Resources, Technology, Policy and Geopolitics will reshape national and commercial realities: How will you invest?

Average annual crude oil prices (real), 1990–2040

Note: Dated Brent.
Source: IHS Markit

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Introduction: What we will cover

**Sheiks, Shale and Wall Street**
Unconventional producers, Wall Street and short cycle barrels are upending oil markets and challenging OPEC supply management

**Competition to Supply Oil**
What barrels will break through?

**Paris Agreement**
Global unity but unresolved global challenges

**Electric Vehicles and Peak Demand**
Peak Demand is in sight, but oil is not dead

**U.S.: New Risk Factor in Global Politics**
Russia, Middle East, Iran, China, North Korea
The Structural Transformation of Oil Markets and its Cyclical Political and Economic Consequences
Shale oil has made the US more energy secure – but US and global oil markets remain deeply intertwined.
US Shale Adds a Faster Gear to the Capex-to-Supply Conveyor Belt

**Short-Cycle (6-12 mo)**
- US Tight Oil
- Global Crude Inventories
- Spare Production Capacity

**Medium-Cycle (1-3 yrs)**
- High-Potential Gulf Projects (Iraq/Iran/Saudi)
- Sustainable Return of Political Barrels (Libya/Nigeria)
- EOR, Tie-backs, Brownfield Expansions

**Long-Cycle (3-5 yrs)**
- Greenfield Conventional Onshore
- Oil Sands
- Offshore Development (esp. Deepwater)

![Illustrative capital flexibility and sanction to first production graph](image)

*Note: Bubble size represents unsanctioned volumes through 2023*

*Source: IHS Markit © 2017 IHS Markit*
Annual wedges of growth and contraction are really a geopolitical drama

Base decline & wedge production in US Onshore

Notes: Due to methodological differences, base decline shown here is understated and must be adjusted to fit with actual growth.
Source: IHS Markit
Wall Street takes center stage: antagonist or protagonist?

2018: dramatic reactive growth depends on capex and price scenarios

<table>
<thead>
<tr>
<th></th>
<th>Production as entry (MMb/d)</th>
<th>Production at exit (MMb/d)</th>
<th>Entry-to-exit change (MMb/d)</th>
<th>New Wells</th>
<th>Rigs</th>
<th>Capex in $ Bn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Case 2018 - $50 Bn</td>
<td>9.7</td>
<td>9.0</td>
<td>-0.7</td>
<td>14,292</td>
<td>562</td>
<td>$50</td>
</tr>
<tr>
<td>Base Case 2018 - $71 Bn</td>
<td>9.7</td>
<td>10.0</td>
<td>0.4</td>
<td>18,110</td>
<td>901</td>
<td>$71</td>
</tr>
<tr>
<td>High Case 2018 - $90 Bn</td>
<td>9.7</td>
<td>10.7</td>
<td>1.1</td>
<td>20,487</td>
<td>1,099</td>
<td>$90</td>
</tr>
</tbody>
</table>

Source: IHS Markit

Production growth path under three sensitivity cases (entry-to-exit 2018)

US production cases: Price-funding combinations in 2018
OPEC, Russia: bet on supply management to cure accumulated ills

Change in crude supply from October 2016 levels

![Bar chart showing change in crude supply from October 2016 levels for different parties.]

Notes: Angola is taken as change from September 2016 levels as agreed at the OPEC meeting on November 30.
Source: IHS

OPEC January-June 2017 average crude production minus agreed target level

<table>
<thead>
<tr>
<th>Country</th>
<th>Change in Production (Million barrels per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>0.03</td>
</tr>
<tr>
<td>Angola</td>
<td>-0.02</td>
</tr>
<tr>
<td>Ecuador</td>
<td>0.01</td>
</tr>
<tr>
<td>Gabon</td>
<td>0.01</td>
</tr>
<tr>
<td>Iran</td>
<td>-0.02</td>
</tr>
<tr>
<td>Iraq</td>
<td>0.00</td>
</tr>
<tr>
<td>Kuwait</td>
<td>-0.01</td>
</tr>
<tr>
<td>Qatar</td>
<td>0.03</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>-0.14</td>
</tr>
<tr>
<td>UAE</td>
<td>0.08</td>
</tr>
<tr>
<td>Venezuela</td>
<td>0.03</td>
</tr>
<tr>
<td>Total</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Notes: Libya and Nigeria are not included in this figure because they are exempted from OPEC production targets. Equatorial Guinea, which joined OPEC in May 2017, is also not included in this figure as its output target has not been explicitly stated by OPEC.
Source: IHS Markit
Short-cycle price dynamic: hard work to stay in place

