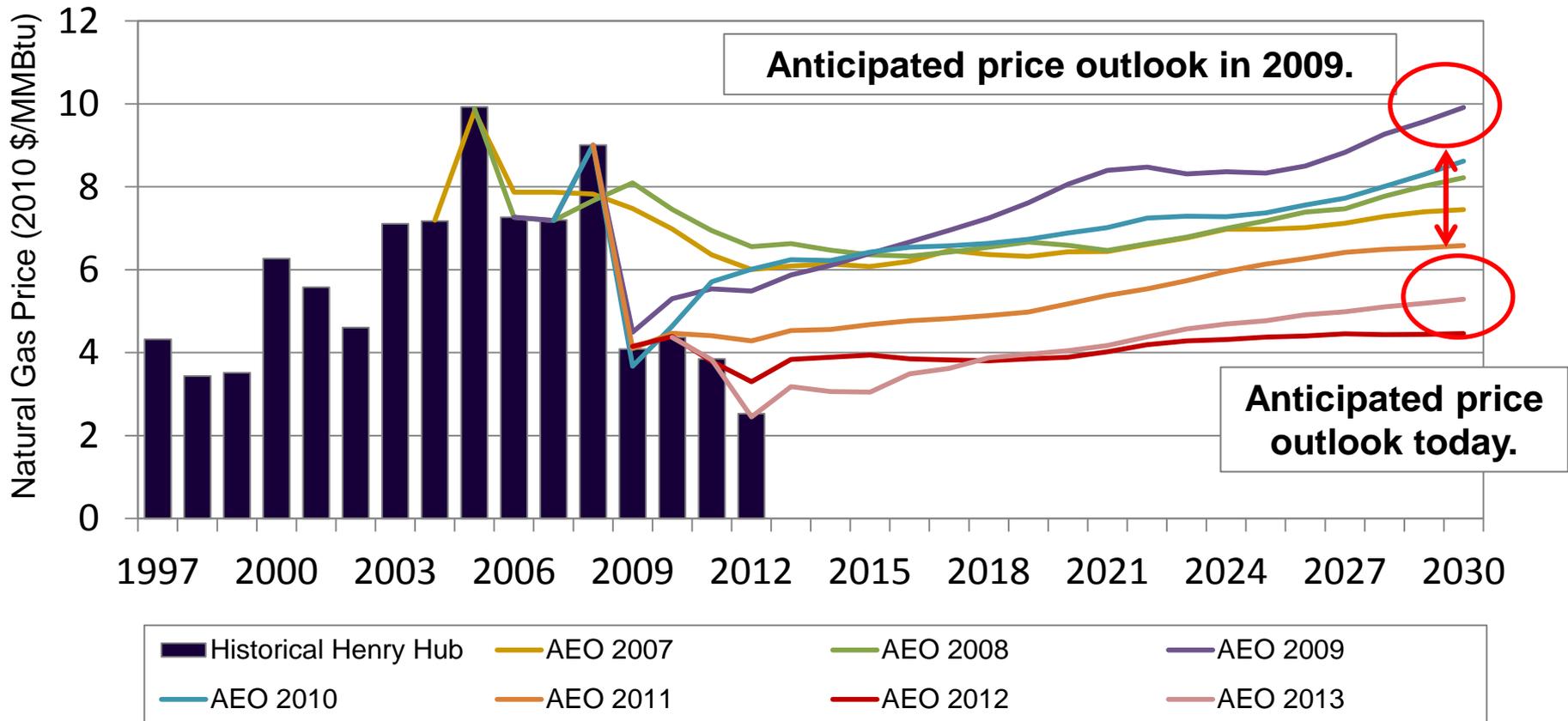
**The factors driving renewed U.S. manufacturing, particularly chemical manufacturing include:**

- Low natural gas price
- Increasing U.S. competitiveness
- (Relative) regulatory certainty
- Agricultural and other final chemical output price stability
  - Product affordability
- Strong global demand for chemicals
- U.S. import displacement opportunities



