The Impact of Changing Natural Gas Prices on Retail Power and Gas Markets

LSU/Center for Energy Studies-Jones Walker Energy Retreat
June 20, 2012

David E. Dismukes, Ph.D.
Center for Energy Studies
Louisiana State University

LSU
Center for Energy Studies

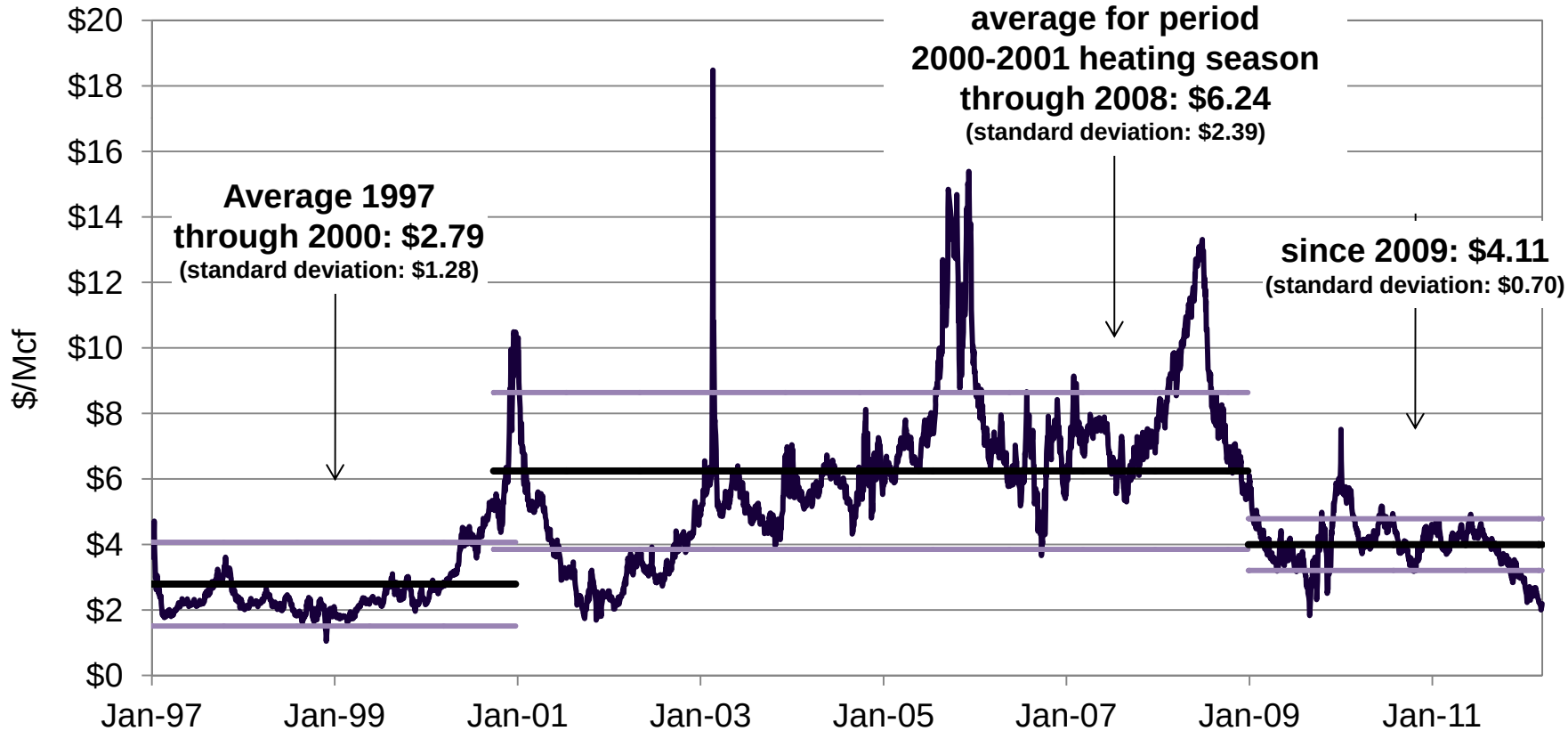
Overview

- Although natural resource estimates vary, there is increasingly clear consensus that the "shale gas revolution" is real, and is likely to continue into the foreseeable future.
- Shale oil development only re-enforces shale gas production returns and could revolutionize U.S. energy markets in the near future.
- Today's problems are not "are we going to have enough gas?" (i.e., 2005) but "what are we going to do with all this gas?"
- Certain sense of desperation with some producers to really push new and novel end uses and markets. Created some "unhappy" relationship issues for industries commonly aligned on many energy policy issues.
- Likely room at the table for the "new" end uses and markets, BUT…
  - Considerable opportunities, and likely changes, in traditional end-use markets that need to be considered and examined.
  - Strong sense of "déjà vu all over again" has to be addressed.

Natural Gas Prices

Natural Gas Price Variability

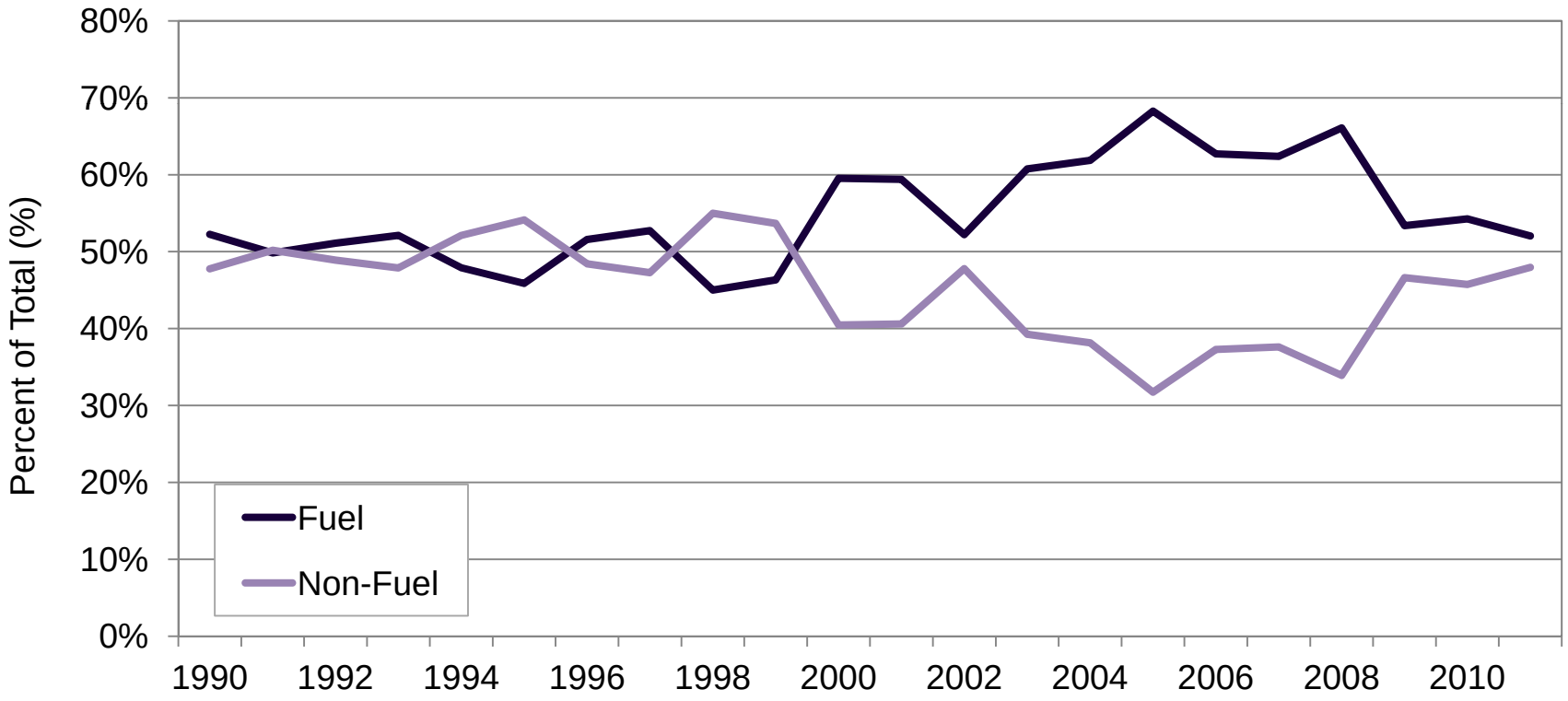
The 2001 to 2009 market trend of higher average prices coupled with high volatility is reversing itself and post 2009 prices are significantly lower.



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

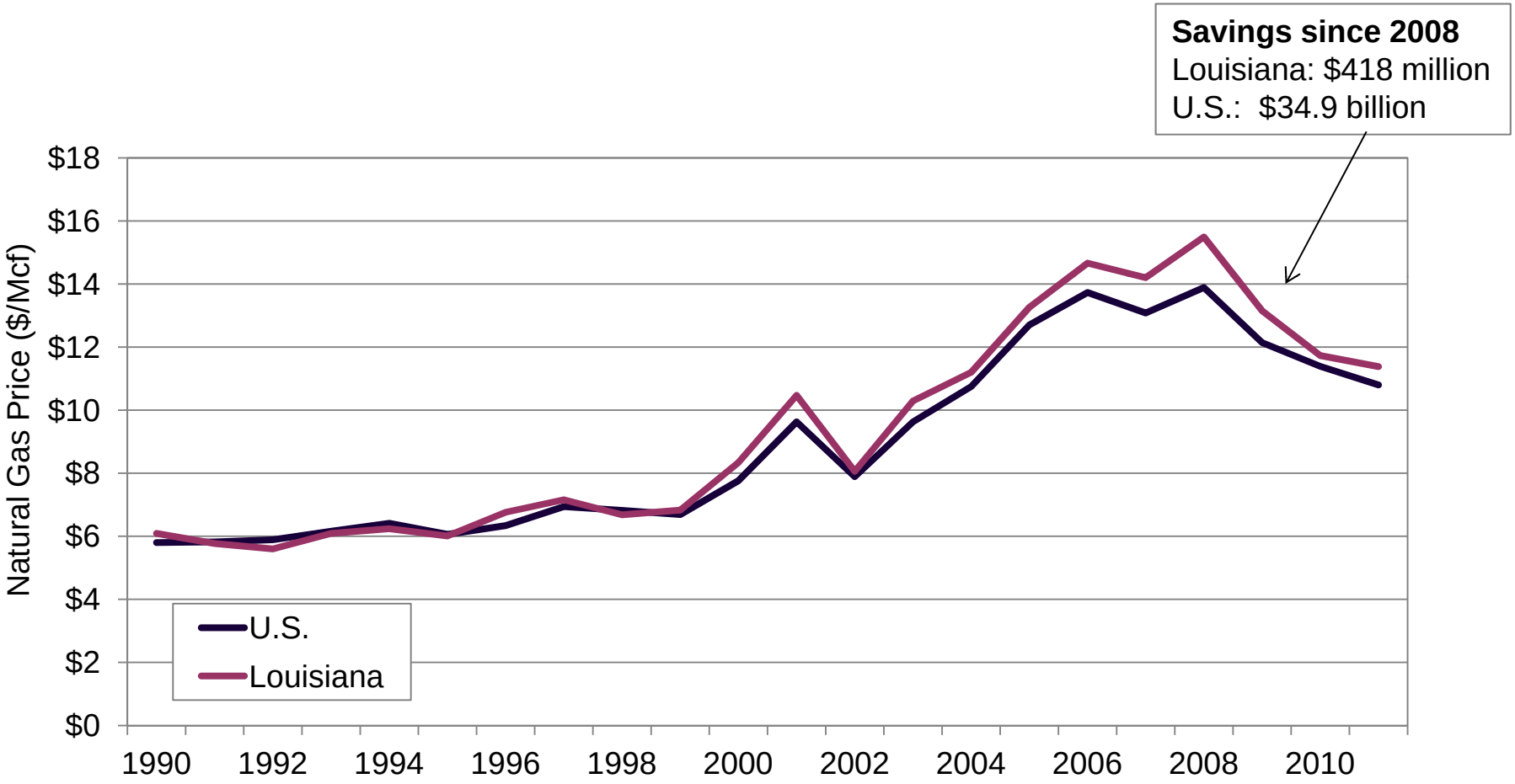
Estimated Gas and Non-Gas Costs in U.S. Distribution Rates

The commodity share of total bills are closer to percentages observed in the 1990s rather than the early 2000s.



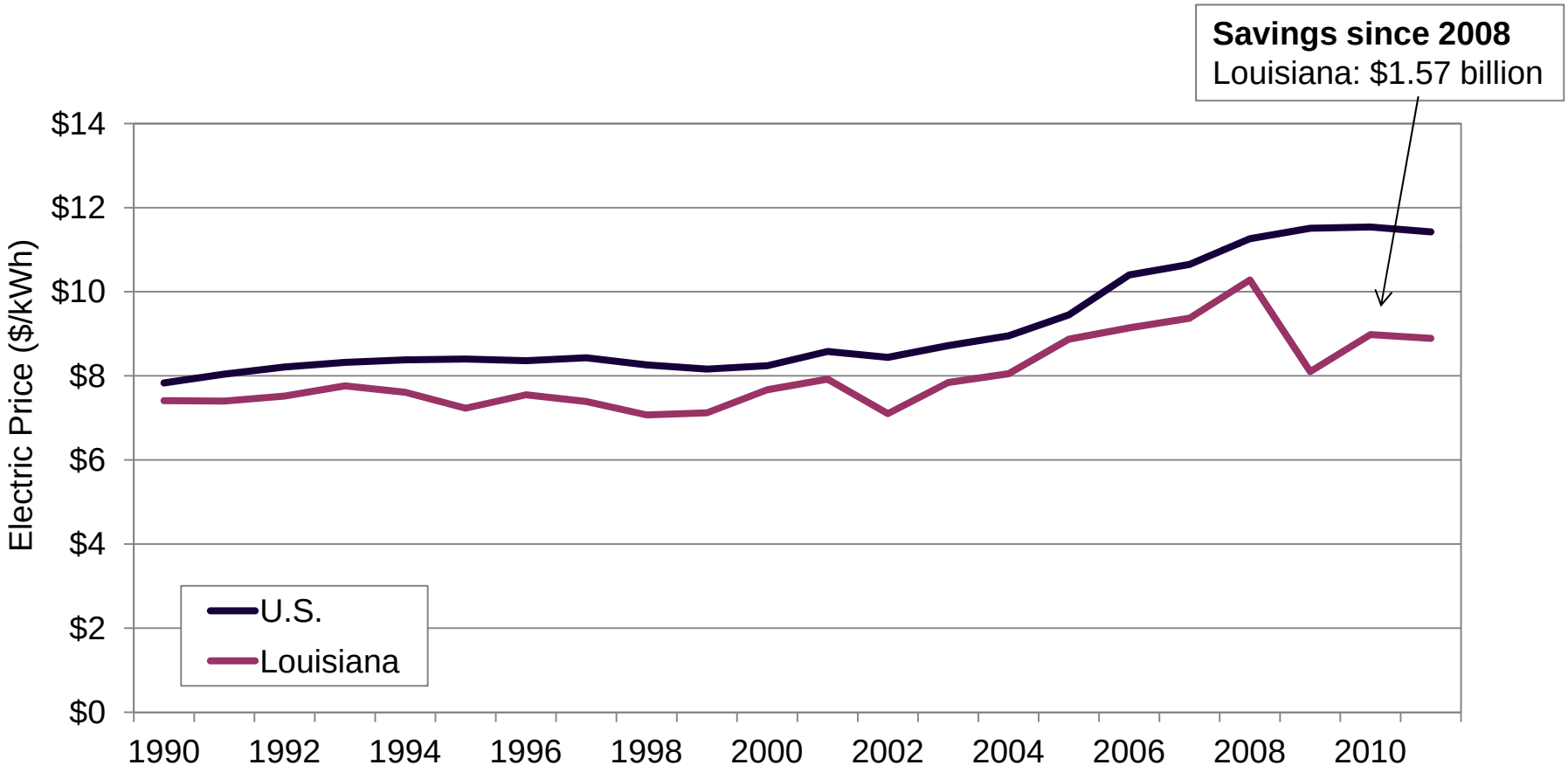
Source: Energy Information Administration, U.S. Department of Energy

