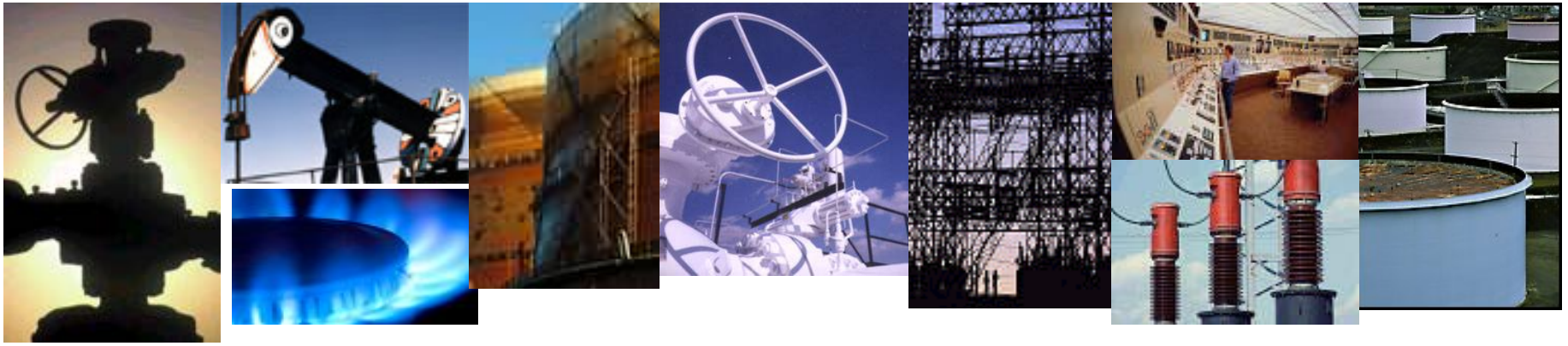
LSU | Center for Energy Studies



Energy Market Changes and Impacts for Louisiana.

Kinetica Partners Shippers Meeting
New Orleans, Louisiana
April 22, 2015

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

Industry Changes

- 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 and will likely become an active and considerable world trading participant (on the supply side).
- Impacts go far beyond domestic energy resource independence and has large manufacturing implications.
- U.S. has the ability (potential) to enter into a new era of economic prosperity.

Understanding Recent Changes

- Recent fall in crude oil prices should not come as a “big” surprise. However, speed and magnitude of the decrease is stunning.
- Factors destined to shift the market:

  (1) End of easy monetary policy (quantitative easing).

  (2) Markets are re-assessing crude oil demand outlook

  - Continued U.S. structural change (increased efficiency/transportation fuel switching).
  - Japanese/European economic contraction.
  - “BRIC” (Brazil, Russia, India, China) slow-down/contraction.

  (3) Trader realization/rationalization of stability and continuity of U.S. unconventional supplies.

  (4) Saudi unwillingness to “catch the falling knife.”

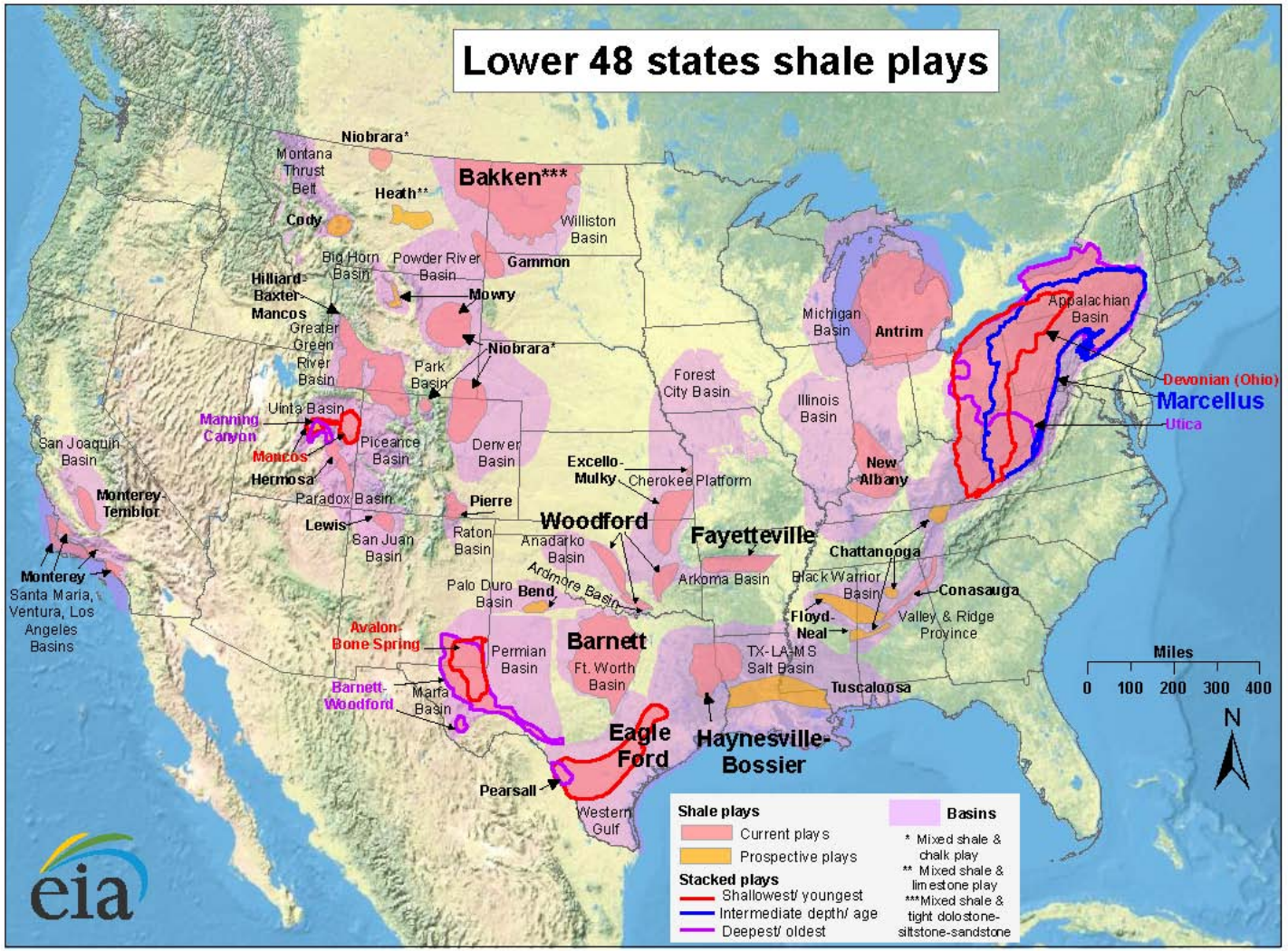
Take Aways

- Likely to continue to see near-term pricing volatility. Market having a tough time processing information.
- Lower prices will reduce upstream activity: but watch the composition (and location) of that activity closely.
- The “genie is out of the bottle,” no country can pursue a long-term strategy of predation without inflicting harm on themselves.
- U.S. producers likely follow actions, and show results, comparable to what happened in natural gas after the financial melt-down: reduce costs, increase capital & operating efficiencies, increase well productivity. (“the best solution for low prices is low prices”)
- Question: will U.S. unconventional prove to the “just in time inventory” needed for U.S. and global energy supplies?
- Could very well find ourselves in new period of energy abundance and diverse supplies (i.e. security).

Unconventional Natural Gas

Domestic Shale Gas Basins and Plays

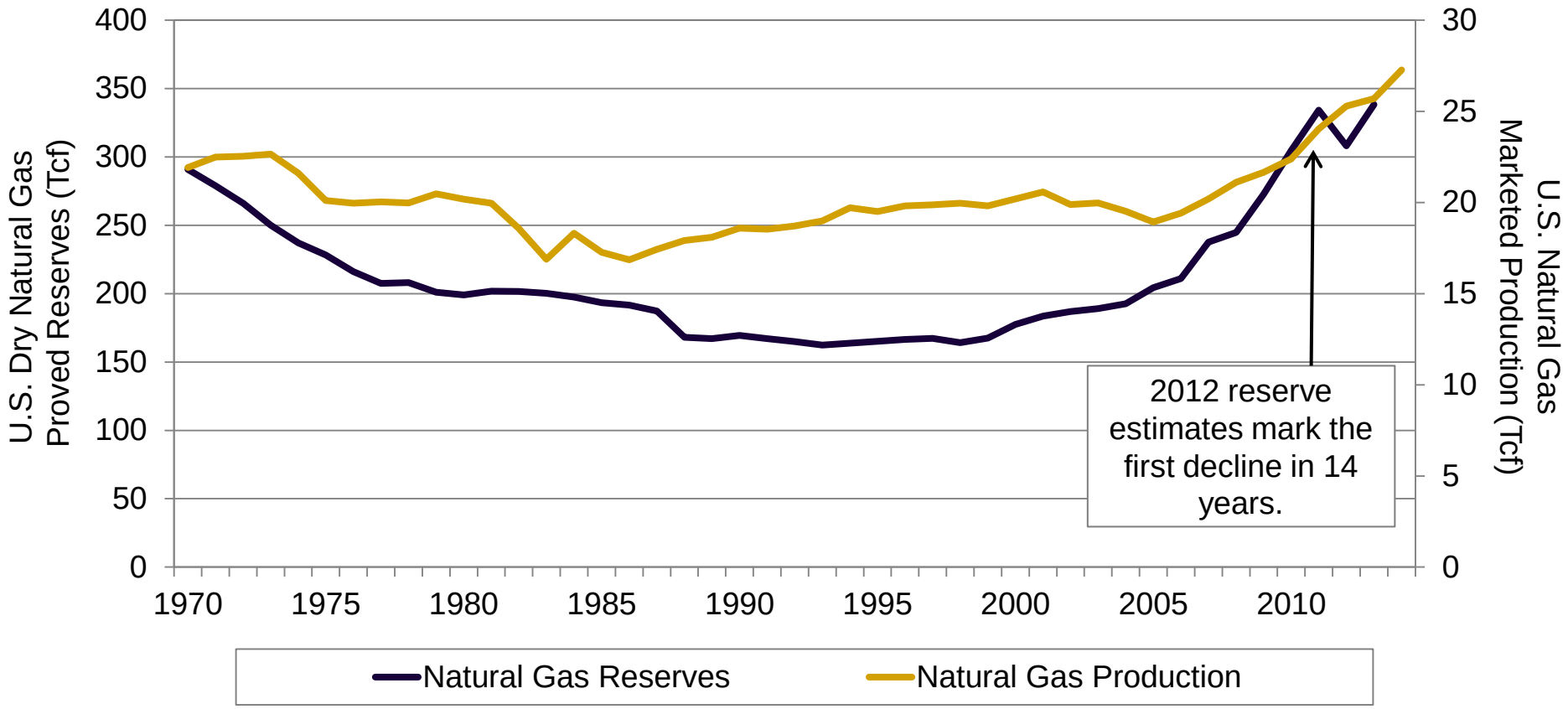
Unlike conventional resources, shale plays (natural gas, liquids, and crudes) are located almost ubiquitously throughout the U.S. and are the primary reason for the decrease in overall and regional natural gas prices.



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

Changes in Reserves and Production

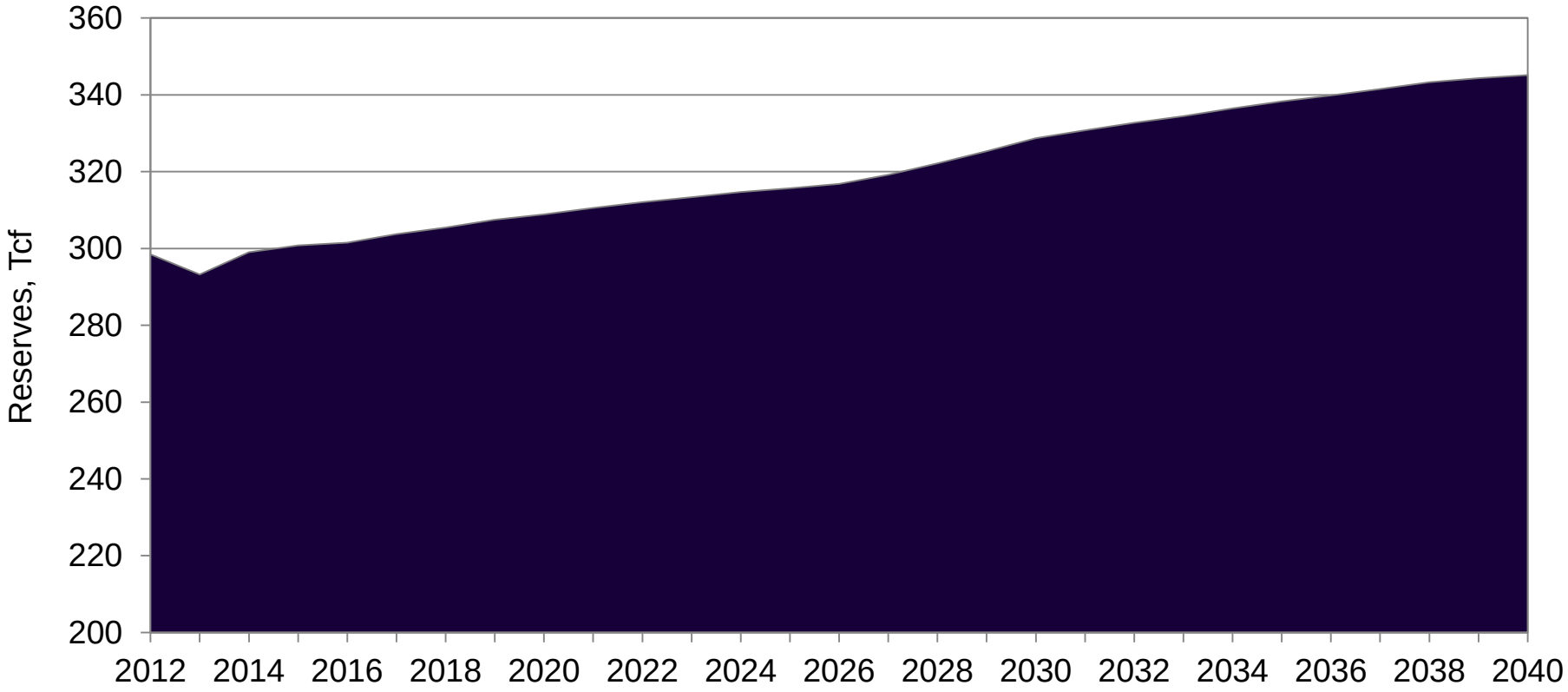
Natural gas production and reserves are at levels not seen since the 1970s and both U.S. natural gas production and reserves are now at an all time recorded peak.



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.

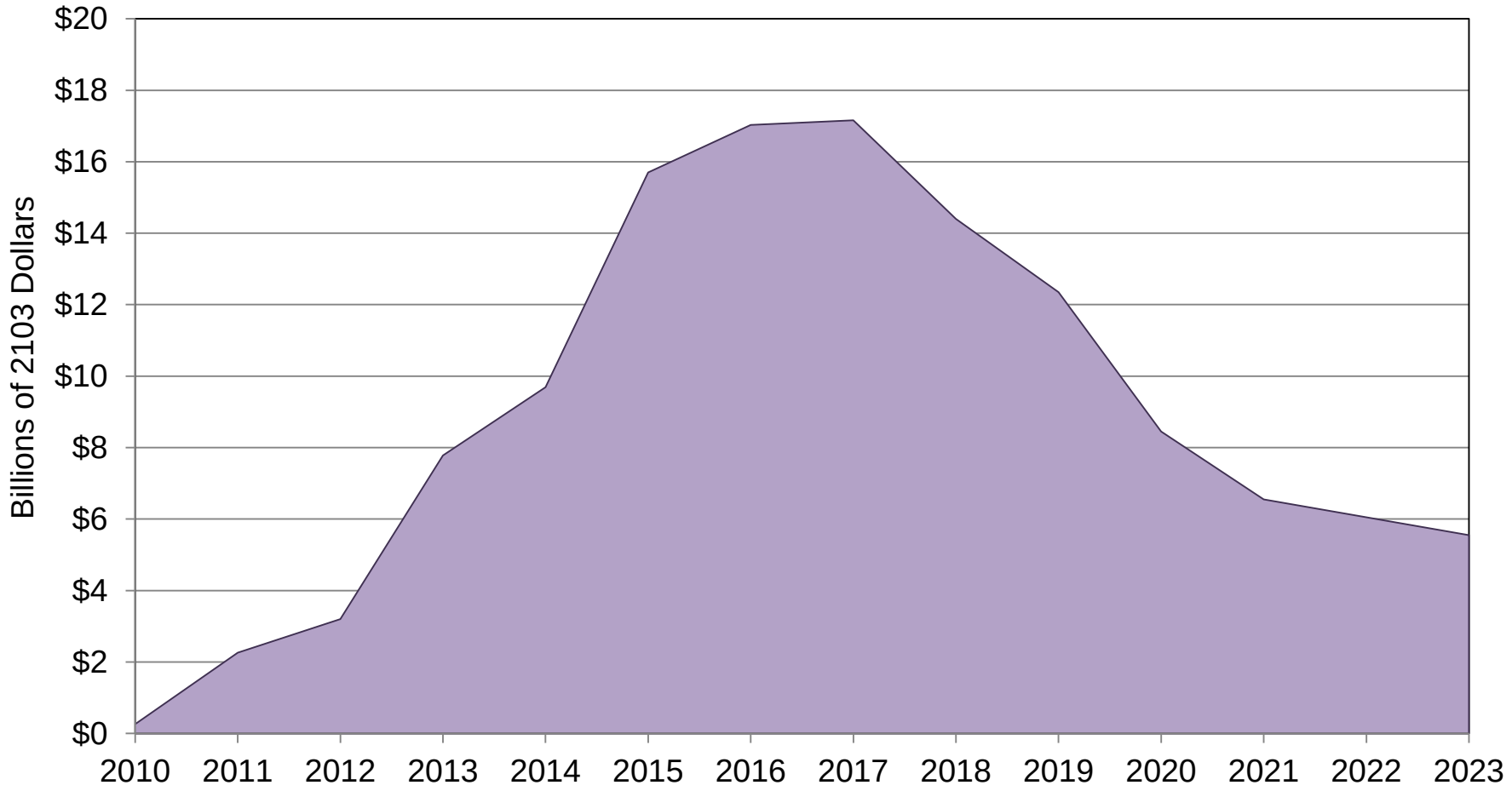


Source: Energy Information Administration, U.S. Department of Energy

Natural Gas and Economic Development: Moving from "Revolution" to "Renaissance"

U.S. Chemical Industry Capital Investment: Incremental Due to Shale Gas

The U.S. chemical industry is expected to invest up to $17 billion per year in incremental expenditures, totaling over $125 billion in the next 12 years.

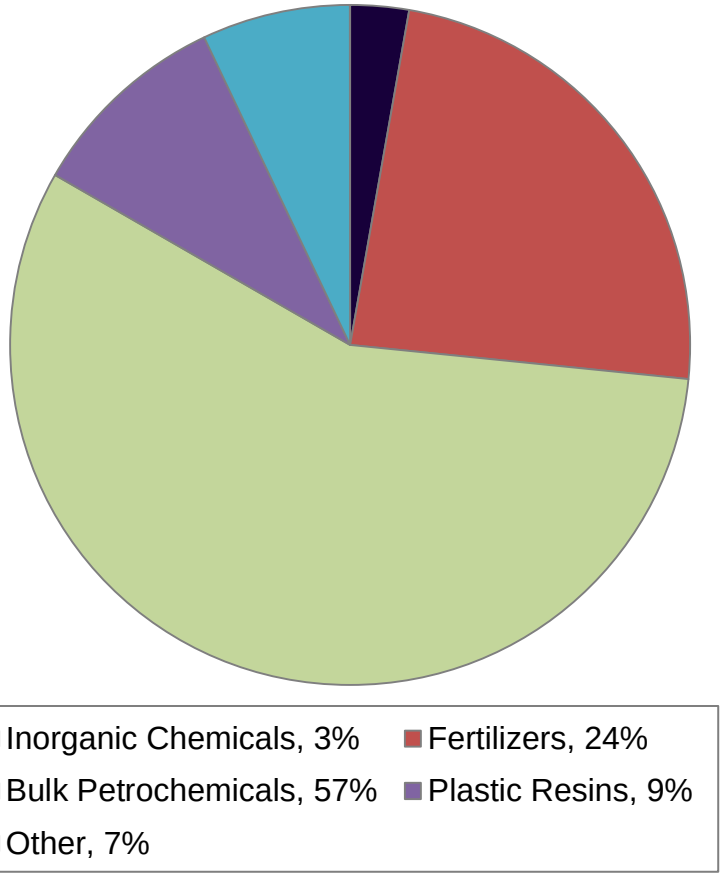


Source: T.K. Swift. 2014. Unconventional Oil & Gas Reignites the Economy. Presentation at NABE Annual Meeting, September 28, 2014.

