



# **U.S. SHALE REVOLUTION: PROSPECTS & LIMITATIONS**

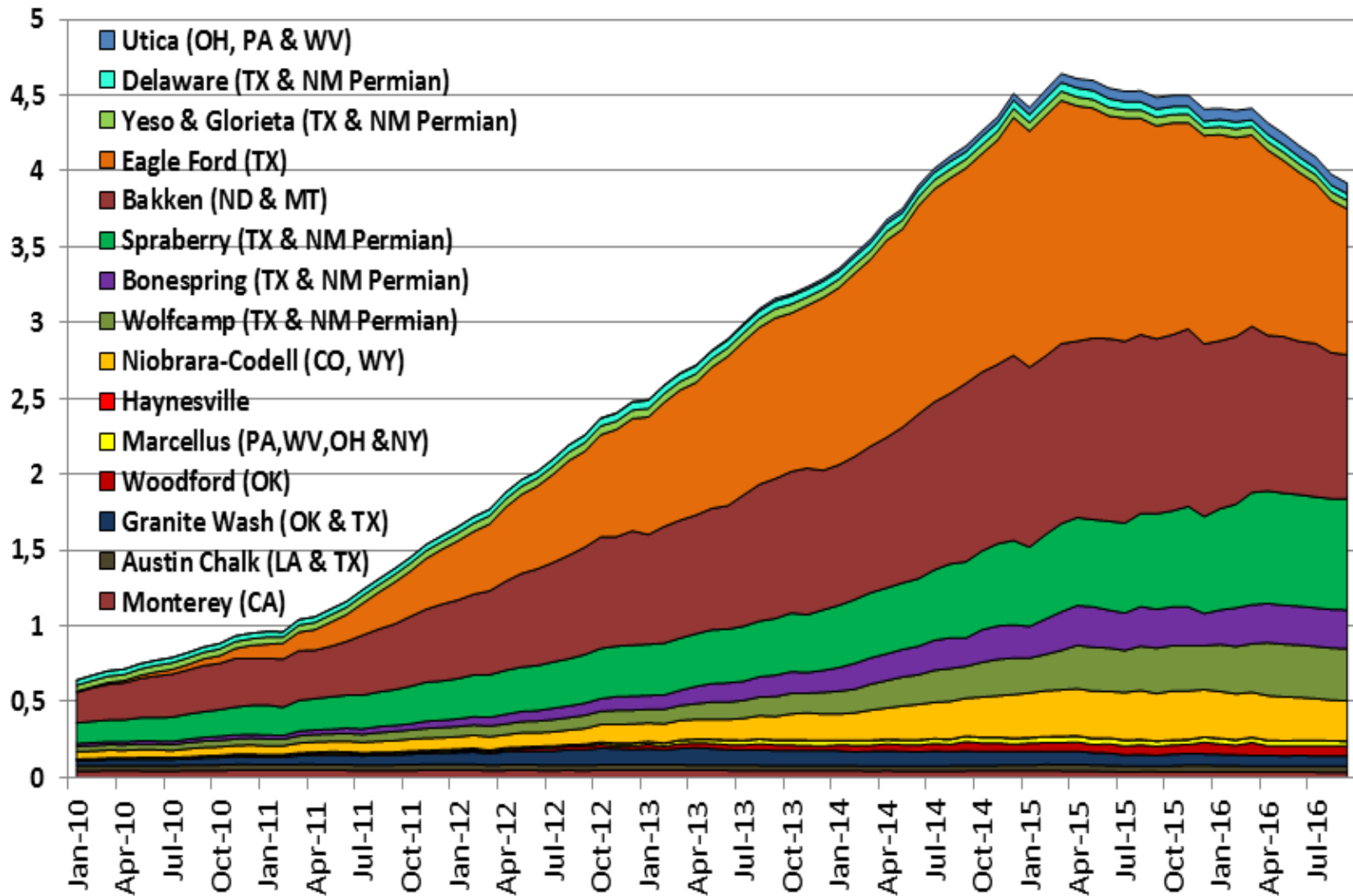
**Nikolai IVANOV, Institute for Energy and Finance**  
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**2nd International Conference**  
**"SCENARIO, FORECASTS AND STATISTICS FOR THE GLOBAL AND REGIONAL**  
**ENERGY DEVELOPMENT"**