Residential Natural Gas Price



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

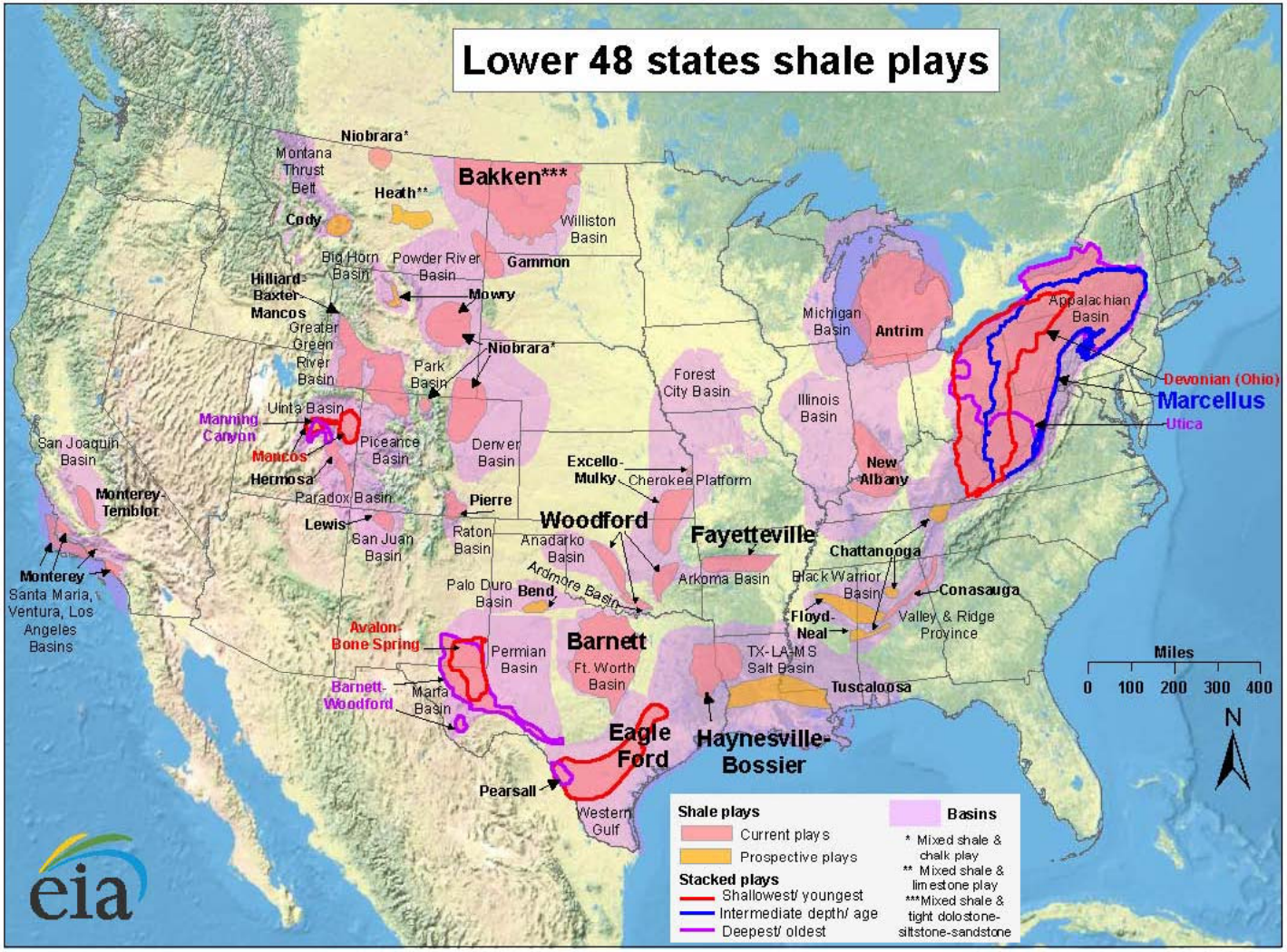
Residential Electric Prices



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

Domestic Shale Gas Basins and Plays

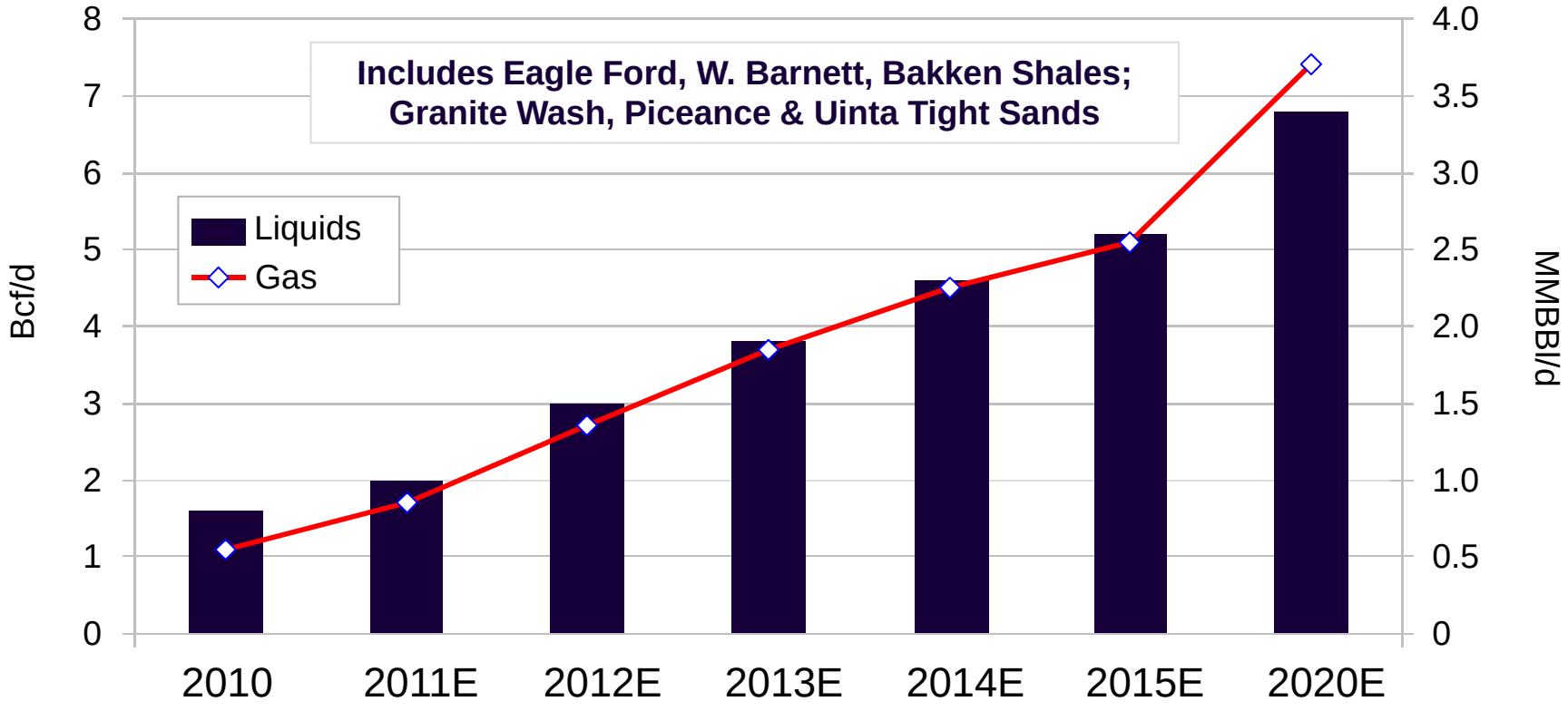
Unlike conventional resources, shale plays (natural gas, liquids, and crudes) are located almost ubiquitously throughout the U.S. and are the primary reason for the decrease in overall and regional natural gas prices.



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

Annual Production, Unconventional Resources

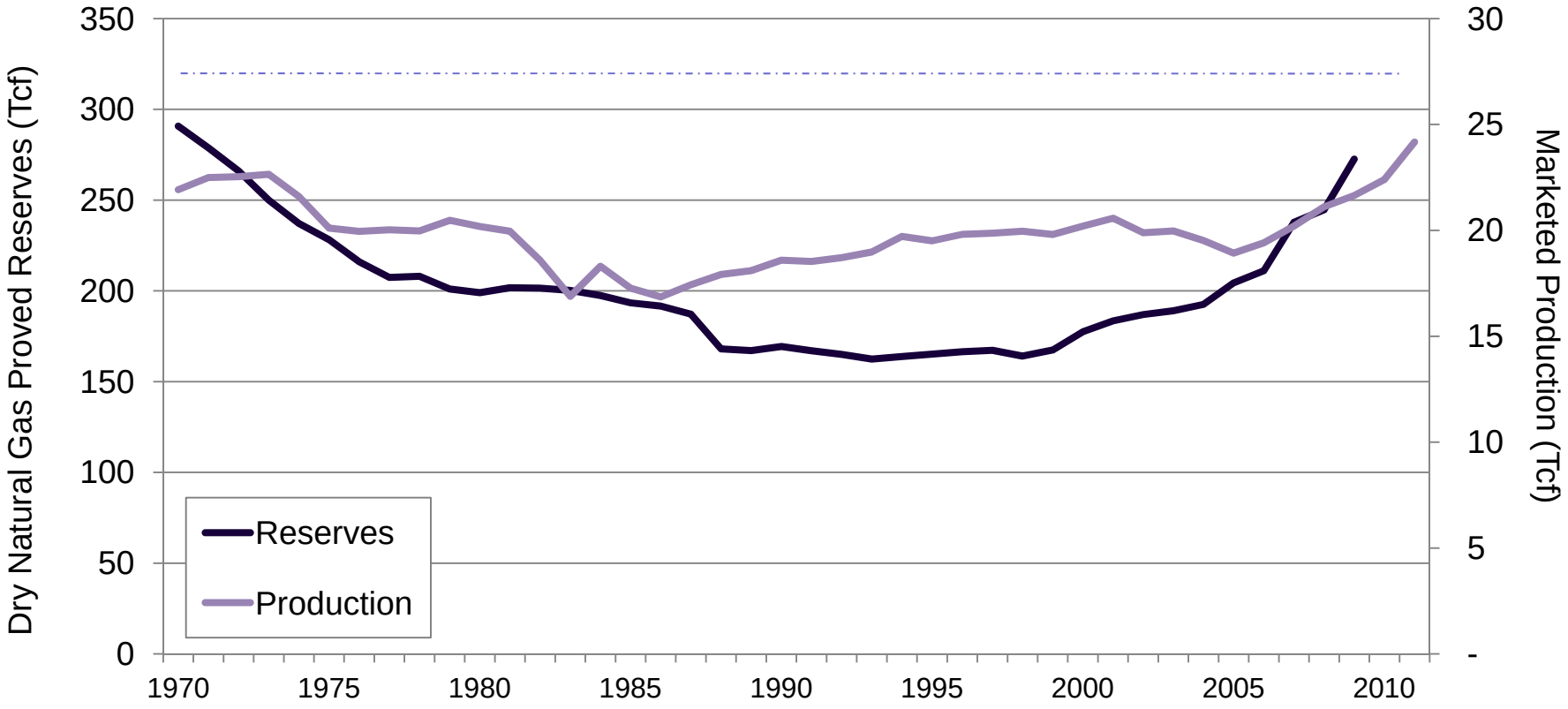
Liquids production from shale plays > 3 million barrels per day by 2020
Associated natural gas > 7 Bcf/d of "costless" supply (or about 2.3 Bcf/d per every 1.0 MMBbls/d of shale-based liquids production).



Source: Advanced Resource Intl; presentation to Cheniere Board, March 2011; Cheniere Research

Natural Gas Proved Reserves and Production

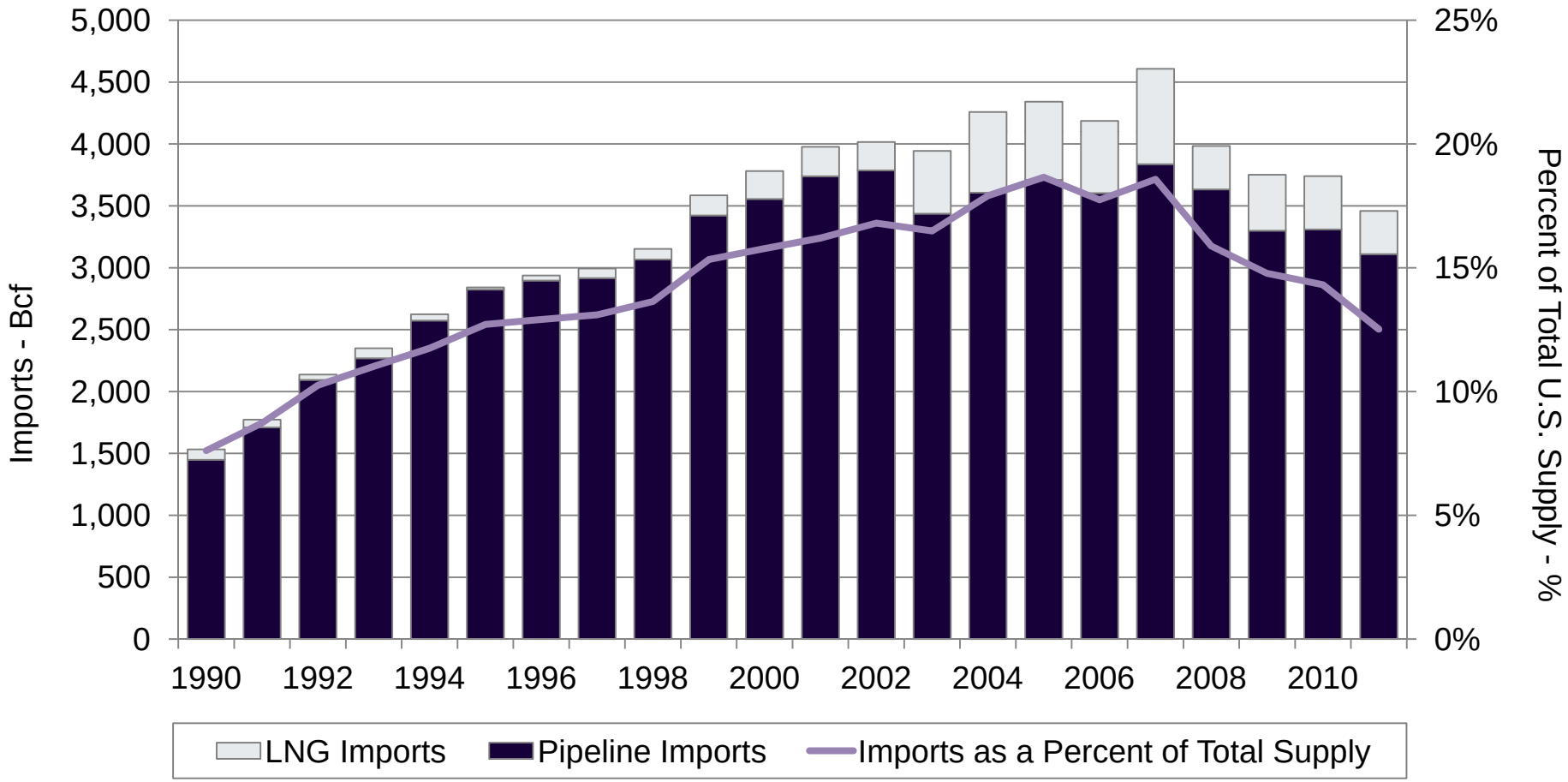
Current U.S. natural gas reserves are approaching record levels not seen since 1970. Natural gas production is at levels that surpass historic peaks.