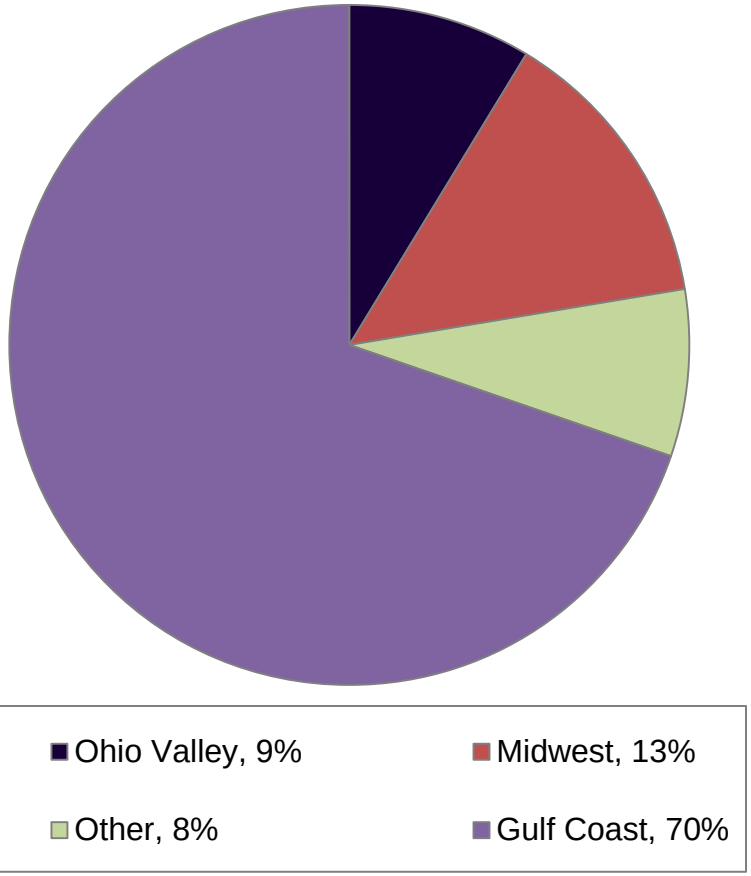
Composition of Announced Projects

The majority of chemical industry investment is in petrochemicals; and in the Gulf Coast region.

Investment by Industry Segment



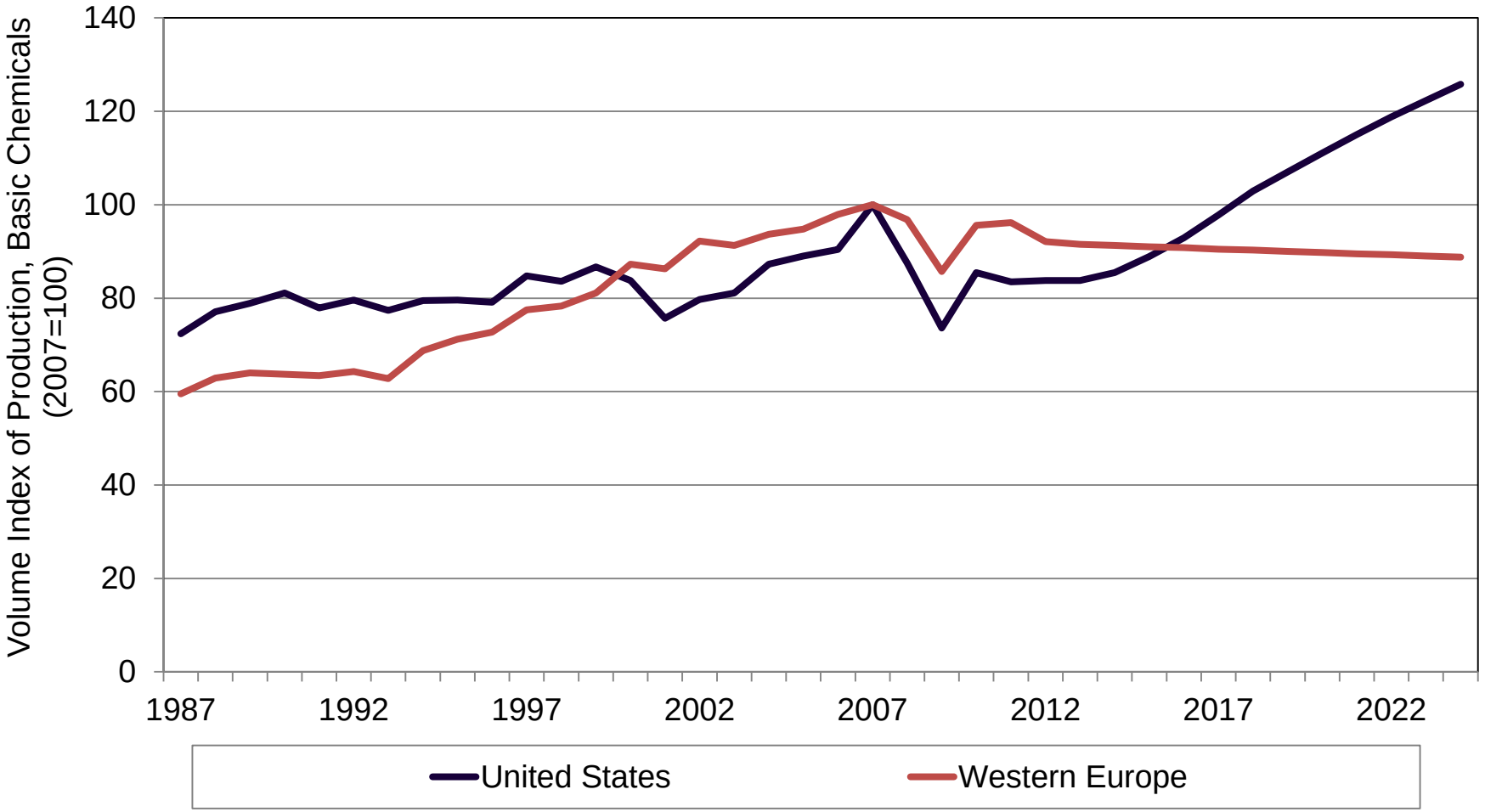
Investment by Region



Source: T.K. Swift. 2014. Unconventional Oil & Gas Reignites the Economy. Presentation at NABE Annual Meeting, September 28, 2014.

U.S. Captures Market Share from Western Europe

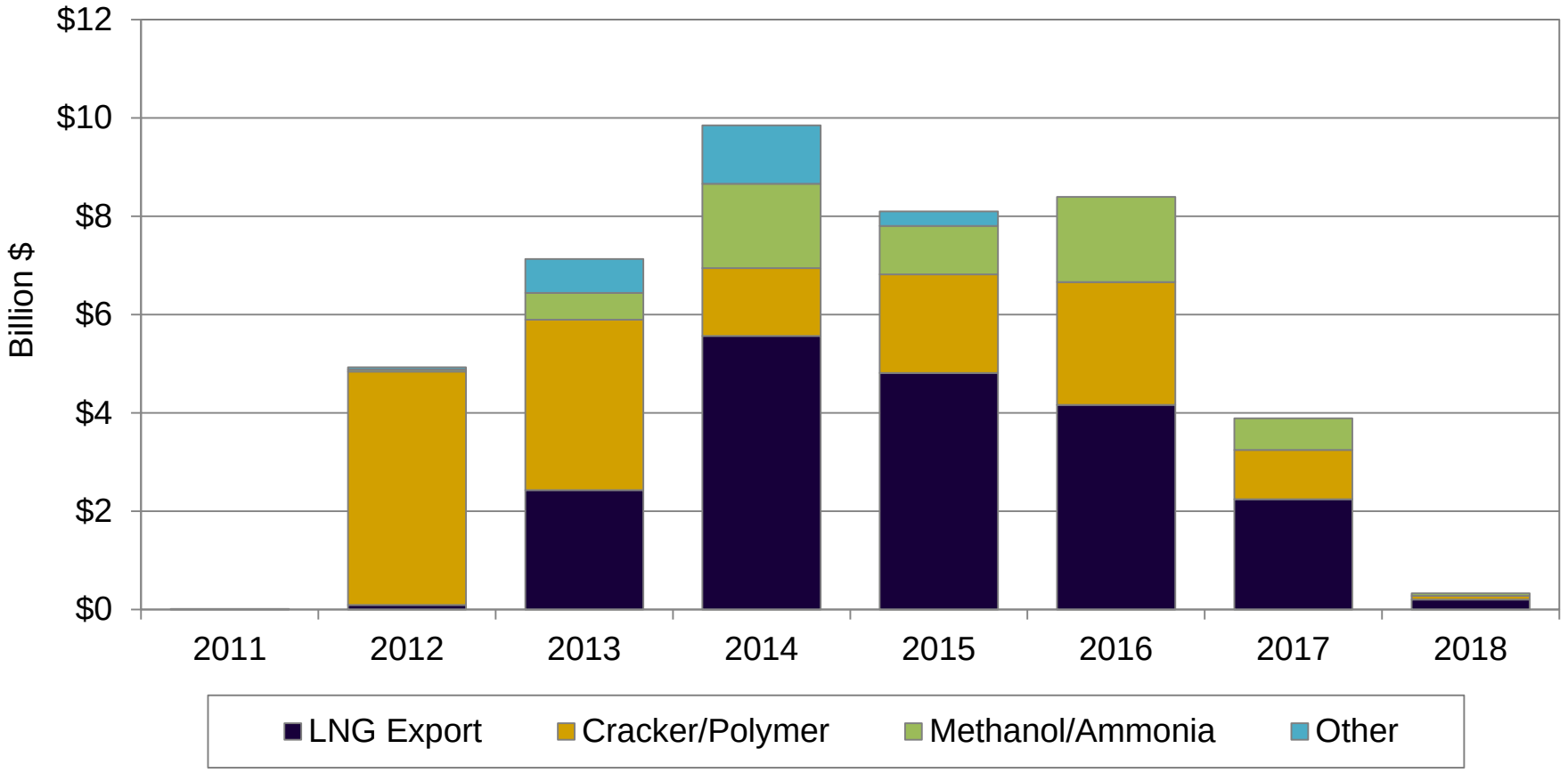
By 2016, U.S. chemical production is expected to reclaim global market share by exceeding that of Western Europe.



Source: T.K. Swift. 2014. Unconventional Oil & Gas Reignites the Economy. Presentation at NABE Annual Meeting, September 28, 2014.

Louisiana Total Capital Expenditures by Sector

Total capital investment associated with all announced natural gas-driven manufacturing investments in Louisiana totals over $42 billion.

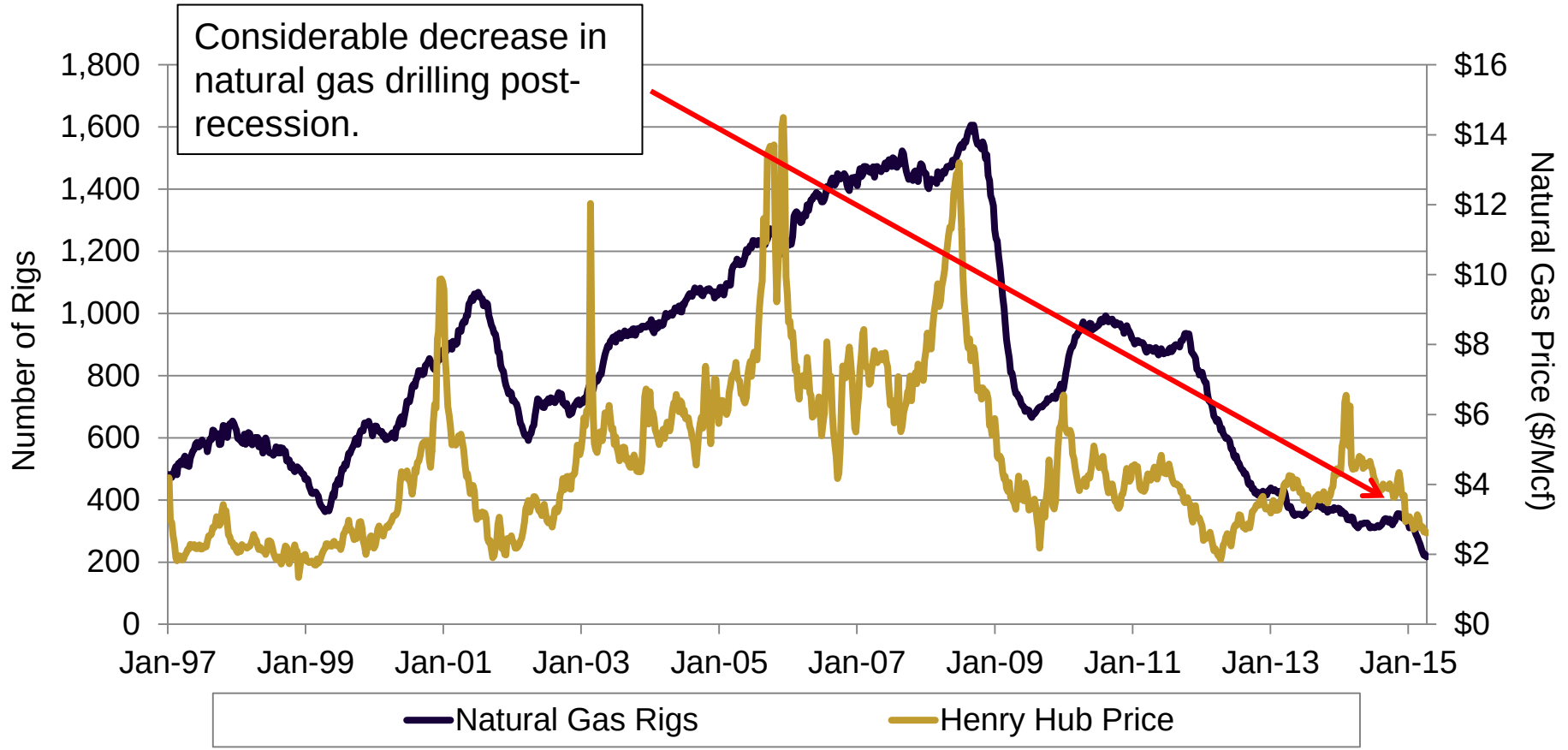


Source: David E. Dismukes (2013). *Unconventional Resources and Louisiana's Manufacturing Development Renaissance*. Baton Rouge, LA: Louisiana State University, Center for Energy Studies.

Unconventional Crude Oil Development

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

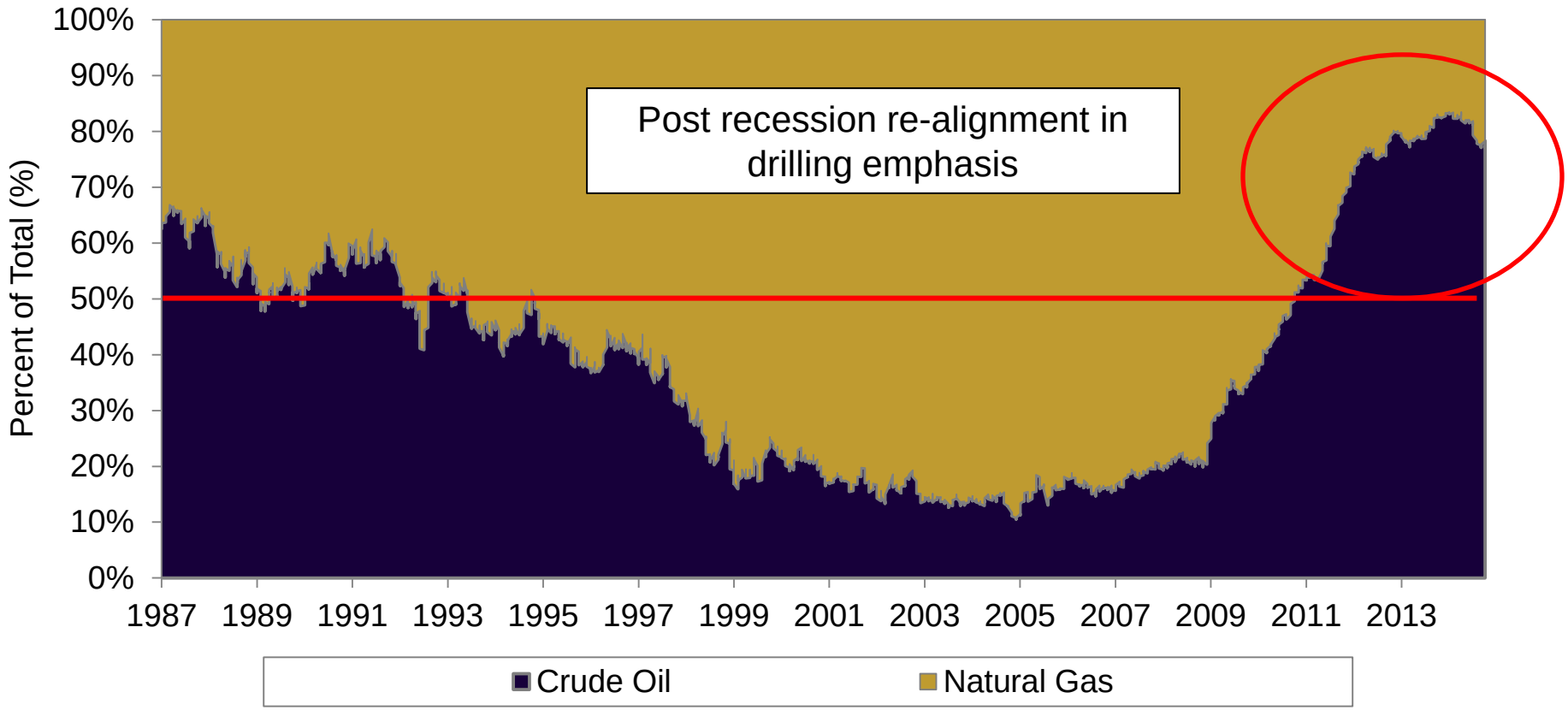
Natural gas rigs closely follow the natural gas spot price. Price decrease that started in 2007 has reduced natural gas drilling attractiveness.



Source: Energy Information Administration, U.S. Department of Energy; and Baker Hughes.