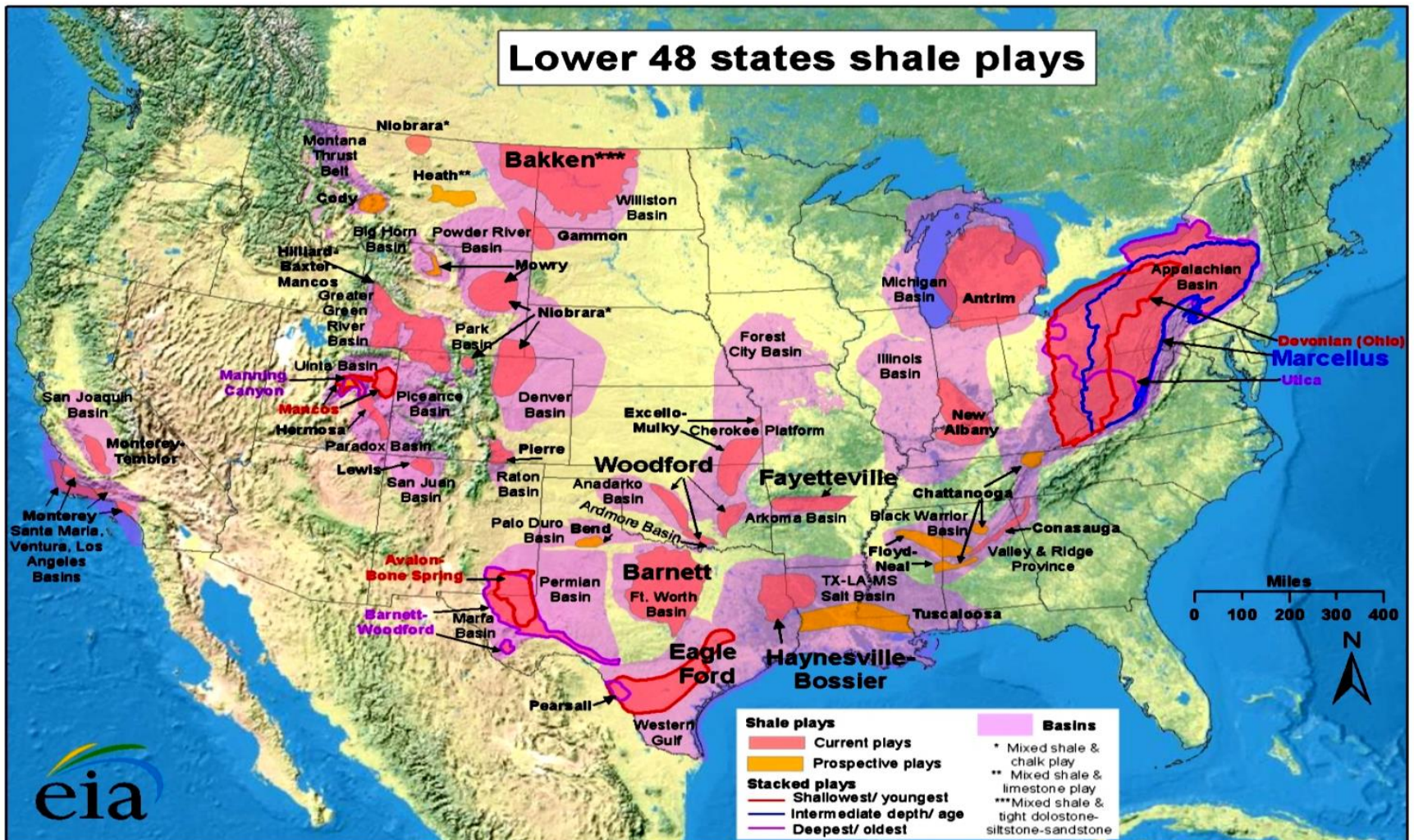
**November 9, 2016**  
**Moscow**

# U.S. Tight Oil Production

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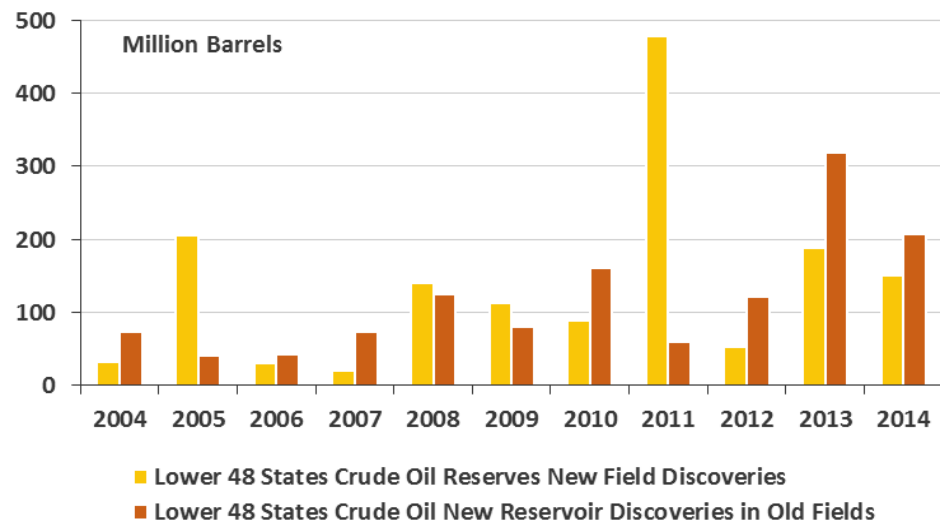
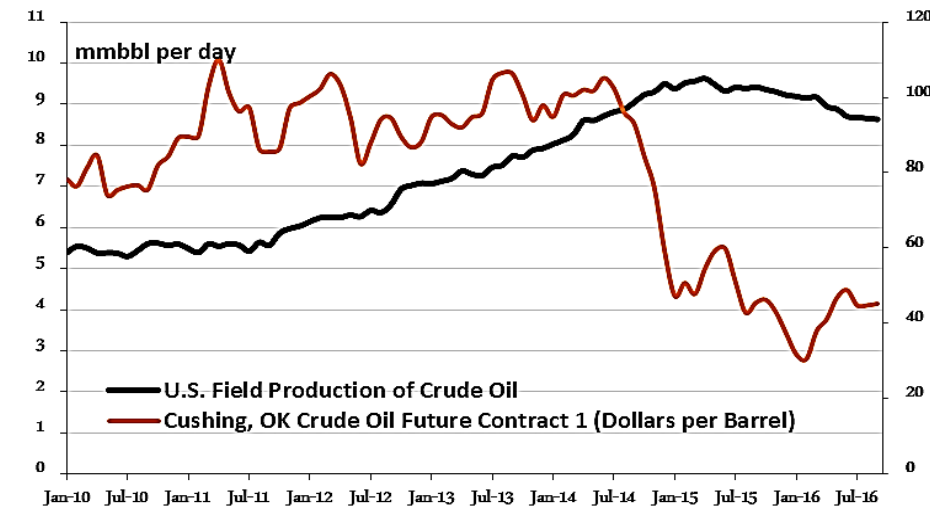
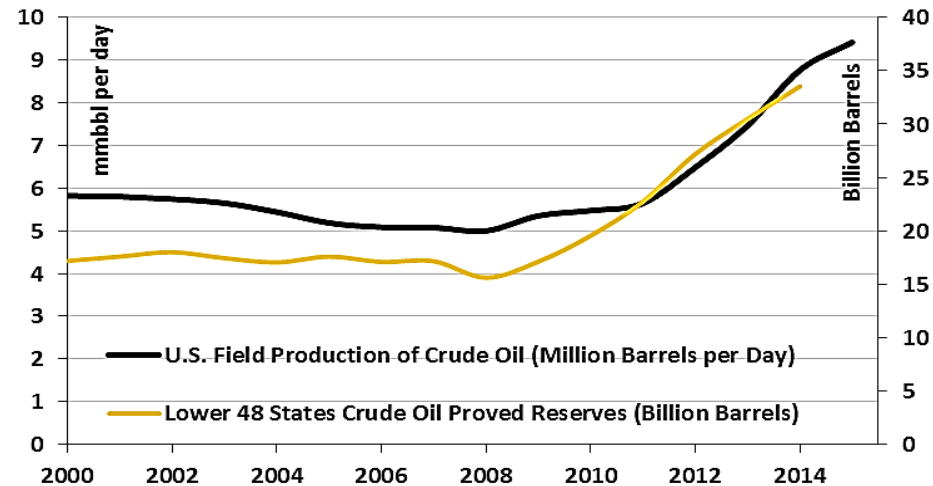
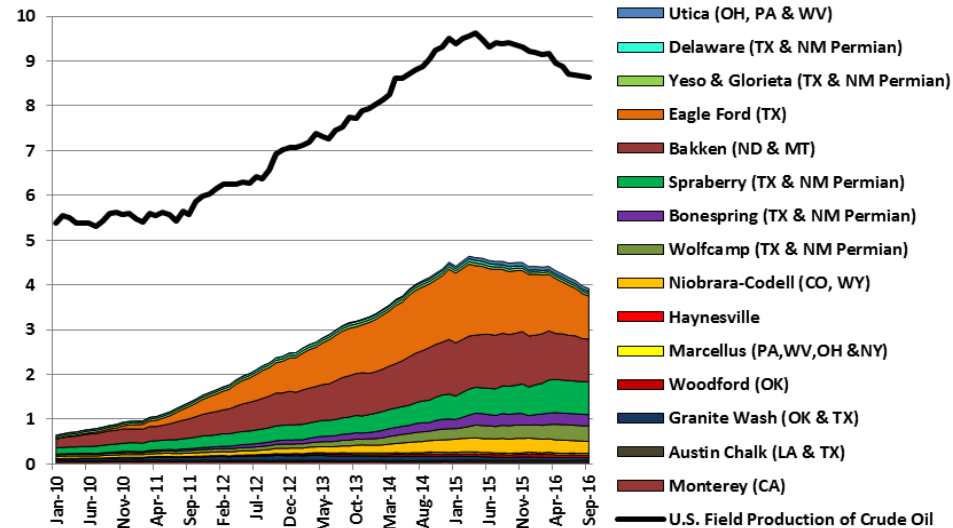
# U.S. Shale Plays





# U.S. Crude Oil Production, Reserves, and WTI Prices

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# Advanced drilling and completing technologies

