



# Trends, Issues and Market Changes for Crude Oil and Natural Gas

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Syngenta*

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Center for Energy Studies

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**Summary and Take Away**

- **New natural gas supply availability is having considerable impacts on all energy markets today and on longer term, forward-looking basis.**
- **Shale revolution is now migrating into liquids and crude oil production. Facilitating additional natural gas production despite low prices.**
- **Considerable economic development opportunities.**
- **Early in the process, considerable uncertainties, considerable risks, difficult to attain information, play understandings still very preliminary – policy need to manage expectations despite the (justified) excitement.**

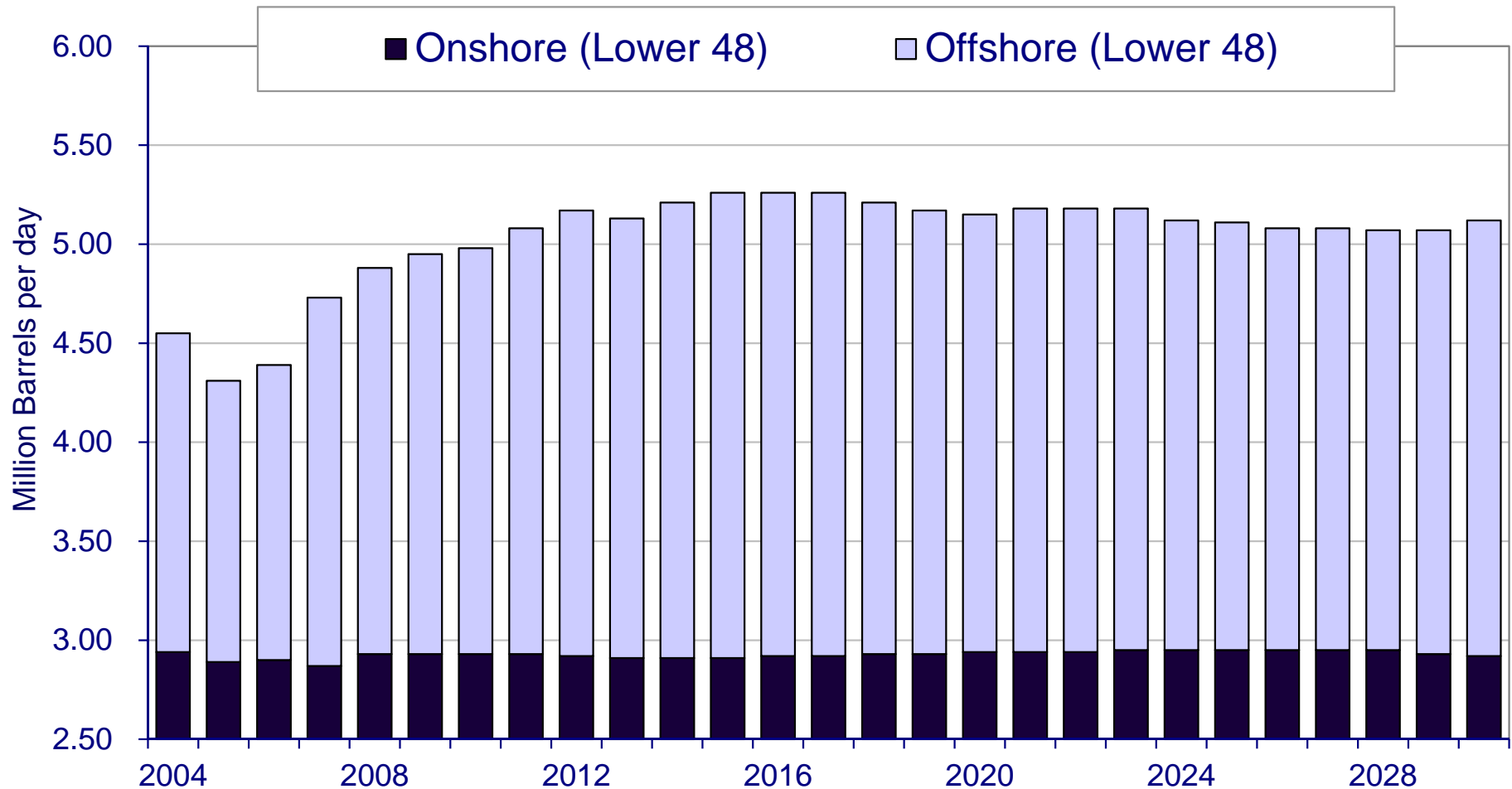


**Reminder – The Way Things Were**



Long Term US Crude Oil Production Forecast (2006)

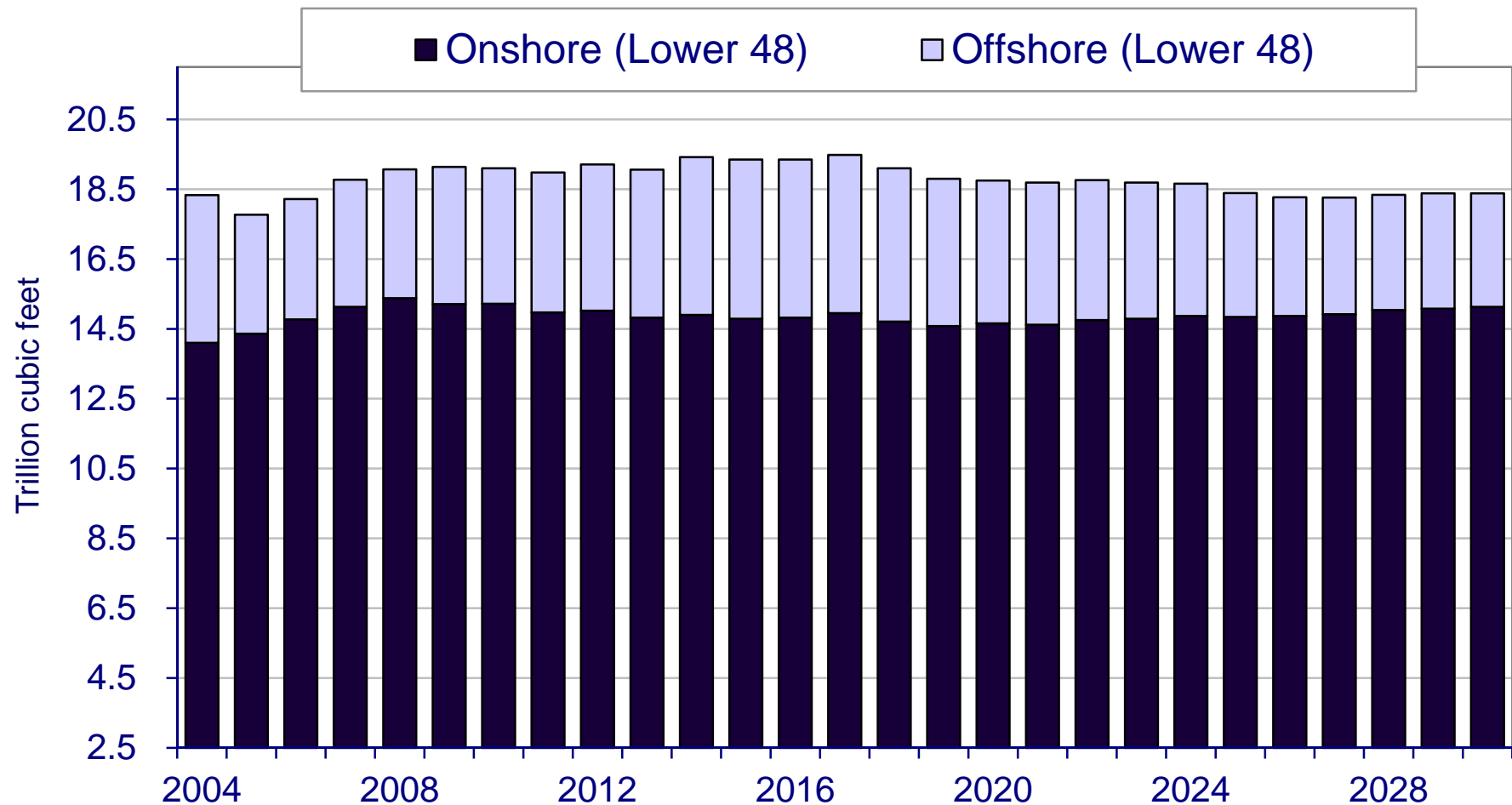
**Relatively uninspiring U.S. crude oil production forecast.**





Long Term US Natural Gas Production Forecast (2006)

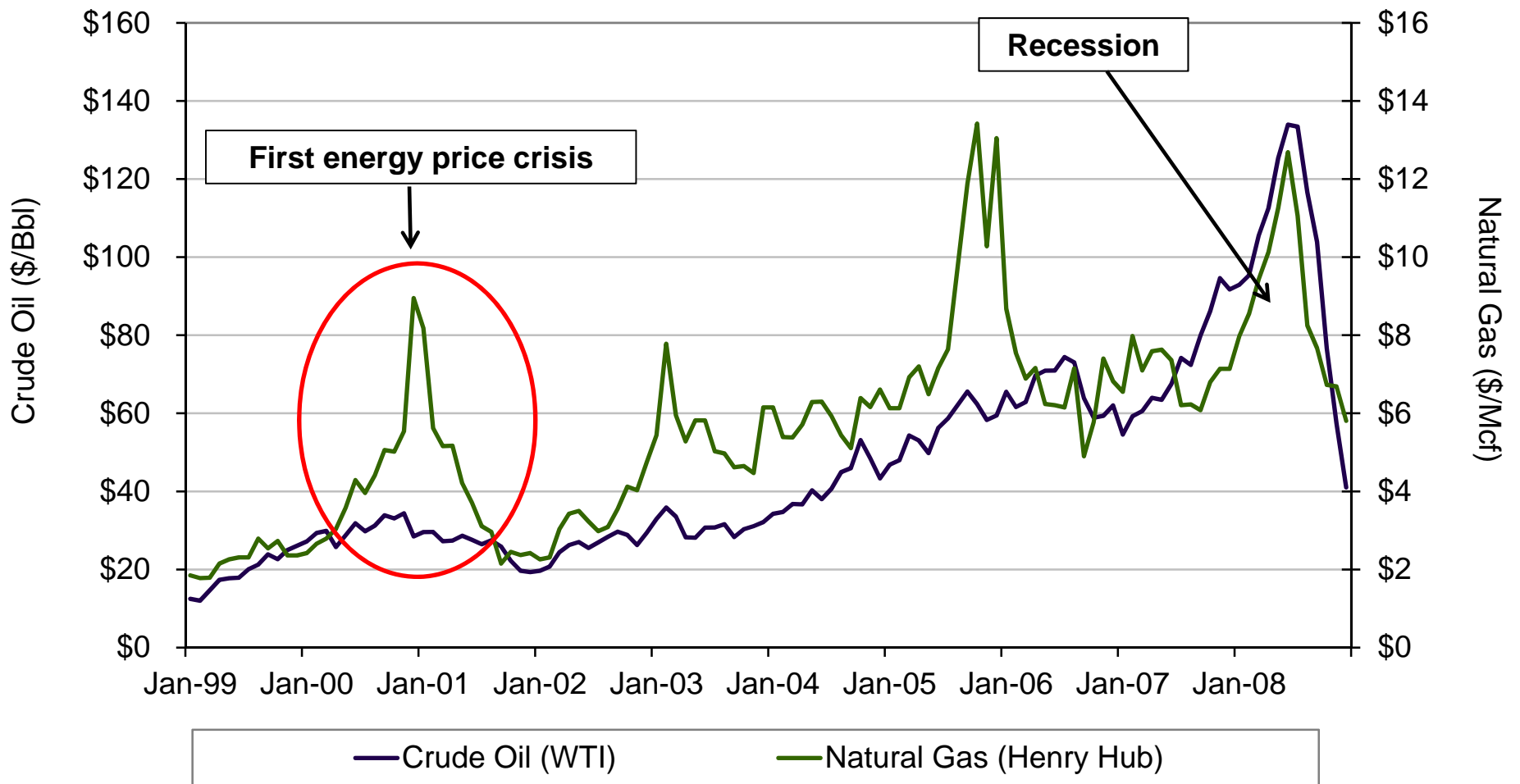
**Natural gas production forecasted to decrease starting in 2016.**





Crude Oil and Natural Gas Prices

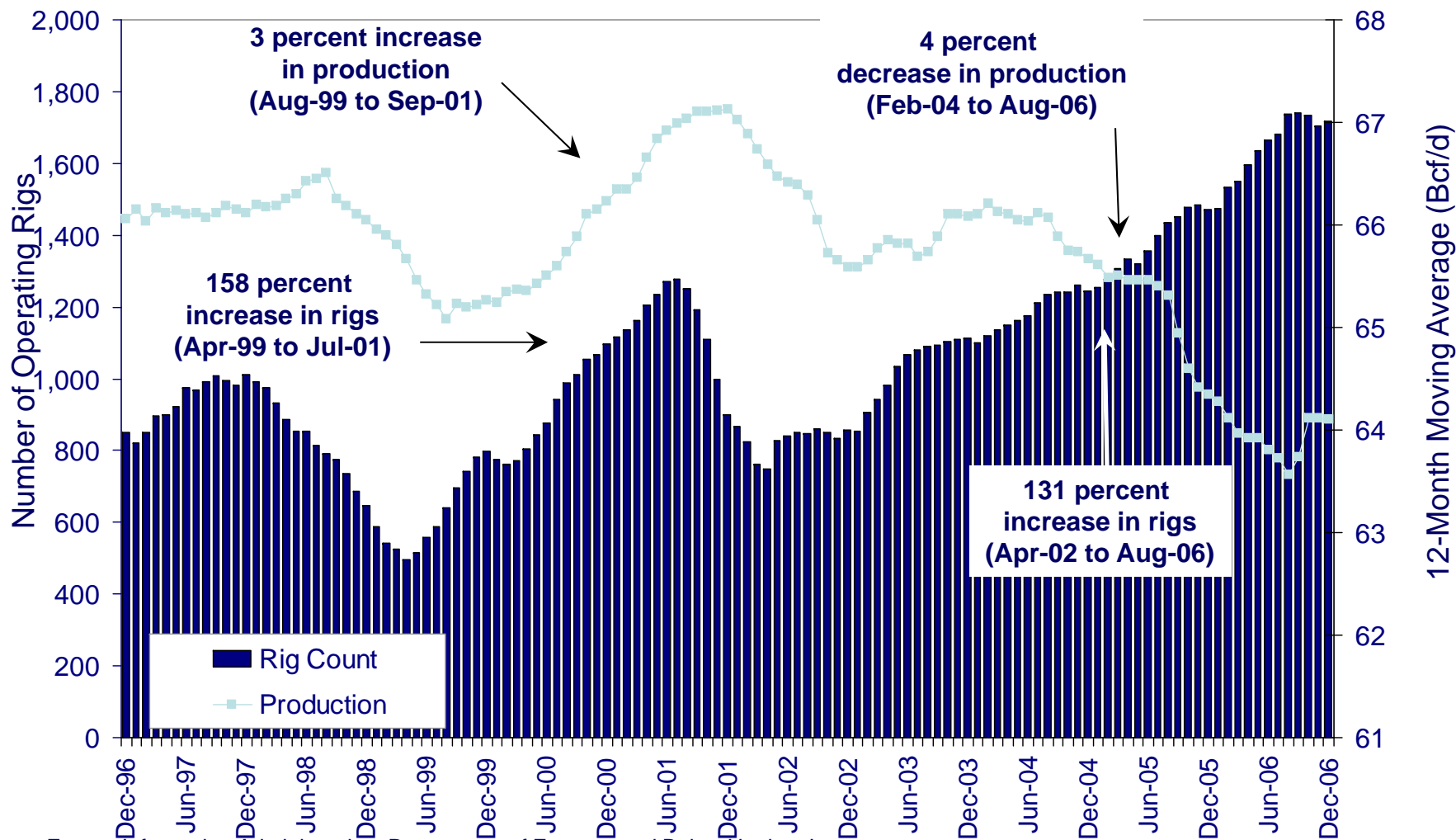
Prices reflected the state of, and outlook for, energy markets.





Historic Monthly Rig Counts and Gas Production (1997-2006)

The maturing nature of US basins reflected in drilling productivity.