U.S. Oil/Gas Rig Split

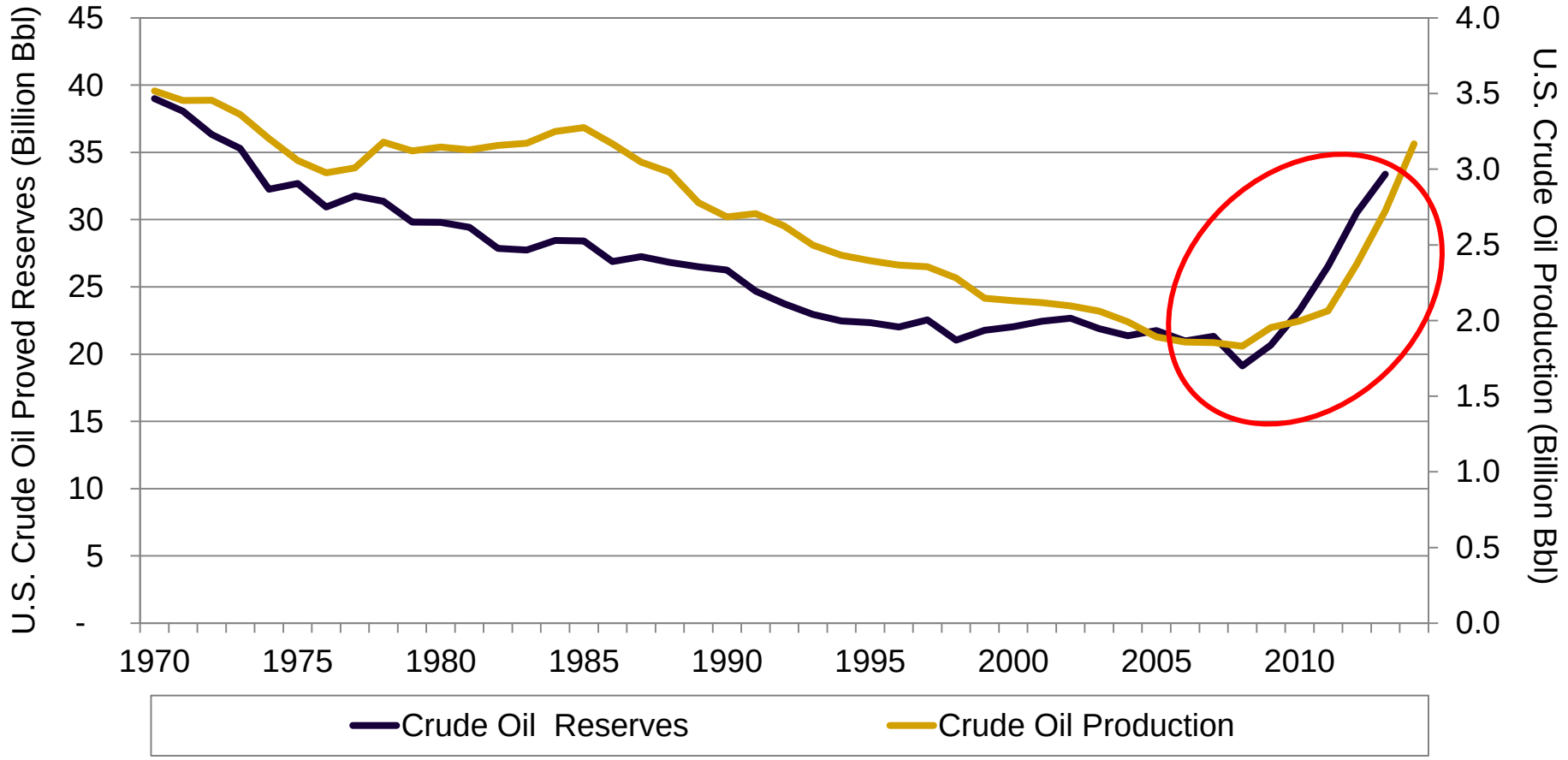
Drilling emphasis over the past 20 years has almost exclusively concentrated on developing new natural gas wells. This has shifted to crude oil drilling emphasis over the past two years.



Source: Baker Hughes

Changes in Crude Oil Reserves and Production

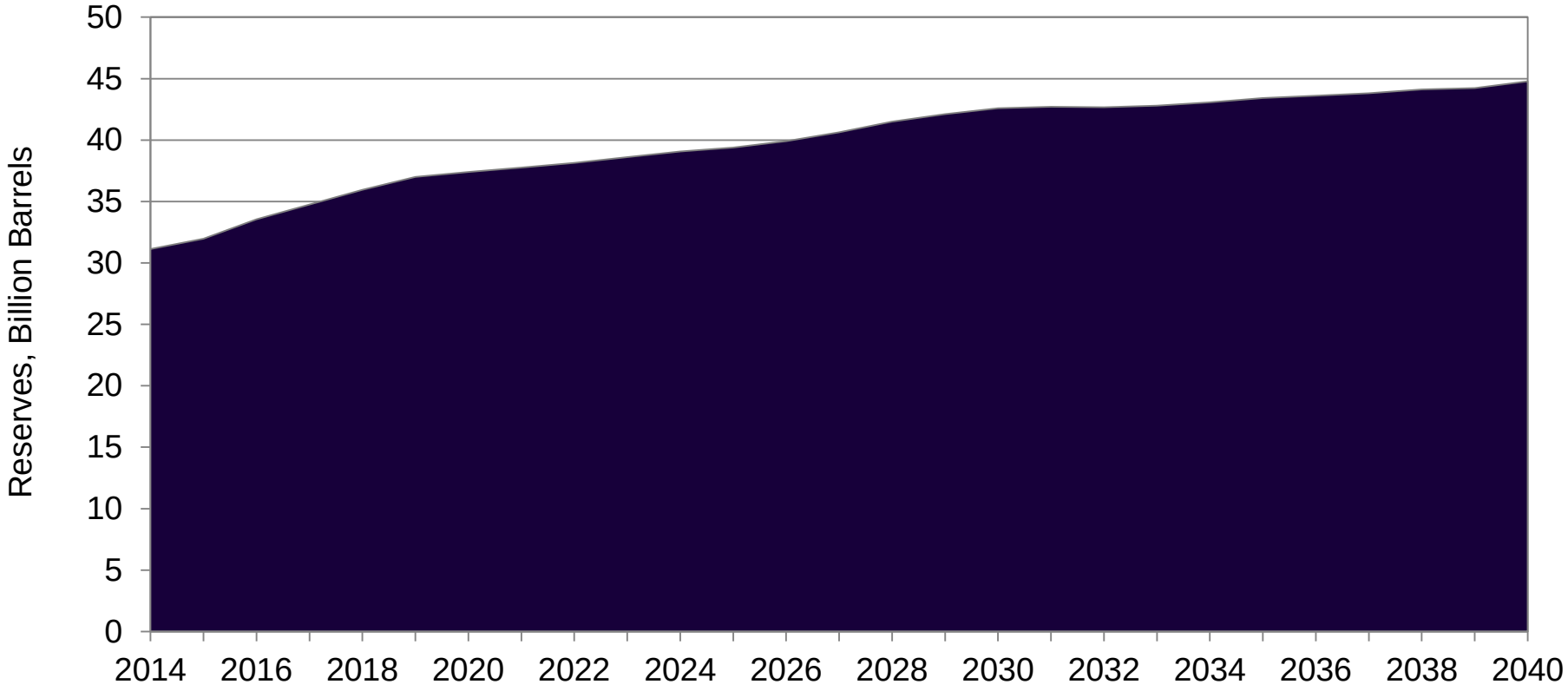
Crude oil production and reserves are climbing back to levels not seen since the early 1980s (reserves).



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

Annual Energy Outlook, Crude Oil Reserves

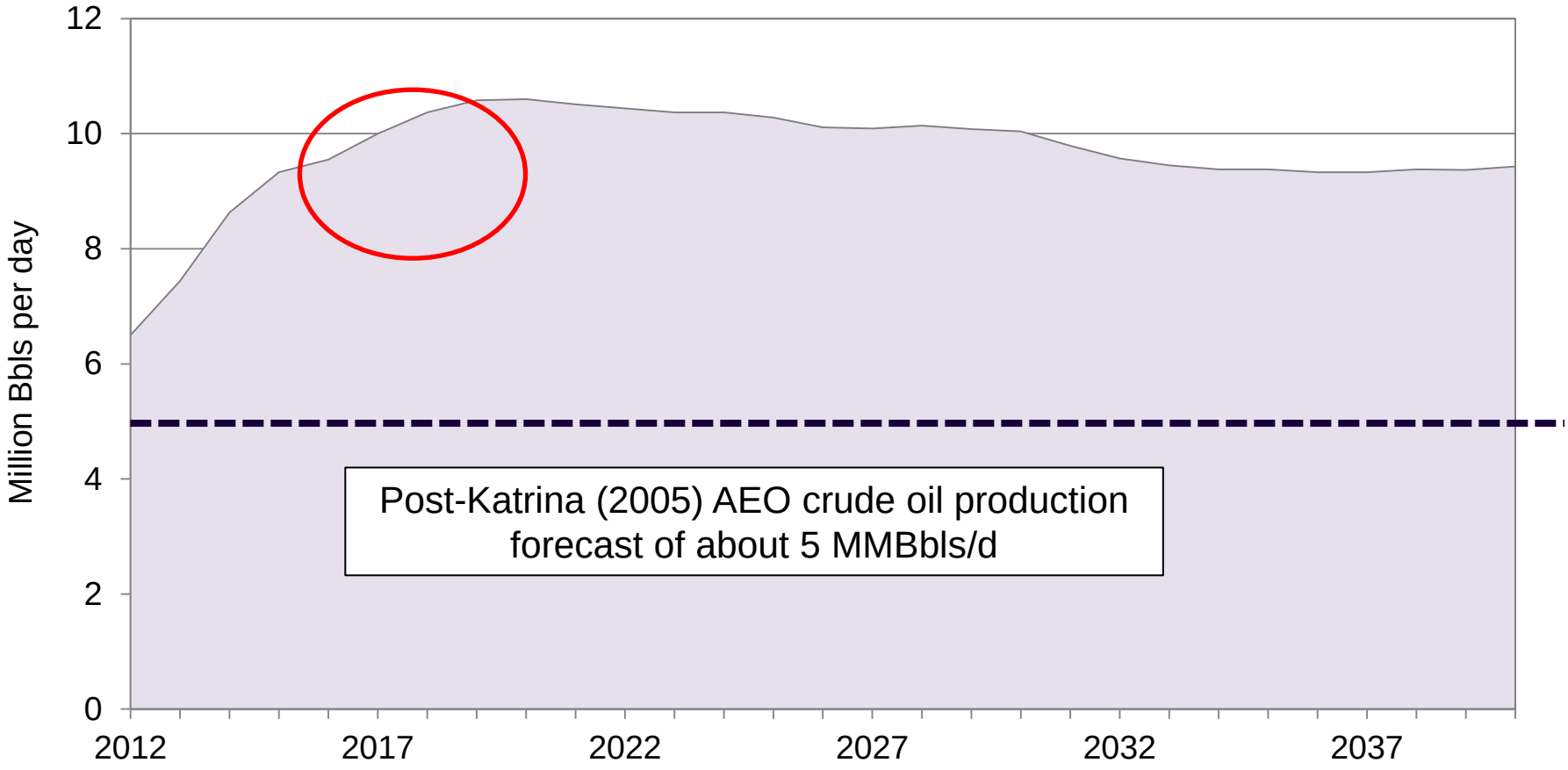
Crude oil reserves are expected to increase 20 percent by 2020 and increase by another 20 percent by 2040.



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

Forecast U.S. Crude Oil Production

U.S. production of crude oil is expected to increase at an average annual rate of 6.4 percent through 2019, and decreases thereafter at a average annual rate of 0.6 percent through 2040.



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

Recent Market Changes

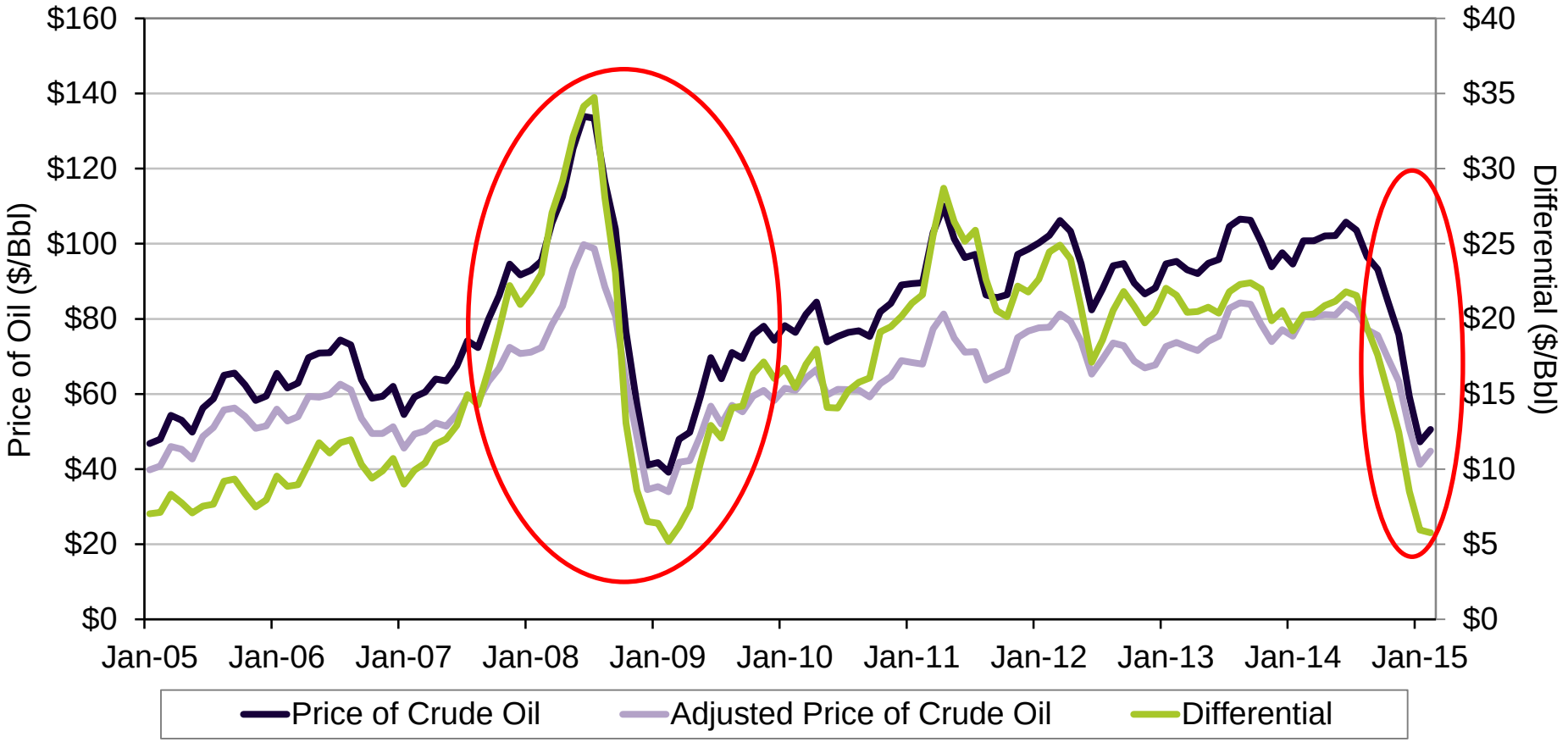
Understanding Recent Changes

Recent market changes not entirely unexpected:

- Changes in dollar valuations due to the anticipated end of U.S. monetary easing.
- Increasingly apparent global economic contraction, particularly in China.
- Increases in non-OPEC production, including U.S. unconventional activity.

Dollar Value and Oil Prices

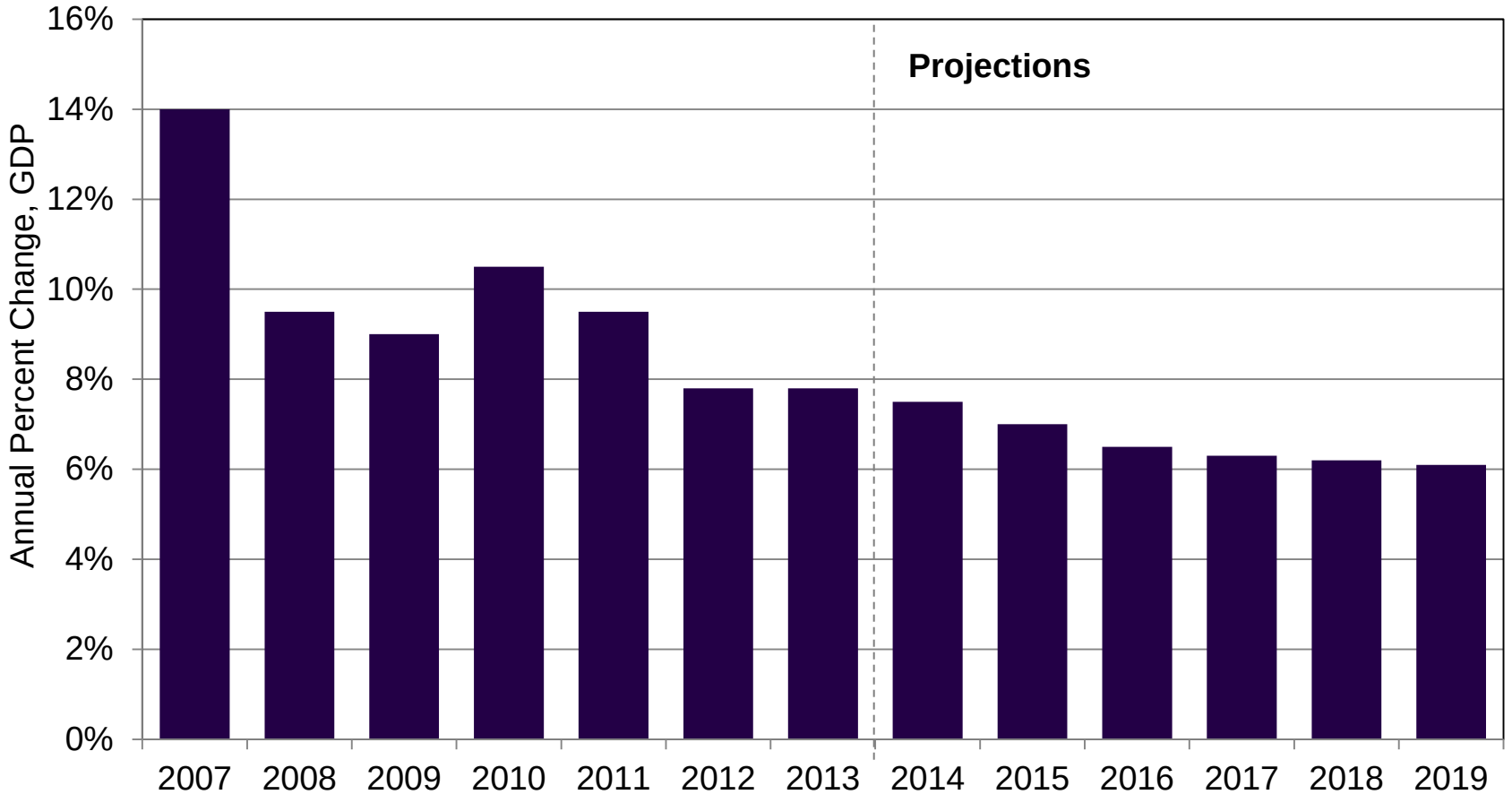
Exchange rate adjusted value of crude oil starting to fall back to levels not seen since the financial crisis of 2008-2009.



Note: The adjusted price of crude oil is the nominal WTI adjusted by the Federal Reserve Bank's Broad Index. The Broad Index is a weighted average of the foreign exchange values of the U.S. dollar against the currencies of a large group of major U.S. trading partners. Base year is 2002.
Source: Federal Reserve Bank of St. Louis; and Energy Information Administration, U.S. Department of Energy.