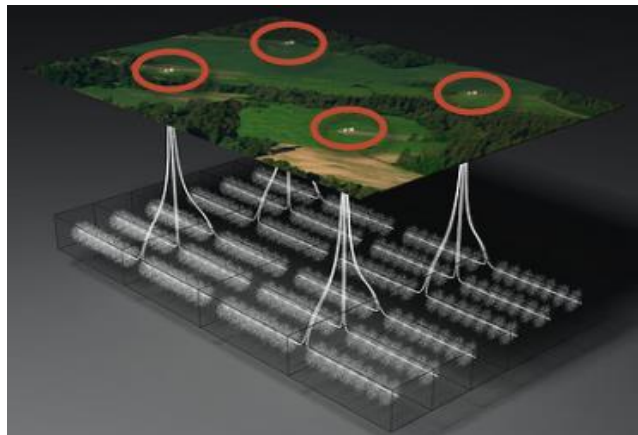
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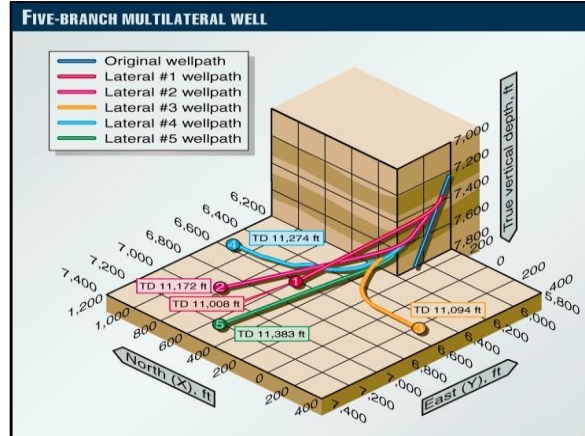
The Schramm T500XD is specifically designed for horizontal and directional drilling to a total depth of 15,000 ft or more. **Schramm** has launched its T500XD Telemast 500,000 lb hoist capacity drill rig currently headed to the Marcellus and Utica shales. The rig has a full 360° walking portability for fast moves from hole to hole without the traditional limits of two axis pad mounted designs.

