Shale, Volatility, and the Global Oil Market

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COLORADO SCHOOL OF MINES
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About PetroNerds and Our Services

• Boutique energy analytics and advisory firm, specializing in US shale oil, based in Denver, CO

• Personalized, data-driven advisory services

• Help our clients understand how the oil market impacts their business

• Provide data and actionable insights needed, not reports and projections that are never read
A PetroNerd:
Presentation Outline

I. Global Oil Market Overview
II. Investor Pressure
III. US Production and Productivity
Global Oil Market

VOLATILITY
Oil Prices
Oil Price Moves

1. 2018 oil price spike followed by correction: demand not supported at elevated prices
2. Market not responding strongly to outages and supply concerns
3. Libya offline
4. Coronavirus is and will continue to have an impact
5. Oil prices feel sentiment driven, demand concern prevailing over supply issues
6. Coronavirus could expose both real economic and political fragilities within China
Nearly 1 mbd of Libyan Output Offline

Libyan Oil Output Grinds To A Halt

General Haftar’s latest gambit is set to send Libya’s output tumbling below 100,000 b/d within days. Its effects are already being felt across the country.

Sustaining oil output in post-Gaddafi Libya has always been a challenge. Periodic shutdowns of oil facilities have at times sent production to rock-bottom levels, wreaking havoc on the country’s finances.

Many Libya observers have long been...
### OPEC Production

<table>
<thead>
<tr>
<th>Country</th>
<th>2017</th>
<th>2018</th>
<th>Jan 19</th>
<th>Sep 19</th>
<th>Oct 19</th>
<th>Nov 19</th>
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<td>2,648</td>
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<td>Libya</td>
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<td>952</td>
<td>883</td>
<td>1,162</td>
<td>1,166</td>
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<td>1,354</td>
<td>1,151</td>
<td>644</td>
<td>685</td>
<td>697</td>
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Total OPEC: 32,013 to 29,444

Notes: Totals may not add up due to inde
Source: OPEC Secretariat.
Russian Production

Graph 5 - 28: Russia's monthly liquids supply

Sources: Nefte Compass and OPEC Secretariat.
Supply and Demand

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<thead>
<tr>
<th></th>
<th>2018</th>
<th>1Q19</th>
<th>2Q19</th>
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<th>2019*</th>
<th>19-18</th>
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<td>98.8</td>
<td>98.6</td>
<td>100.6</td>
<td>101.1</td>
<td>99.8</td>
<td>0.9</td>
<td>100.0</td>
<td>99.7</td>
<td>101.8</td>
<td>102.4</td>
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<td>Non-OPEC supply</td>
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<td>63.8</td>
<td>63.8</td>
<td>64.2</td>
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<td>66.7</td>
<td>67.7</td>
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<td>OPEC NGL</td>
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<td>4.7</td>
<td>4.9</td>
<td>4.8</td>
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<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
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<td>(b) Non-OPEC supply</td>
<td>67.2</td>
<td>68.6</td>
<td>68.6</td>
<td>68.9</td>
<td>70.5</td>
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<td>72.5</td>
<td>71.5</td>
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</table>

World oil supply/demand balance, January 2020 (mb/d)
EIA Global Liquid Fuels Forecast

Source: Short-Term Energy Outlook, January 2020
US Oil Production

Source: EIA

12.7 mbd
EIA US Crude Oil Production Outlook

Source: Short-Term Energy Outlook, January 2020
US Crude Oil Exports

Source: EIA

3.4 mbd
US Crude Oil Imports and Exports

- U.S. Exports of Total Petroleum Products: 5.6 mbd
- U.S. Exports to U.S. of Natural Gas Liquids: 3.8 mbd
- U.S. Imports from Canada of Crude Oil: 3.4 mbd
- U.S. Field Production: 6.2 mbd
- U.S. Imports of Crude Oil: 12.7 mbd

Source: EIA
Conventional Cycles Getting Shorter

This IEA chart shows project development times for conventional upstream oil and gas projects declining precipitously across all project types.

