# The Really Big Game Changer: Crude Oil Production from Shale Resources and the Tuscaloosa Marine Shale

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*Regional Stakeholders Breakfast*
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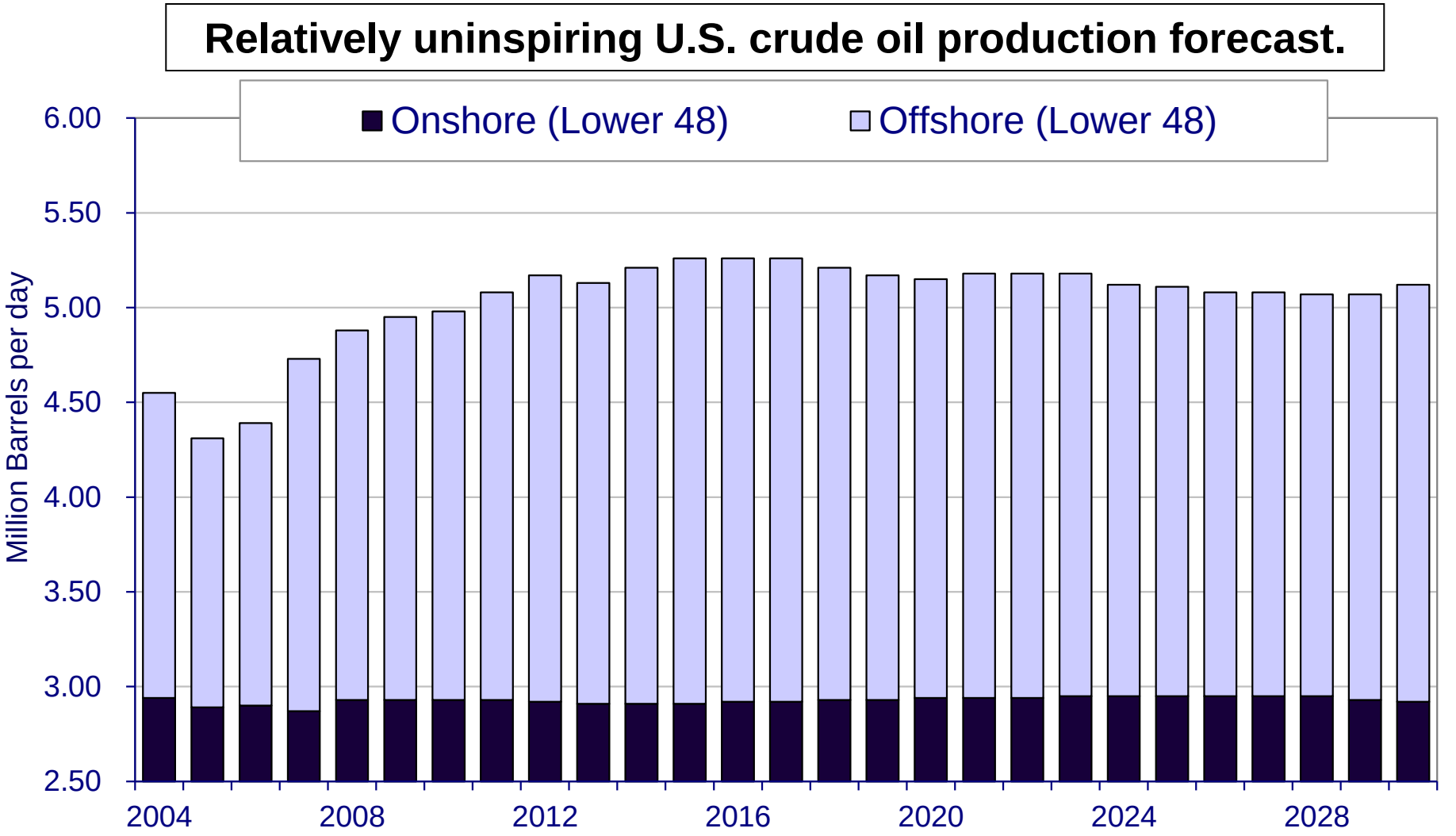
## Summary and Take Away

- **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

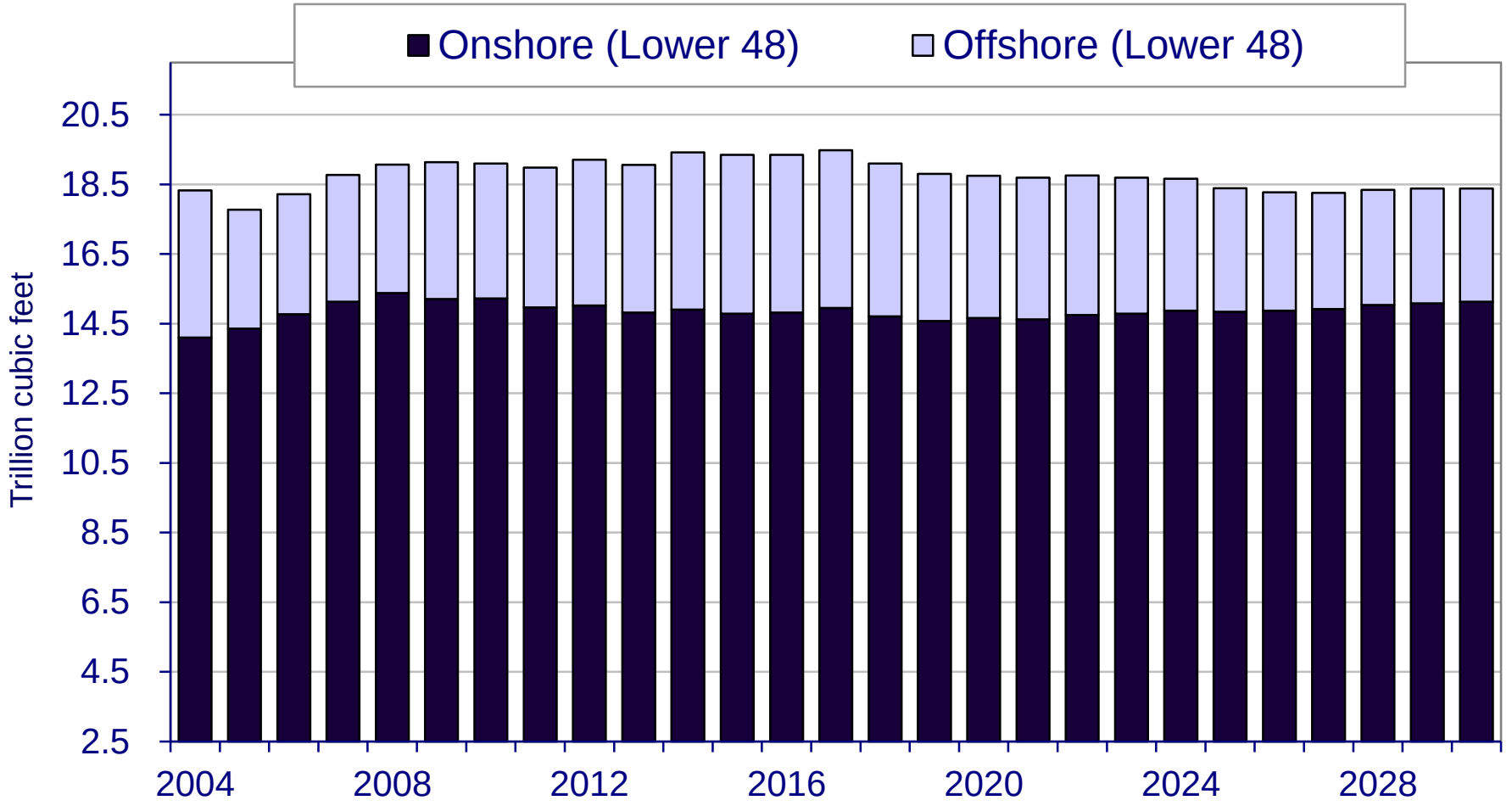
## Long Term US Crude Oil Production Forecast (2006)




Source: USDOE/EIA, Annual Energy Outlook, 2006

## Long Term US Natural Gas Production Forecast (2006)

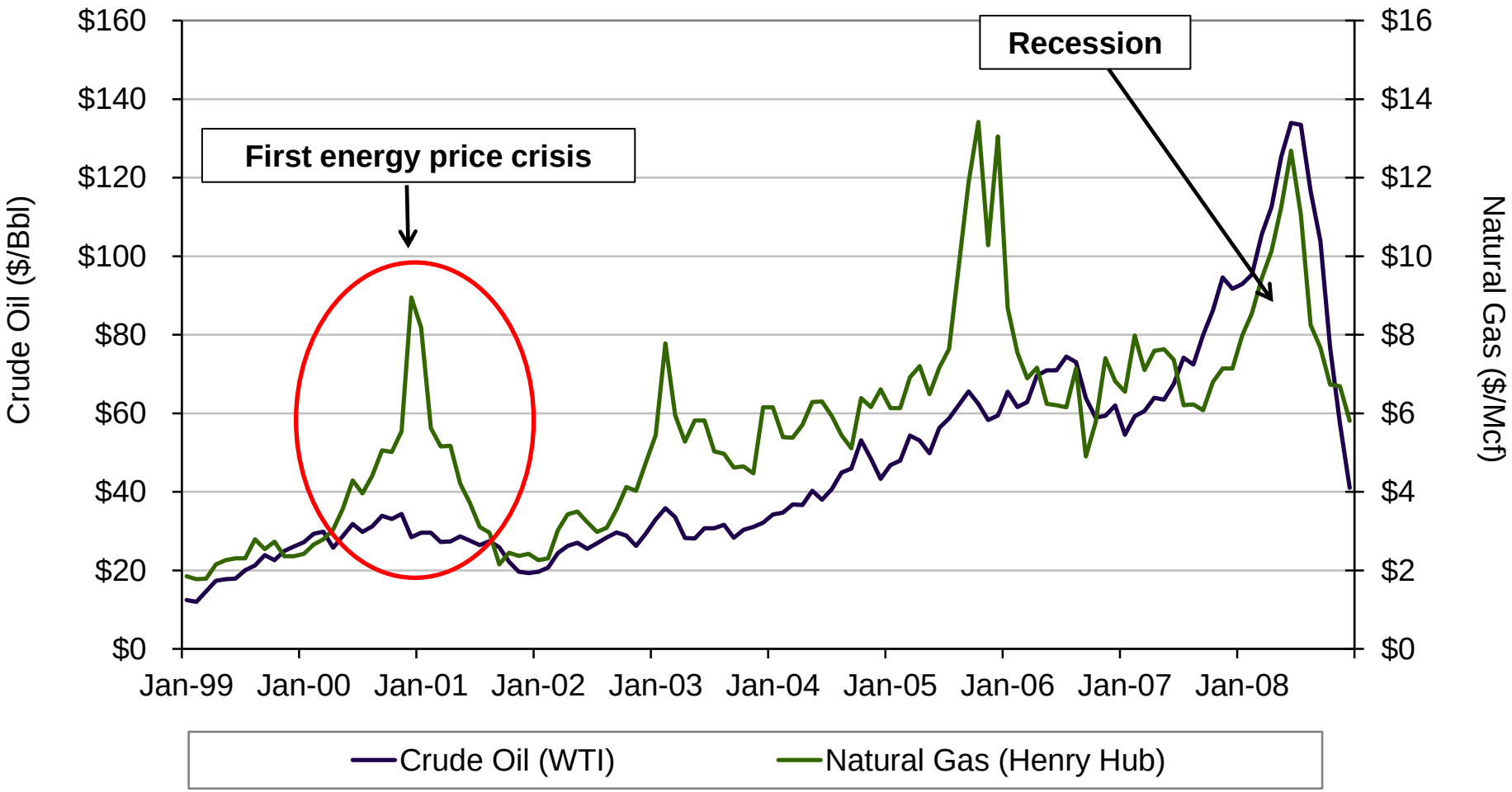
**Natural gas production forecasted to decrease starting in 2016.**




Source: USDOE/EIA, Annual Energy Outlook, 2006

## Crude Oil and Natural Gas Prices

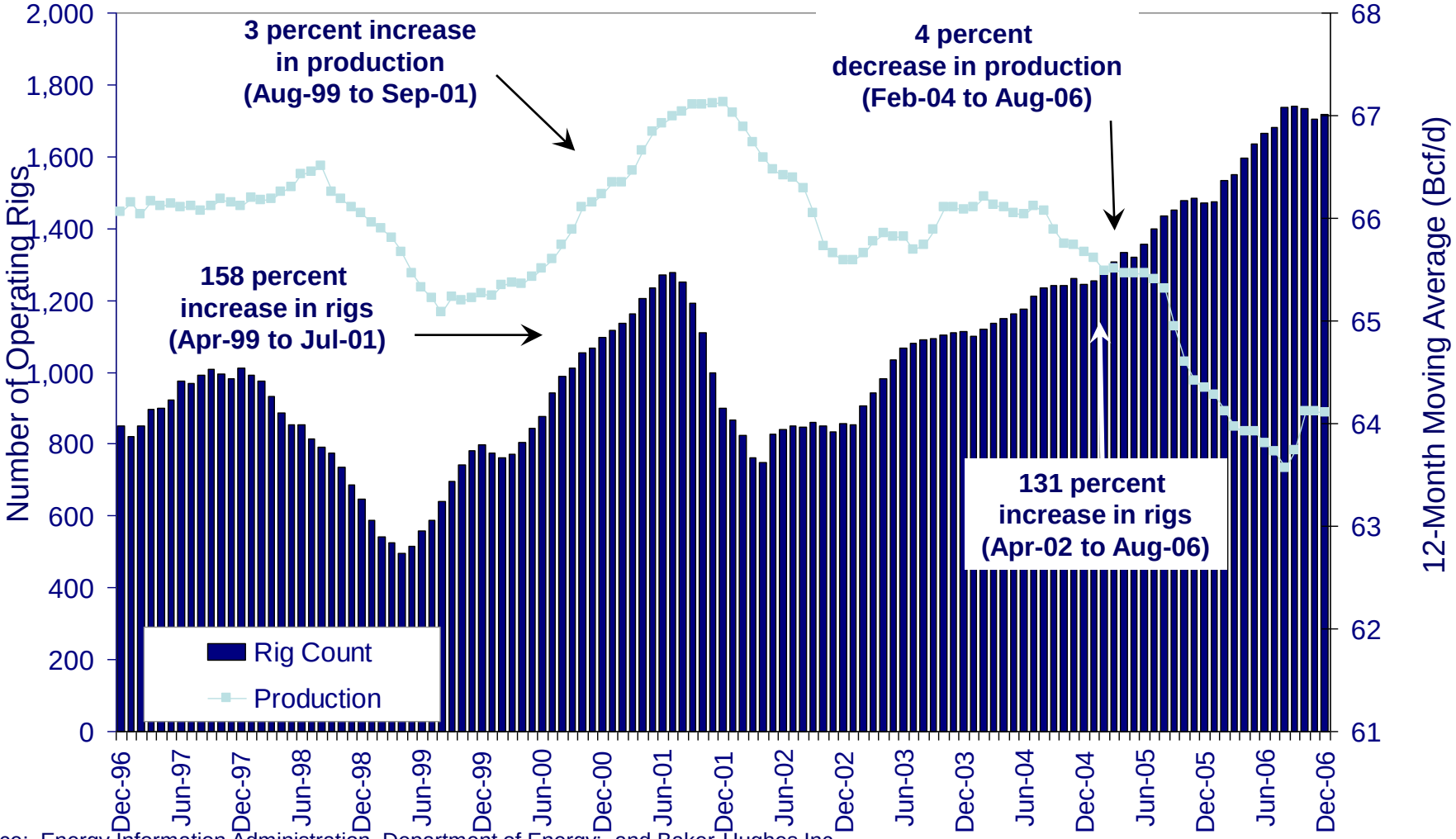
**Prices reflected the state of, and outlook for, energy markets.**