## Natural Gas Price Outlook – Annual Energy Outlook (“AEO”)

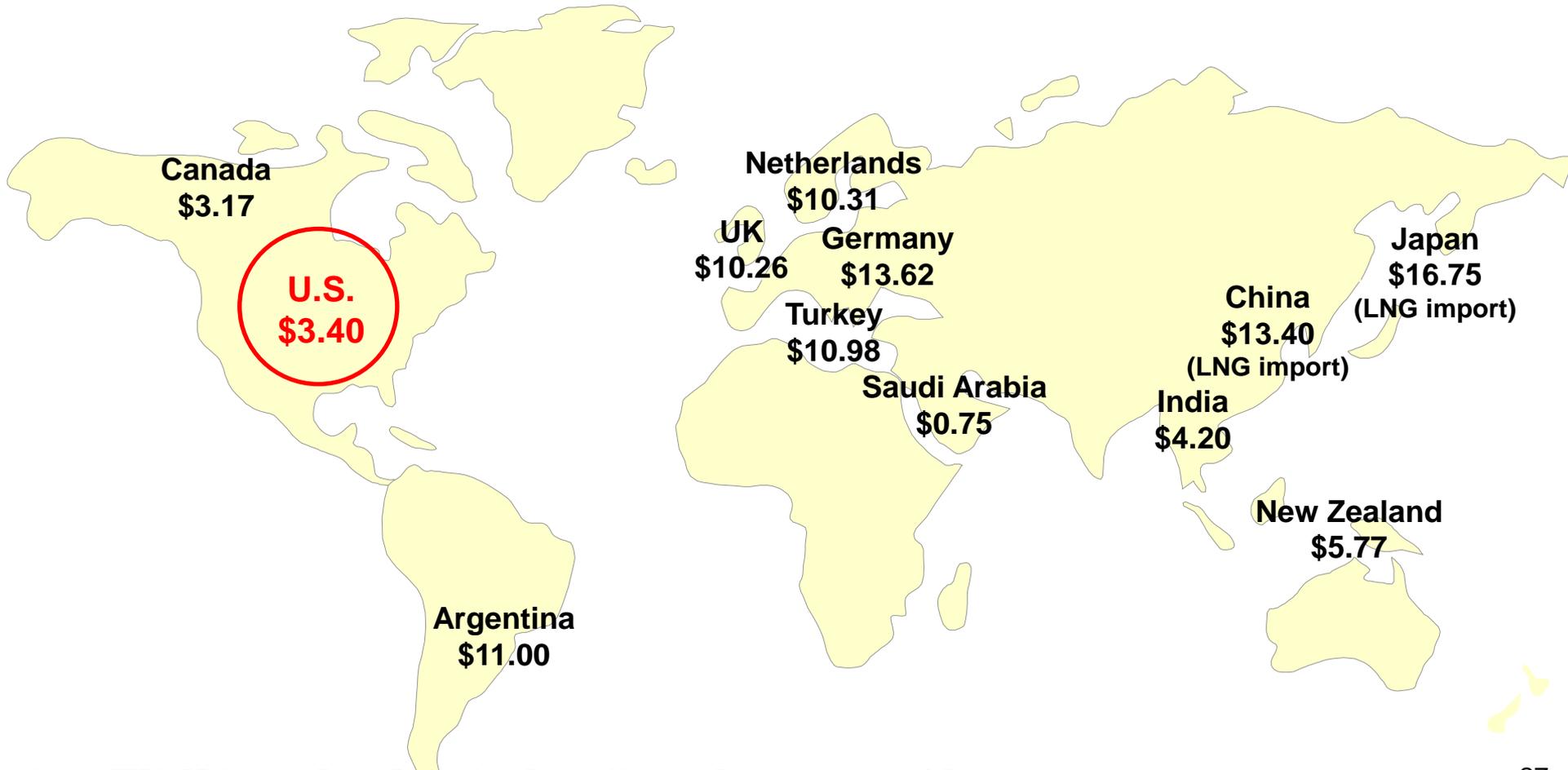
Shale reserves have a significant impact on future price outlook. Abundant supplies should keep prices stable. The current AEO forecasts natural gas prices in 2030 at \$5.29/Mcf (47 percent less than the 2009 AEO forecast).