Changes in Chinese GDP

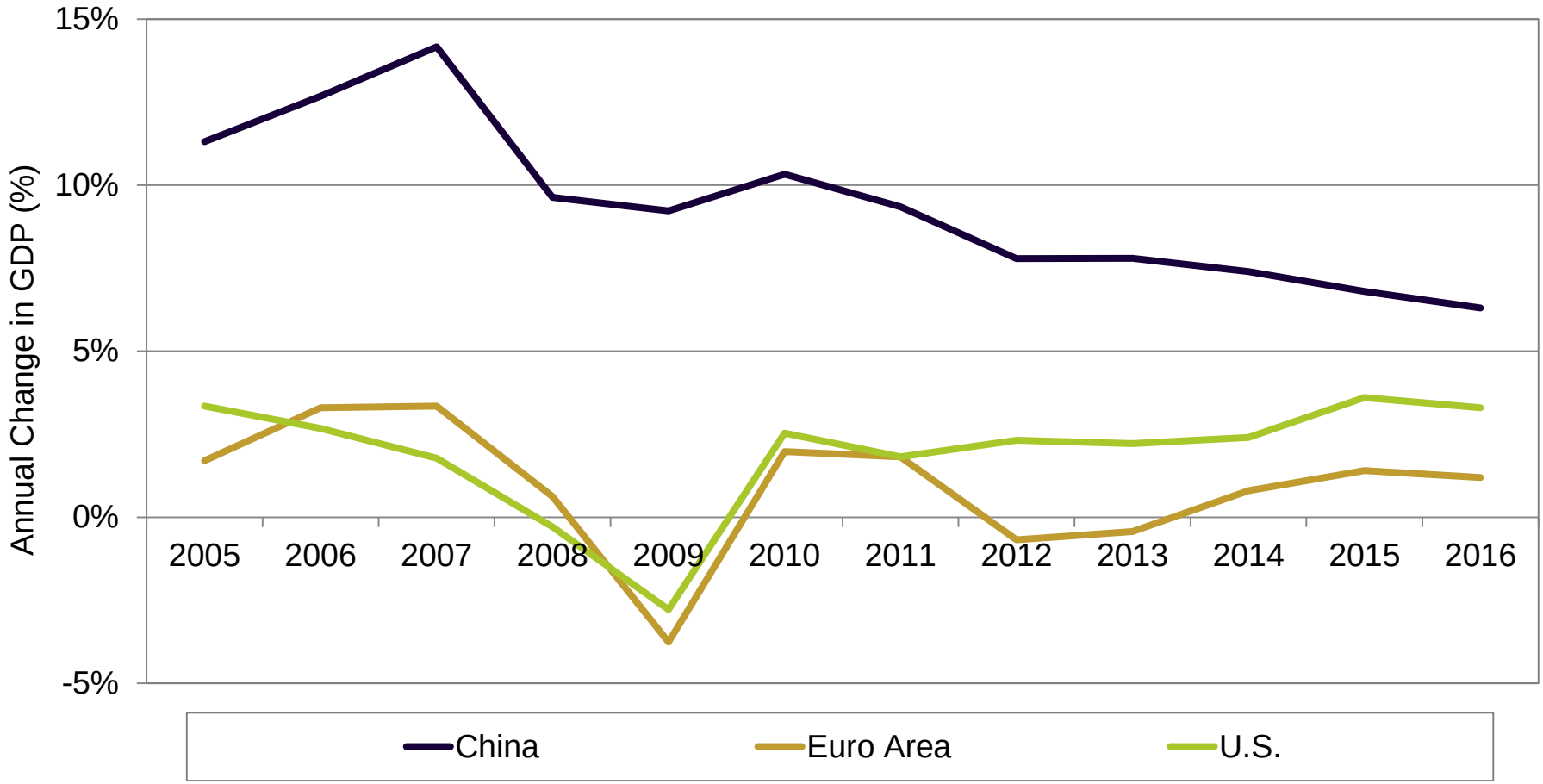
Chinese economic growth slowing considerably from 2007 peaks.



Source: International Monetary Fund.

Annual Changes in Economic Output

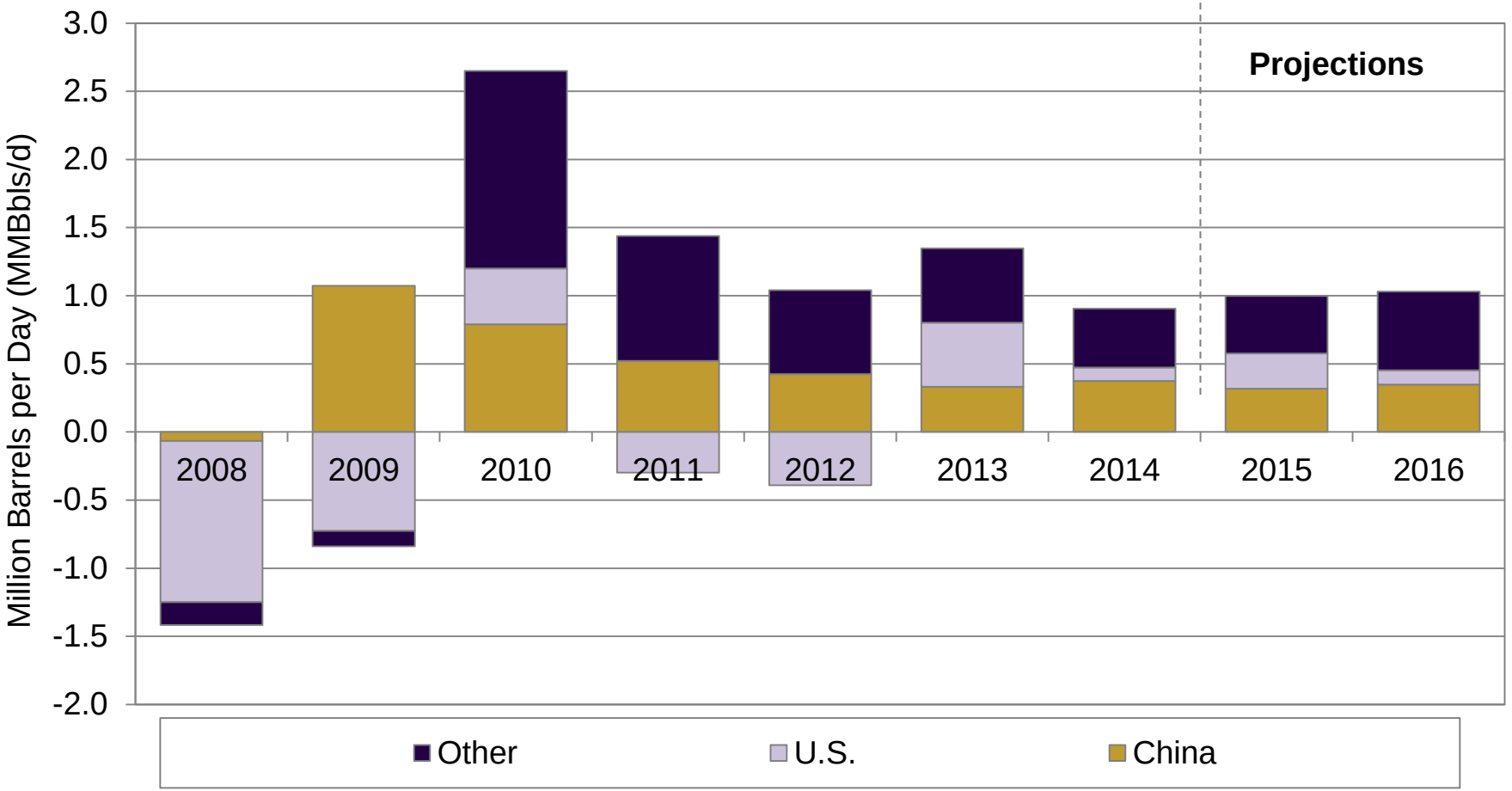
A downturn in growth in China will likely put pressure on the U.S. to help power the global economy.



Source: International Monetary Fund.

Global Liquids Fuels Demand Contraction

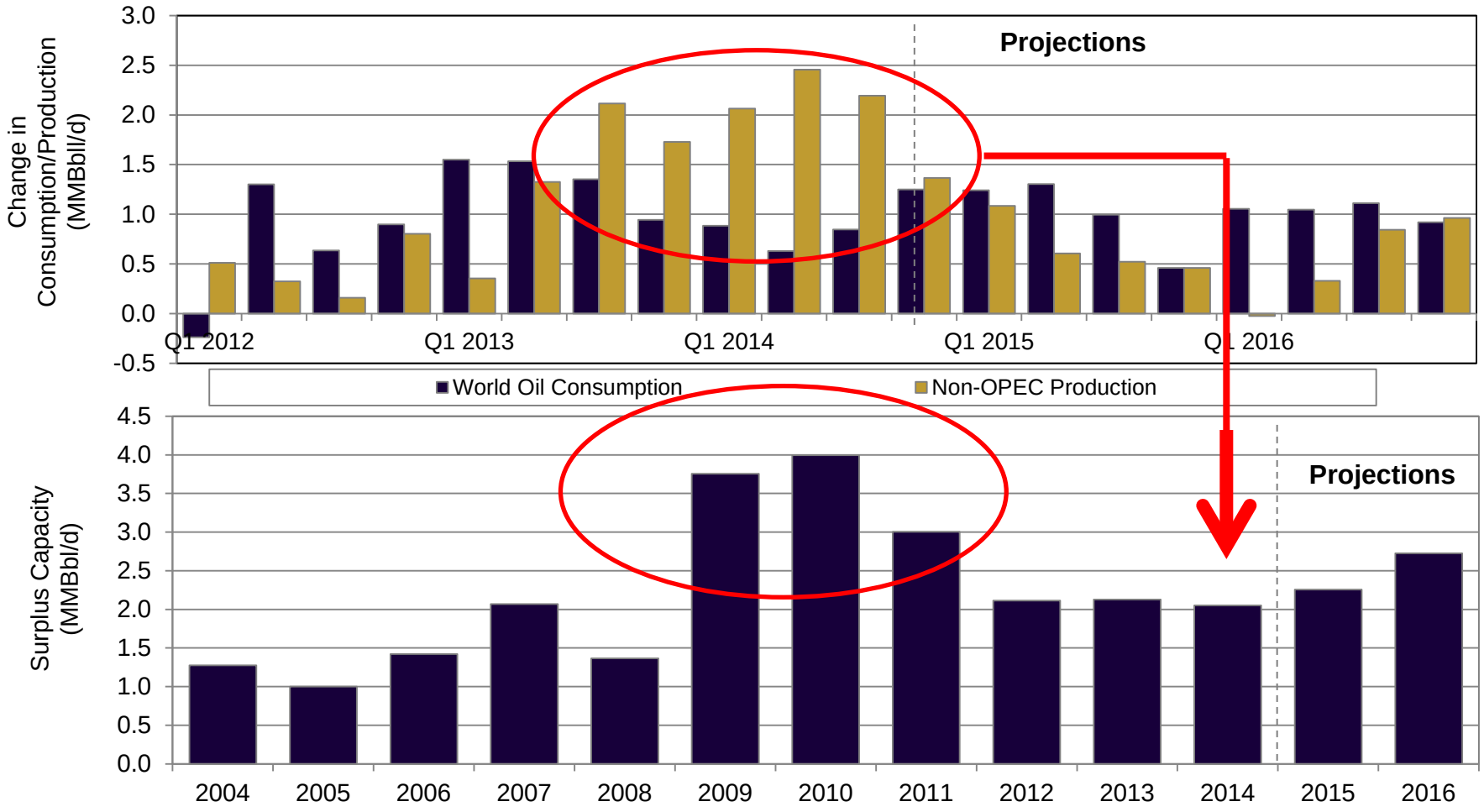
Change in liquids fuel growth slowing considerably, particularly since 2010.



Source: Energy Information Administration, U.S. Department of Energy; and Baker Hughes.

Increased Excess Production Capacity

"Conventional wisdom" suggests excess capacity responsible for the big crude oil price contraction. However, excess capacity has been relatively steady for the last three years.



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

Challenges and Risks by Sector

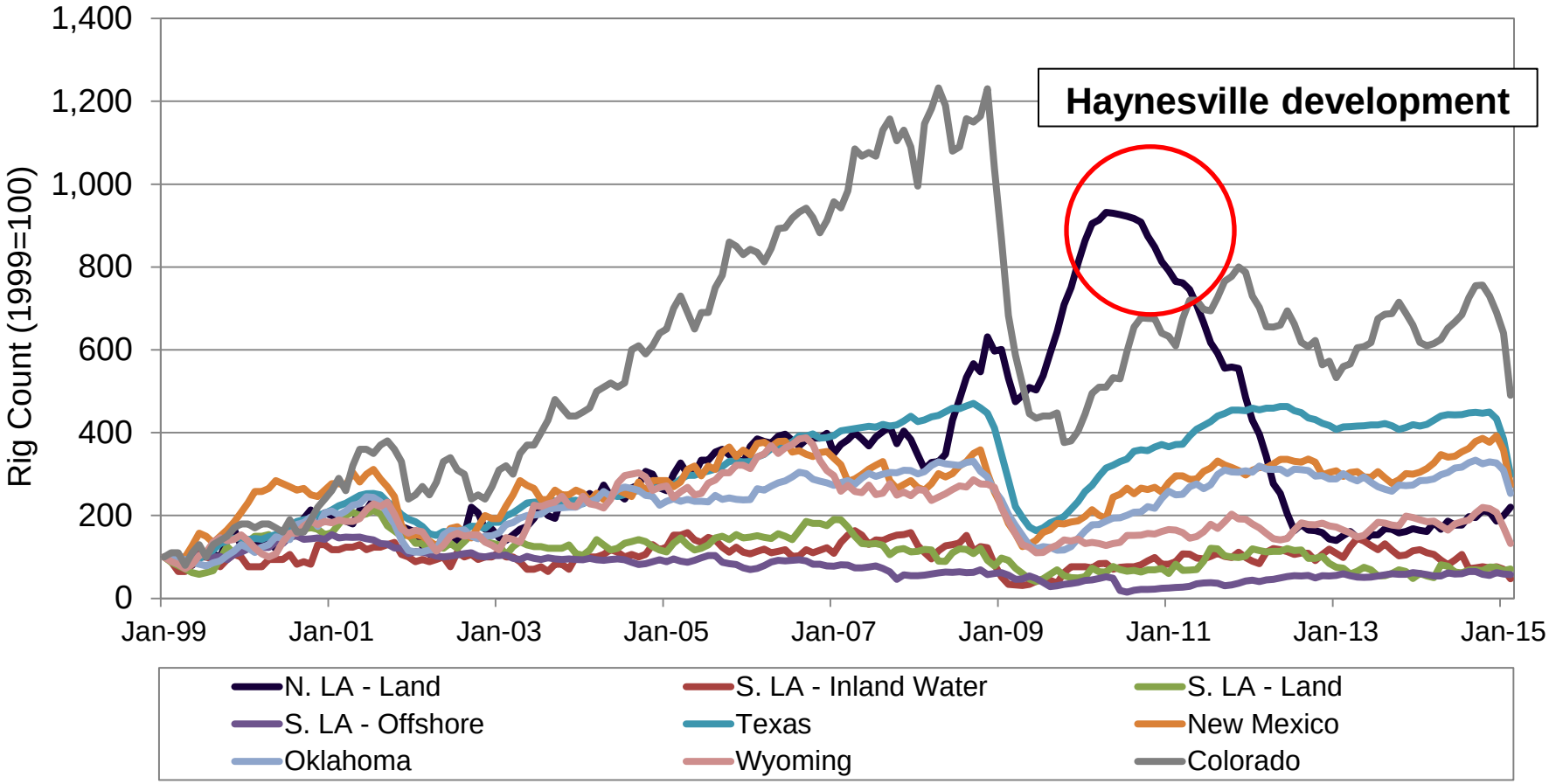
Three sectors important to Louisiana that will be impacted by these recent changes. Impacts will differ for differing reasons.

- **Drilling:** crude oil drilling in Louisiana has been contracting for years so there will be limited impact to in-state activity –
- **Service Sector Activity:** the contraction in total U.S. drilling activity will result in service sector contraction which is large in Louisiana.
- **Industrial Development:** some projects in outlying years will be at risk due to the collapse in energy price differentials (gas to crude).
- **Market Realignment:** crude supply and price outlook still clouded could create new incentives drilling in dry plays like Haynesville if associated gas production starts to fall considerably.

Louisiana Drilling Impacts

Historic Rig Count by State

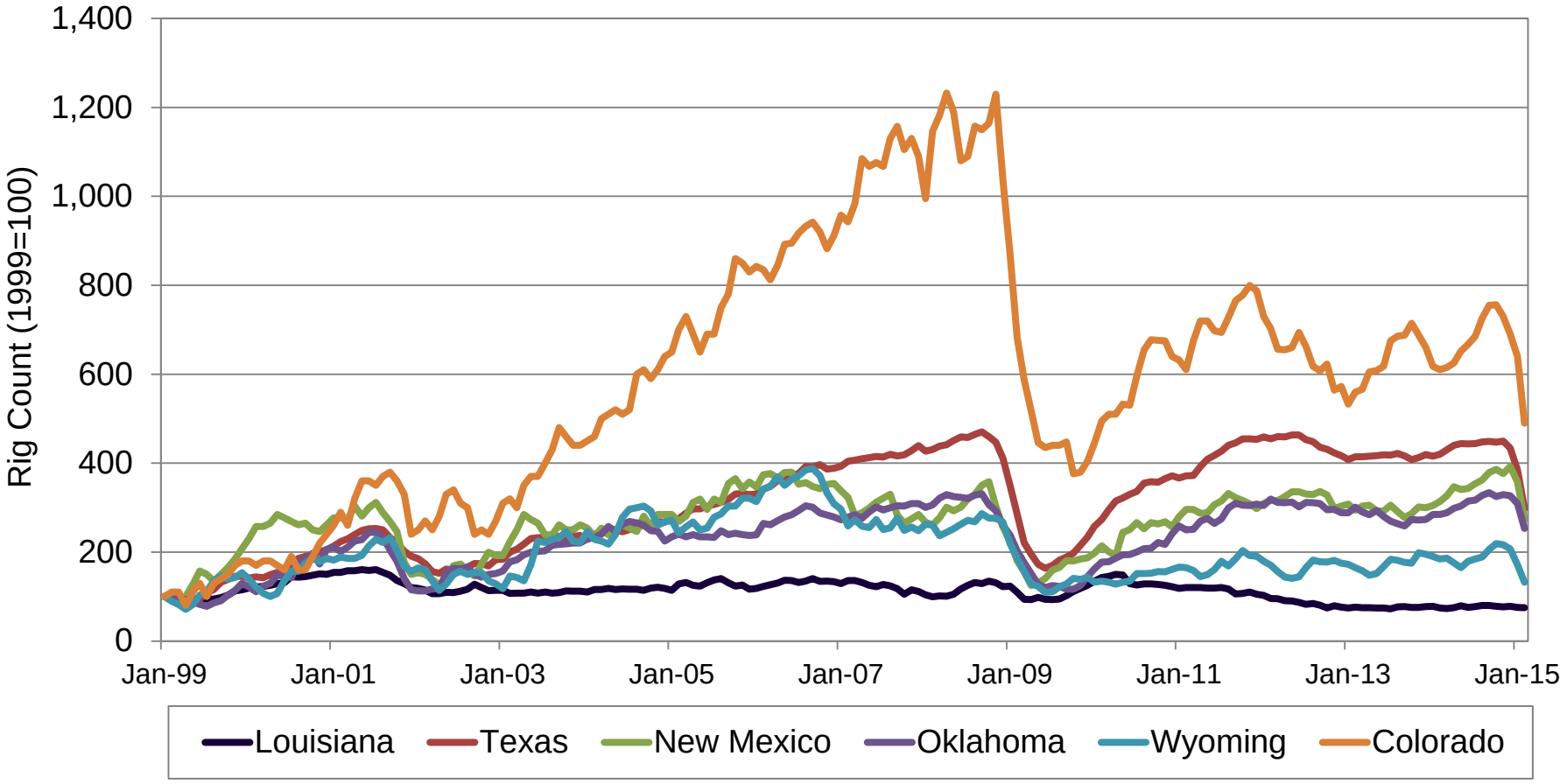
Louisiana rig counts driven by Haynesville. All areas down considerably post-recession.



Source: Baker-Hughes Rig Count.