Source: Federal Reserve Bank

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

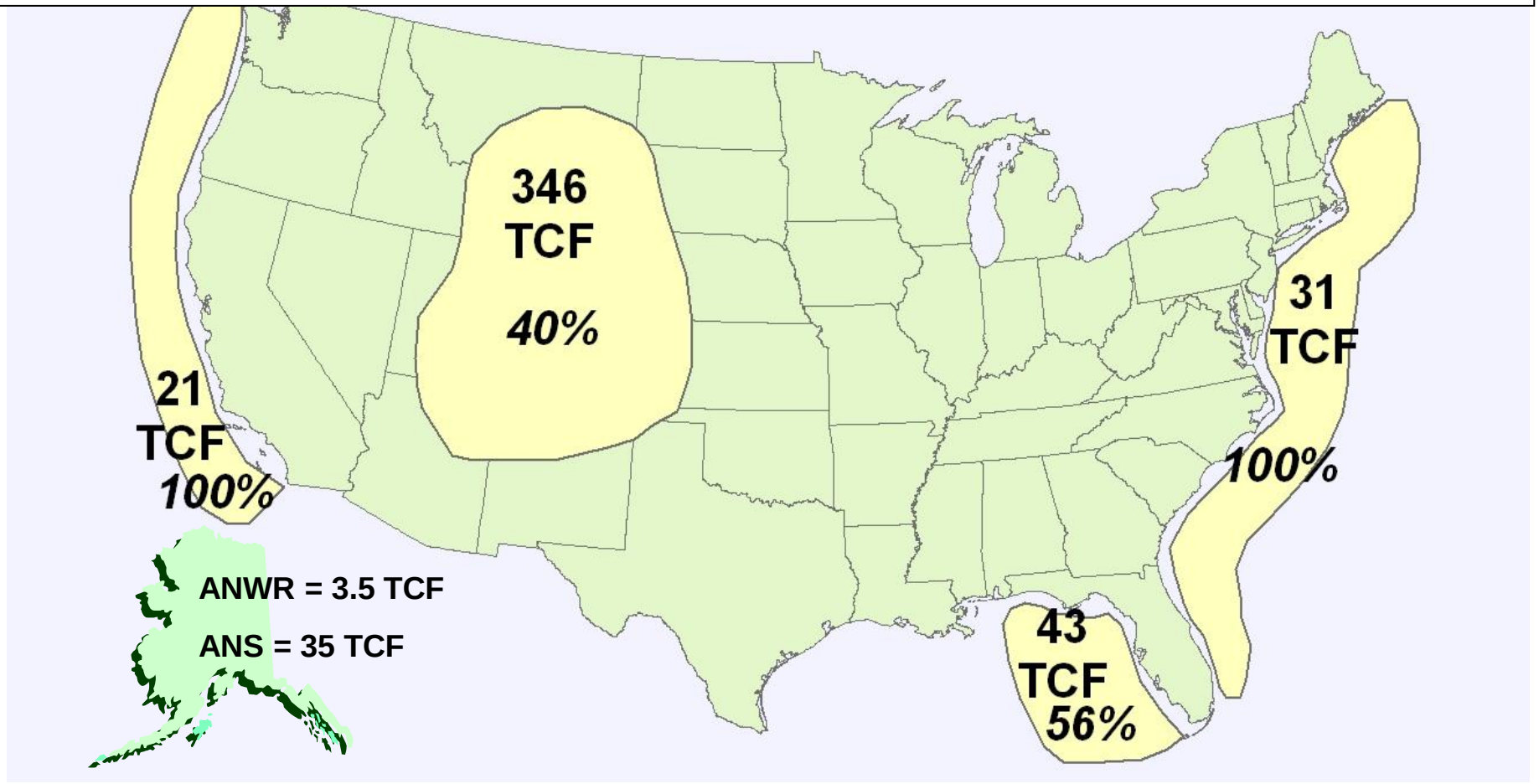
**The maturing nature of US basins reflected in drilling productivity.**




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

## Resource Estimates: Restricted Areas (Percent Restricted)

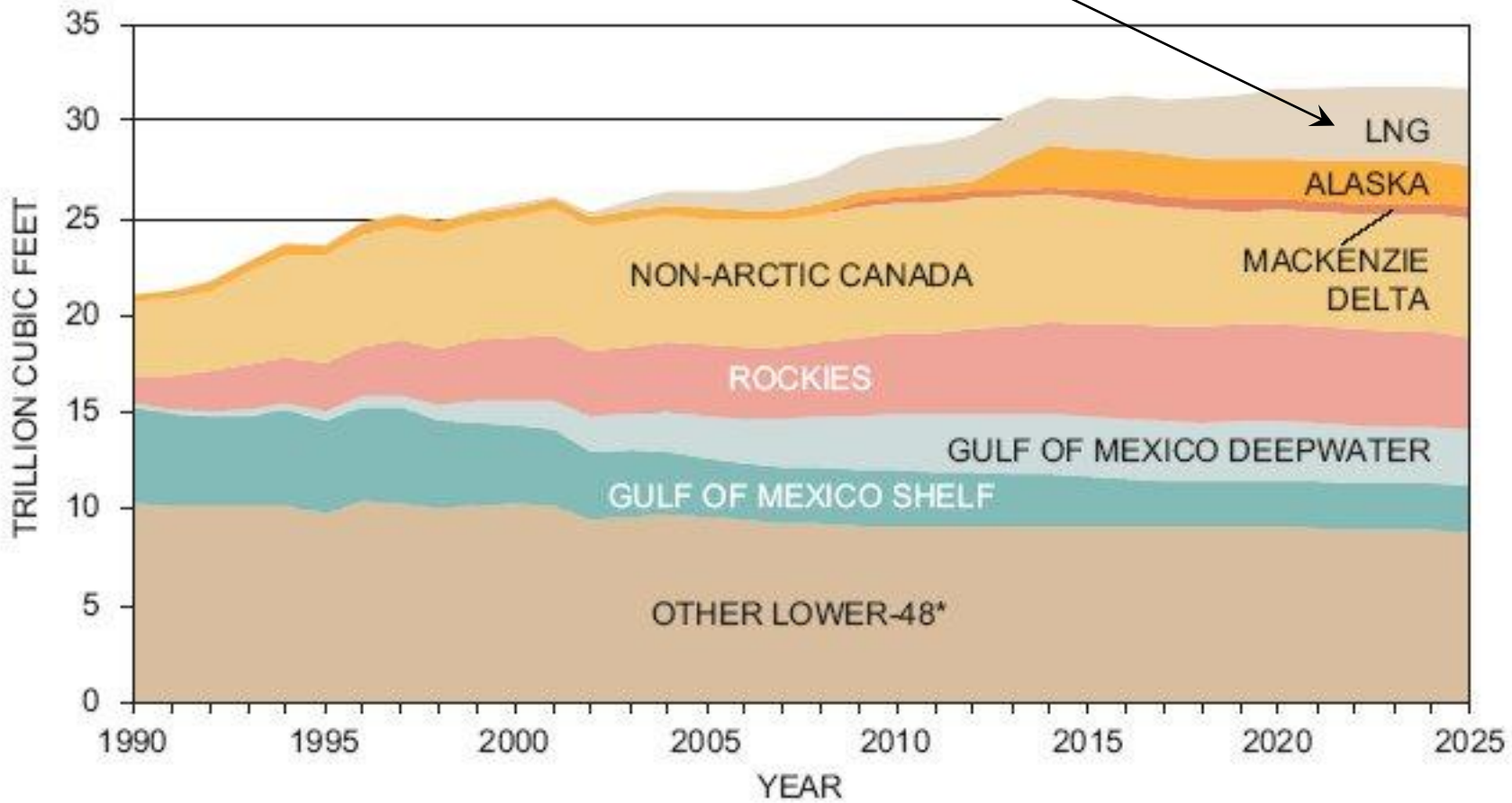
**Policy advocacy focused on restricted areas as a potential solution to the resource constraint problem.**




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.**

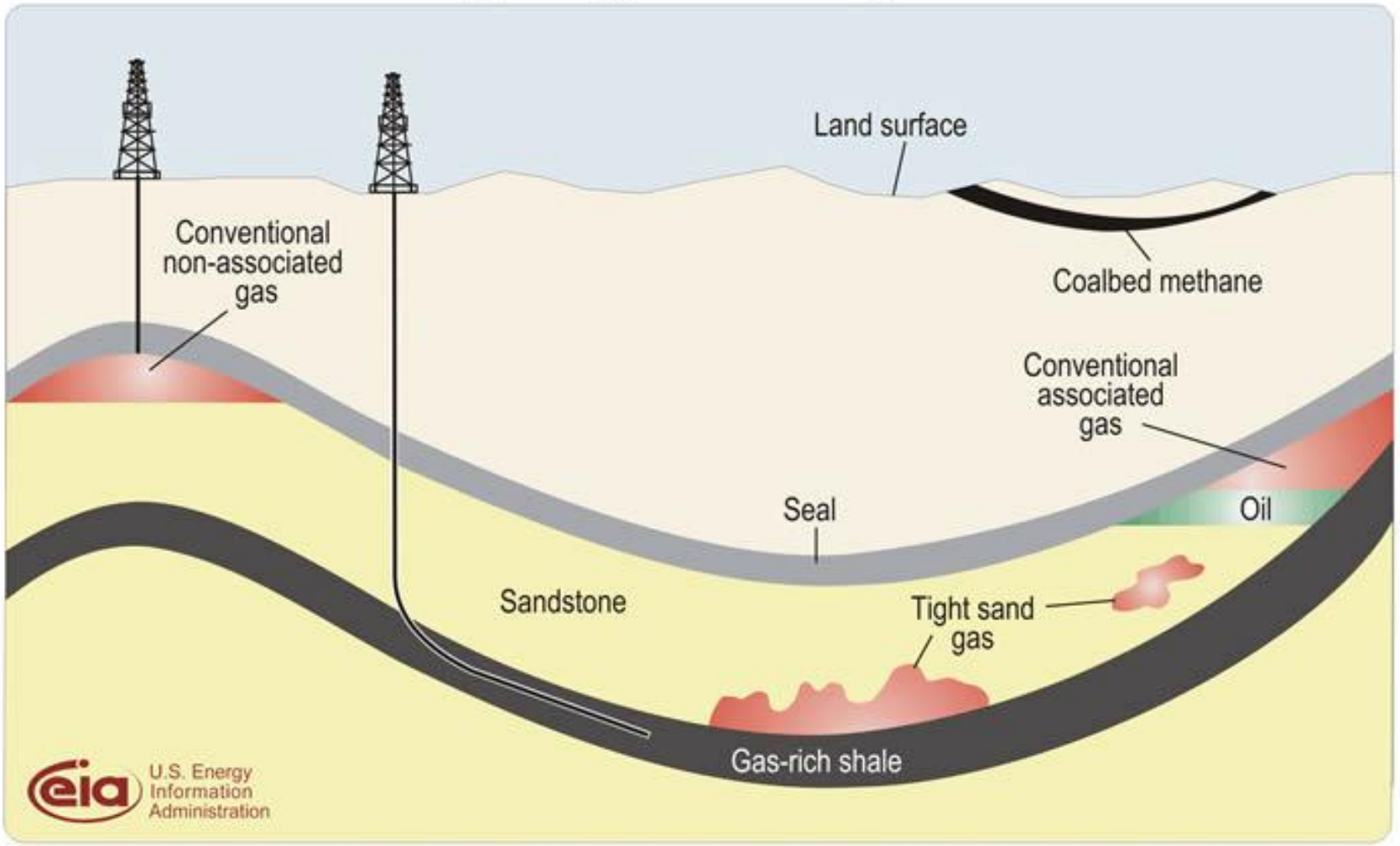



* Includes lower-48 production, ethane rejection, and supplemental gas.

Source: National Petroleum Council

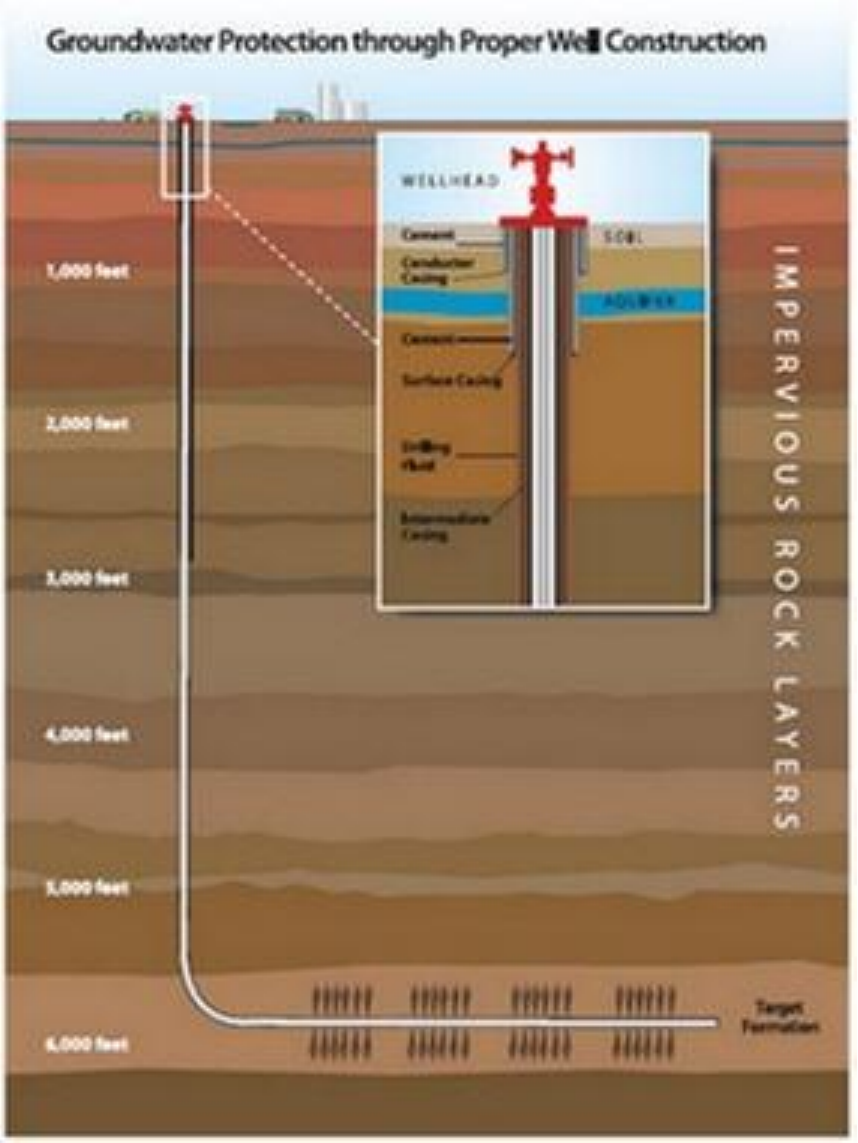
# What Changed? The Way Things Are

## Unconventional vs. Conventional Geological Formations



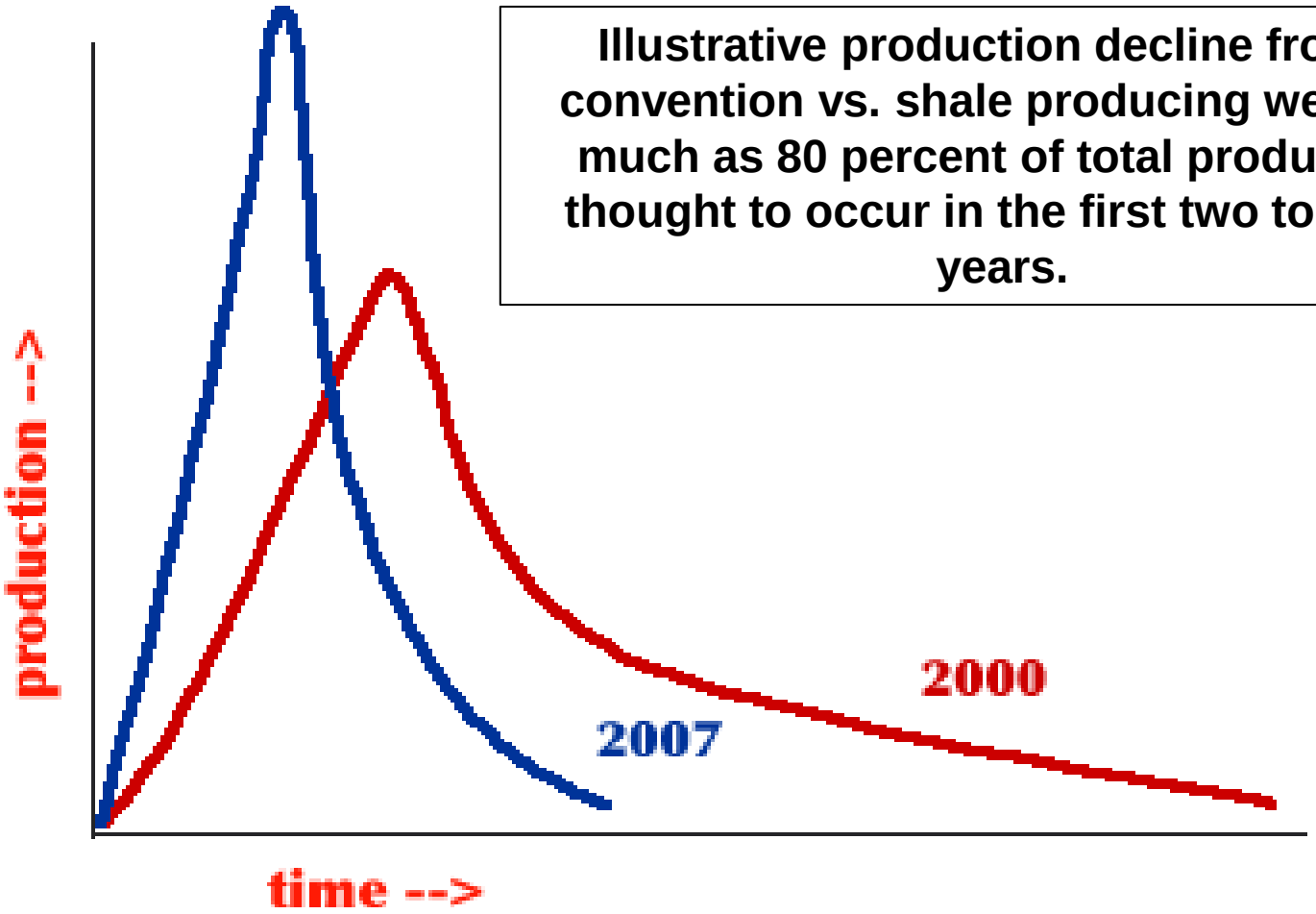
## Shale, Horizontal Drilling, and Fractionation

- 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.