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

Natural Gas Imports

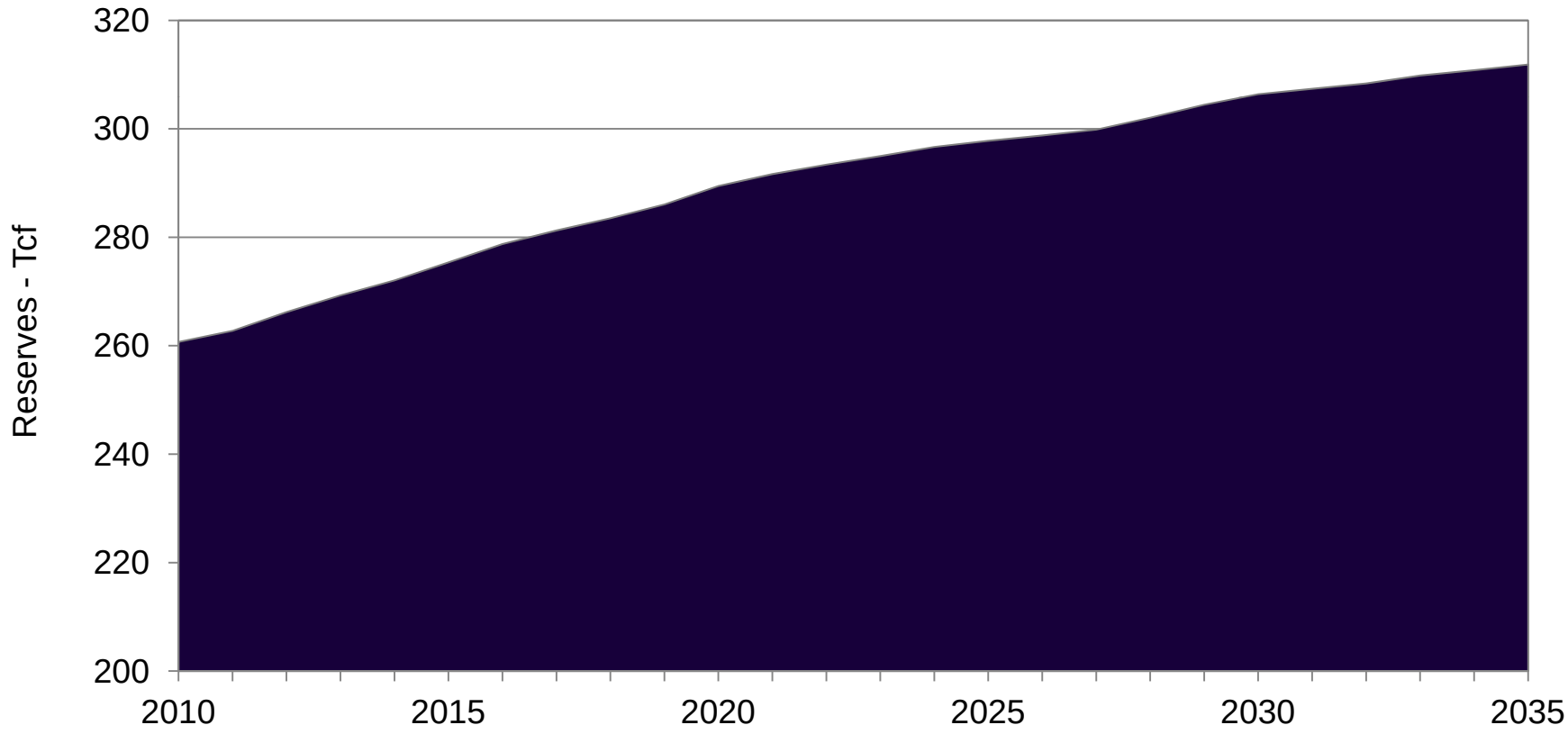
Natural gas imports, once thought the be the supply remedy for meeting future gas needs are falling to levels also not seen since the 1990s.



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

Annual Energy Outlook, Natural Gas Reserves

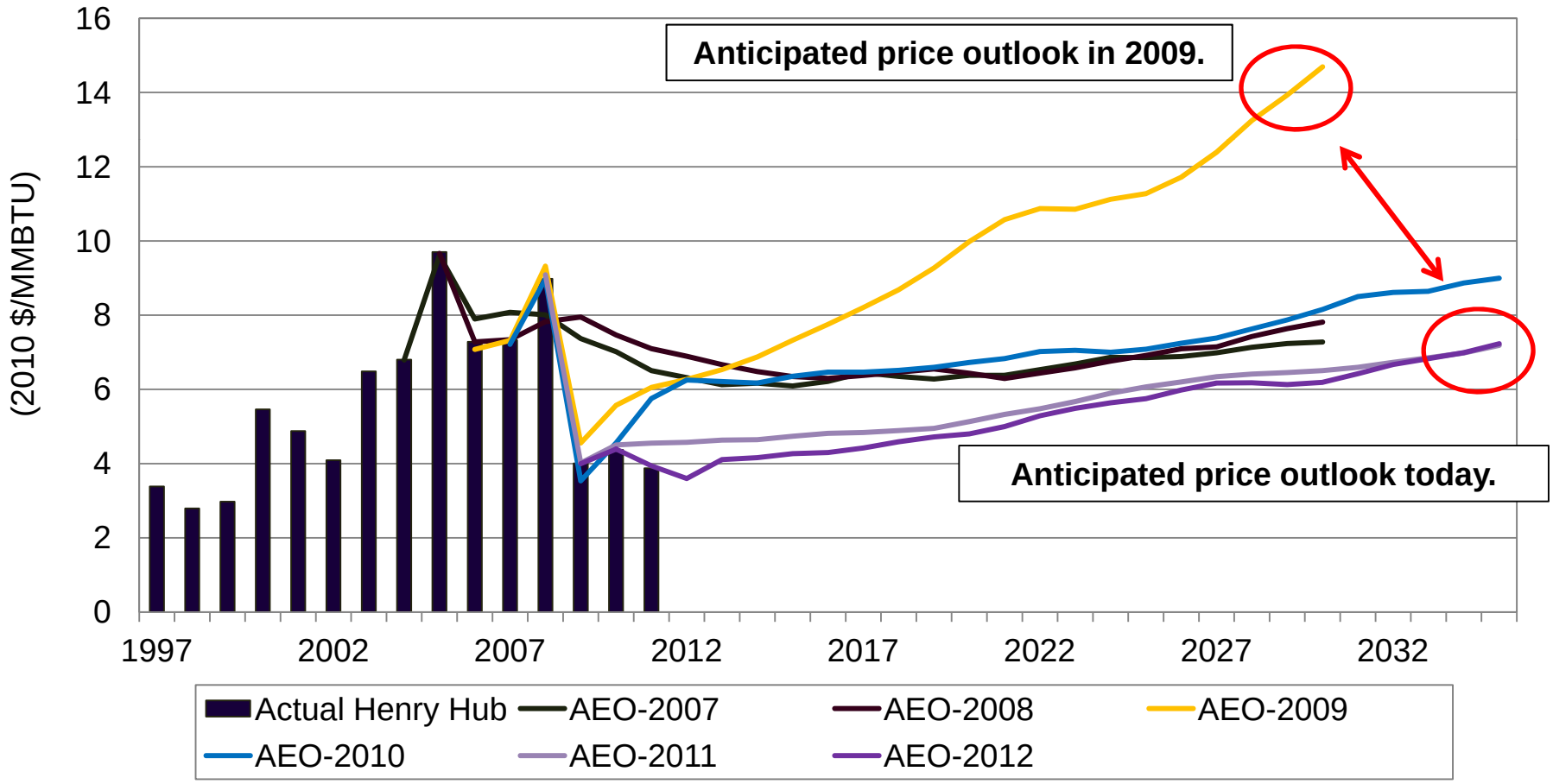
Unconventional resources are not a "flash in the pan" and are anticipated to continue to increase over the next two decades or more.



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

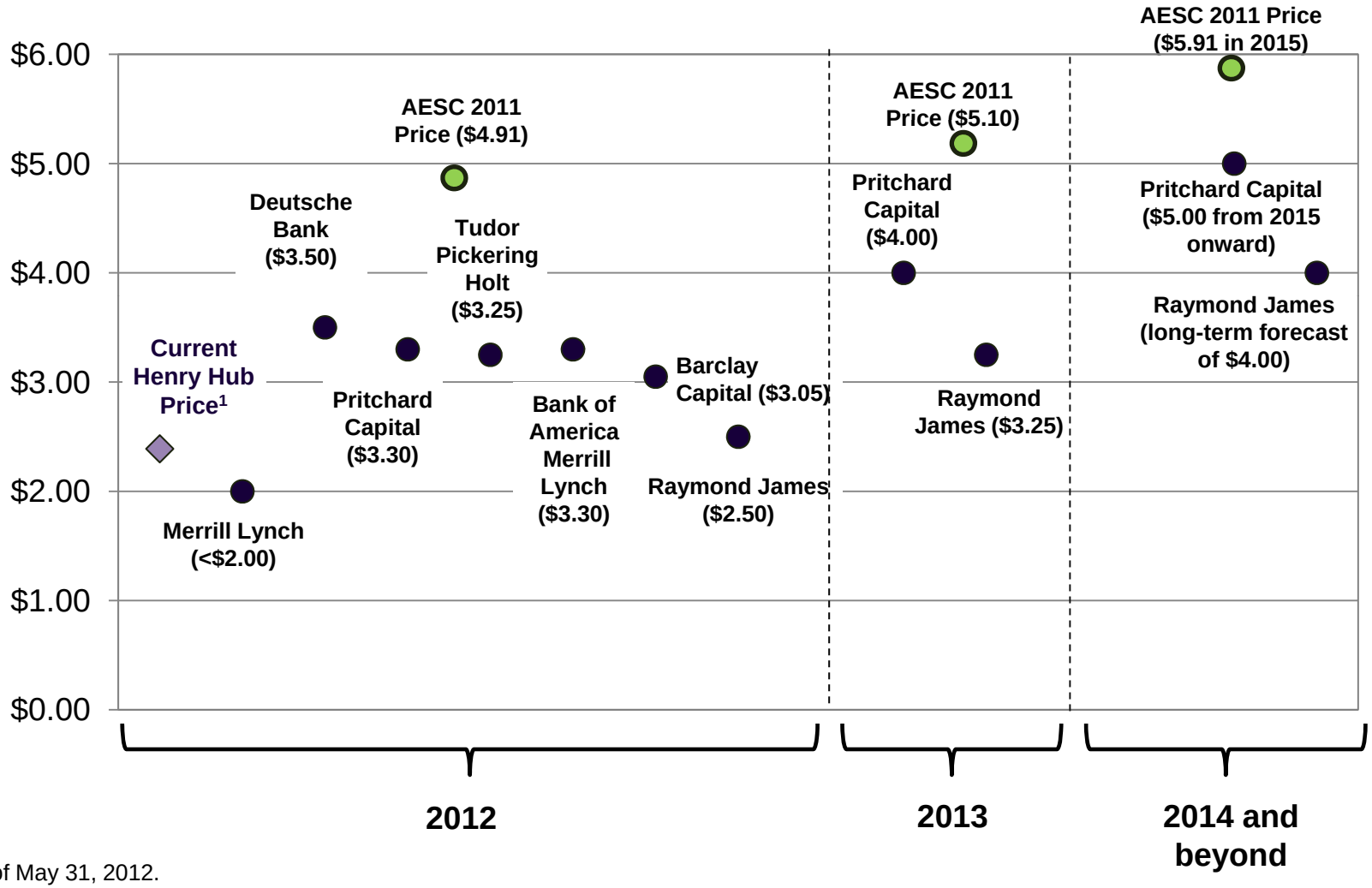
Choosing Most Current Natural Gas Price Forecasts: AEO-2007 to AEO-2012

Shale availability has significant impact on future price outlook.



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

Varying Industry Natural Gas Forecasts



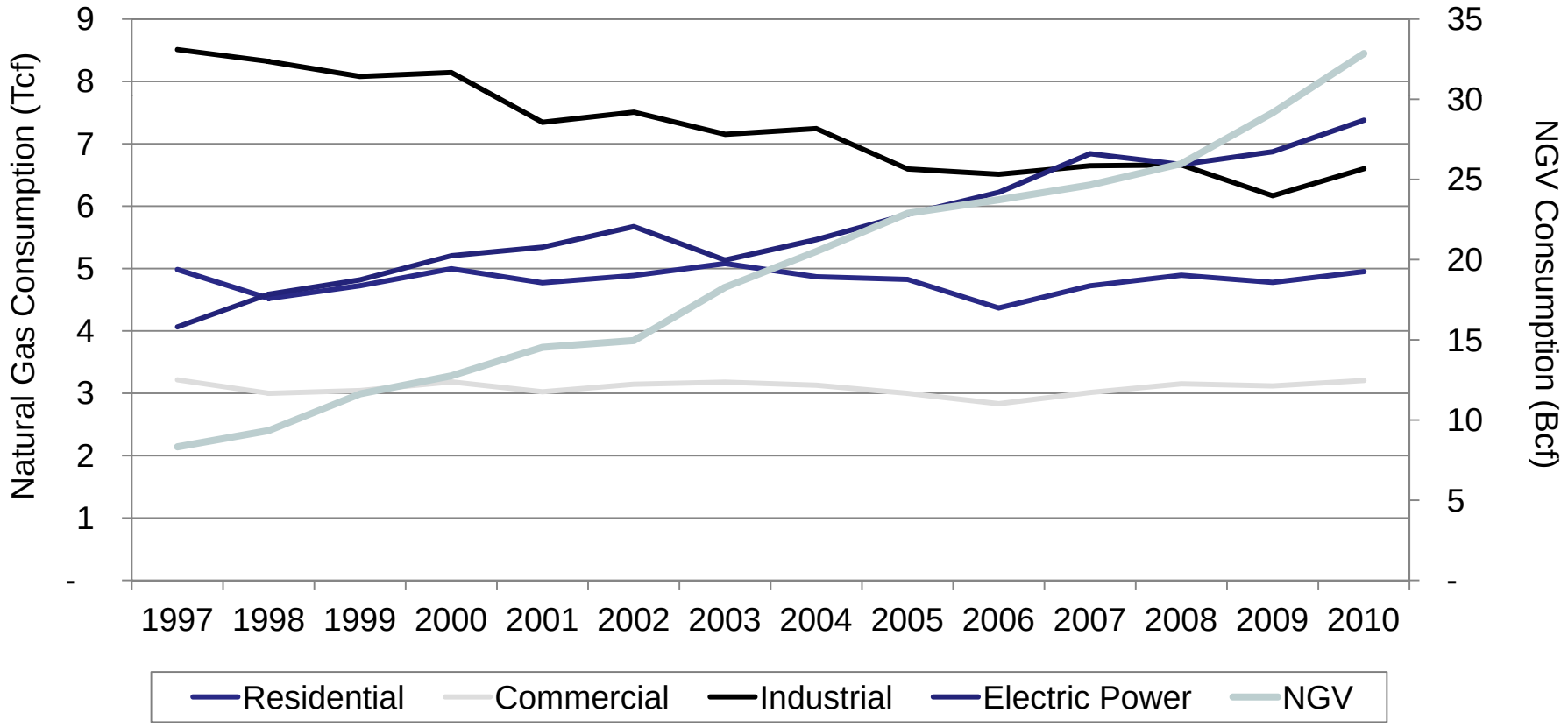
Note: [1] As of May 31, 2012.

