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Technology and Low Oil Prices:
How the Industry Responded

September 2016

Key Takeaways

- As a result of lower oil prices, US oil and gas producers reduced costs, but increased reserves and production through multiple technological improvements
- Major improvements to well completion techniques in the Permian Basin
  - Optimization of completion designs, including increased proppant, longer laterals and increased fluid volumes have increased estimate ultimate recoveries ("EUR")
  - Despite the incremental extra costs associated with the new completion designs, low equipment and personnel utilization rates have resulted in total well costs declining ~25%
- US oil supply is declining with large base declines in the Eagle Ford and Bakken
- Global projects need oil prices >$45 in order to breakeven
  - Despite lower project costs and a more efficient well design process, global production is expected fall outside of Saudi Arabia and the USA
- In a price rebound, we view some drilling costs savings as structural, though some others will rise cyclically
  - This will drive breakevens higher

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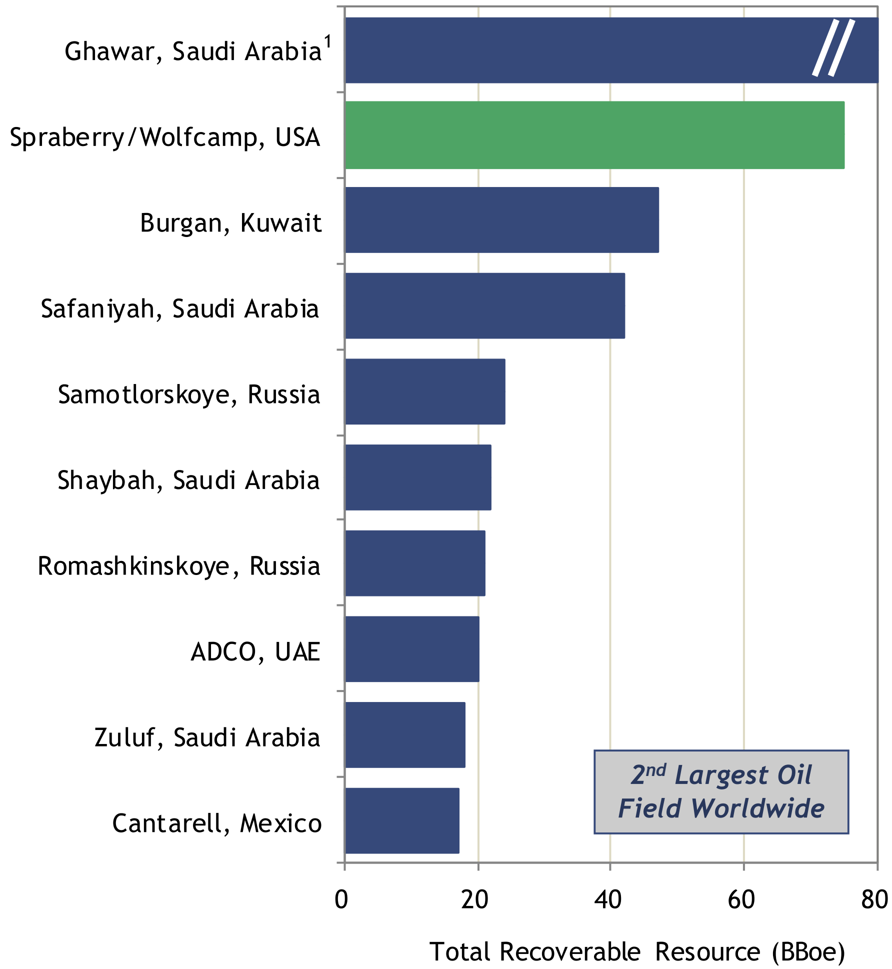
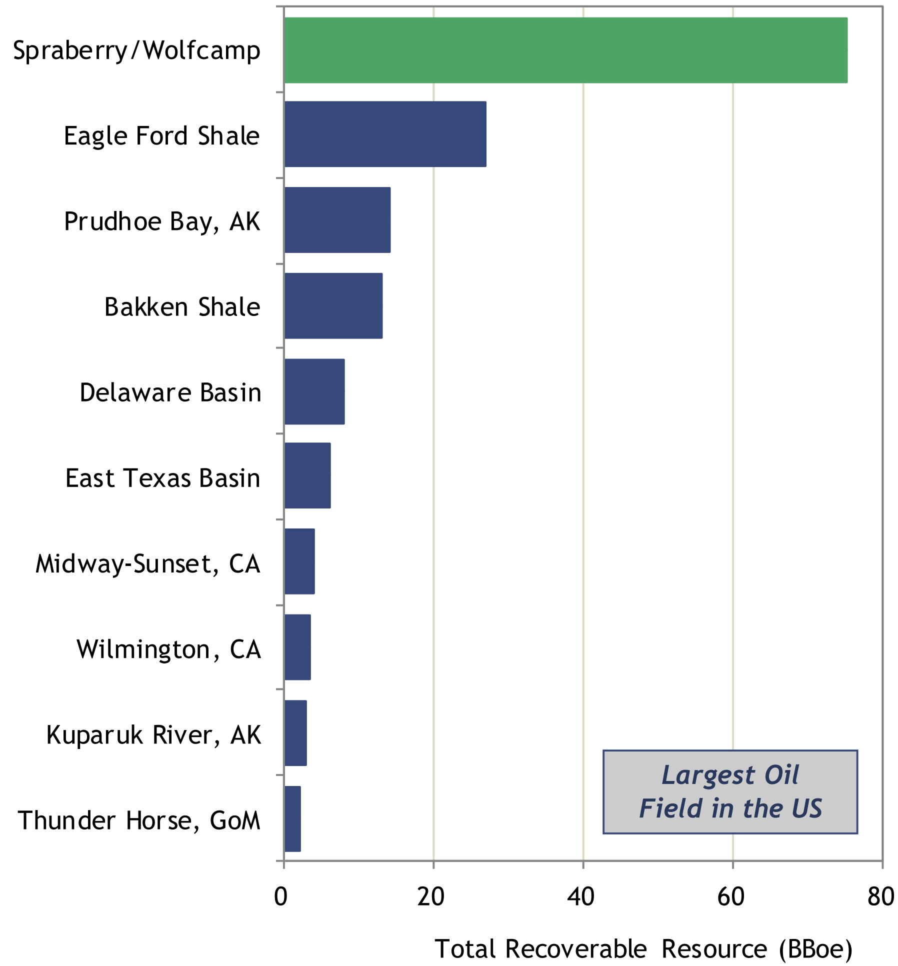
Largest Global and U.S. Oil Fields

Spraberry/Wolfcamp is the world's second largest oil field and the largest US oil field. Other stacked formations in the Midland Basin add additional resource to recoverable estimates.





Source: Pioneer Natural Resources, Investor Presentations.
(1) Ghawar scaled down for illustrative purposes. Its total recoverable resource is ~157 BBoe.