Historic Rig Count by State

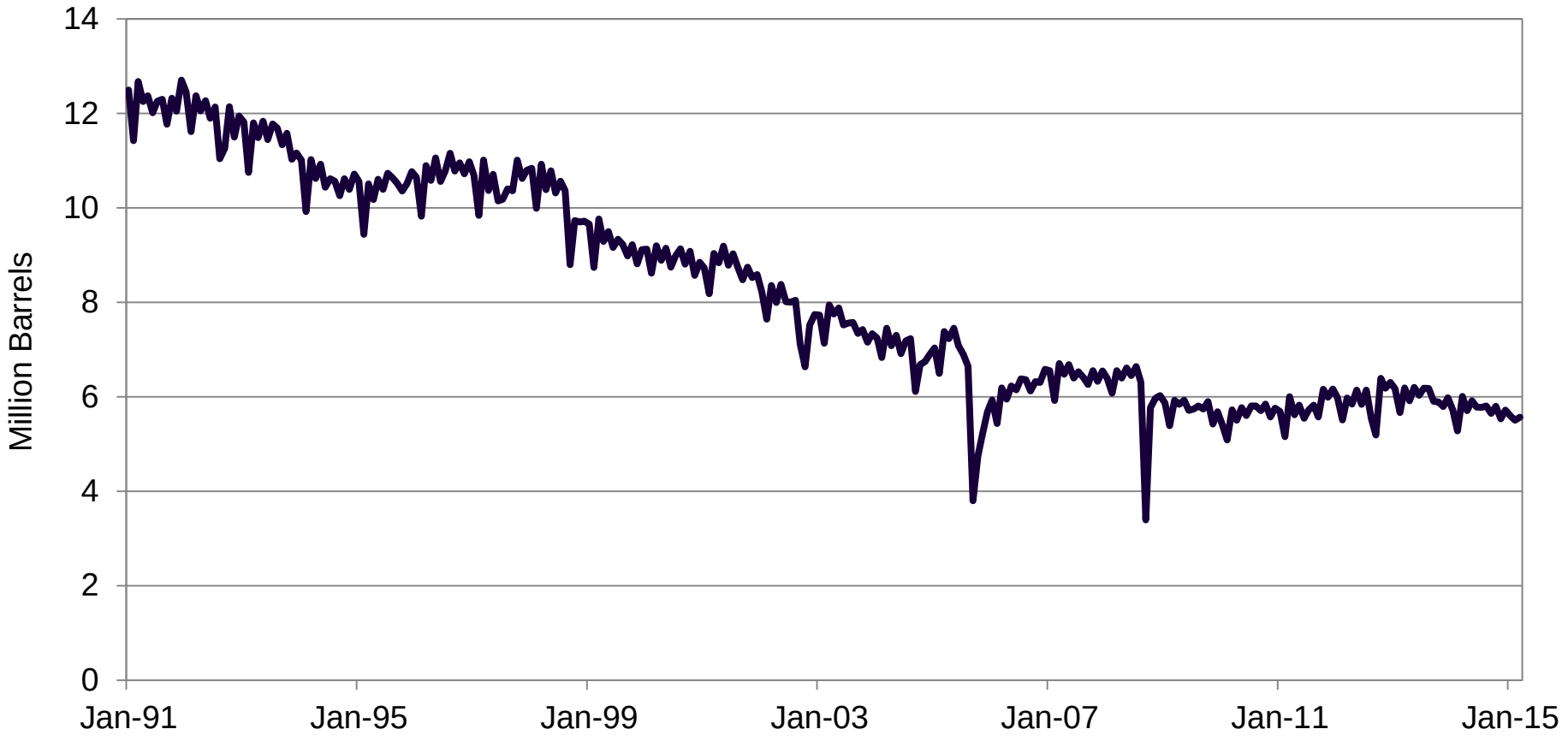
Oil rig activity has been weak for a considerable amount of time (absolute and relative terms).



Source: Baker-Hughes Rig Count.

Louisiana In-State Crude Oil Production Trends (excludes Federal OCS)

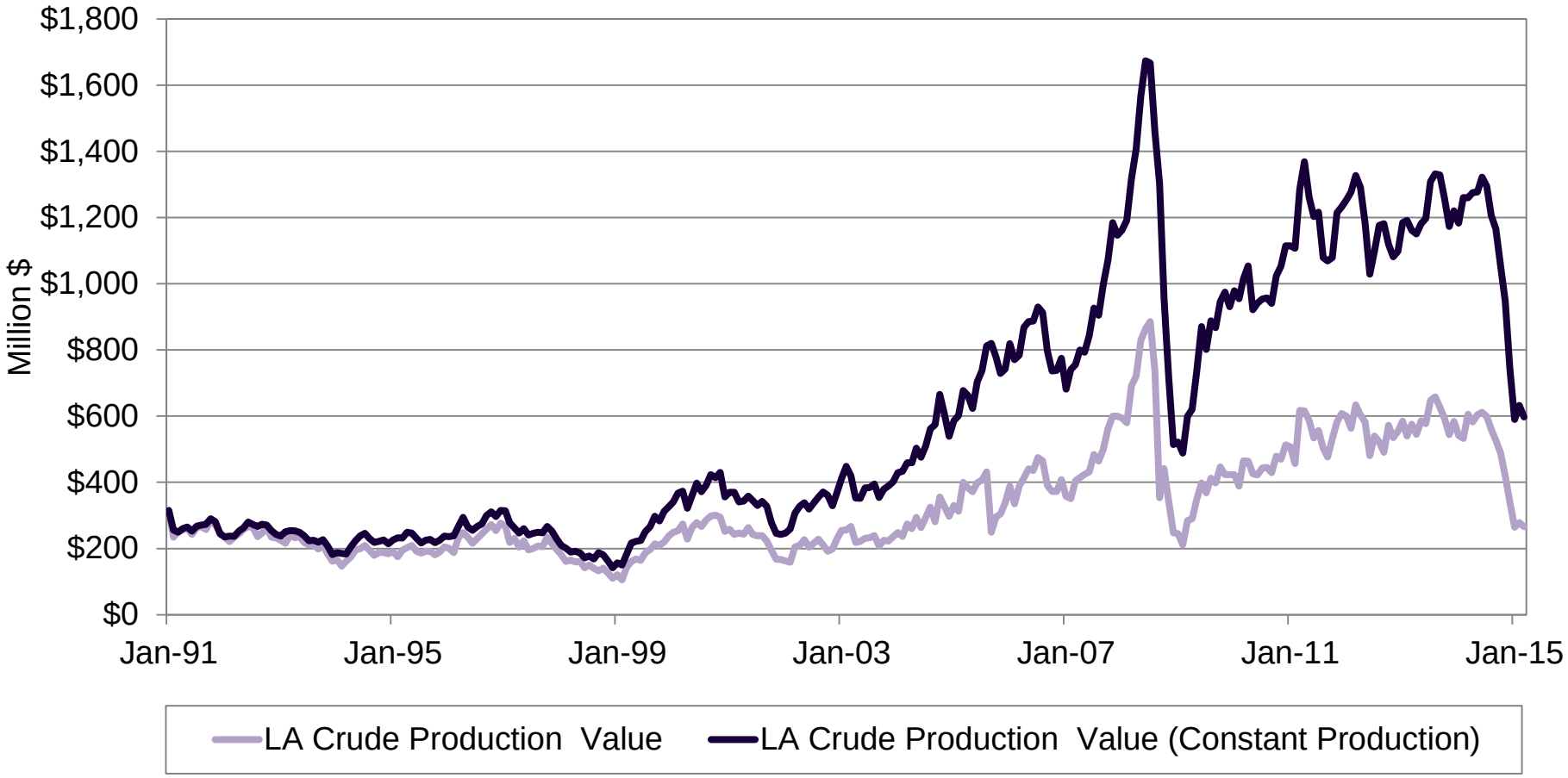
In-state production has been falling rapidly over the past several decades. Current production is about half the 1990 level.



Source: Louisiana Department of Natural Resources.

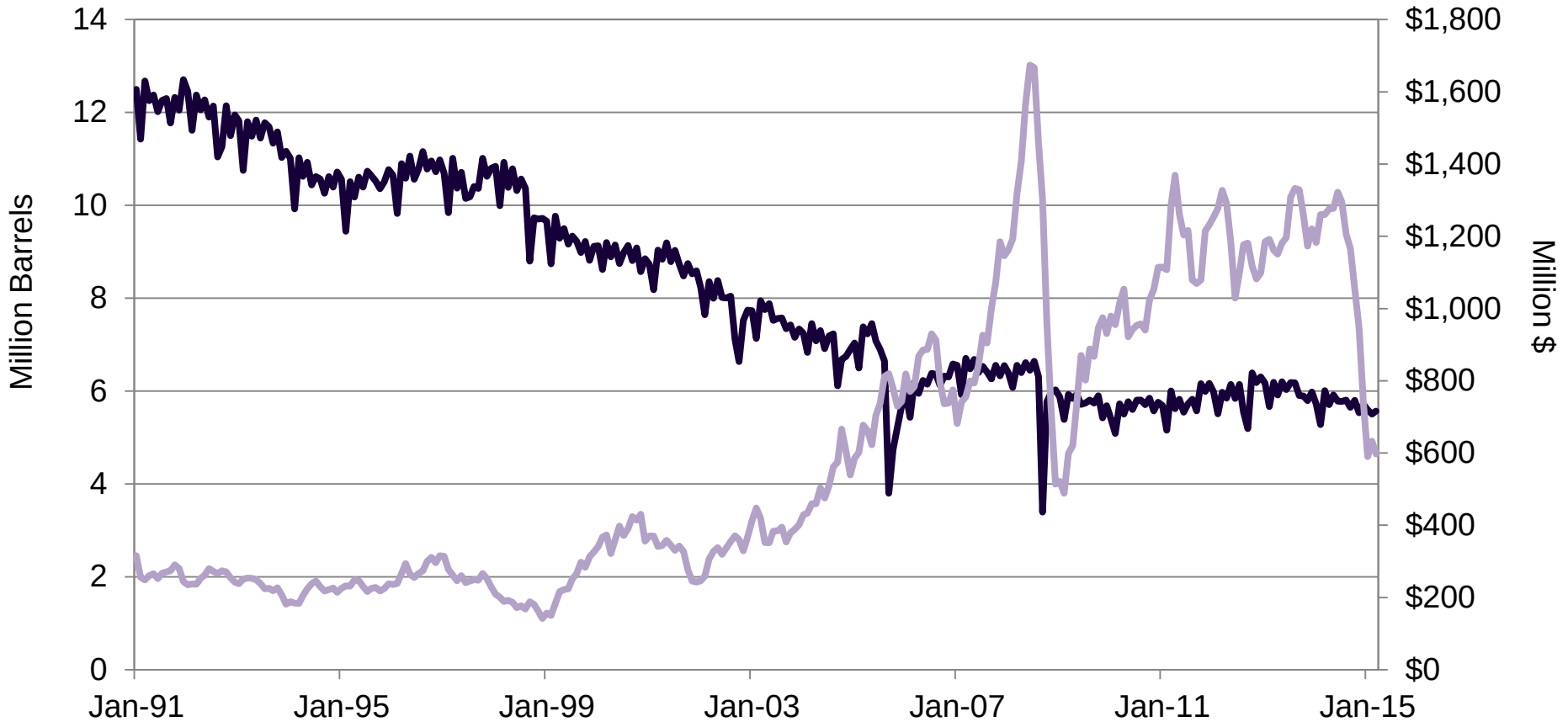
Louisiana Crude Oil Production Values

Output-related losses associated with in-state production have been growing over the past several decades.



In-state Production Declines vs. Losses in Production-related value

The cost of lost production (relative to the early 1990s) is considerable.



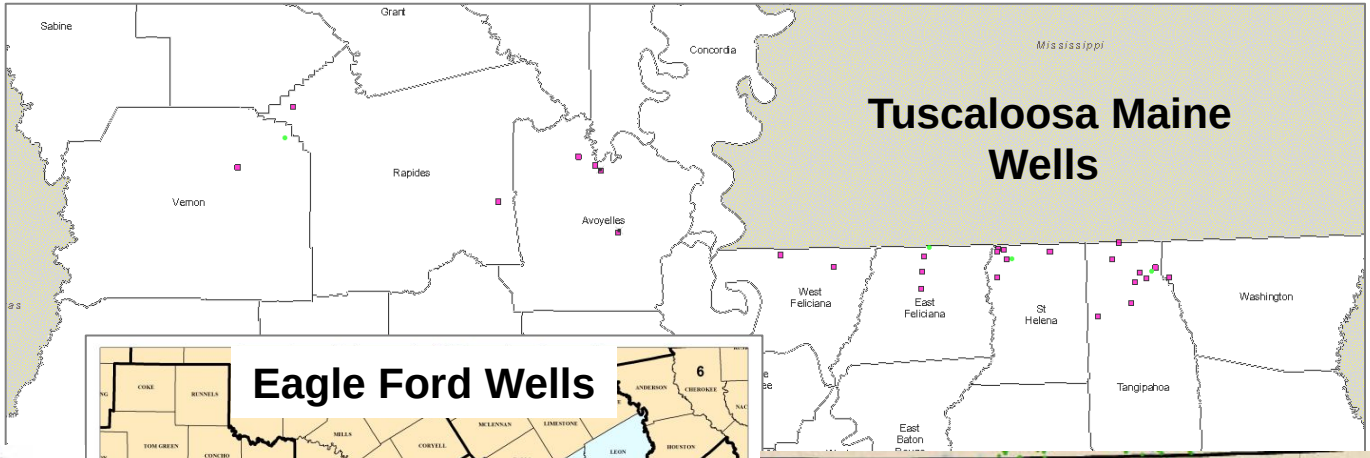
Upstream Opportunities in the Tuscaloosa Marine Shale

- **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** (LGS).
- Other estimates (Amelia Resources) have Original oil in place estimated at **153 BBls, potential at 9 BBbls.**

Source: Map from Oil and Gas Journal

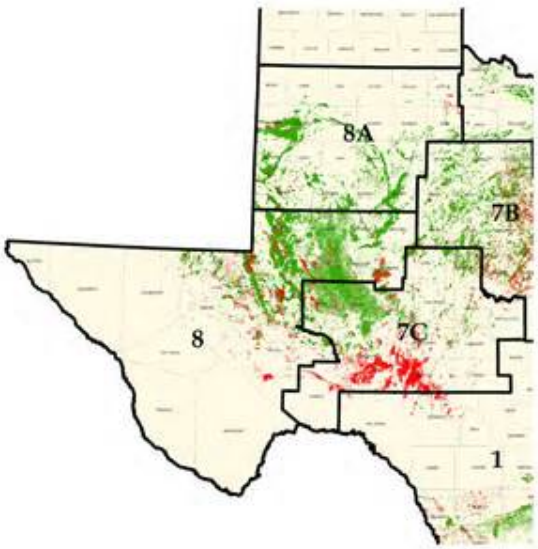
Unconventional Drilling by Major Basin

TMS drilling activity is still in its infancy relative to other maturing unconventional crude oil basins.

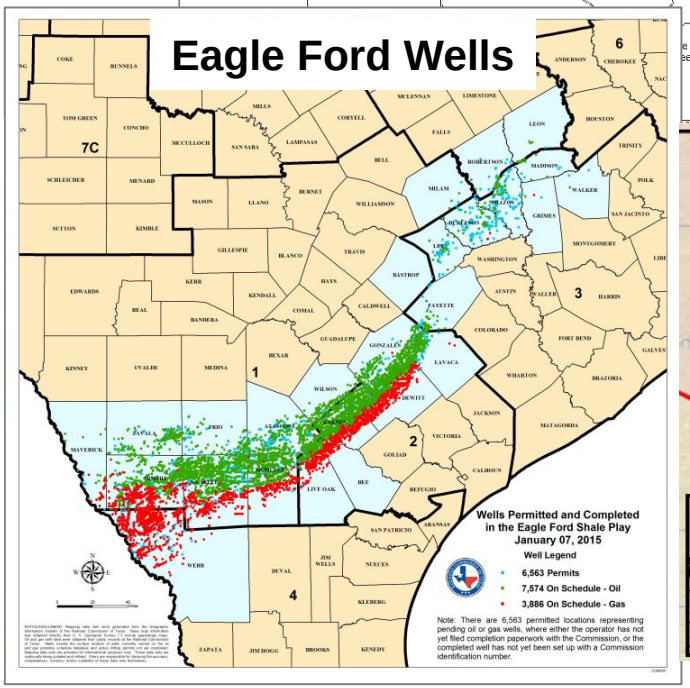


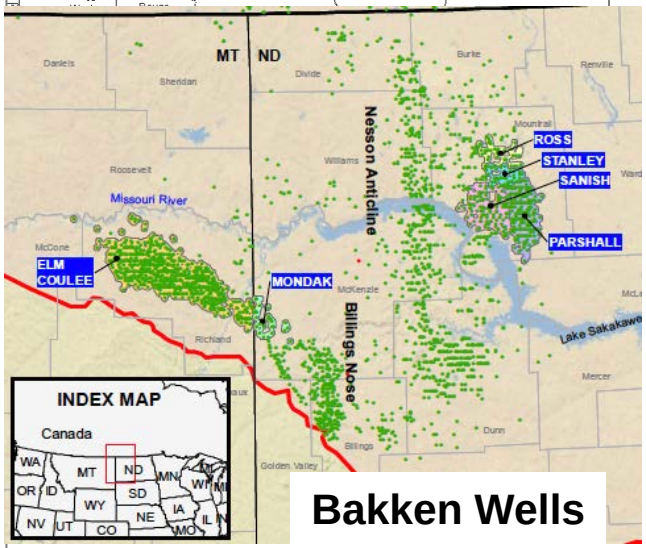
Tuscaloosa Maine Wells

Permian Wells



Eagle Ford Wells

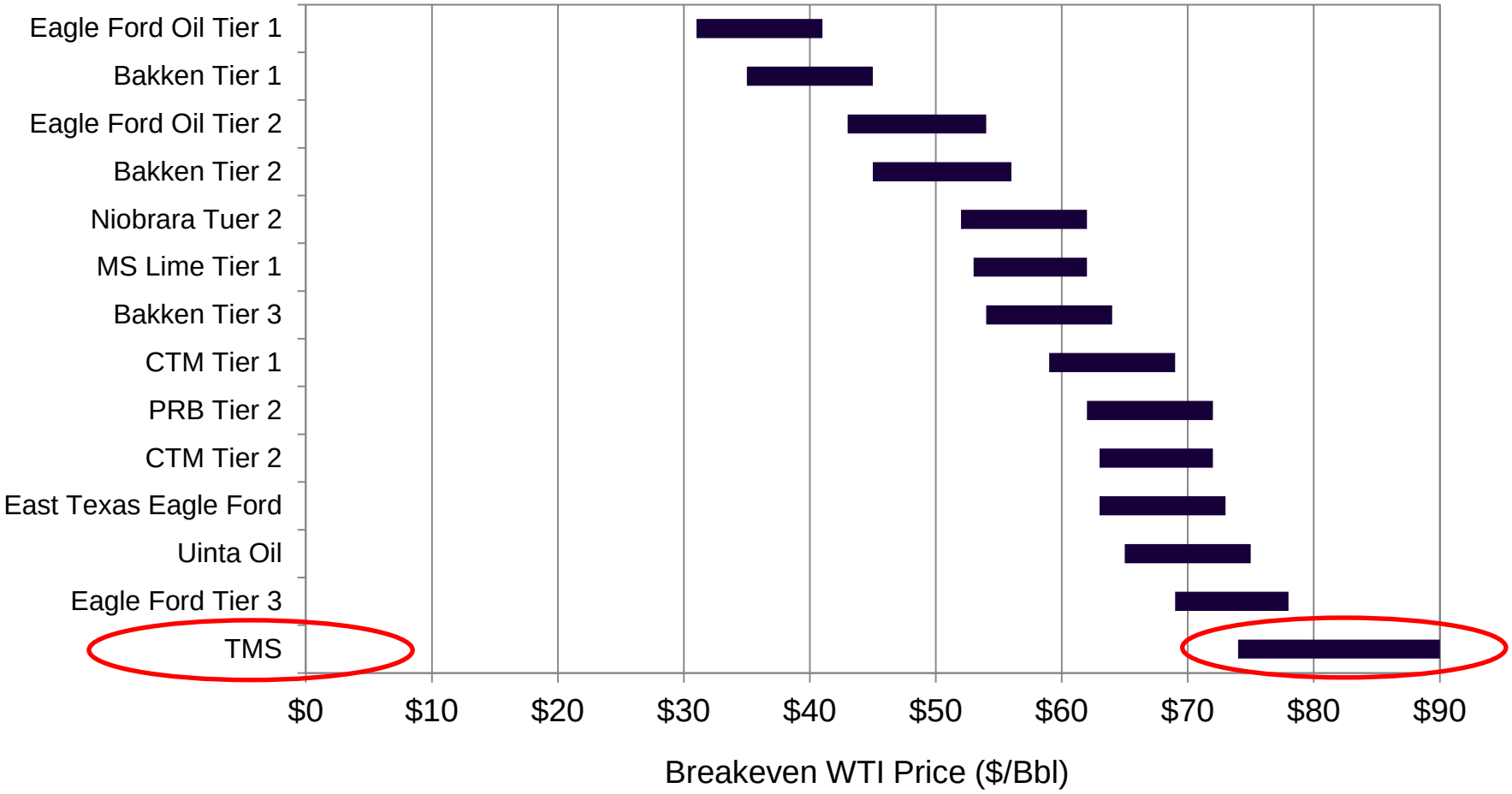




Bakken Wells

U.S. Unconventional Production Costs by Basin

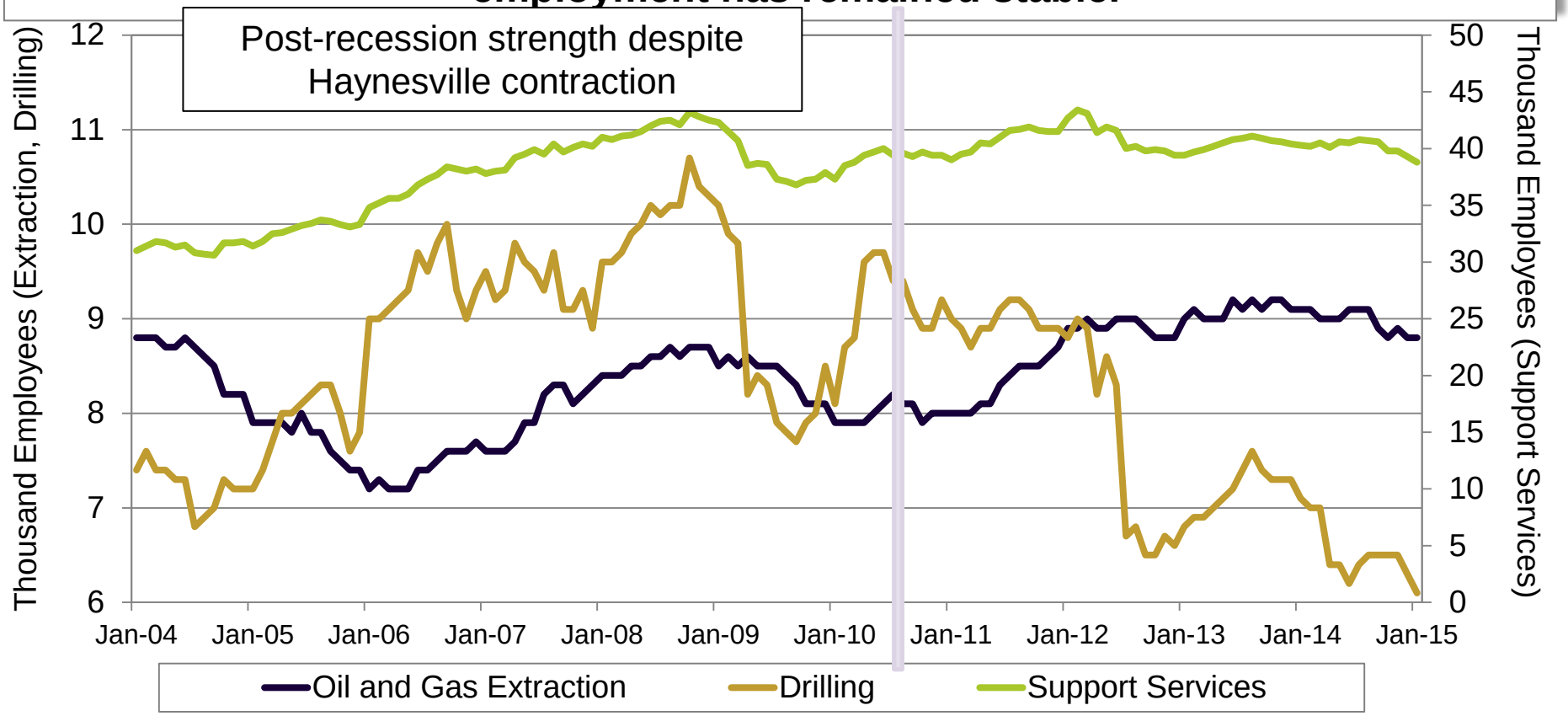
TMS is estimated to have the highest development costs of the major unconventional basins.