Source: Foster Natural Gas/Oil Report. Barclays Capital analysts: producer expectations of “very weak" gas prices in 2012, yet gas production will still manage to grow. March 9, 2012; Hargreaves, S. 2012. Heating homes with gas gets cheaper. CNNMoney.com. January 12, 2012; Holland, B. 2012. Pritchard cuts 2012 gas price forecast 25%. Electric Power Daily. January 19, 2012; and Natural Gas Week. Treadmill: little hope seen for corralling burgeoning gas supply. February 13, 2012 .

New End Uses:
Natural Gas Vehicles

Natural Gas Consumption by Sector

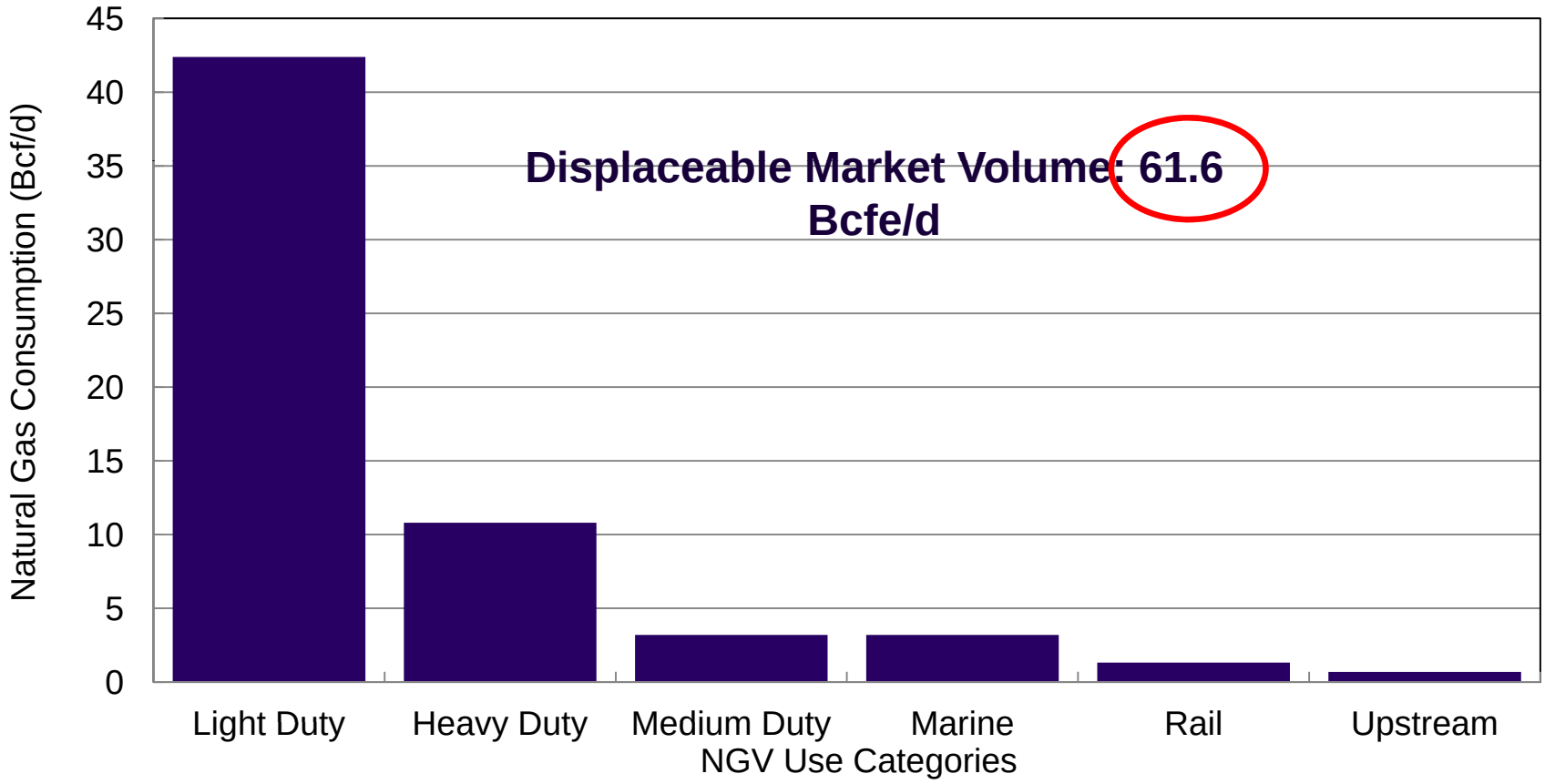
Currently, NGVs account for less than 0.18 percent of U.S. natural gas consumption, but the rate of growth in consumption (158 percent) over the past decade has surpassed all other end-uses.



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

Potential NGV Usage

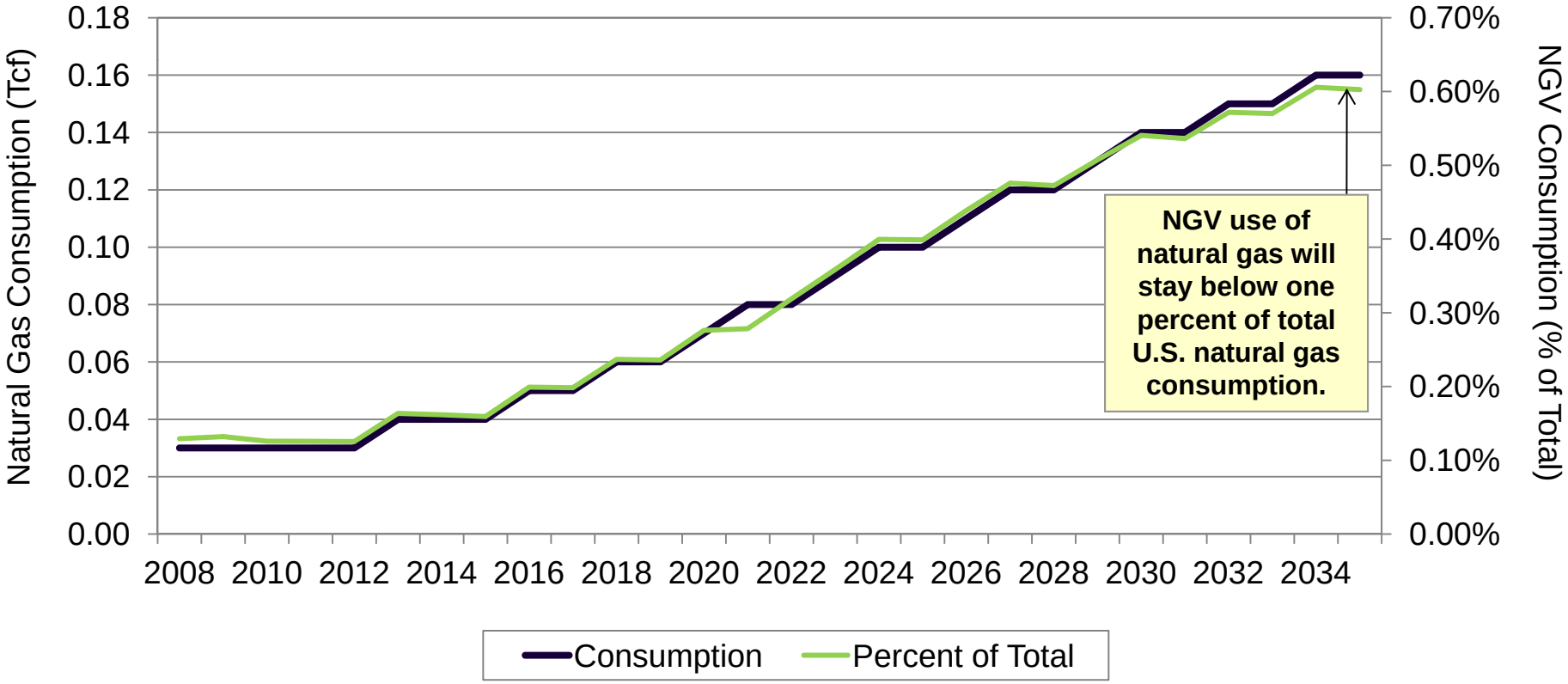
The large potential size of NGV market has a number of competing end-use categories (i.e., chemicals, manufacturing) concerned.



Source: Data and forecast from EIA, Encana, 2010
Displacement opportunities exclude Air, International Shipping, Military, Pipeline Fuel

Potential Natural Gas Consumption – NGV

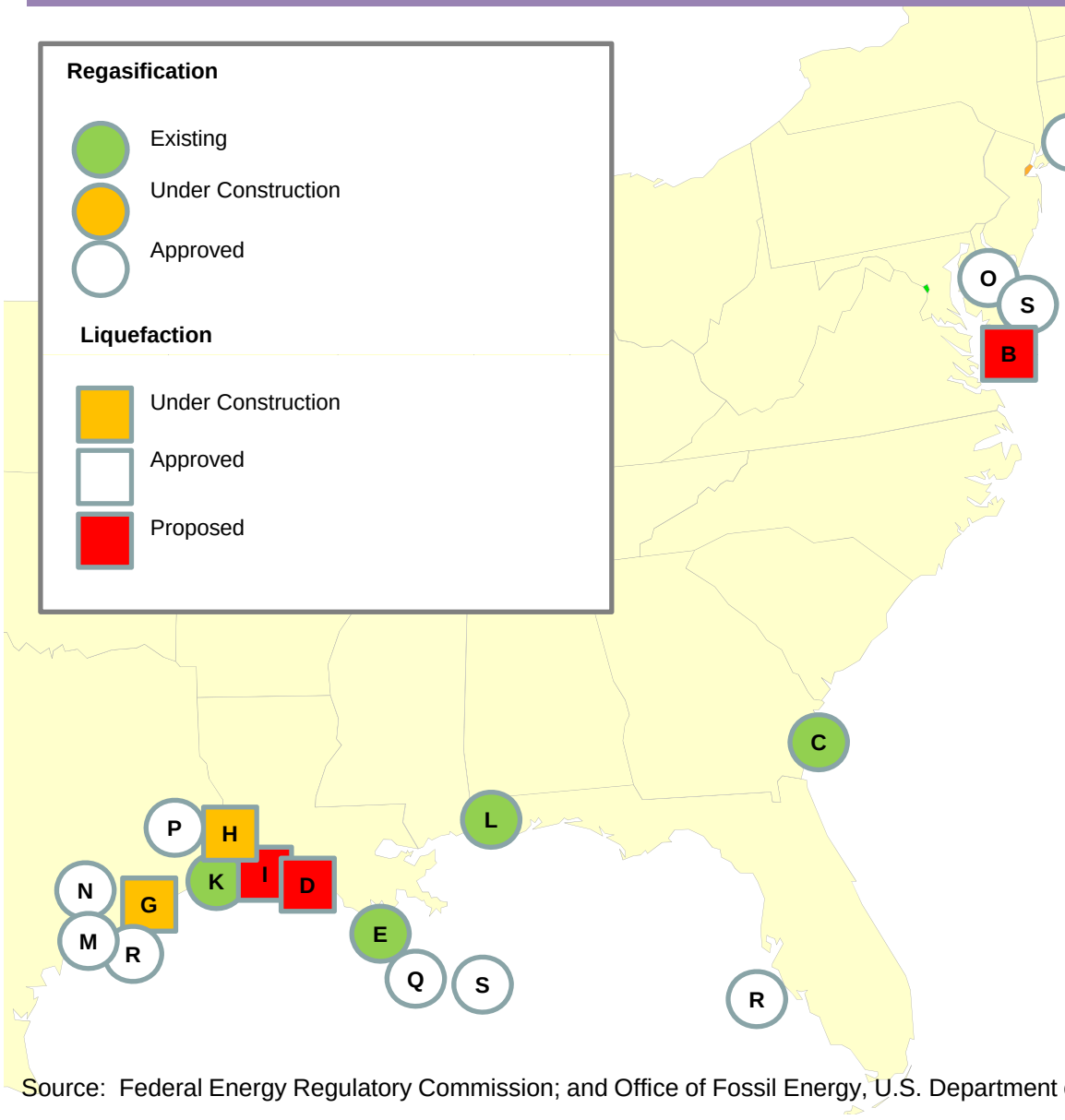
NGV consumption of natural gas is estimated to increase at an average annual rate of 7 percent through 2035. At best, this usage will be considerably less than 1 Tcf and slightly over one-half of one percent of total natural gas market.



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

New End Uses:
LNG and US Natural Gas Exports

Considerable Underutilized LNG Regasification Capacity along GOM



Existing Regasification

A. Everett, MA: 1.035 Bcfd
B. Cove Point, MD: 1.8 Bcfd
C. Elba Island, GA: 1.6 Bcfd (+0.5 Expansion)
D. Lake Charles, LA: 2.1 Bcfd
E. Energy Bridge, GOM: 0.5 Bcfd
F. Northeast Gateway, Offshore MA: 0.8 Bcfd
G. Freeport, TX: 1.5 Bcfd (+2.5 Expansion)
H. Sabine, LA: 4.0 Bcfd
I. Hackberry, LA: 1.8 Bcfd (+0.85 Expansion)
J. Neptune, Offshore MA: 0.4 Bcfd
K. Sabine Pass, TX: 1.0 Bcfd (+ 1.0 Expansion)
L. Pascagoula, MS: 1.0 Bcfd

Approved Regasification

M. Corpus Christi, TX: 2.6 Bcfd
N. Port Lavaca, TX: 1.0 Bcfd
O. Baltimore, MD: 1.5 Bcfd
P. LI Sound, NY: 1.0 Bcfd
Q. GOM Main Pass McMoRan: 1.0 Bcfd
R. Offshore Florida, Port Dolphin: 1.2 Bcfd
S. GOM, Bienville LNG: 1.4 Bcfd

Source: Federal Energy Regulatory Commission; and Office of Fossil Energy, U.S. Department of Energy.

LNG Value Chain

Feedstock (production) costs will be critical in determining the location of basin-specific production along the global LNG supply curve.