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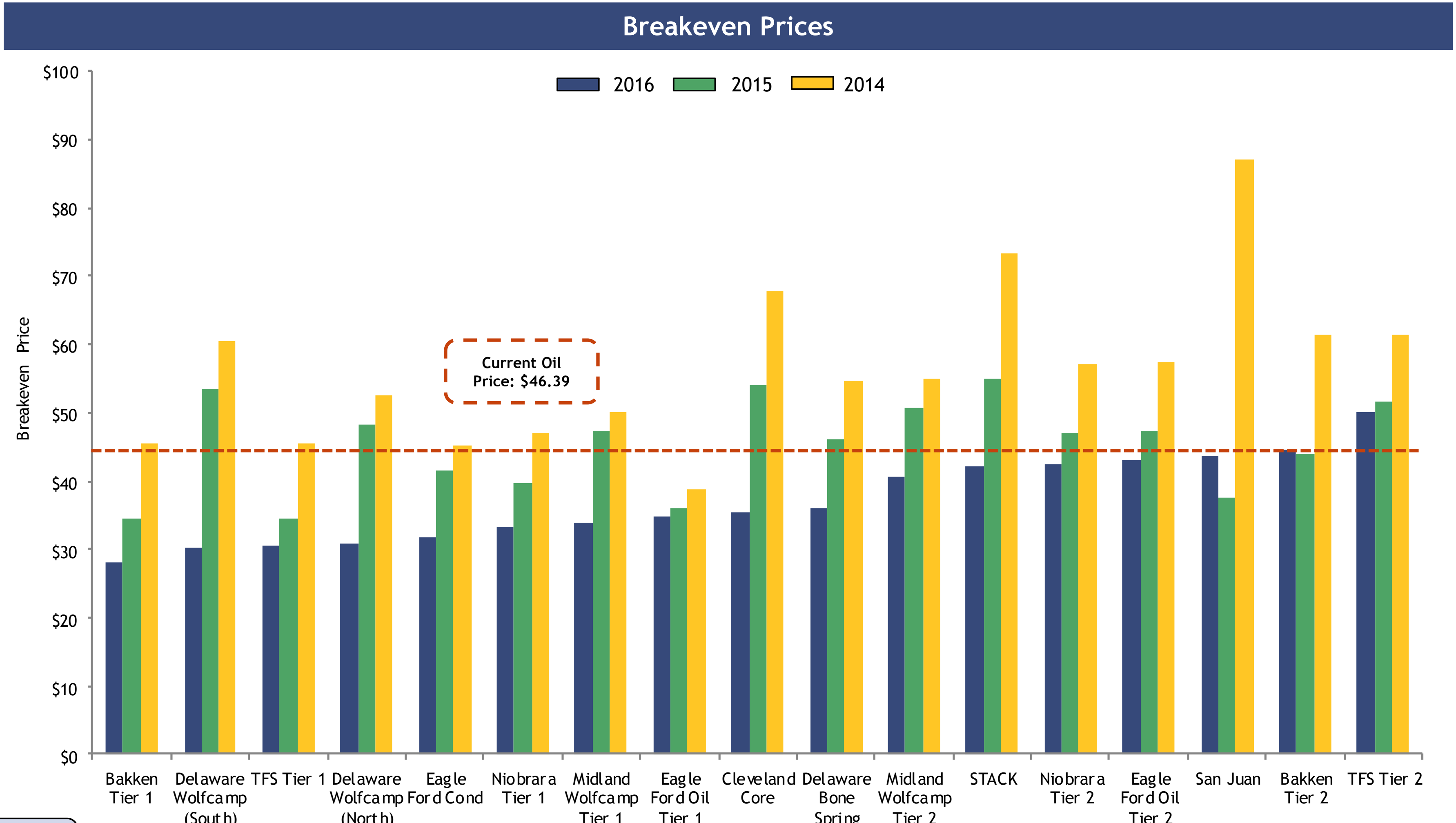
Single Well Break Even Prices

Breakeven Prices down -32% since 2014



	Bakken Tier 1	Delaware Wolfcamp (South)	TFS Tier 1	Delaware Wolfcamp (North)	Eagle Ford Cond	Niobrara Tier 1	Midland Wolfcamp Tier 1	Eagle Ford Oil Tier 1	Cleveland Core	Delaware Bone Spring	Midland Wolfcamp Tier 2	STACK	Niobrara Tier 2	Eagle Ford Oil Tier 2	San Juan	Bakken Tier 2	TFS Tier 2
Current Vs. 2014	-39%	-50%	-33%	-41%	-30%	-29%	-32%	-11%	-48%	-34%	-26%	-43%	-26%	-25%	-50%	-27%	-18%
Current Breakeven	$28	$30	$31	$31	$32	$33	$34	$35	$36	$36	$41	$42	$42	$43	$44	$45	$50

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Source: Bloomberg as of 9/7/2016

Breakevens for Select Global Supply Projects

Full Cycle Cost suggest most global projects need higher oil prices

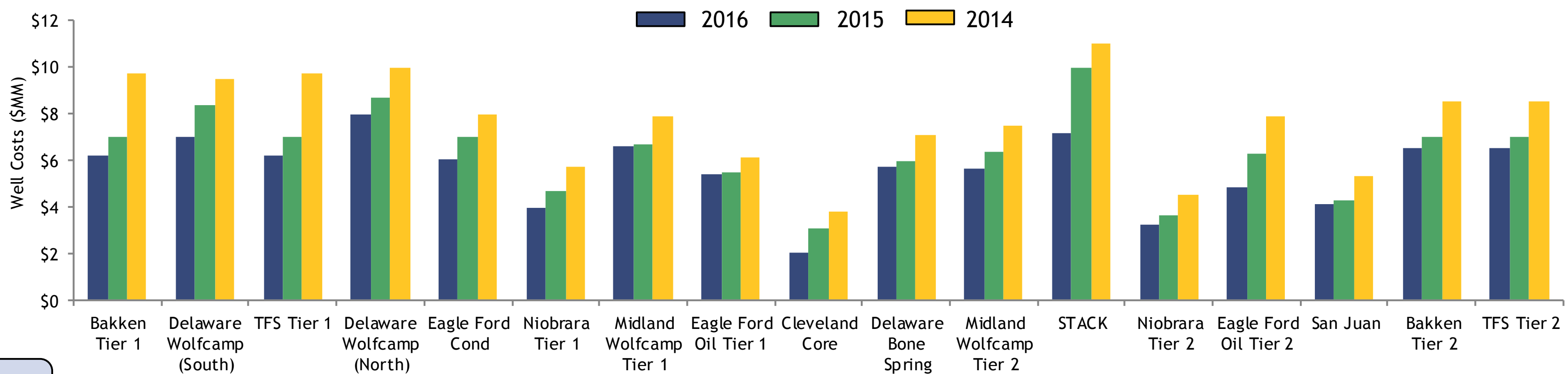
Field	Country	Type	Status	First Production	Full-cycle Break-even ($/bbl)
Shenandoah	US (GoM)	Offshore	Appraisal	2020	$53
SNE	Senegal	Offshore	Appraisal	2022	$46
Lake Albert	Uganda	Onshore	Pre-FID	2021	$48
Cameia	Angola	Offshore	Pre-FID	2020	$51
Johan Sverdrup	Norway	Offshore	Development	2019	$30
Appomattox	US (GoM)	Offshore	Development	2020	$47
Tengiz	Kazakhstan	Onshore	Development	2022	$49
Lula	Brazil	Offshore	Production	2010	$36
Jubilee	Ghana	Offshore	Production	2010	$52
Tawke	Kurdistan	Onshore	Production	2007	$17

- Most global projects need oil prices >$45/bbl to breakeven
- Standardization of development concepts along with optimization and reengineering of project designs have pushed overall costs lower
- Costs internationally have lowered ~20% although deflationary pressures have lagged its US counterparts
- Digitalization of offshore projects have led to more efficient and reliable operations
  - Increased uptime in the North Sea