Louisiana Service Sector Impacts

Louisiana Natural Gas Service Jobs

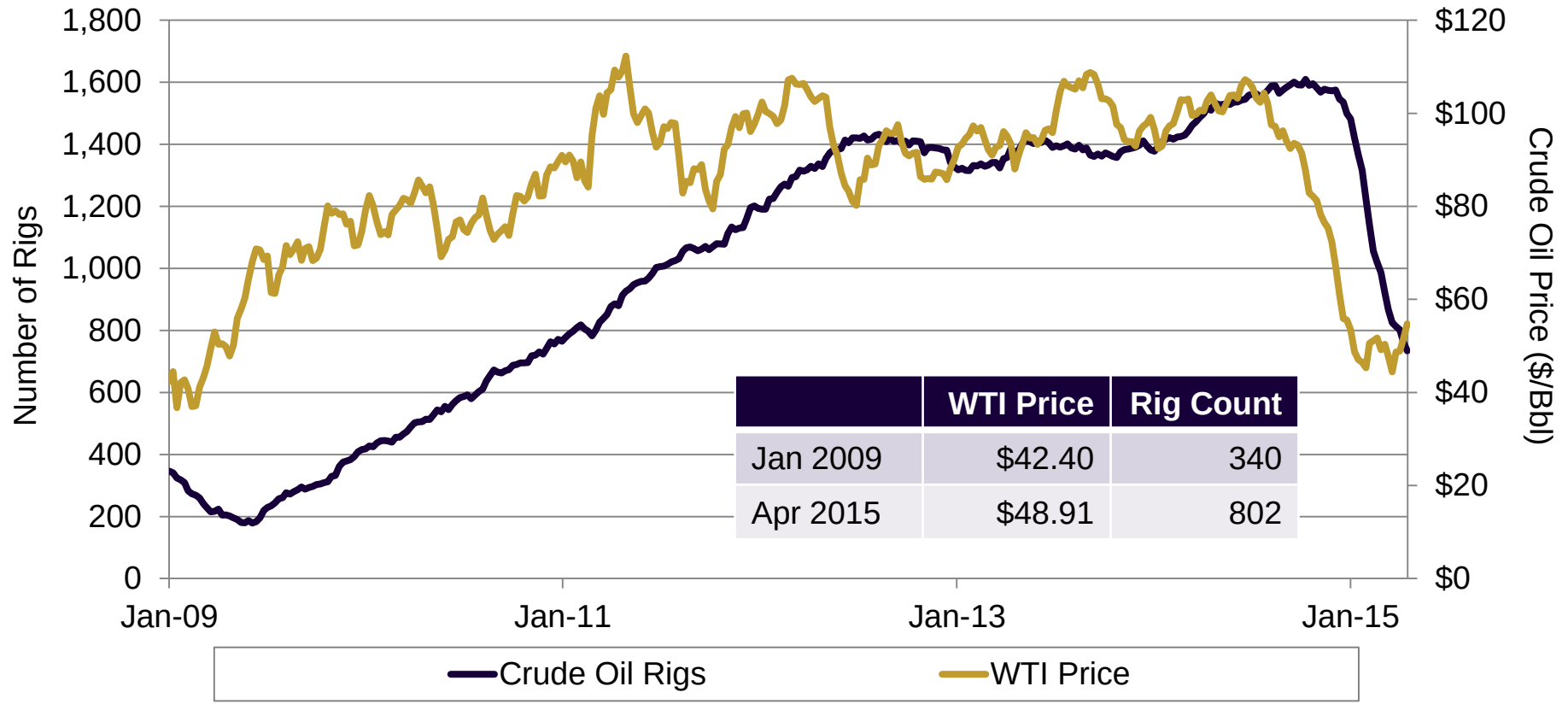
Employment in oil and gas extraction has been increasing at an annual average rate of three percent over the last five years; and support services employment has remained stable.



Source: Bureau of Labor Statistics, U.S. Department of Labor.

U.S. Crude Oil Rig Count and Spot Price

Note that while rig counts are falling, they are no where near the post-recession activity trough which saw comparable crude oil pricing.

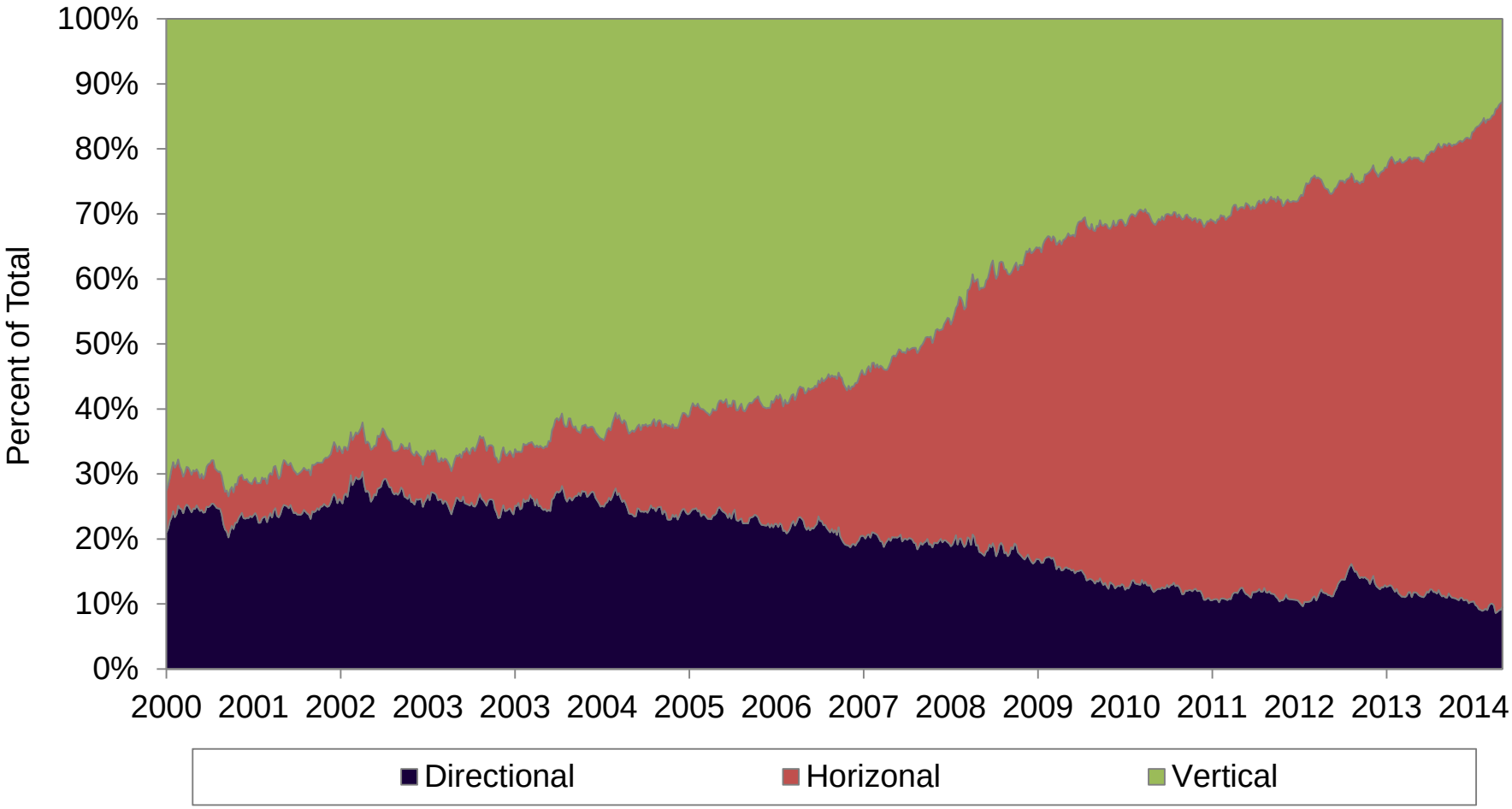


	WTI Price	Rig Count
Jan 2009	$42.40	340
Apr 2015	$48.91	802

Source: Energy Information Administration, U.S. Department of Energy; and Baker Hughes.

U.S. Oil Rig Count by Trajectory

Horizontal rig share of total active rigs still holding firm.



Source: Baker Hughes.

Summary of Recent Oil Rig Changes

Absolute changes have clearly been dominated by horizontal rigs. BUT, on a relative basis, the larger percent contractions have been in vertical/directional drilling.

Date	Levels			Percent Change (%)		
	Directional Rig Change	Horizontal Rig Change	Vertical Rig Change	Directional Rig Change	Horizontal Rig Change	Vertical Rig Change
Oct 2014 to Current	(117)	(610)	(244)	-1.3%	7.5%	-6.2%
Jan 2015 to Current	(64)	(516)	(148)	0.3%	2.9%	-3.2%

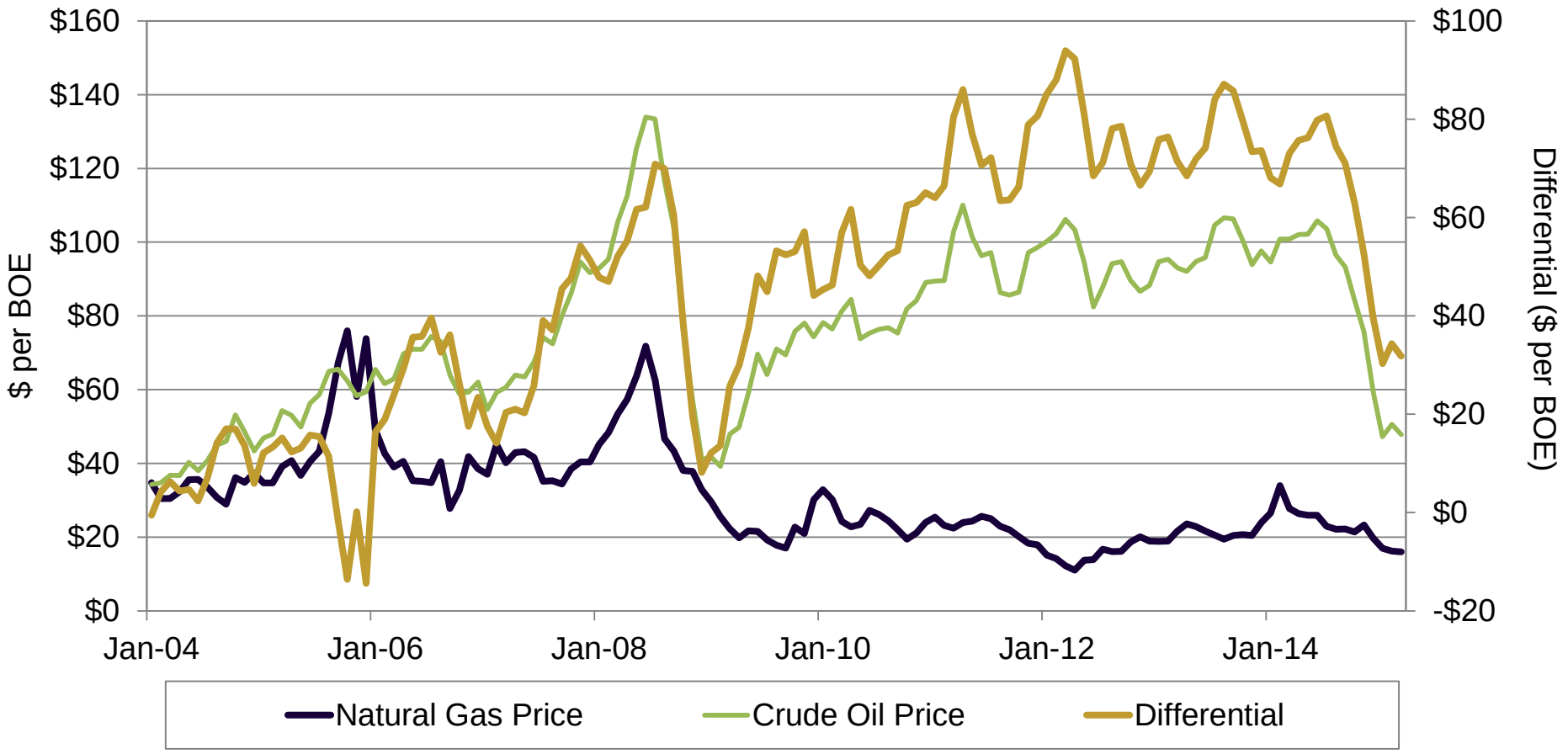
Louisiana Industrial Development Impacts

Risks to Industrial Development

- If crude oil prices fall too far, for too long, concurrent with any slight upward movement in natural gas, there could be some project development “squeeze.”
- All of these projects convert BTUs of natural gas to (petrochemical) product. The competing input for natural gas BTUs is crude oil BTUs. If crude oil BTUs fall, it makes some other competing places (short run) attractive.
- GTL is particularly vulnerable.
- Offsetting this near term “squeeze” is the longer-run perspective that includes abundant natural gas supply availability and volatility. This still tilts in favor of US natural gas-based projects -- BUT -- could put some projects in the “wait and see” position.

Natural Gas and Crude Oil Prices

Natural gas/crude oil price spreads well in excess of $60 Bbl and as high as $80/Bbl. These differentials have collapsed by about half.



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

Example: Changes in Competitiveness of US Sourced LNG

Economics of LNG development are important, but there are additional factors that can influence development such as geopolitical and supply stability concerns that could sustain continued projects.



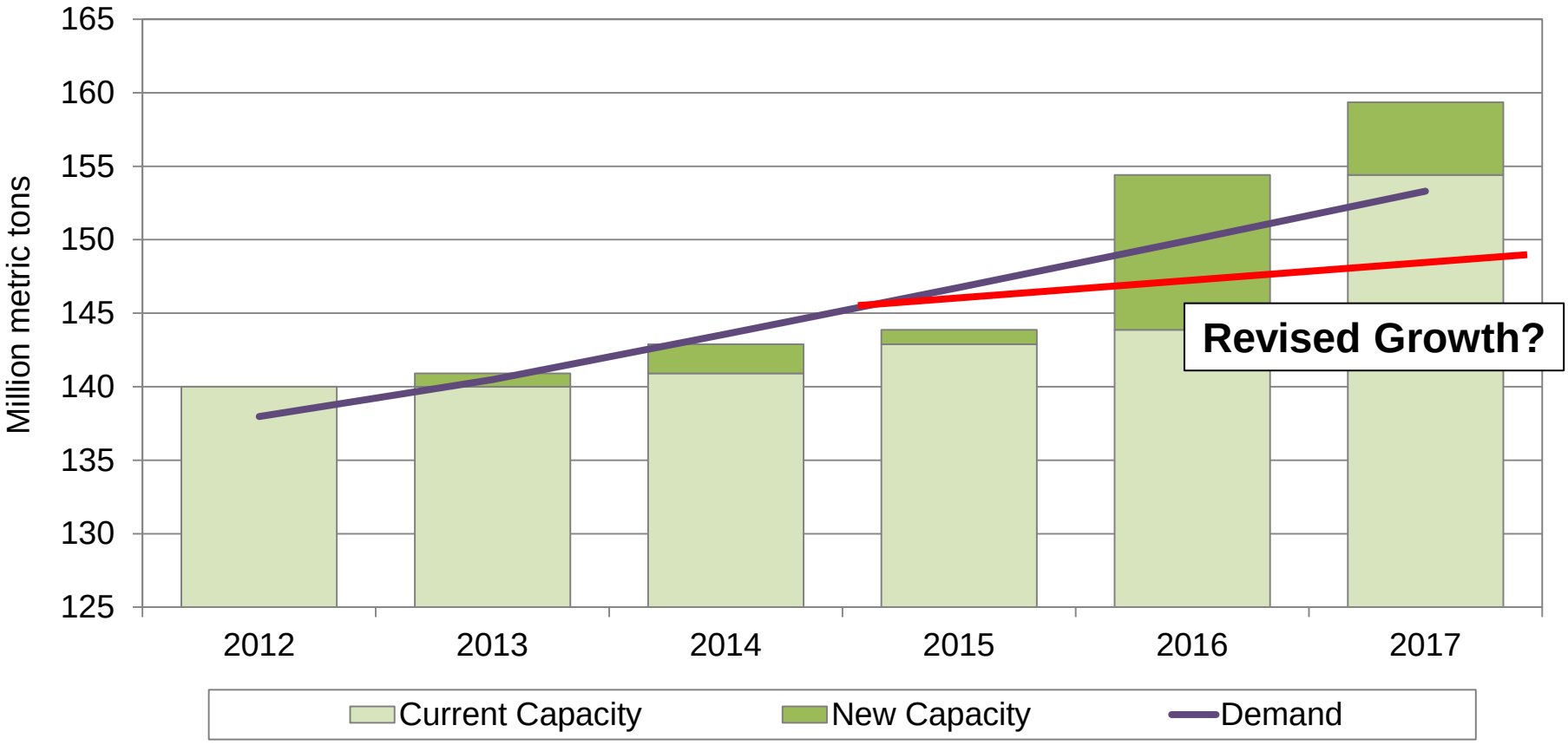

	Feedgas 40-60% ($/MMBtu)	Liquefaction 12%-20% ($/MMBtu)	Shipping & Fuel 20%-40% ($/MMBtu)	Regas 5%-8% ($/MMBtu)	Delivered Cost ($/MMBtu)	Equivalent Oil Price* ($/BOE)
Europe:						
Low	$3.00	$1.25	$1.40	$0.50	$6.15	$35.65
High	$5.00	$1.25	$1.65	$0.50	$8.40	$48.72
Asia:						
Low	$3.00	$1.25	$2.90	$0.50	$7.65	$44.37
High	$5.00	$1.25	$3.45	$0.50	$10.20	$59.16
Caribbean:						
Low	$3.00	$1.25	$0.75	$0.50	$5.50	$31.90
High	$5.00	$1.25	$1.00	$0.50	$7.75	$44.95