Source: Energy Tomorrow

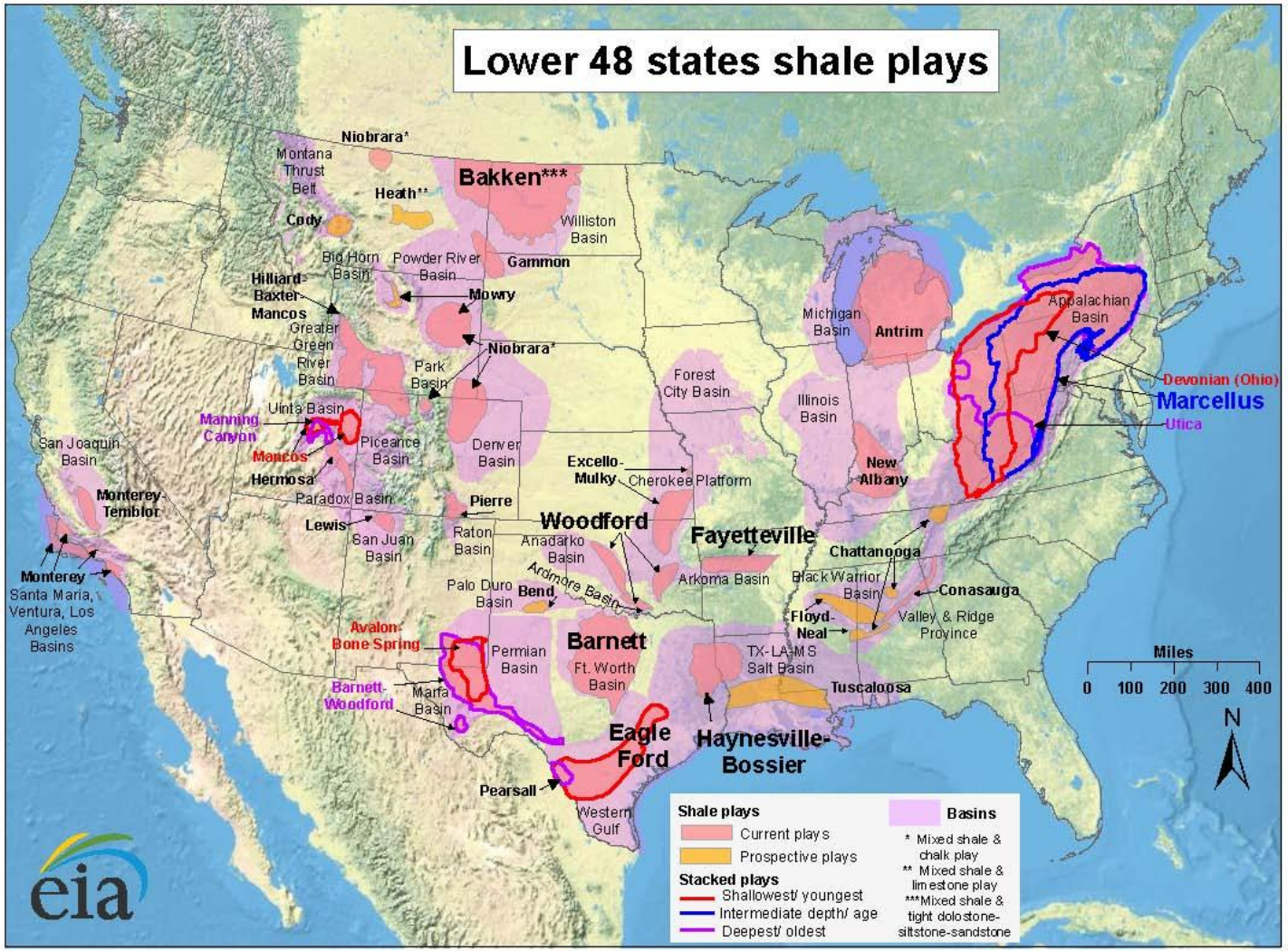
## Production from a Typical Well and Shale Well




**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.**

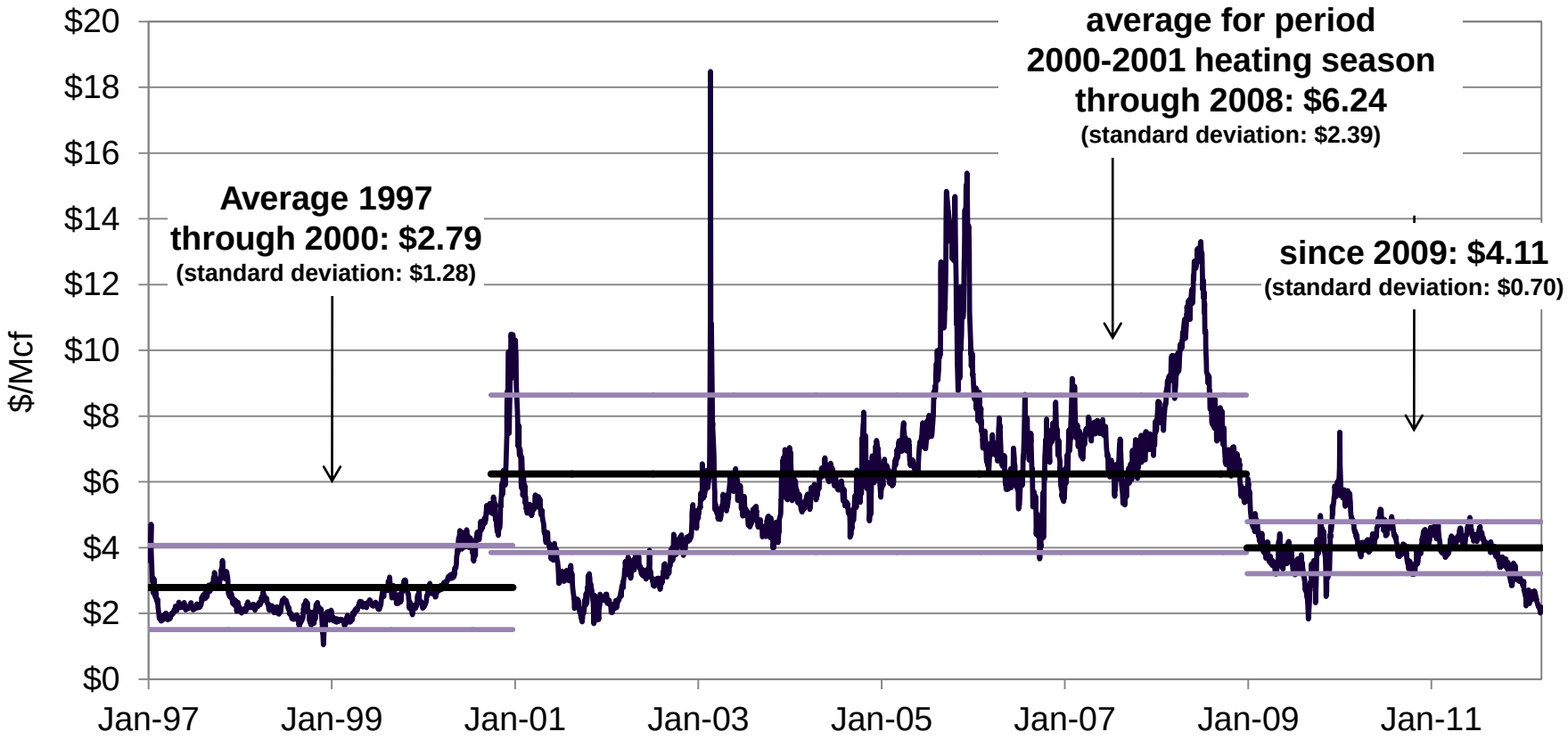



Source: Energy Information Administration, U.S. Department of Energy

# Game Changer 1: Natural Gas

## Natural Gas Price Variability

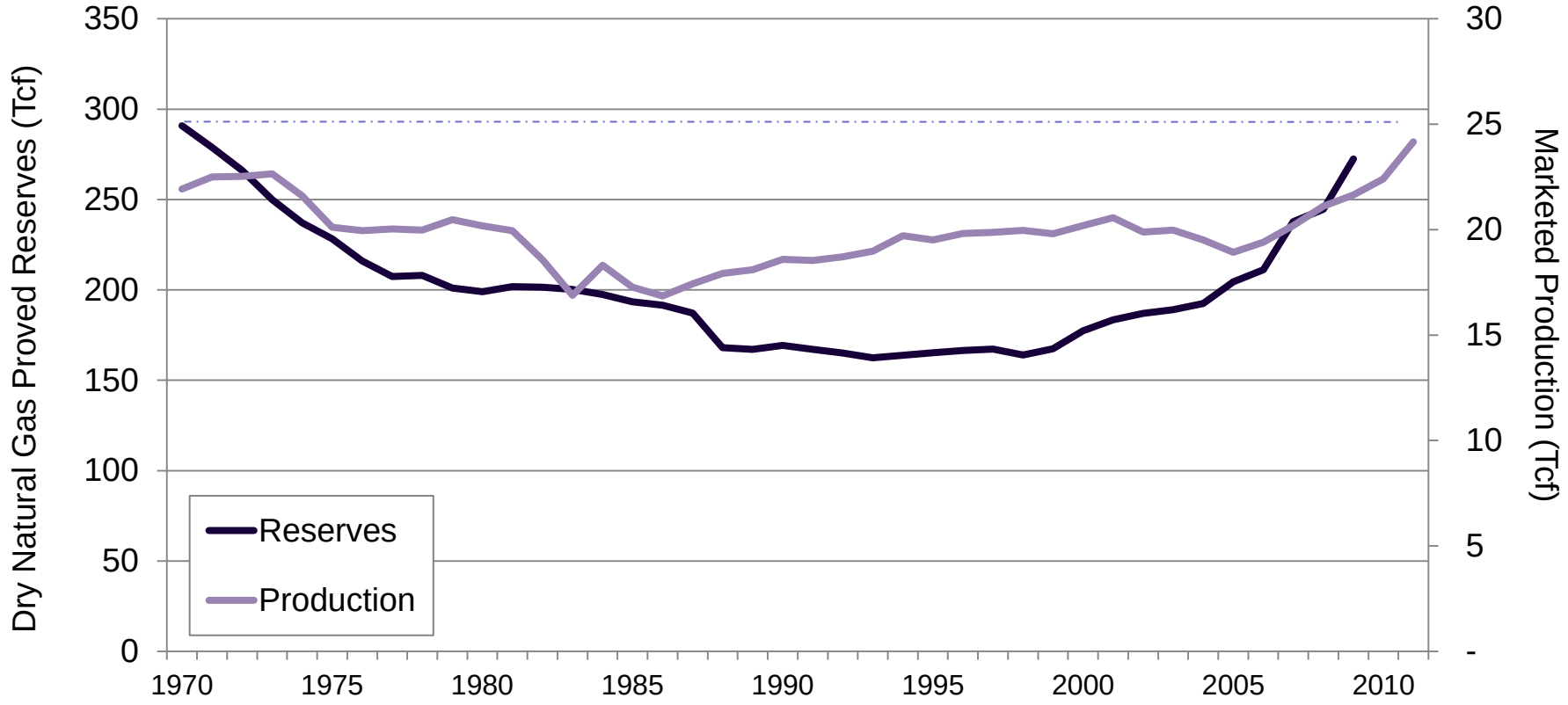
**The 2001 to 2009 market trend of higher average prices coupled with high volatility is reversing itself and post 2009 prices are significantly lower.**




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

## Natural Gas Proved Reserves and Production

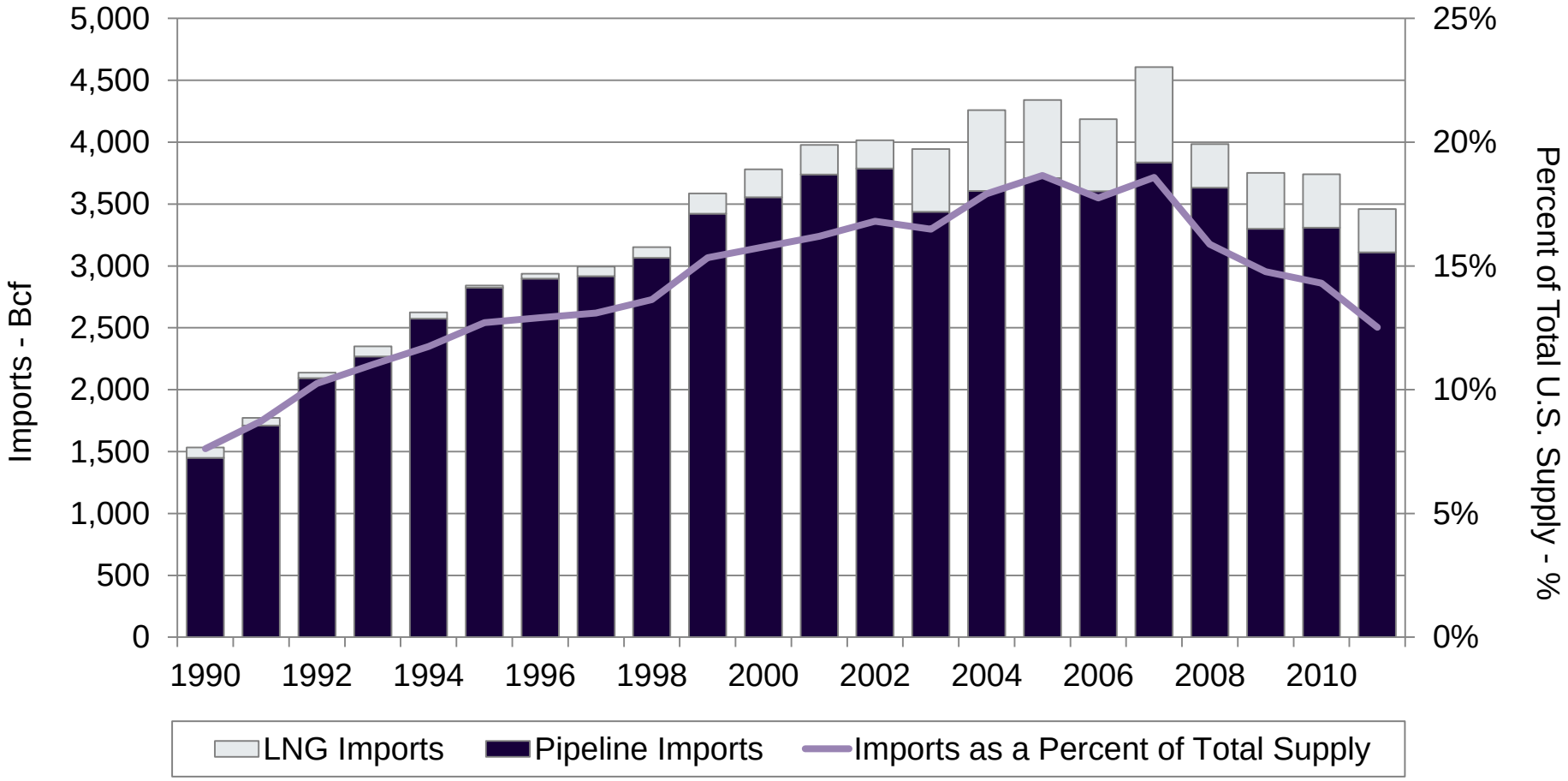
**Current U.S. natural gas reserves are approaching record levels not seen since 1970. Natural gas production is at levels that surpass historic peaks.**