Improvements in Well Costs & EUR's

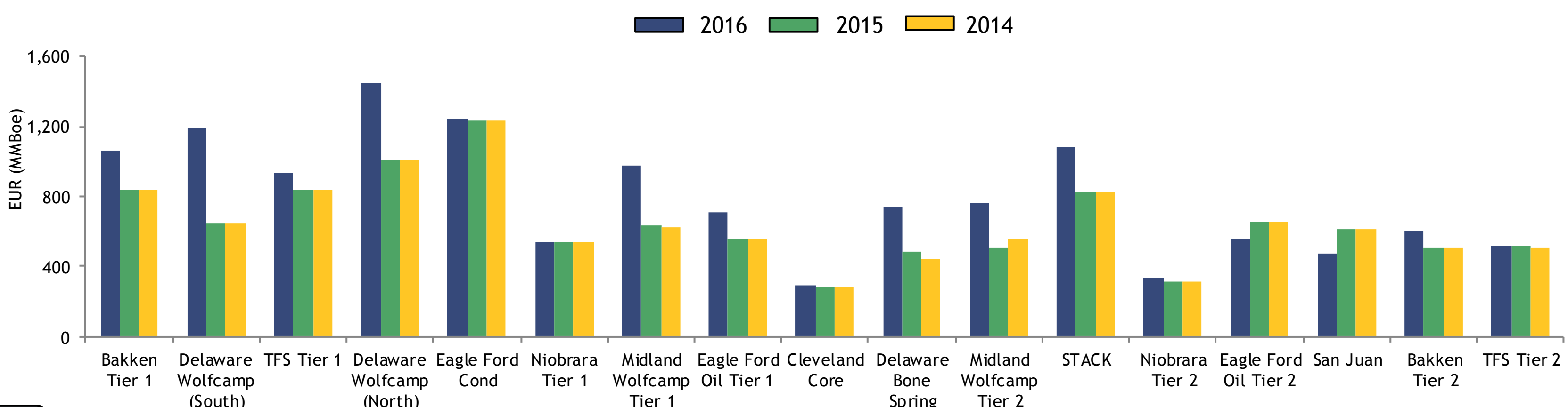
Well Costs are Down 25% While Reserves are Up 18% Since 2014

Well Costs ($MM)



Current Vs. 2014	-36%	-27%	-36%	-20%	-25%	-31%	-17%	-12%	-47%	-19%	-25%	-35%	-29%	-39%	-23%	-23%	-23%

Estimated Ultimate Recovery ($MM)



Current Vs. 2014	26%	85%	11%	43%	1%	0%	57%	25%	3%	66%	36%	31%	8%	-14%	-22%	18%	2%

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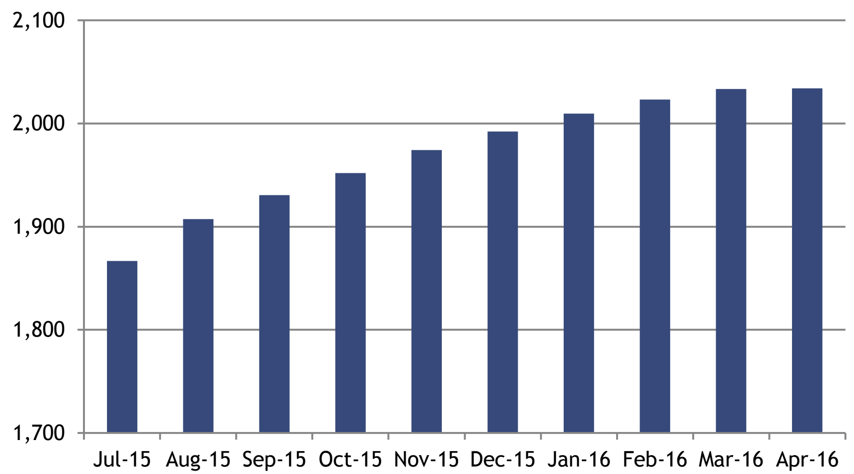
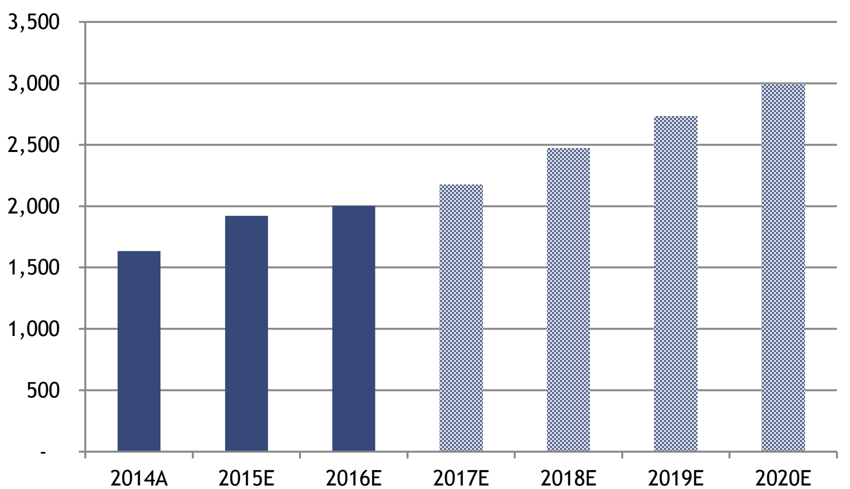
Permian: A Rapidly Improving Basin

YTD Production (kbbl/d)



TPHe Forecast (kbbl/d)



Source: TPHe, EIA, DrillingInfo

- The basin has outperformed on a combination of lower PDP declines, higher capital activity and improved well productivity
- Completions optimization and drilling efficiency gains could spur additional upside in growth
- The basin is well-positioned for growth from an infrastructure perspective through 2018
- The basin is able to maintain flat production within cash flow at ~$52/bbl WTI

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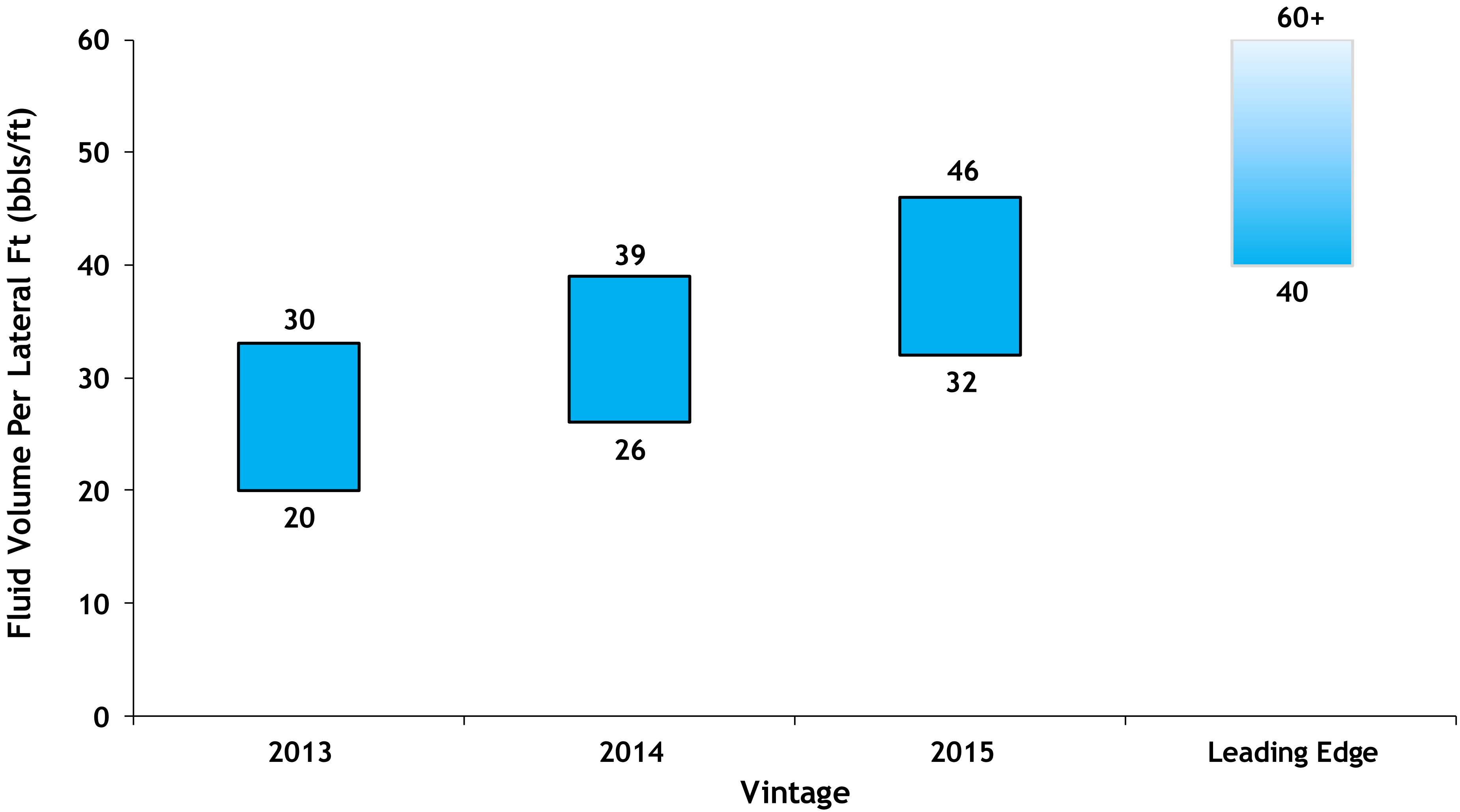
Fluid Volume Change Since 2013