The T500XD also offers a full communication interface connectivity to third-party data acquisition providers that utilize the internet or dedicated satellite communications systems to remote operation centers in multiple locations.

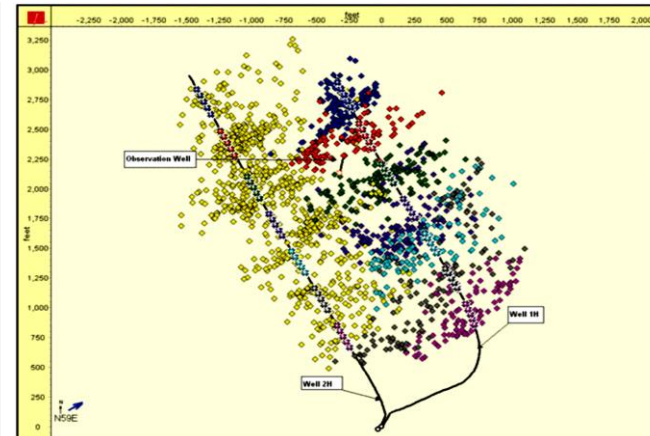
## Pad drilling



## Multilateral drilling



## Microseismic monitoring



# U.S. tight oil plays: production and proved reserves, 2013-14

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In 2014, U.S. crude oil and lease condensate proved reserves increased to 39.9 billion barrels—an increase of 3.4 billion barrels (9.3%) from 2013. U.S. proved reserves of crude oil and lease condensate have risen for six consecutive years, and exceeded 39 billion barrels for the first time since 1972.

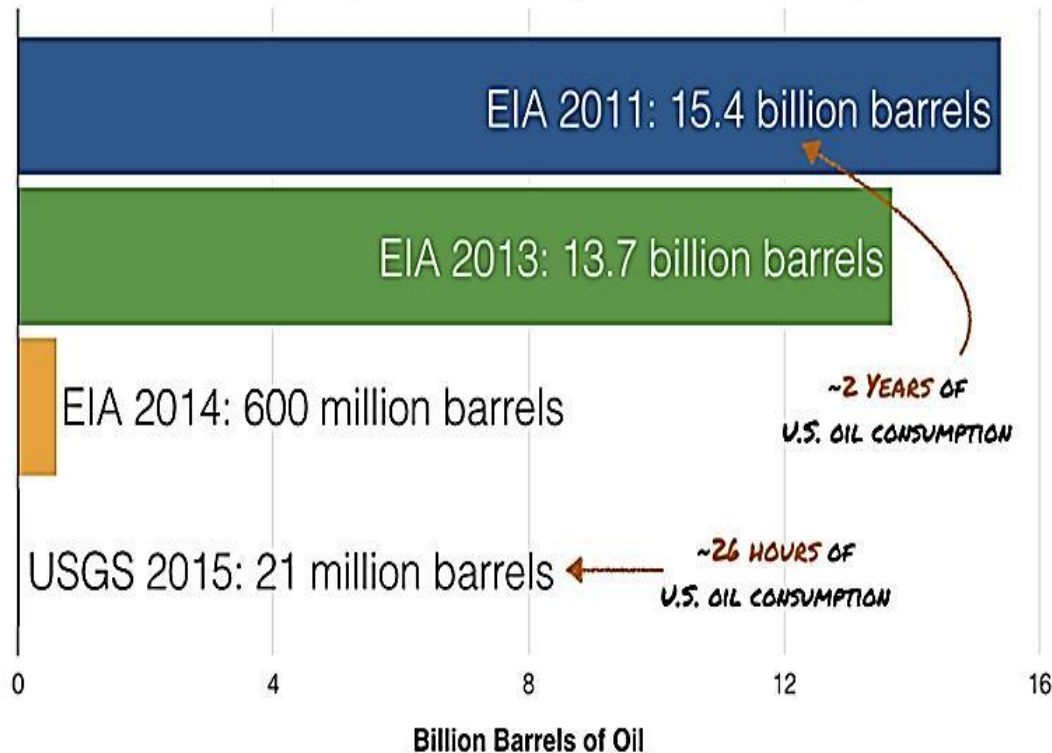
Basin	Play	State(s)	2013 Production	2013 Reserves	2014 Production	2014 Reserves	Change 2013-14 Reserves
Williston	Bakken	ND, MT, SD	270	4 844	387	5 972	1 128
Western Gulf	Eagle Ford	TX	351	4 177	497	5 172	995
Permian	Bone Spring, Wolfcamp	NM, TX	21	335	53	722	387
Denver- Julesberg	Niobrara	CO, KS, NE, WY	2	17	42	512	495
Appalachian	Marcellus*	PA, WV	7	89	13	232	143
Fort Worth	Barnett	TX	9	58	9	47	-11
Sub-total			660	9 520	1 001	12 657	3 137
Other tight oil			41	523	56	708	185
U.S. tight oil			701	10 043	1 057	13 365	3 322

Notes: Includes lease condensate. Bakken/Three Forks tight oil includes proved reserves from shale or low permeability formations reported on Form EIA-23L; Other tight oil includes proved reserves from shale formations reported on Form EIA-23L not assigned by EIA to the Bakken/Three Forks, Barnett, Bone Spring, Eagle Ford, Marcellus, Niobrara, or Wolfcamp tight oil plays. \* The Marcellus Shale play in this table refers only to portions within Pennsylvania and West Virginia.