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

## Natural Gas Imports

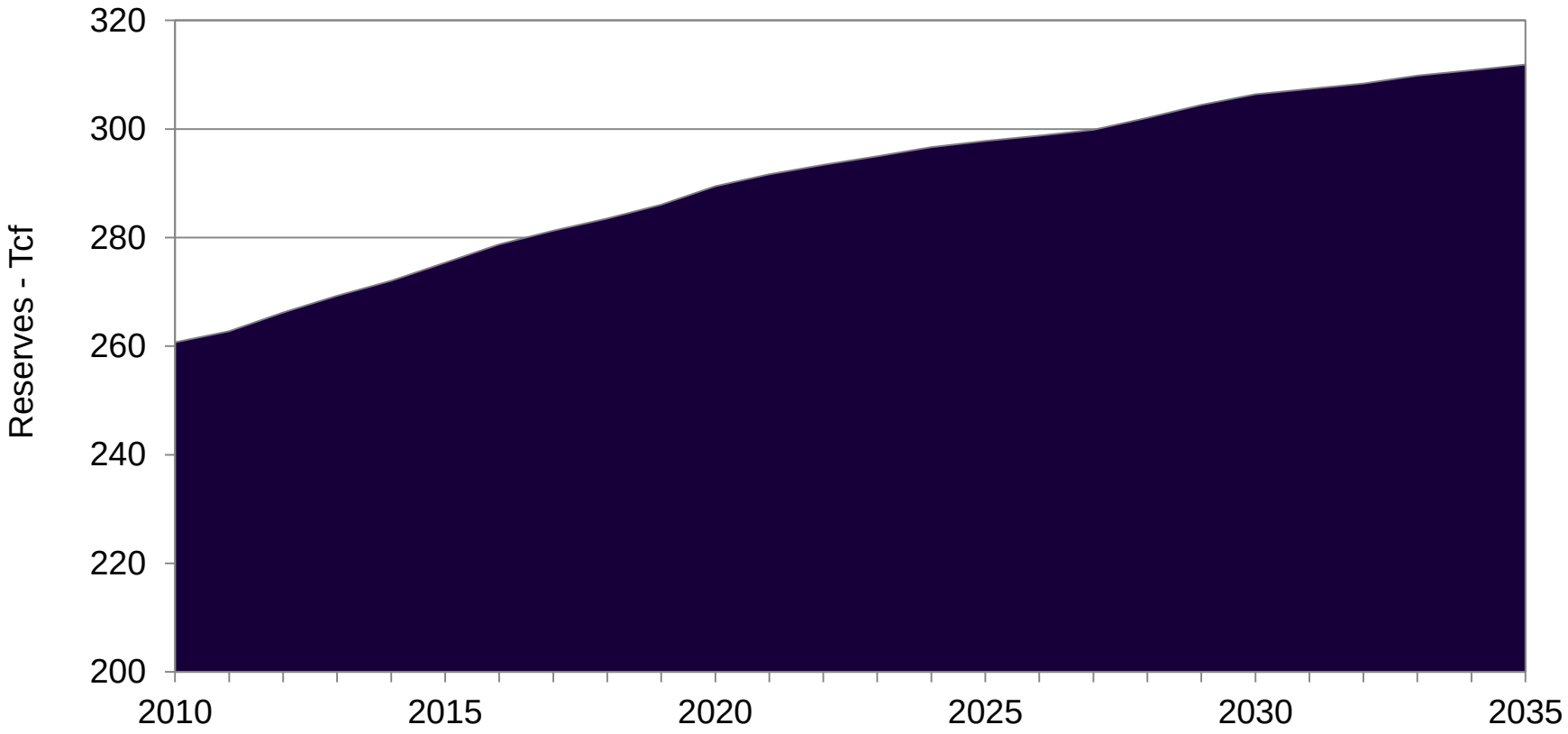
**Natural gas imports, once thought the be the supply remedy for meeting future gas needs are falling to levels also not seen since the 1990s.**




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

## Annual Energy Outlook, Natural Gas Reserves

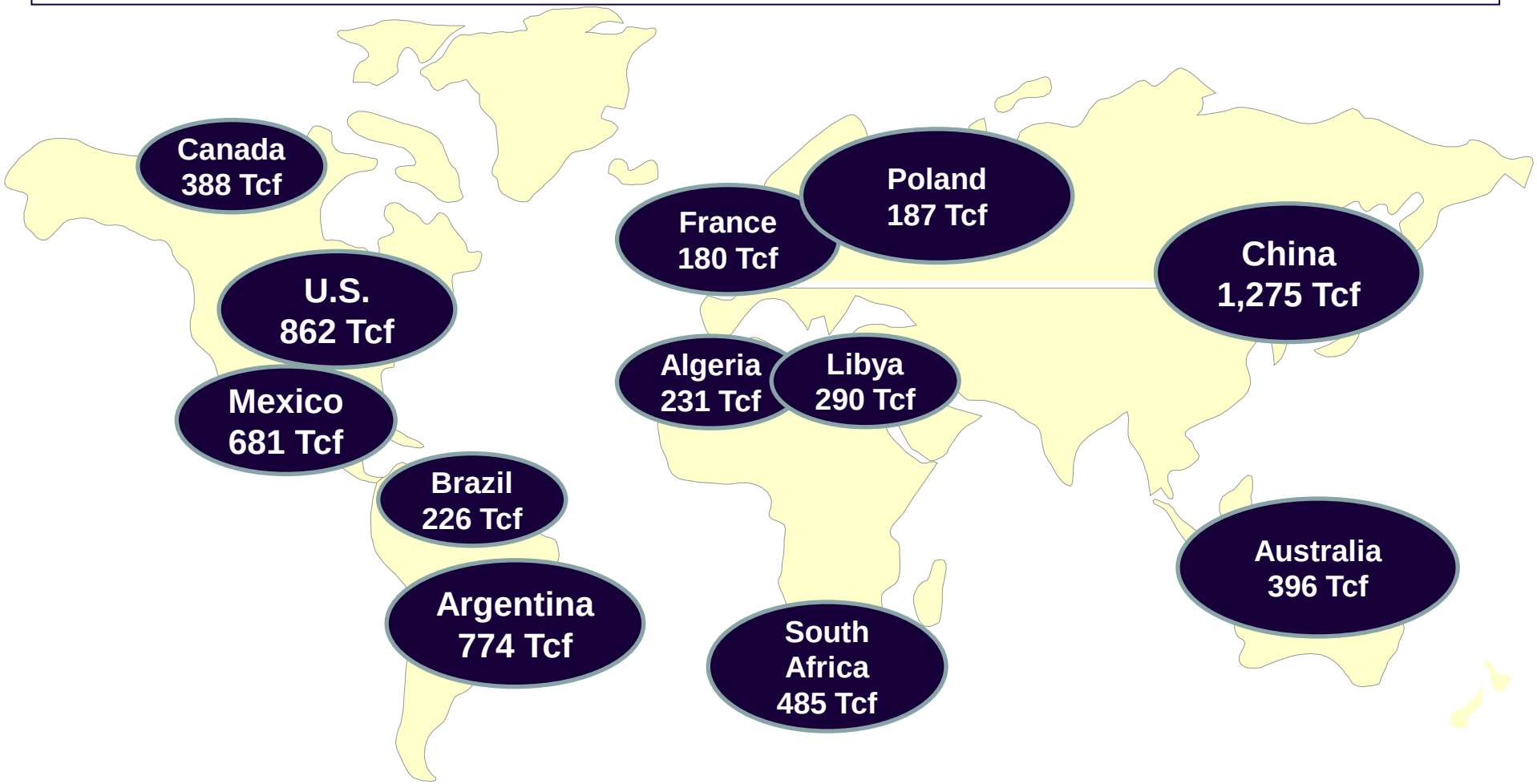
**Unconventional resources are not a "flash in the pan" and are anticipated to continue to increase over the next two decades or more.**




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

## Basin Competition

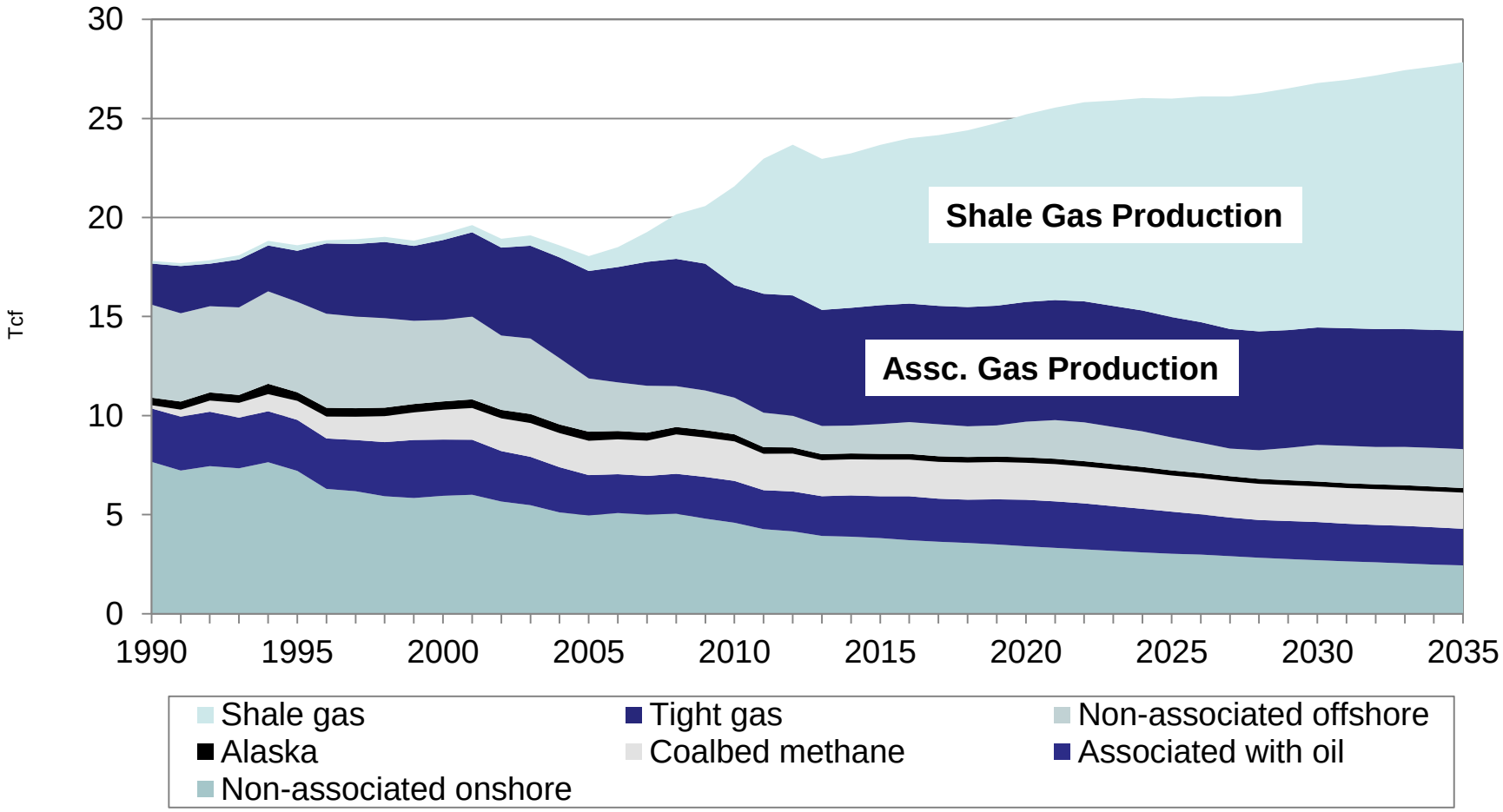
**Close to 6,000 TCF of shale gas opportunities around the world. Coupled with 9,000 Tcf in conventional suggest a potentially solid resource base for many decades.**




Source: MIT Energy Initiative.

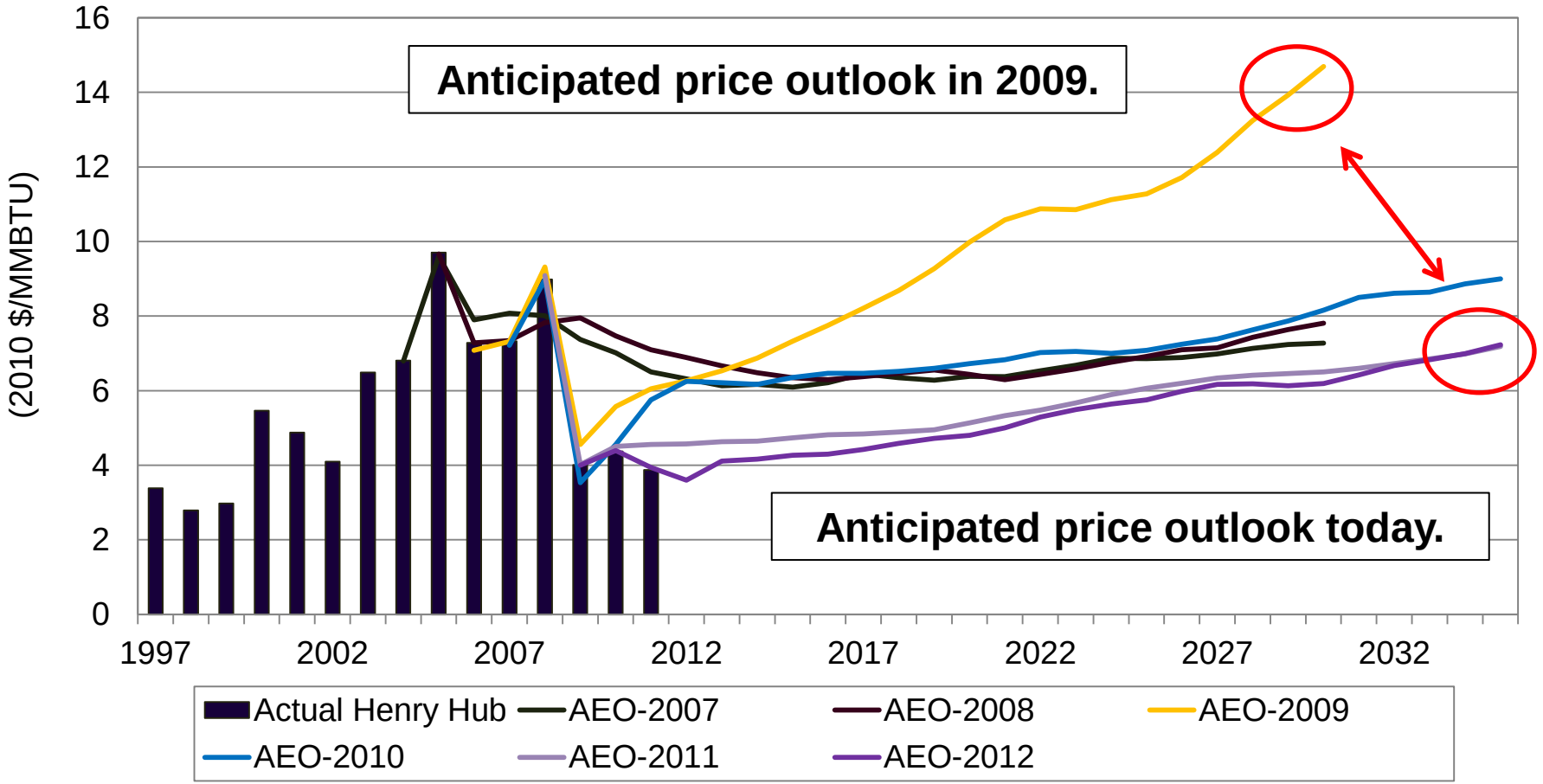
## Forecast U.S. natural gas production, 1990-2035