Sources: Drilling Info, TRRC, NM OCD, and FracFocus, TPH Research

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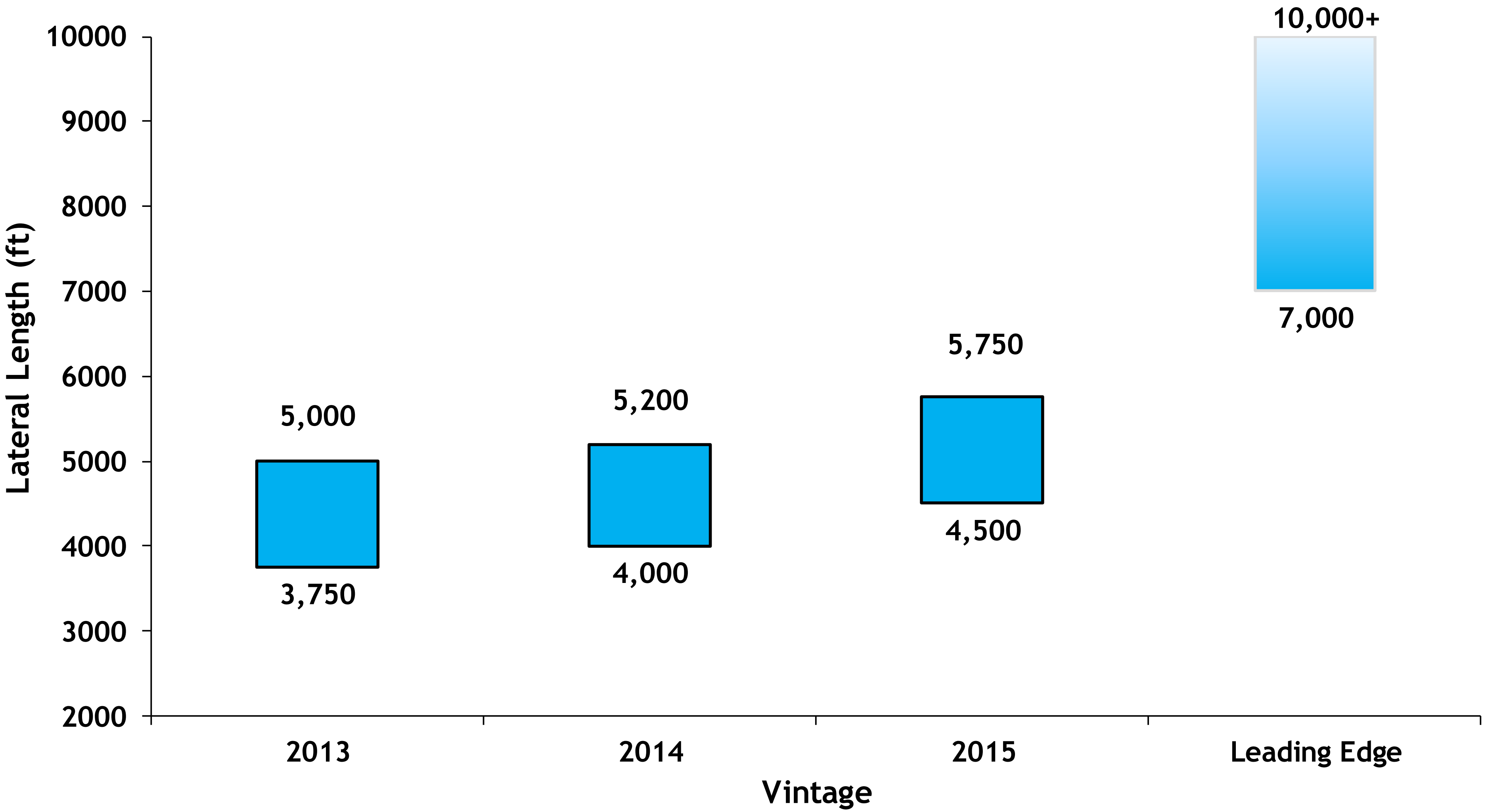
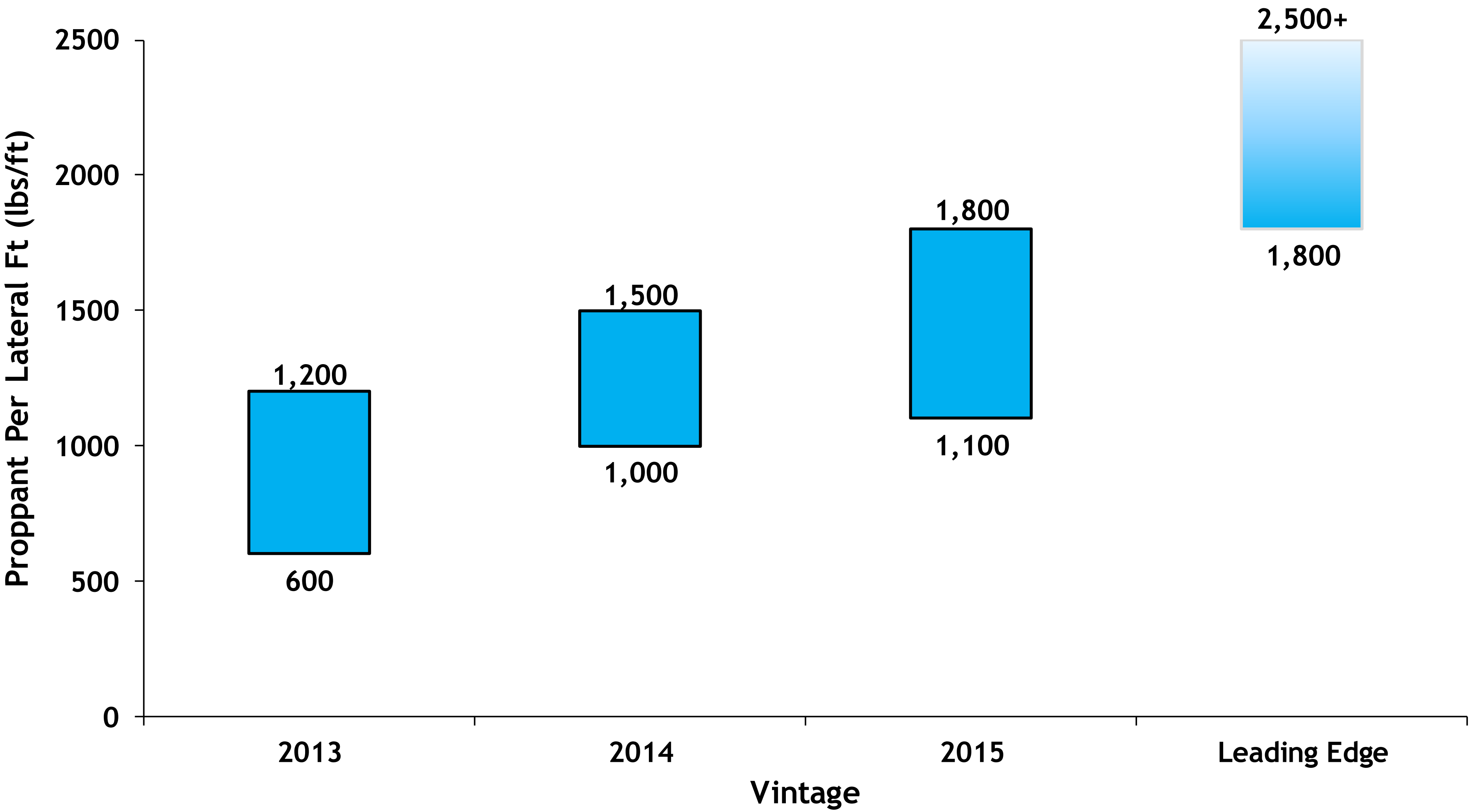
Lateral Length Progression since 2013