Unconventional technology and lessons learned from the short-cycle business model are one of the primary contributing factors to the decline in project development times.

Source: IEA World Energy Investment 2019
Cost Deflation

Cost-adjusted upstream oil and gas investment was 15% higher in 2018 than 2010.

Although IEA has been a leader of the ‘investment shortfall’ bandwagon, more nuanced data, in this case from IEA, shows that the shortfall is a complex and misleading issue – particularly when combined with the previous chart showing reduced project times for conventional development.

Source: IEA World Energy Investment 2019
Peak Demand?

Petroleum consumption peaked in the 1990s just before the Asian financial crisis and has trended downwards since while the economy has continued to expand (albeit quite slowly).

It took a decade for global oil demand to recover to 1979 levels after dropping ~15% from the 1979 peak. The Iranian revolution sent prices higher in '79 and supply subsequently dropped due to the Iran-Iraq war, but demand adjusted downwards due to the 1979 price spike and US recession of the early 80s, causing an oil glut and low-price path that would last through the 1990s.
Investor Pressure

LOSS OF LOVE FOR US SHALE AND OIL AND GAS MORE BROADLY
The Shift in Price and Public Market Sentiment

The S&P 500 Energy Index now accounts for just ~4-5% percent of the S&P 500.

2010 through 2014 WTI averaged $92/barrel (Brent $102)

2015 through 12/27/2019 WTI averaged $53/barrel (Brent $57)

Source: EIA, Bloomberg
Market Pressure for Public Companies

Market Pressure

Muted Oil Prices (Plenty of Supply, Demand Growth Concerns)  Investor Pressure – Returns, Spacing/Inventory, ESG, Climate Change, Peak Demand

S&P 500 Shrinkage – Loss of Generalist Investor

Permian Focus – Rockies & Williston Basin producers struggling for attention  Small and Mid-Large Cap Pressure

Transition and Shake Out

Limited capital access and an expectation that many small and mid-cap producers will be unable to survive a prolonged downturn  Production has remained resilient
Shale Market Dynamics

Generalist investor has left the oil sector - Activists

Opportunity for consolidation - PE and small players - but widespread consolidation has not occurred

Investor Pressure - shareholder returns/positive free cash flow/share price growth? How?

BIG Shale Demand – majors pushing Permian and short cycle (peak demand)

Bifurcation between majors and large caps and small/mid caps

Well Spacing/Inventory/Depletion – ROR vs. NPV
FT “Concerns over environmental impact...”

US energy stocks languish despite shale boom

Concerns over environmental impact and business models dominate

Investors ditch energy stocks
Selection of sector weightings from S&P 500 index (%)

Source: Bloomberg
© FT
S&P 500 Energy Components

Permian Basin Top Producers

Source: https://www.barchart.com/stocks/indices/sp-sector/energies?viewName=performance

Source: PetroNerds, DrillingInfo raw data
EOG - CAPEX, Production, and Free Cash Flow

Sum of CAPEX, Free Cash Flow and Production Volume by Period

Source: PetroNerds
Concho Resources – CAPEX, Production, and Free Cash Flow

Source: PetroNerds
Centennial Resource Development – CAPEX, Production, and Free Cash Flow

Source: PetroNerds
Evolution of Investor Pressure

Pre-2014: Need to diversify beyond the Bakken

2014 Oil Price Correction: Pump and produce, High IPs, Cash Flow

2015 to 2016: PERMANIA, Prices are sub-$60, buy anything and everything (dry powder, no production, at any cost), FOMO
  I. Strict drilling and leasing requirements follow

2017: Begin focusing on cash flow

2018: Investor pressure on returns and free cash flow continues to build, oil prices move up

2019: Generalist investor has left the shale space. Free cash flow neutrality is not enough, serious returns are needed.
  I. Expected more mergers and acquisitions
  II. Favored majors and short cycle
  III. Unclear what would drive share price growth
Capital Sourcing Shift

Question 5:
Based on recent market conditions, which will be the top two capital sources for E&P companies over the next 12 months?