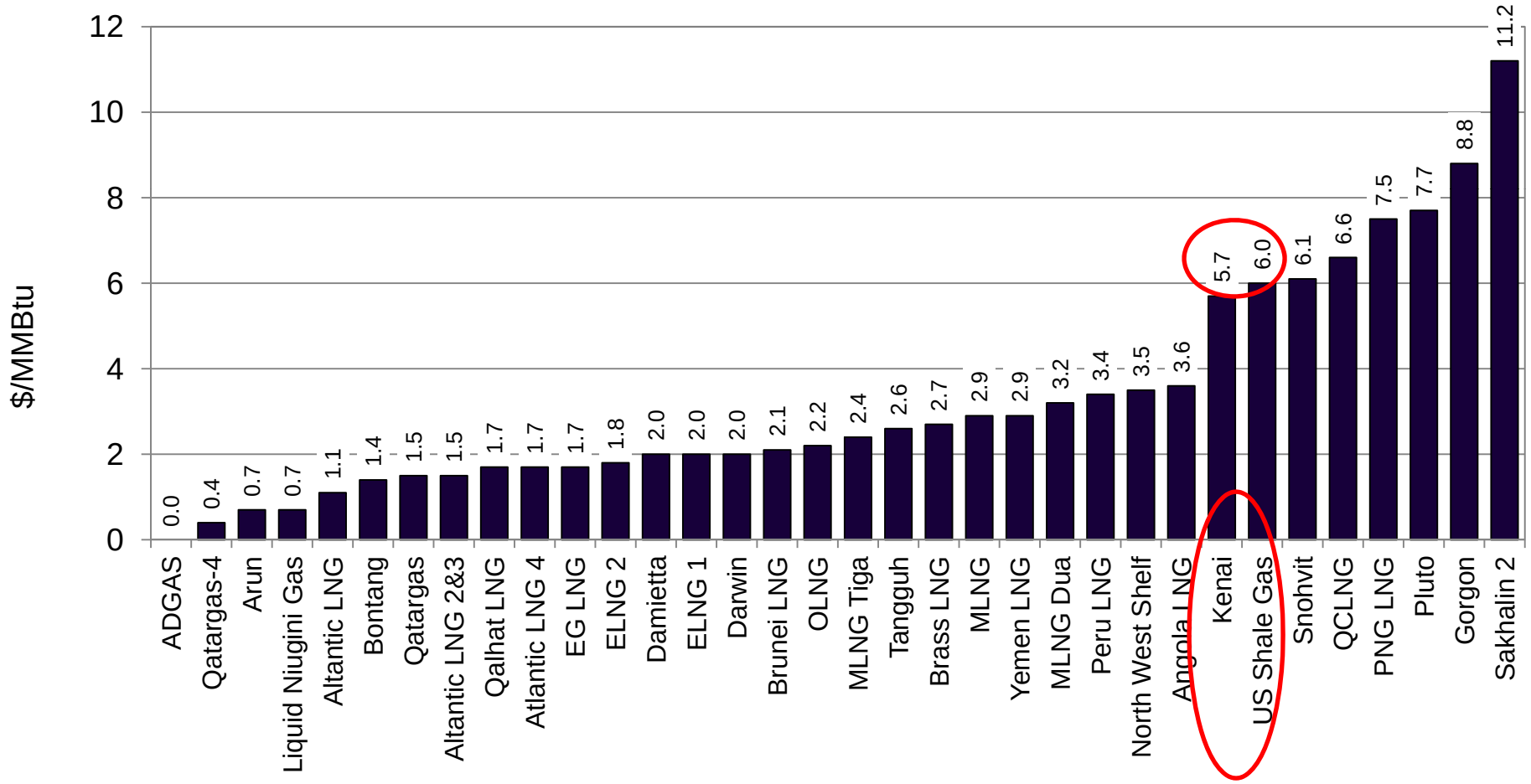

	Feedgas 56% ($/MMBtu)	Liquefaction 11%-17% ($/MMBtu)	Shipping & Fuel 20%-29% ($/MMBtu)	Regas 4%-7% ($/MMBtu)	Delivered Cost ($/MMBtu)	Equivalent Oil Price* ($/BOE)
Europe:						
Low	$4.00	$1.25	$1.40	$0.50	$7.15	$41.47
High	$6.50	$1.25	$1.65	$0.50	$9.90	$57.42
Asia:						
Low	$4.00	$1.25	$2.90	$0.50	$8.95	$51.91
High	$6.50	$1.25	$3.45	$0.50	$11.70	$67.86

Henry Hub:	WTI:
$4.50	$97.00
$5.00	$100.00

Note: *uses a BOE conversion of 5.8 Mcf/BOE.
Source: Cheniere.

FOB Gas Price Necessary to Yield 12 Percent Return (Atlantic Delivery)

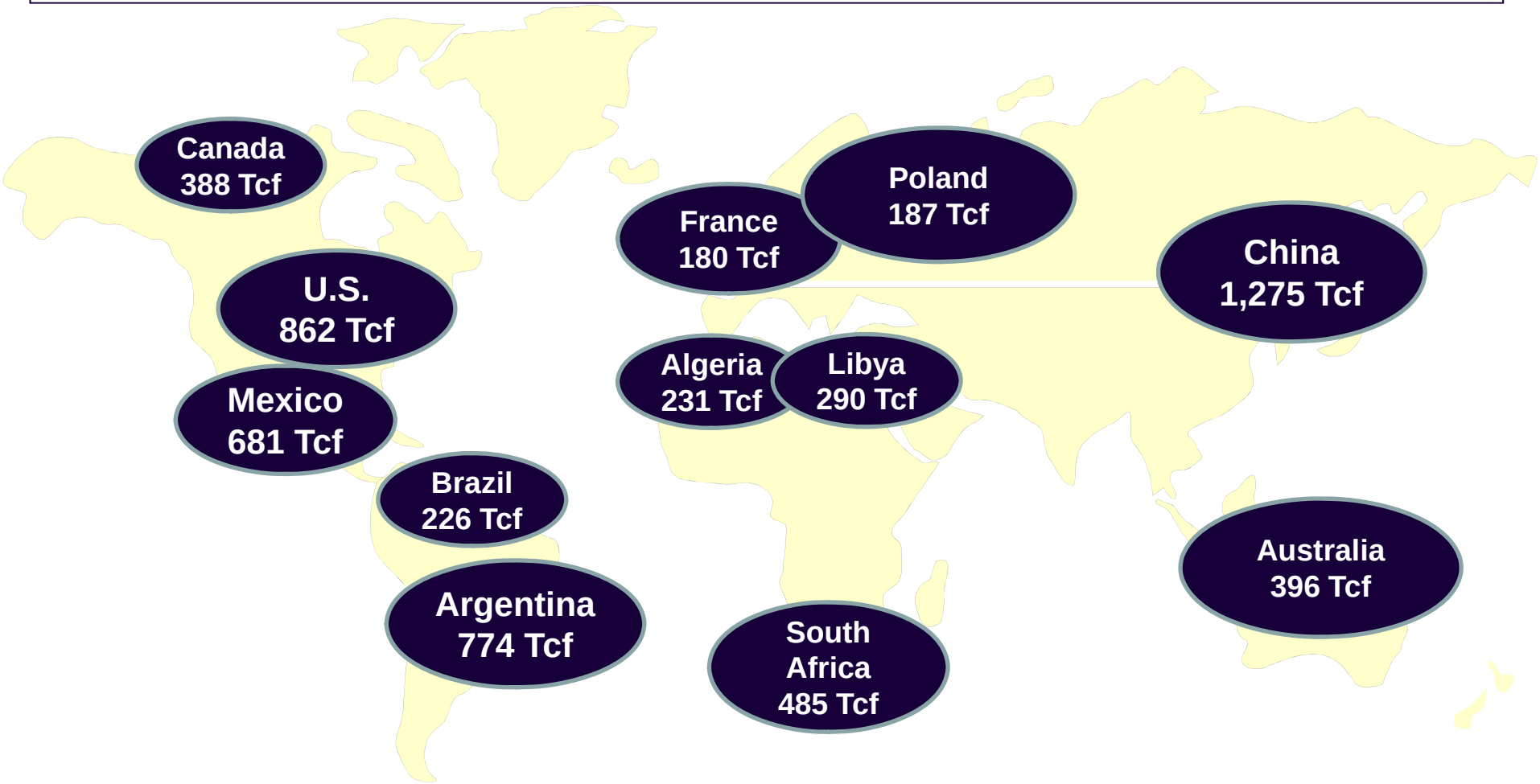
U.S. is likely to be at the upper end of the global LNG supply chain.



Source: Pacific LNG

Basin Competition

Close to 6,000 TCF of shale gas opportunities around the world. Coupled with 9,000 Tcf in conventional suggest a potentially solid resource base for many decades.



Source: MIT Energy Initiative.

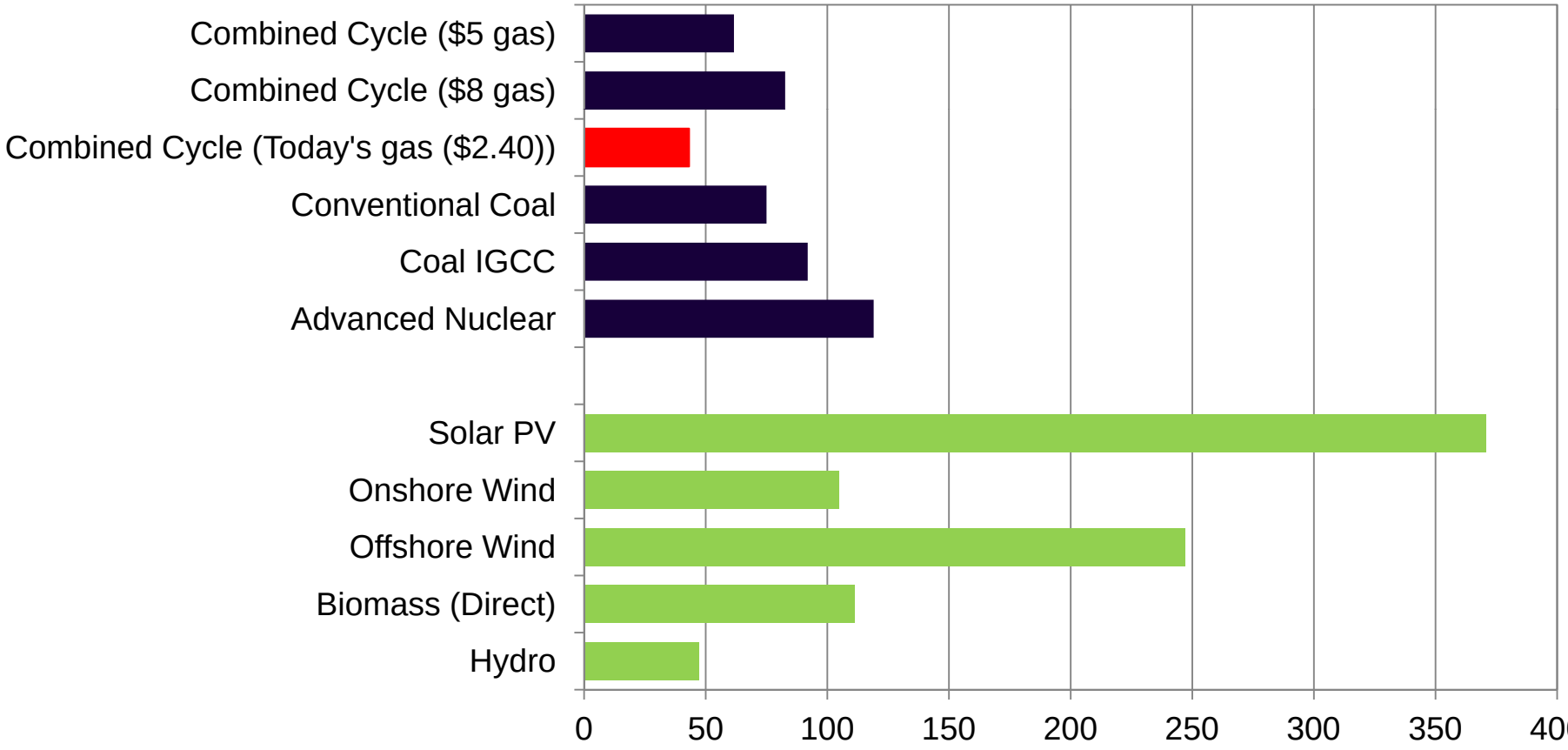
What About "Traditional" End-Uses: Power Generation?

Estimation of Capacity Costs

- **Future capacity costs are a function of needed capacity.**
- **The tighter the (capacity) market, the more likely capacity prices will rise to incent the development of new capacity.**
- **Can be incentives to understate capacity requirements that would/could arise from (1) load growth (2) EPA-induced retirements (3) below-expected renewable capacity development.**
- **Natural gas price decreases drive down an already lower-capital cost investment, with higher operating efficiencies and lower emissions. This creates a large cost differential between natural gas based generation and all other generation technologies (renewables AND other fossil/nuclear).**

Levelized Cost of Generation

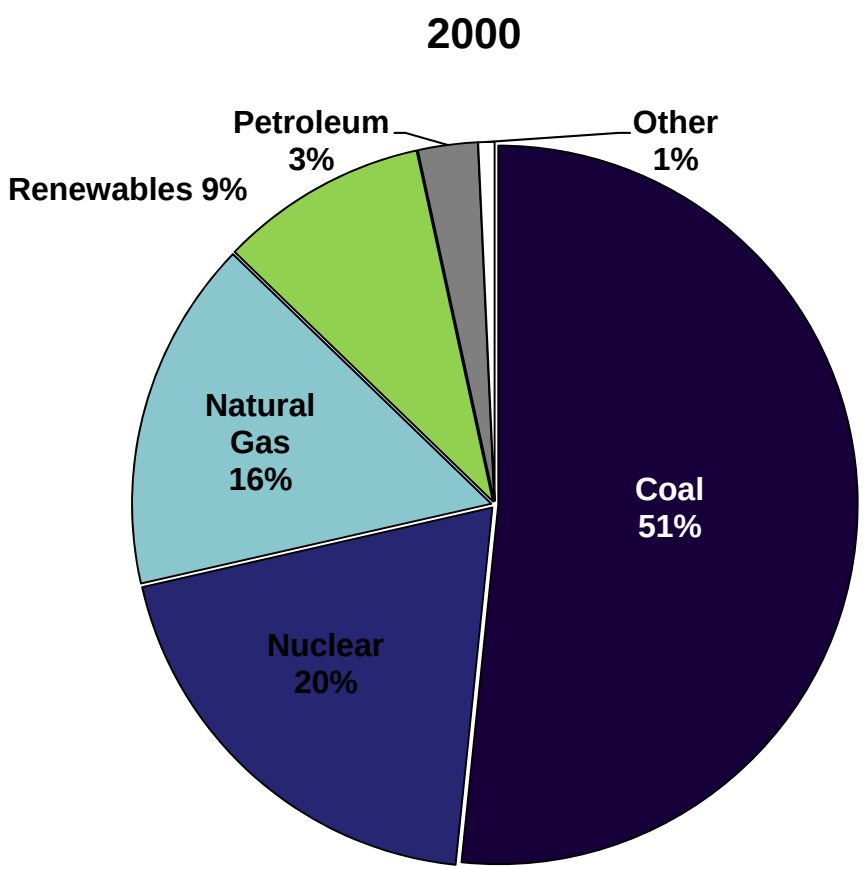
Lower gas prices move the levelized cost (and capacity cost) of the development of new, incremental capacity even lower.