Dated Brent and other benchmark crude price outlook to 2018

Assumptions

- OPEC and Russia maintain some degree of production restraint through 2018, as producers are cautious about the price repercussions of raising output too quickly.

- US and Canadian annual crude production rises a combined 0.8 MMb/d in 2017 and 1.1 MMb/d in 2018. US production posts such growth despite WTI prices in the mid-to-high $40s, owing to ample capital, hedging, and attractive well economics.

- World liquids demand remains robust, posting annual average growth of 1.7 MMb/d in 2017-18, fueled by gains in China, India, and other emerging market economies in Asia.

Benchmark crude price outlook (dollars per barrel)

<table>
<thead>
<tr>
<th></th>
<th>3Q 2015</th>
<th>4Q 2015</th>
<th>1Q 2016</th>
<th>2Q 2016</th>
<th>3Q 2016</th>
<th>4Q 2016</th>
<th>1Q 2017</th>
<th>2Q 2017</th>
<th>3Q 2017</th>
<th>4Q 2017</th>
<th>1Q 2018</th>
<th>2Q 2018</th>
<th>3Q 2018</th>
<th>4Q 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dated Brent</td>
<td>$50.44</td>
<td>$43.71</td>
<td>$33.95</td>
<td>$45.51</td>
<td>$45.80</td>
<td>$49.35</td>
<td>$53.66</td>
<td>$49.58</td>
<td>$50.56</td>
<td>$50.26</td>
<td>$49.50</td>
<td>$48.75</td>
<td>$48.00</td>
<td>$47.26</td>
</tr>
<tr>
<td>LLS</td>
<td>$50.32</td>
<td>$43.56</td>
<td>$35.12</td>
<td>$47.33</td>
<td>$46.53</td>
<td>$50.42</td>
<td>$53.43</td>
<td>$50.12</td>
<td>$50.10</td>
<td>$49.50</td>
<td>$48.53</td>
<td>$47.69</td>
<td>$47.07</td>
<td>$46.46</td>
</tr>
<tr>
<td>WTI</td>
<td>$46.47</td>
<td>$42.03</td>
<td>$33.41</td>
<td>$45.50</td>
<td>$44.88</td>
<td>$49.23</td>
<td>$51.68</td>
<td>$48.11</td>
<td>$48.49</td>
<td>$47.94</td>
<td>$47.00</td>
<td>$46.17</td>
<td>$45.39</td>
<td>$44.74</td>
</tr>
</tbody>
</table>

Notes: LLS = Louisiana Light Sweet. WTI = West Texas Intermediate.
Source: IHS Markit, Argus Media Limited (historical)
Today’s geopolitical drama: prices profoundly shape economic and political choices of producer economies

2017 OPEC Thresholds: Brent at $51/bbl

- Insufficient revenue from oil to balance budget
- Insufficient revenue from oil to balance current account or budget
- Sufficient revenue from oil to balance current account and budget

**Source:** IHS

© 2017 IHS
Who will in the competition to supply the market?
Reactivity of American unconventionals defines the pace for future FID and who supplies future barrels

**Global crude and condensate call on new supply 2019-2023**

<table>
<thead>
<tr>
<th>Year</th>
<th>Sanctioned Projects</th>
<th>Unsanctioned Project Pipelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>(1.575) MMb/d</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>(3.939) MMb/d</td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td>(6.389) MMb/d</td>
<td></td>
</tr>
<tr>
<td>2022</td>
<td>(9.525) MMb/d</td>
<td></td>
</tr>
<tr>
<td>2023</td>
<td>(12.244) MMb/d</td>
<td></td>
</tr>
</tbody>
</table>