# J. David Hughes, Drilling California: A Reality Check on the Monterey Shale

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Estimates of Technically Recoverable Tight Oil in the Monterey Formation



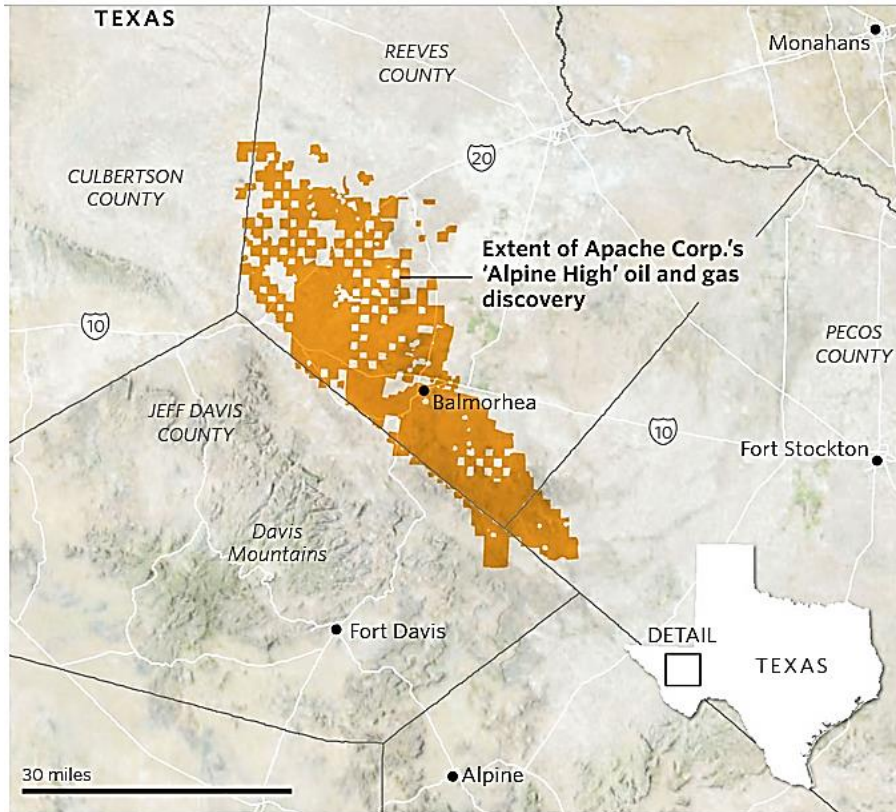
- In 2011, the EIA published a report that stated the Monterey Shale in California had 15.4 billion barrels of recoverable oil, or two-thirds of the then estimated recoverable tight oil in the US. The EIA subsequently downgraded its estimate to 13.7 billion barrels in 2013.
- Post Carbon Institute and PSE Healthy Energy published the report ***Drilling California: A Reality Check on the Monterey Shale***, which concluded that the EIA's estimate was vastly overstated. In May 2014, EIA downgraded its estimate by 96% to 600 million barrels.

In October 2015, the U.S. Geological Survey (USGS) released a report stating that the mean technically recoverable oil resource in the Monterey **was just 21 million barrels**, a further 96% downgrade from the revised 2014 EIA estimate.



# New Oil-Field Discovery in Texas

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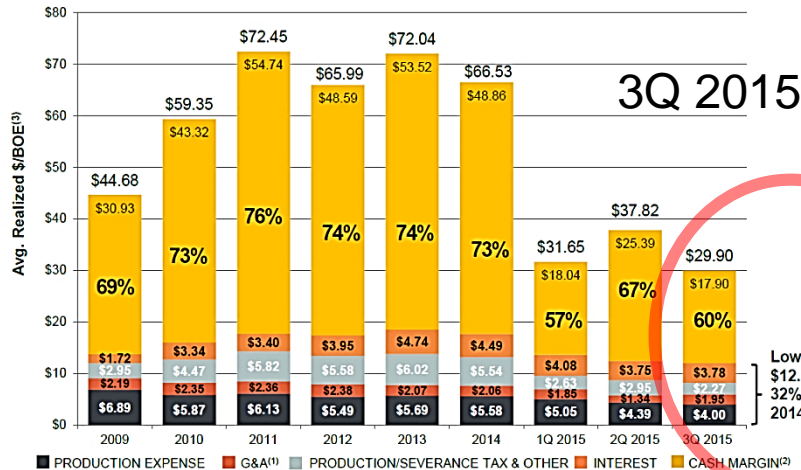
- Apache Corp. says it has discovered the equivalent of at least two billion barrels of oil in a new west Texas field that has the promise to become one of the biggest energy finds of the past decade.
- The discovery, which Apache is calling “Alpine High,” is in an area near the Davis Mountains. It could be worth \$8 billion by conservative estimates, or even 10 times more, according to the company.
- The company has begun drilling in the area and says the early wells, which produce more natural gas than oil, are capable of providing at least a 30% profit margin at today’s prices, including all costs associated with drilling. Some are so prolific that they can break even at a price of 10 cents per million British thermal units, according to the company.