**World Natural Gas Prices for Industry (\$/MMBtu), 2012**

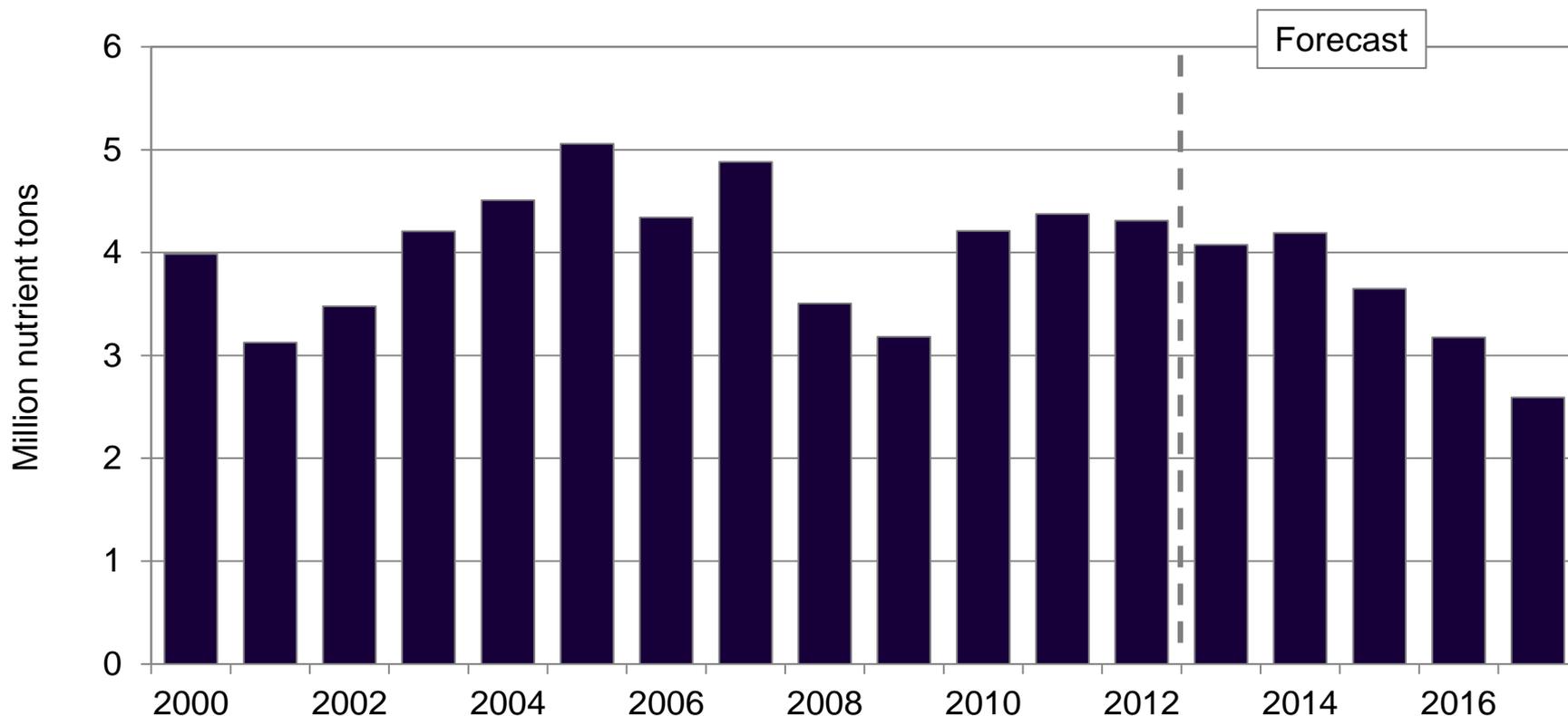
**U.S. natural gas prices are becoming increasingly competitive with other places around the globe that compete for new energy-based manufacturing investment.**