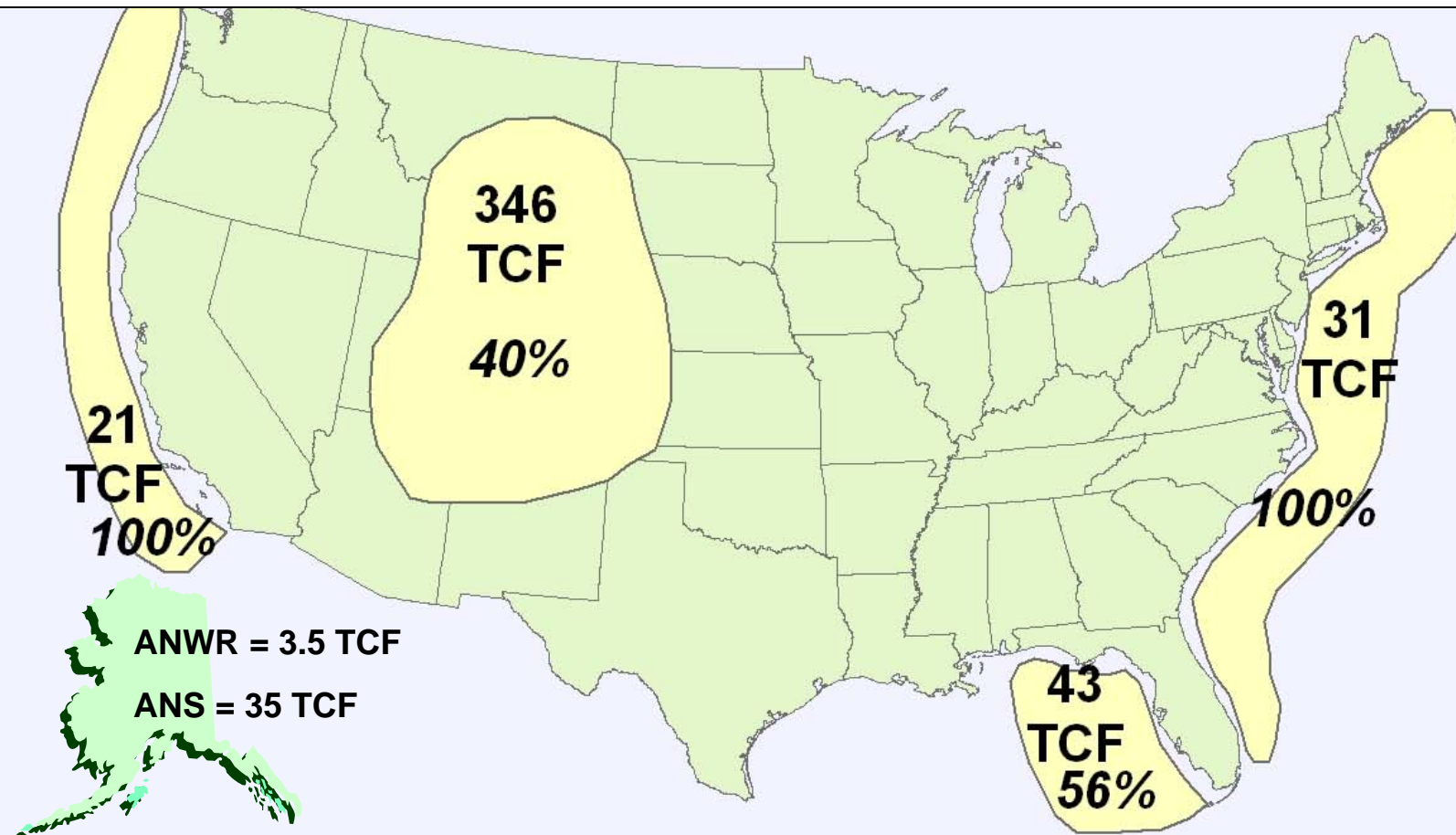


Source: Energy Information Administration, Department of Energy; and Baker-Hughes Inc.



**Resource Estimates: Restricted Areas (Percent Restricted)**

**Policy advocacy focused on restricted areas as a potential solution to the resource constraint problem.**



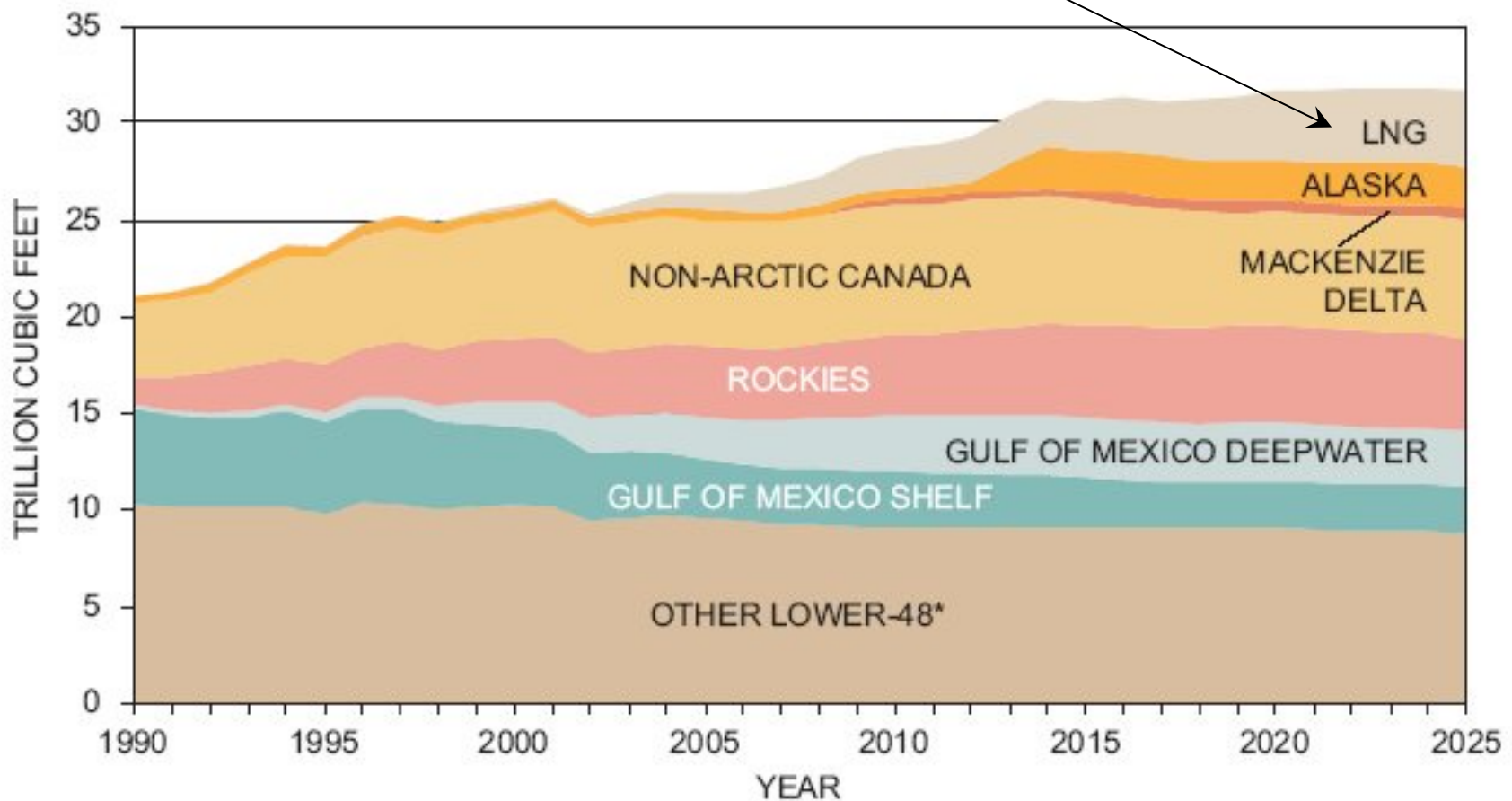
Source: Natural Gas: Can We Produce Enough? Independent Petroleum Association of America, website: <http://www.ipaa.org/govtrelations/factsheets/NaturalGasProdEnough.asp>.





NPC Forecast North American Supply Disposition

**LNG provides 14% of the U.S. supply of natural gas by 2025.**



\* Includes lower-48 production, ethane rejection, and supplemental gas.

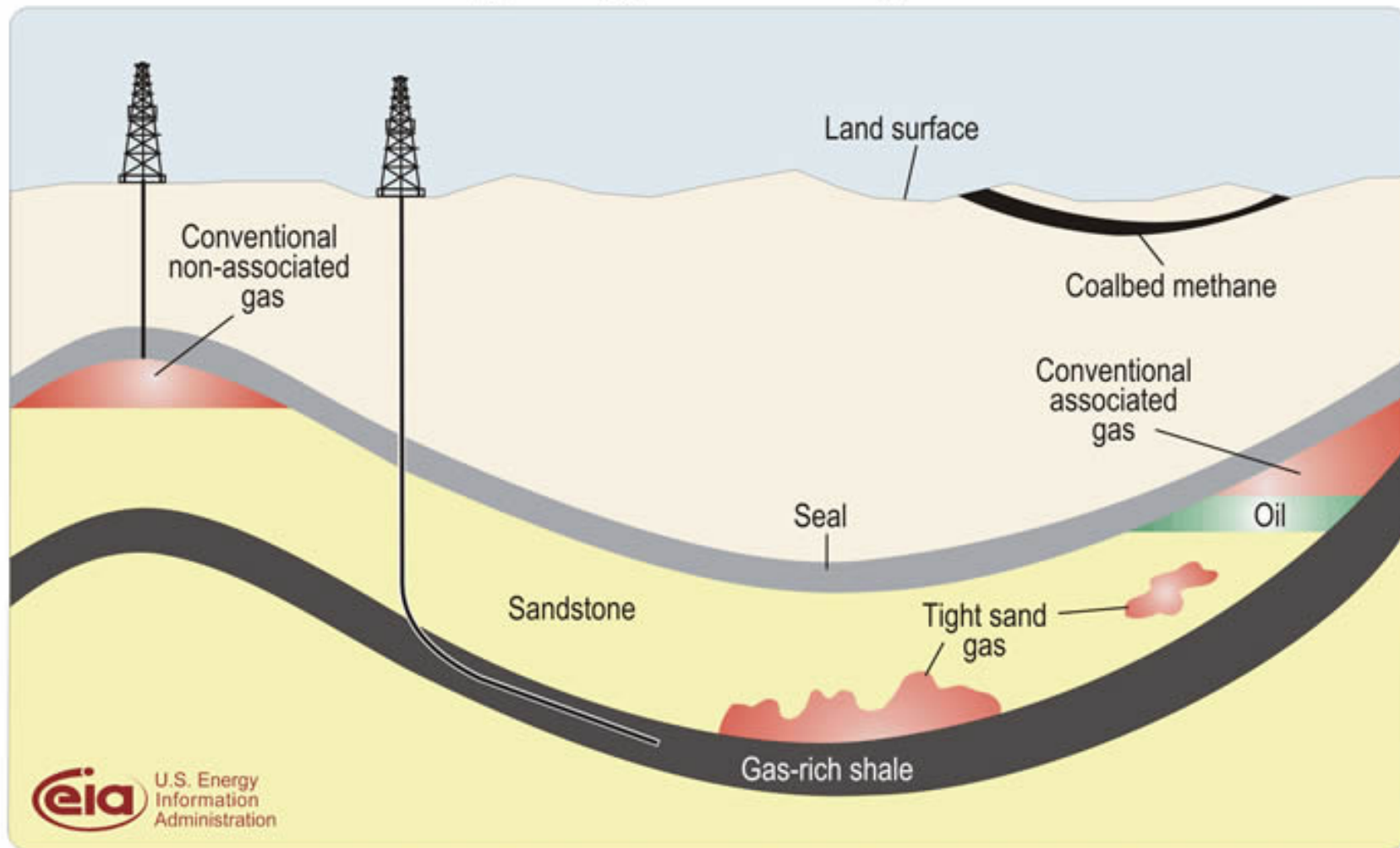


## **What Changed? The Way Things Are**



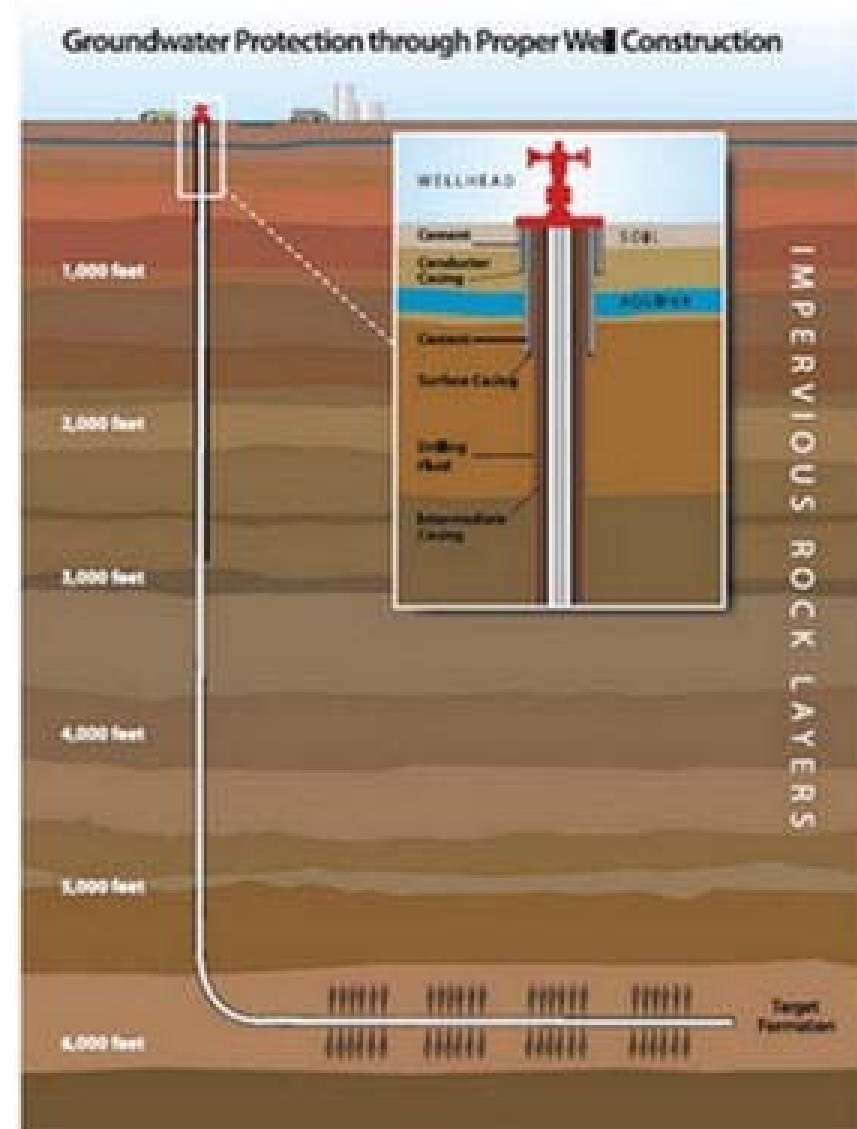
Unconventional vs. Conventional Geological Formations