Sources: Drilling Info, TRRC, NM OCD, and FracFocus, TPH Research

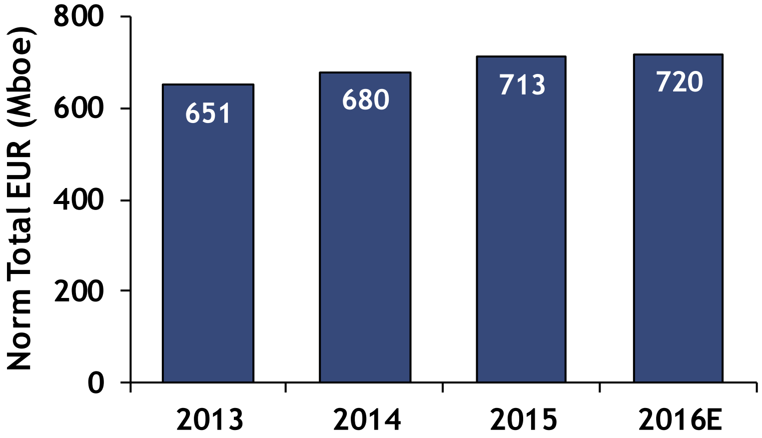
Proppant Loading Shift Since 2013



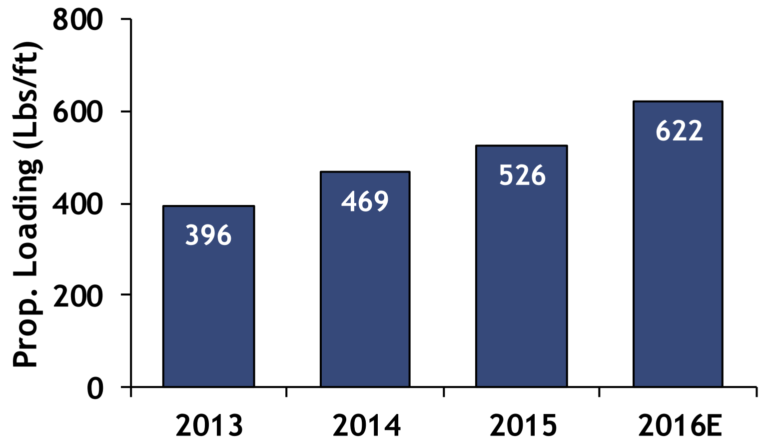
Sources: Drilling Info, TRRC, NM OCD, and FracFocus, TPH Research

Williston Basin
Proppant Loading Driving EUR Uplift

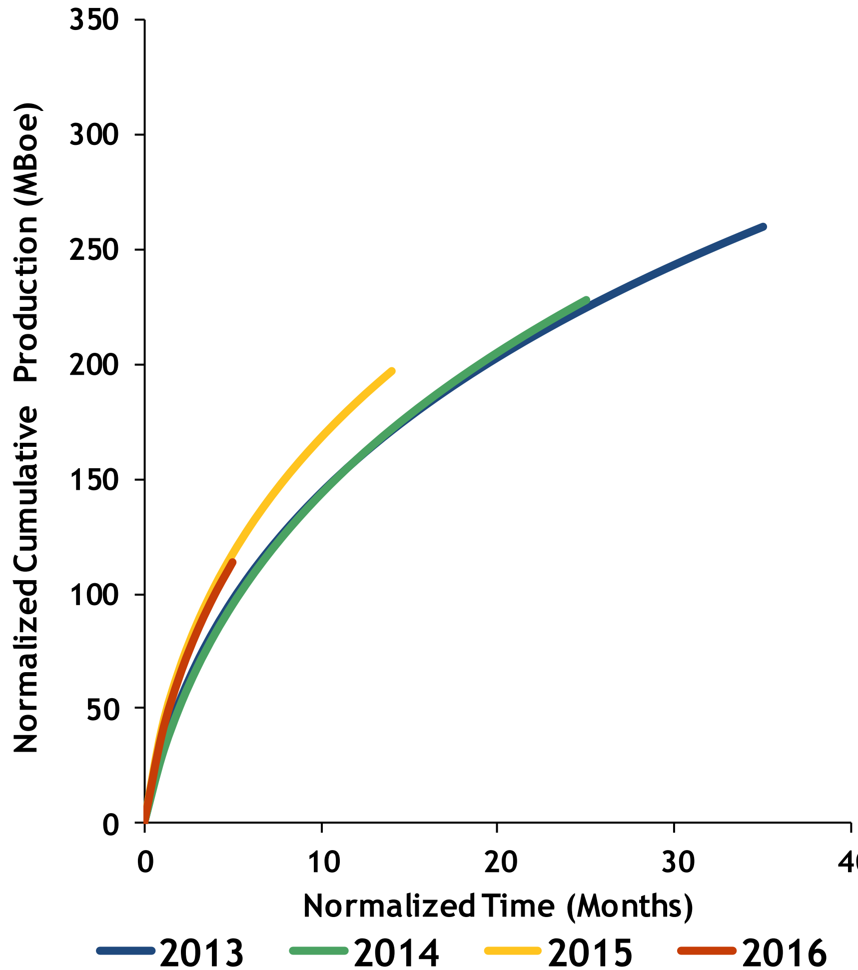
3-Stream Normalized EUR by Vintage



Proppant Loading Per Hydraulic Fracture by Vintage



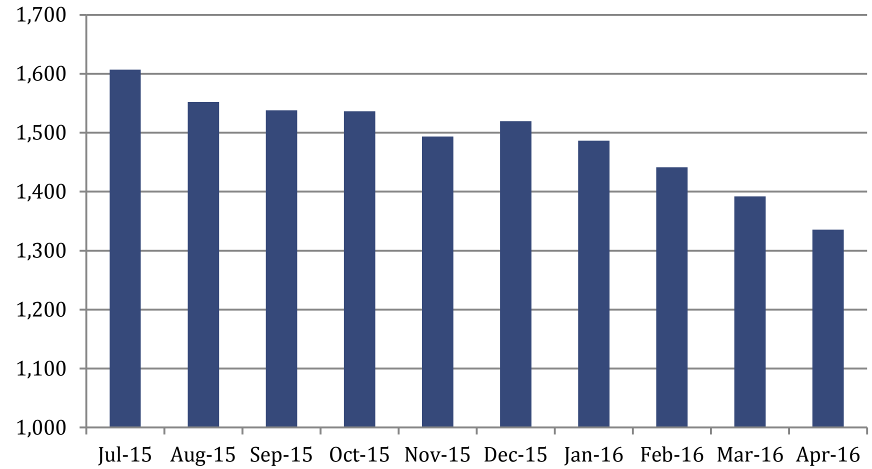
2-Stream Cumulative Production Curves by Vintage