Forecasted U.S. Imports

**U.S. imports are expected to drop by as much as 12 to 18 percent in 2016 and 2017 when new capacity comes online.**



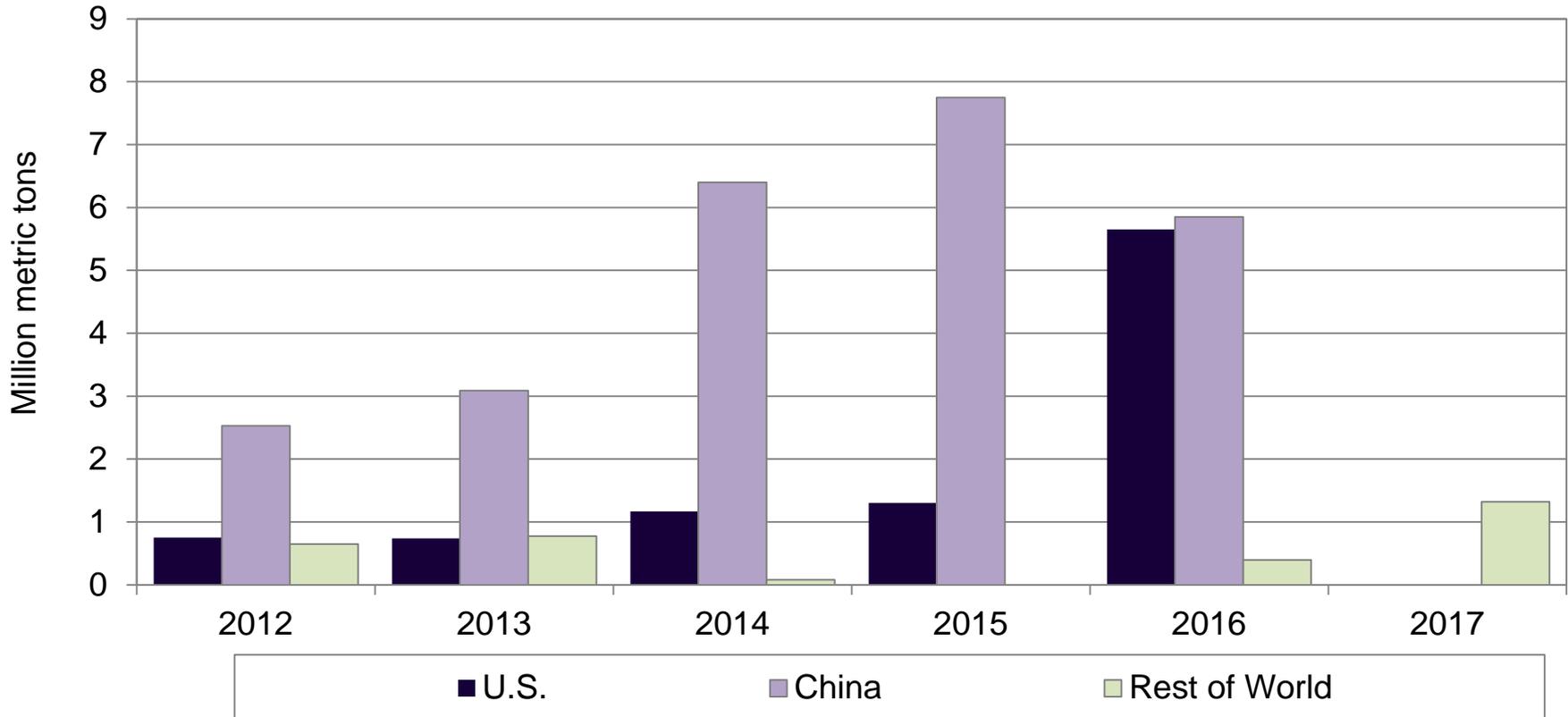
Note: Forecasts based on various industry sources.

Source: International Fertilizer Industry Association; Food and Agriculture Organization of the United Nations; and CF Industries.



## Existing U.S. Proposals as a Share of World

**While U.S. based projects plan to add an impressive amount of methanol capacity, proposed projects in China will add almost three times as much, totaling 25 to 30 million metric tons. Projects in New Zealand, Brazil, Russia, Azerbaijan and India total 3.2 million metric tons. Still, U.S. projects account for 33 percent of worldwide projects.**