Schematic geology of natural gas resources



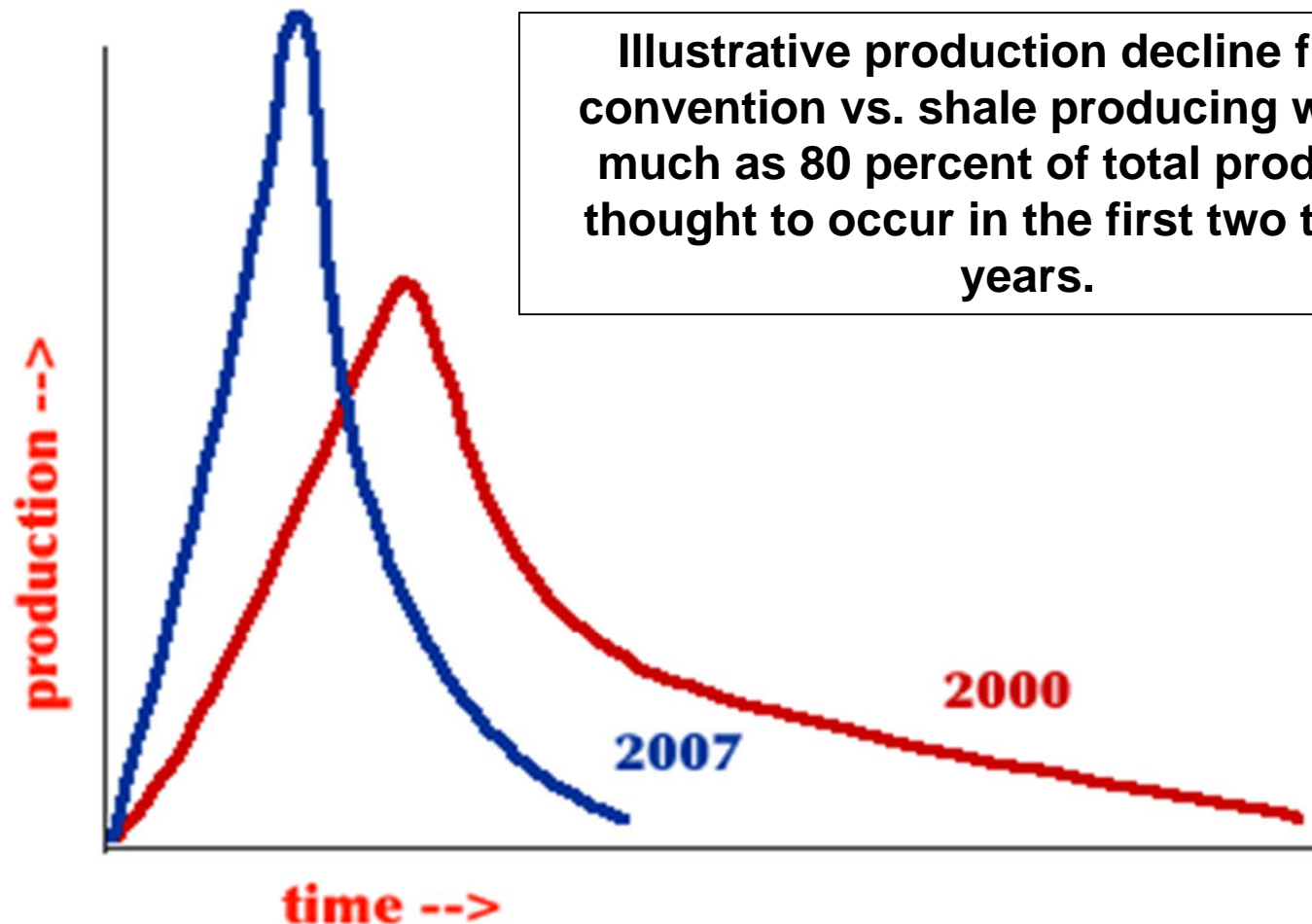
**Shale, Horizontal Drilling, and Fractionation**

- **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.**





Production from a Typical Well and Shale Well



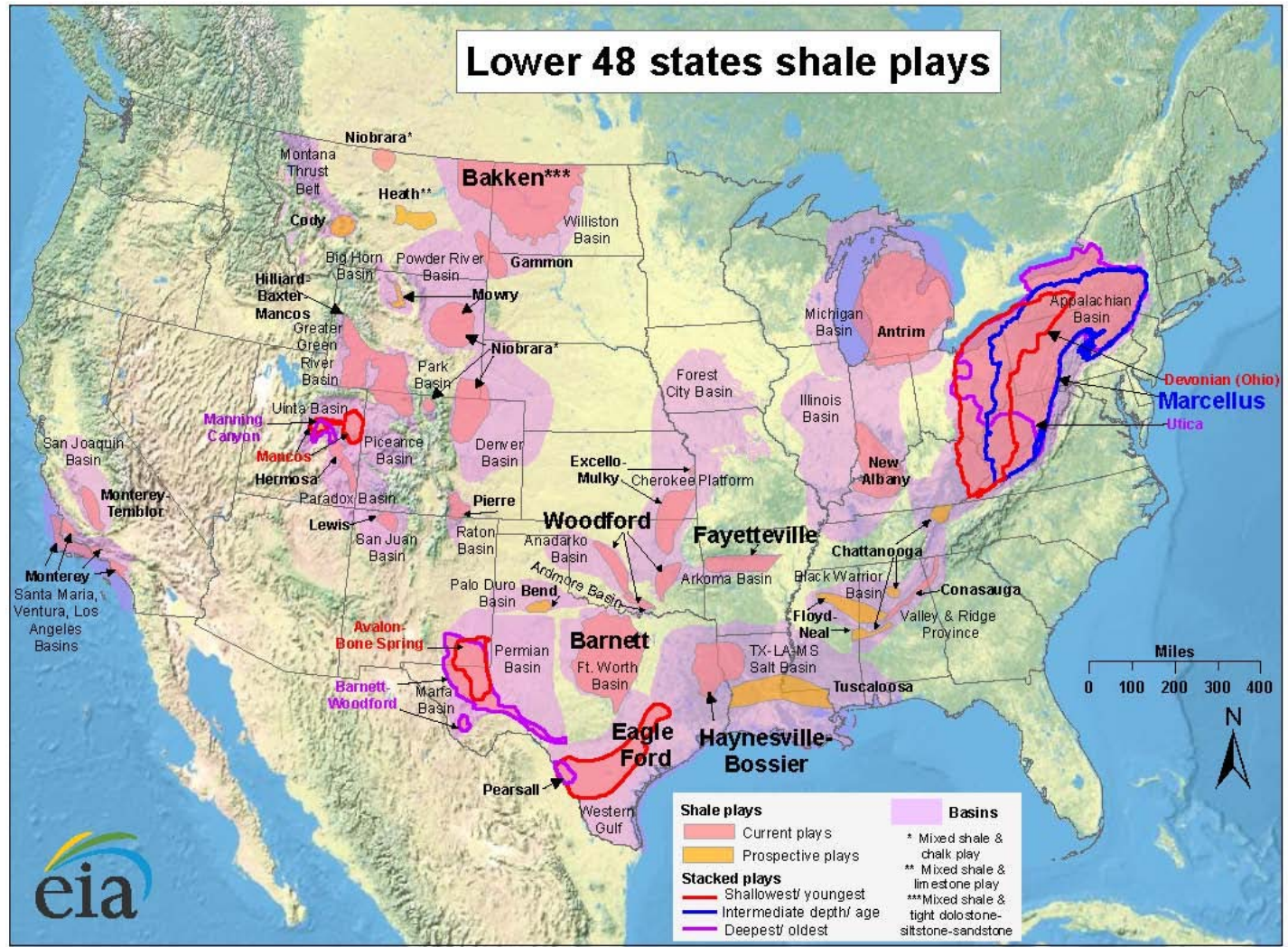
Illustrative production decline from a convention vs. shale producing well. As much as 80 percent of total production thought to occur in the first two to three years.





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.



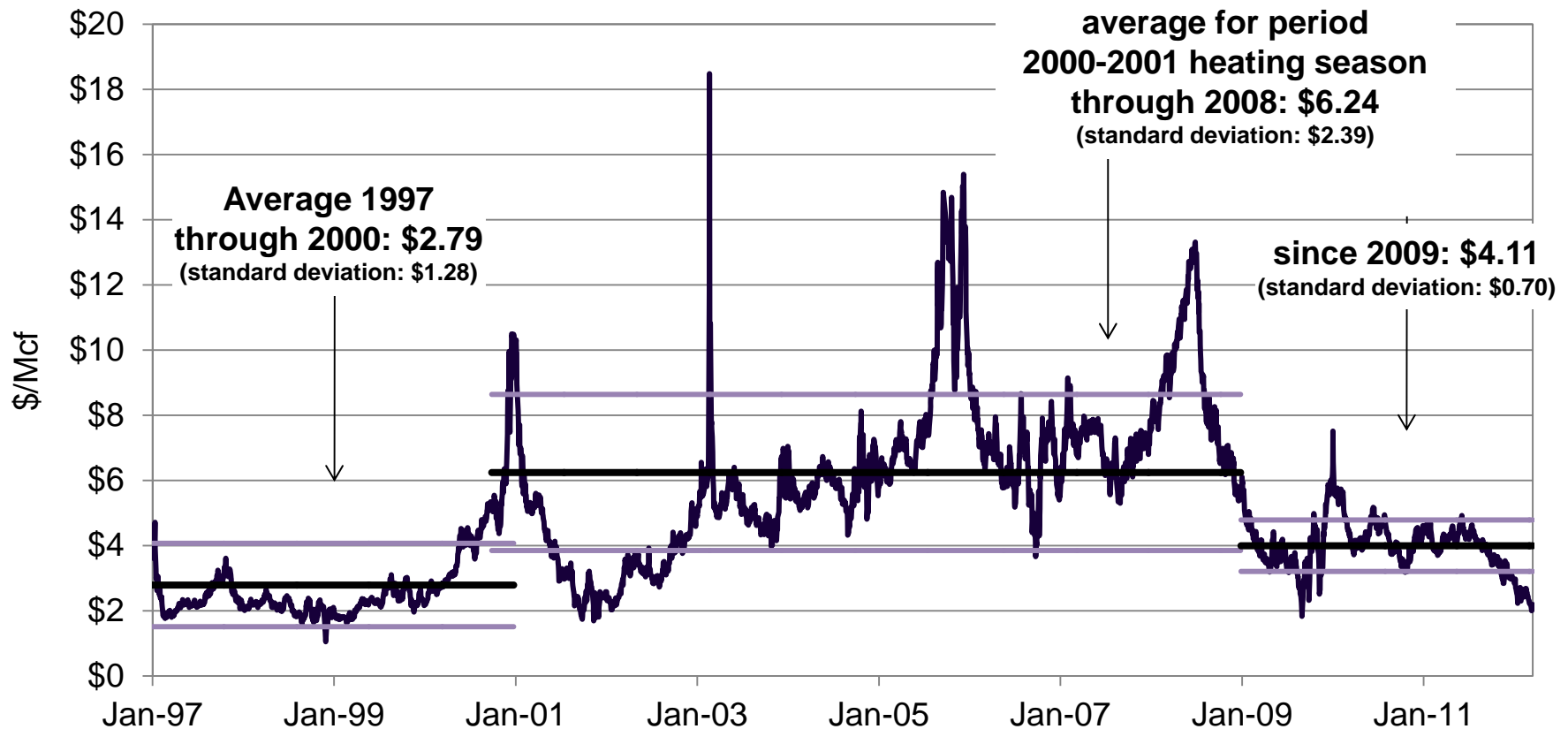


# **Game Changer 1: Natural Gas**



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.

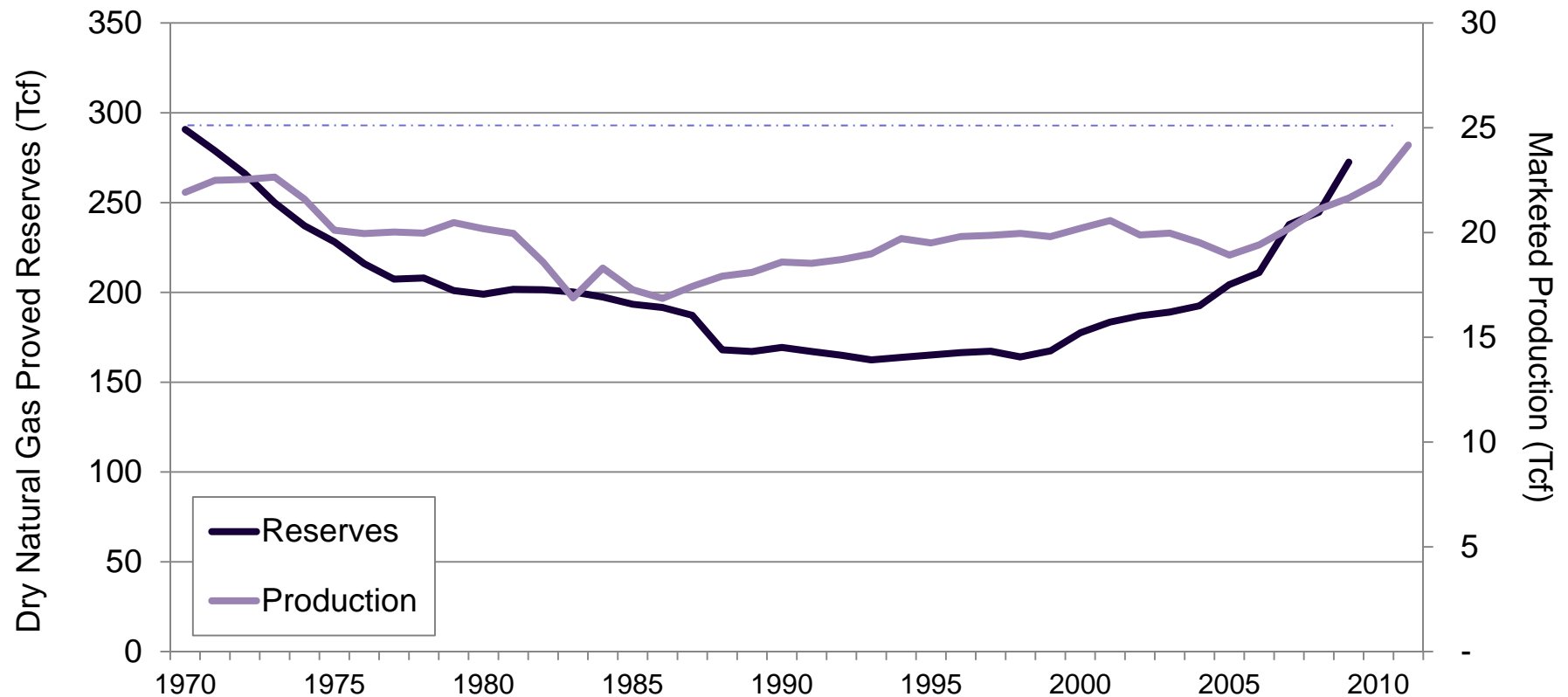






Natural Gas Proved Reserves and Production

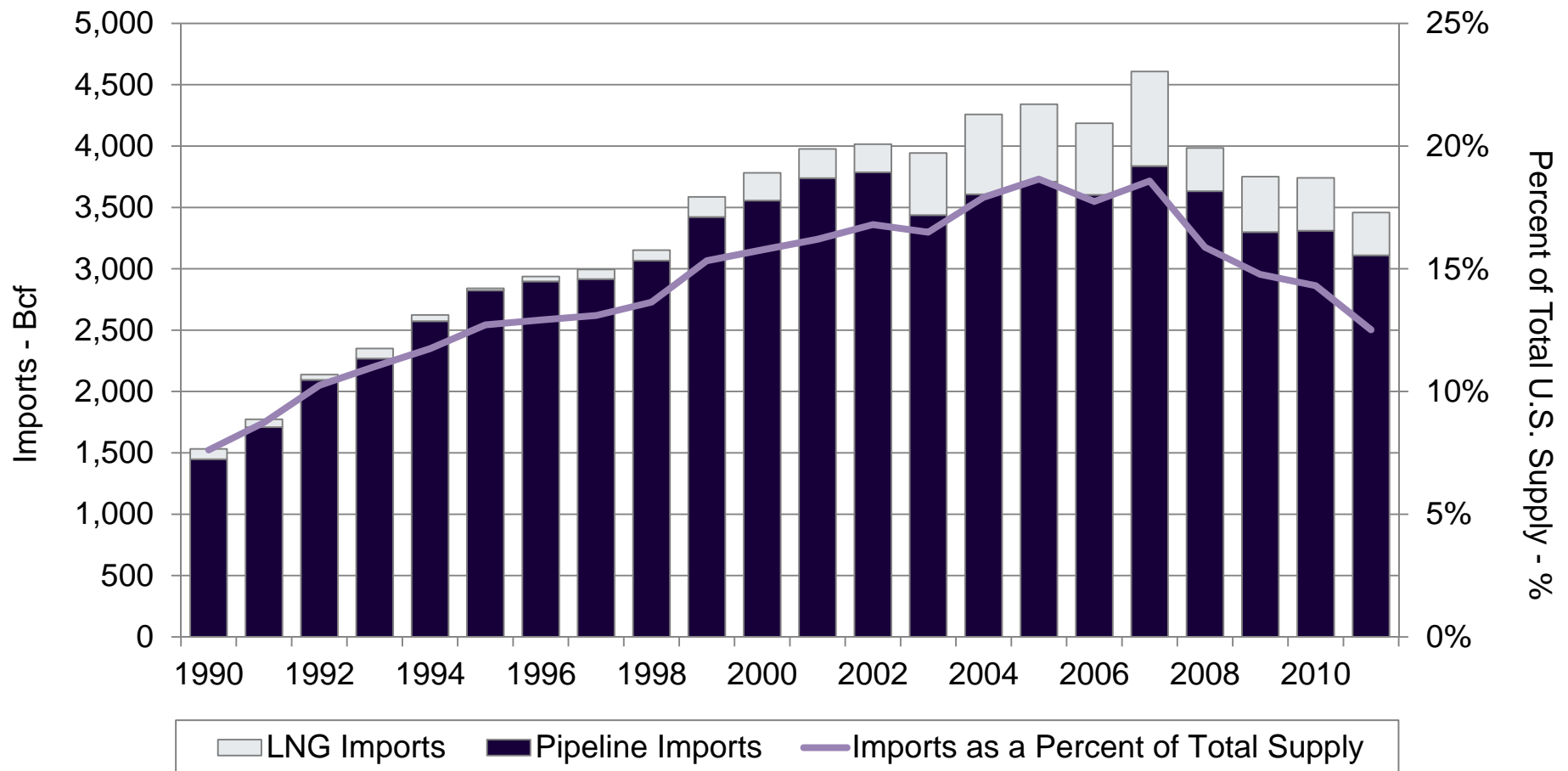
**Current U.S. natural gas reserves are approaching record levels not seen since 1970. Natural gas production is at levels that surpass historic peaks.**