**Global market call on new supply vs. potential growth (2019-2023)**

- **Unsanctioned project pipeline peak capacity (~20-25 MMb/d)**
- **US LTO (4-6 MMb/d)**
- **Gulf-6 (3-5 MMb/d)**

Source: IHS Markit

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Countries entering global hydrocarbons markets need fiscal terms and resource quality to compete: 2017 bid rounds

Number of opportunities indicate a number of licensing rounds (specific licensing rounds/auctions can be held for different areas (onshore/offshore, brown-fields vs green-fields, type of resource (conventional vs unconventional))

*Already closed, pending awards
** Commencing shortly
The deepwater is still important

2017 estimated total production by asset type for 21 largest IOCs

- Conventional onshore: 30%
- Deepwater: 18%
- Oil Sands: 3%
- Orinoco extra-heavy oil: 15%
- Unconventional: 34%

2017-2026 forecast new source incremental growth by asset type

- Conventional onshore: 9%
- Deepwater: 23%
- Conventional shallow: 21%
- Unconventional: 44%

Conventional Shallow 21%
Deepwater 23%
Unconventional 44%
Conventional Ons 9%
Reductions in project cost continue to make global Deepwater competitive in lower oil price environment

Libra breakevens improve with proposed Local Content waivers & further cost reduction

Source: IHS Global Deepwater and Growth Plays Service © 2015 IHS
Paris Accord: Will it reshape global energy markets and geopolitics?
PARIS AGREEMENT: Revolutionized climate negotiations. From seeking the “ideal” to what countries can do.
Entry into force: 4 November 2016

<table>
<thead>
<tr>
<th>Countries that joined the Paris Climate Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratified (160)</td>
</tr>
</tbody>
</table>

Note: Denmark’s agreement excludes Greenland. Map is updated as May 31, 2017. Source: UNFCCC and Business Insider.

- As the world commits to a low carbon transition, the conversation in oil has shifted from “Peak Supply” to “Peak Demand”
- Base case scenarios see total oil demand continuing to rise through 2040, even in lower carbon pathways
  > IHS Rivalry: 113mm bpd
  > IEA New Policies: 108mm bpd
- To achieve a 2°C target, Peak Demand would need to occur by 2021
  > IHS Autonomy: 99mm bpd
  > IEA 450PPM: 94 mm bpd
Eventually the world will have to reconcile NDC pledges with a 2DS target. Will this open new geopolitical battles?

Global GHG emissions and max NDC savings in 2030, BAU versus NDC and 2 Degree emissions levels

Notes: BAU includes LULUCF emissions and is a combination of IHS and country-provided projections; the top 10 emitters shown above are projected to represent up to 80% of reductions pledged by all NDCs.

Source: IHS Markit

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Defining Challenges: 100% energy access, growing population, sustainability – what are the solutions?

1.06 billion people live without electricity

Power sector's coal consumption is expected to rise by over 40% during 2015-25

Coal demand in sub-Saharan Africa increases by around 50% in 2040
Success in achieving a 2DS world requires translating technological change into investment

Evolution of the power generation mix in the 450 Scenario

Source: IEA
To accommodate Non-OECD growth, all countries must change the way they produce and consume energy.
Mobility: vehicle electrification, peak oil demand, and the geopolitical implications
By 2040 Electric Vehicles could represent 30% (Rivalry) to 60% (Autonomy) of LDV sales in US, Europe, India, China (70% of world sales)

LDV sales by powertrain: Rivalry

LDV sales by powertrain: Autonomy

BEV = battery electric vehicle. PHEV = plug-in hybrid electric vehicle.
HEV = hybrid electric vehicle with gasoline ICE. FCEV = fuel cell electric hybrid.
Declining battery cost is a key assumption in scenario outlooks for EV sales. Automotive battery pack costs have declined 53% since 2013.
Driverless technology lowers the cost of mobility and is among the most disruptive forces in LDV demand.