Henry Hub (Mar 2105):	WTI (Mar 2015):	Brent (Mar 2015):
$2.83	$47.82	$55.89

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

Example: Agricultural Chemicals (Ammonia)

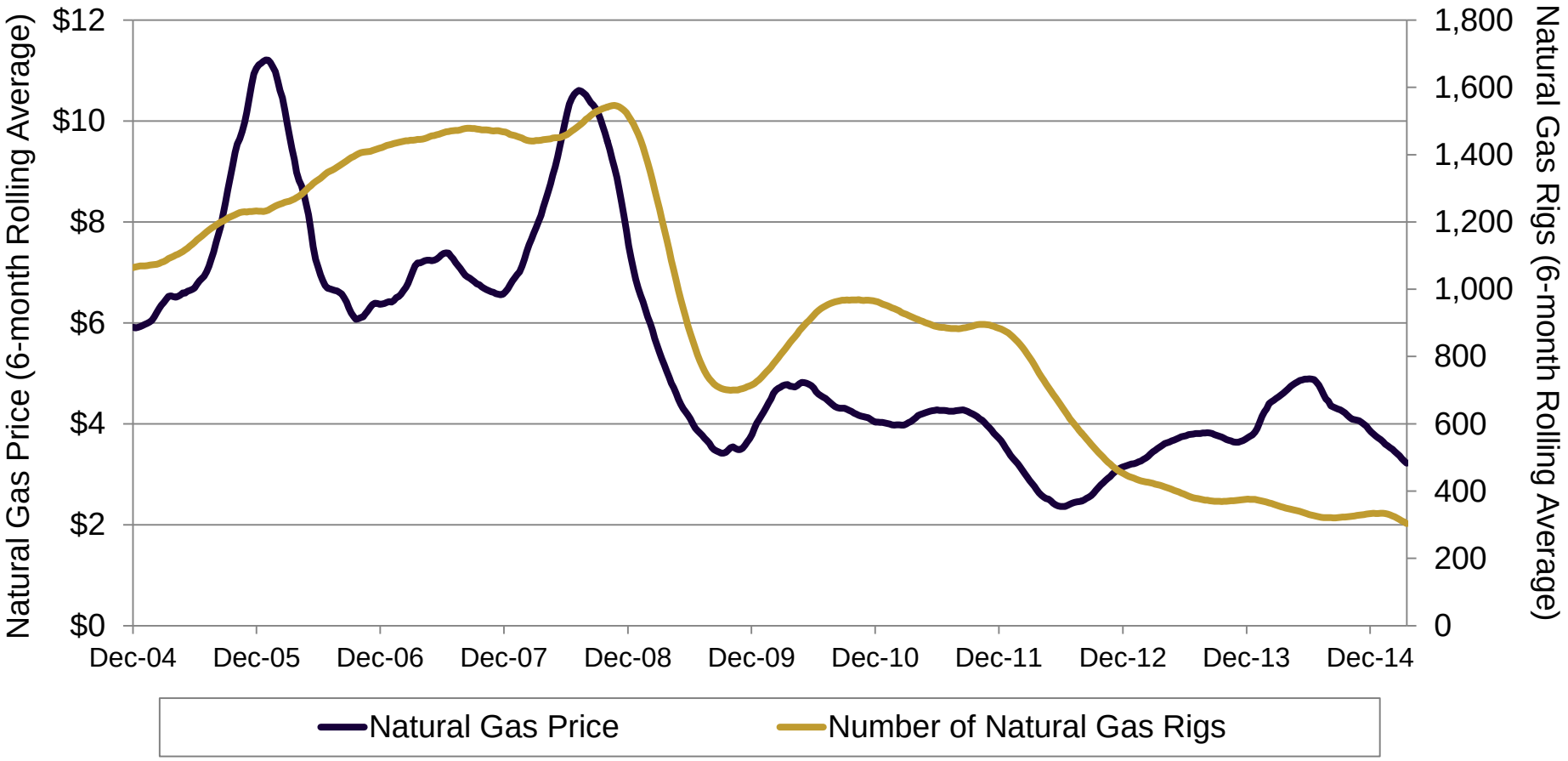
Ammonia demand forecast is based upon slightly weaker than historic average world growth rates. The degree to which the market potentially becomes over-supplied will be function of project cancellations (if any) and continued growth assumptions.



Market Realignment

Natural Gas Prices and Rigs

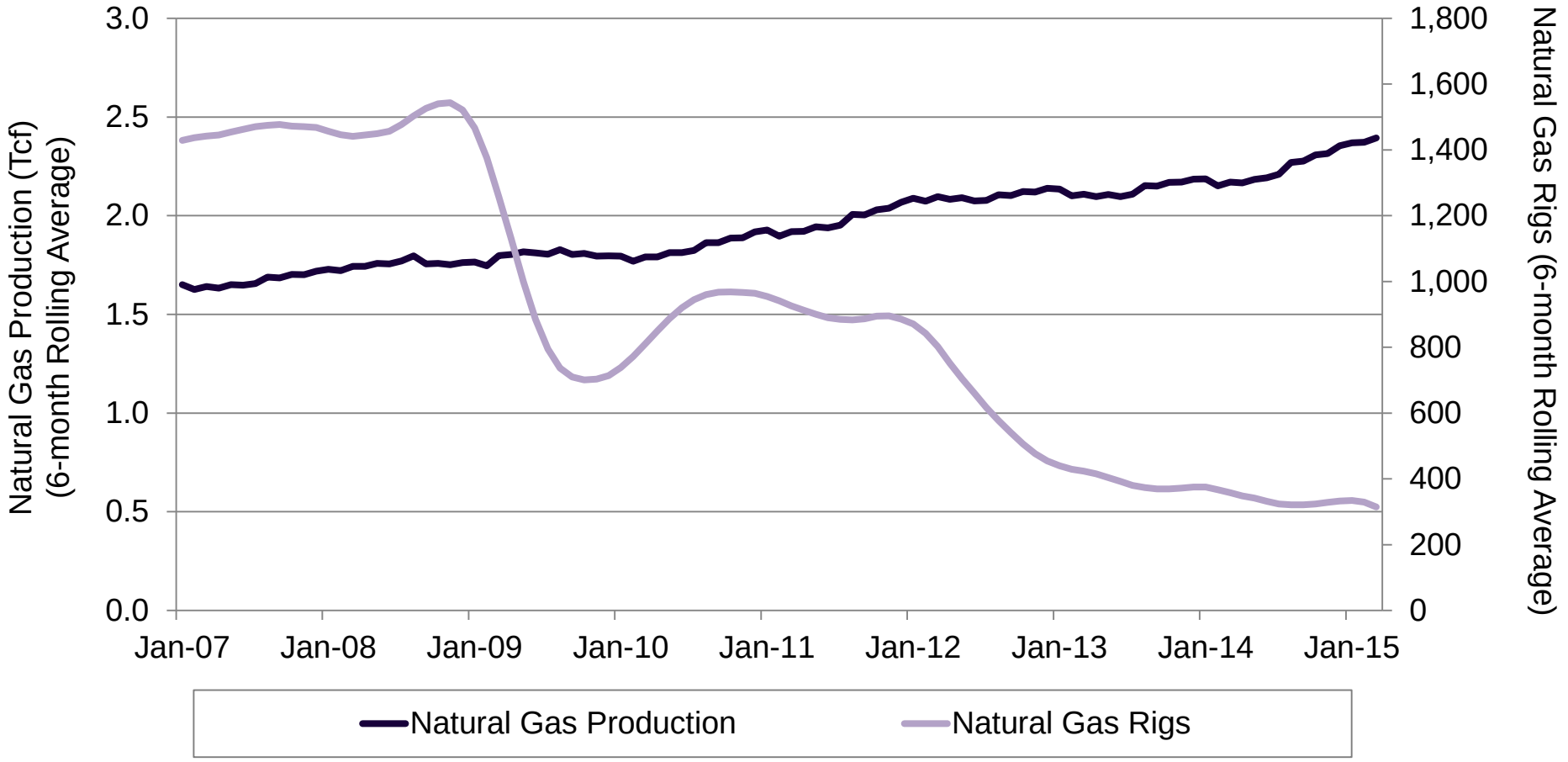
Natural gas drilling rigs activity is very responsive to price, both of which started to decrease rapidly post-recession.



Source: Energy Information Administration, U.S. Department of Energy; Baker Hughes, Inc.

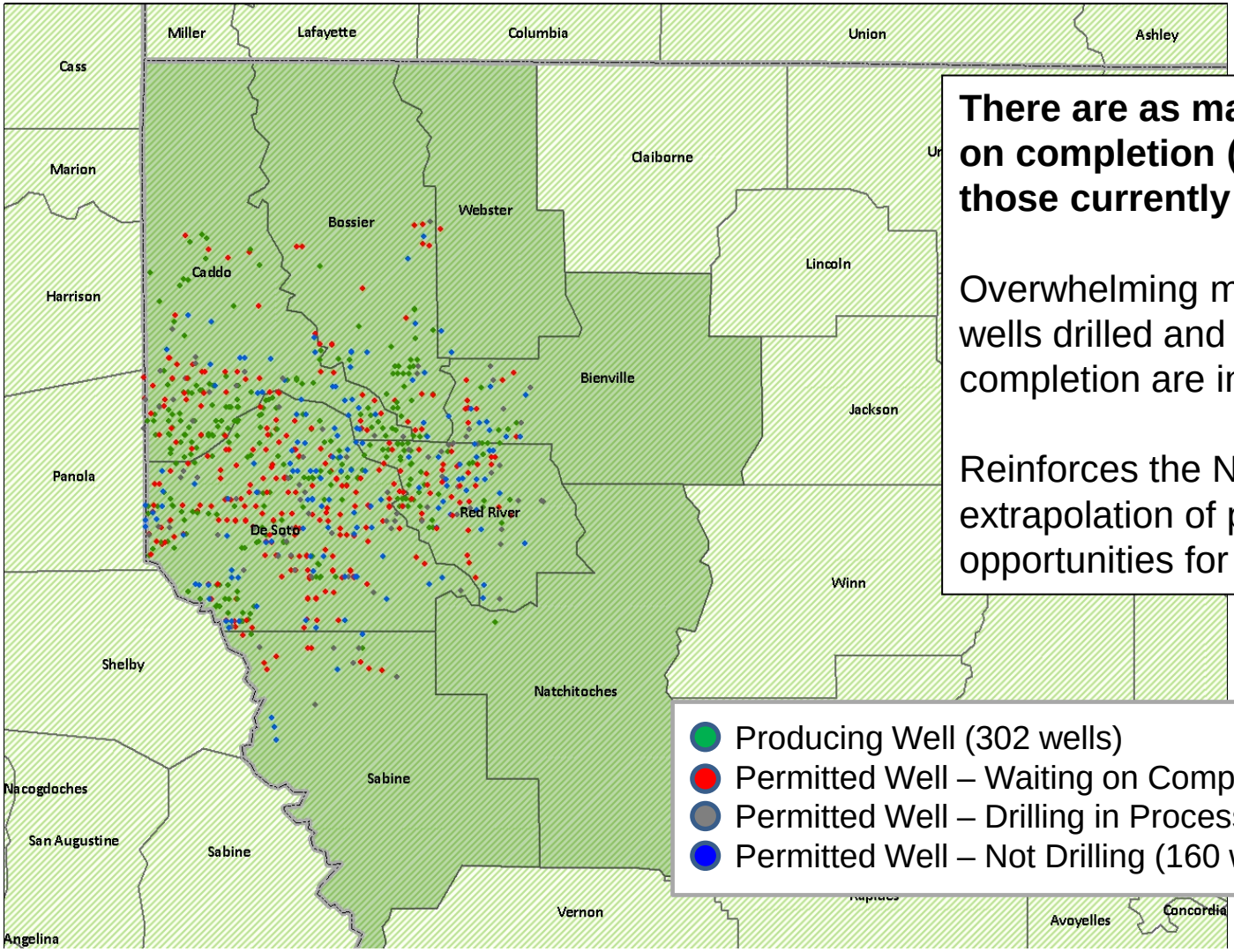
Natural Gas Production and Rigs

Interestingly, natural gas production continued to rise in the face of rapid decreases in rig activity (pre-cursor/corollary for crude oil?)



Source: Energy Information Administration, U.S. Department of Energy; Baker Hughes, Inc.

Example: 2010 Well Status, Haynesville Shale



There are as many wells waiting on completion (306) as there are those currently producing (302).

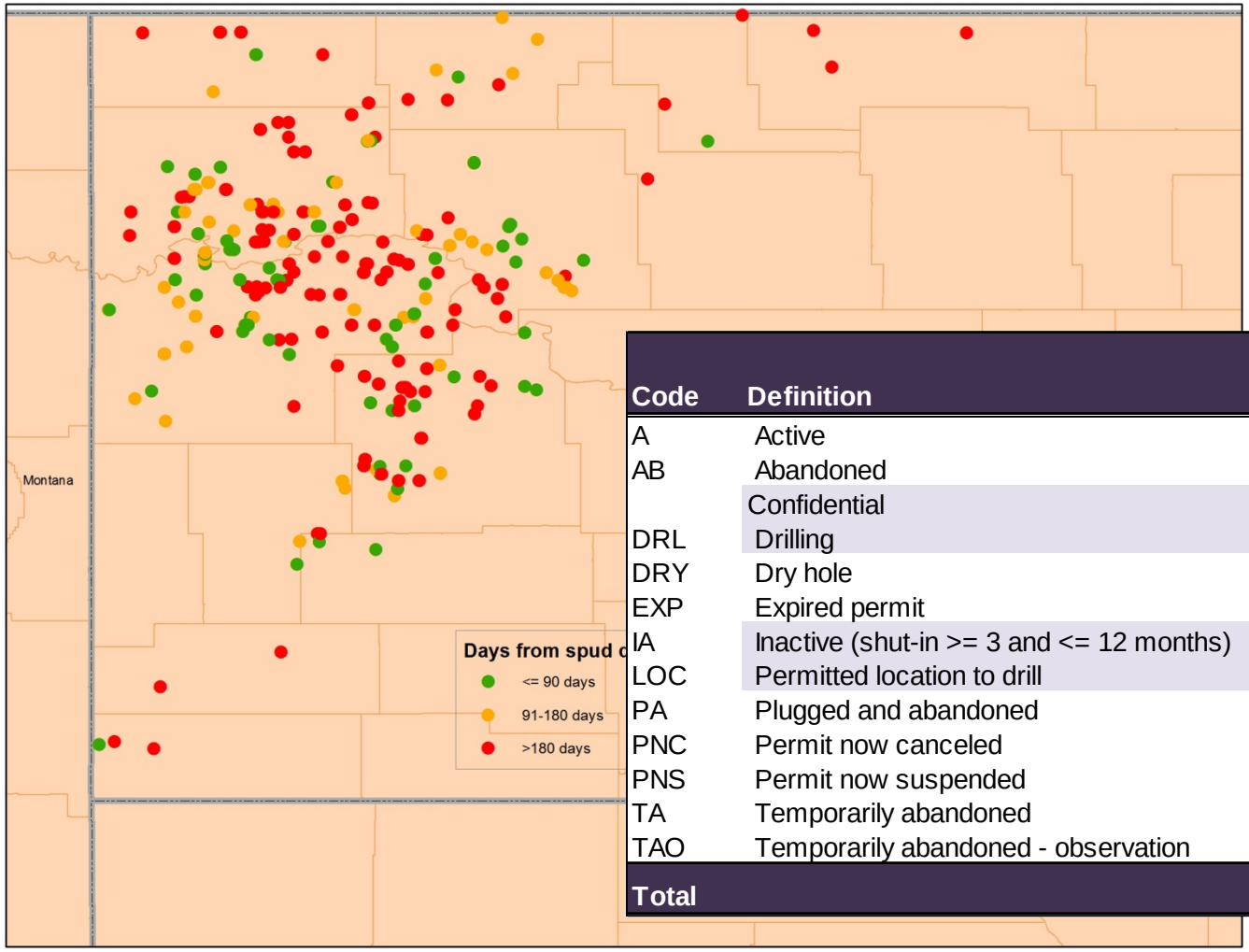
Overwhelming majority of those wells drilled and waiting on completion are in De Soto parish.

Reinforces the Navigant extrapolation of production opportunities for the region.

- Producing Well (302 wells)
- Permitted Well – Waiting on Completion (306 wells)
- Permitted Well – Drilling in Process (97 wells)
- Permitted Well – Not Drilling (160 wells)

North Dakota Wells in Progress

Will unconventional oil follow similar trends to unconventional natural gas?



Code	Definition	Count	Share of Total	Share of Active Only
A	Active	12,767	40.9%	100.0%
AB	Abandoned	270	0.9%	
	Confidential	2,201	7.1%	17.2%
DRL	Drilling	621	2.0%	4.9%
DRY	Dry hole	6,237	20.0%	
EXP	Expired permit	32	0.1%	
IA	Inactive (shut-in >= 3 and <= 12 months)	993	3.2%	7.8%
LOC	Permitted location to drill	598	1.9%	4.7%
PA	Plugged and abandoned	3,999	12.8%	
PNC	Permit now canceled	3,133	10.0%	
PNS	Permit now suspended	-	0.0%	
TA	Temporarily abandoned	315	1.0%	
TAO	Temporarily abandoned - observation	16	0.1%	
Total		**31,182**	**100.0%**	

Producers' Response to Contango

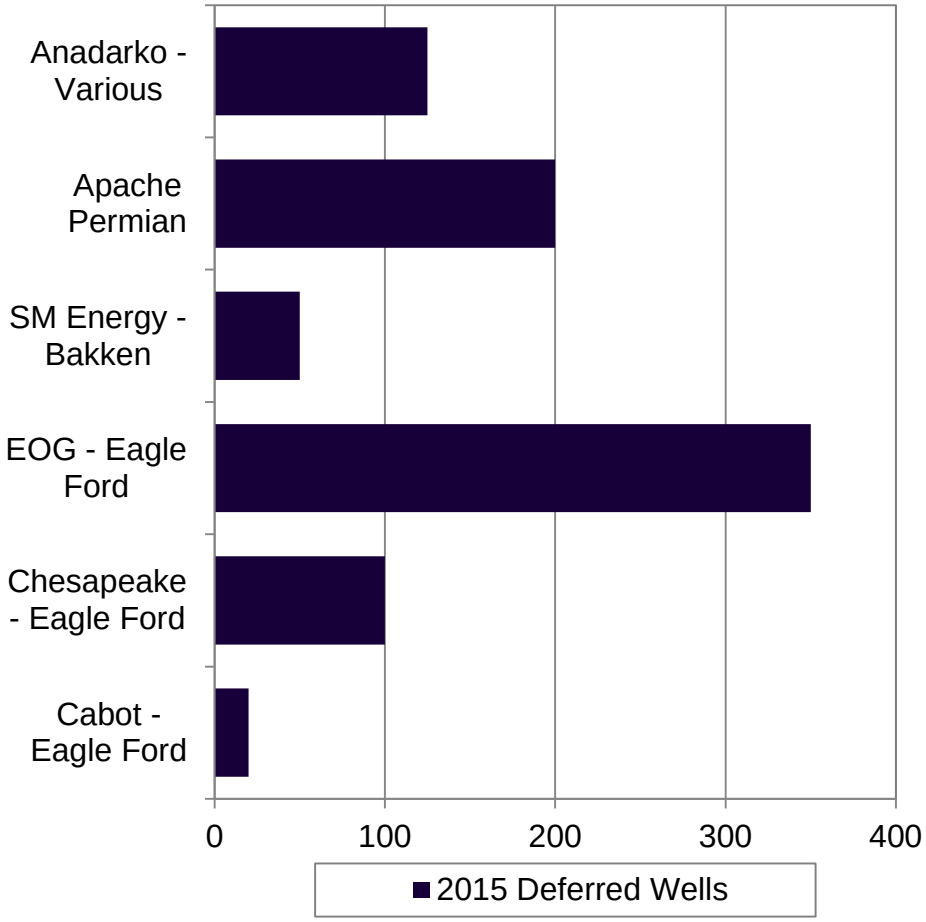
A number of producers have announced their intention to drill wells, but defer completions.