**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.**

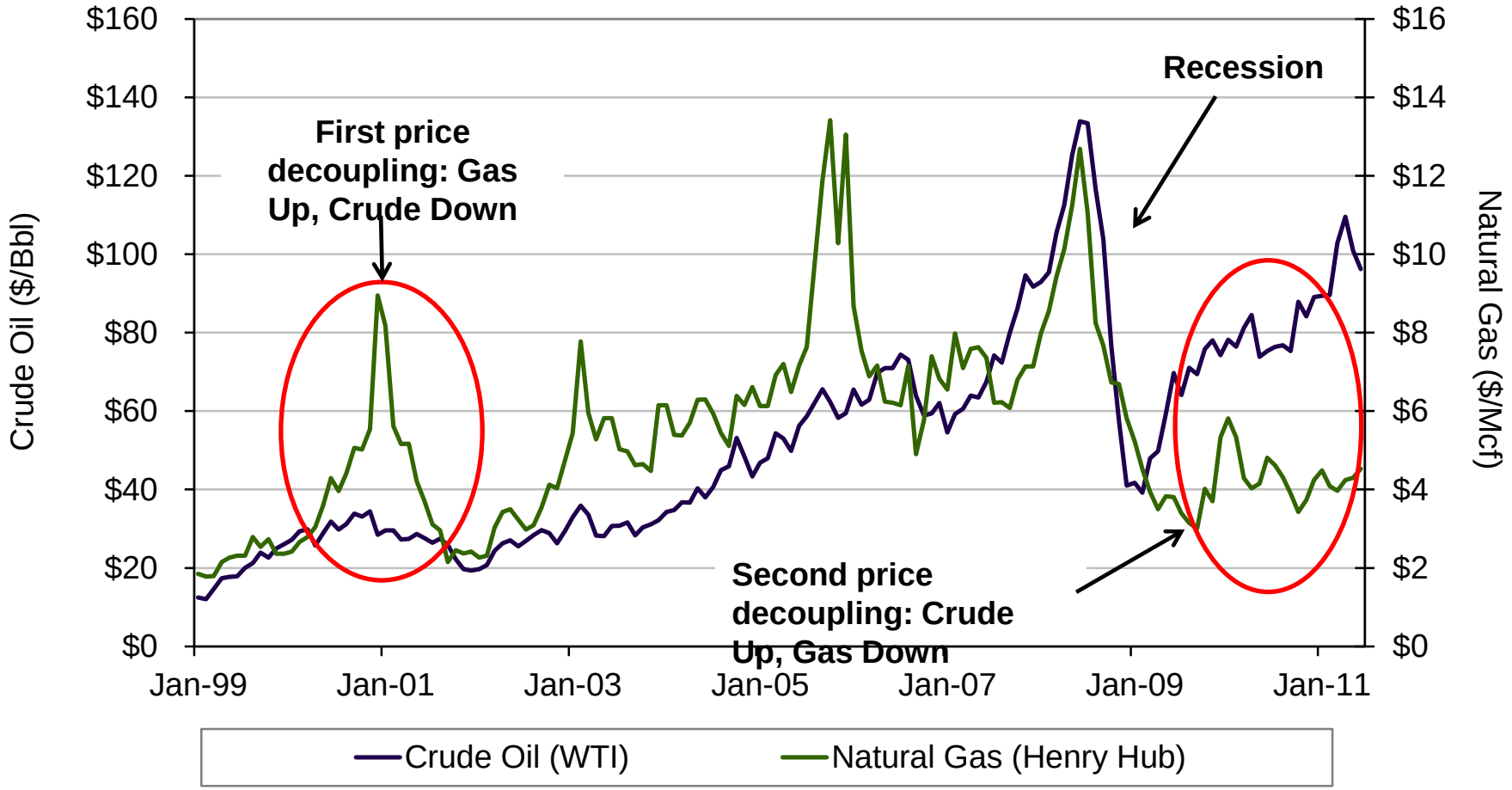



Source: Energy Information Administration, U.S. Department of Energy

# Game Changer 2: Crude and Liquids

## Crude Oil and Natural Gas Prices

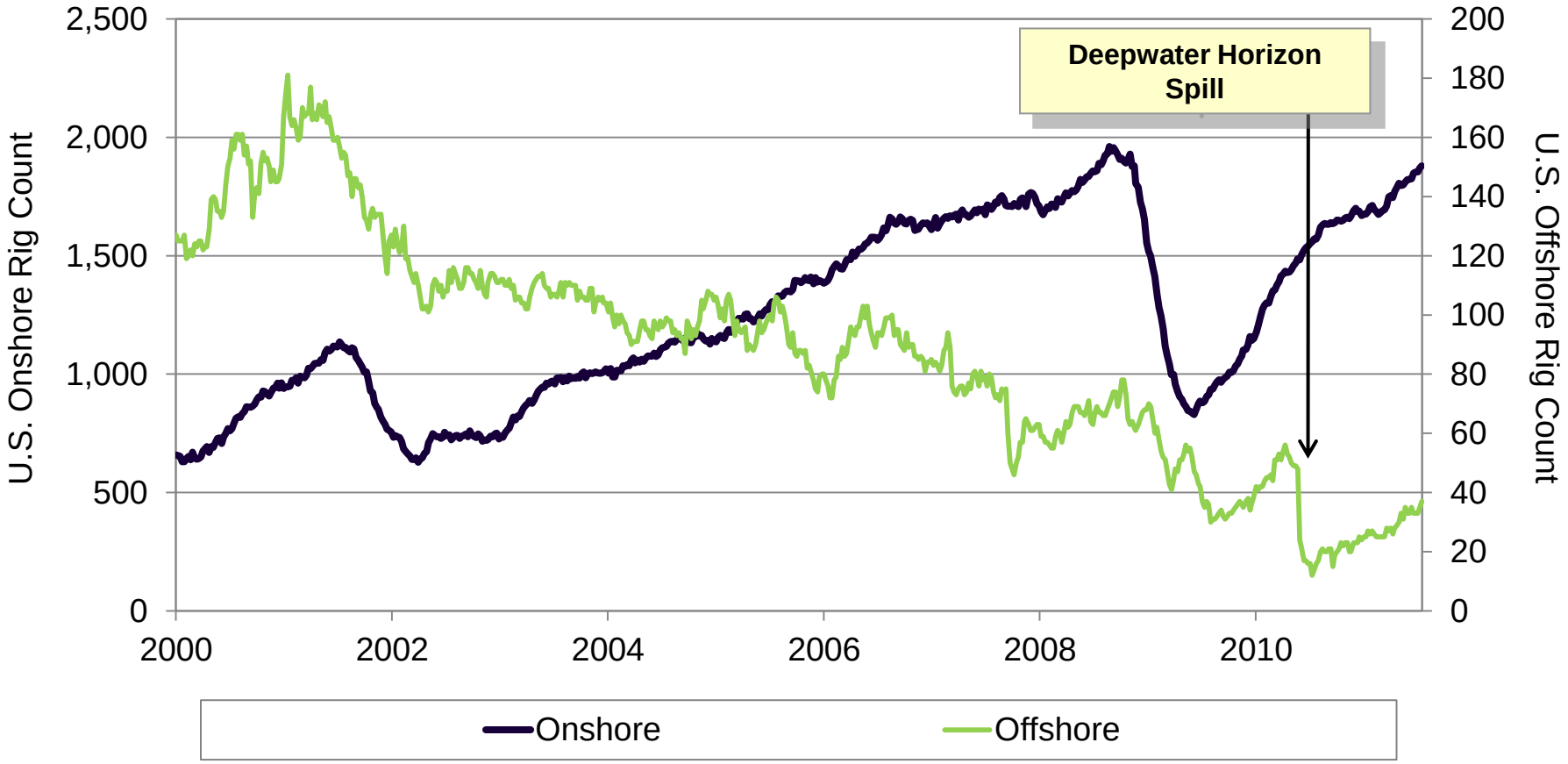
**Two significant breaks (decoupling) of natural gas and crude oil prices.**




Source: Federal Reserve Bank

## Domestic Rig Counts – Onshore vs. Offshore

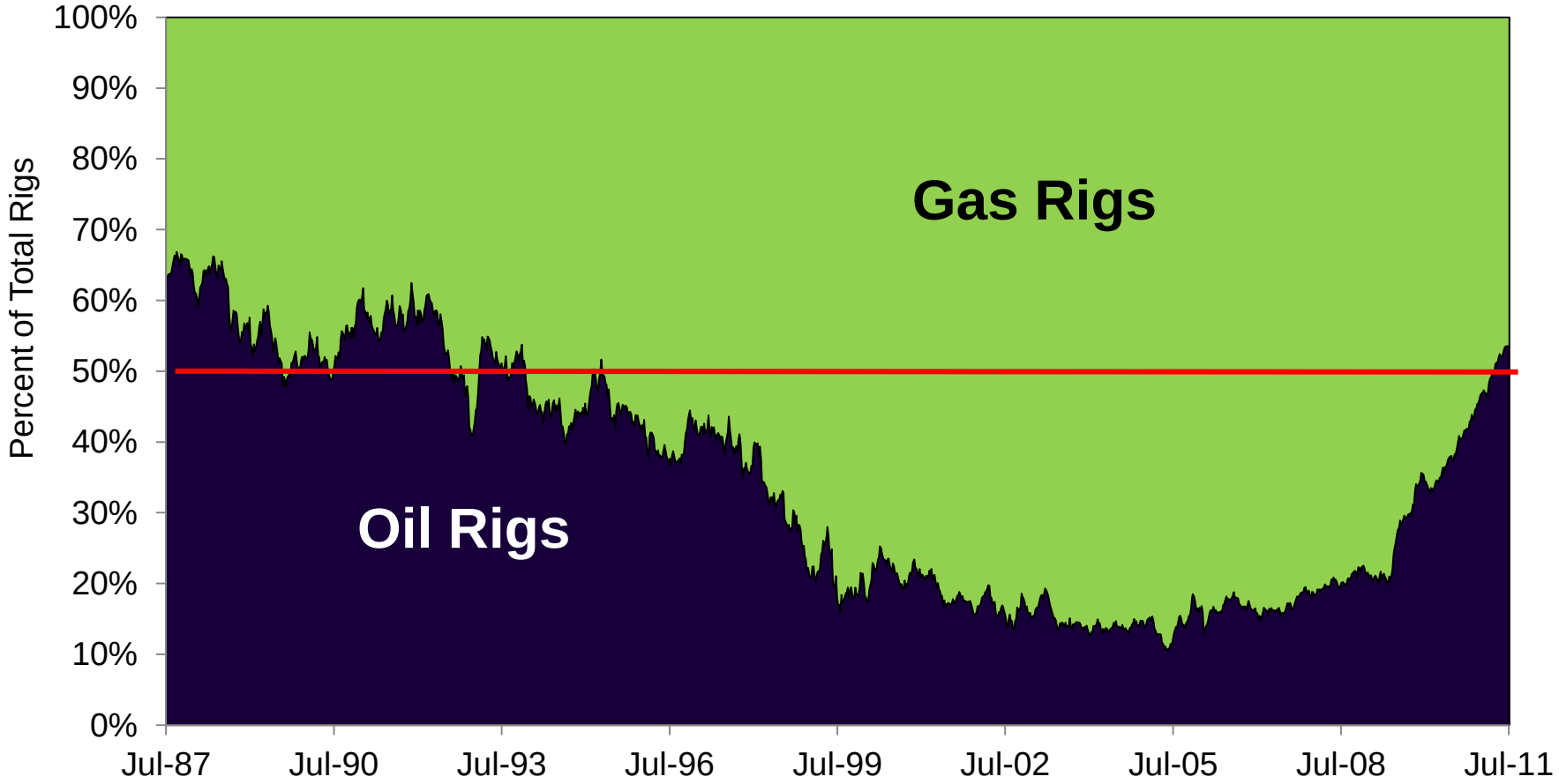
**Onshore rig counts are moving close to their pre-recession levels, primarily motivated by increased crude oil drilling, not natural gas.**




Source: Baker Hughes.

## Domestic Rig Count – Crude Oil vs. Natural Gas

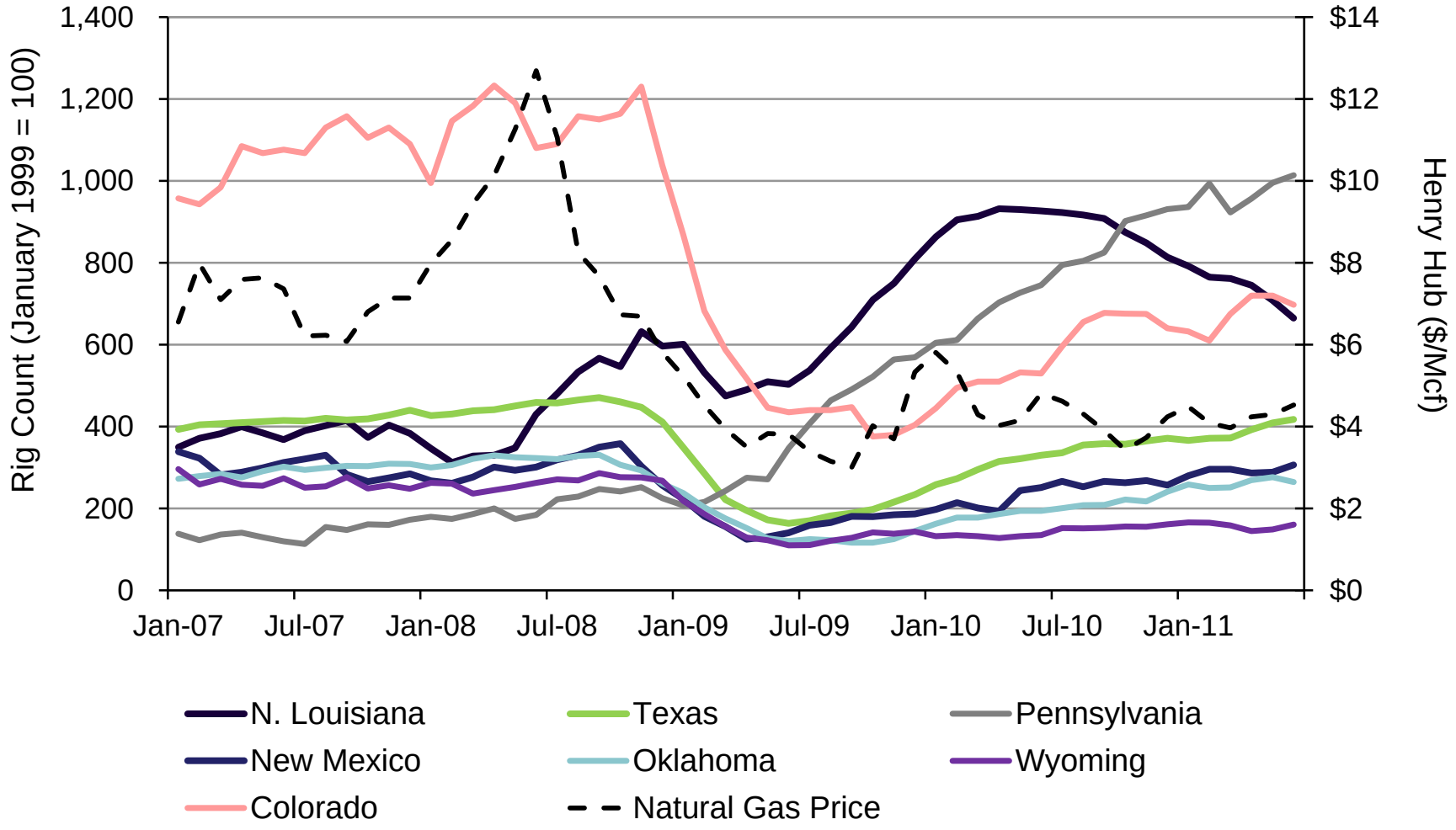
**For the first time in 16 years, the number of oil rigs is equivalent to gas rigs.**




Source: Baker Hughes.

