Outlook for Global Oil Markets
Cycle unlikely to progress in exactly the same manner as past cycles as it reflects structural elements related to technological innovation.

Unparalleled changes creating confusion and uncertainty about long term demand trends.
Old Vs New Forces Impacting Demand

Technology
Legislative and tax policy
Energy efficiency (energy per GDP declining)
Millennials reject vehicle ownership
Growth of alternative energy

Population growth
Emerging economy expansion
Expanding global middle class

~90 Mil BBL/day
Currently
The 2018-2020 Supply Hole Theory: Real or Chimera?

Real: There has been a significant drop in upstream capex spending since 2014. But...

• Drop in capex spending partly offset by falling costs
• Capex spending by majors in 2000s was plagued by cost overruns, write-downs and delays to first oil
• Billions of dollars deployed by majors wound up non-performing – Alaska, Libya, oil sands, Venezuela, Caspian, Iran, Saudi gas initiative, Yamal
• New spending by majors could potentially be better performing, with a shortened time horizon
The 2000s: The Myth of High Capex-Discovery Link

* Dashed lines are hypothetical illustration of minimum future exploration spend that would have been required to achieve 100% reserve replacement. SOURCE: WOODMACKENSIE CONSULTANTS
Reserve Replacement Ratio

100% Replacement

Big 5

Next 20
Stretching E & P Dollars: Decline in Upstream Capex Spending Is Offset by 25% Lower Costs, Shift Away From High Cost “Frontier”

Energy Investment Has Been Cut But Mostly Due to Falling Costs

- Upstream investment expected to be higher in 2017, with potentially +40% y/y growth in NAM E&P capex and +10% in global ex-NAM E&P capex.

Source: IEA, Citi Research
Rubble Collapse Effect:
Russian Oil Production Hit 11.2 mbd in October, up from 10.7 mbd

Russian fields would be typical location for “natural declines”
The Traditional Upstream Supply Hole Could Be More Like a 15 Million b/d Gain Between Now and 2022

Already-sanctioned non-OPEC conventional/deepwater/oil sands projects

- There is already significant momentum in supply growth from sanctioned (FID) greenfield or expansion projects that continue to add oil production even with the recent weaker price environment; however, this all contributes to offsetting underlying declines of pre-existing production.

Source: Company reports, Citi Research
Flexibly Filling the “Supply Hole”: All Eyes on the Permian Region could some day reach 10 million b/d
Supply Hole Could Be Geopolitical

• Venezuela
• Mideast Conflict Escalations
• New Sanctions?
• OPEC Agreement

But then there is shale!
Volume of debt reaching maturity after 2019 is significantly larger than current, reflecting some workouts and extensions (eg basis repayment as oil prices recover).

The question is whether changes in oil prices or continued improvement in productivity will be sufficient to allow debt to either be extended or reduced as 2020 approaches.

US E&P companies’ high yield debt based on maturities estimated by S&P:
   2015: $1.7 billion
   2016: $3.5 billion
   2017: $7.7 billion
   2019: $19.7 billion
   2020: $30.8 billion
Technology revolution is already impacting costs across the entire energy chain.

- Shale economics
- Utility scale renewables
- Logistics planning
- Mobility services
- Energy efficiency and the industrial internet
- To come, energy storage

Rapidly falling costs causing some to predict an explosive S curve deployment effect that will strand fossil fuels
In historical terms, 2000s look anomalous

Monthly Nominal and Real Oil Prices from May 1983 - Present

- Will long-term oil prices have reverted back to historical long-term mean?
- As US Shale production continues to come on line, coupled with technological advances in oil and gas recovery, oil price cycle could shorten
- 1986-2001 average price implies a potential low of ~$33/bbl in nominal terms

Historical Oil Price Statistics (West Texas Intermediate)
Current Nominal Price as of 5/31/2015: $60.30
Real (1982-1984) Price as of 5/31/2015: $25.49 (~11% Premium to Mean)

Mean: $22.95
High: $63.98 (6/30/2008)
Low: $6.87 (11/30/1998)
Median: $17.14

1986 – 2001 Avg.: $14.07
2001 – Present Avg.: $31.29

Source: Bloomberg, West Texas Intermediate (WTI) Cushing Crude Oil Spot Price: USCRYWTCIndex, CPUINSA Index as of May 31, 2015
Are Batteries The Next Great Disruptor?