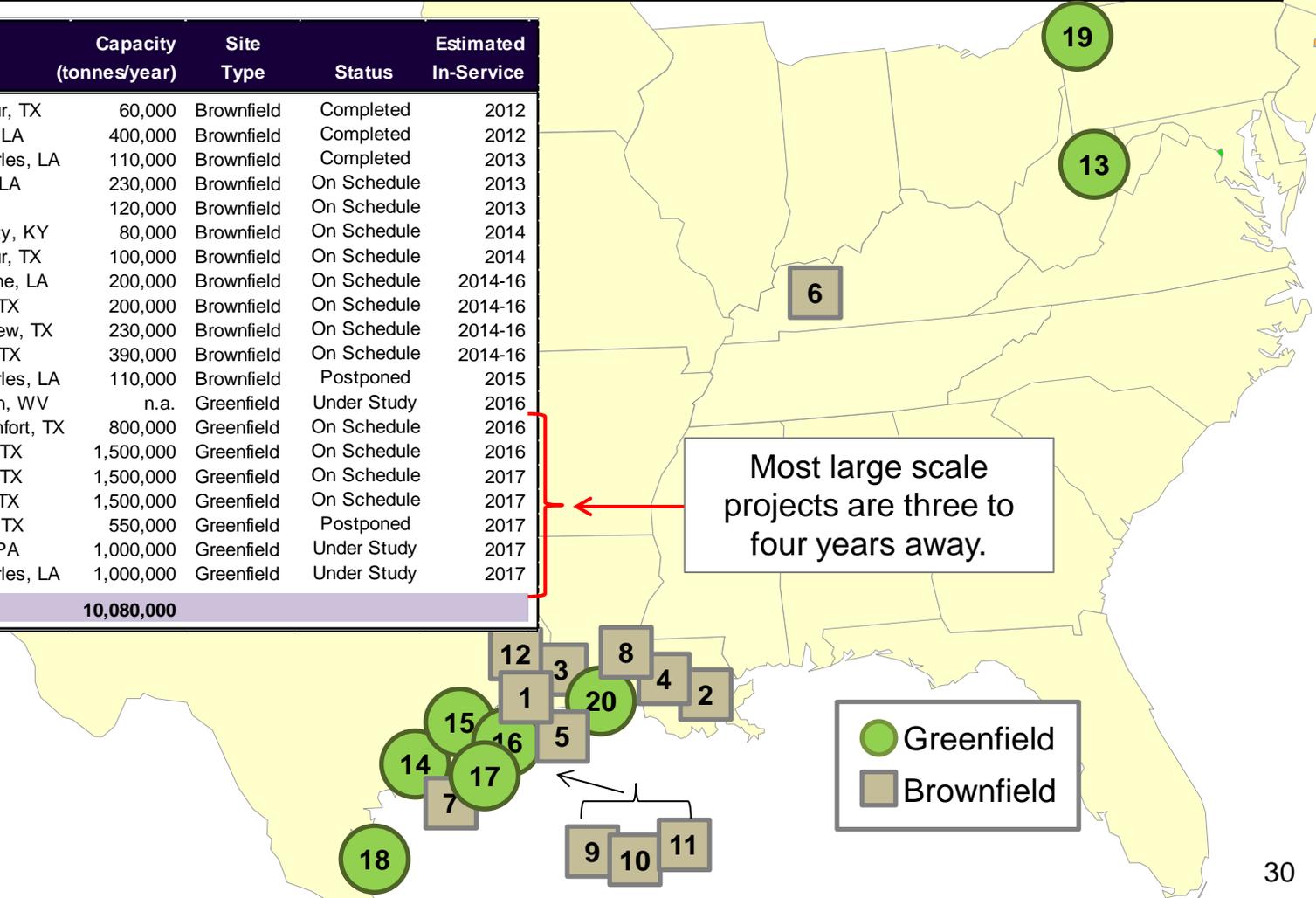




## Recent and Proposed U.S. Ethylene Cracking Capacity Expansions

Over 10 million tons of ethylene cracking capacity is either under construction or has been proposed. This represents more than 35 percent of current ethylene capacity.

Owner/Operator	Location	Capacity (tonnes/year)	Site Type	Status	Estimated In-Service
1. BASF-Total	Port Arthur, TX	60,000	Brownfield	Completed	2012
2. Dow Chemical	Hahnville, LA	400,000	Brownfield	Completed	2012
3. Westlake Chemical	Lake Charles, LA	110,000	Brownfield	Completed	2013
4. Williams	Geismar, LA	230,000	Brownfield	On Schedule	2013
5. Ineos	Alvin, Tx	120,000	Brownfield	On Schedule	2013
6. Westlake Chemical	Calvert City, KY	80,000	Brownfield	On Schedule	2014
7. BASF-Total	Port Arthur, TX	100,000	Brownfield	On Schedule	2014
8. Dow Chemical	Plaquemine, LA	200,000	Brownfield	On Schedule	2014-16
9. Dow Chemical	Freeport, TX	200,000	Brownfield	On Schedule	2014-16
10. LyondellBasell	Channelview, TX	230,000	Brownfield	On Schedule	2014-16
11. LyondellBasell	La Porte, TX	390,000	Brownfield	On Schedule	2014-16
12. Westlake Chemical	Lake Charles, LA	110,000	Brownfield	Postponed	2015
13. Aither Chemical	Charleston, WV	n.a.	Greenfield	Under Study	2016
14. Formosa Plastics	Point Comfort, TX	800,000	Greenfield	On Schedule	2016
15. ExxonMobil Chemical	Baytown, TX	1,500,000	Greenfield	On Schedule	2016
16. Chevron Phillips	Baytown, TX	1,500,000	Greenfield	On Schedule	2017
17. Dow Chemical	Freeport, TX	1,500,000	Greenfield	On Schedule	2017
18. OxyChem/Mexichem	Ingleside, TX	550,000	Greenfield	Postponed	2017
19. Shell Chemical	Monaca, PA	1,000,000	Greenfield	Under Study	2017
20. Sasol	Lake Charles, LA	1,000,000	Greenfield	Under Study	2017
<b>Total</b>		<b>10,080,000</b>			