“This is a giant onion that is going to take us years to unveil and peel back,” Apache Chief Executive John Christmann IV said in an interview. “The industry dogma about this area, all the fundamental premises that most people had about it, were just wrong.”



# Continental Resources' 3Q 2015 vs 3Q 2016 Results

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## 3Q 2016 Highlights

Impressive **STACK** and **SCOOP** density results increasing value

- **Ludwig density:** Eight Meramec wells flowed at a combined peak 24-hour rate of 21,354 Boe per day (70% oil); seven new wells average IP of 2,653 Boe per day
- **May density:** Seven Woodford wells flowed at a combined peak 24-hour rate of 6,881 Boe per day (77% oil); seven wells average IP of 983 Boe per day

**STACK** costs continue to decline in over-pressured oil window

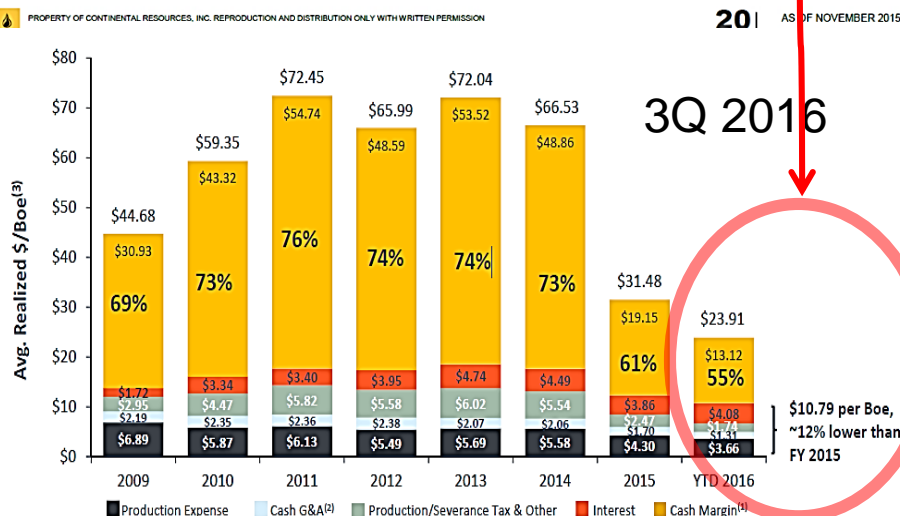
- **Standalone well:** Target \$8.5 million completed well cost (CWC), down \$2.5 million from YE 2015
- **Density wells:** \$7.8 million CWC based on Ludwig density results

Record 30-day Bakken production from enhanced stimulation

- **Brangus North 1-2H2:** 30-day cum of 51.8 MBoe (86% oil), 9,900' lateral
- **Rath Federal 5-22H:** 30-day cum of 43.3 MBoe (84% oil), 13,800' lateral

2016 Guidance updated again on continued strong outperformance

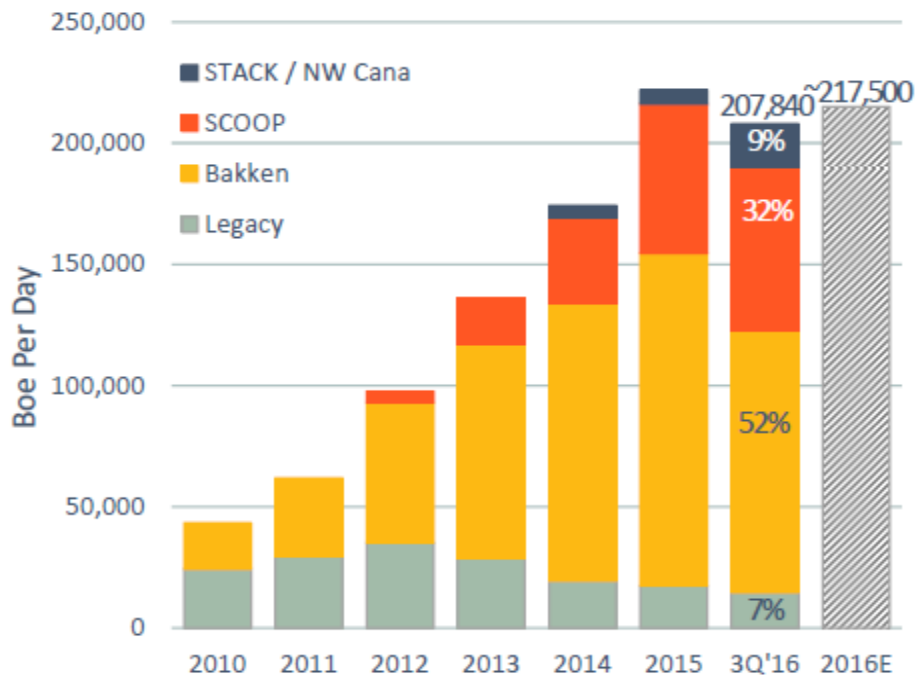
- **Production guidance:** raised to 215,000 - 220,000 Boe per day
- **Exit rate production:** raised to 205,000 - 210,000 Boe per day
- **Production expense:** lowered to \$3.50 - \$4.00 per Boe
- **Non-cash equity compensation:** lowered to \$0.50 - \$0.70 per Boe
- **CAPEX:** increased by \$180 million to \$1.1 billion, due to increasing completions - expect to be cash flow positive for full-year



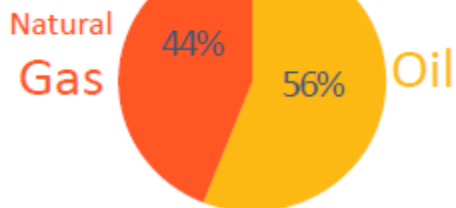
# Continental Resources' Production and Proved Reserves Growth