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

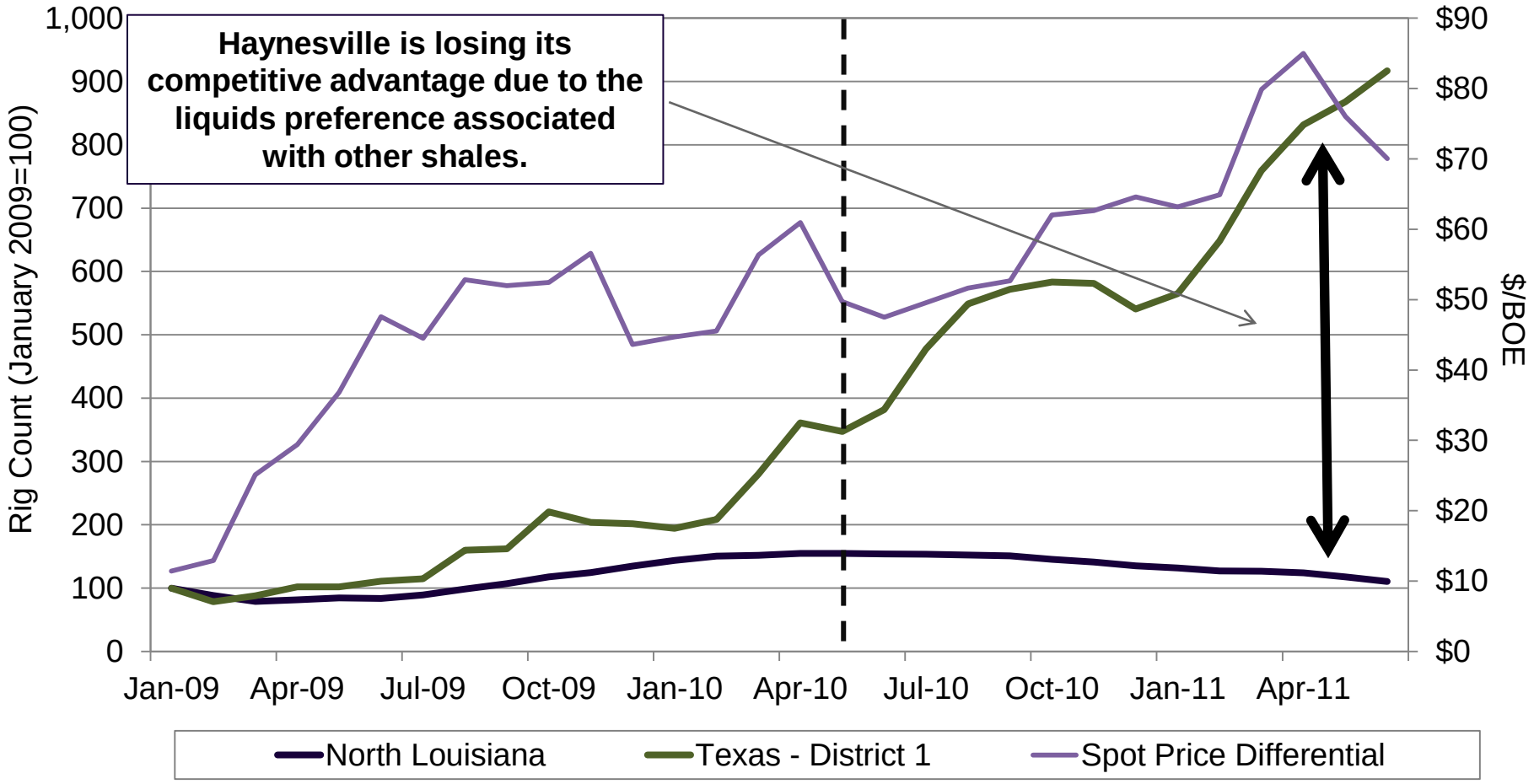
# Drilling rig activity increasing rapidly in liquids rich shale.



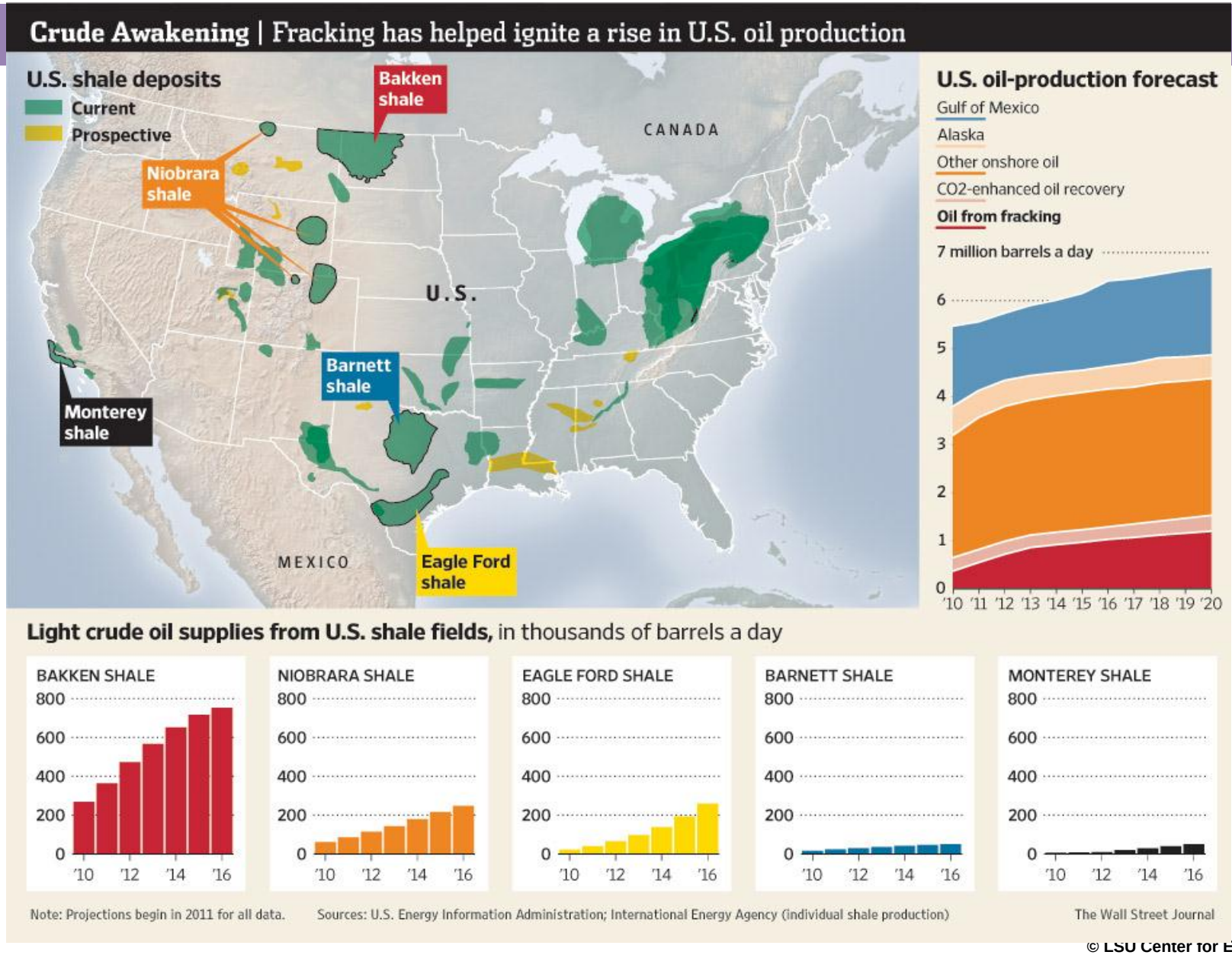

Source: Baker Hughes; and Federal Reserve Bank of St. Louis.

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

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

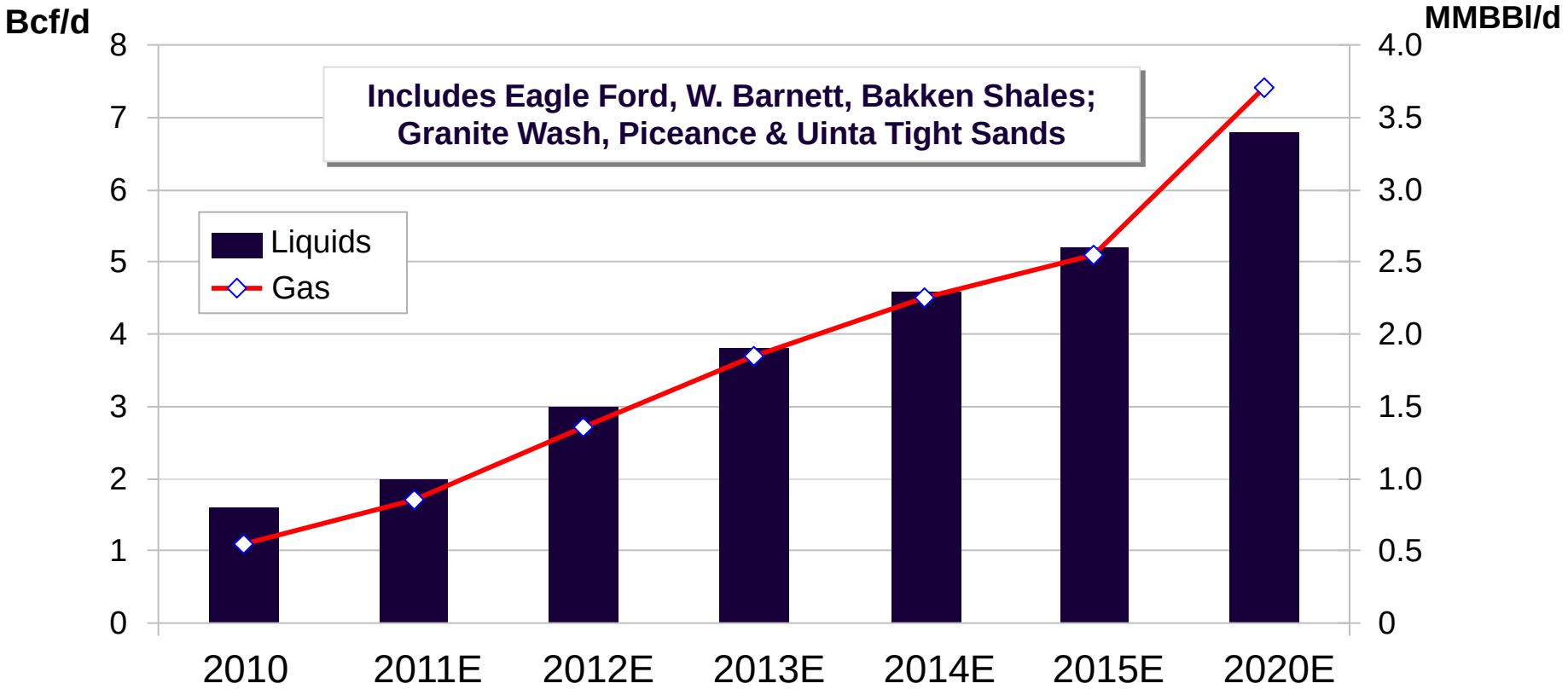



Source: Baker Hughes. Rig counts are indexed to the level of active drilling rigs in each reported area as of January 2009.



## 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).**

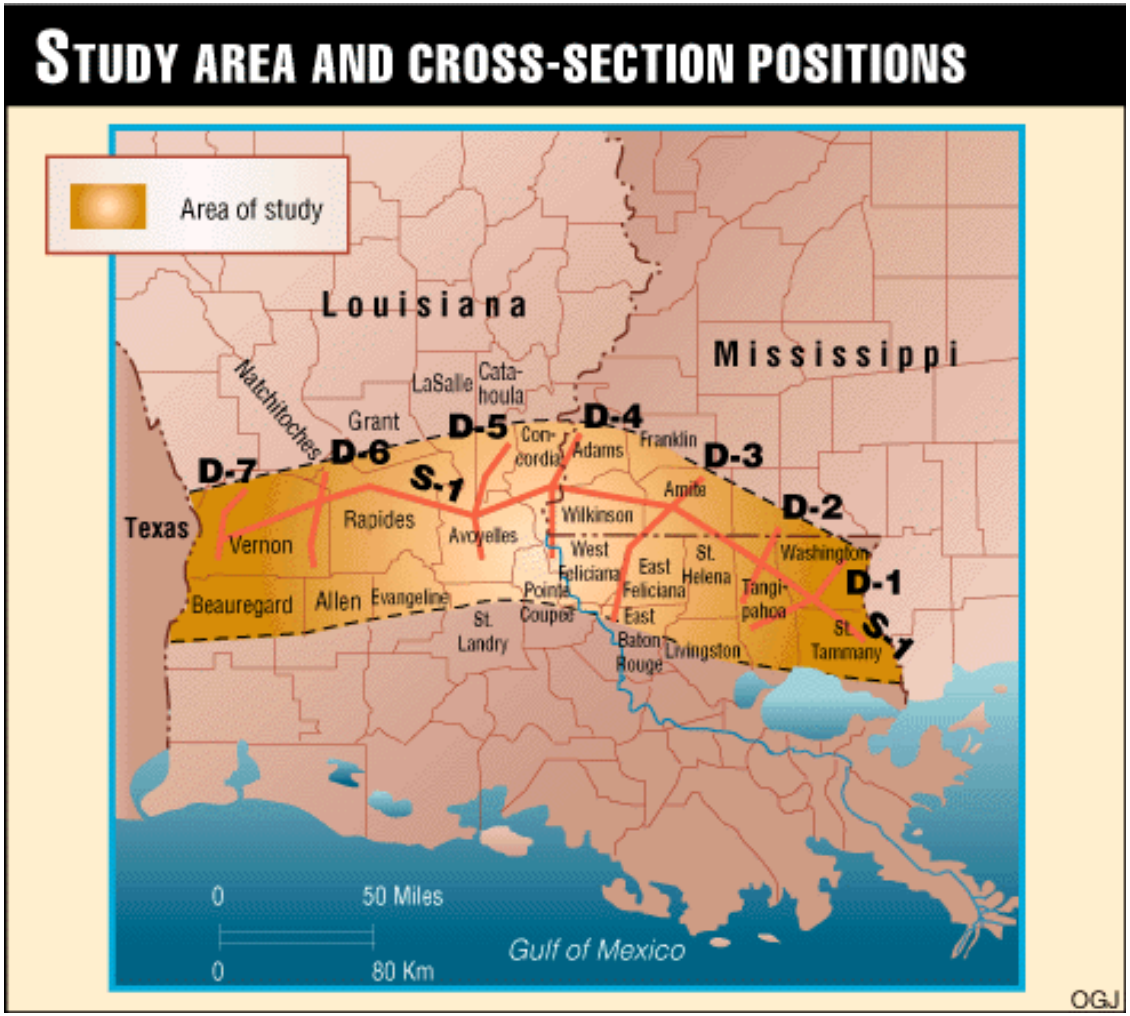



Source: Advanced Resource Intl; presentation to Cheniere Board, March 2011; Cheniere Research