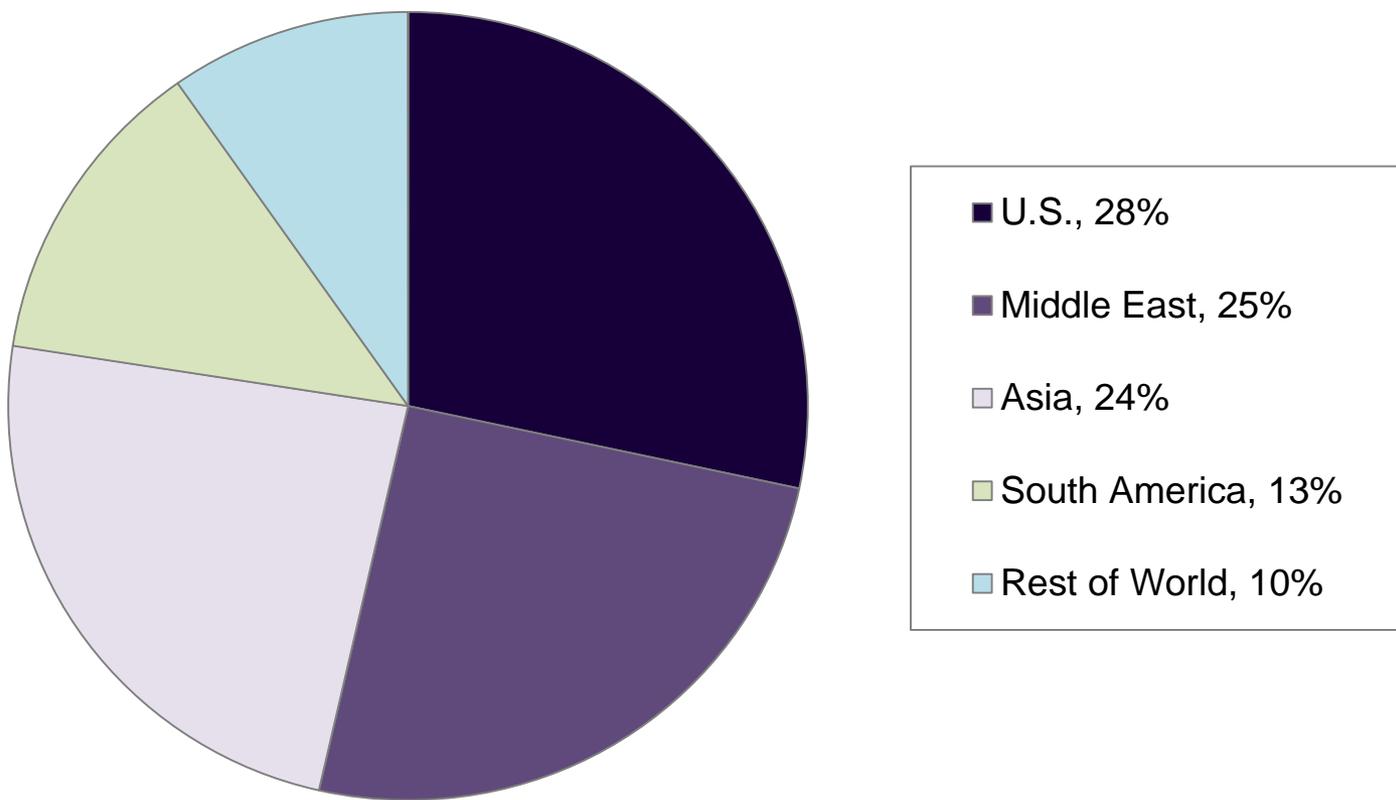


Most large scale projects are three to four years away.