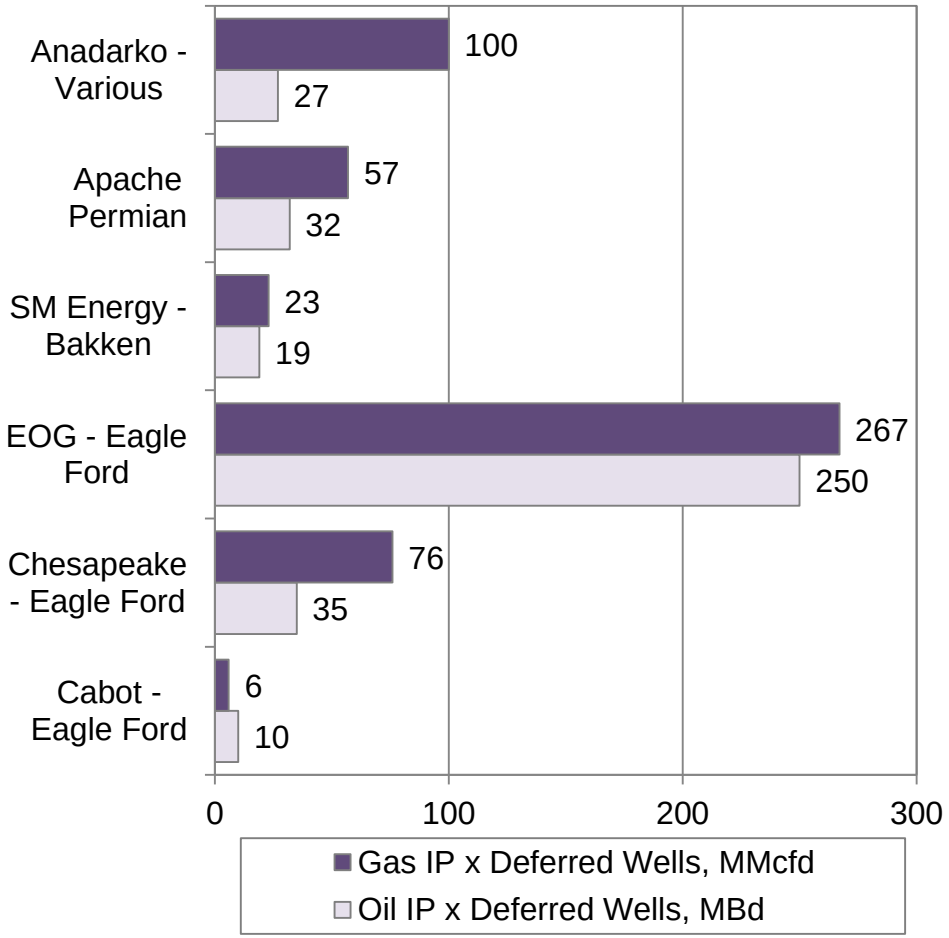
2015 Completion Deferrals	2013-14 Completions per Year	2015 Planned Completion Deferrals	2015 Deferrals vs. 2013-14 Completions per Year
Anadarko – Various	817 per year	125	15%
Apache – Permian	163 per year	200	123%
SM Energy – Bakken	55 per year	50	91%
EOG – Eagle Ford	303 per year	350	116%
Chesapeake – Eagle Ford	214 per year	100	47%
Cabot – Eagle Ford	20 per year	20	100%
Total	**1,571 per year**	**845**	**54%**

Source: Genscape.

Producers' Response to Contango

The impact of these 845 wells would be about 373 Mbd of oil and 528 MMcfd of gas.





Source: Genscape.

Citi Research Estimates (February 3, 2015)

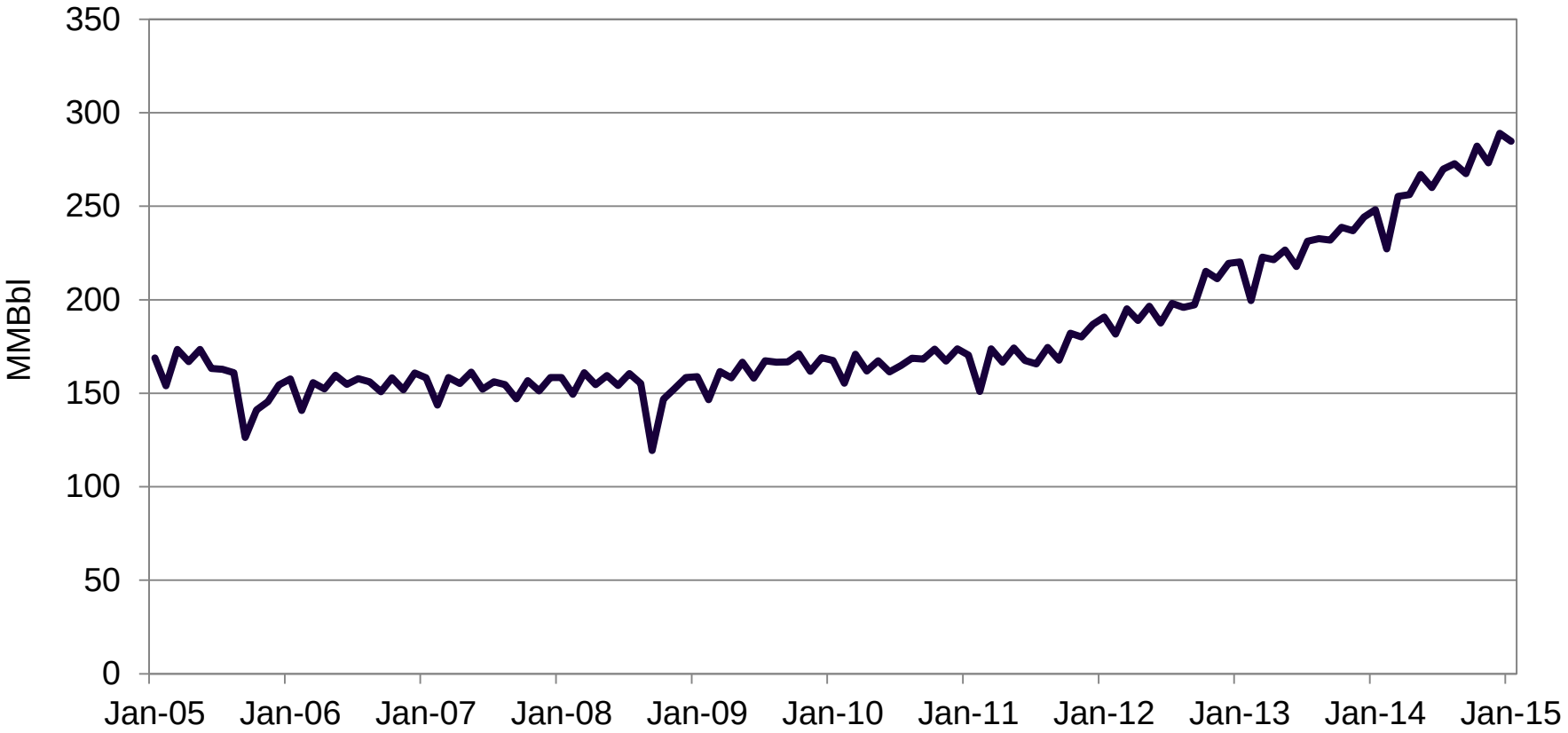
Anticipated contraction of $57 billion in capex, but 1.122 MMBOE/d in new production

	Change in Capex ($MM)	Percent Change in Capex	Change in Production (MBOE/d)	Percent Change in Production
Covered Companies	31,718	-34%	740	11%
Non-Covered Companies	26,151	-24%	382	5%
Total	57,870	-28%	1,122	8%

Total production expected to increase from 14.5 MMBOE to 15.6 MMBOE/d.

U.S. Crude Oil Production

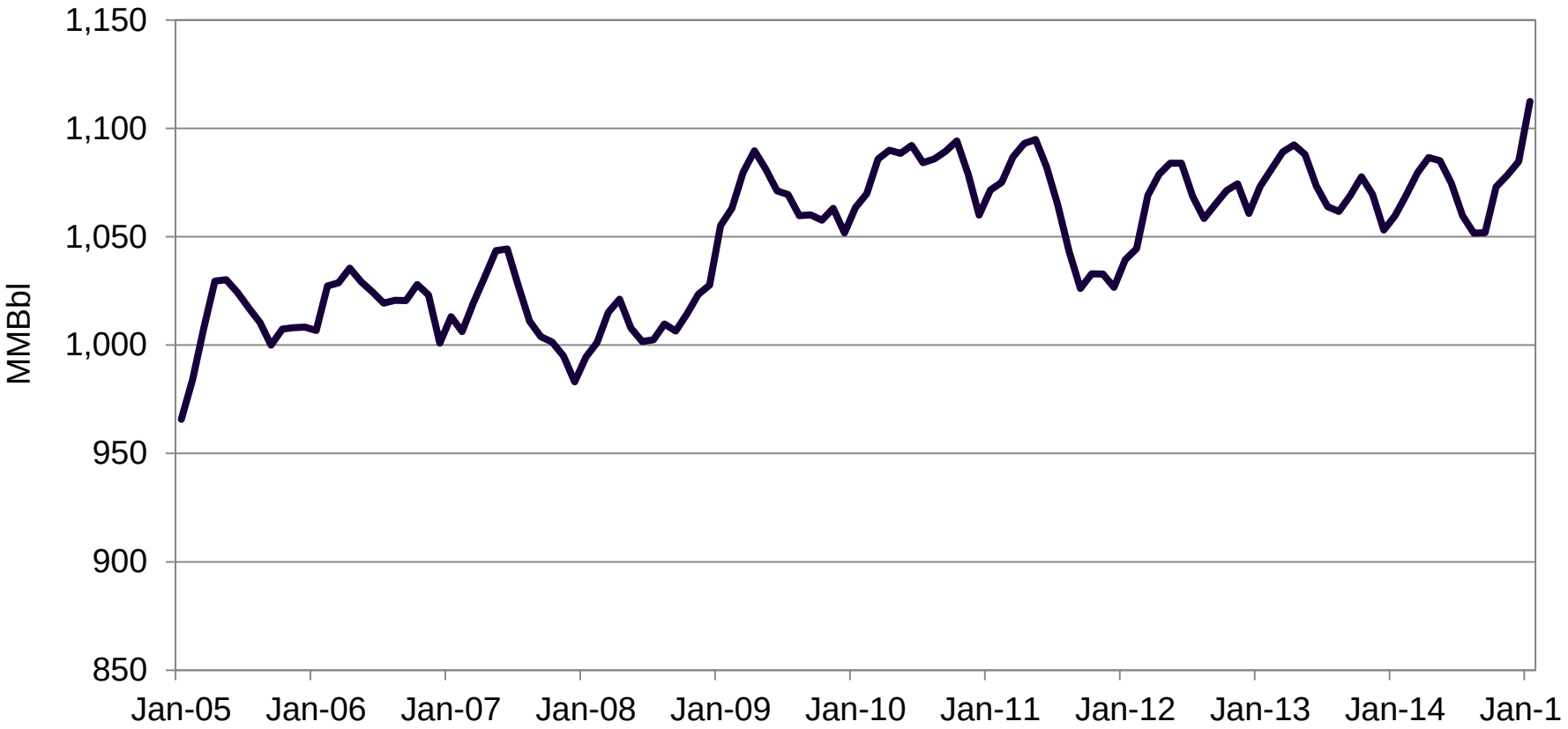
Crude oil production has increased over 70 percent since 2009, at an average annual rate of 10 percent.



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

U.S. Crude Oil Stocks

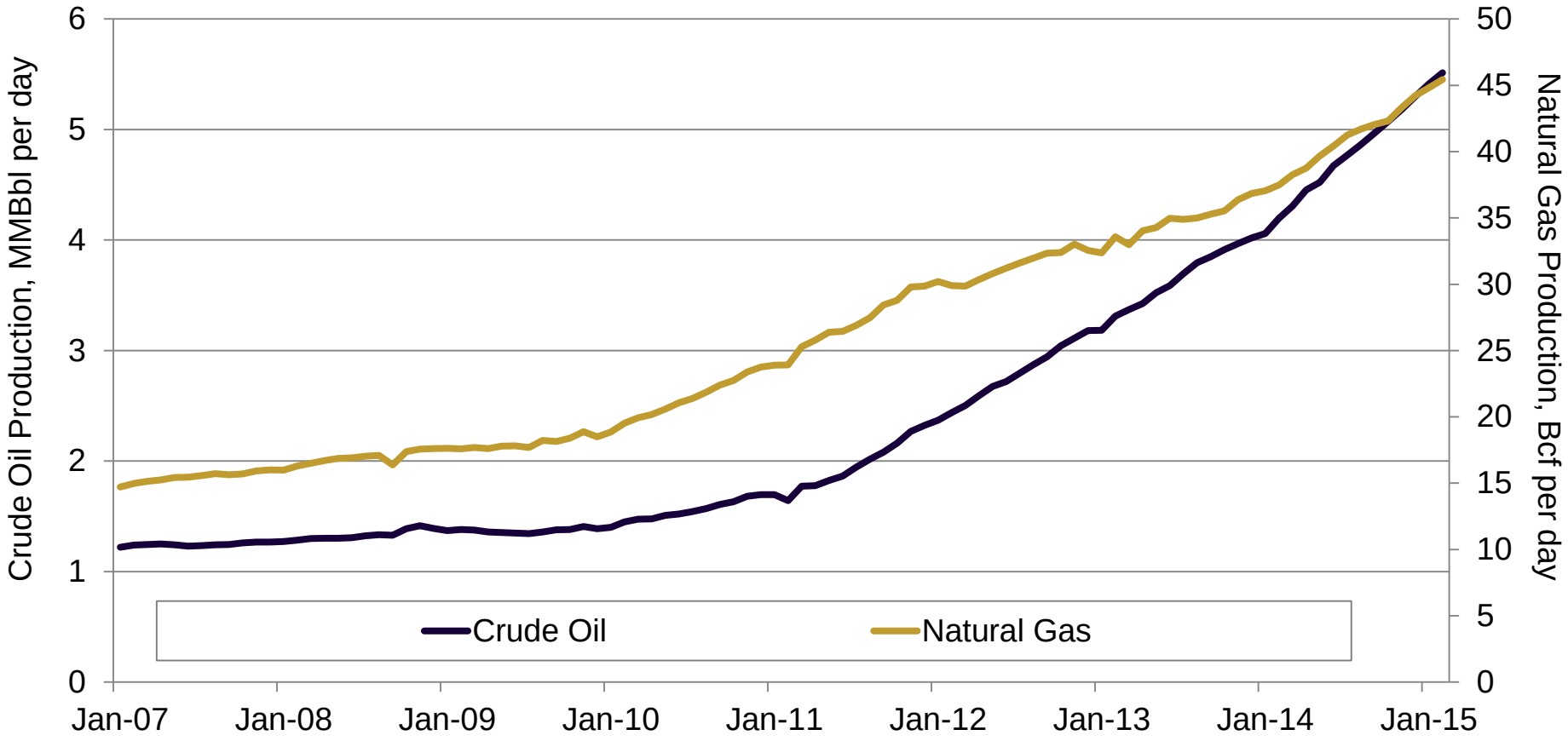
Stocks of crude oil in the U.S. have remained above one billion barrels for the last five years.



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

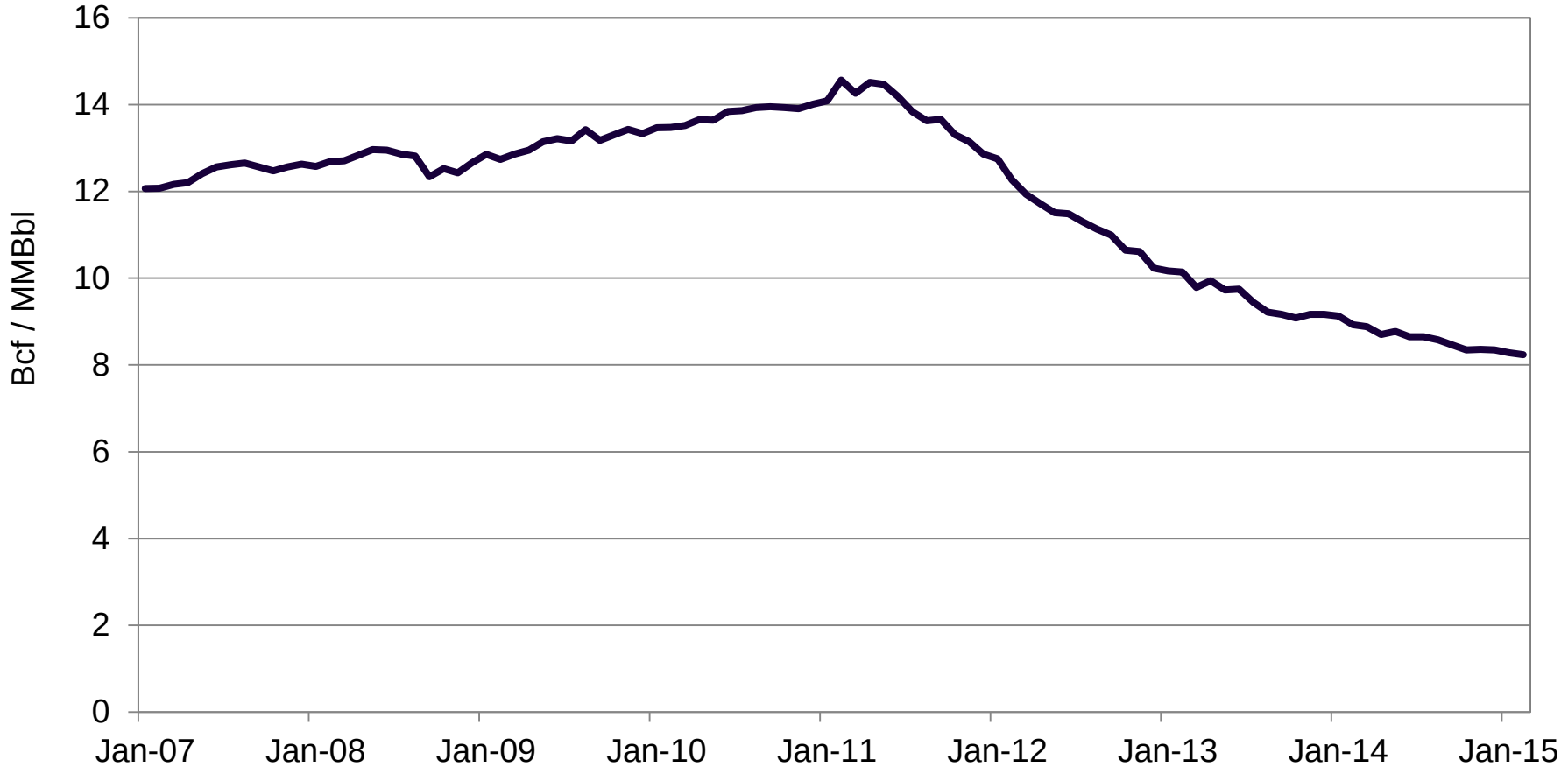
Shale Oil and Gas Production (7 Major Plays)

Considerable amount of "free" natural gas ("associated gas") coming from unconventional crude oil production. Helps to explain (in part) the continued strength in natural gas production in the face of rapid rig count decreases.



Relationship of Shale Oil and Gas Production

Growth in "free gas" has already started to slow, once crude oil rig, and then production activity slows.. It could have implications for natural gas markets.



Conclusions

Conclusions: Outlook

- Likely to continue to see near-term pricing volatility. Market having a tough time processing information.
- Lower prices will reduce upstream activity: but watch the composition (and location) of that activity closely.
- The “genie is out of the bottle,” no country can pursue a long-term strategy of predation without inflicting harm on themselves.
- U.S. producers likely follow actions, and show results, comparable to what happened in natural gas after the financial melt-down: reduce costs, increase capital & operating efficiencies, increase well productivity. (“the best solution for low prices is low prices”)
- Question: will U.S. unconventional prove to the “just in time inventory” needed for U.S. and global energy supplies?
- Could very well find ourselves in new period of energy abundance and diverse supplies (i.e. security).

Questions, Comments and Discussion

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