Natural Gas Imports

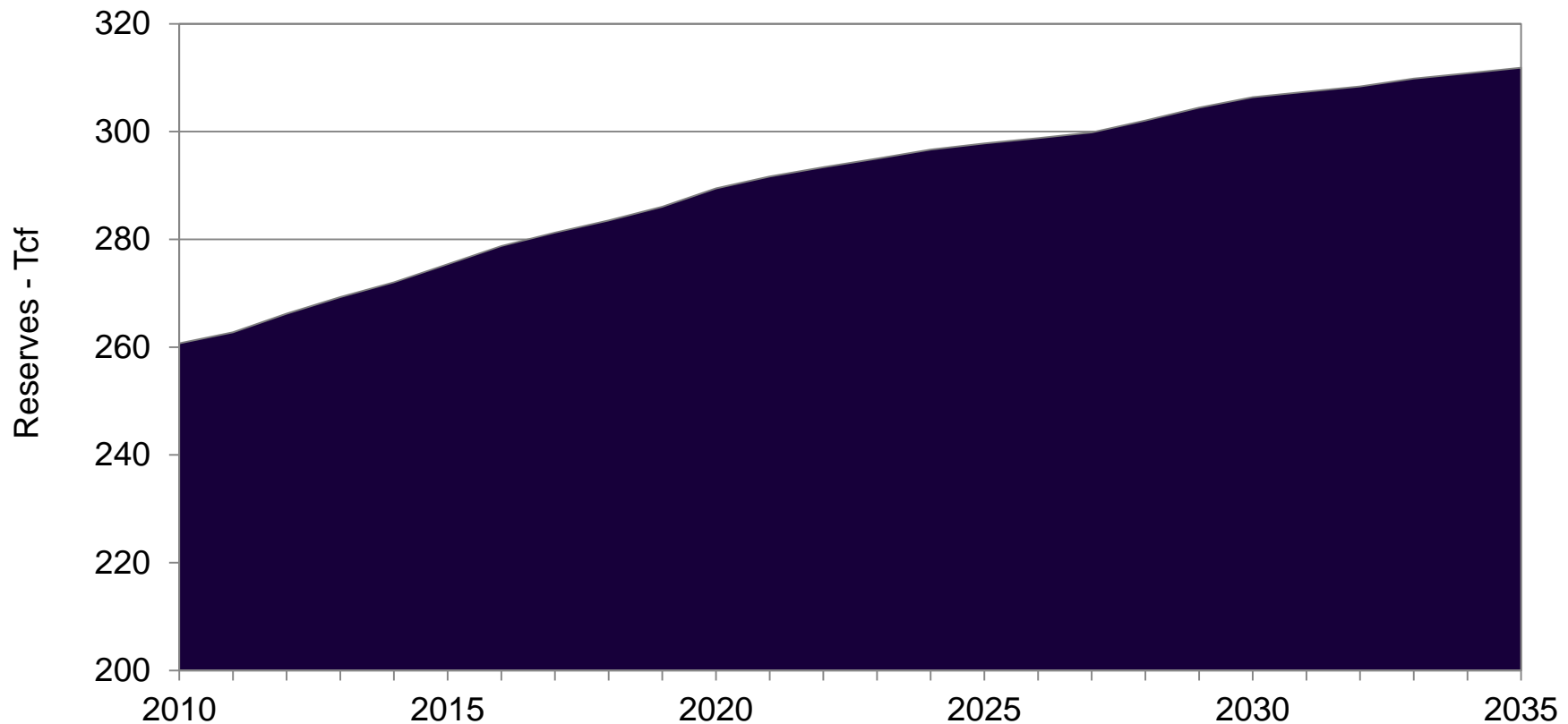
Natural gas imports, once thought to be the supply remedy for meeting future gas needs are falling to levels also not seen since the 1990s.





Annual Energy Outlook, Natural Gas Reserves

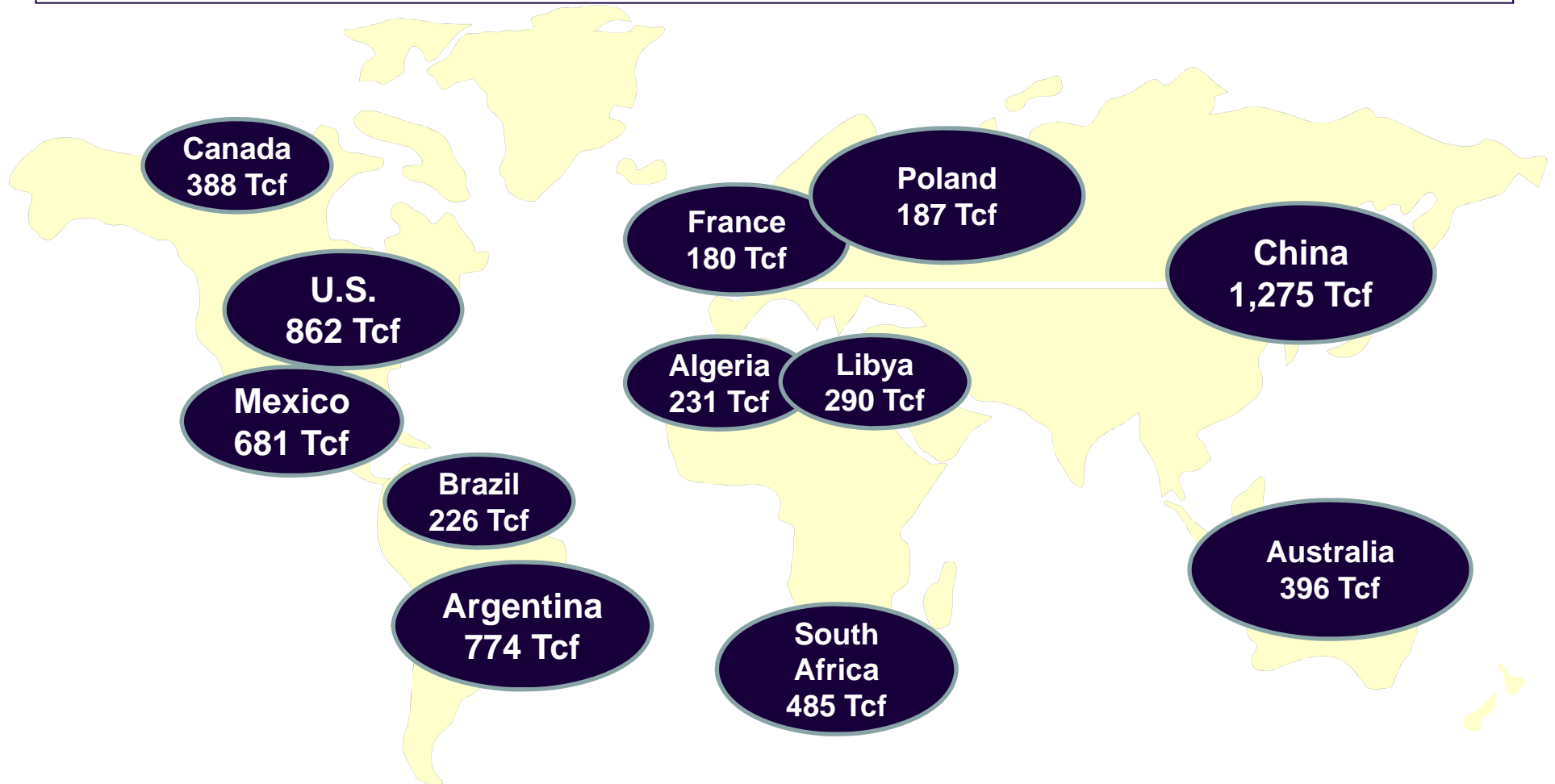
**Unconventional resources are not a “flash in the pan” and are anticipated to continue to increase over the next two decades or more.**



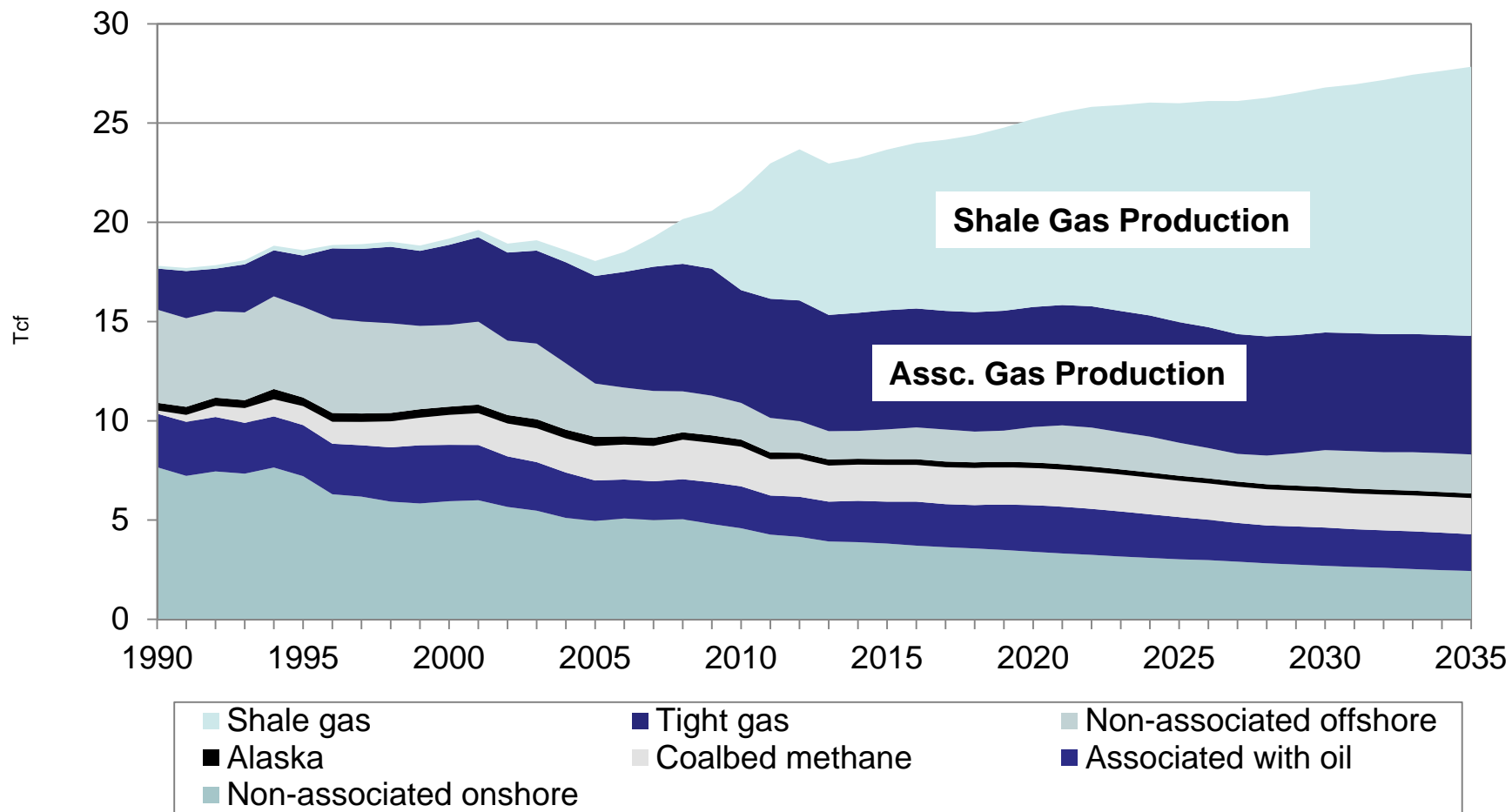


**Basin Competition**

**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.**



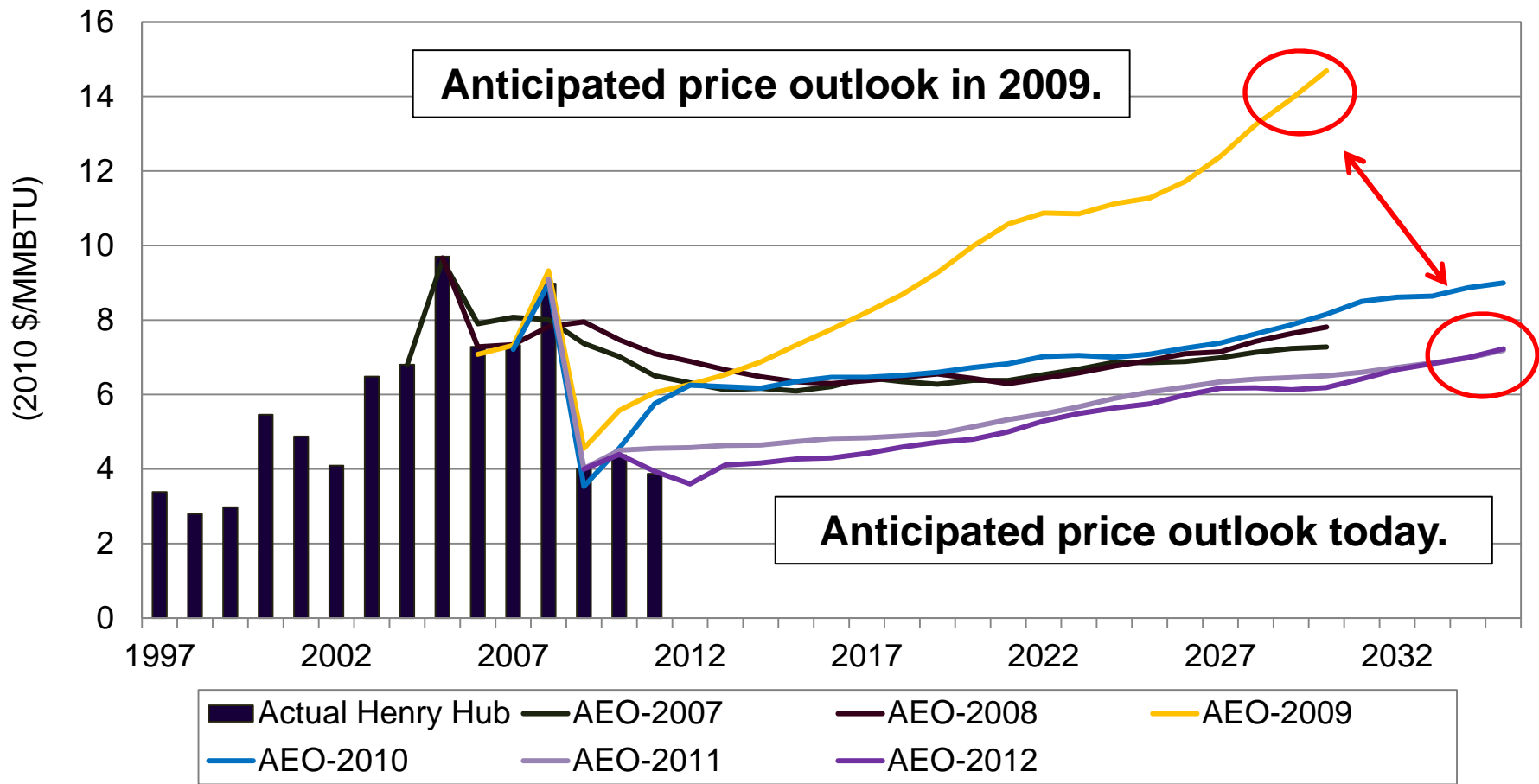
**Shale availability will drive U.S. natural gas supply.**





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

Shale availability has significant impact on future price outlook.