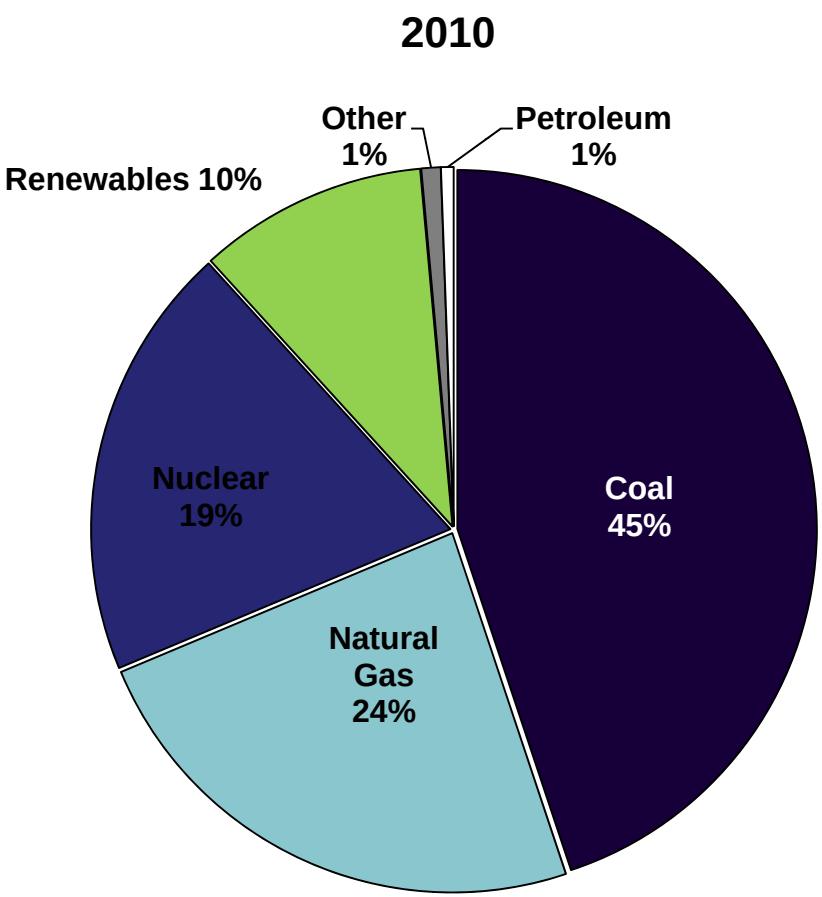


Source: U.S. Department of Energy, Energy Information Administration.

U.S. Power Generation – Fuel Mix

Over 250,000 MWs of natural gas power generation capacity has been added over the past decade at the expense of coal and nuclear. Gas will continue to be the marginal technology for a variety of reasons.

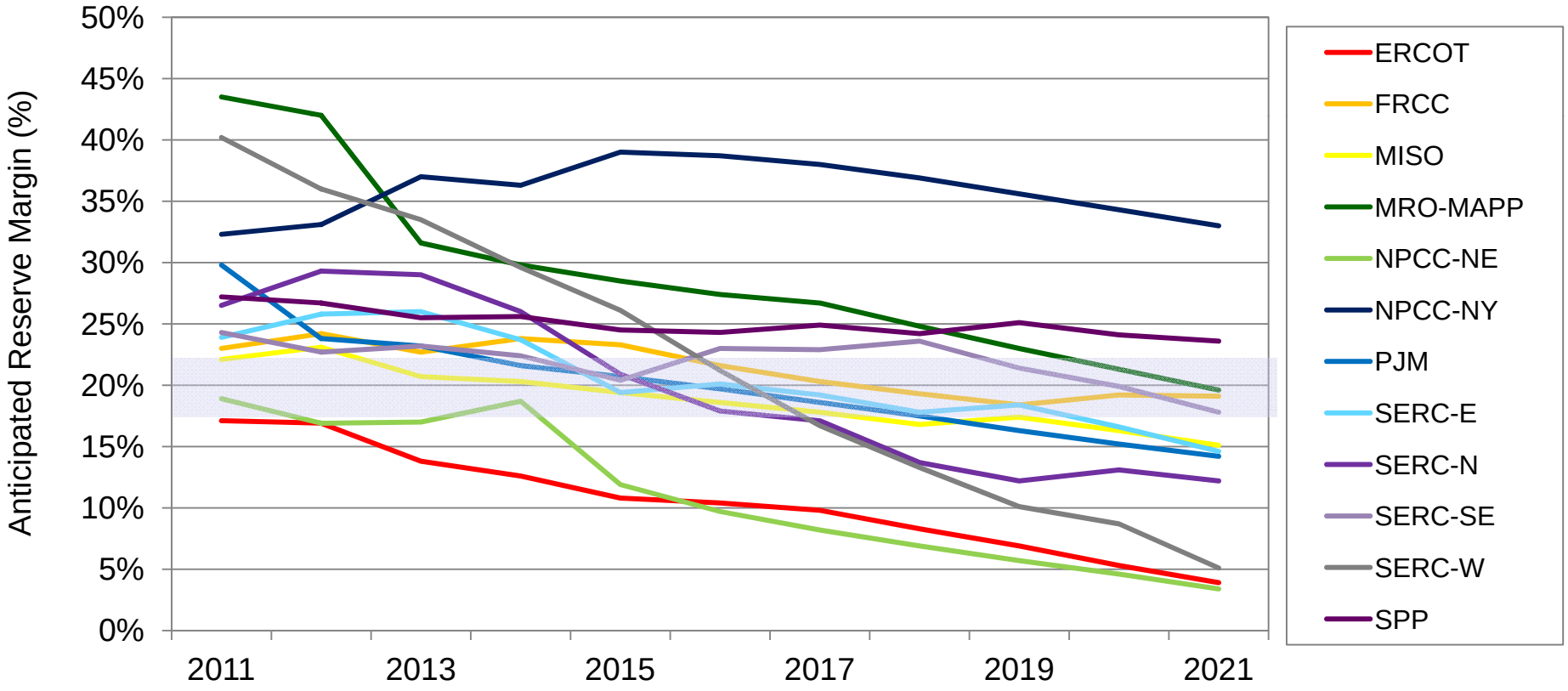




Source: Energy Information Administration, U.S. Department of Energy

Anticipated Planning Reserve Margins

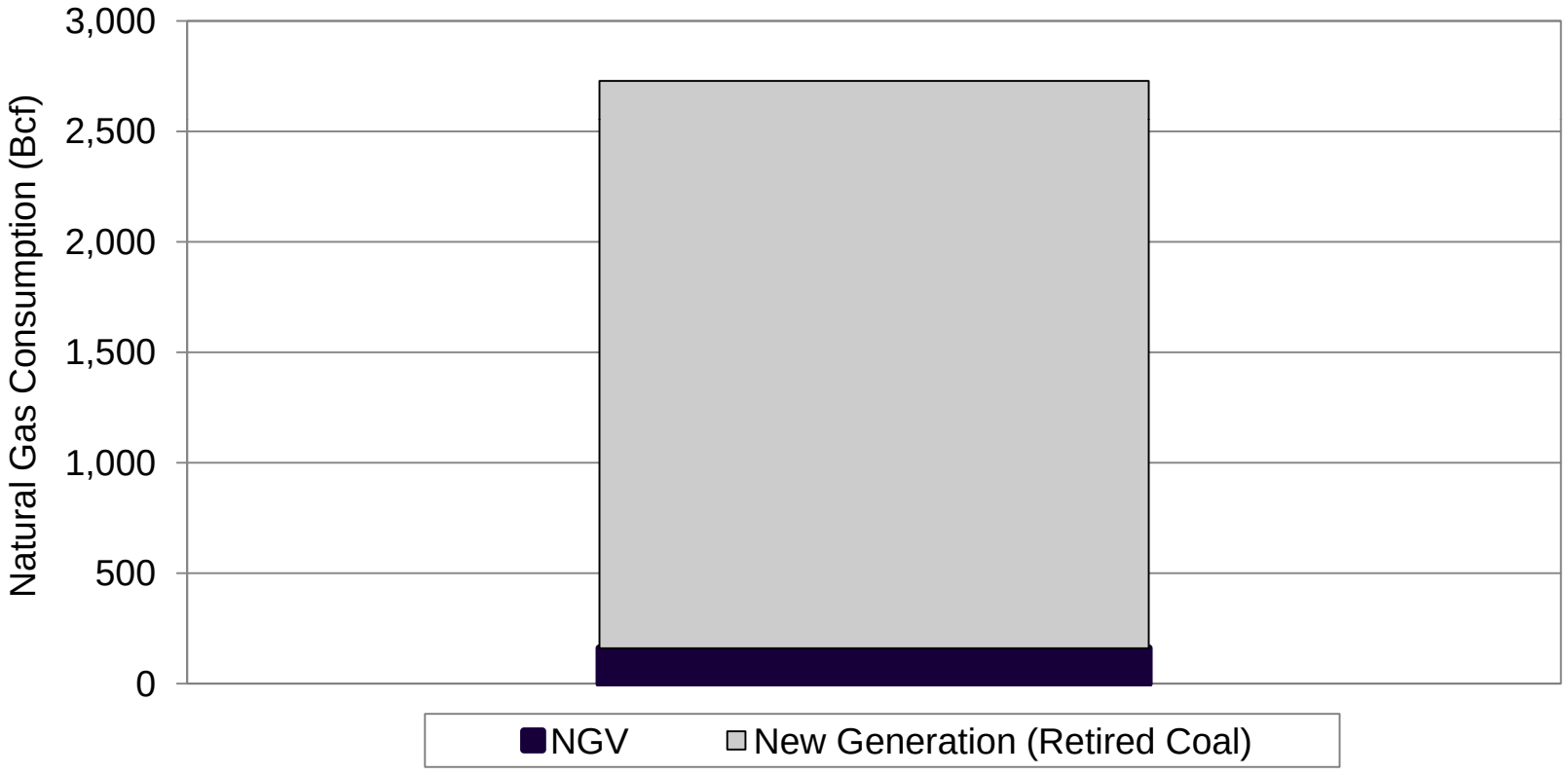
Most areas of the country are anticipating future reserve margins below those typically utilized for planning purposes.



Source: NERC 2011 Long-Term Reliability Assessment

Potential Natural Gas Consumption – New Generation Use (Retired Coal)

The retirement of 45 gigawatts of capacity would have considerably larger impact on natural gas markets than NGV and likely natural gas exports.

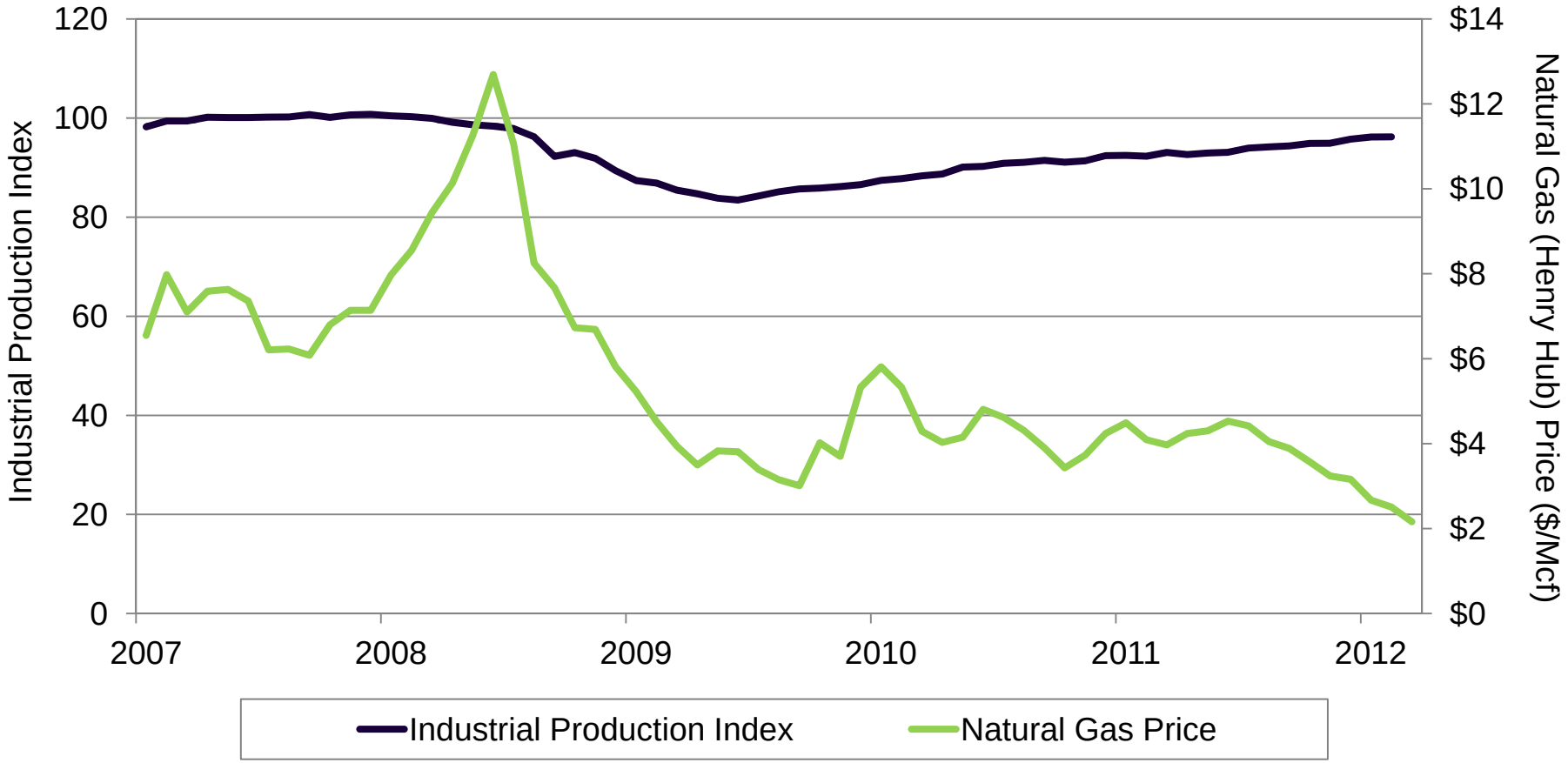


Note: Assumes 160 Bcf of NGV natural gas use. Also assumes retirement of 45 GW of coal-fired capacity, replaced with new natural gas generation with an 85 percent capacity factor and a 7,600 Btu/kWh heat rate.

American Natural Gas and the American Industrial Renaissance?