Cost of mobility per mile traveled by car in the USA

<table>
<thead>
<tr>
<th>Cost per mile travelled in constant 2016 US$</th>
<th>2017</th>
<th>2017</th>
<th>Rivalry 2040</th>
<th>Autonomy 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal owned car (ICE)</td>
<td>$0.58</td>
<td>$0.57</td>
<td>$0.42</td>
<td>$0.53</td>
</tr>
<tr>
<td>Human driver personal car (ICE)</td>
<td></td>
<td></td>
<td>$0.32</td>
<td>$0.36</td>
</tr>
<tr>
<td>Hybrid (driverless)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BEV (driverless)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human driver personal car (ICE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid (driverless)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BEV (driverless)</td>
<td></td>
<td></td>
<td></td>
<td>$0.31</td>
</tr>
</tbody>
</table>

Notes: BEV = battery electric vehicle. Hybrid = gasoline/electric with internal combustion engine. ICE = internal combustion engine.
Source: IHS Markit.
Remember the existing vehicle fleet: fuel economy standards – not EV penetration – have the biggest impact on oil demand

Global LDV gasoline and diesel demand: Rivalry

Notes: This is an illustrative example of how much gasoline EVs displace vs improving fuel economy
“Rivalry without EVs” is calculated by assuming all global electric miles are instead driven by gasoline HEVs
“Rivalry without EVs and constant fuel economy assumes” that all global LDV miles are travelled by vehicles with a constant 25 mpg fuel economy from 2020 out 2040
Source: IHS Markit

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Gasoline and diesel demand will decline, but existing fleets will still make them the principal fuel sources through 2040.

Rivalry LDV energy demand in RTW markets

Autonomy LDV energy demand in RTW markets

Notes: Ethanol is included in gasoline. CNG = compressed natural gas. LPG = liquified petroleum gas.

Source: IHS Markit. Electricity is consumed by LDVs, not demand.
Higher demand and field declines will still require the world to find 43 MMb/d by 2040

Global crude oil and condensate production outlook in 2040

- Crude oil and condensate production in 2016: 82 MMb/d
- Field declines to 2040: 34 MMb/d
- New capacity additions to 2040:
  - Sanctioned: 2 MMb/d
  - YTF: 13 MMb/d
  - Unconventional: 4 MMb/d
  - Unsanctioned: 24 MMb/d
- Crude oil and condensate production in 2040: 91 MMb/d

Source: IHS Markit
Peak Demand: do science fiction and constructive realism meet? Oil countries and companies weigh economic futures

Scenario Forecasts for Oil Demand (mmbpd)
Diversification the new strategy: Saudi Arabia’s Vision 2030

• The Saudi economy is expected to expand **1.3 percent** in 2018, **down from a 2.3 percent projection** in January, according to the IMF.

  > Deputy Crown Prince Mohammed bin Salman’s plan to overhaul the economy and **reduce its reliance on crude** are weighing on growth.

• Successful USD 17.5-billion debut sovereign issue and expectations of additional packages during 2017 expected to unlock **public-private partnerships** and generate greater investment.

• The **Saudi Aramco IPO** marks a historic shift for the Saudi economy and the global oil market writ large.

• **Vision 2030** intends to **diversify the Saudi economy beyond the oil sector** while addressing budget deficits that have plagued the government since 2014.

  > Aramco is working to diversify its portfolio, signing roughly **$50 billion in deals with U.S. companies**.

  – Some of these deals did not directly involve oil, such as one for a new shipbuilding complex in Saudi Arabia.

<table>
<thead>
<tr>
<th>Targets</th>
<th>2016</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Oil Government Rev.</td>
<td>$163 B</td>
<td>$1 T</td>
</tr>
<tr>
<td>Non-Oil Exports</td>
<td>16.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Women in Workforce</td>
<td>22.0%</td>
<td>30.0%</td>
</tr>
<tr>
<td>Unemployment</td>
<td>11.6%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Life Expectancy</td>
<td>74</td>
<td>80</td>
</tr>
</tbody>
</table>
US Politics and Global Uncertainties: Russia, the Middle East, Iran, China, North Korea
US-Russia: domestic crisis and breach of trust complicates tragedy in the Middle East

Michael Flynn
- Recuses himself from Russia inquiry during Senate testimony
- Resigns after not being able to disclose content of his talks with Russia
- Denies knowledge of Trump’s Campaign involvement with the Russians