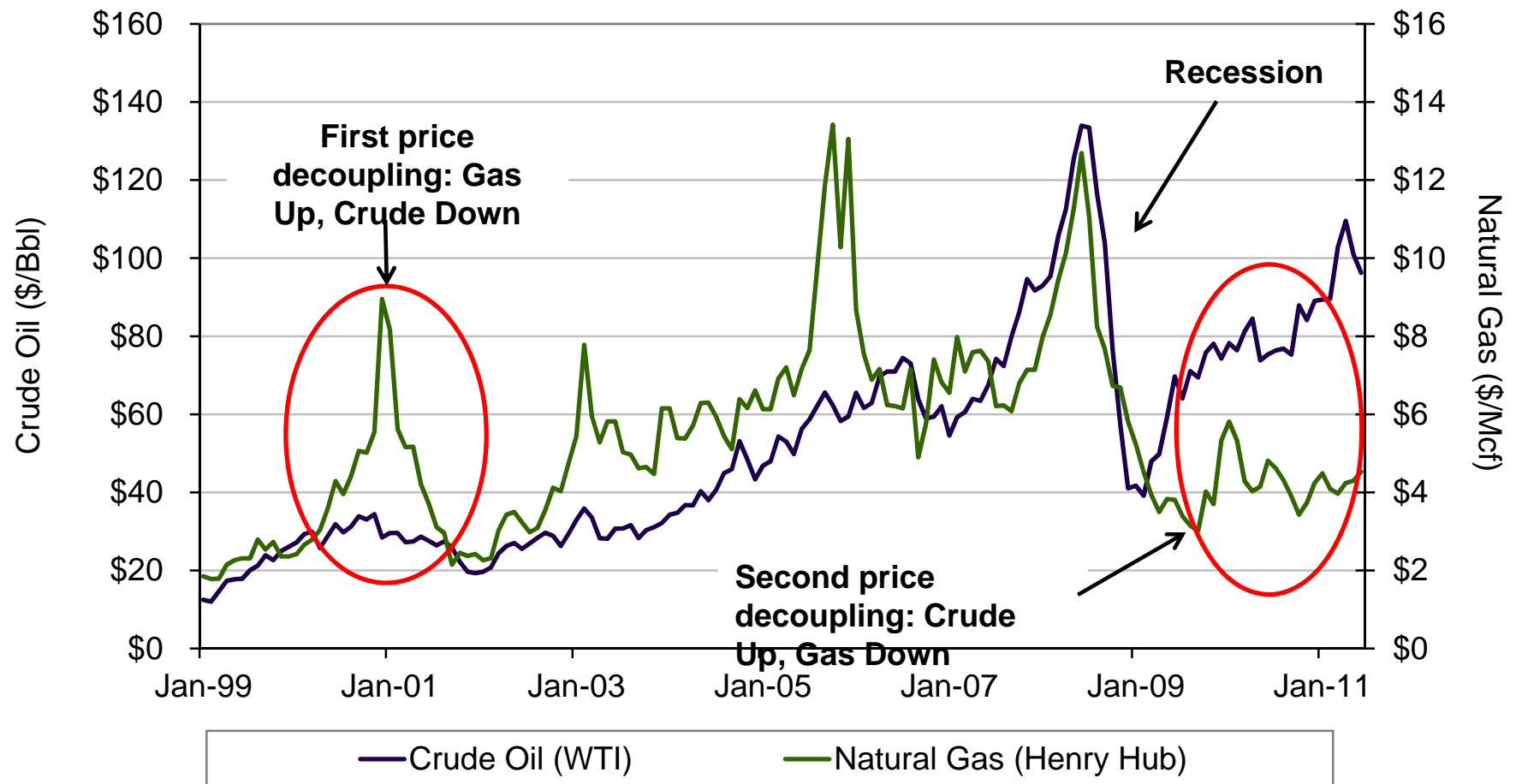


## **Game Changer 2: Crude and Liquids**



Crude Oil and Natural Gas Prices

Two significant breaks (decoupling) of natural gas and crude oil prices.

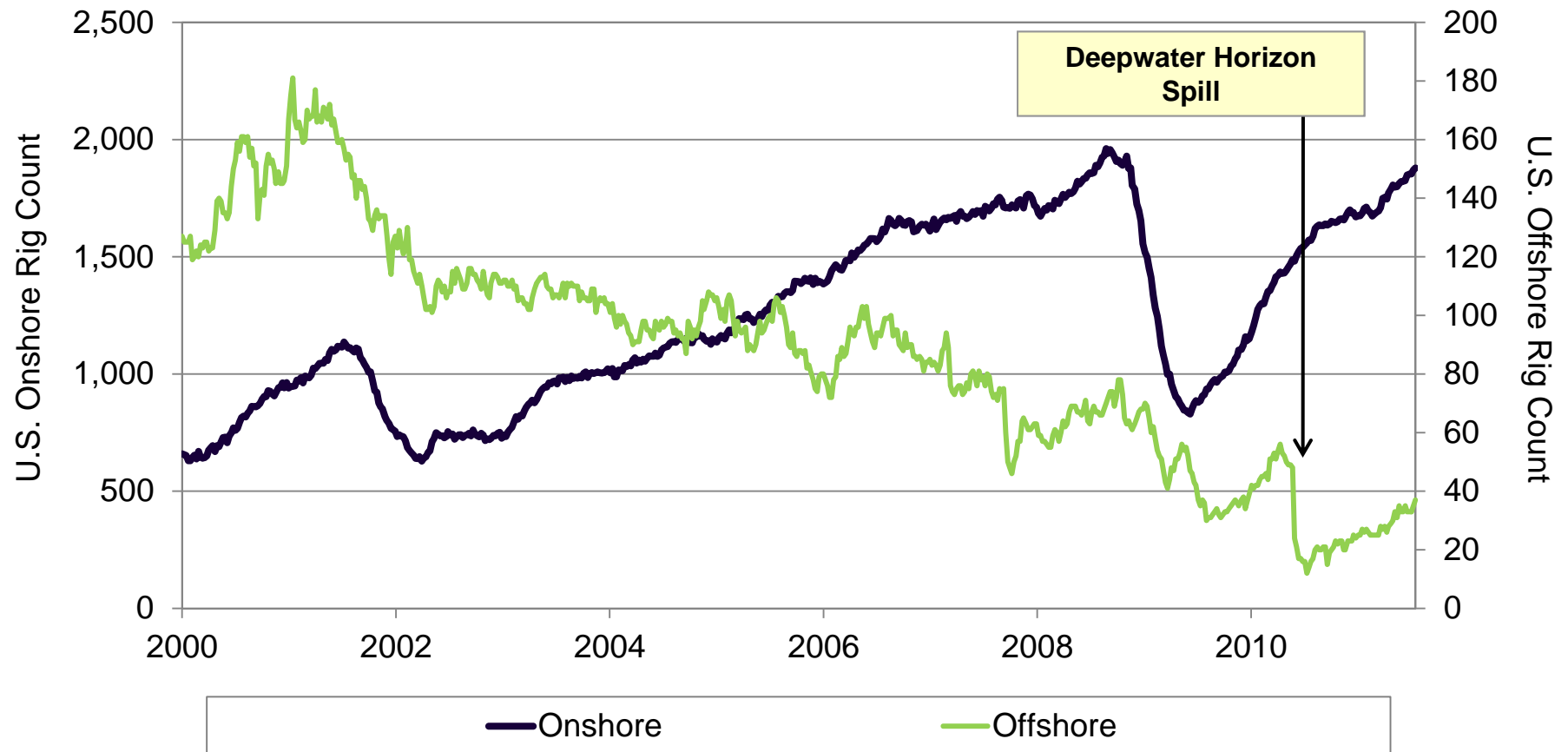






Domestic Rig Counts – Onshore vs. Offshore

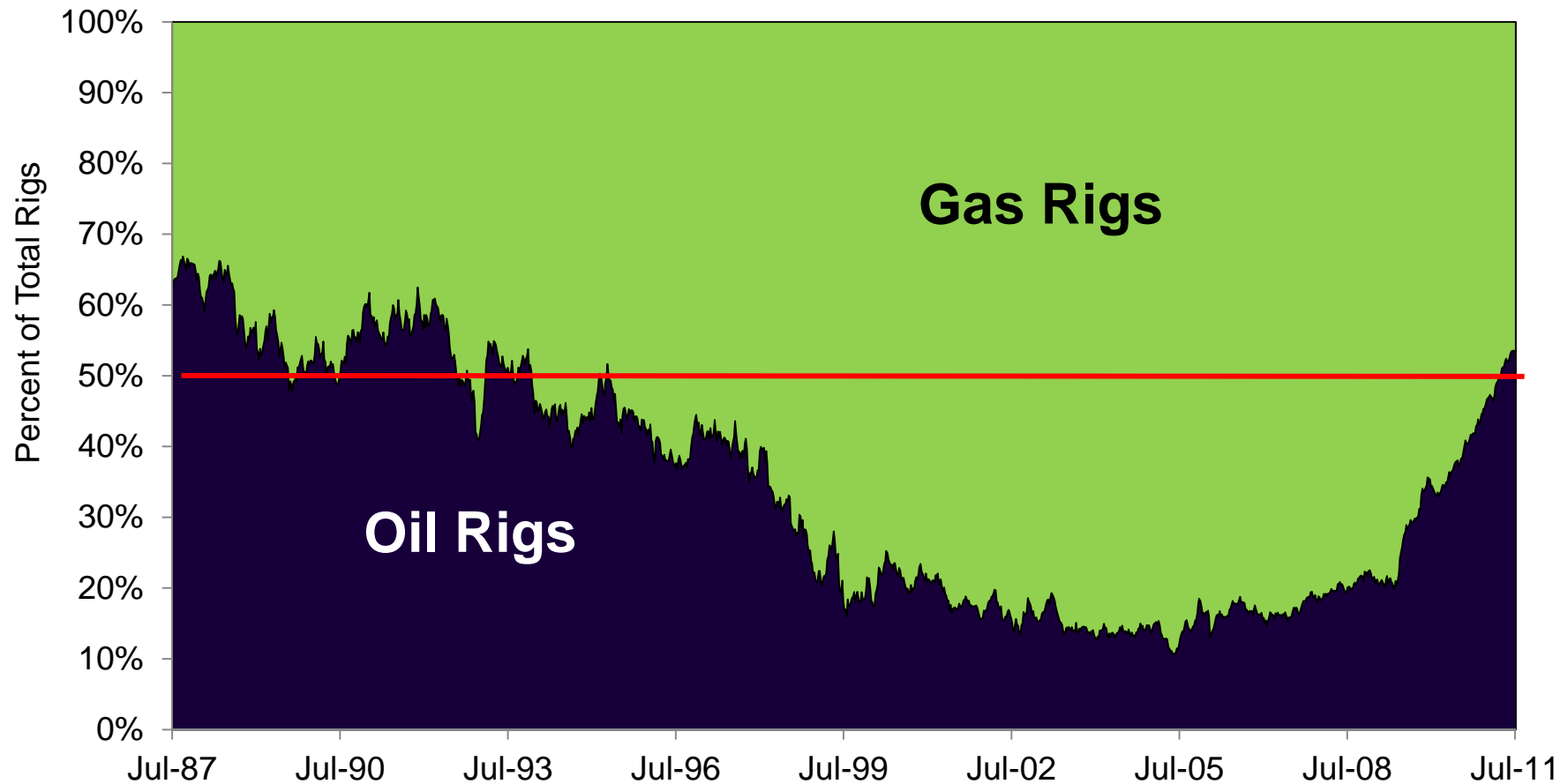
**Onshore rig counts are moving close to their pre-recession levels, primarily motivated by increased crude oil drilling, not natural gas.**





Domestic Rig Count – Crude Oil vs. Natural Gas

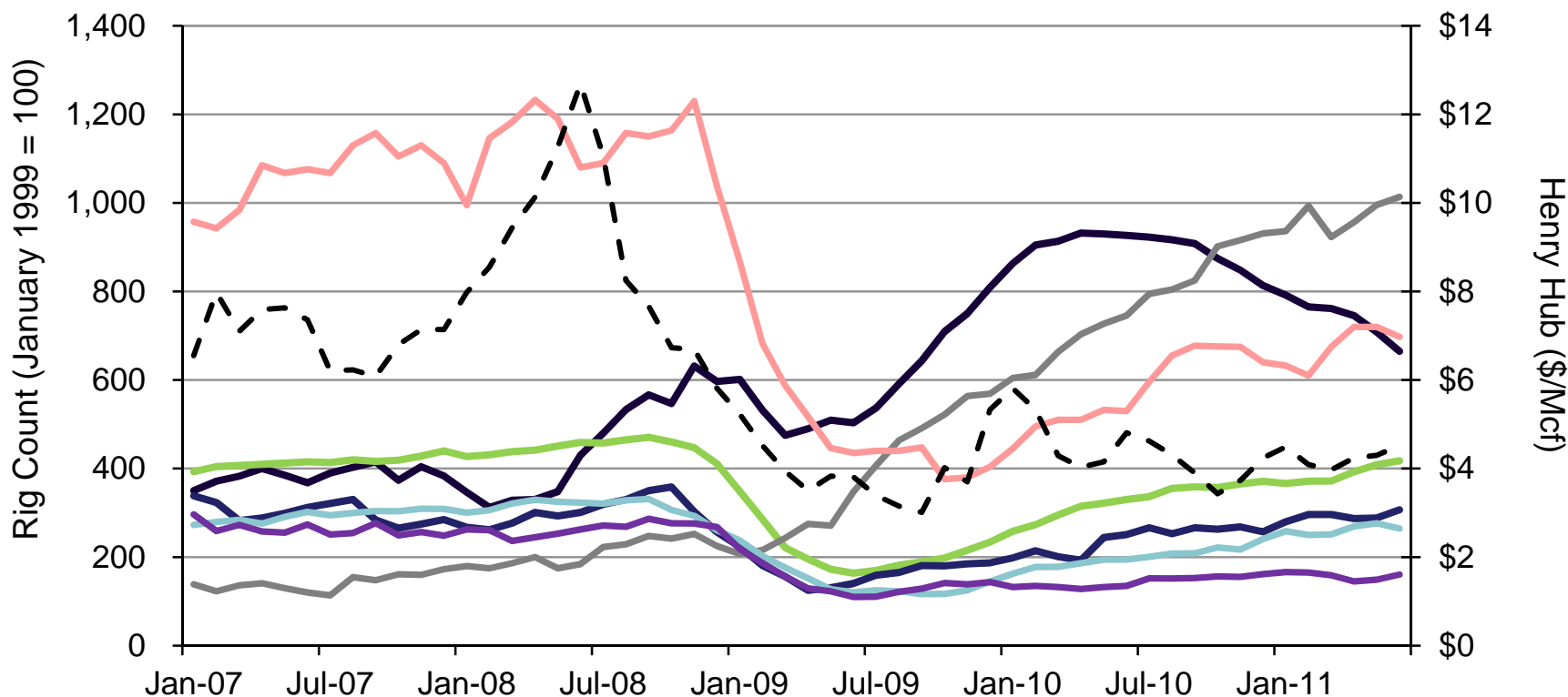
**For the first time in 16 years, the number of oil rigs is equivalent to gas rigs.**





Rig Count and Crude Oil Price, (Each State Measured Relative to 1999 Activity)

Drilling rig activity increasing rapidly in liquids rich shale.