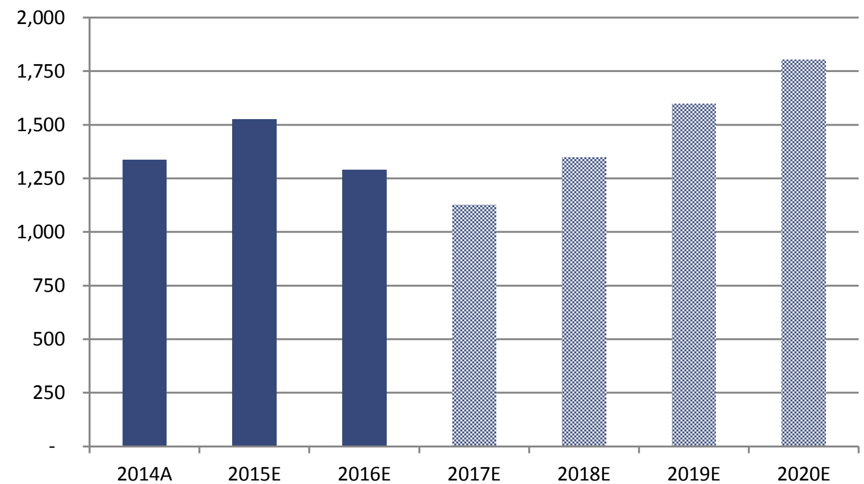
Sources: IHS Enerdeq, IHS Harmony, TPH Research;
Vintage EURs & cumulative production curves based upon a synthetic P50 type well fit in IHS Harmony for wells in Dunn, McKenzie, Mountrail, & Williams Counties, ND undifferentiated by formation. Includes only wells with reasonable completions: 1) >5,000 ft Perf Interval & 2) >2.0 MM lbs of proppant. 2-Stream Production Data; normalized for producing days & a 9,500' Perf Interval. 2016 EUR based on limited data. Graph displays 2-Stream data; Table displays 3-Stream EUR data. NGL assumptions : NGL Yield - 150 Bbls / MMcf; Gas Shrinkage Factor - 25%

Eagle Ford
Its All About The Base

YTD Production (kbbl/d)



TPHe Forecast (kbbl/d)



Source: TPHe, EIA, DrillingInfo

- The basin has been the primary driver of oil production declines in the US as PDP declines have exceeded our expectations
- We believe many companies in the Karnes Trough area boast PDP decline rates between 45-50%, while areas to the East show shallower declines of ~35%
- Rig activity is down ~85-90% from the peak and will need to see material acceleration to stabilize volume declines
- We estimate ~90-100 rigs are needed in order to hold production flat which would require ~$63/bbl WTI to do so within cash flow
- Core inventory depth remains a longer term concern as we see 8-10 years left under a normalized drilling scenario
- Production unlikely to return to 2015 levels until 2019, minimizing infrastructure capacity expansions until the end of the decade

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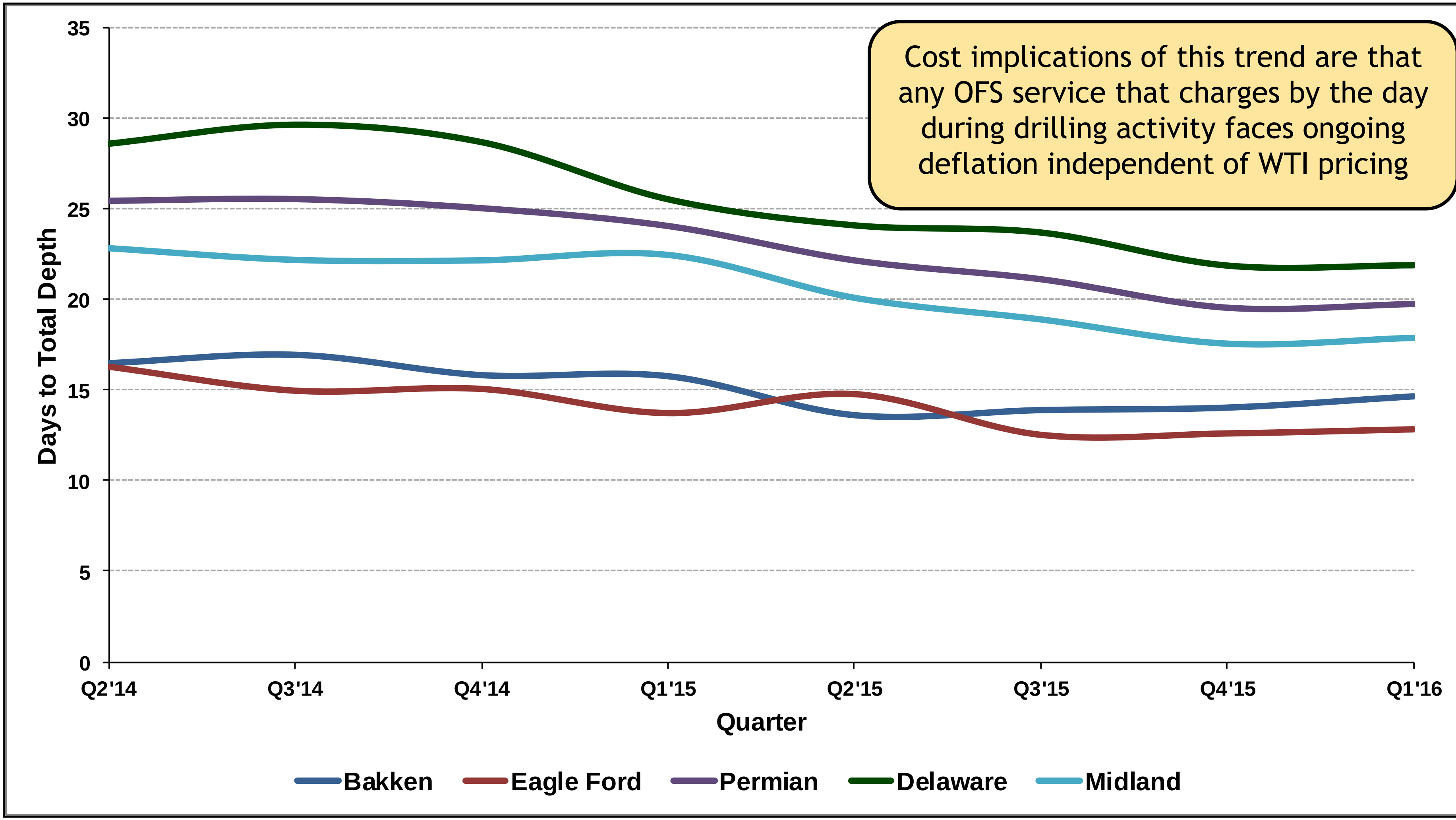
Drilling Improvements – Days to Total Depth



Sources: EIA Basin Definitions, RigData, TPH Research
Days to Total Depth curves for the key shale oil basins as defined by the EIA - Bakken, Eagle Ford, and Permian -are shown on the graph. The curves were synthesized from the 2.5 percentile to the 97.5 percentile. Wells with days to total depth outside of said criteria were considered outliers and consequently excluded from the study.