- Greenfield
- Brownfield

**U.S. Proposals as a Share of World**

**Ethylene projects in the U.S. account for almost 30 percent of projects worldwide.**

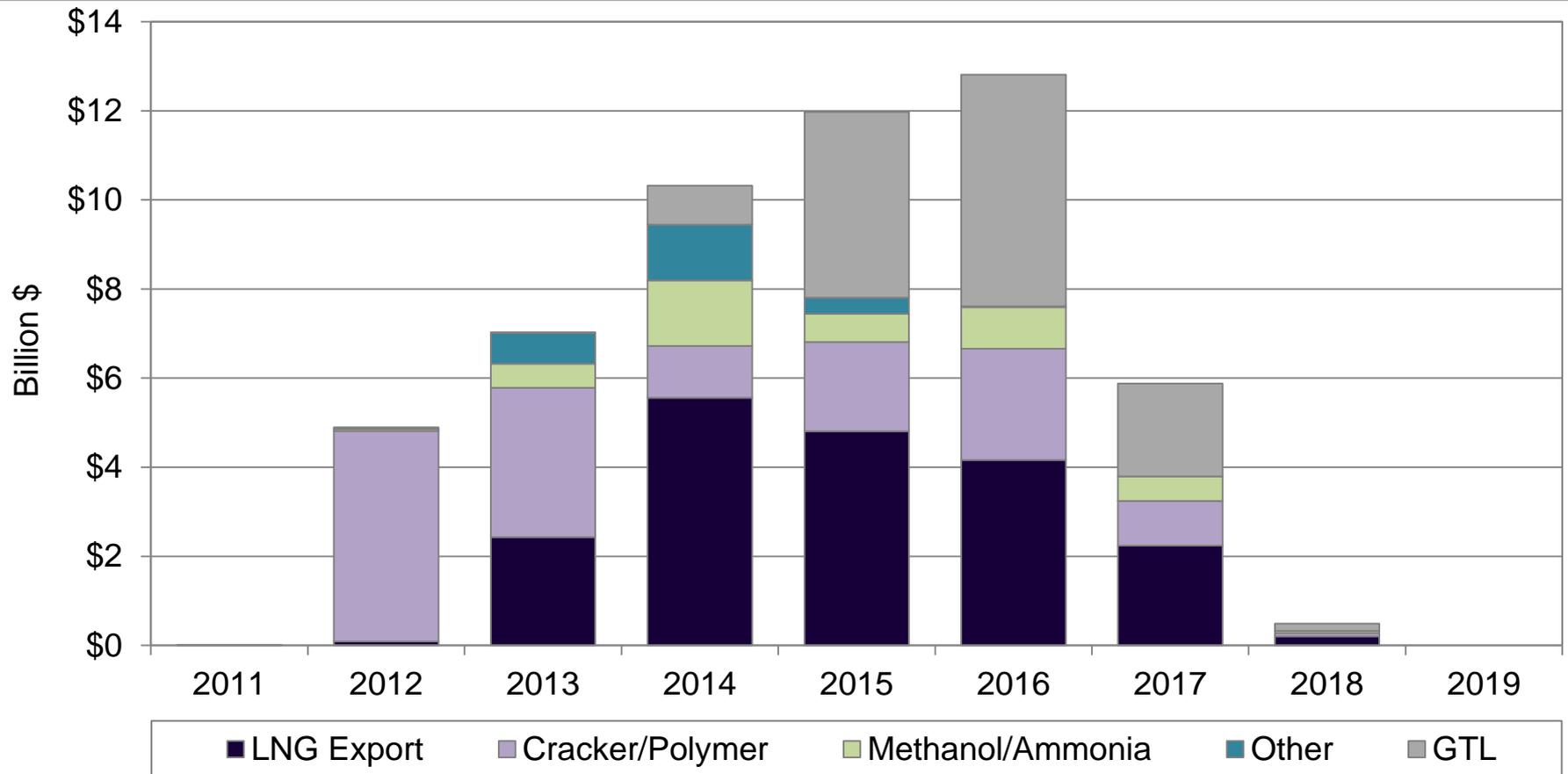


# Development Potential



## LSU-CES Study (2013): Louisiana Total Capital Expenditures by Sector

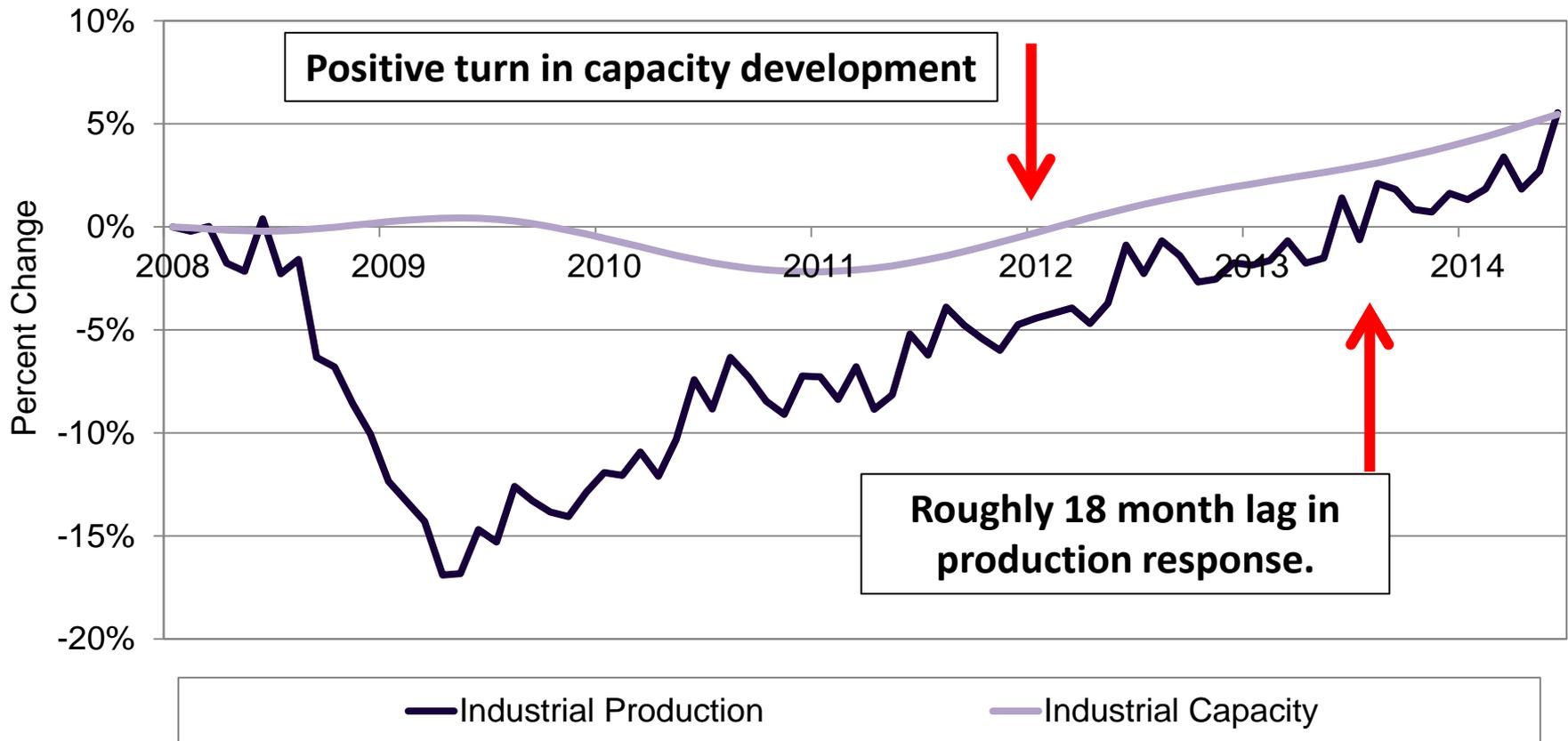
The LSU Center for Energy Studies (CES) reports an estimated \$53.4 billion in new energy-based manufacturing development, most of which is anticipated to occur between 2014 and 2019.





## Industrial Production and Capacity Indices

**Industrial capacity development “leads” later production (and employment trends). Recent development announcements suggest a strong steady opportunity for U.S. manufacturing output and employment growth.**



## **Conclusions**

**Conclusions**

- The unconventional energy production revolution is having **considerable positive economic impacts** on U.S. manufacturing/industrial development.
- However, policy needs to recognize that all of this development and the potential “independence” is **resource-specific** and **policy dependent**.
- “Independence” does not mean that we will be entirely removed, nor disengaged, from global markets and particular areas of the world.



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