2016

<table>
<thead>
<tr>
<th>Source</th>
<th>Responses</th>
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<tbody>
<tr>
<td>Public Equity Offerings</td>
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<tr>
<td>High Yield Debt Offerings</td>
<td>29</td>
</tr>
<tr>
<td>Private Equity</td>
<td>110</td>
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<tr>
<td>Traditional Banks</td>
<td>39</td>
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</table>

2020

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt from Banks</td>
<td>$16%</td>
</tr>
<tr>
<td>Debt from Alternative Capital Providers</td>
<td>$28%</td>
</tr>
<tr>
<td>Equity from Private Equity Firms</td>
<td>$20%</td>
</tr>
<tr>
<td>Joint Ventures with Private Equity Firms (farmouts, Drillas, etc.)</td>
<td>$18%</td>
</tr>
<tr>
<td>Debt from Capital Markets</td>
<td>$11%</td>
</tr>
<tr>
<td>Other</td>
<td>$2%</td>
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</table>

*Respondents could select more than one option. We collected 670 responses. The figures in the chart above indicate the percent of total responses for each option.
EOG Completed Well Costs

Source: PetroNerds, EOG Investor Presentations
Production and Productivity

PERMIAN BASIN FOCUS
Moving Away from Cycle Chasing: Majors Shift to Steady Activity and CAPEX

ConocoPhillips’ analyst day presentation discusses the “look backs” they have performed on their shale activity in the Bakken and Eagle Ford and how much capital was squandered by chasing prices and responding by adjusting activity levels.

They would end up dropping rigs when rig day rates were low and end up bringing on production when oil prices were low.

They expect to achieve five percent higher returns by keeping activity levels stable and not chasing cycles.
Majors Continue Growth in the Permian Basin

Short cycle, competitive, strong breakevens, growth now - not later.

Source: Chevron Q3 2019 Earnings, November 2019
Source: ExxonMobil Q3 Earnings, November 2019
EOG and others talk about their focus on efficiencies from the number of wells drilled per rig per year, to the number of days to drill from spud to target depth, to the completed lateral feet per day. These metrics indicate a diminishing demand for rigs and frac fleets with an increased emphasis on leading technology.
Capital Efficiency Driving Horsepower Efficiency

Source: Concho Resources Investor Presentation, November 2019
Reduction in Need for Services

Efficiencies across the oil and gas D&C value chain are impacting the service sector, from hydraulic fracturing to drilling.

The incremental growth in lateral lengths has had a material impact on service companies as it has occurred during a period of modest prices and investor pressure. The average foot treated per day has gone up as the average lateral length drilled has as well.

Operators are drilling and completing more lateral feet with less equipment/manpower and more efficient use of horsepower.

....efficiency gains across the industry have raised the number of frac stages completed by each fleet by 10% to 20%, which implies a 10% or so decrease in the required active frac fleets. The slowing pace of frac activity in the second half of 2019 is leading to a further reduction of demand for frac fleets, resulting in pricing pressure on services.

Liberty Oilfield Services, Chris Wright, Q3 2019
Changes in the Market

• Despite lower and rangebound oil prices, longer lateral lengths and correlated production increases have continued.
Permian Basin Lateral Length, Well Additions, and WTI

Lateral lengths continue to grow

Source: PetroNerds, raw data Drillinginfo
Range bound oil prices over the course of 2019 and mounting investor pressure resulted in a steady decline in the oil rig count.