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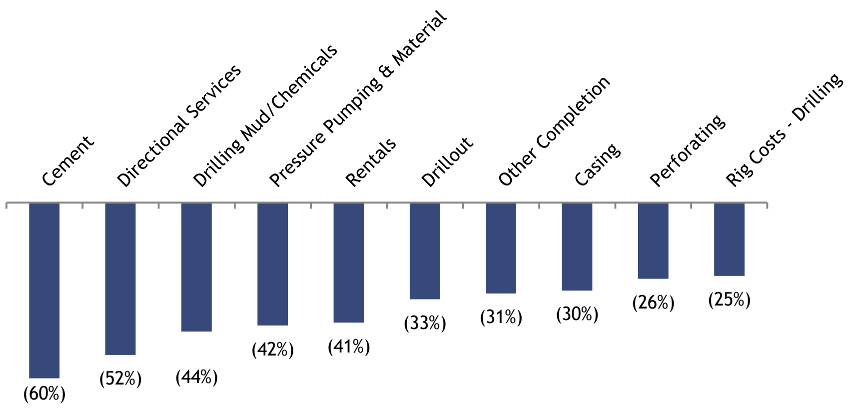
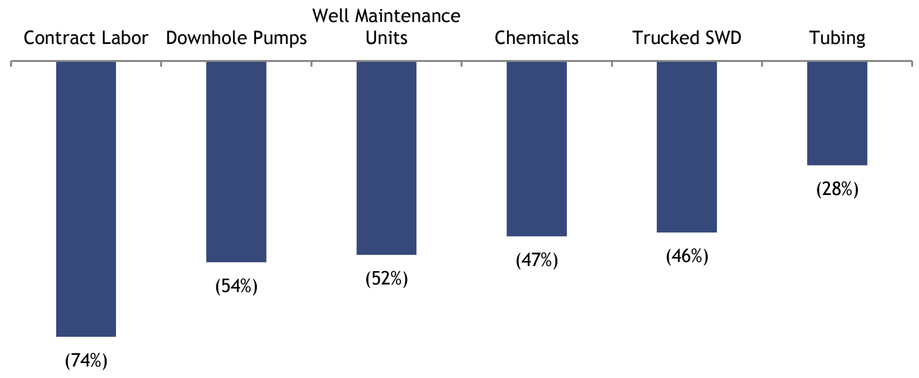
How Much Oil Service Costs Have Fallen… One Example

Current Realized Cost Reductions

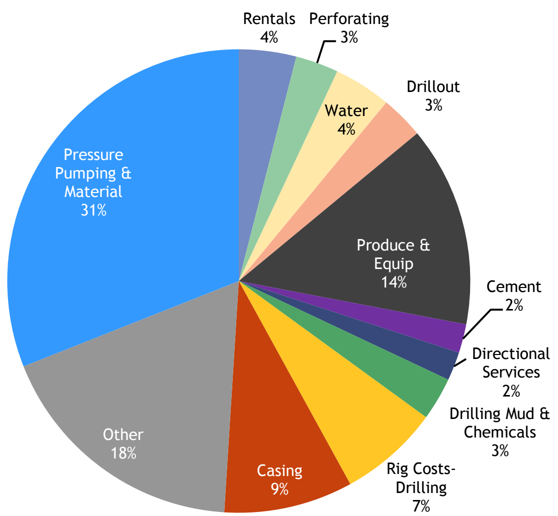
Drilling and Completion Costs



Lease Operating Expenses



Breakdown of Current Drilling and Completion Costs[1]



(1) Artificial lift and intangibles included in produce & equip sector
(2) Diamondback Energy Investor Presentation

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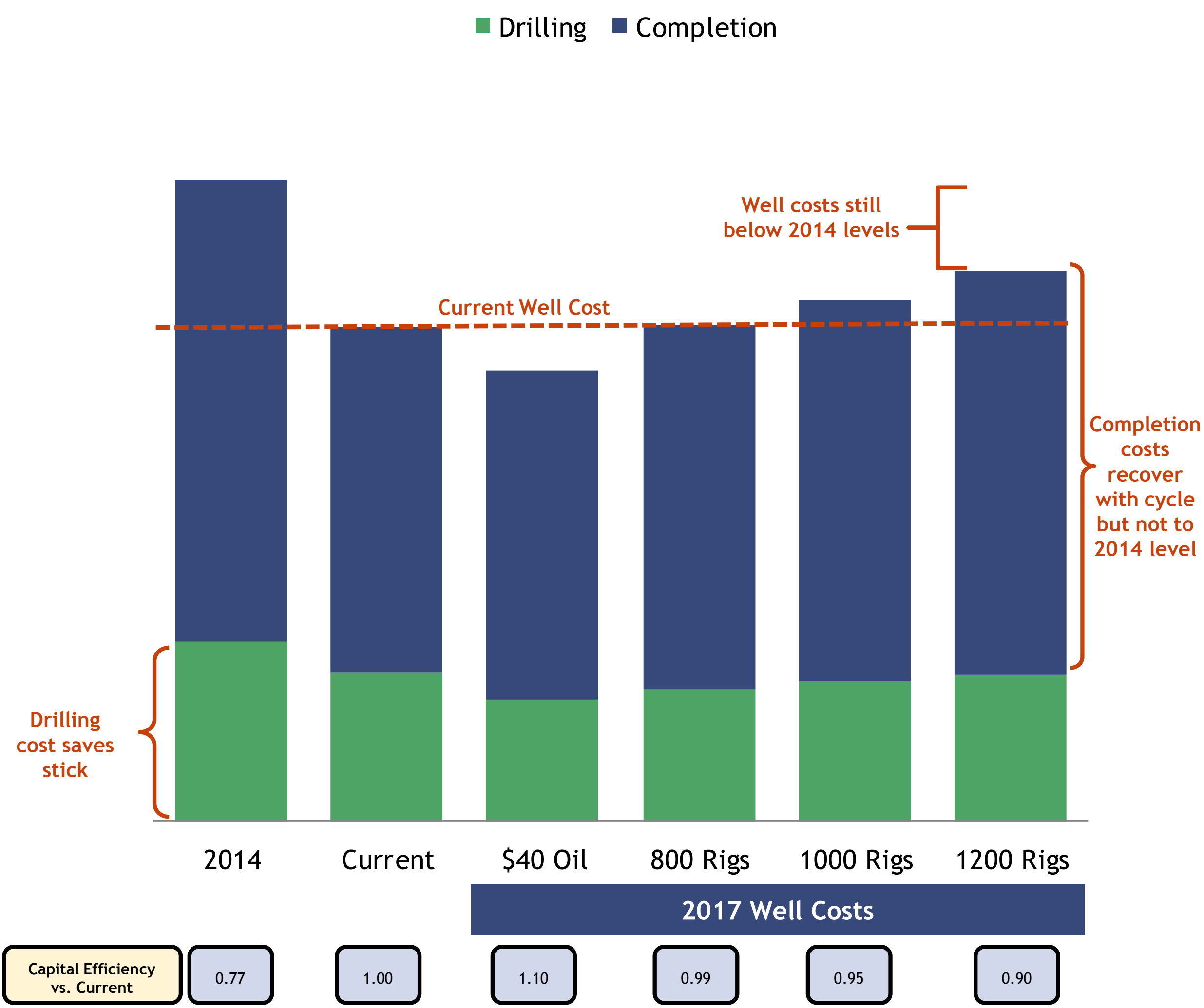
Well Costs in the Recovery