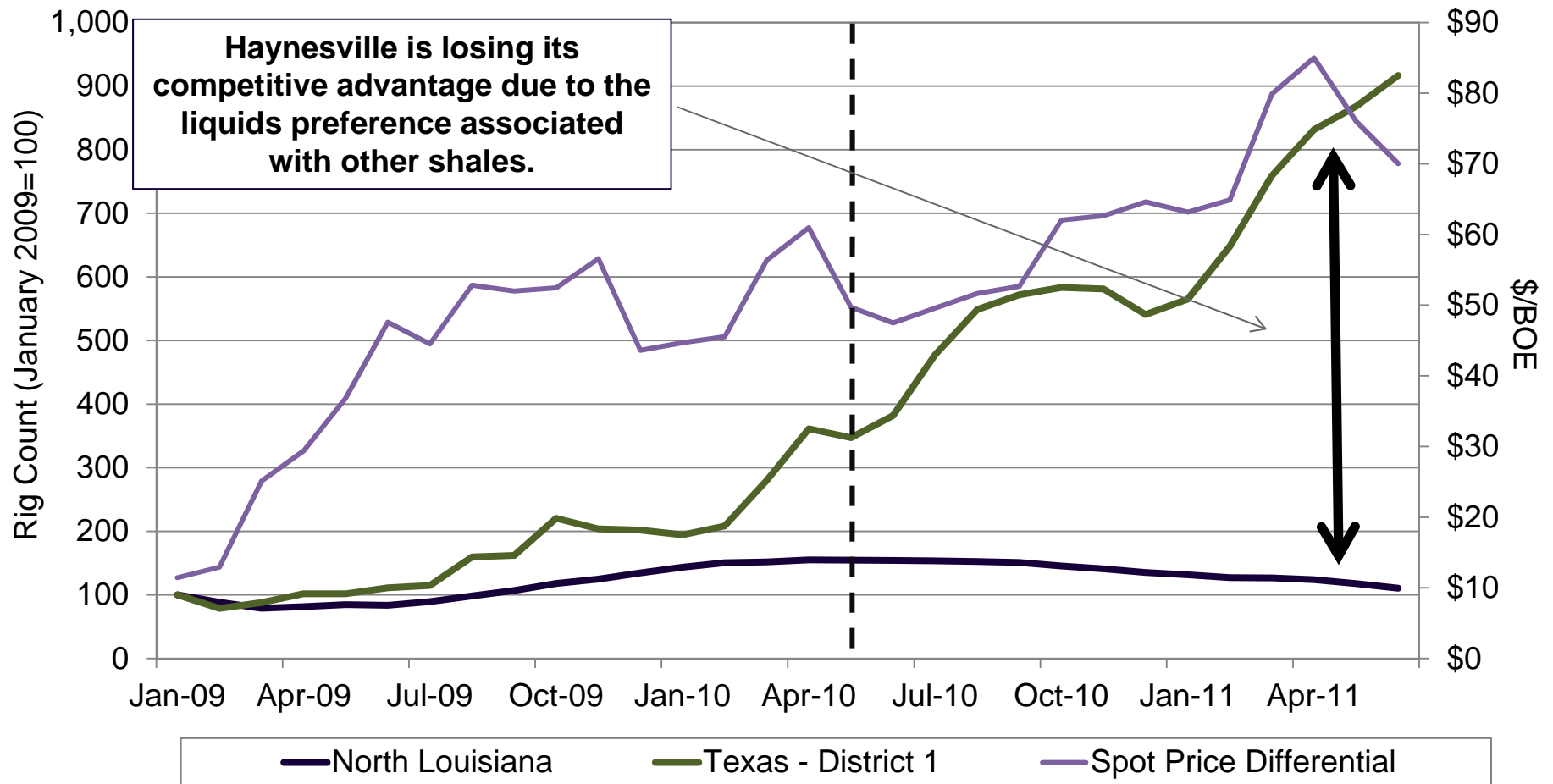
- N. Louisiana
- Texas
- Pennsylvania
- New Mexico
- Oklahoma
- Wyoming
- Colorado
- - Natural Gas Price

Source: Baker Hughes; and Federal Reserve Bank of St. Louis.



Rig Count, North Louisiana (Haynesville) and Texas District 1 (Eagle Ford)

Indexing the rig change from January 2009 highlights the basin preference.



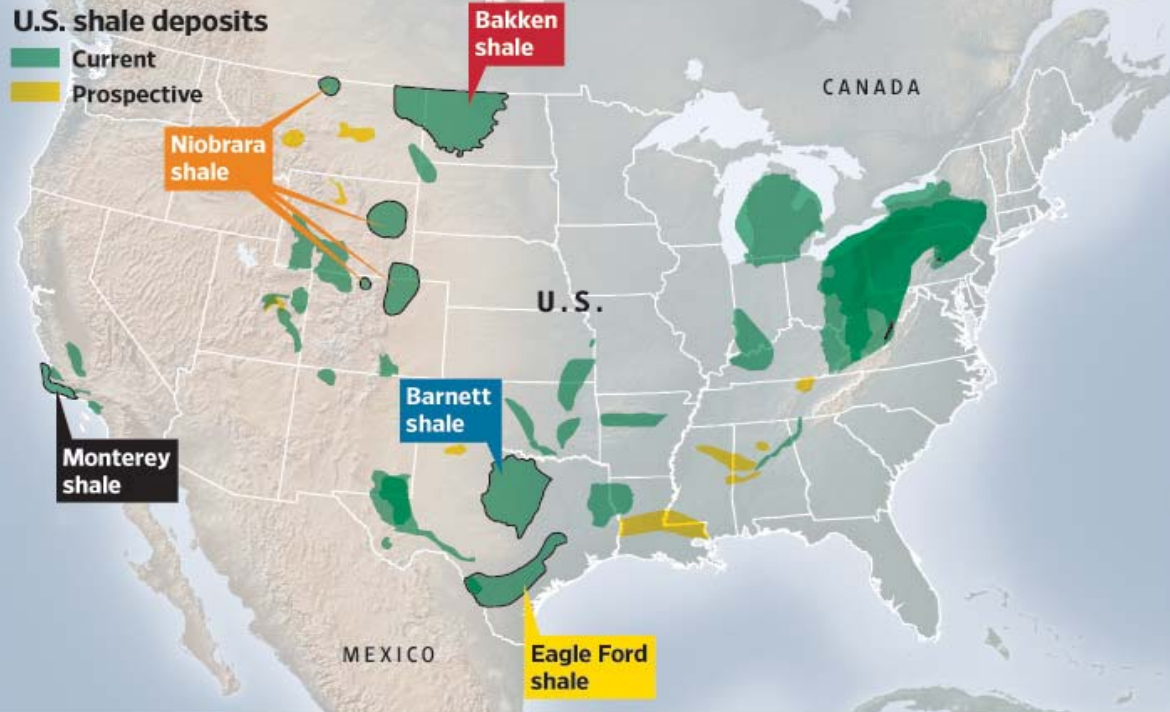
Source: Baker Hughes. Rig counts are indexed to the level of active drilling rigs in each reported area as of January 2009.



Crude Awakening | Fracking has helped ignite a rise in U.S. oil production

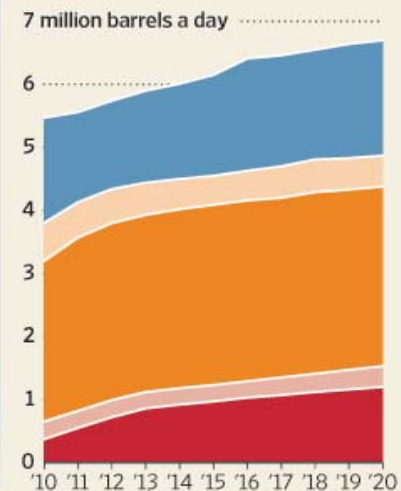
U.S. shale deposits

- Current
- Prospective

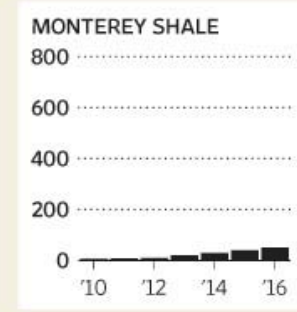
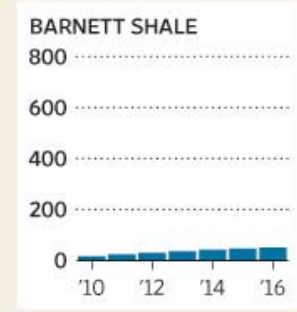
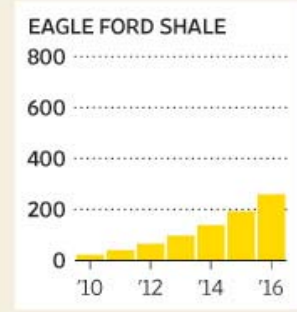
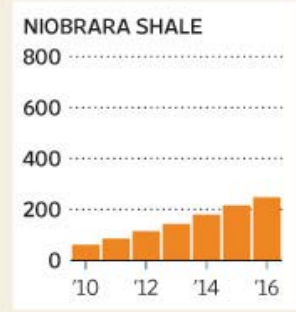
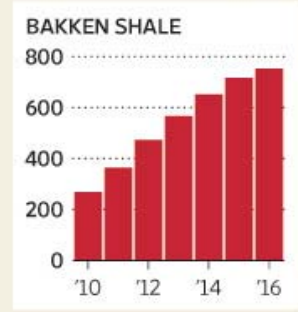


U.S. oil-production forecast

- Gulf of Mexico
- Alaska
- Other onshore oil
- CO2-enhanced oil recovery
- Oil from fracking**



Light crude oil supplies from U.S. shale fields, in thousands of barrels a day



Note: Projections begin in 2011 for all data.

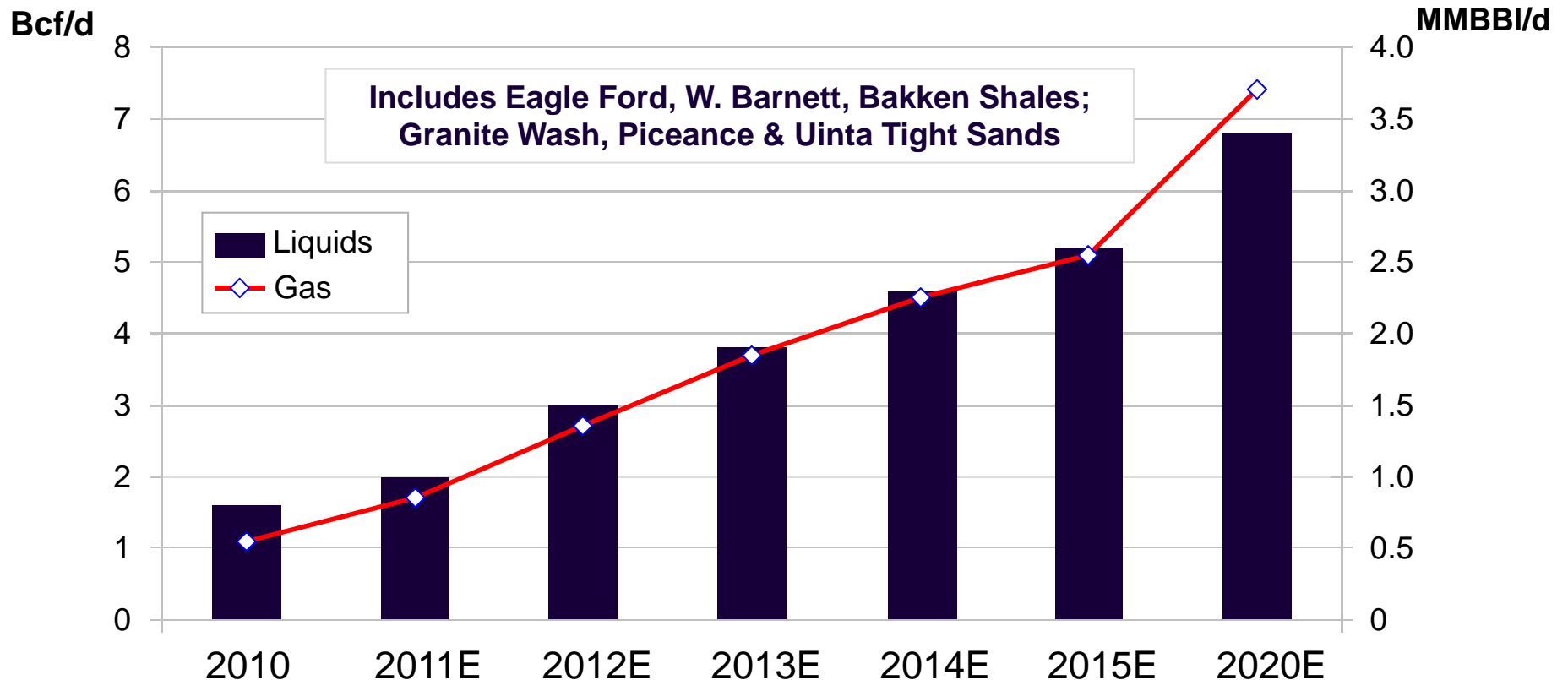
Sources: U.S. Energy Information Administration; International Energy Agency (individual shale production)

The Wall Street Journal



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).





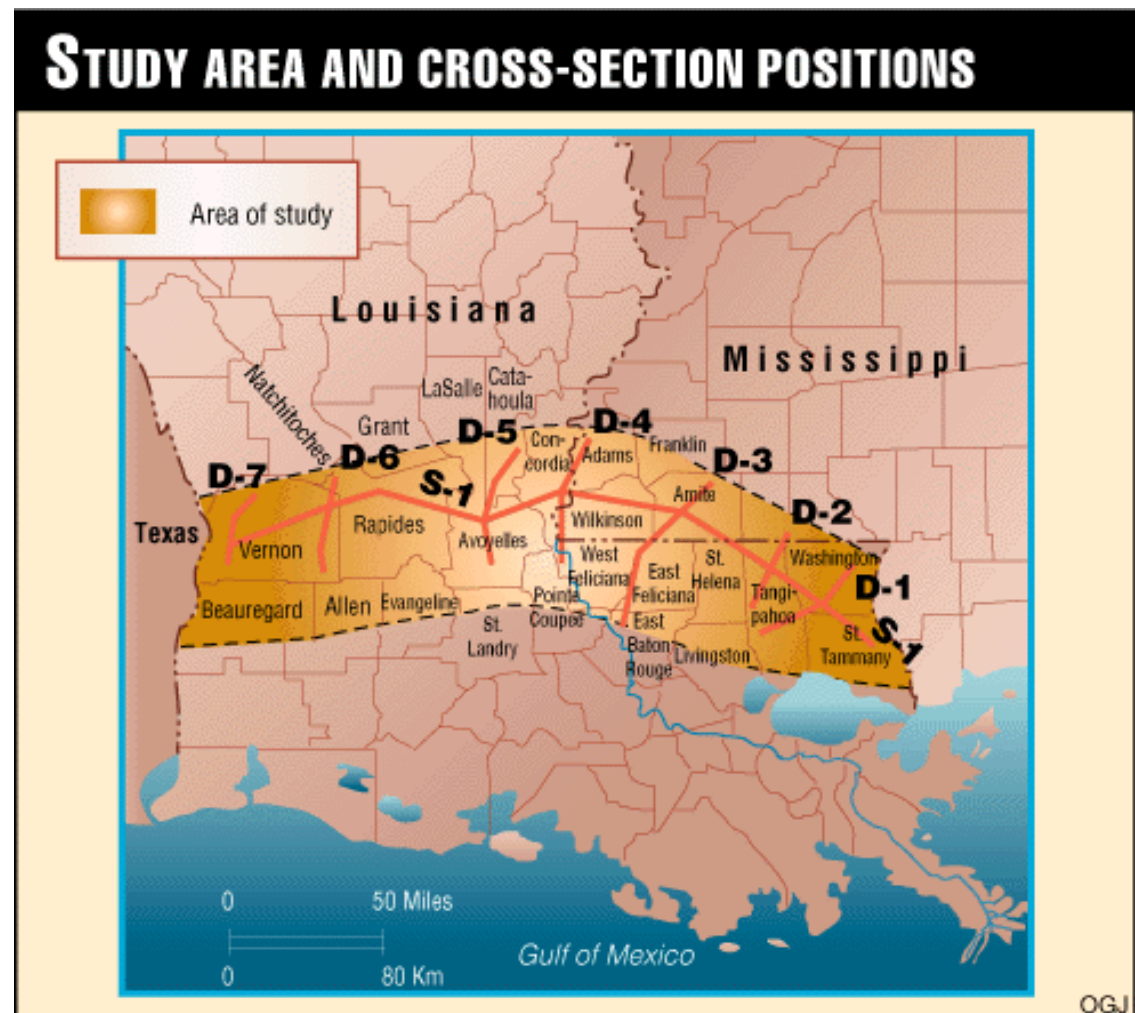
**Closer to Home: Louisiana and the  
Tuscaloosa Marine Shale (“TMS”)**





Crude Oil Shale Opportunities -- Louisiana

- 1998 LGS Study primary publicly-available source of information on the formation.
- Lies between sands of the upper and lower Tuscaloosa.
- Approximately 2.7 MM acres.
- Varies in thickness from 500 feet (MS) to around 800 feet (LA).
- Shallowest opportunity around 10,000 feet – mostly between 11,000 to 12,000 – some areas as deep as 16,000 (EBR).
- Estimated potential resource of 7 BBbls.