James Comey
- Clinton’s E-mails
  - Flynn – Russia investigation
  - Fired by President Trump
- “Leaked” classified information to the media

Rod Rosenstein
- Memo on Comey amidst Russia investigation raises doubt over his objectivity
- Appointed to investigate links between the Russian Gvt. and Trump’s Campaign

Donald Trump Jr.
- Promise of “dirt” on Clinton
- Meeting with Kremlin-connected Russian lawyer
- E-mail disclosure

The Senate

Jeff Sessions

Robert Mueller

Elections

US - Russia: domestic crisis and breach of trust complicates tragedy in the Middle East

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U.S.-Russia Tensions Block Cooperation to Stabilize the Levant, while Russia’s leverage with OPEC increases
Iran: Trump decertification triggers uncertainty that can threaten the nuclear agreement

What decertification means:

- U.S. decides the suspension of sanctions was not “appropriate and proportionate” to the steps that Iran has taken to end its illicit nuclear activities.
- Waivers to continue agreement remain through June
- Administration opens 60-day door to Congress to impose sanctions
- U.S. military against decertification
- Congress may be split
- Impact on oil markets may change over time

Other Parties to the agreement:
- Respect IAEA certification

Core Elements
- From 20,000 to 5,000 centrifuges at Natanz
- Uranium stockpiles reduced by 98% to 300kg for 15 years
  - Uranium stockpiles capped at an enrichment level of 3.67%
  - R&D limited to the Natanz facility for 8 years
  - Fordo facility ceases enrichment for 15 years
- Arak facility redesigned into a research and production facility for medical isotopes
- IAEA access within 24 days for 15 years
China: once excluded from TPP, now writing Asia’s rules of commerce and security

One Belt, One Road (OBOR)

- Silk Road Economic Belt & Maritime Silk Road
  - “This project of the century.”- Xi Jinping
  - More than 60 countries, with a combined GDP of $21 trillion.
  - China has spent $50 billion on the initiative

Asian Infrastructure Investment Bank (AIIB)

- $100 billion in Initial Capital
  - Non-regional members: 25 billion
  - Regional members: 75 billion
    - China: 29.8 billion

Regional Security

- North Korea:
  - Clash of Chinese identities – dominance vs intervention averse

South China Sea

- Each year, $5.3 trillion of trade passes through the South China Sea
  - U.S. trade accounts for $1.2 trillion.
- 7 billion barrels of proven oil reserves
- An estimated 900 trillion cubic feet of natural gas

After TPP

- “Losing the United States from the TPP is a big loss, there is no question about that, but we are not about to walk away [...] certainly there is potential for China to join the TPP.” Malcolm Turnbull, Australian Prime Minister

- Regional Comprehensive Economic Partnership
North Korea: Neither key parties nor critical tolos engaged to generate solutions

“I told Rex Tillerson, our wonderful Secretary of State, that he is wasting his time trying to negotiate with Little Rocket Man”

“I will surely and definitely tame the mentally deranged U.S. dotard with fire.”

Stakes
- Regional: South Korea, North Korea, Japan
- Global: China, U.S., Russia, Europe
- At risk: Global Non-Proliferation regime

Critical Tools
- Mechanism to engage key parties
- Generate options for solutions & consequences
Conclusions: Drivers of Power, Wealth and Sustainability

Lower for longer is today’s energy drama

- Unconventional oil abetted by capital flows create short-term reactivity that rapidly modulates supply and price.

Only cheapest barrels will compete with Gulf and US Shale to enter market

- FID delays could risk future supply shortfalls – but when?

Diversification starts now

- Hedging risk takes time:
  - IPOs, Sovereign Wealth management, gas transition, energy v oil company.
  - EVs will reshape, not end, oil demand

Politics of Confrontation has added U.S. to drivers of global risk

- Russia: Stalemate in relations until U.S. file settled
- Middle East: U.S. alone lacks tolos for stability
- Iran: Decertification triggers uncertainty that could reopen nuclear account
- China: U.S. ceases to write rules of the game
- Korea: Ingredients for solution missing