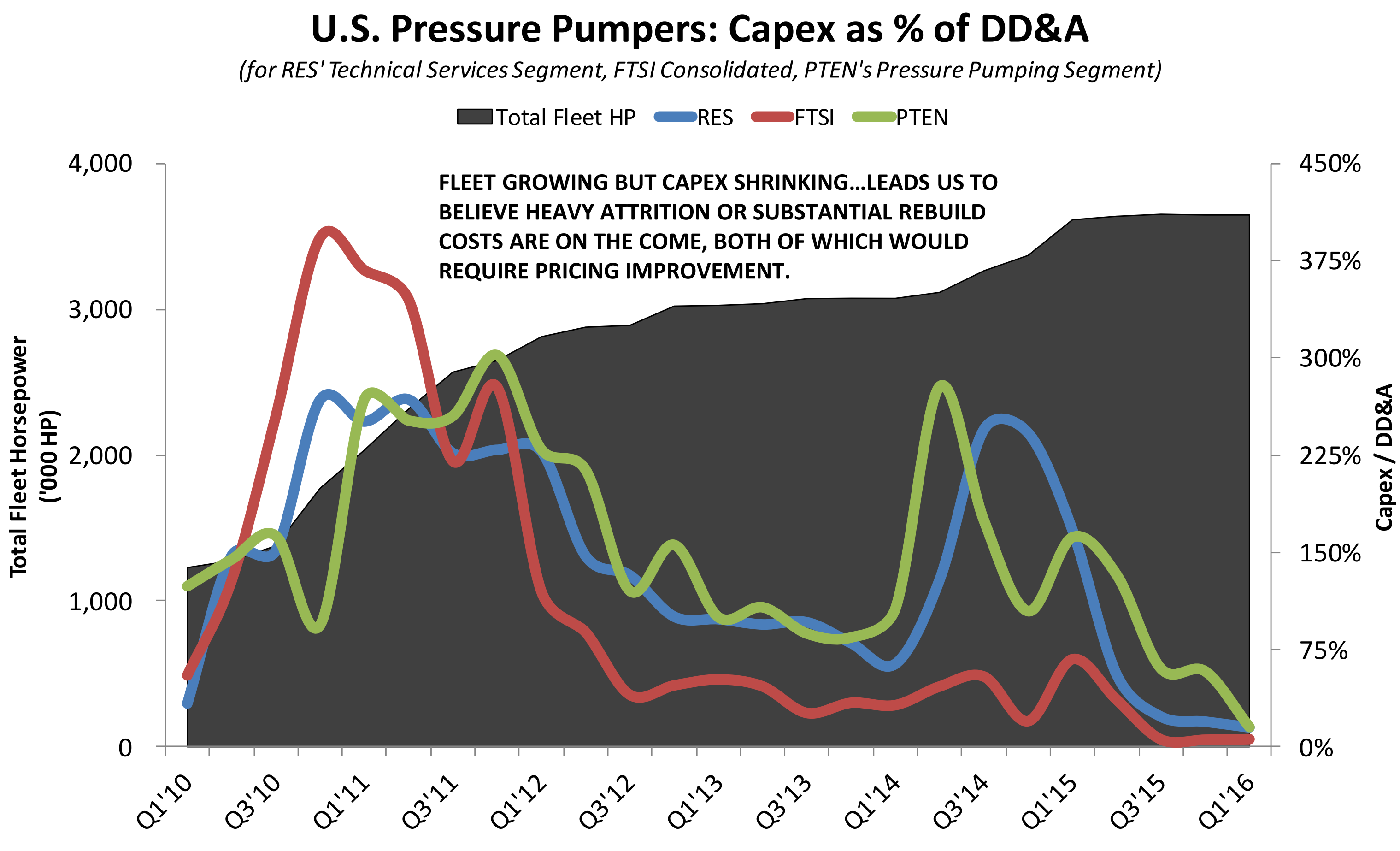
Representative Well Cost Indexed to Current Costs



Source: TPH

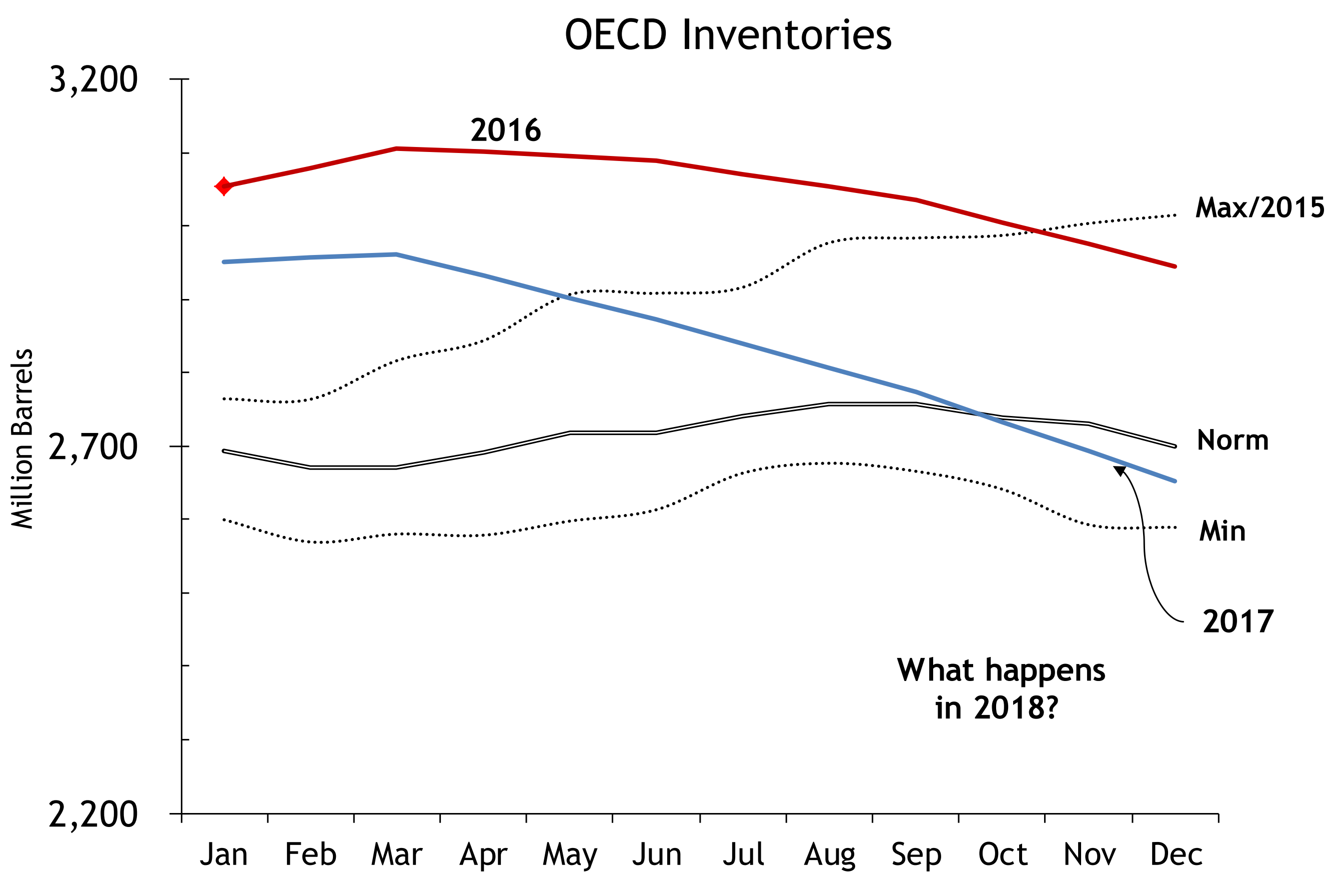
- EBITDA breakeven businesses will need more incentive to destack capacity than healthier ones
- The longer the downcycle duration the worse inflation likely is (but also likely off a lower base)
- As evidenced in the graph, we view drilling costs saves as more structural
- Inflationary pressures likely vary greatly by product/service line, we see pressure pumping (largest well cost line item) as one of, if not the most inflationary

Pressure Pumper Capex Waning…Attrition



Sources: Company Materials, TPH Research

Extremely Tight Market in 2017



Even with increasing OPEC supply in 2016 and 2017, OECD inventories fall below 10-yr norms by 4Q17

Source: IEA, TPH Research

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