U.S. Industrial Production Index and Natural Gas Prices

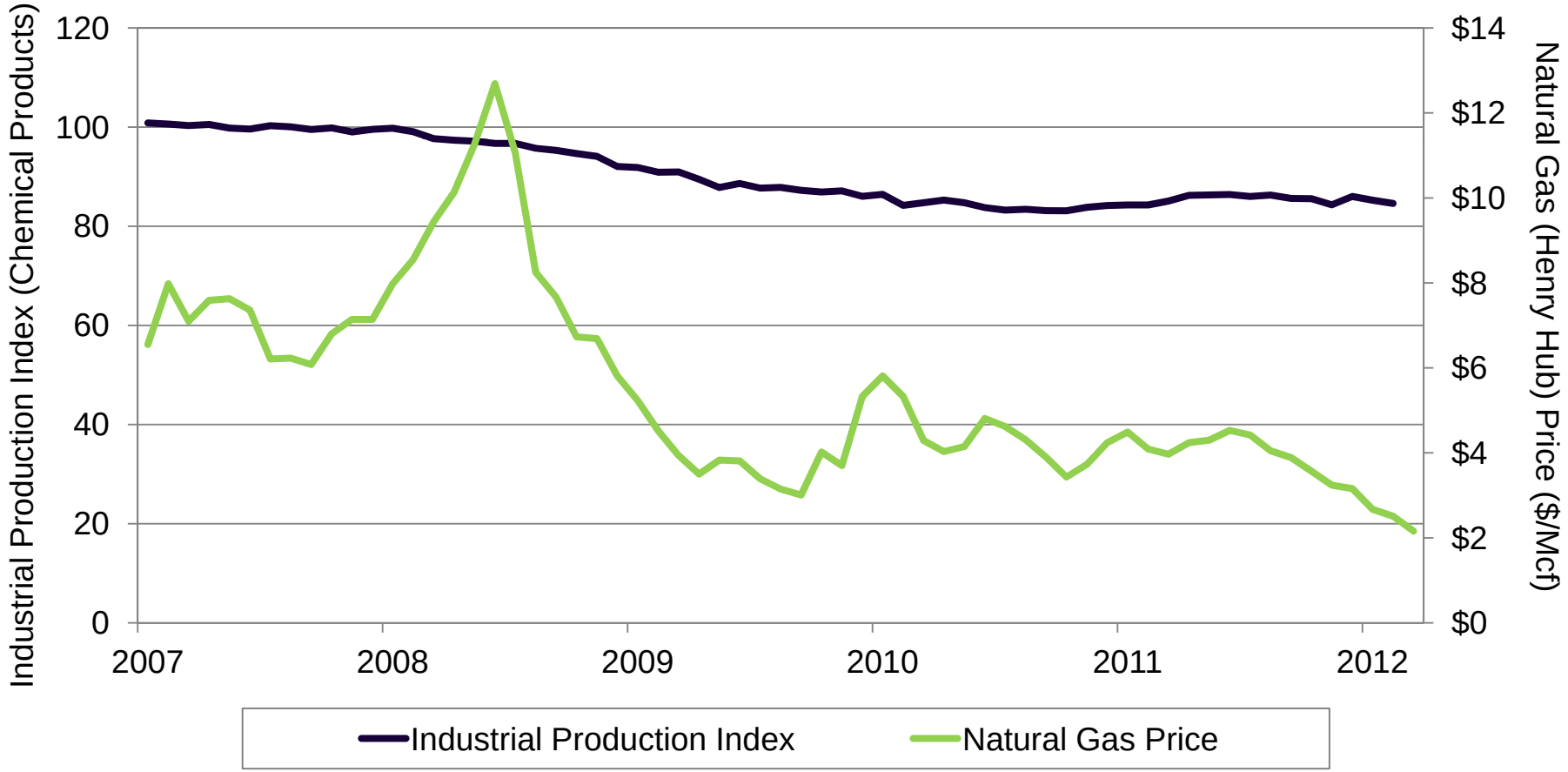
Industrial production showing significant strength. Low natural gas (energy) prices likely an important component for US manufacturing.



Source: Federal Reserve Bank

U.S. Industrial Production Index (Chemical Products) and Natural Gas Prices

Same trends holding in the chemical industry component of the US industrial production index. While these trends appear somewhat weaker, they mask future investment trends and announcements.



Source: Federal Reserve Bank

Recent Expansion Announcements

Sep-2011: Williams announced an expansion at its Geismar olefins production facility (Baton Rouge, LA). The expansion will increase the facility's ethylene production by 600 million pounds per year to a new annual capacity of 1.95 billion pounds and is expected to be in service by the third quarter of **2013**.

Apr-2011: Dow announced plans to increase its ethylene and propylene production, and to integrate its US operations into feedstock opportunities available from increasing supplies of US shale gas. Specifically, the Company plans to increase its ethylene supply and cracking capabilities at existing Gulf Coast facilities by:

- Re-starting an ethylene cracker at its St. Charles operations site near Hahnville, LA by the end of **2012**;
- Improving ethane feedstock flexibility for an ethylene cracker at its Plaquemine, LA site in **2014**;
- Increasing ethane feedstock flexibility for an ethylene cracker at the Freeport, TX site in **2016**;
- Constructing a new, world-scale ethylene production plant in the US Gulf Coast, for startup in **2017**.

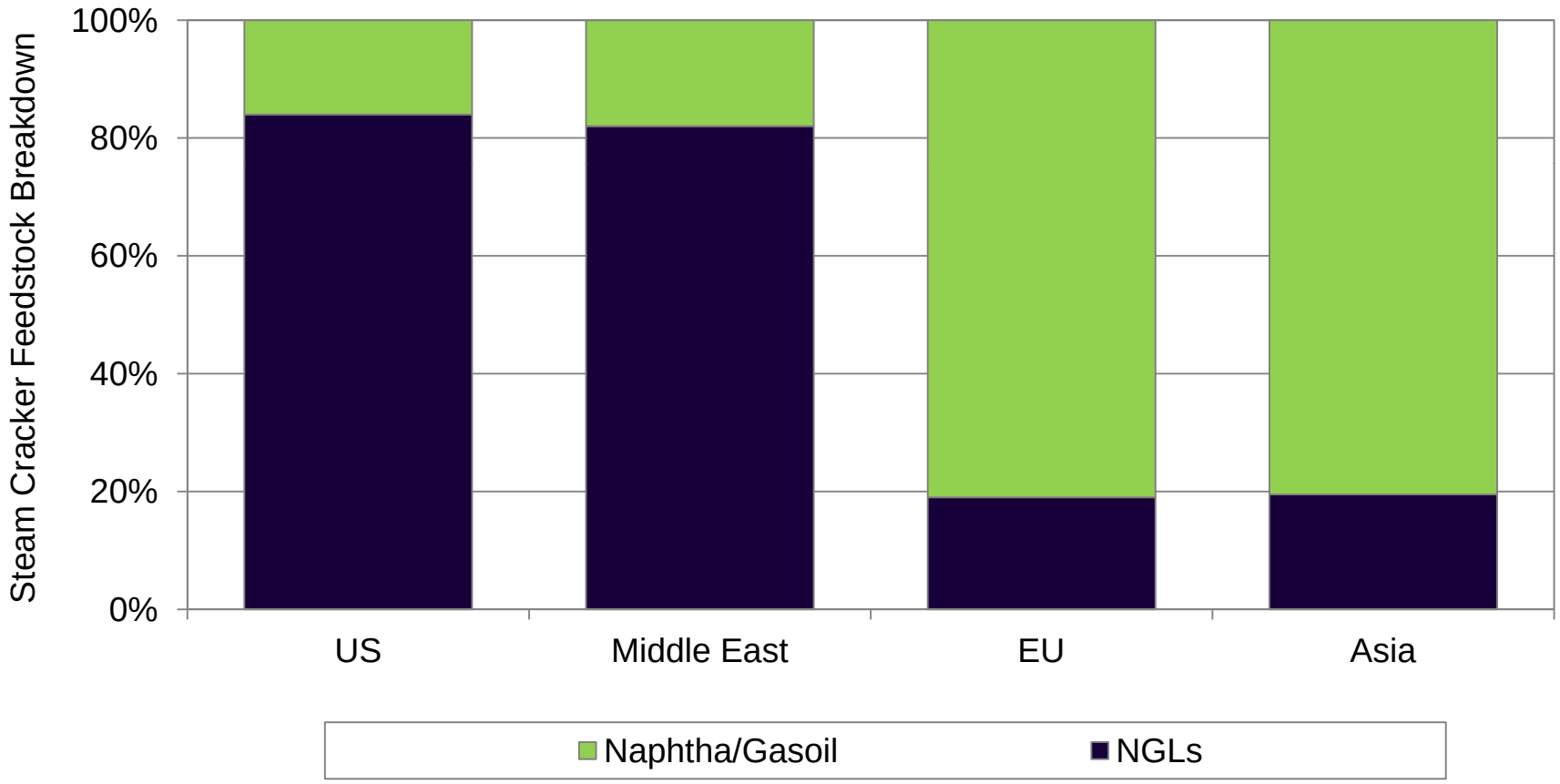
Apr-2011: Westlake Chemical Corporation announced an expansion program to increase the ethane-based ethylene capacity at Lake Charles, LA, and the evaluation of expansion options and the upgrade of ethylene production facilities at Calvert City, KY in order to capitalize on new low cost ethane and other "light" feedstocks being developed.

Mar-2011: Chevron Phillips Chemical announced it is advancing a feasibility study to construct a "world-scale" ethane cracker and ethylene derivatives at one of its existing facilities in the Gulf Coast region. The new facility would utilize the advantaged feed sources expected from development of shale gas reserves.

Dec-2010: Sasol announced plans to construct the world's first commercial tetramerization unit, capable of producing over 100,000 metric tons per year of combined 1-octene and 1-hexene, at its existing Lake Charles, LA Chemical Complex.

Global Steam Cracker Feedstock Breakdown by Region

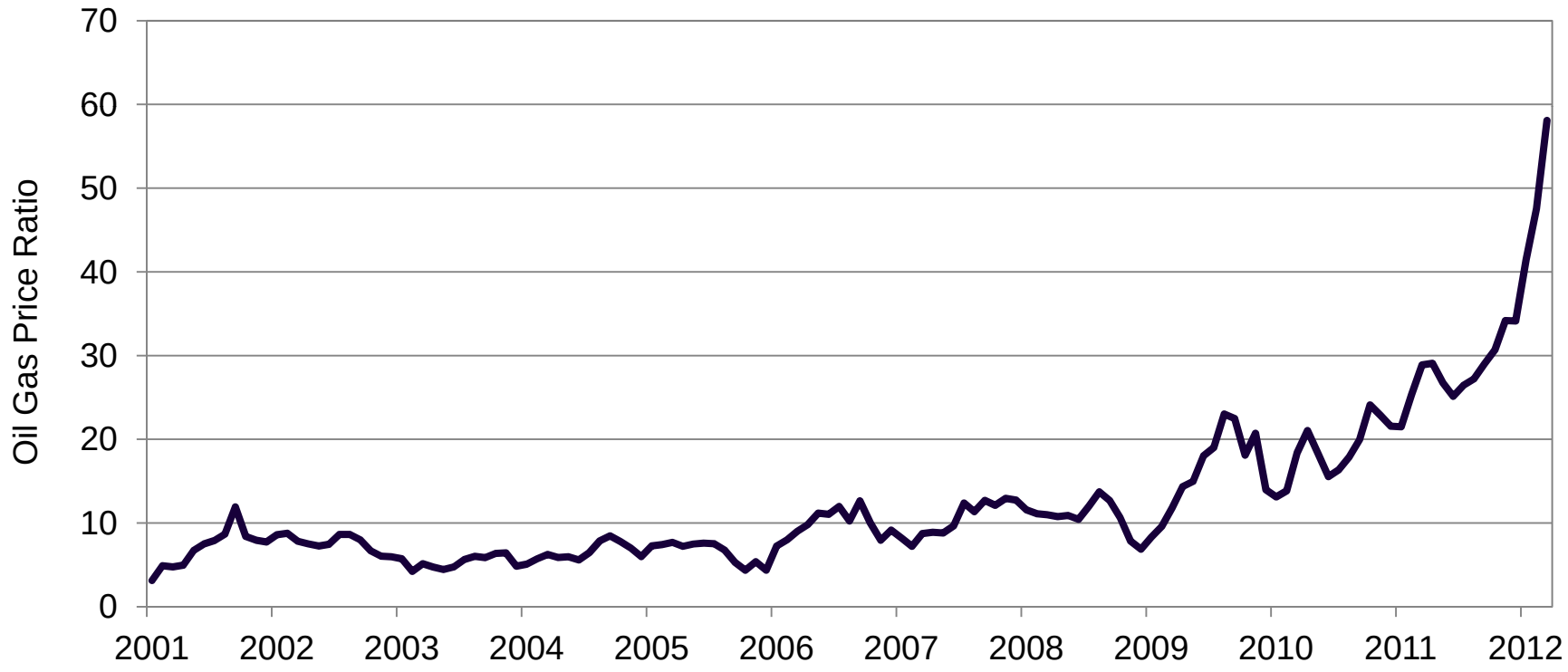
US chemical industry reliance on NGLs creates significant competitive advantage motivating these announcements.



Note: Figure is estimated and for illustrative purposes only.
Source: Navigant Consulting Inc., NGMarket notes, April 2012.

Oil Gas Price Ratio Curve

Increase in oil/gas price ratios also help leverage the opportunities for transforming natural gas to liquid fuels. Two announcements along GOM (Sasol, Shell) already made – billions in investment.



Source: Federal Reserve Bank of St. Louis; and Energy Information Administration, U.S. Department of Energy.

Is There Room of Residential Growth? What Happened to Natural Gas as An Efficiency Measure?

Retail Markets and Use

- New natural gas supply availability is having considerable impacts on all energy markets today and on longer term, forward-looking basis.
- Given the prevalence of natural gas at the margin, this impacts not just retail gas usage, but also power, renewables and environmental valuations.
- Lower gas commodity will also drive down gas as a share of total bill and start to move base rate/commodity cost relationships to longer-run averages.
- If avoided costs (future looking costs) are not re-calibrated to reflect these market changes, it could result in higher-than-cost effective energy efficiency and renewable energy being adopted.

Marginal Costs/Avoided Costs

Marginal cost – the change in total cost resulting from an extremely small change in output. Typically thought of in the short run, although long run marginal costs can be important for planning purposes.

Avoided costs – the real world estimate of long run marginal costs where all factors of production (or inputs such as capital/capacity and other variable costs) are variable.

Important in long run resource planning evaluation as well as evaluation of renewable energy resources and energy efficiency measures.

State Energy Efficiency Policies

WA: pursue all cost effective conservation: ~10% by 2025

OR: 1% annual savings by 2013

CA: save 1,500 MW, 7,000 GWh; reduce peak 1,537 MW: 2010-12

NV: 0.6% annual savings (~5%) to 2015; EE to 25% of RPS

CO: save 3,984 GWh, 2012-20; reduce peak 5% by 2018

AZ: at least 22% cumulative savings by 2020; peak credits

NM: 10% retail electric sales savings by 2020 .