# Closer to Home: Louisiana and the Tuscaloosa Marine Shale ("TMS")

## Crude Oil Shale Opportunities -- Louisiana

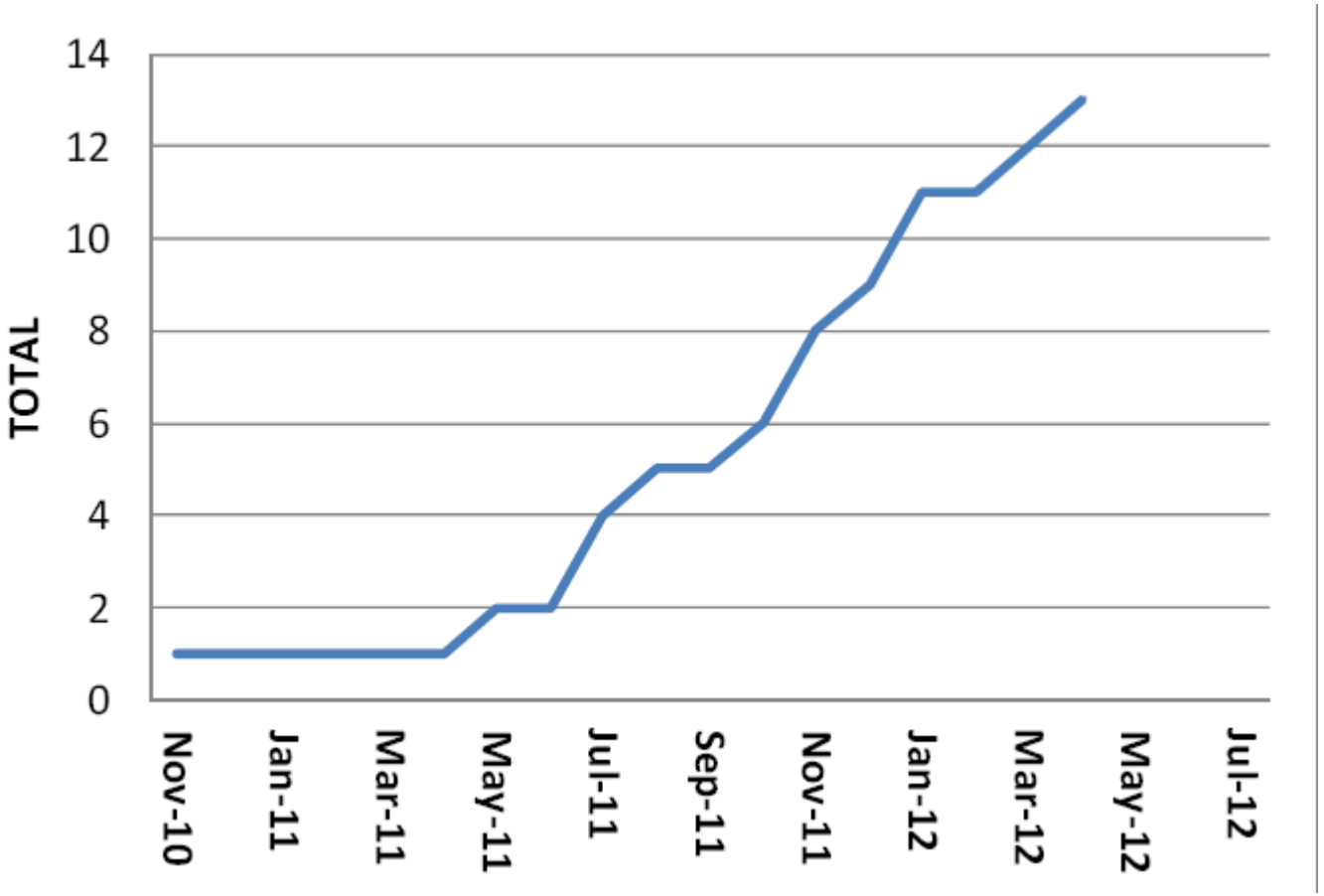
- 1998 LGS Study primary publicly-available source of information on the formation.
- Lies between sands of the upper and lower Tuscaloosa.
- Approximately 2.7 MM acres.
- Varies in thickness from 500 feet (MS) to around 800 feet (LA).
- Shallowest opportunity around 10,000 feet – mostly between 11,000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




Source: Oil and Gas Journal and Louisiana Geological Survey.

## Cumulative TMS Wells Drilled

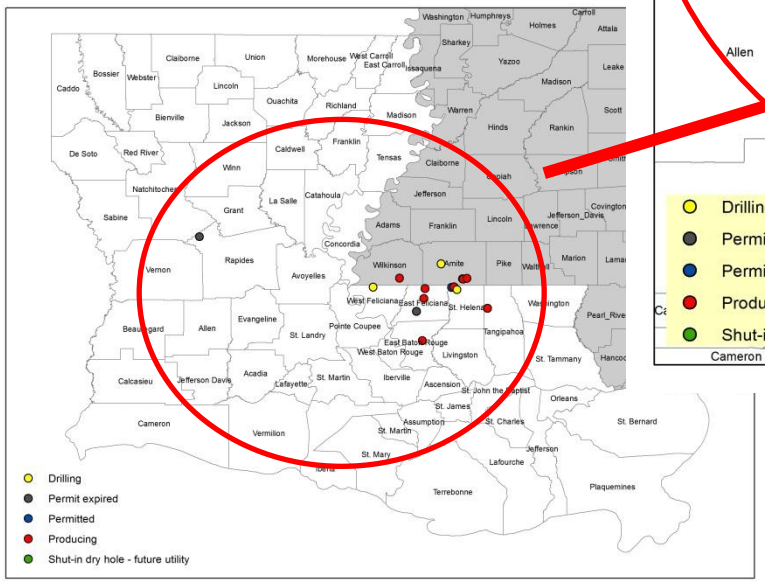
**Approximately 13 wells drilled to date.**

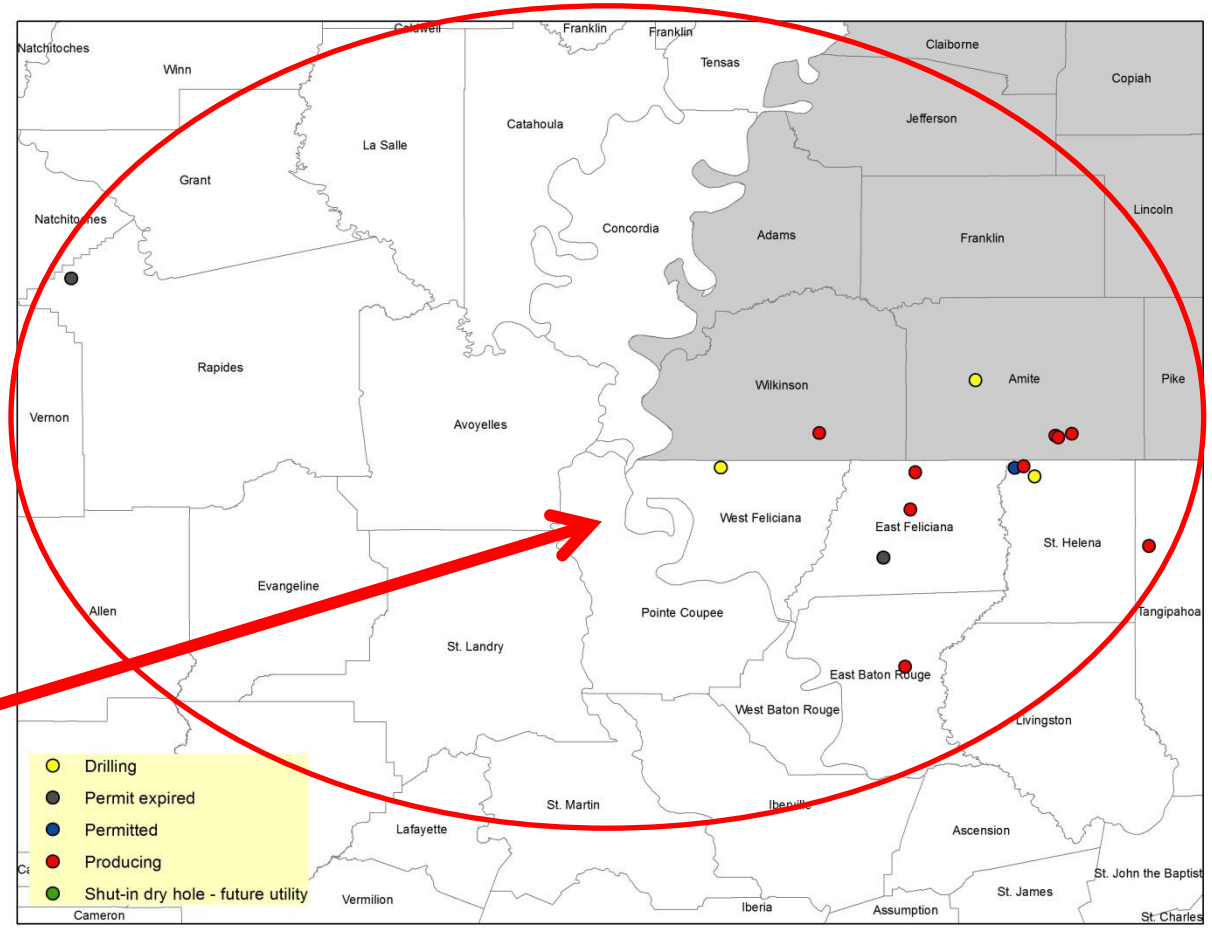



Source: Amelia Resources.

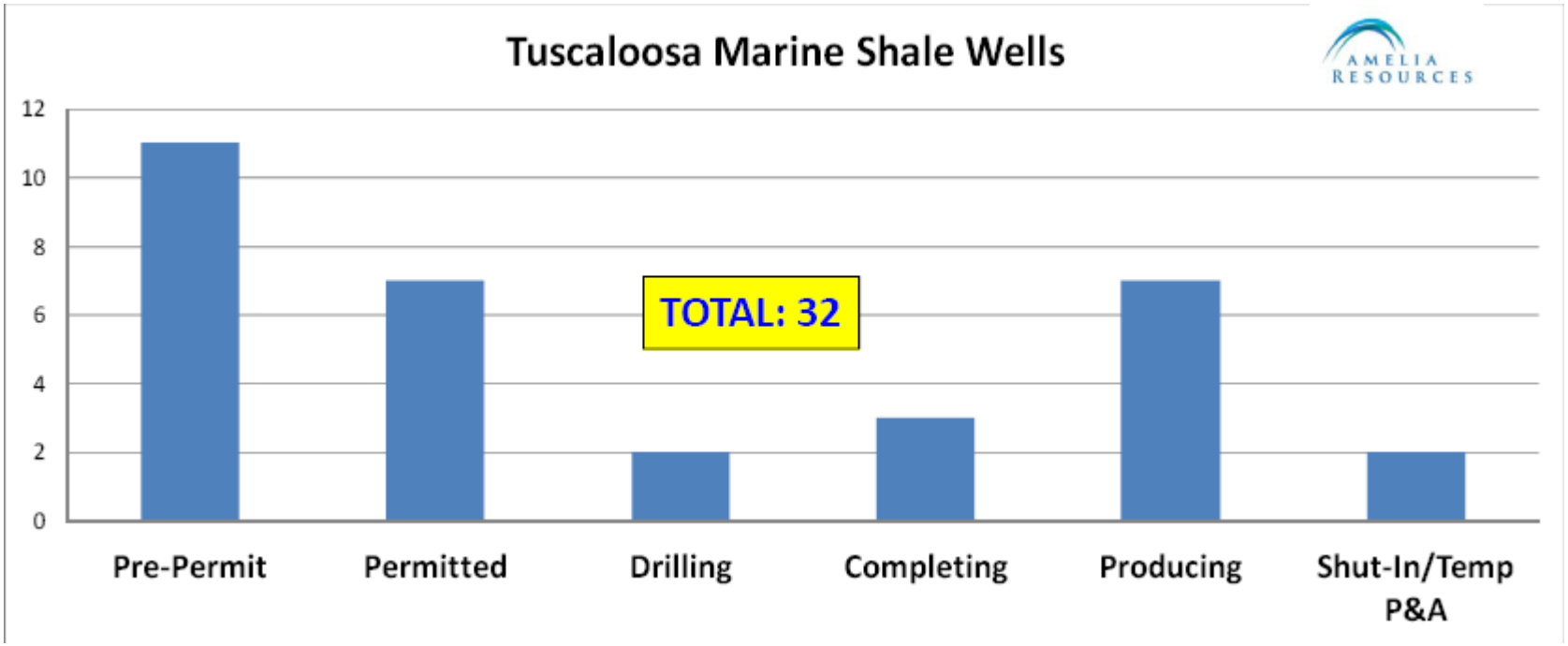
## Production Decline Curve Differences

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



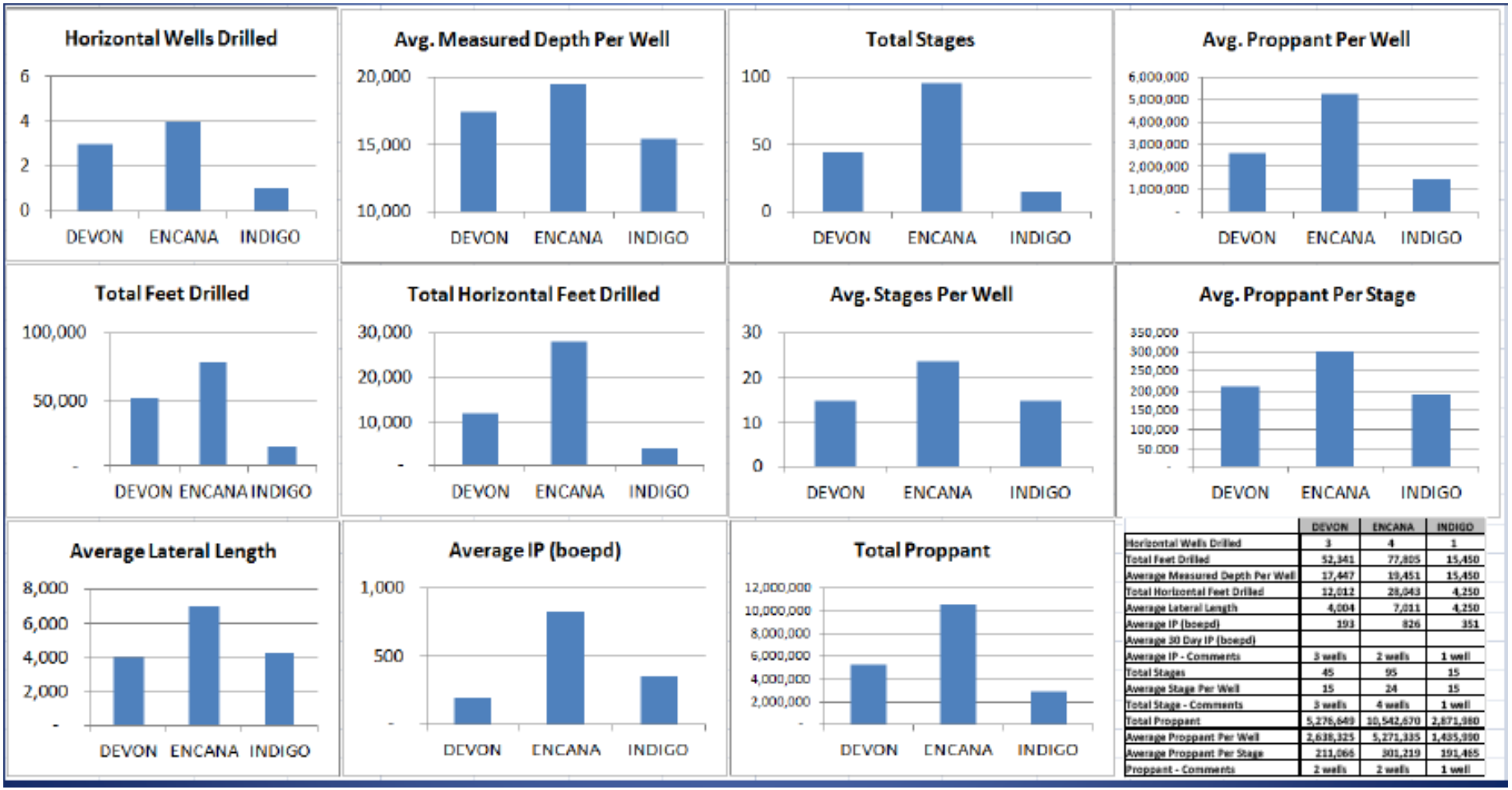



## Tuscaloosa Marine Shale Wells




Source: Amelia Resources.