It's All About the Batteries

Batteries make up a third of the cost of an electric vehicle. As battery costs continue to fall, demand for EVs will rise.

Cost for lithium-ion battery packs

$1,200 per kilowatt hour

Yearly demand for EV battery power

800 gigawatt hours

Source: Data compiled by Bloomberg New Energy Finance
## Comparing Battery Breakthrough Scenario to Other Forecasts

<table>
<thead>
<tr>
<th>Scenario</th>
<th>2040</th>
<th>% change</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEA New Policy</td>
<td>103</td>
<td>Up 14%</td>
<td>Fossil fuels remain 75%</td>
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<tr>
<td>IEA 2 Degrees</td>
<td>74.1</td>
<td>Down 19%</td>
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<td>Statoil Renewal</td>
<td>79</td>
<td>Down 15%</td>
<td>EV growth = Oil less than 40% of transport</td>
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<tr>
<td>50% Battery cost decline scenario</td>
<td>74.6</td>
<td>Down 19%</td>
<td>EVs at close to 20% of all new car sales by 2030</td>
</tr>
</tbody>
</table>
Technological factors could be sufficient to reduce demand in the next two decades, but given the overwhelming influence of population growth, permanent peak in oil demand likely requires policy intervention.

Transportation sector is ~60% of oil demand and projection of vehicle miles driven influences greatly demand forecast.
## UC Davis Oil Demand Scenario Study: Testing Sensitivities of Peak Demand Transport Scenarios

Oil consumption projections through 2050.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
<th>% Reduction Relative to Baseline 2050</th>
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<tbody>
<tr>
<td>Baseline</td>
<td>52.5</td>
<td>55.7</td>
<td>58.8</td>
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<td>No China-India Growth</td>
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<td>52.4</td>
<td>55.1</td>
<td>57.6</td>
<td>60.4</td>
<td>64.8</td>
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<td>76.4</td>
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<td>58.8</td>
<td>62.4</td>
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<td>78.6</td>
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<td>80.8</td>
<td>87.8</td>
<td>0.3%</td>
</tr>
</tbody>
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How sensitive is oil demand to vehicle miles traveled?
30 years of conventional wisdom is over now, forever

- Since 1980s, conventional wisdom held that “easy oil” in non-OPEC would be depleted by 2010s and the world would be increasingly reliant on OPEC oil.

- OPEC responded to this view by taking a revenues oriented strategy in the 2000s. Gulf countries viewed reserves as increasing in value over time for “future generations.”

- Paris climate accords and US shale boom throws this future reserves scarcity model into question

- Uncertainty about long term demand outlook shifting strategic calculus of largest reserve holders
Implications for OPEC

• Flattening or peaking global oil consumption can lead to the situation where not all oil producing countries will be able to exhaust their reserves.

• In such a situation, question becomes whether it is optimal for either OPEC or private oil companies to delay development and production of reserves.

• Musical chairs syndrome – timing to monetize reserves moves forward
New Market Realities

“Freeze” dynamic led all players to seek higher output from which to begin agreement

• Not a repeat of 1998: Context for freeze is long term adjustments that might be required to address peak in oil demand

• Game of Survivor: winner takes all
  • Downstream
  • Exploration
Mobility in Emerging Markets Driver of Future Oil Demand

Global Oil Demand by Sector
(Million Barrels of Oil per Day)

Global Oil Demand Growth by Region
(Million Barrels of Oil Equivalent/Day)

Source: IEA and Independent Analysis
ExxonMobil forecasts freight/diesel to dominate demand growth
Economies are Expanding, but Getting more Efficient

GDP vs. Energy Demand by Country/Region

Source: IEA, IMF, and CVX Analysis