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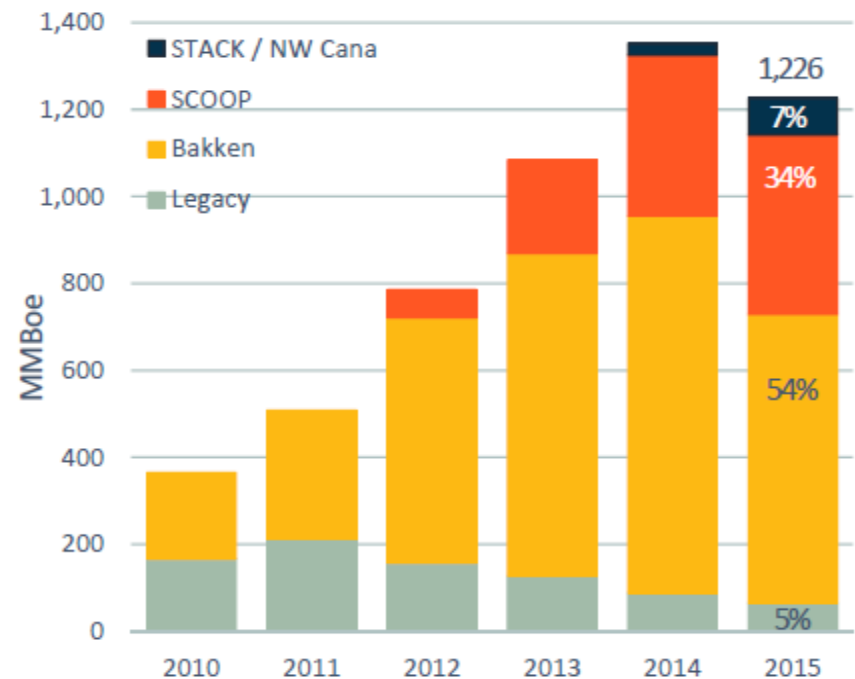
Targeting 215,000 to 220,000 Boe per Day  
Production Average in 2016



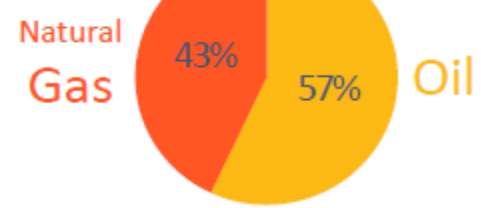
For 3Q 2016:



Total Proved Reserves Down 9% YOY  
with 47% Reduction in WTI Prices



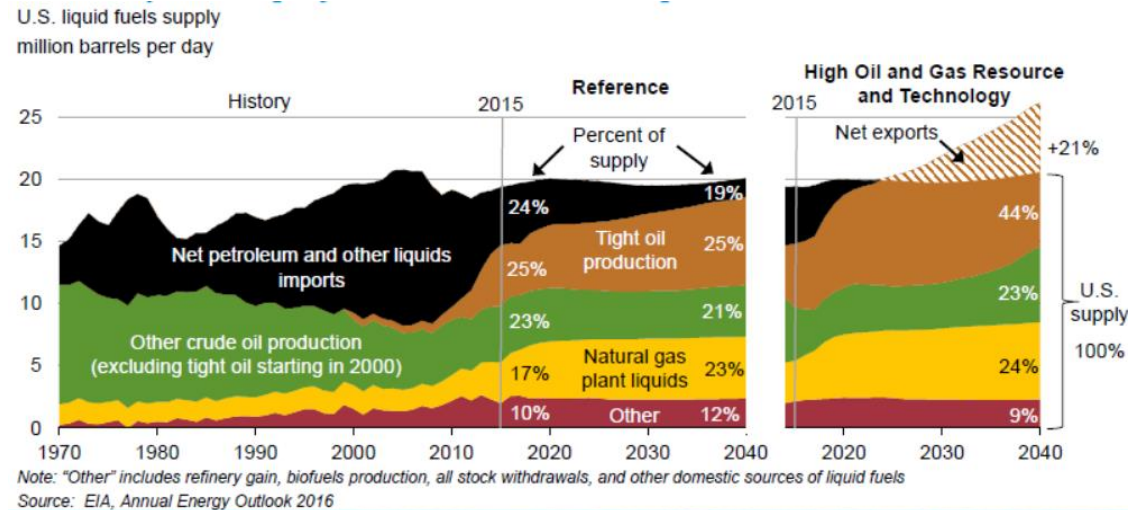
For YE 2015:



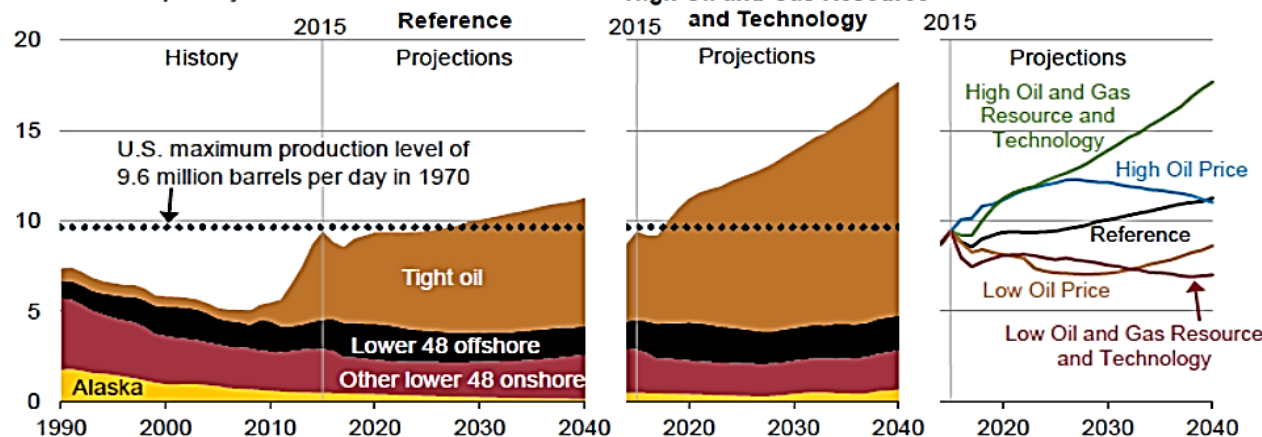
# U.S. crude oil production projections of EIA improves within every subsequent Annual Energy Outlook

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Combination of increased tight oil production and higher fuel efficiency drives projected decline in oil imports



U.S. crude oil production  
million barrels per day



Source: EIA, Annual Energy Outlook 2016

U.S. crude oil production rises above previous historical high before 2030; alternative price and resource/technology cases can differ

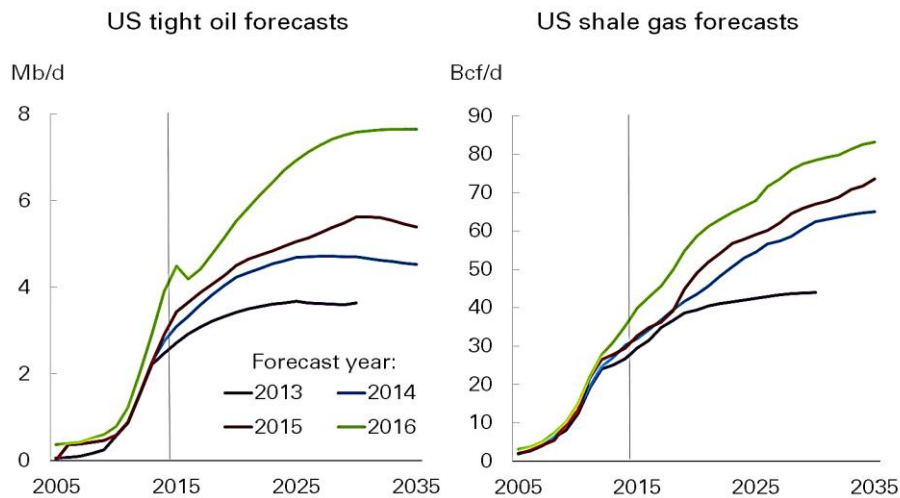


# BP 2016 Energy Outlook – Focus on North America

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Key issues: What have we learned about US shale?

The outlook for US shale has been revised up repeatedly...



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In the 2013 Energy Outlook, US tight oil was projected to reach 3.6 Mb/d by 2030 – that level was surpassed in 2014. After a brief retrenchment due to low prices and falling investment, **US tight oil production is now expected to plateau in the 2030s at nearly 8 Mb/d.**

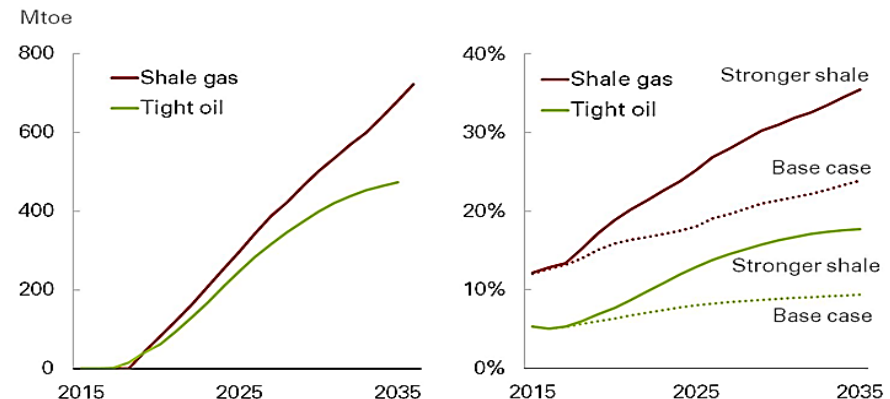
- **The 'stronger shale' case assumes global shale resources are significantly bigger** than in the base case (in the US by 50% for oil and 30% for gas; elsewhere by 100% and 50%), and productivity is 20% higher by 2035.
- As a result, global supplies of tight oil and shale gas are much greater than in the base case.
- North American tight oil output increases to 16 Mb/d by 2035, nearly twice its level in the base case, with its share of global liquids output reaching 14%.

Stronger shale

Case 3: Tight oil and shale gas having even greater potential...



Differences in supply from base case      Shares of total oil/gas production



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# Conclusions

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- Tight oil and shale gas production differs from traditional practices, so shale plays reserves evaluation differs from conventional oil and gas resources appraisal.
- Technically recoverable oil and gas resources in unconventional plays increase as production grows.
- Technology development is the major driver of production increase, subsequent reserves upgrade, and improved production outlook.
- Uncertainty is a key word in shale business, so we will definitely face many surprises in the future.

# Thank You for Attention!