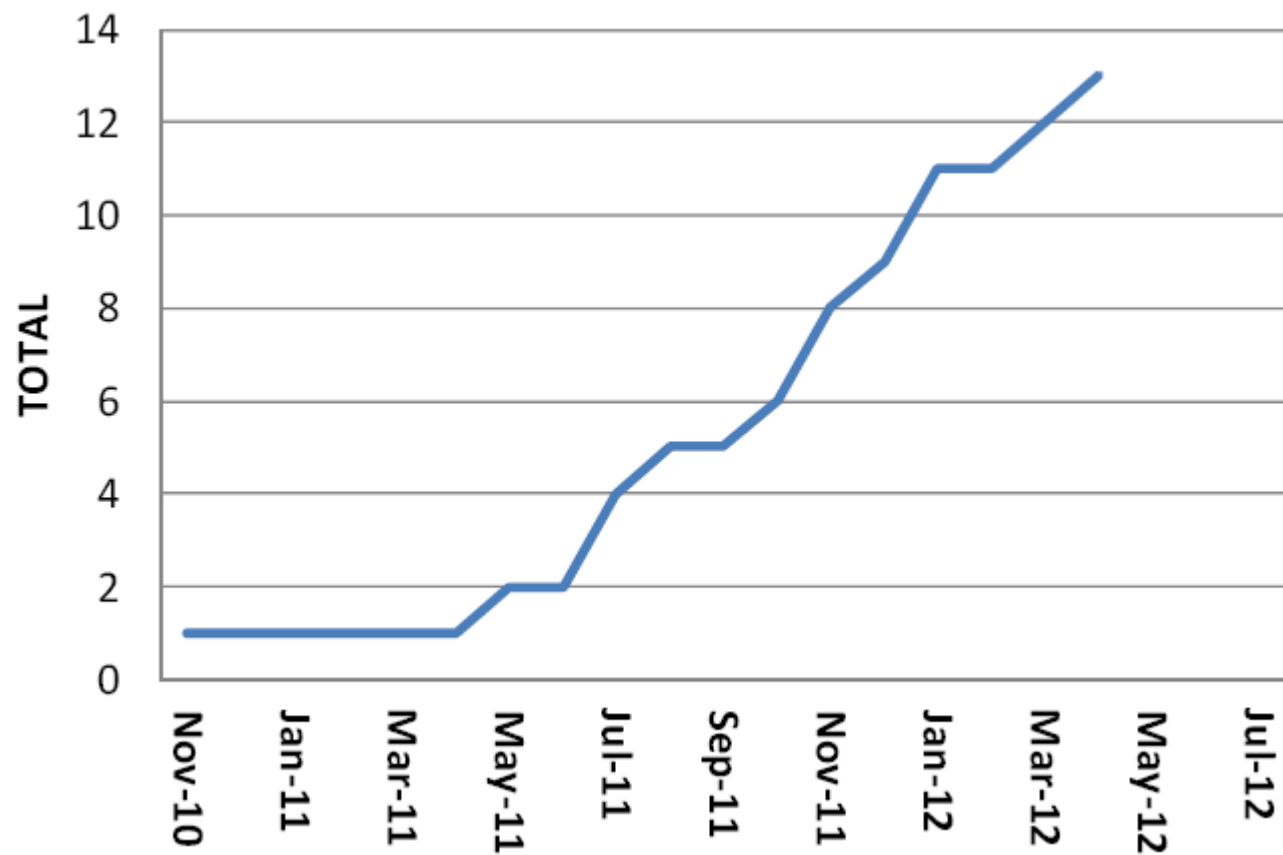






Cumulative TMS Wells Drilled

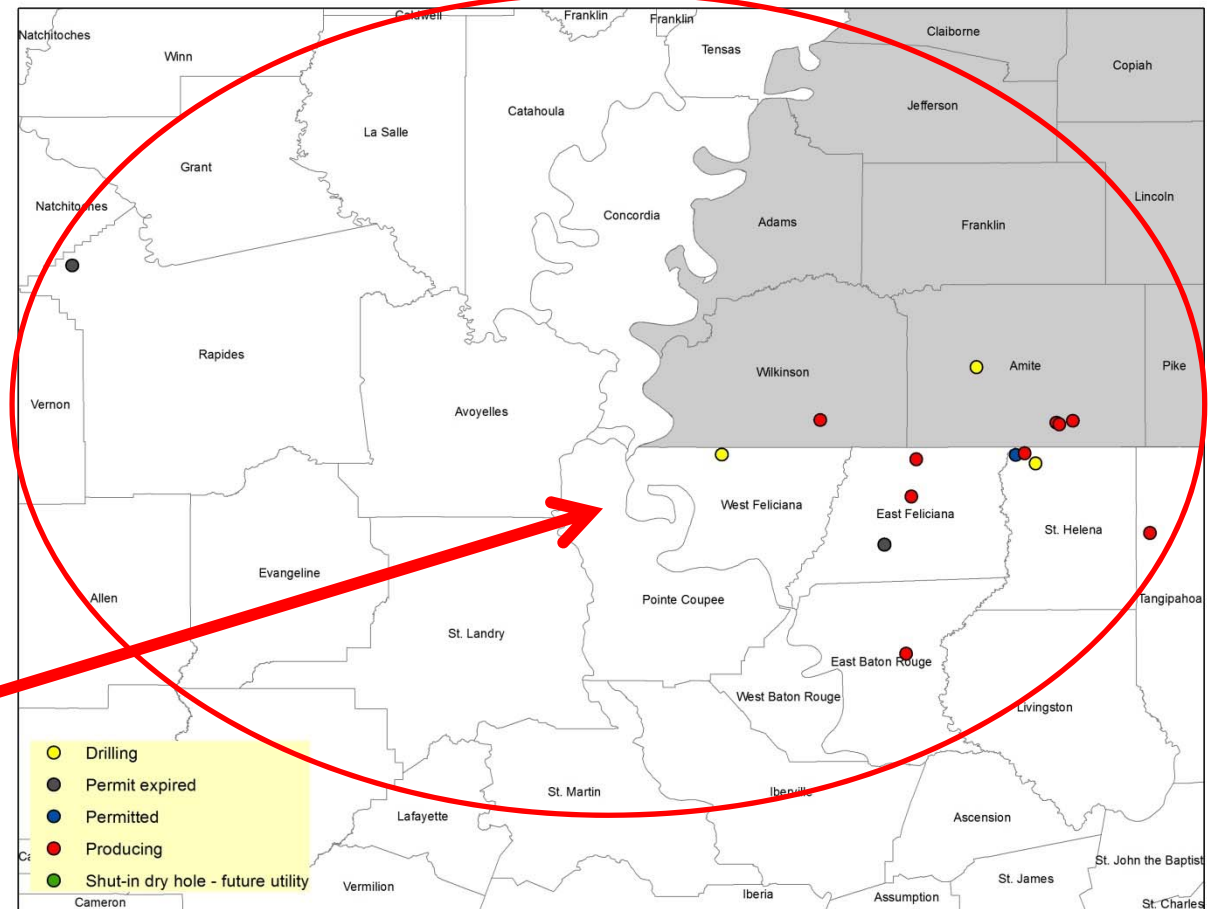
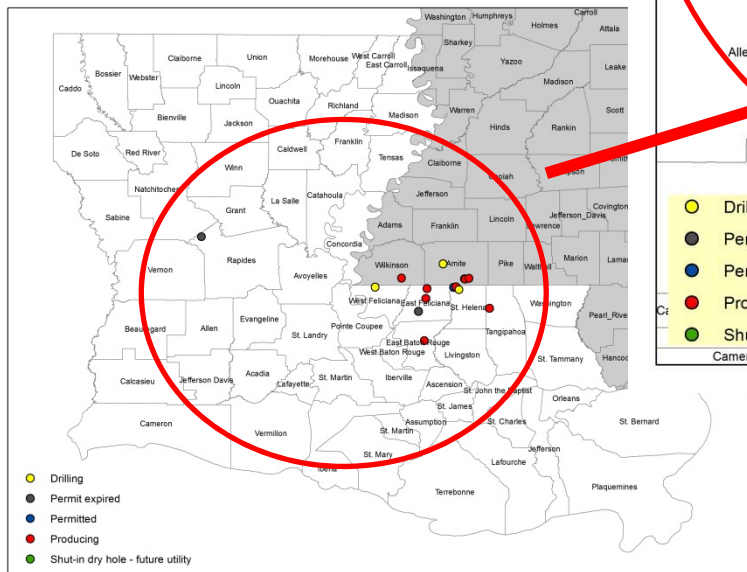
Approximately 13 wells drilled to date.





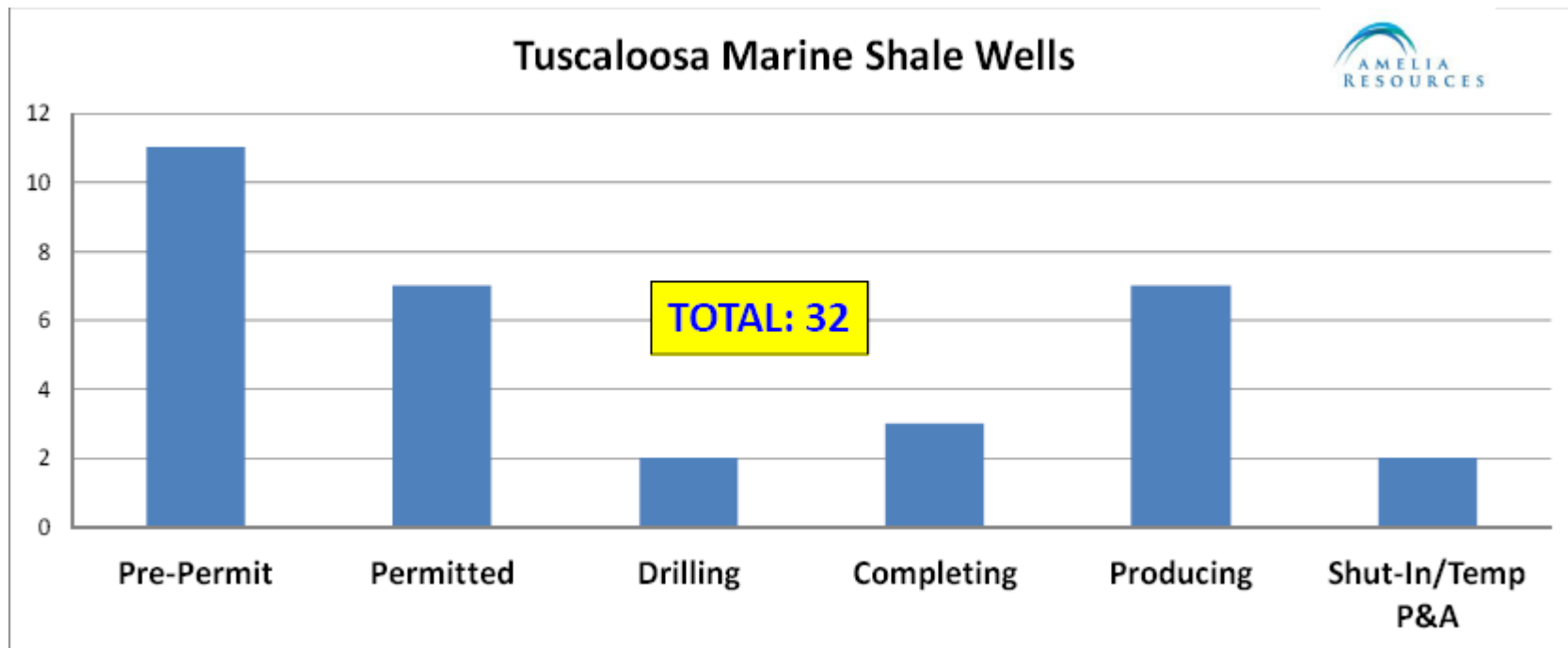
Production Decline Curve Differences

- **Recently-drilled wells located primarily in southwestern MS and in the Florida parishes.**



