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.

Key Takeaways
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.

Spraberry/Wolfcamp, USA
Ghawar, Saudi Arabia
Burgan, Kuwait
Safaniyah, Saudi Arabia
Samotlorskoye, Russia
Shaybah, Saudi Arabia
Romashkinskoye, Russia
ADCO, UAE
Zuluf, Saudi Arabia
Cantarell, Mexico

Thunder Horse, GoM
Kuparuk River, AK
Wilmington, CA
Midway-Sunset, CA
East Texas Basin
Delaware Basin
Bakken Shale
Prudhoe Bay, AK
Eagle Ford Shale
Burgan, Kuwait
Spraberry/Wolfcamp

Total Recoverable Resource (BBoe)

Source: Pioneer Natural Resources, Investor Presentations.
(1) Ghawar scaled down for illustrative purposes. Its total recoverable resource is ~157 BBoe.
Single Well Break Even Prices
Breakeven Prices down -32% since 2014

Source: Bloomberg as of 9/7/2016
### Breakevens for Select Global Supply Projects

Full Cycle Cost suggest most global projects need higher oil prices

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

- 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)

Estimated Ultimate Recovery ($MM)

Current Vs. 2014
Permian: A Rapidly Improving Basin

- 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.

**Source:** TPHe, EIA, DrillingInfo
Fluid Volume Change Since 2013

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

<table>
<thead>
<tr>
<th>Year</th>
<th>EUR (Mboe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>651</td>
</tr>
<tr>
<td>2014</td>
<td>680</td>
</tr>
<tr>
<td>2015</td>
<td>713</td>
</tr>
<tr>
<td>2016E</td>
<td>720</td>
</tr>
</tbody>
</table>

Proppant Loading Per Hydraulic Fracture by Vintage

<table>
<thead>
<tr>
<th>Year</th>
<th>Prop. Loading (Lbs/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>396</td>
</tr>
<tr>
<td>2014</td>
<td>469</td>
</tr>
<tr>
<td>2015</td>
<td>526</td>
</tr>
<tr>
<td>2016E</td>
<td>622</td>
</tr>
</tbody>
</table>

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%
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.

Source: TPHe, EIA, DrillingInfo
Drilling Improvements - Days to Total Depth

Cost implications of this trend are that any OFS service that charges by the day during drilling activity faces ongoing deflation independent of WTI pricing.

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.
How Much Oil Service Costs Have Fallen... One Example

Current Realized Cost Reductions

Drilling and Completion Costs

<table>
<thead>
<tr>
<th>Service</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract Labor</td>
<td>(74%)</td>
</tr>
<tr>
<td>Downhole Pumps</td>
<td>(54%)</td>
</tr>
<tr>
<td>Well Maintenance Units</td>
<td>(52%)</td>
</tr>
<tr>
<td>Chemicals</td>
<td>(47%)</td>
</tr>
<tr>
<td>Trucked SWD</td>
<td>(46%)</td>
</tr>
<tr>
<td>Tubing</td>
<td>(28%)</td>
</tr>
</tbody>
</table>

Current Realized Cost Reductions

Lease Operating Expenses

1. Breakdown of Current Drilling and Completion Costs

- Rentals 4%
- Perforating 3%
- Drillout 3%
- Pressure Pumping & Material 31%
- Water 4%
- Producing & Equip 14%
- Cement 2%
- Directional Services 2%
- Drilling Mud & Chemicals 3%
- Casing 9%
- Rig Costs-Drilling 7%
- Other 18%

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

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.

Source: TPH
Pressure Pumper Capex Waning...Attrition

U.S. Pressure Pumpers: Capex as % of DD&A
(for RES' Technical Services Segment, FTSI Consolidated, PTEN's Pressure Pumping Segment)

FLEET GROWING BUT CAPEX SHRINKING...LEADS US TO BELIEVE HEAVY ATTRITION OR SUBSTANTIAL REBUILD COSTS ARE ON THE COME, BOTH OF WHICH WOULD REQUIRE PRICING IMPROVEMENT.

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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