## Tuscaloosa Trend Scout Report, Score Card

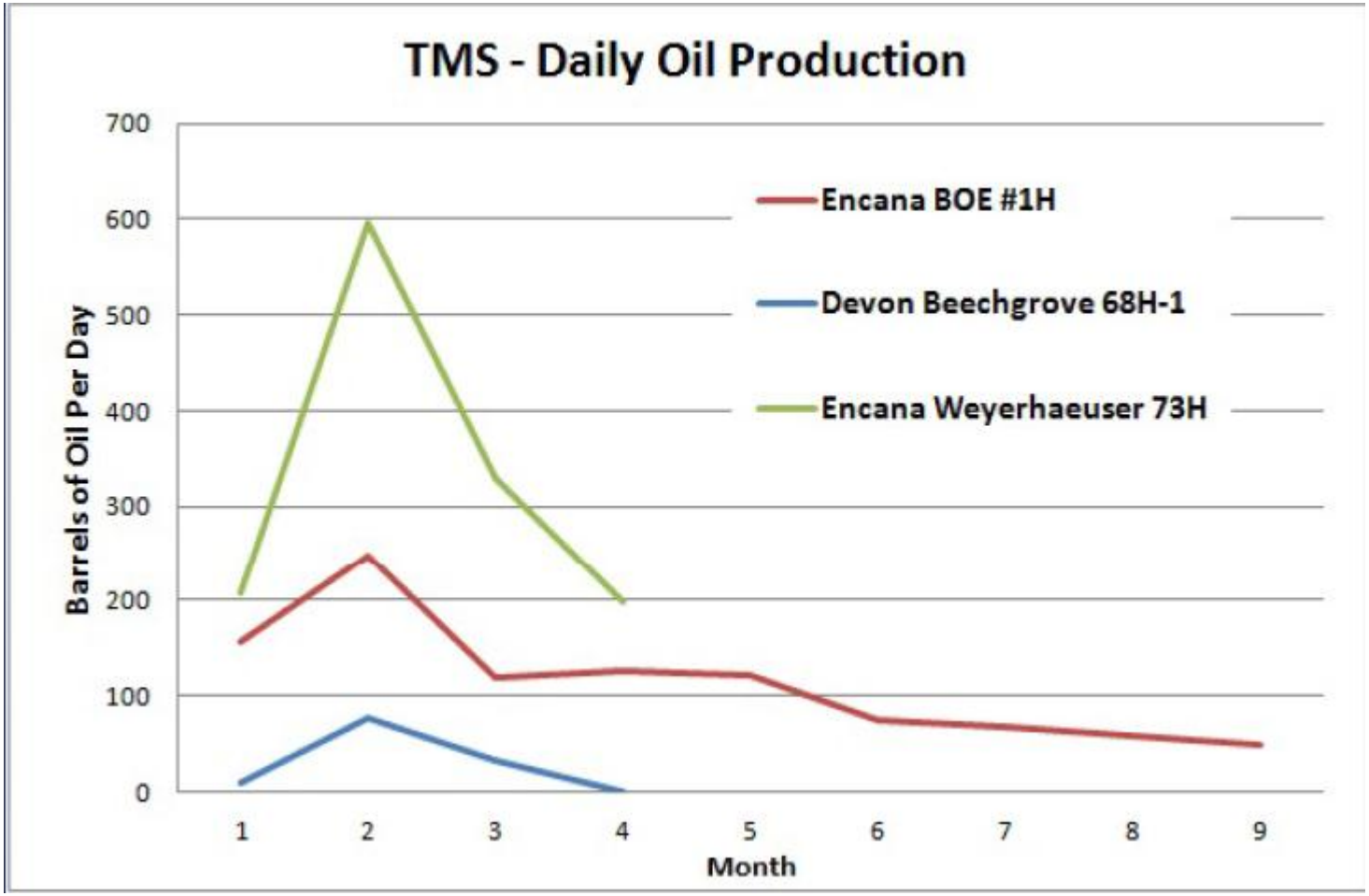



| | DEVON | ENCANA | INDIGO |
|---|---|---|---|
| Horizontal Wells Drilled | 3 | 4 | 1 |
| Total Feet Drilled | 52,341 | 77,805 | 15,450 |
| Average Measured Depth Per Well | 17,447 | 19,451 | 15,450 |
| Total Horizontal Feet Drilled | 12,012 | 28,043 | 4,250 |
| Average Lateral Length | 4,004 | 7,011 | 4,250 |
| Average IP (boepd) | 193 | 826 | 351 |
| Average 30 Day IP (boepd) | | | |
| Average IP - Comments | 3 wells | 2 wells | 1 well |
| Total Stages | 45 | 95 | 15 |
| Average Stage Per Well | 15 | 24 | 15 |
| Total Stage - Comments | 3 wells | 4 wells | 1 well |
| Total Proppant | 5,276,649 | 10,542,670 | 2,871,980 |
| Average Proppant Per Well | 2,638,325 | 5,271,335 | 1,435,990 |
| Average Proppant Per Stage | 211,065 | 301,219 | 191,465 |
| Proppant - Comments | 2 wells | 2 wells | 1 well |

Source: Amelia Resources.

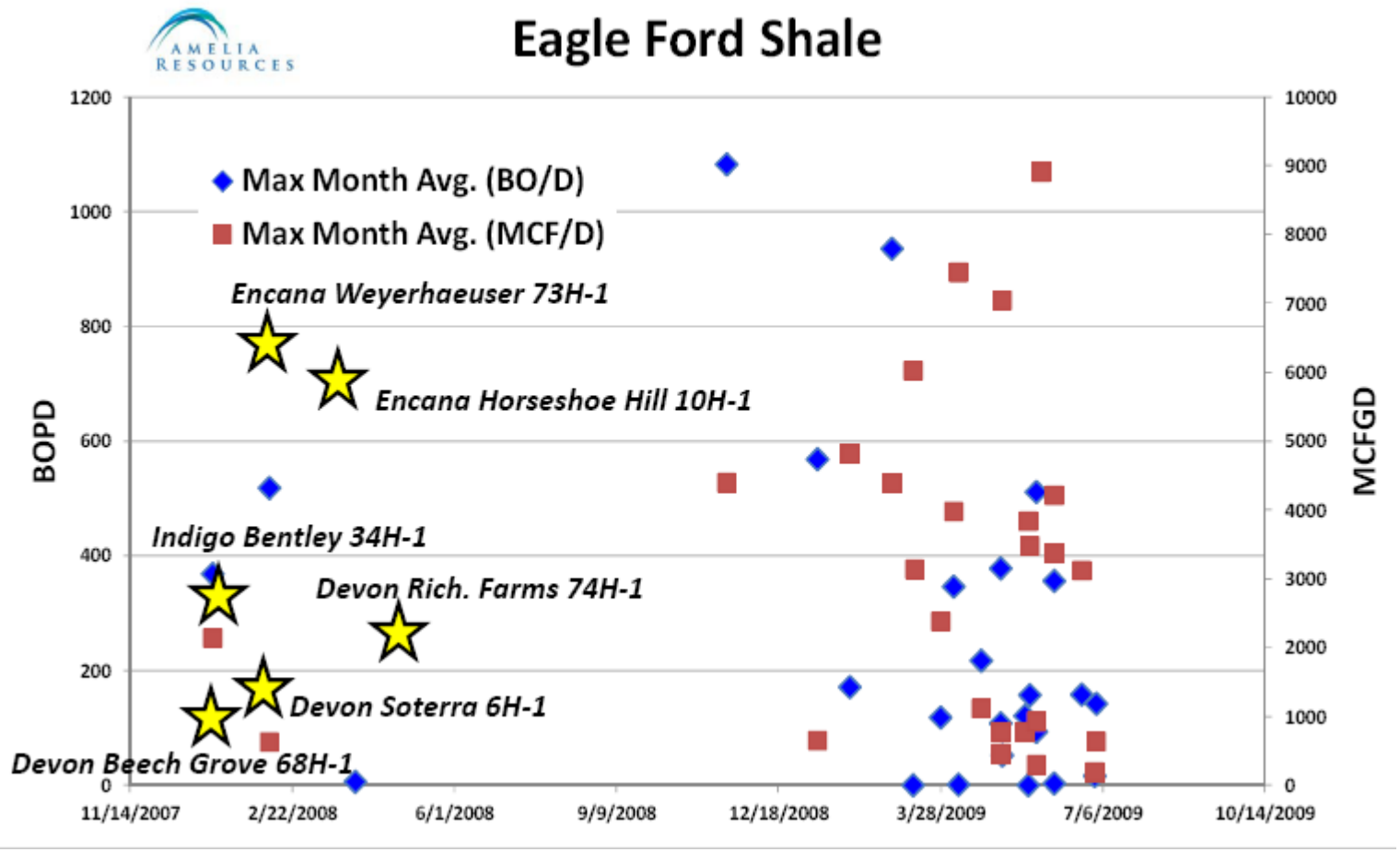
## TMS Daily Oil Production

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




Source: Amelia Resources.

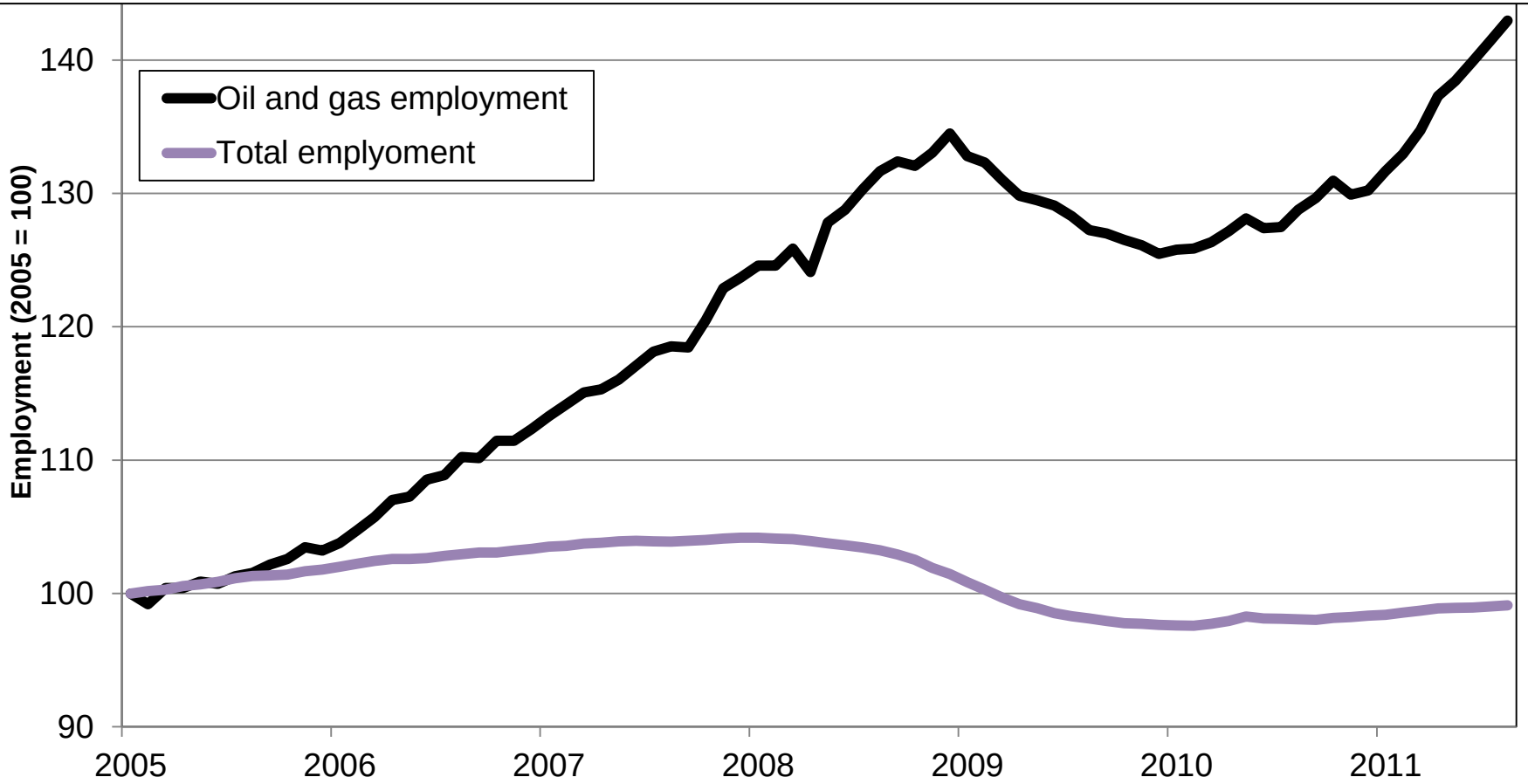
## The Early Days, Eagle Ford Shale




Source: Amelia Resources.

## United States Employment (2005 = 100)

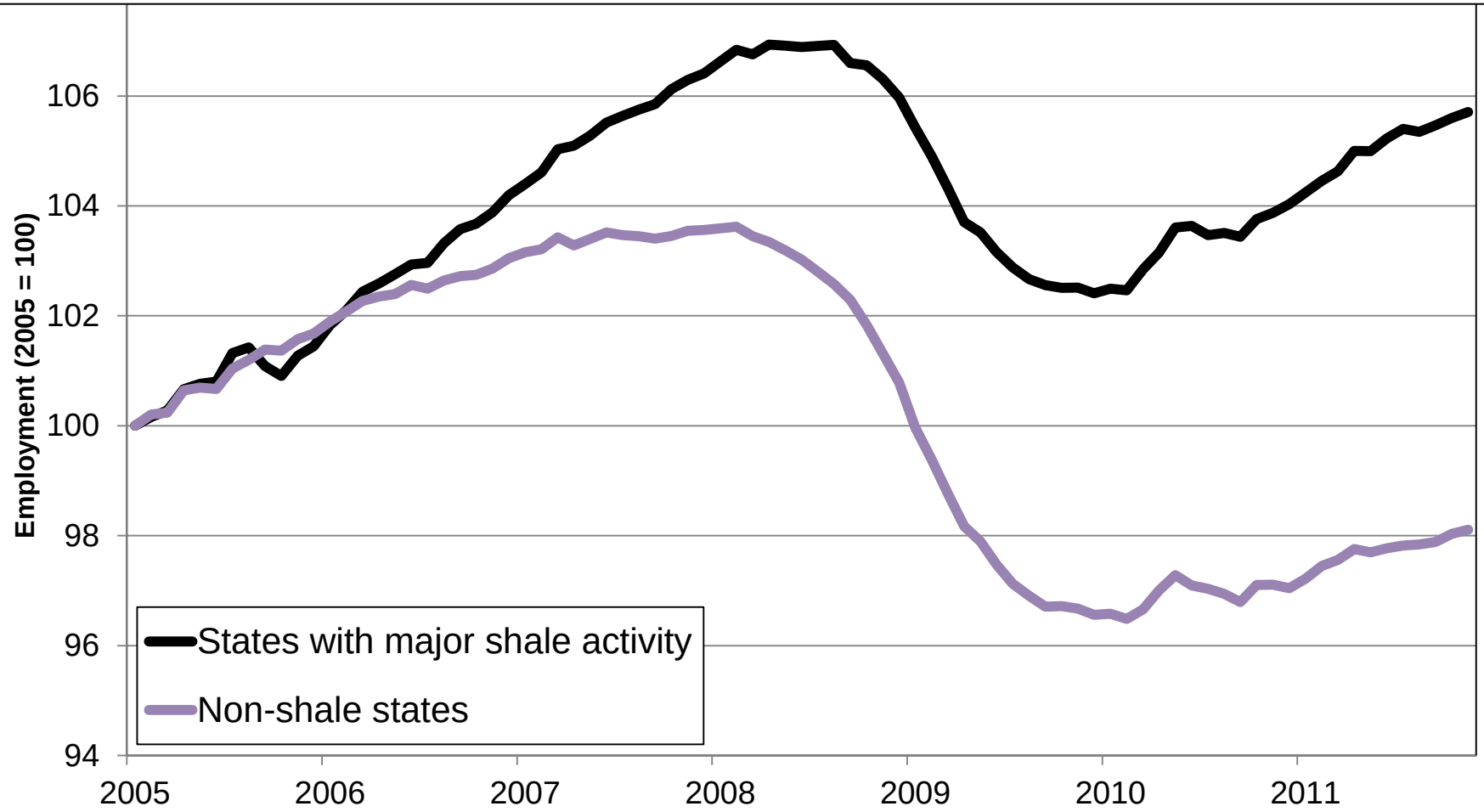
**Oil and gas employment is almost 40 percent above its 2005 level while total U.S. employment struggles to regain four years of losses.**




Source: Bureau of Labor Statistics

## 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.**

## Questions, Comments and Discussion

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