OK: EE 25% of renewable goal

TX: reduce 30% annual growth; 0.4% winter and summer peaks beginning in 2013

HI: 4,300 GWh electricity reduction (~40% of 2007 sales by 2030)

MN: 1.5% annual savings to 2015

IA: 1.5% annual; 5.4% cumulative savings by 2020

WI: 1.5% electric savings and peak reductions by 2014

MI: 1% annual savings by 2012

IL: 2% energy reduction, by 2015; 1.1% from 2008 peak by 2018

IN: 2% energy savings by 2019

OH: 22% energy savings by 2025 ; 7% peak by 2018

ME: 30% reduction and 100 MW peak by 2013

VT: ~6.75% cumulative savings, 2009-2011 summer and winter peak reduction targets

MA: 2.4% annual electric savings by 2012

NY: reduce electric use 15% by 2015

CT: 1.5% annual savings, 2008-2011

RI: reduce consumption 10% by 2022

DE: reduce consumption and peak 15% by 2015

PA: reduce consumption 3%; peak 4.5% by 2013

MD: reduce electricity use and peak 15% by 2015

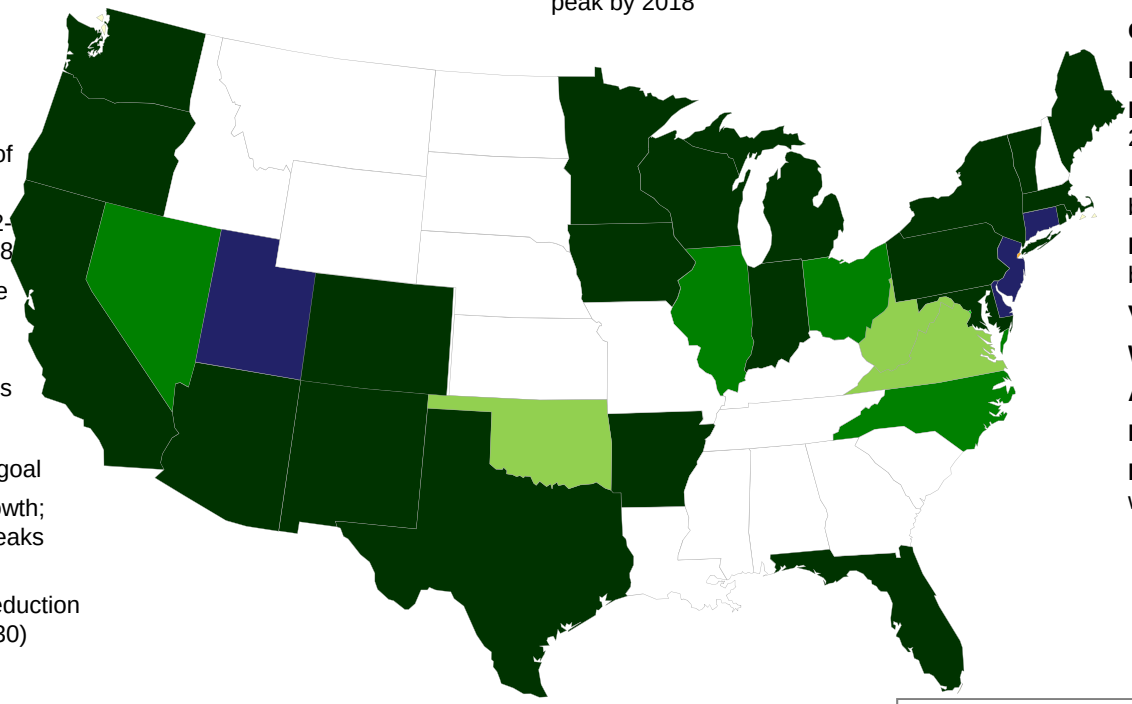
VA: reduce electric use 10% by 2022

WV: EE & DR earn credits in A&RES

AR: 0.75% electricity savings by 2013

NC: EE to meet up to 25% of RPS by 2011

FL: 3.5% energy savings and summer and winter peak reductions by 2019

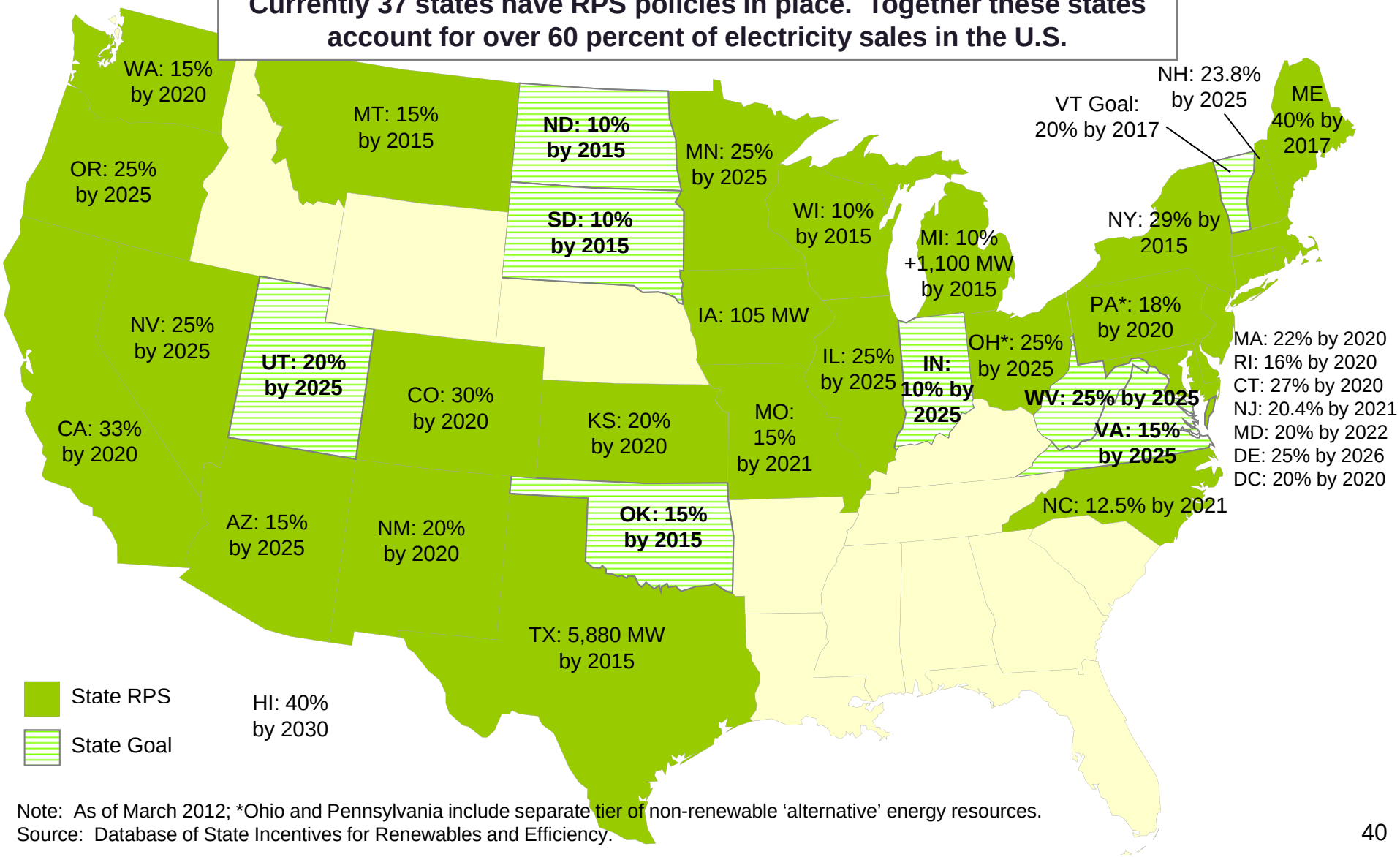


- EERS by regulation or law (stand-alone)
- EE in RPS (hybrid)
- EE in renewable goal
- EE regulations pending

Note: As September 13, 2011.
Source: Federal Energy Regulatory Commission.

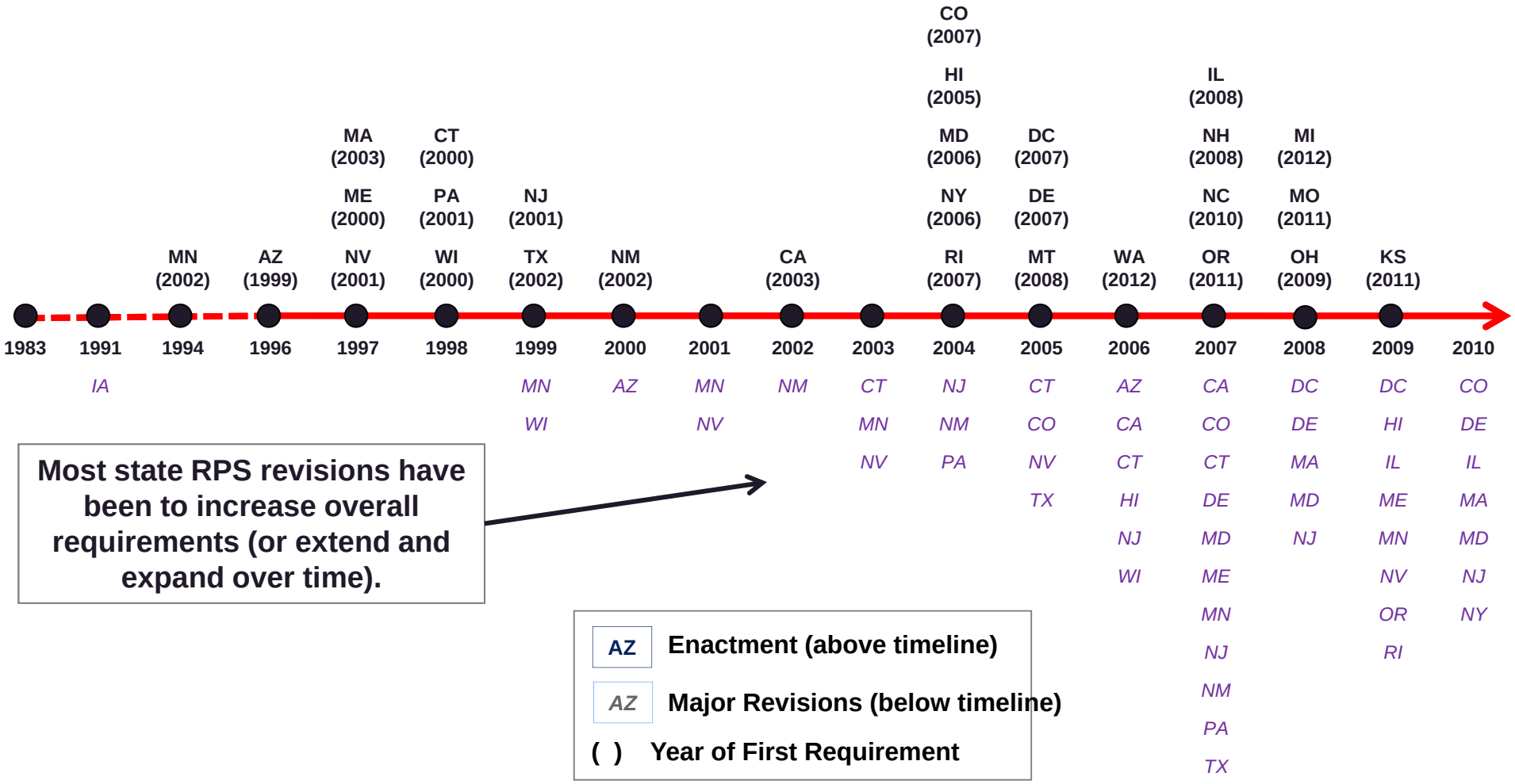
RPS States

Currently 37 states have RPS policies in place. Together these states account for over 60 percent of electricity sales in the U.S.



Note: As of March 2012; *Ohio and Pennsylvania include separate tier of non-renewable 'alternative' energy resources.
Source: Database of State Incentives for Renewables and Efficiency.

RPS State Adoption and Revisions



Most state RPS revisions have been to increase overall requirements (or extend and expand over time).

AZ **Enactment (above timeline)**

AZ **Major Revisions (below timeline)**

( ) Year of First Requirement

Source: Ryan Wiser, State of the States: Update on RPS Policies (2010).

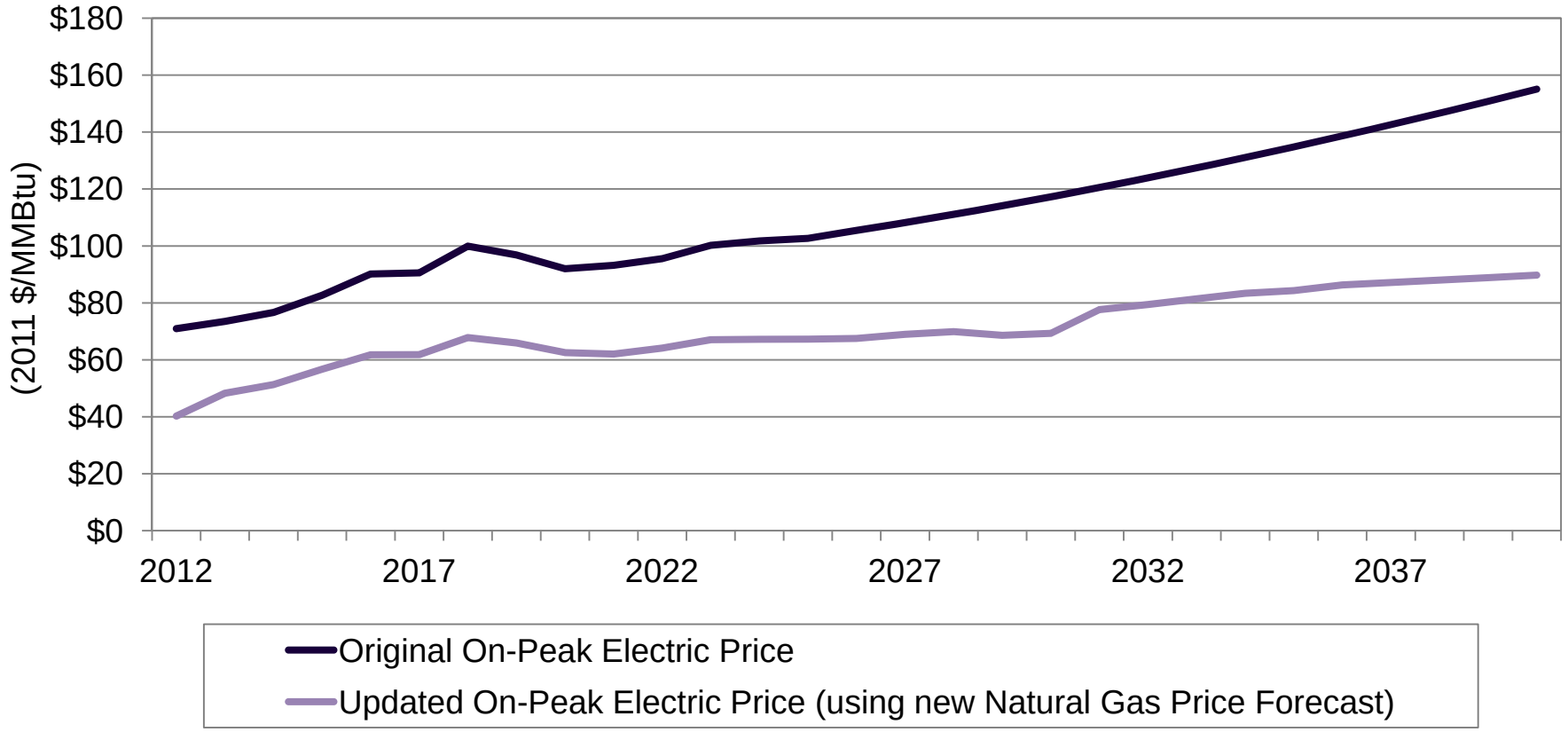
Longer Run Renewable Impacts

- **Renewable energy business is starting to recognize many of the hard lessons learned by merchant generators over a decade ago (i.e., contracts matter, spot market prices can fall).**
- **Second-phase RE development challenges include:**
  - **A. Natural gas generation back-up (capacity, efficiency).**
  - **B. Power transmission development and investment.**
  - **C. Cost and implications of over-incenting investment.**
  - **D. Natural gas prices, RECs, SRECs, and other RE credit prices.**

(A) + (B) + (C) + (D) = HIGHER COSTS

Changing Forecasted Natural Gas Prices Impact on Electric Price

Updated forecasts can have a considerable impact on the forecasted avoided cost. Energy costs often account for a sizable share of overall avoided cost.



Source: Avoided Energy Supply Cost, 2011 Report

Conclusion

Conclusions

- **Energy policies, up to and including those associated with natural gas development, driven a lot by politics, expectations, and other factors. Economics and geology, to date, support robust development and supplies. There should be room at the table for everyone.**
- **Regulator and large user concerns that this is a resource that has large risks and cannot be counted upon, despite, what is a clear three to four year solid production and reserve development run that consistently beats expectations.**
- **Continued need to address (1) the "bread and butter" end uses and (2) the likelihood (unlikelihood) of the "déjà vu all over again" outcomes in natural gas markets.**
- **There are solutions to these problems, and for traditional end-uses, those solutions may rest with the acknowledging and placing contractual value on capacity (reserves).**

Questions, Comments and Discussion

dismukes@lsu.edu

www.enrg.lsu.edu