Source: EIA, BakerHughes
US Shale Oil Production

8.3 mbd of shale oil production

Largely driven by the Permian Basin at 4.4 mbd

Source: PetroNerds, DrillingInfo
Bottlenecks Alleviated by New Pipelines

Source: Enterprise Products Partners Analyst Meeting Presentation, April 2019
Natural Gas
Permian Basin Production

Source: PetroNerds, DrillingInfo

Associated gas and water could cause production constraints and bottlenecks
Permian Basin Production Forecast

Historical Production

Flat/Current Rate Forecast - 439 Wells/Month

Decline Forecast - 329 Wells/Month

Growth Forecast - 549 Wells/Month

Cushing OK WTI Spot Price FOB $/bbl

Barrels Per Day

$/Barrel


$20 | $40 | $60 | $80 | $100 | $120

6,000,000 | 5,000,000 | 4,000,000 | 3,000,000 | 2,000,000 | 1,000,000
Combo Look: Concho, Diamondback, EOG, and Exxon

Source: PetroNerds, raw data DrillingInfo
Are well spacing issues really going to kill the boom?

**Shale Companies, Adding Ever More Wells, Threaten Future of U.S. Oil Boom**

Newer wells drilled close to older wells are generally pumping less oil and gas and could hurt output, leading frackers to cut back on the number of sites planned and trim overall production forecasts.

*The Wall Street Journal*

By Christopher M. Matthews, Rebecca Elliott and Bradley Olson

March 3, 2019 6:26 p.m. ET

**MARKETS**

**Tight Squeeze**

In recent years, oil producers have drilled "child wells" in close proximity to increase the number of drilling locations and extract more oil and gas. New studies indicate that adding too many wells diminishes production in each well.

- **Current trend:** 375 ft. apart
  - Wells are bolted together, but production can suffer due to decreased pressure.
- **New recommendation:** 750 ft. apart
  - Wells are spaced out, potentially increasing production per well.

**Estimated production loss from overdrilling in South Texas**

- **600 ft. apart:**
  - Full production
  - 375 ft. apart: 28% loss in production
  - 237 1/2 ft. apart: 40% loss

*Note drawing is schematic. Source: State (production loss excluding mobile-size Energy/Department (drilling). American Petroleum Institute (API)).*
The prospect of stacked payzones and multiple targets combined with relatively tight well spacing has drawn investment.
Differentiated Views on Well Spacing

Not a one size fits all - EOG vs. PXD on Well Spacing

Source: EOG Q2 2019 Earnings, Pioneer Natural Resources September 2019 Investor Presentation
Concho’s Spacing Revisions

Source: Concho Resources Investor Presentation, Q3 2019
How many wells can you drill?

Source: Diamondback Energy Investor Presentations, Q3 2019 and Q2 2019
Spacing Tests Underperform and Further Spook Investors

2019 – “Dominator” project, 29 wells, downspace test 50 percent **vertically** and horizontally

2017 – 33 wells, only 330 ft apart
The Permian Basin Learning Curve

Source: Pioneer Natural Resources Oct 2013 Investor Presentation
While productivity appears to be flattening, it is not experiencing diminishing marginal returns as lateral lengths continue to increase, meaning productivity remains stable on barrels per lateral foot basis while efficiency improvements continue to be made.

Source: PetroNerds, raw data DrillingInfo
Well Additions by Play

Source: PetroNerds, raw data Drillinginfo
Productivity by Play

**Average Lateral Length**

<table>
<thead>
<tr>
<th>Basin</th>
<th>Denver Jules</th>
<th>Eagle Ford</th>
<th>Permian</th>
<th>Williston</th>
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</table>

**First 6 Month Oil Per Lateral Foot**

<table>
<thead>
<tr>
<th>Basin</th>
<th>Denver Jules</th>
<th>Eagle Ford</th>
<th>Permian</th>
<th>Williston</th>
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Source: PetroNerds, raw data Drillinginfo
Williston Basin Productivity Continues to Disprove Skeptics

Source: PetroNerds, raw data DrillingInfo