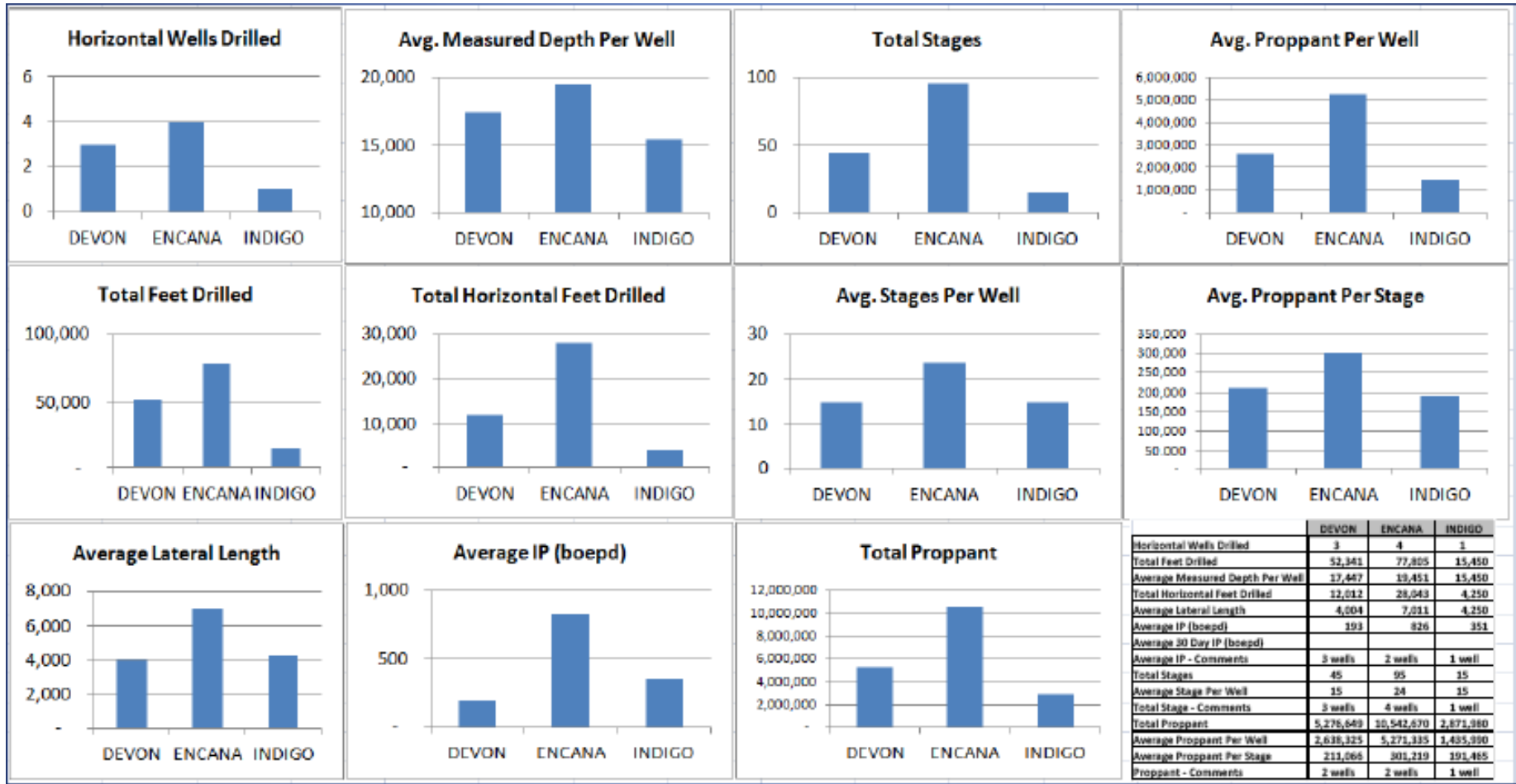


Tuscaloosa Marine Shale Wells





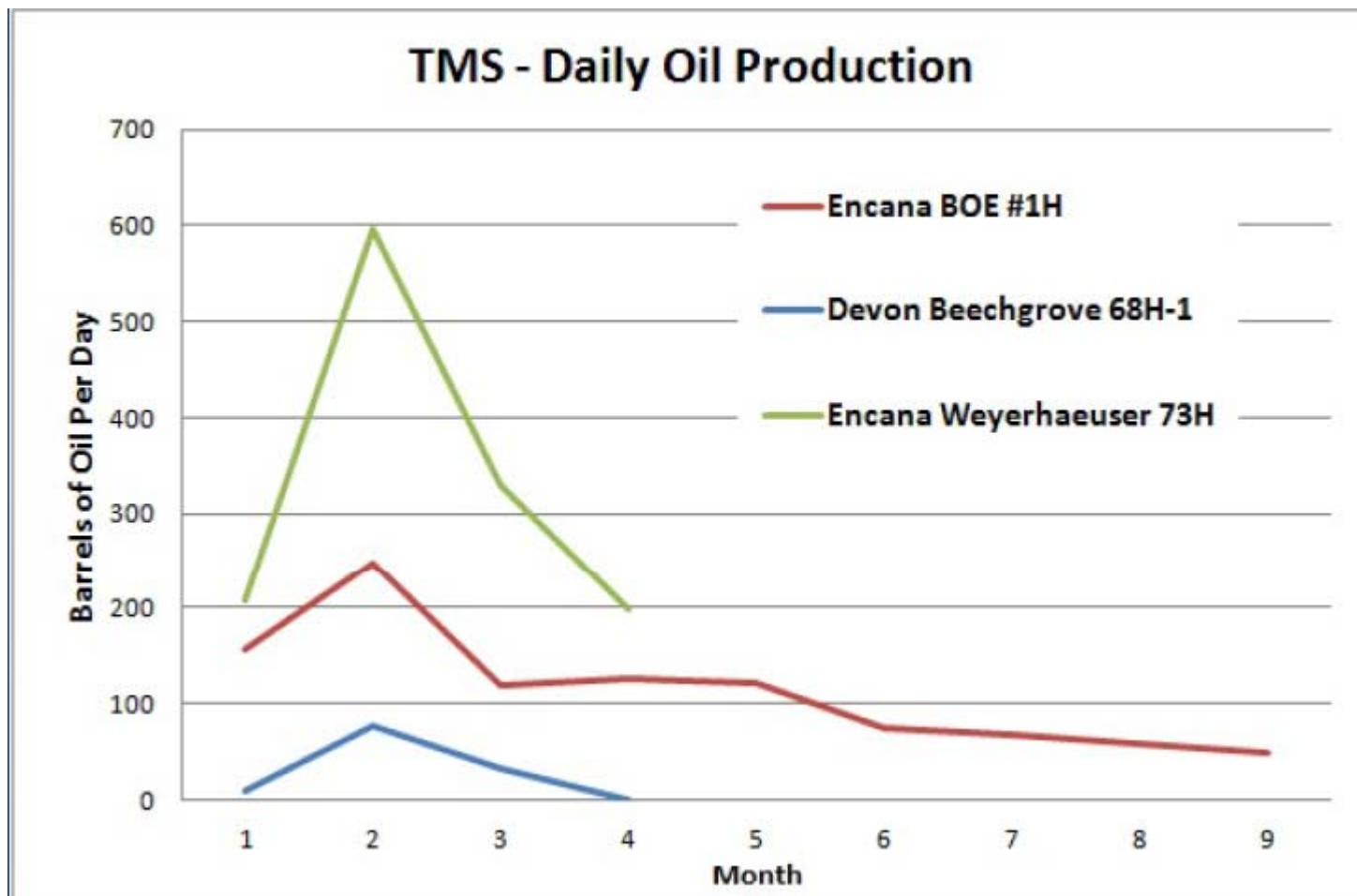
Tuscaloosa Trend Scout Report, Score Card





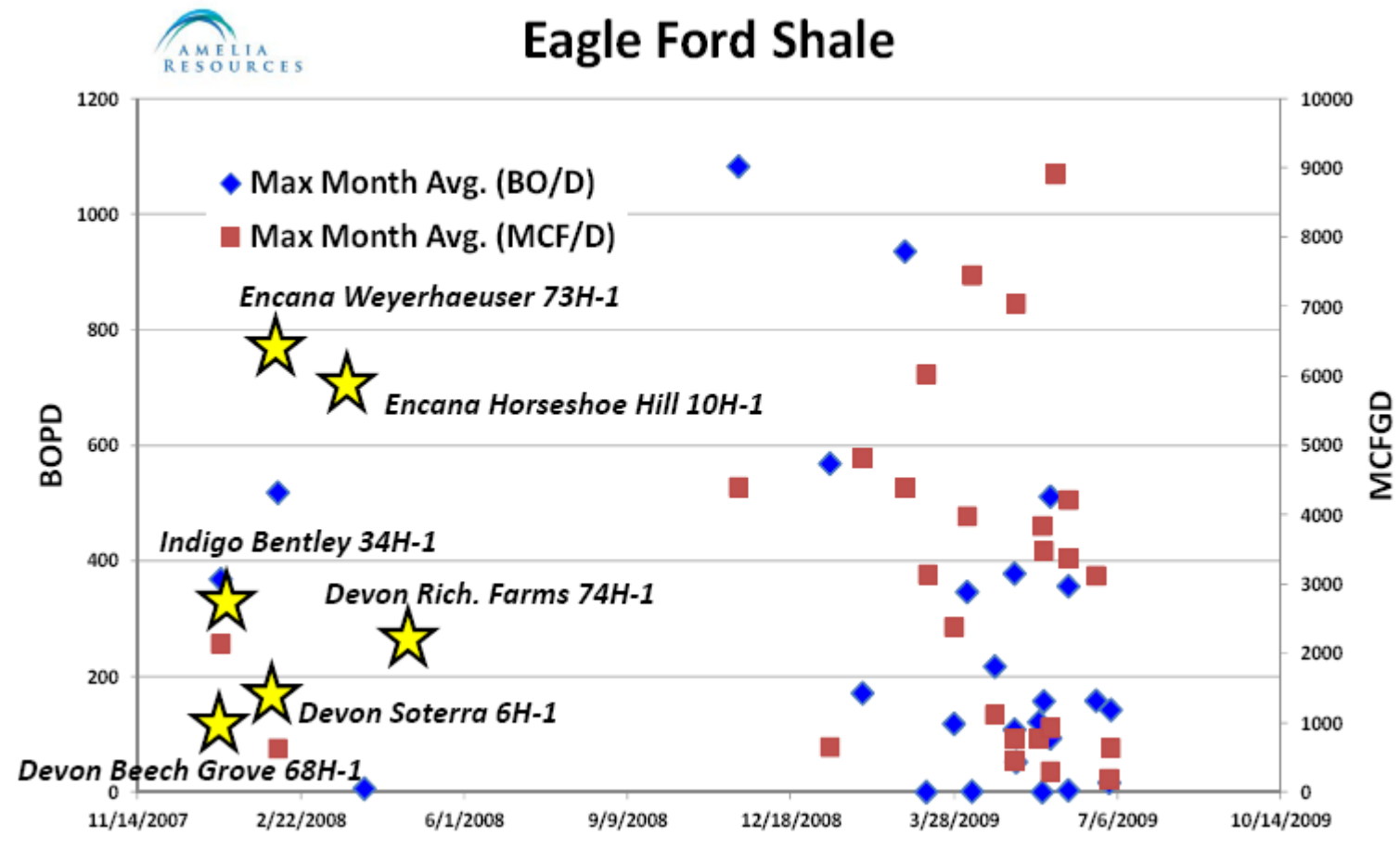
TMS Daily Oil Production

Initial production (“IP”) rates important, but only one of several statistics that should be reviewed given typical production characteristics and uncertainty.





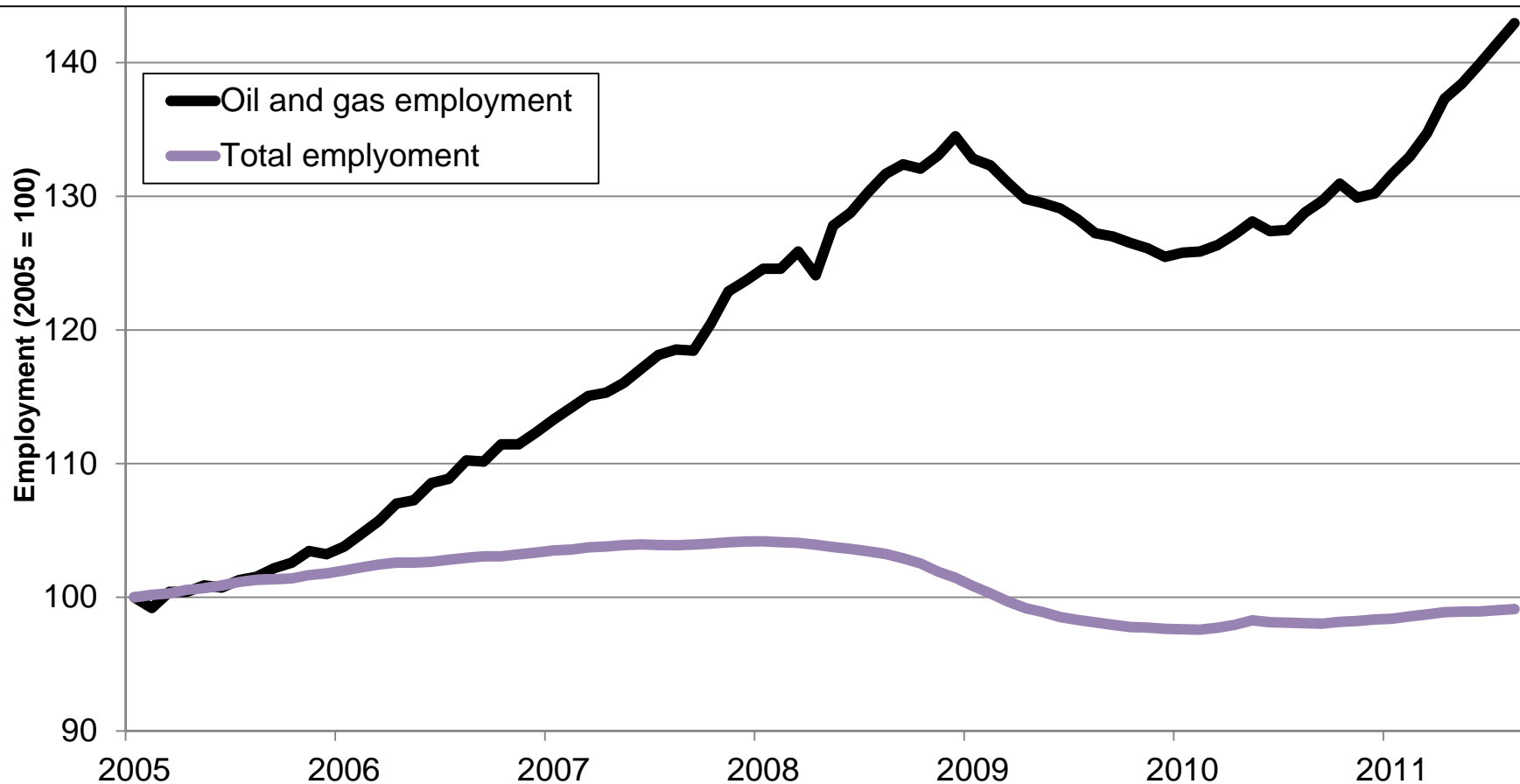
The Early Days, Eagle Ford Shale





United States Employment (2005 = 100)

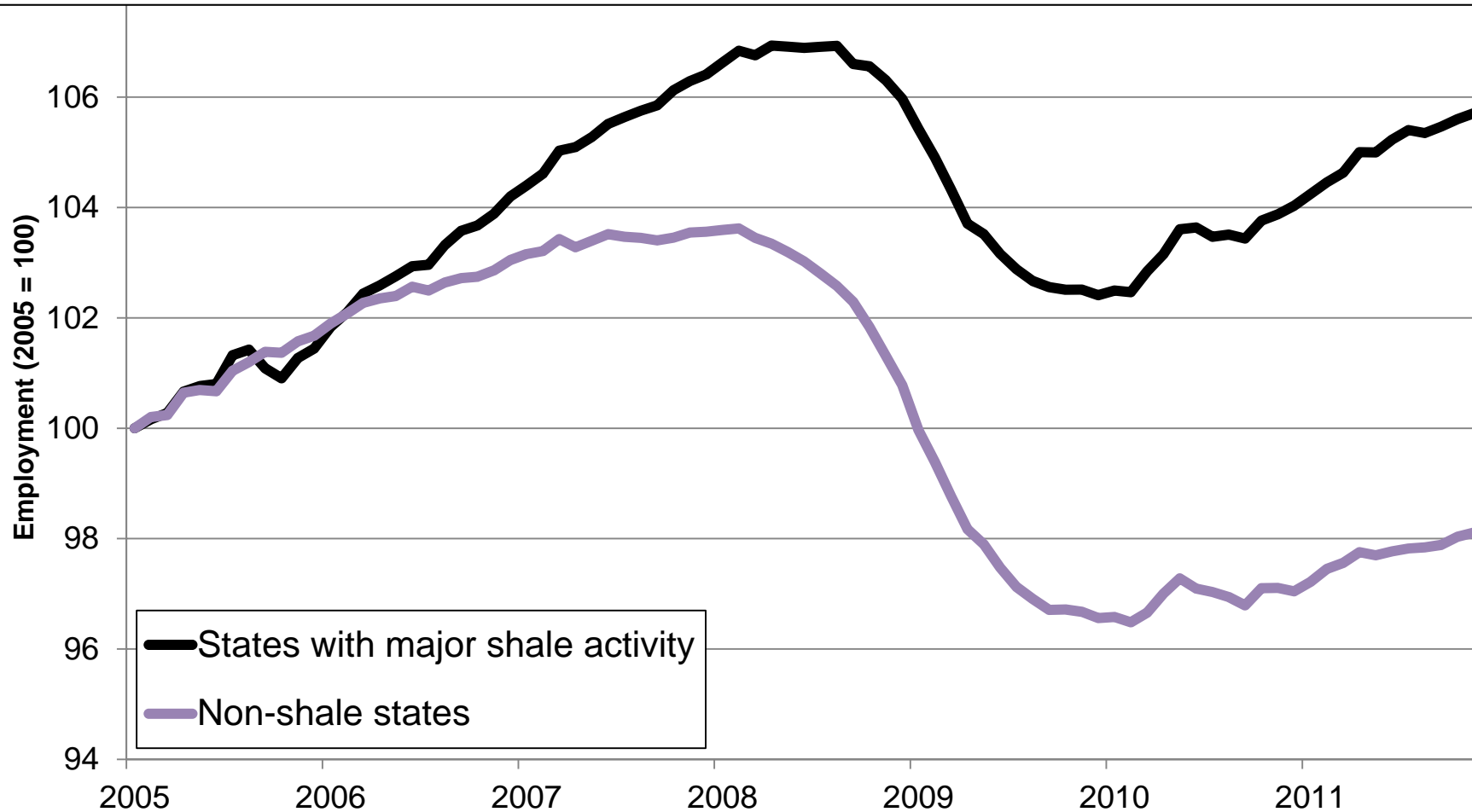
**Oil and gas employment is almost 40 percent above its 2005 level while total U.S. employment struggles to regain four years of losses.**





U.S./Shale Producing State Employment (2005 = 100)

A comparison of total employment tells story beyond just oil and gas.  
Recession not as severe; recovery more robust.



Shale states: LA, TX, AR, ND, UT, CO, & PA  
Source: Bureau of Labor Statistics





## **Conclusions**



**Conclusions**

- **Exceptional industry performance: employment up; reserves up; production up; investment/capacity up; and exports up.**
- **Traditional sectors of energy industry have proven they are high technology, high capital, and high growth – you’d have a hard time figuring that out watching the nightly news.**
- **Policy and perception continue to be things that plague continued industry development. It is hard to imagine the development and innovation that could arise if the current policy uncertainty were removed.**
- **Policy uncertainty is the biggest impediment to continued development. Significant short-term policy retrenchment on unconventional resources could lead to economic impacts that would pale in comparison to past financial and housing crisis.**



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